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Policy documents related to quality improvement

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Minutes of Meeting - Internal Quality Assurance Cell (IQAC)

The IQAC meeting was conducted on Saturday, 7<sup>th</sup> August 2021 at 11.30a.m online on Google meet platform. Dr. Srija Unnikrishnan chaired the meeting.

The following members were present:

Fr. Valerian D'Souza

Dr. Srija Unnikrishnan

Dr. D.V.Bhoir

Dr. Bhushan Patil

Dr. V.S.Jorapur

Mr. D.S.S.Sudhakar

Mr. Lalit Prasad

Dr. Vasim Shaikh

Ms. Shilpa Patil

Mrs.Kranti Wagle

Ms. Garima Tripathi

Mr. Lester Fernandes

Mr.Ninad Shetty

Dr. Sunil Surve

Item no.1	<p><b>Confirming minutes of meeting held on 5th October,2019.</b></p> <p>Rv.Fr.Valerian D'souza welcomed the members present.Fr. Valerian mentioned that due to the pandemic the IQAC meeting has been scheduled online.Dr. Sunil Surve read out the minutes of the last meeting held on 5th October 2019.</p>
Item no.2  Discussion	<p><b>Action taken report based on recommendations.</b></p> <p>Dr. Surve informed the members that according to the recommendations received in the last meeting following actions were taken:</p> <p>1) Training of faculty in thrust areas</p> <p>Dr. Surve informed the members that many of the faculty members have attended online courses in the thrust area and the faculty members are enrolling themselves for new courses teacher.</p> <p>2) Syllabus of Electronics &amp; Computer Science</p>

Date: 09/08/21

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	Dr. Surve informed the members that suggestions given by IQAC members were forwarded to the Syllabus Committee for the department.
Item no.3	<b>Inclusion of HOD's in IQAC committee</b>
Discussion	Dr. Surve informed the members that as suggested by Rv. Fr. Valerian D'souza in last meeting the Head of departments are included in IQAC committee.
Item4	<b>Status of AQAR(NAAC) submission</b>
Discussion	<p>Dr. Surve informed the members that the AQAR is the Annual Quality report which was submitted to NAAC. It consists of seven points and only point no. 2 and 6 are left to be uploaded. Dr. Surve briefed the members about the AQAR submission process and informed the members that the format has changed with respect to last year.</p> <p>Mr. Lester asked whether the AQAR can be made available to the members of IQAC. Dr. Surve informed that since there is some sensitive data in the AQAR it cannot be circulated. But the basic SSR report would be circulated among the members of IQAC.</p> <p>Mr. James asked whether the AQAR is really needed for the members and suggested that there is no need to share the complete data.</p>
Item no.5	<b>Approval of IQAC events to be organized.</b>
Discussion	<p>Dr. Surve presented the list of events to be organized by IQAC.</p> <ol style="list-style-type: none"> <li>1. Seminar on Universal Human Values</li> </ol> <p>Dr. Srija Unnikrishnan informed the members that AICTE has now made it mandatory for all faculty members to undergo the "Universal Human Values " program in order to introduce human values as apart of our technical education. She further mentioned that Prof. Garima Tripathi would be take an introductory session on UHV as she has undergone a five day training program on UHV.</p> <ol style="list-style-type: none"> <li>2. Faculty development program on NAAC process</li> </ol> <p>Dr. Surve informed the members that in order to update the faculty members about the NAAC process one event has been planned.</p> <ol style="list-style-type: none"> <li>3. Lecture series on upcoming Technologies</li> </ol> <p>Dr. Surve informed the members that a lecture series on upcoming technologies would be organized for second and third year students. He said initially some introductory lectures will be organized.</p> <p>Prof. Garima Tripathi suggested taking preferences from students for their area of interest and then plan lecture series for them. Adding on to this Dr. Srija suggested forming a special interest group in college where students can meet ,collaborate according to their interests.</p>



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	<p>Mr. Mihir suggested planning events for financial management also.</p> <p>Dr. Jagruti Save and Mr. Vikram Dingra suggested organizing events on career counselling.</p> <p>Mr. Ninad Shetty mentioned that it would be helpful for students to be a part of a Special interest group.</p> <p>4. Stress Management</p> <p>Dr. Surve mentioned that the Stress Management event is planned for students as well as faculty .</p> <p>5. How to create interactive video lectures</p> <p>Dr. Surve suggested that every faculty should make their interactive video lectures according to students' requirements.</p> <p>Mr. Lester informed that a lot of MOOC videos are available online and faculty can make good use of them.</p> <p>6. College life to Corporate life</p> <p>Event where industrial visits could be planned.</p> <p>7. Entrepreneurial journey</p> <p>Dr. Jorapur mentioned that rather than taking sessions on the above topic, students can be sent for training by EDP where they get hands-on experience.</p> <p>8. Innovation and Entrepreneurship</p> <p>To develop an innovative mindset and understand Entrepreneurship.</p>
Item no.6	<p><b>Any other matter with permission of chair</b></p> <p>1. Dr. Srijia asked Dr. Surve to modify the mechanism formulated for the identification of slow and advanced learners according to the current scenario.</p> <p>2. Mr. Lester suggested making use of ATAL platform for startups and funding projects through government bodies. Dr. Jorapur informed that college is trying to register through ASI but there were some glitches while registering for the same.</p> <p>3. Rv. Fr. Valerian D'souza suggested that there should be some event organized for Industry Connect.</p> <p>4. Dr. Bhushan Patil gave a proposal for conducting a webinar for faculty on Scopus index publication.</p>

Meeting ended with the vote of thanks by Dr.Srija Unnikrishnan.



Dr. Srijia Unnikrishnan

Chairman

Date: 09/08/21

## Action Taken Report

Suggestion	Action Taken
1. Training of faculty in thrust area	Many of the faculty members attended online courses in thrust areas. Also many faculty members have completed online courses for improving their skills
2. Syllabus of Electronics and Computer Science	Suggestion regarding to syllabus are forwarded to syllabus committee through internal faculty members
3. Inclusion of HODs in IQAC committee	HODs are added in IQAC committee

## IQAC-CRCE Event list for the year 2021-2022

Sr.no	Event Name	Objectives of Event	Target audience
1.	Seminar on Universal Human Values.	<ul style="list-style-type: none"> <li>• To Understand human aspiration.</li> <li>• To understand the need of Value Education in fulfilling our aspirations.</li> <li>• To identify the need for value education in the current education system.</li> </ul>	All the teaching and non-teaching faculty.
2.	Faculty development program on NAAC process	<ul style="list-style-type: none"> <li>• To improve academic and administrative performance of the institution.</li> </ul>	All the teaching and non-teaching staff.
3.	Lecture series on upcoming Technologies	<ul style="list-style-type: none"> <li>• To provide upcoming technological information.</li> <li>• Stimulate self-confidence through the knowledge and application of technology.</li> <li>• To develop practical solutions through creation of product/solution.</li> </ul>	Students of second, third and final year.
4.	Stress Management	<ul style="list-style-type: none"> <li>• To have a significant positive impact in both professional and personal lives.</li> </ul>	Students and faculty
5.	How to create interactive video	<ul style="list-style-type: none"> <li>• To promote active learning through video lecture</li> </ul>	All teaching faculty

	lectures	<ul style="list-style-type: none"> <li>• To maximize student's engagement with video.</li> </ul>	
6.	College life to Corporate life.	<ul style="list-style-type: none"> <li>• To prepare students for a smooth transition from college to the corporate world.</li> </ul>	Students of third and final year.
7.	Entrepreneurial Journey	<ul style="list-style-type: none"> <li>• To understand the qualities of an entrepreneur.</li> <li>• To motivate and inspire any aspiring entrepreneur.</li> </ul>	Students of second, third and final year .
8.	Innovation & Entrepreneurship	<ul style="list-style-type: none"> <li>• To understand innovation and the need for innovation</li> <li>• To identify different types of Innovation</li> <li>• To develop an innovative mindset and understand Entrepreneurship.</li> </ul>	First year students.

# Research and Ethics policy document

## Code of Ethics for Authors and Publishing your Work

### Preamble:-


University OF Mumbai Adopted Notification regarding Promotion of Academic Integrity and Prevention of Plagiarism by UGC vide circular number Th./ICD/2018-19/558 dated 6<sup>th</sup> October 2018. Our institute has circulated the same to all teachers and makes every attempt to follow this in true spirit. Research students check their manuscript/progress seminar reports/thesis for similarity and their reports are kept in their personal files. Only original articles are allowed by supervisors for further processing. Awareness program for the same was conducted for all teachers in the institute. Every student submitting a thesis, dissertation, or any other such documents to our institute submits an undertaking indicating that the document has been prepared by him or her and that the document is his/her original work.

### Code of Ethics and Publishing your Work:-

- The work of the authors should be original research that is transparent and written by them in their own words.
- The work of the author should not infringe any intellectual property rights or any rights of others.
- The authors should clearly cite the source of the materials which is taken from some other published work
- The authors should also cite their own work to avoid self-plagiarism.
- The authors should also get permission from other authors to use their images or tables in their manuscript wherever applicable.
- The authors should write the manuscript in such a way that the work should be transparent reproducible.
- The authors manuscript should not be submitted to more than one journal at a time.
- Any conflict of interest should be clearly stated while submitting the article for any publication including those of the funding agencies.
- The work of the authors should be authentic, true and should not be manipulated.
- The authorship of the work should be given to those who have significantly contributed to improving the quality of the manuscript.



- The authors should ensure that they strictly adhere to the ethical guidelines given by their discipline where subjects like human are involved.



**Dr. Bhushan T. Patil**

**Dean, Research & Development**

**Fr. C. Rodrigues College of Engg.**



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# RESEARCH ETHICS POLICY

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**Effective from 17th Oct 2022**



DR. B. S. DAGA  
Member Secretary (Institutional Ethics Committee)

DR. SURENDRA RATHOD  
Principal

***Moulding Engineers Who Can Build the Nation***





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## **Section 1: Objective**

FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING, a premier Engineering College, is committed to develop best quality technical personnel with sound knowledge in basic engineering principles, technical skills, innovative research capabilities and exemplary professional conduct to use technology for the benefit of society with the highest ethical values. The college is established to impart uninterrupted dissemination of knowledge to top ranking students from all sections of the society. The college is responsible to cultivate higher values of honesty, integrity, responsibility, mutual respect for persons and property and respect for human rights.

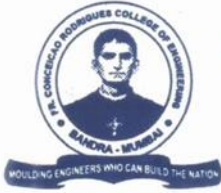
In order to achieve this, appropriate guidelines are framed to enforce professional ethics in the personal conduct which will be binding on all the students and staff in the college. Institutional Ethics Committee is constituted to formulate Research Ethics Policy for FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING.

## **Section 2: Institutional Ethics Committee (IEC)**

The Institutional Ethics Committee shall be comprised of senior faculty members with Principal as the Chairman of the committee. An IEC is established to formalize institutions commitment to the promotion of high scientific and ethical standards in the interest of communities and researchers. All research involving human subjects or data related to human subject as a patient should be conducted in accordance with the three basic principles, namely Beneficence, Respect for Persons and Justice.

## **Section 3: Responsibilities of Institutional Ethics Committee**

- Formulate the Research Ethics Policy for Fr CRCE
- Provide independent and competent review of all ethical aspects of research proposals
- Review research proposals submitted to it within a reasonable time and document its views in writing to the applicant's
- Safeguard the dignity, rights, safety, and well-being of all study participants and communities paying special attention to investigations that may involve vulnerable participants
- Consider the suitability of Investigator(s) for the proposed study with respect to relevant qualification, training and experience.
- Report breaches of Research Ethics Policy or non-compliance of ethical practices among students, faculty and staff to the Principal for taking necessary actions.
- Recommend actions on non-compliance of ethical practices among students, faculty and staff
- Propose corrective actions on report of non-adherence to the Policy.
- Remain trained and up to date on the regulatory requirements



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- Make amendments and clarity to the Policy as and when required.
- If required then review following documents to arrive at the conclusion:
  - (i) Experimental Methodology
  - (ii) Protocols followed during experimentation
  - (iii) Investigators profile
  - (iv) Investigators agreement with sponsor
  - (v) Investigators undertaking

#### **Section 4: Responsibilities of the Students/Scholars**

It shall be the responsibility of the students and scholars to:

- (i) Read, understand and be aware of this Research Ethics Policy and subsequent amendments brought to it.
- (ii) Respect the laws of the country, rights of individuals and to conduct in a responsible and dignified manner at all times. One must show due respect to people while interacting for academic purposes by way of data collection, and surveys for student projects.
- (iii) Obtain written consent from human subjects/participants and prior approval of Research Ethics Committee in projects involving any kind of direct measurement of human physiological parameters such as ECG/EMG etc.
- (iv) Ensure that, the rights of an individual will be respected and their property and life will not be put under threat at any circumstances. Academic work must not pose a risk or danger to people or the environment. Necessary clearances and permits/licenses must be obtained while handling, storing and disposing of radioactive, toxic or harmful materials.
- (v) Follow ethical practices in publications/thesis/project reports etc. by checking plagiarism and by avoiding self-plagiarism. Be cautious to avoid so-called "predatory journals" which publish papers with minimal or no review. It is unethical to publish in such journals of this nature.
- (vi) Carefully avoid data fraud and all unacceptable forms of data manipulation, such as or subtracting data points at will, editing images to produce a false result, creating images artificially and presenting them as data or using the same figure or table to describe different experiments. The conclusions claimed in a research paper must be genuine.
- (vii) Honestly claim authorship of documents. The list of authors in research papers, reviews, books, monographs or policy documents should not be manipulated to give undue credit to those who have not contributed ("honorary authorship") or deny credit to those who have contributed sufficiently.



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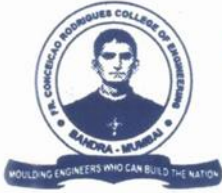
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(viii) Improve the balance of under-represented sections and provide supportive environment by avoiding bias, favouritisms and discrimination of any kind. Academic communities are enriched by the presence of people of different ethnicities, genders, religions, castes, tribes, socio- economic strata, affiliations, backgrounds and sexual orientations. There must not be direct or indirect bias or discrimination against any individual based on the above categories.

## **Section 5: Responsibilities of Staff**

It shall be the responsibility of the members of staff to:

- (i) Read, understand and be aware of this Ethics Policy and subsequent amendments brought to this Research Ethics Policy.
- (ii) Respect the rights of individuals and to conduct in a responsible, unbiased and dignified manner at all times. One must show due respect to people while interacting for academic purposes by way of data collection, and surveys for student projects.
- (iii) Obtain written consent from human subjects/research participants and prior approval of Ethics Committee in projects involving direct measurement of human physiological parameters such as ECG/EMG etc.
- (iv) Ensure that, the rights of an individual will be respected and their property and life will not be put under threat under any circumstances. Academic work must not pose a risk or danger to people or the environment. Necessary clearances and permits/licenses must be obtained while handling, storing and disposing of radioactive, toxic or harmful materials.
- (v) Follow ethical practices in publications/thesis/project reports etc. by checking plagiarism and by avoiding self-plagiarism. Be cautious to avoid so-called "predatory journals" which publish papers with minimal or no review. It is unethical to publish in such journals.
- (vi) Avoid data fraud and all unacceptable forms of data manipulation, such as adding or subtracting data points at will, editing images to produce a false result, creating images artificially and presenting them as data or using the same figure or table to describe different experiments. The conclusions claimed in a research paper must be genuine.
- (vii) Honestly claim authorship of documents. The list of authors in research papers, reviews, books, monographs or policy documents should not be manipulated to give undue credit to those who have not contributed ("honorary authorship") or deny credit to those who have contributed sufficiently.



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## **Section 6: Procedures for Corrective Action**

This Policy is envisaged to employ procedures for dealing with allegations of research misconduct, as well as any other kind of misconduct as described in this document, against its staff and students.

It is compulsory for researchers to adhere to norms of engineering practice and follow all safety guidelines. Researcher should take more pre-caution when human subjects are involved or design & development of products to be used on human subjects are involved. Institute strongly discourages the unethical practices or data collection, data analytics, data reproduction or drawing inference from the data.

### **(i) Corrective action:**

If a publication or report/thesis is found to contain plagiarism or manipulated data, the concerned department must ensure that a correction or retraction is published in the same place as the original paper.

On the other side, if a decision is found to have been made based on a bias or conflict of interest, then it should be overturned and the process must be repeated from first step, if necessary.

In general, every effort must be made to ensure that an unethical action does not succeed in propagating false knowledge or incorrect decisions.

### **(ii) Punitive action**

Should be as per the norms of regulating bodies, publication houses and government agencies.

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# RESEARCH PROMOTION POLICY

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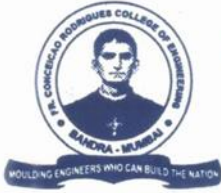
Effective from 17th Oct 2022



DR. KETKI JOSHI  
In-charge Research and Development

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## **Preamble:**

Fr. Conceicao Rodrigues College of Engineering encourages multidisciplinary quality research related to science, engineering and technology in the domain of Computer Engineering, AI and Data Science, Electronics engineering, Mechanical engineering, Sciences and Humanity. Academic research, funded research projects, and the creation of intellectual property in the engineering and technology domains are all part of the research activities. The institute strives to create a vibrant research environment for faculty and students engaged in emerging areas. A research and development committee is formed to support the research ecosystem and channel the related activities.

## **Vision:**

To foster an environment conducive to multi-disciplinary research in engineering and technology.

## **Mission:**

1. To promote inventiveness and moral research among faculty, students, and alumni.
2. To encourage interdisciplinary and collaborative research that benefits various facets of society and industry.

## **Objectives:**

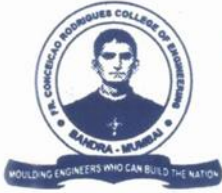
- To inspire faculty and students to realize their research potential and improve their involvement in research and development activities.
- To support collaboration and interdisciplinary research projects.
- To support the students and faculty in their efforts to create, protect, and leverage Intellectual Property Rights.

In light of these goals, a research and development committee has been formed at Fr. CRCE to strengthen the institute's presence in the field of research by actively promoting research culture and facilitating research activities.

## **Short-Term Objectives:**

- Conducting faculty and student development programmes to improve understanding of research and IPR.
- Creating awareness and encouraging quality research publications in standard journals.
- Creating awareness and encouraging students and faculty to apply and publish patents and IPR.
- Facilitating applications for research grants to various funding agencies





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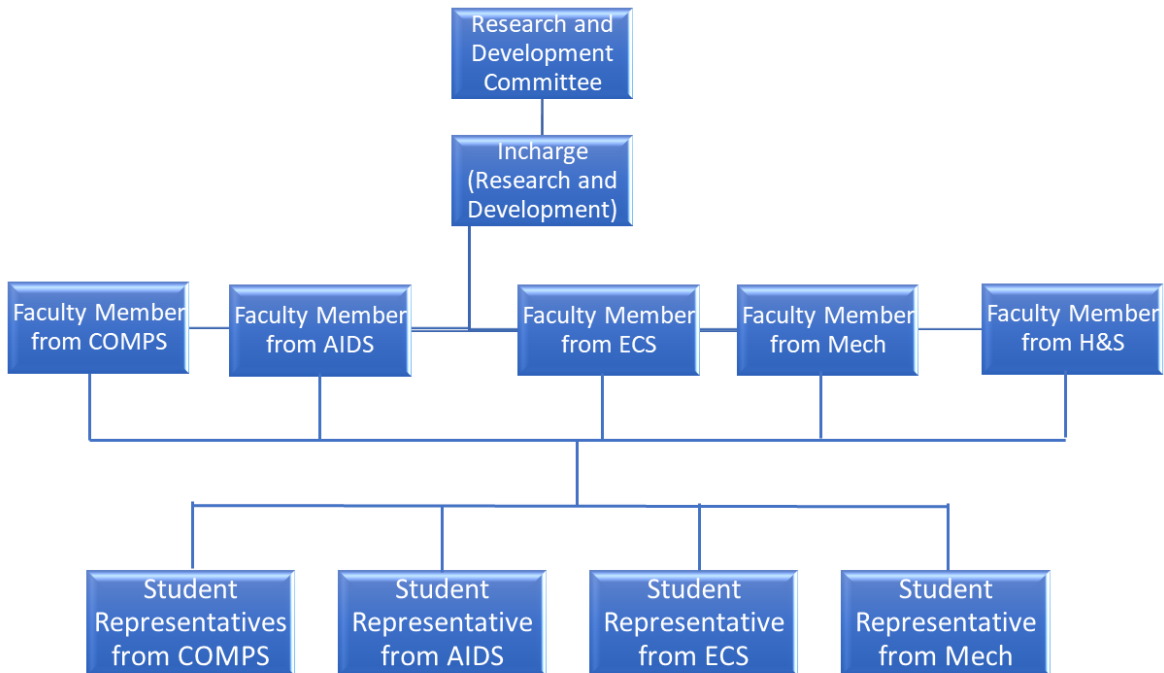
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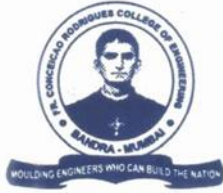
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### Long-Term Objectives:

- Collaborating with national/international agencies on research projects and IPRs.
- Enhancing research contribution by the students and faculty in the institute and improve its research ranking.
- Channelizing efforts by researchers to receive grants, commercialization of Patents and IPRs and the technology transfer.
- Engaging the researchers in providing technology solutions to practical problems implementable in the industry and society.

### Structure of Research and Development Committee





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## **Roles and Responsibilities of the Committee:**

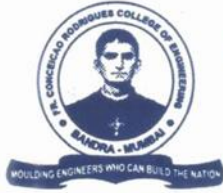
### **Faculty Members in the Research Committee:**

1. To work toward motivating Institute faculty and students to achieve R&D objectives, short-term and long-term research and development goals.
2. Encourage faculty to write effective research proposals and to provide the necessary assistance when applying to various funding agencies.
3. Encourage faculty and students to organise and attend conferences/STTP/workshops/Seminars/Training/FDP/SDP related to cutting-edge technology, research, and intellectual property.
4. Raise awareness of, and encourage, quality publications, research contributions, and IP generation among faculty and students.
5. To familiarise students with new technological innovations and research prospects.

### **Student Representatives in the Research Committee:**

1. Assist faculty members in organising various events such as workshops, seminars, trainings, and certification courses to promote research and intellectual property rights.
2. Informing students about various R&D initiatives and research project opportunities, and encouraging them to participate in related activities.
3. Encouraging students to publish research papers or apply for patents related to minor or major projects completed during the academic course.





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## **Department of Electronics and Computer Science**

### **Major Thrust Areas and Research Facilities**

#### **Abstract:**

The department was established in 1987 with B.E. in Electronics Engineering. From the academic year 2019-20, the course is renamed to Electronics and Computer Science to cope up with the 4<sup>th</sup> Industrial revolution. The perfect blend of knowledge of computer technologies with electronics provides the path to the new edge computing. In line with one of the missions of the department “To cultivate an ambience to encourage innovation, research and entrepreneurship skills”, the R & D cell promotes research culture and research projects in the department by providing computing as well as hardware facilities. The main focus is to develop multi-disciplinary projects that address the societal problems in real-life. One of the possibilities could be by integrating AI/ML solutions in Internet of Things (IoT) in areas like Smart farming, Healthcare, Smart Cities, etc. Novel research in solving security issues in IoT is also a desired outcome. The department also aims to produce quality research publications and competent multi-disciplinary projects by students and faculties. The department/institute also offers honours/minor Degree programs in Artificial Intelligence and machine learning, cyber security and, Block chain.

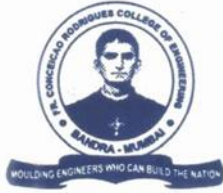
#### **Objectives:**

1. To investigate and analyse the issues related to power consumption, security, data privacy and data linking in real-world and provide solution using IoT and related technologies.
2. To design, analyse and develop automated system with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.
3. To develop system and applications programs by optimizing, analysing and investigating the theoretical analysis of the algorithms.

#### **Research Domains:**

The department has following research domains mainly.

1. Internet of Things
2. Automation
3. Computation and Algorithms
4. VLSI Design



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### Research Facilities:

The facilities available with departments/Institute are as follows:

Thrust Areas	Description	Facilities/ resources
Internet of Things	Issues related to Power consumption, Security, Data privacy, Complexity of Data, Issues related to data linking and processing	Raspberry Pi4 Model B (4GB) Kit with Sensors, Node MCU ESP8266 Board, IOT based digital electronics workbench, IOT Sensor Interface, ESA 51 E, PIC 18Fxx Board with LED USB Interface
Automation	Nonlinear Systems, Multi-agent systems and their coordinated control, Intelligent Data Mining Algorithms and Applications, Health Monitoring and Intelligent Fault Diagnosis Systems, Soft-Computing in Modelling and Control, Brain Computer Machine Learning, Unmanned Aerial Vehicles	Instrumentation and Transducer trainer with on board Sensor and Actuators, 6 Axis Robotic, Arm with 250gm Payload Capacity, Industrial 4 port I/O link IFM Germany make with Temperature and speed I/O Sensors, PLC TRAINER-10 with Allen Bradley micrologix 1400(with software license), HUMAN MACHINE INTERFACE (HMI), WINLOG PRO,32TAG WEB ENABLED SCADA SOFTWARE
Computation & Algorithms	Data structures, Algorithms, Computer organization and architecture, Operating system, Object oriented programming, Image processing, Machine Learning, Deep Learning, Artificial Intelligence	Department has three computing laboratory with state-of-the-art software/tools like Jupyter, Tensorflow, JDK, PGAdmin, Hadoop. Specialized high end Machine learning server with 32GB GPU to cater to ML projects.
VLSI Design	Analog CMOS VLSI Design, Mixed Signal Design, FPGA based System Design	FPGA prototype boards, Simulation tools



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## Department of Mechanical Engineering

### Major Thrust Areas and Research Facilities

The department presently offers B.E. (Mechanical Engineering), M.E. (Mechanical Engineering) with specialization in CAD/CAM and Robotics and Doctoral Program in Mechanical Engineering. The department also offers honours programs in Robotics, 3D Printing, Data Science and IOT.

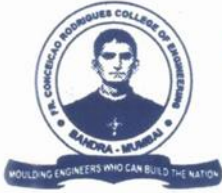
Having a legacy in production engineering since its establishment in 1984 and experience in offering Mechanical Engineering program at PG and PhD level, the department converted UG program in production engineering into mechanical engineering in 2019-20, in response to the changing industry requirements. With an experienced and qualified pool of faculty and state-of-art laboratories, the department has the following research domains and departmental/institute level facilities.

#### Research Domains:

The department has three research domains.

1. Manufacturing
2. Design
3. Automation

Research Domains	Thrust Areas	Research Facilities
<b>Manufacturing</b>	Design of CNC Systems Smart materials Nano materials Composite materials Material characterization Microstructure analysis Minimum quantity lubrication machining MQL Machining with nano-fluids Sheet metal forming Plastic injection moulding Additive manufacturing Computer Aided Manufacturing Manufacturing System Simulations Discrete Event Simulation Manufacturing Process Simulations Machine vision and applications	Production Grade CNC Machines MQL unit High resolution inverted microscope with material analysis software Digital UTM Fatigue Tester Metallurgical Furnace 3D Printer Arena Manufacturing System Simulation software



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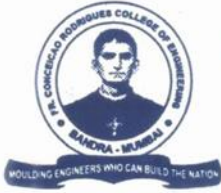
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<b>Design</b>	Computer Aided Design Computer Aided Engineering Simulation based Design and Optimization using Finite Element Analysis (FEA) Simulation based Design and Optimization using Computational Fluid Dynamics (CFD)	Modelling and Analysis softwares: Autocad, Solidworks, Ansys, NX11 Machine Learning and data analytics softwares
<b>Automation</b>	Mechatronics and IOT Industrial Robotics Vision Systems	Automation Softwares: Fluidsim for Pneumatics and Hydraulics PLC Systems Robotic Arm



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## Department of Computer Engineering

### Major Thrust Areas and Research Facilities

The Department of Computer Engineering was established in 1991. The department offers B.E. in Computer Engineering, a four-year degree program with an intake of 120 students. It has excellent infrastructure and highly qualified and professionally skilled faculty. The department conducts various training programs to help faculty and students to improve their technical knowledge. The Department has received a Research Grant from the Department of Science and Technology (DST), and Mumbai University for Innovative Projects and Minor Research Grant. It has signed MoU with several companies like Tata Consultancy Services, IBM and D-Link. Graduates of our department have been recruited by major IT companies such as TCS, Accenture, Morgan Stanley, JP Morgan Chase, ZS, Seclure, SAP, Amdocs to name a few.

#### Abstract:

The Department of Computer Engineering has a goal to increase the number of innovative and mostly multi-disciplinary research projects through the efforts of faculty members and students. This results in the nurturing of research activities, the procurement of equipment and the development of state-of-the-art research facilities. These projects address the requirements of real-life problems. More importantly, one of the major mandates of the Department of Computer Engineering is to participate in international conferences and reputed journals. The issue of concern to society is also addressed by the faculty members and students through sponsored projects. The deliverables of the R&D endeavour are innovative and affordable technology and products.

#### Thrust Areas and Subareas of Computer Engineering Department:

Big Data, IoT, AI, and automation are the key components of Industry 5.0 in every industry. Therefore, it is crucial to investigate interdisciplinary fields for computer science and engineering applications. Cyber Physical Systems is one of these areas, where joint research projects are carried out with other departments.

Research domain	Description	Facility
Data Science, Artificial Intelligence and Computing	Machine Learning, Deep Learning, Natural Language Processing, Big Data Analytics, Data and Web Mining, Machine Vision, Cloud Computing	Advance Computing Lab supported with Deep Learning and Cloud server.



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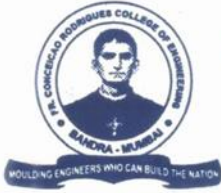
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Cyber Physical Systems	Blockchain Technology, Cryptography and Network Security, Cybernetics, Human- Computer Interaction, Robotics, Quantum Computing, Internet of Things	Network and Security Lab supported with D Link DCS wireless kit and switches.
Software and System Engineering	Algorithms, Computer Architecture, Operating system, Database Systems Software Engineering	Programming and Database Lab





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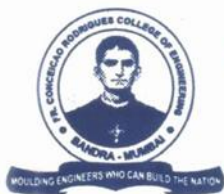
## Department of Artificial Intelligence and Data Science Engineering

### Major Thrust Areas and Research Facilities

Globalization, fast-paced growth of data and technological advancement has created a lot of exciting career opportunities. Data Science and Artificial Intelligence are the two most important technologies in the world today. While Data Science makes use of Artificial Intelligence in its operations, modelled after the natural intelligence possessed by humans, Artificial Intelligence is the algorithmic intelligence that is possessed by the machines to perform various autonomous actions. Data Science is a multi-disciplinary field that has conquered industries around the world. It has brought about a fourth industrial revolution in the world today. This is a result of the contribution by the massive explosion in data and the growing need of the industries to rely on data to create better products. We have become a part of a data-driven society. Data has become a dire need for industries that need data to make informed decisions. Fr. CRCE offers a new-age BE program in Artificial Intelligence and Data Science with the main objective of setting up students' careers in the most high-demand industry of the twenty-first century. Department has an experienced pool of faculty and UpToDate computing lab facilities to excel in this domain. Yet, our relatively small size makes for a collaborative and cooperative environment within which a broad set of research groups flourish.

#### Thrust Areas and Subareas of AI&DS Department:

Research domain	Description	Facility
Data Science, Artificial Intelligence and Computing	Machine Learning, Neural networks and Deep Learning Data Mining Natural Language Processing, Big Data Analytics, Data and Web Mining, Machine Vision, Cloud Computing Pattern Recognition Data warehousing	Advance Computing Lab supported with Deep Learning and Cloud server and Workstations with configuration such as Intel core i7-11700, 16Mb cache, 8 core, 16GB, DDR4, 1TB HDD, Nvidia T1000



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## Department of Humanities and Science

### Major Thrust Areas and Research Facilities

Humanities and Science department established in 1984. With an experienced and qualified pool of faculty and state-of-art laboratories, the department has the following research domains and departmental/institute level facilities.

The department has four research domains-

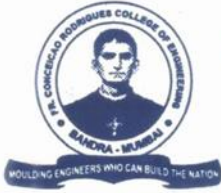
1. Physics
2. Chemistry
3. Mathematics
4. Communication Skills

Research Domains	Thrust Areas
Physics	Material Science Conducting Polymer and their Nanocomposites Material characterization
Chemistry	Plant Extraction Medicinal Chemistry Material Chemistry Nanotechnology Environmental Chemistry
Mathematics	Mathematical Finance Game Theory Environmental Science
Communication Skills	English Literature Communication Skills

#### Research Facilities:

Department has sufficient facilities to conduct experimental as well as theoretical research in mathematics, sciences and humanities. Various test and measuring instruments are available in the department.





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## **Institute Initiatives to Promote Research and Development**

### ***International Conference on Advances in Computing, Communication and Control***

A biennial multidisciplinary International Conference on Advances in Computing, Communication and Control (ICAC3) is organised by Fr. Conceicao Rodrigues College of Engineering. The primary goal of this conference is to promote research and development activities in Computing, Communication and Control in India and the rest of the world. The Conference also aims to offer a collaborative platform for the people in Academics, Research and Industry to address emerging issues and solutions in the above-mentioned areas. The previous seven editions of the Conference were organized in January 2009 (In cooperation with ACM), January 2011 (Springer), January 2013 (Springer), April 2015 (Procedia Computer Science), December 2017 (IEEE), December 2019 (IEEE) and December 2021 (IEEE Xplore) respectively. The best paper award is also given to the authors whose work represents breakthrough research in the respective field.

### ***Anti-plagiarism software***

Turnitin Anti-plagiarism software is purchased by the institute to facilitate the submission of quality research papers. It is essential that the software is extensively used by the faculty to check originality of Research Papers, Doctoral Thesis, PG and UG reports by the students.

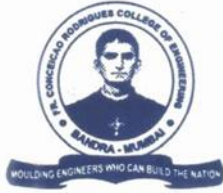
### ***Sponsored Research Projects:***

Fr. CRCE encourages faculty to submit a research project for extramural funding to various institutions such as the All India Council for Technical Education (AICTE), Department of Science and Technology (DST), University Grant Commission (UGC), University of Mumbai etc. The Research and Development Committee will provide assistance and support in the submission of sponsored research projects to various funding agencies. The committee will facilitate proposal review by involving senior researchers from the institute related to the respective domain to evaluate and comment on necessary improvements related to the idea, methodology, feasibility, novelty, and contribution.

Even though all teachers are encouraged to apply for various research grants, it is mandatory for Professors and Associate Professors to apply for Major Research Grants in every academic year. Annual performance of Professors and Associate Professors will be judged based on the research grants applied and amount of research grant fetched.

### ***Workshops/Seminars/FDPs/STTPs/SDPs:***

Fr. CRCE has organised and shall continue to organise a variety of workshops, seminars, FDPs, STTPs, SDPs, and trainings on cutting-edge technologies, research, and intellectual property. The committee on research and development will encourage faculty and students to organise and participate in such activities. The committee will plan and carry out various Research and IPR-related activities to facilitate idea exchange and promote research culture, with the goal of improving individuals' and the institute's research profile.



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***Research Collaboration and Memorandum of Understanding (MoU):***

The Research and Development Committee, in collaboration with the research guides of the research centre and experienced faculty members from various domains, will facilitate the signing of Memorandums of Understanding (MOU) related to research activities with various organisations. Annual performance of faculty shall be judged on successful research collaboration with industries and research

The institute has MoUs with various organizations/universities/institutes Tata Consultancy Services, IBM, D-Link, University of Texas at EL Paso. Synergy Consultancy, Christiani Sharpline to name a few.

***Research Scholars Colloquium:***

Research colloquium is the proposed activity which can be conducted during the international conference ICAC3 being organised by the institute biennially. The research scholars and faculty working on sponsored project will be presenting their ongoing research project or sponsored project. The activity will be open to all the faculty, students and research scholars with the objective of facilitating interaction and sharing the latest results and findings with the faculty and students interested in the related field. The award may be given to the best presentation to encourage quality research and development.

**Paper publications / Patent Applications related to B.E./M.E./PhD Project Work**

B.E./M.E. students are required to publish a paper or apply for patent / copyright based on the outcomes of the major project. It is essential that the students follow industry standards specific to their domain and use open-source software Latex while writing project reports. For PhD all the norms related to publications given by University of Mumbai should be followed.

**Paper publications / Patent Publications by Faculty**

1. Faculty publications and patents are integral part of ranking and accreditation of programs and institutes. Good quality publications indicate research culture of the institution and can bring laurels to the institute and faculty involved. Hence faculty are required to publish paper or file a patent every year. It is mandatory for every faculty to publish at least one journal paper in an academic year.
2. Quality of publication has always been a matter of concern and hence it is necessary to set minimum acceptable standards. At Fr. CRCE, publication by faculty would be claimed if it is published in **SCI, Scopus or Web of Science index journal**.
3. It is mandatory for everyone to write '**Fr. Conceicao Rodrigues College of Engineering**' as an affiliation in the papers. Affiliation should be mentioned in full and not the acronyms like CRCE.
4. All faculty members should create and use **ORCHID ID** and should be linked to the Scopus.



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### **Incentives / awards for research achievements:**

**Financial support to Undergraduate students for paper presentation at national / international conference:** Undergraduate students are eligible to get financial assistance in the form of partial reimbursement of the conference registration fee on successful presentation of the paper at national / international conference with necessary prior approvals. Research and Development committee can scrutinise the applications and institute financial supports will be based on quality of paper, quality of journal/conference and impact of research.

**Best Ph.D. Thesis:** Ph.D. thesis of all the research scholars completing Ph.D. from the college research centre during the academic year will be evaluated by an expert panel. Best Ph.D. Thesis will be awarded to the researcher having most significant research contribution among the candidates. The evaluation will be based on the criteria related to publications in national and international journals, conferences and transactions, book chapters, awards and recognitions, collaborative research, funding and IPRs. Rubrics for evaluation of best thesis shall be developed.

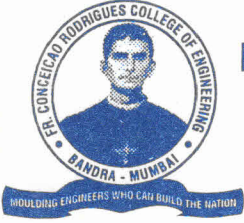
**Research Grant:** A faculty member working on a research project funded by external agency will be provided necessary support from the institute for its completion and will be permitted to use the infrastructure and research equipment available in the institute, with prior approval through proper channel. Institute may issue 'Letter of Appreciation' to a faculty member who successfully complete the funded research project.

### **Annual Reports:**

The research and development committee will prepare the following annual reports at the end of academic year:

- R&D activities conducted during the year
- Faculty and student contribution to research
- List of publications by faculty and students

## Policy related to Placement and Training



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Ref.: CRCE / 2021 / 177

Date : August 12, 2021.

## **NOTICE**

### **Final Year Students**

Dear Students,

Hope you all are safe and healthy.

Attached is the Placement Policy for the Academic Year 2021-22.

All students are required to sign and take their parents consent signature on it and submit the same to the Faculty Incharges on or before 31<sup>st</sup> August 2021.

Best wishes for your placement / higher studies career options.

**PRINCIPAL**

Encl : as above.

C.C. : Placement Co-ordinators

H.O.Ds – Mech. / ECS / Computer / A.I & D.S.

Class Teachers - Production – Prof. Saurabh Korgaonkar

Electronics – Prof. Jayen Modi

Computer – Prof. Monali Shetty

Info. Tech. – Prof. I Prajakta Bhangale

## Campus Placement Policy

Students and parents are requested to read this thoroughly before signing. Placement is a privilege to the students not a right. These guidelines are framed to ensure equality and fairness of opportunity to all the students. The guidelines will ensure that maximum number of students getting campus placement. This document has to be signed by all Final year students before academic year.

### Rules for students participating in the campus :

1. Students will be provided with placement assistance in the final academic year.
2. College suggests that all students interested in the campus placement to undergo training programs conducted by competent industry trainers as training increases success of placement(s).
3. The campus recruitment may happen on campus / off the campus at company office or pooled campus college as decided by college / company(s).
4. Students will be allowed to participate in any number of company(s) process as long as they do not get offer and they are serious and responsible in each of the company(s) process.
5. Offers are categorized based on CTC and/or Profile , For Academic year 2021-22, CTC band / categories are:

CTC	Offer Type	Profile
5 LPA or less	Normal	Any Profile
10 LPA or less	Dream	Any Profile
15 LPA or less	Dream +	Any Profile
Further in slab of 5 LPA	Super dream...	Any Profile
Any CTC	Core	Profile for Core branches like Production, Mechanical, Electronics etc.

1. Eligibility criteria for any of the company(s) will be as decided by the visiting company.
2. Student(s) with offer in higher CTC band can't participate for companies which fall in lower CTC band irrespective of accepting or declining the higher CTC offer.
3. Student(s) can hold only one offer in any of the CTC bands irrespective of accepting or declining the current offer.
4. Core offer students will not be eligible to participate further in any company(s) irrespective of accepting or declining the core offer.
5. Any interested student(s) who is having non-core offer in normal CTC band will be eligible for participating in Core company(s) process.
6. Student selected in Dream or higher band, transcript will not be issued for one calendar year from the last date of their final examination irrespective of acceptance or rejection or leaving the job after joining.
7. College does not have control over the Role(s) / Profile(s) offered during the hiring process and/or at the time of joining, Joining date, employment terms & conditions of the company.
8. If the scheduled campus drive is cancelled by company(s), the college will not be responsible.
9. Student(s) who gets offer from Job portals / off campus drives, on their own efforts are requested to inform the college about the same and such students will be continued to be treated as unplaced and interested can continue to participate in the campus drives conducted by the college.
10. Change of choice from campus placement to further studies category is permitted with prior permission from the Principal provided student does not have any offer.
11. Any participating student(s) who is not serious / irresponsible / dishonest in any of the company(s) process will be disqualified and will not be allowed to participate in further company(s) process.
12. All placed students have to submit copy of the offer letter / letter of intent to the branch faculty I/c for the purpose of office records.
13. Principal will have the discretionary powers to decide on any particular rule / company / student on a case to case basis keeping balance of interests of the college, student and company(s) and Principal's decision will be final.

### Rules for further studies / other career interest:

1. Any eligible interested student can participate in the bulk recruiter / other companies decided by the college without blocking the transcripts.
2. Any point of time student can change their choice from further studies category to campus placement category with prior permission from the Principal.
3. Any student who has Dream or higher and / or core offer will not be eligible for the transcript for one calendar year from date of completion of the final examination irrespective of accepting, declining the offer or resigning from the job.

### Declaration by the student and parent(s):

1. I have understood the rules for the campus placement, higher studies and other career options.
2. I will be participate in the campus placement program / I have decided to opt for higher studies or other career options

**[Strike out whichever is not applicable]**

### Student Details:

Roll No: \_\_\_\_\_ Name: \_\_\_\_\_ Signature with date: \_\_\_\_\_

### Parents Details:

Name(s): \_\_\_\_\_ Signature(s) with date: \_\_\_\_\_

# Proposed IRG Policy

## Policies

### **Consultancy Projects**

Consultancy projects may be looked into:

#### **1. Category I:**

- A consultancy is requested by an agency (client) from a Faculty/Staff.
- The assignment to be carried out at client site
- No infrastructural requirement from institute for the assignment
- **Consultant staff will be allowed to visit client site for completion of assignment for 52 days in a year not more than one day per week during running semester.**
- **Sharing of funds received may be as follows:  
After necessary deductions like taxes etc. 70% should be distributed to staff/s involved in the work and 30% to the institute.**

#### **2. Category II**

1. A consultancy is requested by an agency (client) from a faculty/Staff.
  2. The assignment to be carried out at Institute
  3. Institute infrastructural required for the assignment
- 4. Sharing of funds received may be as follows:  
After necessary deductions like taxes etc. 60% should be distributed to staff/s involved in the work and 40% to the institute**

#### **3. Category III**

4. Consultancy is requested by an agency (client) from Institute
  5. Institute assigns a consultant to complete the assignment
  6. Institute infrastructural required for the assignment
- Consultant team will be allowed to visit client site for completion of assignment for 52 days in a year not more than one day per week during running semester.

**Sharing of funds received may be as follows:**

**After necessary deductions like taxes etc. 50% should be distributed to staff/s involved in the work and 50% to the institute**

### **1.3 Policy for Training Program/Seminar/Workshops/FDP**

**Proposed Scheme for disbursement of revenue generated by training Programme/ short term courses.**

Training Programs

1. Faculty/Staff members can conduct value added training program within the institute or at client site
2. All such training programs will be conducted before / after the institute working hours
3. Trainer team will be allowed to visit client site for completion of assignment for 52 days in a year not more than one day per week during running semester.

**Trainer's Team share= 50% of funds received and available after necessary tax deductions.**

Training Team Share :

<b>Sr.</b>	<b>Team Member Title</b>	<b>% Share</b>
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No.		
1	Coordinator	10% of funds received by staff/s
2	Trainer	70 % of funds received by staff/s
3	Lab Assistant	7 % of funds received by staff/s
4	Class IV	3 % of funds received by staff/s
5	Accounts	5 % of funds received by staff/s
6	Principal	5 % of funds received by staff/s

**Note: This distribution corresponds to the disbursal from share received towards staff from institute.**

- All the necessary AMC” s of computers and equipment/instruments pertaining to different laboratories may be given to staff/s (to be treated them as vendors) at the 75% of the quoted price obtained from outside vendor.  
**Sharing of funds received may be as follows:  
After necessary deductions like taxes etc. 50% should be distributed to staff/s involved in the work and 50% to the institute.**
- Additional Training programs may be conducted by staff/s in the upcoming fields with a discounted fee of 50% charged by outside vendor.  
**Sharing of funds received may be as follows:  
After necessary deductions like taxes etc. 50% should be distributed to staff/s involved in the work and 50% to the institute**

# Innovation and Start up policy



## **FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING**

( Affiliated to Mumbai University and Approved by AICTE)

FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W), PIN- 400050

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# **INNOVATION AND STARTUP POLICY**

A Guiding Framework for Faculty and Students

*Paving the way of Entrepreneurship*

Draft – Version1 – 17 August 2020

Updated – Version2 – 12 January 2021

Updated – Version 3 – 25 January 2021

(HEI Approved Version)

**Fr.CRCE – INNOVATION AND STARTUP POLICY COMMITTEE****NISP Policy Formulation and Implementation Team with support of Institution's  
Innovation Council team.**

<b>Name of the Member</b>	<b>Member Type</b>	<b>Role of the member</b>
Dr. Srijia Unnikrishnan	Head of the Institute	Chairman
Prof. Swati Ringe	Faculty	NISP Coordinator
Prof. Kranti Wagle	Faculty	President – IIC
Mr. Mahesh Sharma	Training and Placement	Network Enabler
Dr. D.V. Bhoir	Professor Dean-Student affairs	ARIIA Coordinator
Dr. V. S. Jorapur	H.O.D. - Production dept.	Head - Startup Cell
Dr. Sapna Prabhu	H.O.D. - E.C.S. dept.	Formulation & Implementation
Dr. B.S. Daga	H.O.D. - Computer dept.	Formulation & Implementation
Dr. Jagruti Save	H.O.D. - AI & Data Science dept.	Formulation & Implementation
Dr. Hemant Khanolkar	H.O.D. – Humanities dept.	Formulation & Implementation
Dr. Sunil Surve	Dean Academics	Formulation & Implementation
Dr. Bhushan Patil	Professor and Dean R&D	IPR Cell In-charge
Prof. Hitendra Vaishnav	Faculty	Startup Cell
Prof. Prachi Patil	Faculty	Internship Activity Coordinator
Prof. Heena Pendhari	Faculty	Innovation Activity Coordinator
Prof. Prajakta Bhangale	Faculty	E-Cell in-charge
Mr. Ayush Jain	Alumni- UthopiaTech	Alumni Entrepreneurs
Mr. Manthan Dakshni	Alumni	Startup Founder
Mr. Parag Doshi	Alumni	Entrepreneur-Industry Associate
Mr. Gangan Rajendra	External	Entrepreneur -Industry Associate
Mr. Dinesh Jairam Israni	External	Naman Angels-Industry Associate
Mr. Sagar Sarvade	External	Entrepreneur
Mr. Saif Naqvi	Student	Startup Founder
Mr. Rohit Madke	Student	Startup Founder

**INSTITUTE INNOVATION COUNCIL- (IIC-FrCRCE) 2020-21**

<b>Position</b>	<b>Designation</b>	<b>Name</b>
Chairman	Principal	Dr. Srija Unnikrishnan
President	Assistant Professor	Prof. Kranti Wagle
Vice President	Assistant Professor	Prof. Ashwini Pansare
Convener	Assistant Professor	Prof. Dileep C.C.
NISP Coordinator	Assistant Professor	Prof. Swati Ringe
Innovation Activity Coordinator	Assistant Professor	Prof. Heena Pendhari
Startup Activity Coordinator	Assistant Professor	Dr. V. S. Jorapur, Prof. Hitendra Vaishnav
Internship Activity Coordinator	Assistant Professor	Prof. Prachi Patil
IPR Activity Coordinator	Professor and Dean R&D	Dr. Bhushan Patil , Prof. Deepali Bhise
Social Media Coordinator	Assistant Professor	Prof. Sangeeta Parshionikar
ARIIA Coordinator	Professor Dean-Student affairs	Dr. D. V. Bhoir
NIRF Coordinator	Assistant Professor	Prof. Ketaki Joshi
E-Cell in-charge	Assistant Professor	Prof. Prajakta Bhangale
Tinkering Lab	Assistant Professor	Prof. Saurabh Kulkarni
Member	Assistant Professor	Prof. Vaibhav Godbole
Member	Assistant Professor	Prof. Prajakta Dhamnaskar
Member	Assistant Professor	Prof. Vaibhav Godbole
Innovation Coordinator (Student)	Student Coordinator	Yash Kane
Startup Coordinator (Student)	Student Coordinator	Advait Bhushan Marde
IPR Coordinator	Student Coordinator	Sahil S Nikalje
Social Media Coordinator	Student Coordinator	Aryan Patil
Internship Coordinator	Student Coordinator	Hritik Manish Kothari
Representative from nearby Incubation Centre	Member	Prof. K. T. Talele, SPIT, Mumbai
Representatives of SIDBI / NABARD / Lead Bank / Investor	Member	Mr.Sanjeev Kumar, Sr. Manager, Corporation Bank,HillRoad Bandra-w
Technical Experts from nearby Industry	Member	Mr. Samir Kaji, M.D. Selec Controls P. Ltd
Alumni Entrepreneurs	Member	Mr. Ayush Jain, UthopiaTech
<b>INSTITUTES TECHNICAL AND NON TECHNICAL COUNCILS</b>		
Students from the host institution	Council in-Charge Student	Sakshi Dave Mayank Mishra Divita Phadakale Cyril Varghese Kanjiramyalil Nijo Ninan Sheetal Sharma Kaylynn Rodrigues Shreya Bilonikar Sherwin Dsouza Carol Mendonca Lancylord Dmonte

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**DEFINITIONS**

MoE:-	Ministry of Education
AICTE:-	All India Council of Technical Education
MIC:-	MoE Innovation Cell
IIC-FrCRCE :-	Institute Innovation Council of Fr. C. R.C. E.
NISP:-	National Innovation and Startup Policy
E-Cell:-	Entrepreneurship cell
IPR:-	Intellectual Property Rights
SPV:-	Special Purpose Vehicle is a subsidiary created by parent company to isolate financial risk
Pre-Incubation:-	It represents process which works with entrepreneurs who are in early stages of setting up their company. Usually entrepreneurs come into such programs with just an idea of early prototype/product/service.

## **Preamble**

Ministry of Education Innovation cell (MIC) along with All India Council of Technical Education (AICTE) released National Innovation and Startup Policy 2019 in September 2019.

With the understanding of recent trends, Fr. Conceicao Rodrigues College of Engineering (Fr.CRCE) have joined this NISP campaign to nurture “Innovation and Startup” culture.

The committee comprising faculty members from Institute Innovation Council(IIC), Entrepreneurship Cell(E-Cell), Start-up Cell, Intellectual Property Rights (IPR) cell, Internship coordinator and External members like startup founders, Entrepreneurs, Alumni is formed to discuss, formulate institute level startup policy and implementation of all innovation and entrepreneurship related activities within the institute. The institute is in the process of applying the incubation facility within the campus.

## **Vision**

**“Moulding Engineers Who Can Build The Nation”**

## **Mission**

To Facilitate a platform for innovative minds to transform their ideas into viable business propositions to start a business venture.

## **Short Term Objectives**

1. To facilitate generation of Innovative solution for real life problems.
2. To encourage and stimulate campus startups in the institution.

## **Long Term Objectives**

To link INNOVATION to ENTERPRISES leading to FINANCIAL SUCCESS.



## 1. Strategies and Governance

- Innovation and Entrepreneurship (I & E) Promotion is an important activity at Fr. Conceicao Rodrigues College of Engineering (Fr.CRCE). Specific objectives and associated performance indicators are to be identified for assessment.
- Implementation of Entrepreneurial vision will be achieved through mission statements rather than Stringent Control System.
- The NISP implementation team is formulated to achieve this agenda.
- Investment in entrepreneurial activities is a part of the institutional financial strategy. Currently 0.3% of budget of the total annual budget of the institution is allocated for funding and supporting innovation and startups related activities through the creation of separate "Innovation Fund". Minimum 1% of total annual budget is proposed.
- The financial strategy involves raising funds from diverse sources as mentioned below.
  - Encourage to bring in external funding through government (state and central) agencies such as DST, DBT, MHRD, AICTE, TDB, TIFAC, DSIR, CSIR, BIRAC, NSTEDB, NRDC, Startup India, Invest India, MeitY, MSDE, MSME, UoM etc. and non-government sources.
  - Approach private and corporate sectors to generate funds, under Corporate Social Responsibility (CSR) to support technology incubators.
  - Engage alumni actively to get Sponsorships, Mentoring or Consulting support.
- Importance of innovation and entrepreneurial agenda is known across the institute. It is promoted and **highlighted at institutional programs such as conferences, convocations, workshops etc.**
- Action plan is formulated at Institute level, which is in line with the current document along with well-defined short-term and long-term goals. Micro action plans are to be developed by the departments to accomplish the policy objectives.
- Product to market strategy for startups will be developed.
- Development of entrepreneurship culture will not be limited within the boundaries of the institution.
- This Policy will be updated time to time as per the need.

## 2. Startups Enabling Institutional Infrastructure

- Creation of pre-incubation and incubation facilities for nurturing innovations and startups at the institute is the high priority. Objective is to link INNOVATION to ENTREPRISES leading to FINANCIAL SUCCESS.
- IIC-FrCRCE cell is established as per the guidelines issued by MoE Innovation Cell at the institute. In order to support pre-incubation; IPR cell, Startup cell, E-cell and Student clubs have been set up for facilitating and mobilizing resources from different sources.
- This facility is available 24x7 to all the stakeholders of the institution.
- Mentoring and other relevant services through Pre- incubation/Incubation units will be offered in turn for fees and(or) zero payment basis. The modalities regarding equity sharing will depend upon the nature of services offered by these units.
- A separate incubation facility may be established as a support system at the institutional level for pre-incubation, incubation, IPR protection, industry linkages, exposure to entrepreneurial ecosystem, etc.

## 3. Nurturing Innovations and Startups

Institute will facilitate the startup activities / technology development by assisting student/faculty/staff (the potential entrepreneur) in the following manner.

- Permission to use institute infrastructure and facilities like Project lab, Computers, Printer, scanner, Fax machine, Internet Connection, Cubicle for brainstorming sessions, access to college library, conference room and video conferencing facility as per the requirement.
- Encouragement to do Short term/Part-time entrepreneurship training.
- Mentoring support on regular basis.
- Facilitation in a variety of areas including technology development, ideation, design thinking, fund raising, financial management, cash-flow management, new venture planning, business development, product development, social entrepreneurship, product costing, marketing, brand development, human resource management as well as law and regulations impacting a business.
- At present Mumbai University does not allow student entrepreneurs to earn credits for working on innovative prototypes/Business Models. Efforts to be made so that student inventors may be allowed to opt for start-up in place of their **mini project/major project**, seminars, internship.

- The area in which a student wants to initiate a startup may be **interdisciplinary** or multi-disciplinary. However, the student must describe how they will separate and clearly distinguish their ongoing research activities as a student from the work being conducted at the start up.
- Student entrepreneurs are allowed to use the address of Hostel (or) pre-incubation and (or) incubation unit to register their venture while studying at the institute.
- Student entrepreneurs will be allowed to sit for the examination, even if their attendance is less than the minimum permissible percentage, by taking prior permission from the institute with some criteria.
- Every faculty may be encouraged to mentor startups.
- Participation in start-up related activities needs to be considered as a legitimate activity of faculty and considered while evaluating the annual performance of the faculty. Institute will update/change/revise performance evaluation policies for faculty and staff as stated above.
- Institute incubation facility may link the startups to other seed-fund providers/angel funds/venture funds or itself may set up seed fund once incubation activities mature.
- Institute incubation facility may extend startup facility to Alumni of the institute as well as outsiders.
- Institute incubation facility will allow licensing of IPR from institute to start up. Ideally students and faculty members intending to initiate a start-up based on the technology developed or co-developed by them or the technology owned by the institute, should be allowed to take a license on the said technology on easy term, either in terms of equity in the venture and/ or license fees and/ or royalty to obviate the early stage financial burden.
- In return for the services and facilities, the legal entity designated by the institute incubation facility may take 1 to 5% equity/ stake in the startup/ company, based on use of brand, faculty contribution, infrastructure support and use of the institute's IPR. The legal entity designated by the institute would normally take nominal equity share, unless its full- time faculty/ staff have substantial shares. Other factors for consideration should be space, infrastructure, mentorship support, seed- funds, support for accounts, legal, patents etc.
- For staff and faculty, the legal entity designated by the institute would not take more than 20% of shares that staff faculty takes while drawing full salary from the institution; however, this share will be within the 5% cap of company shares, listed above.
- No restriction on shares that faculty / staff can take, as long as they do not spend more than 20% of office time on the startup in an advisory or consultative role and do not compromise with their existing academic and administrative work / duties. In case the

faculty/ staff holds the executive or managerial position for more than three months in a startup, then they may go on sabbatical/ leave without pay/ earned leave.

- In case of compulsory equity model, Startup may be given a cooling period of 3 months to use incubation services on rental basis to make a final decision based on satisfaction of services offered by the legal entity designated by the institute/incubator. In that case, during the cooling period, the legal entity designated by the institute cannot force startups to issue equity on the first day of granting incubation support
- The institute could consider providing services based on a mixture of equity, fee-based and/ or zero payment model. So, a startup may choose to avail only the support, not seed funding, by the institute on rental basis.

#### **4. Product Ownership Rights for Technologies Developed at Institute**

- When institute facilities / funds are used substantially or when IPR is developed as a part of curriculum/ academic activity, IPR is to be jointly owned by inventors and the institute.
- Inventors and institute could together license the product / IPR to any organisation including for commercial benefits, with the patentee having the primary say. License fees could be either / or a mix of
  - Sale and transfer fees or one-time technology transfer fees
  - Royalty as mutually agreed
  - Shares/partnership in the company licensing the product
- An institute may not be allowed to hold the equity as per the current statute, so SPV may be requested to hold equity on their behalf or as amended from time to time.
- On the other hand, if product/ IPR is developed by innovators not using any institute facilities, outside office hours (for staff and faculty) or not as a part of curriculum by student, then product/ IPR will be entirely owned by inventors in proportion to the contributions made by them. In this case, inventors can decide to license the technology to third parties or use the technology the way they deem fit.
- If there is a dispute in ownership, a minimum five member committee consisting of two faculty members (having developed sufficient IPR and translated to commercialization), two of the institute's alumni/ industry experts (having experience in technology commercialization) and one legal advisor with experience in IPR, will examine the issue after meeting the inventors and help them settle this, hopefully to everybody's satisfaction. Institute can use alumni/ faculty of other institutes as members, if they cannot find sufficiently experienced alumni / faculty of their own.
- Institute IPR cell or incubation center will only be a coordinator and facilitator for providing services to faculty, staff and students. They will have no say on how the invention is carried out, how it is patented or how it is to be licensed. If the institute is

to pay for patent filing, they can have a committee which can examine whether the IPR is worth patenting and own the patent. The committee should consist of faculty who have experience and excelled in technology translation.

- The institute's decision-making body with respect to incubation / IPR technology-licensing will consist of faculty and experts who have excelled in technology translation. Other faculty in the department / institute, including heads of department, heads of institutes, deans or registrars, will have no say in the above.
- Institute promotes Interdisciplinary research and publications or startup and entrepreneurship.

## **5. Organizational Capacity, Human Resources and Incentives**

- All departments work in coherence for development interdisciplinary projects by student teams.
- Periodically some external subject matter experts such as guest lecturers or alumni are engaged for strategic advice and bring in skills which are not available internally.
- Faculty and staff is encouraged to do courses on innovation, entrepreneurship management and venture development.
- The stakeholders who actively contribute and support entrepreneurship agenda are rewarded with sabbaticals, office and lab space for entrepreneurial activities, institutional awards, training, points in the appraisal for consideration of promotion.

## **6. Creating Innovation Pipeline and Pathways for Entrepreneurs at Institute Level**

- NISP awareness is generated among students, faculty and staff to know the value of entrepreneurship and its role in career development or employability from time to time.
- Students are encouraged to select elective subjects like entrepreneurship development. Integration of education activities with enterprise-related activities is done in teaching learning process.
- Students are encouraged to develop entrepreneurial mindset through experiential learning by exposing them to training in cognitive skills and Initiatives like idea and innovation competitions, hackathons, workshops, bootcamps, seminars, conferences, exhibitions, mentoring by academic and industry personnel, throwing real life challenges.
- Awards and recognition are routinely organized.

- Institute endeavours to link their start-ups and companies with a wider entrepreneurial ecosystem and by providing support to students who show potential, in the pre-startup phase. Connecting student entrepreneurs with real life entrepreneurs will help the students in understanding real challenges which may be faced by them while going through the innovation funnel and will increase the probability of success.
- Institute has established the Institution's Innovation Council (IIC) as per the guidelines of MoE's Innovation Cell and allocates appropriate budget for its activities. IICs guide institutions in conducting various activities related to innovation, startup and entrepreneurship development. Collective and concentrated efforts are undertaken to identify, scout, acknowledge, support and reward proven student ideas and innovations and to further facilitate their entrepreneurial journey.
- Networking events may be organized to create a platform for the budding entrepreneurs to meet investors and pitch their ideas.
- Institute may provide business incubation facilities like premises at subsidized cost. Laboratories, research facilities, IT services, training, mentoring etc. to the aspiring startups.
- A culture is promoted to understand that money is not FREE and is risk capital. The entrepreneur must utilize these funds and return. While funding is taking risk on the entrepreneur, it is an obligation of the entrepreneur to make every effort possible to prove that the funding agency did right in funding him/ her.
- Institute envisages to develop a ready reckoner of Innovation Tool Kit, which must be kept on the homepage on the institute's website to answer the doubts and queries of the innovators and enlisting the facilities available at the institute.

## **7. Norms for Faculty Startups**

- Roles of faculty may vary from being an owner/ direct promoter, mentor, consultant or as on-board member of the startup.
- Institute should work on developing a policy on 'conflict of interests' to ensure that the regular duties of the faculty don't suffer owing to his/her involvement in the startup activities.
- Faculty startup may consist of faculty members alone or with students or with faculty of other institutes or with alumni or with other entrepreneurs.
- Faculty must clearly separate and distinguish on-going research at the institute from the work conducted at the startup/ company.
- In case of selection of a faculty start up by an outside national or international accelerator, a maximum leave (as sabbatical/ existing leave/ unpaid leave/ casual

leave/ earned leave) of one semester/ year (or even more depending upon the decision of review committee constituted by the institute) may be permitted to the faculty.

- Faculty must not accept gifts from the startup.
- Faculty must not involve research staff or other staff of the institute in activities at the startup and vice-versa.
- Human subject related research in startups should get clearance from the ethics committee of the institution.

## **8. Pedagogy and Learning Interventions for Entrepreneurship Development**

- Institute has adopted a diversified approach like cross disciplinary learning, mentoring, innovative lab experiments, case studies, presentations to produce desirable learning outcomes focusing innovation.
- Student clubs/ bodies/ departments are created for organizing competitions, bootcamps, workshops, awards, etc.
- Institute has started awarding annual 'INNOVATION TROPHY' to motivate students to come up with outstanding ideas.
- Entrepreneurship education is imparted to students at curricular/ co-curricular/ extra- curricular level through elective/ short term or long-term courses and seminars on innovation, real life success and failure stories by internal and external stakeholders to evolve the culture of collaboration.
- In the beginning of every academic session, the institute conducts an induction program about the importance of Innovation and Entrepreneurship so that freshly inducted students are made aware about the entrepreneurial agenda of the institute and available support systems.
- Pedagogical changes need to be done to ensure that the maximum number of student projects and innovations are based around real life challenges.

## 9. Collaboration, Co-creation, Business Relationships and Knowledge Exchange

- Institute incubation facility will collaborate with potential partners, resource organizations, micro, small and medium sized enterprises (MSMEs), social enterprises, schools, alumni, professional bodies, entrepreneurs, incubators, finance teams, legal teams, Government bodies like BMC to build an ecosystem to support entrepreneurship and co-design the programs with stakeholder involvement.
- Institute incubation facility will organize networking events for better engagement of collaborators and knowledge gain.
- Knowledge management should be done by the institute through development of innovation knowledge platforms using inhouse Information & Communication Technology (ICT) capabilities.

## 10. Entrepreneurial Impact Assessment

Impact assessment with well-defined evaluation parameters should be done for all entrepreneurial activities like

- Engagement of all departments and faculty in the entrepreneur teaching and learning.
- Support system provided at the institutional level for pre-incubation, incubation, IPR protection, industry linkages, exposure to entrepreneurial ecosystem, etc.
- Satisfaction of participants.
- New business relationships created by the institutes.
- Number of startups created.

Impact assessment for measuring the success should be in terms of sustainable social, financial and technological impact in the market. COMMERCIAL success is the ONLY measure in the long run.



# Maharashtra Public University Act



GOVERNMENT OF MAHARASHTRA  
LAW AND JUDICIARY DEPARTMENT

MAHARASHTRA ACT No. VI OF 2017

THE MAHARASHTRA PUBLIC  
UNIVERSITIES ACT 2016

( As modified upto the 6th September, 2018 )



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139. Membership of State Legislature and of Parliament.
140. Questions regarding interpretation and disputes regarding constitution of university authority or body, etc.

(vi)

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- 141. Protection of Acts and orders.
- 142. Delegation of powers.
- 143. Acts and proceedings not invalid merely on ground of defect in constitution, vacancies, irregularity in procedure, etc.

CHAPTER XV  
**ESTABLISHMENT OF NEW UNIVERSITIES**

- 144. Issue of order providing for matters when a new university is constituted.

CHAPTER XVI  
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- 145. Continuance of existing officers and employees of university.
- 146. Provisions relating to continuance and constitution of authorities.
- 147. Repeal and savings.
- 148. Removal of difficulties.

SCHEDULE.

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MAHARASHTRA ACT No. VI OF 2017<sup>1</sup>

[THE MAHARASHTRA PUBLIC UNIVERSITIES ACT, 2016.]#

[This Act received the assent of the Governor on the 10th January 2017; assent first published in the *Maharashtra Government Gazette*, Part IV, on the 11th January 2017.]

Amended by Mah. 27 of 2018 U (28-11-2017)\*

” ” ” 48 of 2018 (6-8-2018)\*

**An Act to provide for academic autonomy and excellence, adequate representation through democratic process, transformation, strengthening and regulating higher education and for matters connected therewith or incidental thereto.**

**WHEREAS** it is expedient to provide for academic autonomy to non-agricultural and non-medical universities in the State of Maharashtra and to make better provisions therefor;

**AND WHEREAS** the Government of Maharashtra had appointed committees under the Chairmanships of Dr. Arun Nigvekar, Dr. Anil Kakodkar, Dr. Ram Takwale and Late Mrs. Kumud Bansal with a view to consider and recommend on different aspects of higher education and learning and to suggest various measures to ensure such autonomy;

**AND WHEREAS** after considering the recommendations of the said committees the Government of Maharashtra considers it expedient to make a law to provide for academic autonomy and excellence, adequate representation through democratic process, transformation, strengthening and regulating higher education and to regulate the non-agricultural and non-medical universities in the State of Maharashtra in more effective manner, to provide for participation of universities in social and educational spheres, to establish Maharashtra State Commission for Higher Education and Development, to constitute various Boards, and to repeal the Maharashtra Universities Act, 1994; it is hereby enacted in the Sixty-Seventh Year of the Republic of India as follows:—

Mah.  
XXXV  
of  
1994.

CHAPTER I

PRELIMINARY

1. (1) This Act may be called the Maharashtra Public Universities Act, 2016.

(2) It shall come into force on such date\*\* as the State Government may, by notification in the *Official Gazette*, appoint.

2. In this Act, unless the context otherwise requires,—

(1) “academic services unit” means university science and instrumentation centre, academic staff college, computer centre, university printing press or any other unit providing specialized services for the promotion of any of the objectives of the university;

(2) “adjunct professor”, “adjunct associate professor” or “adjunct assistant professor” means a person from industry, trade, agriculture, commerce, social, cultural, academic or any other allied field who is so designated during the period of collaboration or association with the university;

Short title  
and  
commence-  
ment.

Definitions.

1. For Statement of Objects and Reasons, see Maharashtra Government Gazette, 2016, Extra Part V-A, dated the 6th April, 2016, Page 118.

# For Report of Joint Committee, see Maharashtra Government Gazette, 2016 Extra Ordinary No. 41, Extra Ordinary Part V-A, dated the 5th December 2016.

U Maharashtra Ordinance No. 1 of 2018 was repealed by Mah. 27 of 2018.

\* This indicates the date of commencement of Act.

\*\* This Act came into force on 1st March 2017 vide G.N.H & TED, MPIJA-2015/(319/15)/Uni-4/Part-2,MGG Part IV B, dated the 27th February 2017.

(3) “affiliated college” means a college which has been granted affiliation by the university;

(4) “authorities” means the authorities of the university as specified by or under this Act;

(5) “autonomy” means a privilege of the university conferred by the Statutes to permit a college, institution or a university department to conduct academic programmes and examinations, develop syllabus for the respective subjects and issue certificates of passing the examinations;

(6) “autonomous college”, “autonomous institution” or “autonomous department” means a college, institution or department to which autonomy is granted and is designated to be so by the Statutes;

(7) “bodies” means the bodies of the university formed by the respective authorities;

(8) “Chancellor” and “Vice-Chancellor” means, respectively, the Chancellor and the Vice-Chancellor of the university;

(9) “choice based credit system” means the curricular system that offers multiple interdisciplinary choices for students to select from the courses (core, elective or minor or soft skill courses) to accumulate credits as prescribed in Statutes;

(10) “cluster university” means the cluster university established under sub-section (6) of section 3 of the Act;

(11) “collaboration” means collaborative academic activity of the university or college or institution with other universities, academic institutions including local, regional, national or international institutions, research institutions and organizations in the field of agriculture, industry, trade and commerce, sports, social, cultural, science, technology and any other field;

(12) “college” means a college affiliated to the university, situated in the university area or jurisdiction;

(13) “College Development Committee” means the College Development Committee constituted under section 97 of this Act;

(14) “Collegium of Heads of Department of Affiliated Colleges and recognized institutions” means an electoral college consisting of heads of departments from affiliated colleges and recognized institutions who shall elect from amongst themselves as members to the concerned authorities;

(15) “Collegium of Graduates of the University” means an electoral college consisting of registered graduates of the university, who shall elect from amongst themselves as members to the different authorities;

(16) “Collegium of Management Representatives” means an electoral college consisting of representatives of management committees of affiliated or autonomous colleges or institutions who shall elect from amongst themselves as members to the different authorities;

(17) “Collegium of Principals” means an electoral college consisting of fulltime approved Principals and Directors of recognized institutions who shall elect from amongst themselves as members to the different authorities;

(18) “Collegium of Teachers” means an electoral college consisting of fulltime approved teachers from affiliated and autonomous colleges and recognized institutions, who shall elect from amongst themselves as members to the different authorities;

(19) “Collegium of University Teachers” means an electoral college consisting of fulltime teachers from University Departments, University Institutions, and Conducted Colleges appointed by university who shall elect from amongst themselves as members to the different authorities;

(20) “Commission” means the Maharashtra State Commission for Higher Education and Development constituted under section 76 of this Act;

(21) “community college” means an institution providing skill-based academic programs as prescribed in the Statutes;

(22) “conducted college” means a college maintained and managed by the university;

(23) “De-notified Tribes (*Vimukta Jatis*)” means tribes declared as such by the State Government, from time to time;

(24) “department” means a department teaching a particular subject or a group of subjects in a college or an institution as prescribed in the Statutes;

(25) “Director” means a head of an institution including a centre or a school of the university as designated by the Management Council or a head of a recognized institution;

(26) “Director of Higher Education” and “Director of Technical Education” means respectively Director of Higher Education, Maharashtra State and Director of Technical Education, Maharashtra State;

(27) “Empowered Autonomous College” means an autonomous college that is identified by the University Grants Commission as College with potential for Excellence or College Excellence, which has high level grade as specified by the Government by notification in the Official Gazette as has been given the status of Empowered Autonomous College by the Authority under the Statutes, with a power to grant degree of such College jointly with the affiliating University;

(28) “Empowered Autonomous Cluster Institutions” means a group of autonomous Colleges or institutions of the same management or educational society which includes the colleges or institutions, identified by the University Grants Commission as College with potential for excellence or College of excellence, which have high level grade as specified by the Government by-notification in the Official Gazette as has been given the status of Empowered Autonomous Cluster Institution by the Authority under the Statutes, and is empowered to grant a joint degree with the affiliating University;

(29) “Empowered Autonomous Skills Development College” means, a college which has been recognized by the university for conducting the skills development programmes as prescribed by the university as per the National, State Level policy regarding Skills Qualification and Education Framework and which is given the status of Empowered Autonomous Skills Development College by the university to which it is affiliated and is empowered to grant a joint degree, certificate, diploma and advanced diploma with the affiliating university;

(30) “fee” means tuition fees, other fees and charges, including developmental charges;

(31) “Head of the University Department”, “Head of the Institution” and “Head of the College Department” means respectively, a Head of the University Department, a head of the recognized institution and a head of the college department, as prescribed in the Statutes;

(32) “higher education” means the pursuit of knowledge beyond learning at the stage of higher secondary school education;

(33) “Hostel” means a place of residence for the students of the university or a college or an institution, provided, established, maintained, by the university or college or institution, as the case may be;

(34) “institution” means an academic institution of higher learning, not being a college, associated with and admitted to the privileges of the university;

(35) “inter-disciplinary studies” means the combined academic studies and research in different disciplines as prescribed by statutes;

(36) “Knowledge Resource Centre” means a library established by the university on the campus or sub-campuses of the university to hold in print, electronic and audio-video format material, monographs, reference volumes, text and review books, all types of journals and any other material in various format useful for education, research, extension services or for similar purposes;

(37) “management” means the trustees or the managing or governing body, by whatever name called, of any trust registered under the Maharashtra Public Trusts Act, or any society registered under the Societies Registration Act, 1860 or a Company registered under section 8 of the Companies Act, 2013, under the management of which one or more colleges or recognized institutions or other institutions of higher learning, are conducted and admitted to the privileges of the university:

XXXIX  
of  
1950.  
21 of  
1860.  
18 of  
2013.

Provided that, in relation to any college or institution established or maintained by the Central Government or the State Government or a local authority like a Zilla Parishad, Municipal Council or Municipal Corporation, it means, respectively, the Central Government or the State Government or Zilla Parishad or the Municipal Council or the Municipal Corporation, as the case may be;

(38) “multi-disciplinary studies” means the combined academic studies and research in different streams of a particular discipline as prescribed by Statutes;

(39) “Nomadic Tribes” means tribes wandering from place to place in search of their livelihood, as declared by the State Government, from time to time;

(40) “non-vacational academic staff” means such staff as the State Government may classify to be non-vacational academic staff and includes all such staff which is complimentary to academic staff but, shall not include the staff engaged purely in discharging administrative functions;

(41) “Other Backward Classes” means any socially and educationally backward classes of citizens as declared by the State Government and includes Other Backward Classes declared by the Government of India in relation to the State of Maharashtra;

(42) “post-graduate department” means a department in a college or institution of higher learning, research or specialized studies, recognized to be so by the university and imparting post-graduate instruction or guidance for research;

(43) “prescribed” means prescribed by Statutes or Ordinances or Regulations, as the case may be, made by or under this Act;

(44) “Principal” means a teacher who is duly approved as a Principal by the university;

(45) “Pro-Vice-Chancellor” means the academic and executive officer, next to the Vice-Chancellor having purview of the entire university;

(46) “recognized institution” means an institution of higher learning, research or specialized studies, other than a college, and recognized to be so by the university;

(47) “registered graduate” means a graduate of a university registered or deemed to be registered by or under this Act with one of the universities;

(48) “satellite centre” means an integral part of an affiliated or conducted college or recognized institution imparting academic programmes, co-curricular, research and extension activities in rural or tribal region, neighbouring the location of such college or institution, established with the object of reaching the unreached, on the terms and conditions specified by the State Government by an Order in the *Official Gazette*;

(49) “Schedule” means the Schedule to this Act;

(50) “Scheduled Castes” means such castes, races or tribes or parts of, or groups within, such castes, races or tribes as are deemed to be Scheduled Castes, in relation to the State of Maharashtra under article 341 of the Constitution of India;

(51) “Scheduled Tribes” means such tribes or tribal communities or parts of or groups within, such tribes or tribal communities as are deemed to be Scheduled Tribes in relation to the State of Maharashtra under article 342 of the Constitution of India residing in any part of the State of Maharashtra;

(52) “school” means a school of studies maintained by or recognized as such by the university or autonomous college, Empowered Autonomous College, Empowered Autonomous Cluster Institution;

(53) “Skills Knowledge Provider” means an institution which has been recognized by the university for conducting such courses as prescribed by the university as per the National, State Level policy regarding Skills Qualification Framework;

(54) “Special Backward Category” means socially and educationally backward classes of citizens declared as a Special Backward Category by the State Government;

(55) “State” means the State of Maharashtra;

(56) “State Government” or “Government” means the Government of Maharashtra;

(57) “Statutes”, “Ordinances” and “Regulations” means, respectively, the Statutes, Ordinances and Regulations of the university, made by or under this Act;

(58) “Student” means an individual who is admitted and registered for an academic programme of the University or affiliated, conducted, autonomous colleges and recognized, institutions of the University;

(59) “Students Council” means the Students Council established under section 99 of the Act;

(60) “Sub-Campus” means a comprehensive inherent independent unit of the university for a predetermined geographical jurisdiction for decentralization of academic, administrative, research and extension activities of that jurisdiction, with the objective of improving efficiency and effectiveness;

(61) “teacher” means full-time approved professor, associate professor, assistant professor, reader, lecturer, librarian, principal, Director of an institution, Director of Knowledge Resource Centre, Director of Centre of Lifelong Learning and Extension, deputy or assistant librarian in the university, college librarian, Director or instructor of physical education in any university department, conducted, affiliated or autonomous college, autonomous institution or department or recognized institution of the university;

(62) “Tribunal” means the tribunal established under section 80 of the Act;

(63) “university” means any of the public universities mentioned in the Schedule and includes a cluster university within the meaning of sub-section (6) of section 3;

(64) “university area” means the area specified against the name of the university in the Schedule;

(65) “university department” means a department established and maintained by the university as prescribed by the Statutes;

(66) “University Grants Commission” means the University Grants Commission established under the University Grants Commission Act, 1956;

3 of  
1956.

(67) “university institution” means a centre, a school, or an institute established and maintained by the university as prescribed by the Statutes;

(68) “university teacher” means a full time teacher appointed by the university.

CHAPTER II  
PUBLIC UNIVERSITIES

3. (1) Each of the existing public universities specified in column (1) of Part I of the Schedule, with effect from the date of commencement of this Act, shall be deemed to be constituted under this Act for the same area specified in column (2) of the said part, for which it was constituted immediately before the date of commencement of this Act.

Incorporation  
of  
Universities.

(2) The State Government may, from time to time, by notification in the *Official Gazette*, constitute any new university under this Act by such name, for such area and with effect from such date, as may be specified by it, and insert necessary entries in Part II of the Schedule; and may for that purpose or any other purposes specified in that behalf diminish, increase or alter the area of any existing or new university, by suitably amending the Schedule, by the said notification, and thereupon the entries in column (2) of Part I, or in column (2) of Part II, as the case may be, of the Schedule, shall stand amended accordingly, and all educational institutions, whether colleges, institutions, autonomous or empowered autonomous colleges, empowered autonomous cluster institutions, post-graduate departments, schools on the sub-campuses, by whatever name called, within the area of the new university, which are affiliated to or recognized by the existing university shall, from the date aforesaid, stand affiliated to or recognized by the new university:

Provided that, no such notification shall be issued except on a resolution passed by both Houses of the State Legislature.

(3) Notwithstanding anything contained in sub-section (2), if, in the exigency of circumstances the new university considers it expedient that certain privileges of the existing university to which such educational institutions as referred to in sub-section (2), were entitled immediately before the date specified under the said sub-section should be continued for a certain period, not exceeding a period of five years in the aggregate, after the date aforesaid, the new university may accordingly forward its recommendations to the State Government and on receipt of such recommendations the State Government may, if it is satisfied that such privileges should be so continued, by notification in the *Official Gazette*, provide that for such period, as may be specified in the notification, such privileges shall continue.

(4) The Chancellor, Vice-Chancellor, Pro-Vice-Chancellor, Registrar, members of the Senate, Management Council and Academic Council for the time being holding office as such in each university are hereby constituted and declared to be a body corporate by the name specified therefor in the Schedule and shall have perpetual succession and a common seal and may by that name sue and be sued.

(5) Each university shall be competent to acquire and hold property, both movable and immovable, to lease, sell or otherwise transfer or dispose of any movable or immovable property, which may vest in or be acquired by it for the purposes of the university, and to contract and do all other things necessary for the purposes of this Act:

Provided that, no such lease, sale or transfer of such property shall be made without the valuation made thereof by the approved valuer appointed by the university and without the prior consent of the State Government.

(6) Notwithstanding anything contained in this Act, the State Government may, by notification in *Official Gazette*, constitute a cluster university comprising of a cluster of affiliated or autonomous colleges or institutions of a university. Such cluster university shall comprise of such university authorities and shall exercise such powers and perform such functions of university as may be specified in such notification:

Provided that, every such notification shall be laid as soon as may be, after it is issued, before each House of the State Legislature.

Objects of  
University.

4. The objects of the university, in general, shall be to disseminate, create and preserve knowledge and understanding by teaching, research and development, skill development, training and education, extension and service and by effective demonstration and influence of its corporate life on society in general, and in particular, the objects shall be to,

(1) carry out its responsibility of creation, preservation and dissemination of knowledge;

(2) promote discipline and the spirit of intellectual inquiry and to dedicate itself as a fearless academic community to the sustained pursuit of excellence;

(3) encourage individuality and diversity within a climate of tolerance and mutual understanding;

(4) promote freedom, secularism, equality, social justice as enshrined in the Constitution of India, and to be catalyst in patriotic socio-economic transformation by promoting basic attitudes and values of essence to national development;

(5) promote the conducive environment for ensuring social harmony, coexistence, integral humanism and upliftment of the poorest of the poor;

(6) extend the benefits of knowledge and skills for development of individuals and society by associating the university closely with local, regional and national problems of development;

(7) carry out social responsibility as an informed and objective critic, to identify and cultivate talent, to train the right kind of leadership in all walks of life and to help younger generation to develop right attitudes, interests and values;

(8) promote equitable distribution of teaching, learning, training and other support services facilities of higher education;

(9) provide for efficient and responsive administration, scientific and technology management and develop organization of teaching, learning, training, research and extension;

(10) devise motivational systems to ensure that individual cognitive abilities are not constrained but rather the innovative spirit and desire to make true contribution and realize self-achievement is nurtured;

(11) promote acquisition of knowledge in a rapidly developing and changing society and to continually offer opportunities of upgrading knowledge, training and skills in the context of innovations, research and discovery in all fields of human endeavour by developing a higher educational network with use of modern communication media, information and communication technology and other emerging and future technologies appropriate for a learning society;



(12) promote national integration, fraternity and preserve cultural heritage and inculcate respect towards different religions and diverse cultures of India through the study of different religions, literature, history, science, art, civilizations and cultures;

(13) develop work culture and promote dignity of labour through applied components in the syllabi;

(14) build up financial self-sufficiency by undertaking academic teaching, training and allied programmes, research and development activities for public and private industries, Governmental organizations at local, regional, national and global level and resource generative services in a cost-effective manner;

(15) promote better interaction and co-ordination among different universities, institutions and colleges in the given university, other universities in the State, in the region, in the nation and at global level by all such means generally to improve the governance of the university and facility it provides for higher education;

(16) generate and promote a sense of self-respect and dignity amongst the weaker sections of the society;

(17) to promote gender equality and sensitivity in society;

(18) strive to promote competitive merit and excellence as the sole guiding criterion in all academic and other matters relating to students.

**5. The university shall have the following powers and duties, namely:—**

Powers and  
duties of  
University.

(1) to provide for instructions, extension, teaching, learning and training in such branches or subjects or disciplines and courses of study including a choice based credit system and any other system that may emerge in future, as the university may, from time to time, determine;

(2) to make provision for research and for the advancement and dissemination of knowledge, and generally to cultivate and promote the arts (including fine arts and performing arts), humanities, social sciences, accounts and commerce, pure and applied sciences, technologies, managements, different forms of medicine, engineering, law, physical education and other branches of learning and culture and their multi-disciplinary and inter-disciplinary areas;

(3) to make provision to enable conducted and affiliated colleges and recognized institutions to undertake specialized studies;

(4) to make provisions for creation of autonomous, empowered autonomous and empowered autonomous cluster of institutions;

(5) to develop procedures and processes for recognition of private skills education providers and empowered autonomous skills development colleges;

(6) to organize, maintain and manage university departments, schools, institutions, laboratories, knowledge resource centers, learning resource centers, libraries, museums and equipment for teaching, learning, training, research and development or extension;

(7) to establish, maintain and manage departments, institutions of research, institutions of specialized studies or academic services unit;

(8) to establish, maintain and manage constituent, community and conducted colleges, institutions, hostels, health centers, auditoria and gymnasiums;

(9) to provide for establishment, on the university campus and Sub-Campuses, of autonomous institutions like multi-university and inter-university centers, research laboratories, modern instrumentation centers and like centers of learning, set up by the University Grants Commission, Central Government or the State Government, teaching or learning or training colleges or institutions at local, regional, national and global level, which may be used by a university or college or group of universities or colleges:

Provided that, in the case of any industry or any non-Government organization availing themselves of such facility of a university or such organizations providing the facility to a university, prior approval of the State Government shall be obtained by the university concerned;

(10) to provide for establishment of sub-campuses for serving a group of colleges, and also to provide for and maintain common resource centers in such sub-campuses in the form of post-graduate departments, multi-disciplinary or interdisciplinary schools, knowledge resource centers, libraries, laboratories, computer centers, and the like centers of learning and skills training, as per the guidelines laid down by the State Government or the University Grants Commission;

(11) to create posts of directors, principals, university teachers, non-vacation academic staff, non-teaching skilled, administrative, ministerial staff and other posts required by the university, from its funds and from the funds received from other funding agencies, prescribe their qualifications, experience and pay-scales, and make appointments thereto;

(12) to make appointments to the posts of directors, principals, university teachers, non-vacation academic staff, non-teaching skilled, administrative, ministerial staff and other posts sanctioned by the State Government as per the qualifications and experience specified by the State Government and the University Grants Commission;

(13) to appoint or recognize persons working in any other university or organization as adjunct professors, adjunct associate professors, adjunct assistant professors, visiting professors of the university for specified periods;

(14) to facilitate mobility of teachers within the university and to other universities with the consent of the teacher concerned;

(15) to prescribe the courses of instruction and studies for the various examinations leading to specific degrees and diplomas or certificates;

(16) to prescribe the courses of instruction and studies in choice based credit system for the various examinations leading to specific degrees, diplomas or certificates in a stand-alone format or joint format with other State or national or global universities;

(17) to make provision, wherever feasible, in the university departments, colleges, institutions, recognized institutions and schools, for survey and collection of statistics, data and other particulars relevant to various developmental activities including State and National plans, evaluation of the developmental schemes with the participation of the students as a part of their curricular activities;

(18) to supervise, control and regulate admission of students for various courses of study in university departments, schools, multi-disciplinary and inter-disciplinary schools, community, conducted and affiliated colleges, institutions and recognized institutions;

(19) to guide teaching in colleges by deputation of teachers from a pool of teachers of the university and supplement teaching in colleges for improving their standards;

(20) to institute degrees and post-graduate diplomas and post-higher secondary diplomas, certificates and other academic distinctions on the basis of examinations or by other tests or otherwise;

(21) to hold examinations or evaluations and confer degrees and post-graduate diplomas and award post-higher secondary diplomas and certificates and other academic distinctions on persons who,—

(a) unless exempted therefrom in the manner prescribed, have pursued approved courses of study in the university, or in a college or in an institution or a recognized institution or a school and have passed the examinations and earned the required credits or marks or grades prescribed by the university; or

(b) have pursued approved courses of study in the university, or in a college or in an institution or a recognized institution or in an autonomous college or an autonomous recognized institution or in empowered autonomous college or empowered autonomous cluster institutions or a school and have passed the examinations and earned the required credits or marks or grades prescribed by the university; or

(c) have engaged in research under conditions provided by Ordinances and Regulations;

(22) to confer and award such degrees, diplomas and certificates to, and provide for such lectures, instructions and training for external students, and the students under correspondence and distance education, online and continuing education courses;

(23) to confer honorary degrees or other academic distinctions as prescribed by the Statutes;

(24) to lay down the conditions of affiliation of colleges and recognition of institutions taking into account the credibility of the management and the norms of academic performance of colleges, faculties and subjects, as may be laid down, from time to time, and satisfy itself by periodical assessment or otherwise, that those conditions are fulfilled;

(25) to admit to the privileges of the university, affiliated colleges and institutions not maintained by the university and withdraw all or any of those privileges, temporarily or permanently;

(26) to designate a university department, conducted college, an affiliated college, institution or school as an autonomous university department, conducted college, affiliated college or institution or school, as the case may be, in accordance with the guidelines, if any, laid down by the State Government or University Grants Commission;

(27) to designate a conducted college, an affiliated college, institution or school as an empowered conducted college, affiliated college or institution or school, in a stand-alone or cluster form, as the case may be, in accordance with the guidelines, if any, laid down by the State Government or University Grants Commission;

(28) to monitor and evaluate the academic performance of university departments, university institutions, conducted colleges and of affiliated colleges, autonomous or empowered colleges in a stand-alone or cluster form and recognized institutions for affiliation or recognition, as the case may be, and for periodical accreditations;

(29) to inspect, where necessary, all types of colleges or institutions and recognized institutions through suitable machinery established for the purpose, and take measures to ensure that proper standards of instruction, teaching, learning, training and research, and extension are maintained by them and adequate library, class rooms, laboratory, hostel, workshop and other academic facilities are provided for;

(30) to hold and to manage trusts and endowments and institute and to award fellowship, travelling fellowship, scholarship, studentship, medals and prizes for teachers and students of the university and colleges;

(31) to fix, demand and receive or recover such fees and other charges, as may be regulated by the Ordinances, from time to time;

(32) to constitute a fee fixation committee;

(33) to supervise, control and regulate the conduct and discipline of the students of the university, colleges, institutions, recognized institutions, schools and hostels;

(34) to provide for mobility of students from formal to non-formal stream and vice-versa, and also among the other universities in the State and outside the State;

(35) to provide facilities for revision or in-service courses for teachers of the university, colleges, schools and institutions;

(36) to make arrangements for promoting the healthy atmosphere, corporate life and welfare of the students of the university, colleges, schools and institutions;

(37) to make arrangements for promoting welfare of the employees of the university;

(38) to co-ordinate and regulate teaching, learning, training and research and extension in the colleges and recognized institutions;

(39) to provide for the training and education in the domain of quality, intensive workshops or learning exercises on enhancing quality and also mechanism for setting up of internal quality assurance for quality improvement of teachers and non-teaching employees;

(40) to provide for periodical assessment of the performance of teachers and non-teaching employees in the colleges, institutions and university in accordance with the norms prescribed by the University Grants Commission or the State Government;

(41) to regulate and provide for attendance of the teachers on the premises of the university or colleges or institutions during teaching hours and beyond teaching hours, as prescribed and to prohibit teachers from taking or conducting private tuitions or private coaching classes;

(42) to regulate and provide for attendance of the non-teaching employees on the premises of the university or colleges or institutions during working hours and beyond working hours, as prescribed;

(43) to enforce conduct and discipline rules for teachers and non-teaching employees prescribed by the State Government;

(44) to prescribe code of conduct for managements;

(45) to prescribe and enforce students charter;

(46) to establish, maintain and manage, whenever necessary,—

(a) Knowledge Resource Centre;

(b) university extension boards;

(c) information bureaus;

(d) employment guidance bureaus;

(e) Autonomous Evaluation Boards; and

(f) such other activities as may be necessary and possible to fulfill the objects of the university;

(47) to make provision for participation of students in,—

(a) the national service scheme;

(b) the national cadet corps;

(c) home guards and civil defense;

(d) the national sports organization;

(e) physical and military training;

(f) extra-mural teaching and research;

(g) programmes related to Lifelong Learning and Extension;

(h) any other programmes, services or activities directed towards cultural, economic and social betterment as may be necessary and possible, to fulfill the objects of the university;

(48) to provide for special training or coaching for competitive examinations, for recruitment to the public services, public sector undertakings and other competitive employment opportunities;

(49) to co-operate or collaborate with any other university, institution, authority or organization for research and advisory services and for such purposes to enter into appropriate arrangement with other universities, institutions, authorities, or organizations to conduct certain courses as the situation may demand;

(50) to rescind or suspend affiliation or recognition or empowered status granted to colleges or institutions or cluster of institutions;

(51) to borrow funds for the purposes of the university on the security of the property of the university, with the prior permission of the State Government;

(52) to explore the possibilities of augmenting the resources of the university by exploring or innovating activities such as research and development, consultancy, training programmes and providing services for different clients from industry, trade or any other non-government organizations;

(53) to transfer the management of an affiliated college, institution or autonomous college or empowered autonomous college or cluster of institutions in case where irregularities or commissions or omissions of criminal nature by the management of such college or institution or mismanagement of such college or institution are *prima-facie* evident, to any other management;

(54) to undertake academic collaboration programmes, research and advisory services with universities and institutions abroad, with prior approval of the State Government;

(55) to receive funds for collaboration programmes from foreign agencies, subject to rules and regulations of the Central Government and State Government in that behalf;

(56) to create development corpus out of surplus that the university may generate through its teaching, learning, training, research and development, consultancy, and any other academic and support activities and to invest it in a professional manner and use the interest generated through it for the growth and development of academic, research and development, academic and physical infrastructure development and any other infrastructure;

(57) to lay down for teachers and university teachers, such instructions or directions as, in the opinion of the university, may be necessary in academic matters;

(58) to undertake development programmes in higher education, research, consultancy based projects and training programmes for outside agencies, by charging fees, so as to generate resources;

(59) to make special provisions for the benefit of university education to be made available to classes and communities which are socially and educationally backward;

(60) to make special provisions for such benefits of university education to be made available for women students and differently-abled students as the university may think necessary;

(61) to make special provision for higher education in rural and tribal areas;

(62) to take appropriate measures in order to increase the gross enrolment ratio;

(63) to implement the national literacy and adult education program through teachers and students on voluntary basis in the university system and to evolve measures to give due weightage to the efforts and performance of the students in this area in addition to their normal academic performance, and also to evaluate the performance of the teachers in this area;

(64) to promote by itself, or in co-operation with other universities, the study of Marathi and the use of Marathi as a medium of instruction, study, research and examination, in adherence to the policies of the State Government;

(65) to promote by itself, or in co-operation with other universities or organizations, the study of foreign languages in general and Asian languages in particular;

(66) to evolve an operational scheme for ensuring accountability of teachers, non-vacation academic and non-teaching staff of the university, institutions and colleges;

(67) to provide for joint appointments in single grade of pay in more than one department or administrative section in the university, as also between university departments and between the university-public or university-private or university public-private partnership research laboratories or university-industry or university-other bodies;

(68) to create knowledge and disseminate it and foster high quality research which is contemporary, globally competitive and locally as well as regionally and nationally relevant;

(69) to have a learner-centric approach and perform the role of being a knowledge creator;

(70) to strengthen education at under-graduate, post-graduate level, enhance research and development culture and relevant degree programmes and cultivate desire for entrepreneurship;

(71) to create a comprehensive digital university framework for both, e-learning and e-administrative services;

(72) to exploit the power of 'learning by collaboration' and 'participation' with use of information and communication technology;

(73) to cultivate research parks, technology incubators and other engagement entities to translate university research to commercial domain and coordinated projects involving multiple faculty groups from several disciplines that address some important issues before the State;

(74) to identify skills to which students need to be exposed to, by taking into account the local needs, training facilities available, emerging needs and new employment opportunities;

(75) to provide an environment for the all-round development of youth by exposing them to the rich cultural heritage of the country and creating opportunities for development of skills in sports;

(76) to ensure introduction of choice based credit system with transferable credit points from four streams, namely, the academic stream, the technology stream, the professional and social stream and the personality and cultural development stream;

(77) to facilitate mobility of teachers to collaborating institutions such as industries, research and development laboratories, non-Government organizations, engaged in societal development, to enable translation of knowledge to viable real life applications and in turn enrich university programmes;

(78) to establish centers or institutions in foreign countries with the permission of the Central and the State Government;

(79) to establish vocational or skills based community colleges in partnership with industry;

(80) to implement recommendations report of the Commission within the time-frame given by it;

(81) to comply with and carry out any directives issued by the State Government, from time to time, with reference to above powers, duties and responsibilities of the university;

(82) to conduct academic audit of university departments, conducted colleges, affiliated colleges, institutions or schools, at regular intervals;

(83) to do all such other acts and things as may be necessary for, or incidental or conducive to, the attainment of all or any of its objects.

Jurisdiction  
and  
admission to  
privileges of  
University.

**6. (1)** The territorial limits, within which the powers conferred upon the university by this Act shall be exercised, shall comprise the whole of the university area as specified against the name of such university in the Schedule:

Provided that, the benefit of distance-education courses, correspondence courses, open university courses or external degree courses of any university may, with the prior permission of the State Government, extend and cover the entire area of the State outside the university area:

Provided further that, if a university desires to establish sub-campus or centre or institution in any foreign country, on its own or in collaboration with any other Indian or foreign university or institution, it may do so with the prior sanction of the Central and the State Government.

(2) Subject to the provisions of sub-section (3) of section 3, no educational institution situated within the university area shall, except with the consent of the university and the sanction of the State Government, be associated in any way



with, or seek admission to any privilege of, any other university established by law with the exception of the state open university and Research or Project collaborations of university, colleges with any other university or colleges :

Provided that, if an educational institution, public or private, Indian or foreign, seeks to be associated with or be admitted to the privileges of a university, jurisdiction of which is not restricted to any State or area, such association or admission may be permitted by the State Government :

Provided further that, if a university, the jurisdiction of which is not restricted to any State or area, wishes to establish a centre or other unit of research in the university area on its own or in collaboration with any public or private Indian or foreign university or institution, it may do so with the sanction of the State Government and also with the sanction of the Central Government, if the collaboration is with the foreign university or institution.

(3) If an educational institution, public or private, Indian or foreign, associated with or admitted to the privileges of any other university established by law, seeks to be associated with, or be admitted to the privileges of a university, such association or admission may be permitted with the sanction of the State Government and consent of the university concerned.

(4) Save as otherwise, provided by or under this Act, any privilege enjoyed by any educational institution within the area of another university before the date on which this Act comes into force, shall not be withdrawn, without the sanction of the State Government.

(5) If a new district is created by the State Government, the area of such district shall be under the jurisdiction of such university, as may be declared by the State Government, by notification in the *Official Gazette*, for the purpose of admission to the privileges of such university.

7. (1) No citizen of India shall be excluded from any office of the university or from membership of any of its authorities, bodies or committees, or from appointment to any post, or from admission to any degree, diploma, certificate or other academic distinction or course of study on the ground only of sex, race, creed, class, caste, place of birth, religious belief or profession or political or other opinion :

University open to all irrespective of sex, race, creed, class, caste, place of birth, religion, or opinion.

Provided that, the university may maintain, accredit or recognize any college or institution exclusively for women, or reserved for women.

(2) The university shall adopt government policy and orders issued, from time to time, in regard to the reservation for Scheduled Castes, Scheduled Tribes, De-notified Tribes (*Vimukta Jatis*), Nomadic Tribes and Other Backward Classes for appointment to different posts of teachers and non-teaching employees and for the purpose of admission of students in the affiliated or conducted or community colleges, university departments, university institutions or recognized institutions.

(3) The university shall adopt with the general policy of the State Government in regard to the welfare of various categories of weaker sections of the society, minorities, women and persons with disability as directed by the State Government, from time to time.

Control of  
State  
Government  
on  
Universities.

**8.** (1) Without prior approval of the State Government, the university shall not,—

(a) create new posts of teachers, officers or other employees;

(b) revise the pay, allowances, post-retirement benefits and other benefits of its teachers, officers and other employees;

(c) grant any special pay, allowance or other extra remuneration of any description whatsoever, including ex-gratia payment or other benefits having financial implications, to any of its teachers, officers or other employees;

(d) divert any earmarked funds received for any purpose other than that for which it was received;

(e) transfer by sale or lease of immovable property ;

(f) incur expenditure on any development work from the funds received from the State Government or University Grants Commission or any person or body for the purposes other than the purposes for which the funds are received;

(g) take any decision regarding affiliated colleges resulting in increased financial liability, direct or indirect, for the State Government.

(2) The university shall be competent to incur expenditure, in consonance with the policies and directives of the State Government issued from time to time, from the funds received from,—

(a) various funding agencies without any share or contribution from the State Government;

(b) contributions received from individuals, industries, institutions, organizations or any person whatsoever, to further the objectives of the university;

(c) contributions or fees for academic or other services offered by the university for aided and self-supporting academic programmes;

(d) development fund, or any other fund established by the university; for the purposes of,—

(i) creation of posts in various cadres;

(ii) granting pay, allowances and other benefits to the posts created through its own funds provided those posts are not held by such persons, who are holding the posts for which government contribution is received;

(iii) starting any academic programmes on self-supporting basis;

(iv) granting remunerations or incentives to its employees for performing any task assigned to them other than their regular duties and responsibilities;

(v) incurring expenditure on any development work and on welfare activities of its students and employees:

Provided that, there is no financial liability, direct or indirect, immediate or in future, on the State Government.

(3) The State Government may, in accordance with the provisions contained in this Act, for the purpose of securing and maintaining uniform standards in all universities in the State, by notification in the *Official Gazette*, prescribe a Standard Code providing for the classification, manner and mode of selection, appointment, induction and advance training, field exposure, deputation and reservation of post in favour of members of the Scheduled Castes, Scheduled Tribes, De-notified Tribes (*Vimukta Jatis*), .Nomadic Tribes, and Other Backward Classes, duties, workload, pay, allowances, post-retirement benefits, other benefits, conduct and disciplinary matters and other conditions of service of the officers, teachers and other employees of the universities and the teachers and other employees in the affiliated colleges and recognized institutions (other than those managed and maintained by the State Government, Central Government and the local authorities) and the provisions for absorption of teachers and employees in the university departments, affiliated or conducted colleges and institutions who are aided and rendered surplus. However, the unaided teachers and employees who are rendered surplus in university departments, affiliated or conducted colleges and institutions shall not be eligible, for absorption at the aided vacancies in university departments, affiliated or conducted colleges and institutions. Where such Code is prescribed, the provisions made in the Code shall prevail, and the provisions made in the Statutes, Ordinances and Regulations made under this Act, for matters included in the Code shall, to the extent to which they are inconsistent with the provisions of the Code, be invalid.

(4) Qualifications and experience for the purpose of appointment of non-teaching employees in the universities, affiliated colleges and recognized institutions (other than those managed and maintained by the State Government, Central Government and the local authorities) shall be as may be specified by the Government, by an order published in the *Official Gazette*.

(5) Notwithstanding anything contained in this Act, if the circumstances so require and the State Government considers it necessary to do so, it may appoint, on deputation, a suitable person possessing the requisite qualifications to perform the duties of the Registrar, Finance and Accounts Officer or the Director of the Board of Examinations and Evaluation, for a period of not more than one year at a time and not more than three years in the aggregate.

(6) The State Government through any officer not below the rank of Joint Director, Higher Education or Technical Education shall have right to cause inspection of any affiliated, conducted, or autonomous college recognized institution or university department.

(7) In case of failure of the university to exercise powers or perform duties specified in section 5, or where the university has not exercised such powers or performed such duties adequately, or where there has been a failure to comply with any order issued by the State Government, or under any other circumstances as the State Government may deem fit, the State Government may issue a directive to the university for proper exercise of such powers or performance of such duties or comply with the order; and it shall be the duty of the university to comply with such direction. In case the university fails to comply with the directives, the State Government shall call upon the University to give reasons in writing as to why

the directives were not complied with. If the State Government is not satisfied with the explanation, it may refer the matter to the Chancellor for taking necessary action under sub-section (3) of section 9.

(8) The State Government shall carry out test audit or full audit of the accounts of a university, college, school or institution, a regularly at such intervals as it may deem fit.

### CHAPTER III OFFICERS OF THE UNIVERSITY

Chancellor  
and his  
Powers. **9.** (1) The Governor of Maharashtra shall be the Chancellor of every university and the Chancellor, by virtue of his office, shall be the Head of the university.

(2) The Chancellor, when present, shall preside over the Convocation of the university and may issue directions to the Vice-Chancellor to convene the meeting of any authority of the university for specific purposes, whenever necessary, and the Vice-Chancellor shall submit the minutes of such meeting to the Chancellor for his perusal.

(3) The Chancellor,—

(a) shall, on receiving a reference from the State Government under the proviso to sub-section (7) of section 8 in such matter; or

(b) may, in any matter *suo motu* or otherwise,

call for a report or an explanation or such information and record relating to such matter or any matter or affairs of the university, and shall, after considering such report or explanation, or information or record, issue such directions thereupon as may be deemed fit in the interest of the university or student or larger interest of the public, and his directions shall be final and shall be complied with by the university forthwith.

(4) The Chancellor may, after taking report in writing from the Vice-Chancellor, suspend or modify any resolution, order or proceeding of any authority, body, committee or officer which in his opinion, is not in conformity with this Act, Statutes, Ordinances or Regulations made thereunder, or is not in the interest of the university and the university, authority, body, committee and officer, shall comply with the same:

Provided that, before making any such order, the Chancellor shall call upon the university, authority, body, committee or, as the case may be, officer to show cause why such an order should not be made, and if any cause is shown, within the time fixed by the Chancellor, he shall consider the same and wherever he deems it necessary, after consulting the State Government, decide the action to be taken in the matter, and his decision shall be final.

(5) Where, in the opinion of the Chancellor, the conduct of any elected or nominated or appointed or co-opted member is detrimental to the smooth functioning of university or any authority or body or committee, he may, after giving such member an opportunity to offer his explanation in writing and after considering such explanation, if any, and satisfying himself that it is necessary so to do, disqualify such member or suspend him for such period, as he may deem fit.

(6) The Chancellor shall exercise such other powers and perform such other duties as may be conferred upon or vested in him by or under this Act.

**10.** The following shall be the other officers of the university, namely:—

- (1) the Vice-Chancellor;
- (2) the Pro-Vice-Chancellor;
- (3) the Registrar;
- (4) the Deans of Faculties;
- (5) the Director of Board of Examinations and Evaluation;
- (6) the Finance and Accounts Officer;
- (7) the Director of Sub-campus of the University;
- (8) the Director of Innovation, Incubation and Linkages;
- (9) the Director Knowledge Resource Center;
- (10) the Director of Lifelong Learning and Extension;
- (11) the Director of Students Development;
- (12) the Director of Sports and Physical Education;
- (13) the Director of National Service Scheme;
- (14) such other officers in the service of the university as may be prescribed by Statutes.

Other  
officers of  
University.

**11.** (1) There shall be a Vice-Chancellor who shall be the principal academic and executive officer of the university and *ex-officio* Chairperson of the Management Council, Academic Council, Board of Examinations and Evaluation, Board of Lifelong Learning and Extension, Finance and Accounts Committee, Board of National and International Linkages and the Board for Innovation, Incubation and Enterprise, Board of Information Technology, Board of Students' Development, Board of Sports and Physical Education and Board of Research and shall preside in the absence of the Chancellor at any convocation for conferring degrees and also at any meeting of Senate. His powers and duties shall be as provided in section 12.

Appointment  
of Vice-  
Chancellor.

(2) Save as otherwise provided, pay and allowances, terms and conditions of service of the Vice-Chancellor shall be such as may be determined by the State Government, from time to time.

(3) The Vice-Chancellor shall be appointed by the Chancellor in the manner stated hereunder :—

(a) There shall be a committee consisting of the following members to recommend suitable names to the Chancellor for appointment of Vice-Chancellor, namely:—

- (i) a member nominated by the Chancellor, who shall be the retired Judge of the Supreme Court or retired Chief Justice of a High Court or an eminent scholar of national repute or a recipient of Padma Award in the field of education;

(ii) the Principal Secretary of Higher and Technical Education Department or any officer not below the rank of Principal Secretary to Government nominated by the State Government;

(iii) the Director or Head of an institute or organization of national repute established by an Act of Parliament, nominated by the Management Council and the Academic Council, jointly, in the manner specified by the State Government by an order published in the *Official Gazette*.

(b) The member nominated by the Chancellor shall be the Chairman of the committee.

(c) The members nominated on the committee shall be persons who are not connected with the university or any college or any recognized institution of the university.

(d) No meeting of the committee shall be held unless all the three members of the committee are present.

(e) The committee shall recommend a panel of not less than 5 suitable persons for the consideration of the Chancellor for being appointed as the Vice-Chancellor. The names of the persons so recommended shall be in alphabetical order without any preference being indicated. The report shall be accompanied by a detailed write-up on suitability of each person included in the panel.

(f) A person recommended by the committee for appointment as Vice-Chancellor shall,—

(i) be an eminent academician and an administrator of high caliber;

(ii) be able to provide leadership by his own example;

(iii) be able to provide vision; and have ability to translate the same into reality in the interest of students and society; and

(iv) possess such educational qualifications and experience as may be specified by the State Government, by an Order published in the *Official Gazette*, in consultation with the Chancellor.

(g) The eligibility conditions and the process for recommendation of names for appointment as Vice-Chancellor shall be given wide publicity to ensure the recommendation of most suitable candidates.

(4) The Chancellor may appoint one of the persons included in the panel to be the Vice-Chancellor:

Provided that, if the Chancellor does not approve any of the persons so recommended, he may call for a fresh panel either from the same committee or after constitution of a new committee for the purpose, from such new committee.

(5) The process of preparing the panel of the suitable persons for being appointed as the Vice-Chancellor, shall begin at least six months before the probable date of occurrence of the vacancy of the Vice-Chancellor, and the process of appointment of the Vice-Chancellor shall be completed at least one month before the probable date of occurrence of the vacancy of the Vice-Chancellor.

(6) The person appointed as the Vice-Chancellor shall, subject to the terms and conditions of contract of service, hold office for a period of five years from the date on which he takes charge of his office or till he attains the age of sixty-five years, whichever is earlier and he shall not be eligible for re-appointment.

(7) The person appointed as the Vice-Chancellor shall hold a lien, if any, on the substantive post held by him prior to the appointment.

(8) In any of the following circumstances, the exigency whereof shall solely be judged by the Chancellor, namely :—

(i) where the committee appointed under clause (a) of sub-section (3) is unable to recommend any name within the time limit specified by the Chancellor;

(ii) where the vacancy occurs in the office of the Vice-Chancellor because of death, resignation or otherwise, and it cannot be conveniently and expeditiously filled in, in accordance with the provisions of sub-sections (3) and (4);

(iii) where the vacancy in the office of the Vice-Chancellor occurs temporarily because of leave, illness or other causes; or

(iv) where there is any other emergency;

the Chancellor may appoint any suitable person, to act as the Vice-Chancellor for a term not exceeding twelve months, in the aggregate as may be specified in his order :

Provided that, the person so appointed shall cease to hold such office on the date on which the person appointed as the Vice-Chancellor in accordance with the provisions of sub-sections (3) and (4) assumes office or the Vice-Chancellor resumes office.

(9) The Vice-Chancellor shall be a whole-time salaried officer of the university and shall receive pay and allowances, and other facilities as determined by the State Government. In addition, he shall be entitled to free furnished residence, a motor car including its maintenance, repairs and fuel required therefor, with the service of a chauffeur, free of charge.

(10) Such sumptuary allowance shall be placed at the disposal of the Vice-Chancellor, as the State Government may approve.

(11) If a person receiving an honorarium from the consolidated fund of the State, or if a principal of an affiliated college or a recognized institution or a university teacher is appointed as Vice-Chancellor, his terms and conditions of service shall not be altered to his disadvantage during his tenure as Vice-Chancellor.

(12) Notwithstanding anything contained in the foregoing sub-sections, the person referred to in sub-section (7) shall stand retired from his original post in accordance with the terms and conditions of service of that post.

(13) The Vice-Chancellor may, by writing under his signature addressed to the Chancellor, after giving one month's notice resign from his office and shall cease to hold his office on the acceptance of his resignation by the Chancellor or from the date of expiry of the said notice period, whichever is earlier.

(14) The Vice-Chancellor may be removed from his office if the Chancellor is satisfied that the incumbent,—

- (a) has become insane and stands so declared by a competent court; or
- (b) has been convicted by a court for any offence involving moral turpitude; or
- (c) has become an undischarged insolvent and stands so declared by a competent court; or
- (d) has been physically unfit and incapable of discharging functions due to protracted illness or physical disability; or
- (e) has willfully omitted or refused to carry out the provisions of this Act or has committed breach of any of the terms and conditions of the service or any other conditions, prescribed by the State Government under sub-section (2), or has abused the powers vested in him or if the continuance of the Vice-Chancellor in the office is detrimental to the interests of the university ; or
- (f) is a member of, or is otherwise associated with, any political party any organization which takes part in politics, or is taking part in, or subscribing in aid of, any political movement or activity.

*Explanation.*— For the purposes of this sub-clause, whether any party is a political party, or whether any organization takes part in politics or whether any movement or activity falls within the scope of this sub-clause, the decision of the Chancellor thereon shall be final :

Provided that, the Vice-Chancellor shall be given a reasonable opportunity to show cause by the Chancellor before taking recourse for his removal under sub-clauses (d), (e) and (f).

Powers  
and duties  
of Vice-  
Chancellor.

**12.** (1) The Vice-Chancellor shall be the principal academic and executive officer of the university responsible for the development of academic programmes of the university. He shall oversee and monitor the administration of the academic programmes and general administration of the university to ensure efficiency and good order of the university.

(2) He shall be entitled to be present, with the right to speak, at any meeting of any other authority or body or committee of the university, but shall not be entitled to vote thereat, unless he is the Chairperson or member of that authority or body.

(3) The Vice-Chancellor shall have the power to convene meetings of any of the authorities, bodies or committees, as and when he considers it necessary to do so.

(4) The Vice-Chancellor shall ensure that directions issued by the Chancellor are strictly complied with or, as the case may be, implemented.

(5) It shall be the duty of the Vice-Chancellor to ensure that the directives of the State Government, if any, and the provisions of this Act, Statutes, Ordinances and Regulations are strictly observed and that the decisions of the authorities, bodies and committees which are not inconsistent with this Act, Statutes, Ordinances and Regulations are properly implemented.



(6) The Vice-Chancellor may defer implementation of a decision taken or a resolution passed by any authority, body or committee of the university if, he is of the opinion that the same is not consistent with the directives of the State Government or with the provisions of the Act, Statutes, Ordinances and Regulations or that such decision or resolution is not in the interest of the university and at the earliest opportunity refer it back to the authority, body or committee concerned for reconsideration in its next meeting with reasons to be recorded in writing. If differences persist, he shall within a week, giving reasons submit it to the Chancellor for decision and inform about having done so to the members of the authority, body or committee concerned. After receipt of the decision of the Chancellor, the Vice-Chancellor shall take action as directed by the Chancellor and inform the authority, body or committee concerned, accordingly.

(7) If there are reasonable grounds for the Vice-Chancellor to believe that there is an emergency which requires immediate action to be taken, or if any action is required to be taken in the interest of the university, he shall take such action, as he thinks necessary, and shall at the earliest opportunity, report in writing the grounds for his belief that there was an emergency, and the action taken by him, to such authority or body as shall, in the ordinary course, have dealt with the matter. In the event of a difference arising between the Vice-Chancellor and the authority or body whether there was in fact an emergency, or on the action taken where such action does not affect any person in the service of the University, or on both, the matter shall be referred to the Chancellor whose decision shall be final :

Provided that, where any such action taken by the Vice-Chancellor affects any person in the service of the university, such person shall be entitled to prefer, within thirty days from the date on which he receives notice of such action, an appeal to the Management Council.

*Explanation.* - For the purposes of this sub-section, action taken by the Vice-Chancellor shall not include disciplinary action taken against any employee of the university.

(8) Where any matter is required to be regulated by the Statutes, Ordinances or Regulations, but no Statutes, Ordinances or Regulations are made in that behalf or where there is an exigency to amend Statutes, Ordinances or Regulations, the Vice-Chancellor may, for the time being, regulate the matter by issuing such directions as he thinks necessary, and shall, at the earliest opportunity thereafter, place them before the Management Council or other authority or body concerned for approval. He shall, at the same time, place before such authority or body for consideration the draft of the Statutes, Ordinances or Regulations, as the case may be, required to be made in that behalf :

Provided that, such direction shall have to be converted into Statute, Ordinance or Regulations as the case may be, within six months of issuing of such direction failing which such direction shall automatically lapse.

(9) The Vice-Chancellor shall be the appointing and disciplinary authority for the university teachers.

(10) The Vice-Chancellor shall be the appointing and disciplinary authority for officers of the university of the rank of Assistant Registrar and of the rank equivalent thereto and above.

(11) As the Chairperson of the authorities or bodies or committees of the university, the Vice-Chancellor shall be empowered to suspend member from the meeting of the authority, body or committee for persisting to obstruct or stall the proceedings or for indulging in behaviour unbecoming of a member, and shall report the matter accordingly, to the Chancellor.

(12) The Vice-Chancellor shall place before the Management Council a report of the work of the university periodically as provided under the Ordinances.

(13) The Vice-Chancellor shall have the power to, --

(a) accord recognition to institutions of higher learning, research specialized studies in accordance with the provisions of this Act;

(b) accord recognition to autonomous colleges, empowered autonomous colleges or cluster of institutions and empowered skills development colleges in accordance with the provisions of this Act;

(c) accord recognition to private skills education providers in accordance with the provisions of this Act;

(d) accord recognition as qualified teachers to the experts from the field of application oriented industries or companies and domain specific experts in various professional skills, working as training experts in private skills education providers and empowered skills development colleges.

(e) approve the recommended panel of referees for thesis or dissertations for awarding post-graduate, doctorate and higher degrees.

(14) (a) The Vice-Chancellor shall have right to cause inspection to be made by the Pro-Vice-Chancellor or such person or persons or body of persons as he may direct, of the university, its buildings, laboratories, libraries, museums, workshops and equipment and of affiliated, conducted or autonomous college, empowered autonomous colleges or cluster of institutions, recognized or autonomous institutions, empowered skills development colleges or private skills education provider, hall or hostel maintained or recognized by the university, and of the examinations, teachings and other work conducted by or on behalf of the university, and to cause an inquiry to be made in a like manner regarding any matter connected with the administration or finance of the university, affiliated, conducted or community or autonomous college, empowered autonomous colleges or cluster of institutions, recognized or autonomous institutions, empowered skills development colleges or private skills education provider:

Provided that, the Vice-Chancellor shall, in the case of affiliated or autonomous college, empowered autonomous colleges or cluster of institutions, recognized or autonomous institutions, empowered skills development colleges or private skills education provider, give notice to the management of such affiliated or autonomous college, empowered autonomous colleges or cluster of institutions, recognized or autonomous institutions, empowered skills development colleges or private skills education provider of his intention to cause an inspection or an inquiry to be so made:

Provided further that, the management shall have the right to make such representation to the Vice-Chancellor as it thinks necessary before such inspection or inquiry is made;

(b) after considering such representation, if any, the Vice-Chancellor may cause such inspection or inquiry to be made or may drop the same;

(c) in the case of management when an inspection or inquiry has been caused to be made, the management, shall be entitled to appoint a representative, who shall have the right to be present and be heard at such inspection or inquiry;

(d) the Vice-Chancellor may, if the inspection or inquiry is made regarding any college or institution admitted to the privileges of the university, communicate to the management the result of such inspection or inquiry;

(e) the management shall communicate to the Vice-Chancellor such action, if any, as it proposes to take or has been taken by it;

(f) where the management, does not, within the time fixed by the Vice-Chancellor, take action to his satisfaction, the Vice-Chancellor shall be competent to impose a fine upon the management and direct the management to stop the fresh admissions to the colleges or institutions or to decide any other action to be taken in this behalf and the same shall be communicated to the management concerned for compliance.

(15) The Vice-Chancellor shall forward to the State Government report on the recommendation of the Management Council, regarding the temporary alternative arrangements, in the interest of students, to run the day to day academic and administrative activities, of the management of an affiliated college, institution or autonomous college or empowered autonomous college or cluster of institutions in case of dispute regarding the management of the affiliated college and where irregularities or commissions or omissions of criminal nature by the management of such college or institution or mismanagement of such college or institutions are, *prima facie*, evident to committee of inquiry appointed by the university and to make the necessary arrangements to run the day to day academic and administrative activities of such college till the dispute is statutorily resolved. The decision of the State Government in this behalf shall be final and binding.

(16) The Vice-Chancellor shall exercise such other powers and perform such other duties as may be conferred upon him by or under this Act.

**13.** (1) The Pro-Vice-Chancellor shall be the academic and executive officer next to the Vice-Chancellor having purview of the entire university.

Pro-Vice-Chancellor.

(2) The Pro-Vice-Chancellor shall be a person who has held the post of professor, or principal of a college or an institution with not less than fifteen years teaching or research experience.

(3) The Pro-Vice-Chancellor shall be the Chairperson of the Board of Deans, Board of Sub-campuses, Board of University Departments and Inter-Disciplinary Studies, Board of Post-Graduate Education in Colleges; and an *ex-officio* Chairperson of the Research and Recognition Committee.

(4) The Pro-Vice-Chancellor shall be a full time salaried officer of the university and shall work directly under the superintendence, direction and control of the Vice-Chancellor.

(5) Save as otherwise provided, pay and allowances admissible to him as well as the terms and conditions of his service shall be such as may be determined by the State Government, from time to time.

(6) The Chancellor shall, in consultation with the Vice-Chancellor, appoint a Pro- Vice-Chancellor for the university.

(7) The term of Pro-Vice-Chancellor shall be co-terminus with the term of office of the Vice-Chancellor or till he attains the age of sixty-five years, whichever is earlier.

(8) The provisions of sub-section (11) of section 11 shall, in regard to the conditions of service of Pro-Vice-Chancellor, *mutadis-mutandis*, apply.

(9) The Pro-Vice-Chancellor shall act as the chairperson of the authorities, bodies and committees, in the absence of the Vice-Chancellor.

(10) When the office of the Pro-Vice-Chancellor falls vacant or when the Pro-Vice-Chancellor is, by reason of illness or absence or any other cause, unable to perform the duties of his office, the Vice-Chancellor, may appoint a suitable person qualified to be appointed as Pro-Vice-Chancellor to officiate as Pro-Vice-Chancellor, till the Pro-Vice-Chancellor resumes office, or a new Pro-Vice-Chancellor assumes duty, as the case may be.

(11) The Pro-Vice-Chancellor may, by writing under his signature addressed to the Vice-Chancellor, after giving one month's notice resign from his office and shall cease to hold his office on the acceptance of his resignation by the Vice-Chancellor or from the date of expiry of the said notice period, whichever is earlier.

(12) The Pro-Vice-Chancellor may be removed from his office by the Chancellor on the recommendation of the Vice-Chancellor, if he is satisfied that the incumbent,—

(a) has become insane and stands so declared by a competent court; or

(b) has been convicted by a court for any offence involving moral turpitude; or

(c) has become an undischarged insolvent and stands so declared by a competent court; or

(d) has been physically unfit and incapable of discharging functions due to protracted illness or physical disability; or

(e) has willfully omitted or refused to carry out the provisions of this Act or has committed breach of any of the terms and conditions of service or any other conditions, prescribed by the State Government under sub-section (5) or has abused the powers vested in him or if, the continuance of the Pro-Vice-Chancellor in the office is detrimental to the interests of the university; or

(f) is a member of, or is otherwise associated with, any political party or any organization which takes part in politics, or is taking part in, or subscribing in aid of, any political movement or activity.

*Explanation.*- For the purposes of this clause, whether any party is a political party, or whether any organization takes part in politics or whether any movement or activity falls within the scope of this clause, the decision of the Vice-Chancellor thereon shall be final :

Provided that, the Pro-Vice-Chancellor shall be given a reasonable opportunity to show cause by the Vice-Chancellor before taking recourse for his removal under clauses (d), (e) and (f).

(13) The Pro-Vice-Chancellor shall,—

(a) be the principal academic planning and academic audit officer for the academic development programmes, including post-graduate teaching, research and extension programmes and collaborative programmes of the university;

(b) ensure that quality in education and central academic services is maintained by the university;

(c) be responsible for fostering intellectual interaction across the university and for ensuring that there is research and development and industry linkages;

(d) ensure that the long-term and short-term development plans of the university and its colleges in their academic programmes are duly processed and implemented through relevant authorities, bodies, committees and officers;

(e) monitor appointment of principals and teachers of affiliated colleges and institutions, autonomous colleges and institutions, empowered autonomous colleges, cluster of institutions and recognized institutions or post-graduate centers;

(f) accord approval to the appointments of principals and teachers of affiliated colleges and institutions, autonomous colleges and institutions, empowered autonomous colleges, cluster of institutions and recognized institutions or withdraw the same in accordance with the procedure as prescribed in the Ordinances;

(g) accord approvals to selection committees for appointment of teachers in the colleges as per the norms of the University Grants Commission and the State Government;

(h) recommend proposals to the Management Council for the establishment of conducted colleges, schools, departments, institutions of higher learning, research and specialized studies, knowledge resource centre, academic services units, libraries, laboratories and museums in the university;

(i) consider and recommend proposals to the Management Council for creation of the posts of directors, principals, university teachers, non-vacation academic staff, non-teaching employees and other posts required by the university, from the funds of the university and from the funds received from other funding agencies, and qualifications, experience and pay-scales for such posts;

(j) be the principal liaison officer with the external funding agencies for generating funds for the collaborative and development programmes of the university and monitor their proper utilization;

(k) be responsible for preparation of the comprehensive perspective plan, annual plan, and undertaking the systematic field survey within geographical jurisdiction under section 107;

(l) be responsible for establishing liaison for fostering and promoting collaboration between the university, colleges and national and international institutions and scientific, industrial and commercial organizations;

(m) be responsible for submission of an annual report on the progress achieved in different developmental and collaborative programmes to the Vice-Chancellor who shall place the same before the Management Council;

(n) exercise such other powers and perform such other duties as prescribed under this Act or assigned to him, from time to time, by the Vice-Chancellor.

Registrar. **14.** (1) The Registrar shall, be the Chief Administrative Officer of the university. He shall be a full-time salaried officer and shall work directly under the superintendence, direction and control of the Vice-Chancellor.

(2) The qualifications and experience for the purpose of selection of the Registrar shall be as laid down by the University Grants Commission and approved by the State Government.

(3) The Registrar shall be appointed by the Vice-Chancellor on the recommendation of a selection committee constituted for the purpose under this Act.

(4) Appointment of the Registrar shall be for a term of five years or till he attains the age of superannuation whichever is earlier and he shall be eligible for re-appointment by selection on the recommendation of a selection committee constituted for the purpose, for only one more term of five years in the university in which he is serving.

(5) When the office of the Registrar falls vacant or the Registrar is, by reason of illness or absence or any other cause, unable to perform the duties of his office for a period not exceeding six months, the Vice-Chancellor shall appoint a suitable person to officiate as the Registrar until the new Registrar assumes duty or the Registrar resumes duty, as the case may be.

(6) The Registrar shall,—

(a) act as a Member-Secretary of the Senate, Management Council, Academic Council and such other authorities, bodies and committees, as prescribed by or under this Act;

(b) be the appointing and the disciplinary authority of the employees of the university other than the teachers, non-vacation academic staff and officers of the rank of Assistant Registrar and other officers holding posts equivalent thereto or above. An appeal by a person aggrieved by the decision of the Registrar may be preferred within thirty days from the date of communication of such decision, to the Vice-Chancellor;

(c) be the custodian of the records, the common seal and such other property of the university as the Management Council may, commit to his charge;

(d) conduct elections to various authorities and bodies of the university as per the programme approved by the Vice-Chancellor;

(e) prepare and update the Handbook of the Statutes and Regulations approved by the authorities, bodies or committees, from time to time, and make them available to all members of the authorities and officers of the university;

(f) receive complaints and suggestions in regard to the improvement of administration and consider them for appropriate action;

(g) render necessary assistance for inspection of the university, its buildings, class rooms, laboratories, libraries, knowledge resource centre, museums, workshops and equipment is made by such person or persons or body of persons, as directed by the Vice-Chancellor;

(h) organise training and orientation of non-teaching employees in the university and affiliated colleges;

(i) have the power to enter into agreements, sign documents and authenticate records on behalf of the university, subject to the decision of the authorities of the university;

(j) place before the Management Council a report of the development activities of the university every six months;

(k) have the power to seek information in regard to any matter of the university, from the Deans, Finance and Accounts Officer and any other officer of the university for submission to the State Government and other external agencies;

(l) exercise such other powers and perform such other duties, as prescribed by or under this Act or assigned to him, by the Vice-Chancellor and Pro-Vice-Chancellor, from time to time.

**15.** (1) There shall be a Dean for each faculty, who shall be a full time salaried officer.

Dean of  
Faculty.

(2) The Dean shall be appointed by the Vice-Chancellor on the recommendations of the selection committee for the purpose under this Act.

(3) The term of Dean shall be co-terminus with the term of office of the Vice-Chancellor or till he attains the age of superannuation, whichever is earlier:

Provided that, the new Vice-Chancellor may continue his services as a Dean till the new Dean is duly appointed:

Provided further that, in case vacancy occurs in the office of the Vice-Chancellor because of death, resignation or otherwise, the dean shall continue to hold the post till the end of that academic year.

(4) The qualification and experience for the purpose of selection of the Dean shall be the qualification and experience of the Professor or principal having aggregate minimum teaching or research experience of not less than fifteen years.

(5) The Vice-Chancellor may nominate Associate Dean for the particular group of related board of studies, as may be required, for assistance, support and co-ordination and the minimum qualifications and experience for such nomination shall be at par with the post of Dean :

Provided that, the salary, allowances and other pecuniary benefits payable to the Associate Dean shall be met by the University out of its own resources and there shall not be any liability, direct or indirect, on the State Government for the said purpose.

Powers and  
duties of  
Dean.

**16.** The Dean shall,—

(a) be responsible for academic planning and academic audit of the programmes and implementation of academic policies approved by the Academic Council in respect of academic development, maintenance of quality of education including standards of teaching and research and training of teachers within his faculty. He shall work directly under the superintendence, direction and control of the Vice-Chancellor;

(b) be responsible for development and application of quality benchmarks or parameters for various academic and administrative activities of higher education;

(c) facilitate the creation of a learner-centric environment conducive for quality education;

(d) arrange for feedback responses from the students, the teachers, non-teaching staff, the parents and the other stakeholders on quality-related institutional processes;

(e) ensure appropriate actions, as are needed for maintenance of quality of teaching spelt out by the Internal Quality Assurance Cell;

(f) ensure that the teachers appraisal by students is carried out and the reports thereof are sent to the university authorities concerned;

(g) be responsible for dissemination of information on the various quality parameters of higher education, as may be defined by various national level bodies dealing with assessment and accreditation of quality in educational institutions;

(h) organize inter-institutional and intra-institutional workshops, seminars on quality related themes and promotion of quality circles;

(i) co-ordinate quality-related activities, including adoption and dissemination of good practices, development and maintenance of institutional database, through management information system for the purposes of maintaining or enhancing the institutional quality;

(j) be responsible for development of quality culture in higher education;

(k) prepare Annual Quality Assurance Report of programmes within his faculty, based on the quality parameters or assessment criteria, developed by the relevant quality assurance bodies, in the prescribed format;

(l) be responsible for bi-annual development of quality parameters and ranking of integral units of higher education based on the Annual Quality Assurance Report;

(m) interact with State Quality Assurance Cell in the pre-accreditation and post-accreditation quality assessment, sustenance and enhancement endeavours;

(n) recommend to the Management Council proposals for the institution of fellowship, travelling fellowship, scholarship, studentship, medals and prizes and making Regulations for their award;



(o) recommend to the Management Council through the Academic Council, proposals for the conduct of inter-faculty and area or regional studies, common facilities, such as instrumentation centers, knowledge resource centers, Science and Technology Parks, entrepreneurship development and industry incubation center, intellectual property rights center, workshops, hobby centers, museums, etc.;

(p) control, regulate and co-ordinate research activities to maintain standards of teaching and research in the university departments, post-graduate departments in colleges and recognized institutions;

(q) recommend to the Academic Council proposals for conduct of post-graduate courses in university departments, post-graduate departments in colleges and recognized institutions;

(r) recommend to the Academic Council the norms of recognition of post-graduate teachers and research guides in post-graduate departments in colleges, autonomous colleges and institutions, empowered autonomous colleges, cluster of institutions and recognized institutions;

(s) recommend to the Academic Council the norms of recognition of under-graduate teachers and project guides in under-graduate departments in colleges, autonomous colleges and institutions, empowered autonomous colleges, cluster of institutions and recognized institutions;

(t) recommend to the Academic Council the norms of recognition of experts working in industries or private professional skills development companies or private skills development institutions, as recognized teachers for the certificate or diploma or advanced diploma or associate degree programmes which may be run by colleges, institutions, autonomous colleges and institutions, empowered autonomous colleges or cluster of institutions, empowered skills development colleges and private skills education provider, as recommended by the university authorities;

(u) be responsible for ensuring standards of under-graduate and post-graduate teaching and research in the faculty;

(v) be responsible for ensuring academic development of the faculty under his purview and proper implementation of the decisions of the Board of Studies, Faculty, Academic Council, Management Council and the Board of Examinations and Evaluation in respect of his faculty;

(w) be responsible for creation of a repository of questions with model answers which shall be continuously updated and expanded;

(x) enquire into any malpractices committed in any academic programmes in the faculty by a university department, affiliated or conducted or community or autonomous, empowered autonomous colleges or cluster of institutions or recognized institutions, on being directed by the Academic Council and submit a report of the findings to the Academic Council;

(y) render necessary assistance for redressal of grievances of the students in the faculty;

(z) prepare proposals for award of fellowship, scholarship and other distinctions in the faculty for submission to the Academic Council;

(za) prepare reports as required by the various authorities or bodies of the university, the State Government, the Central Government, the Central Educational Commissions or Councils, Commission and any such other body;

(zb) exercise such other powers and perform such other duties as prescribed by or under this Act or assigned to him by the Vice-Chancellor or Pro-Vice-Chancellor from time to time.

Director of  
Board of  
Examina-  
tions and  
Evaluation.

**17.** (1) The Director, Board of Examinations and Evaluation shall be a full time salaried officer and shall work directly under the directions and control of the Vice-Chancellor. He shall discharge his functions under the superintendence, direction and guidance of the Board of Examinations and Evaluation, and shall be concerned with the implementation of the policies and directives given by the Board of Examinations and Evaluation.

(2) The qualifications and experience for the purpose of selection of the Director, Board of Examinations and Evaluation shall be as may be specified by the State Government, by an order published in the *Official Gazette*.

(3) The Director, Board of Examinations and Evaluation shall be appointed by the Vice-Chancellor on the recommendation of the selection committee constituted for the purpose under this Act:

Provided that, in appointing the Director, Board of Examinations and Evaluation preference shall be given to the persons with proven capacity of use of technology in delivery of education.

(4) Appointment of the Director, Board of Examinations and Evaluation shall be for a term of five years or till he attains the age of superannuation, whichever is earlier and he shall be eligible for re-appointment by selection on the recommendation of a selection committee constituted for the purpose, for only one more term of five years in the university in which he is serving.

(5) The Director, Board of Examinations and Evaluation shall,—

(a) be the principal officer-in-charge of the conduct of university examinations, tests and evaluation, and declaration of their results;

(b) be the Member-Secretary of the Board of Examinations and Evaluation and of the committees appointed by the Board except the committees constituted for appointment of paper-setters, examiners and moderators;

(c) be responsible for making all arrangements necessary for holding examinations, tests and evaluation, and for timely declaration of results;

(d) evolve and implement in consultation with the Board of Examinations and Evaluation, processes for proper and smooth conduct of examinations and evaluation;

(e) prepare and announce in advance the programme of examinations, after seeking approval of the Board of Examinations and Evaluation;

(f) arrange for printing of question papers;

(g) postpone or cancel examinations, in part or in whole, in the event of malpractices or if the circumstances so warrant, and take disciplinary action or initiate any civil or criminal proceedings against any person or a group of persons or a college or an institution alleged to have committed malpractices, in consultation with the Vice-Chancellor;

(h) take disciplinary action where necessary against the candidates, paper setters, examiners, moderators, or any other persons connected with examinations and evaluation, found guilty of malpractices in relation to the examinations and evaluation;

(i) review, from time to time, the results of university examinations and evaluation, and forward reports thereon to the Board of Examinations and Evaluation;

(j) strive to declare the results of every examination and evaluation conducted by the University within thirty days from the last date of the examination for that particular course and shall in any case declare the results latest within forty-five days as provided in section 89 and in case of delay, prepare a detailed report outlining the reasons;

(k) take all steps for implementation of all academic and administrative decisions taken by the Board of Examinations and Evaluation;

(l) implement decisions taken by the various university authorities, connected with the examination and evaluation process;

(m) implement all policy and operative decisions with reference to the choice based credit system, both at the under-graduate, post-graduate levels and in other teaching programmes;

(n) organize workshops for teachers in the subjects concerned, in order to acquaint them with new trends in the assessment processes, such as cognitive and summative assessment, creation and use of repository of questions, use of technology in paper setting and conduct of examinations, tests and evaluation;

(o) ensure innovative and effective use of information and communication technology in the entire process of the conduct of examinations and evaluation;

(p) arrange for proper assessment of performance of candidates at the examinations and process the results;

(q) ensure that answer books for all degree examinations are assessed through the central assessment system;

(r) ensure that every teacher and non-teaching employee in the university, affiliated or conducted college or recognized institution renders necessary assistance and service in respect of examinations of the university and in evaluation process;

(s) carry out all other duties and functions assigned to him by the Board of Examinations and Evaluation;

(*t*) undertake any other task assigned to him by the university authorities to carry out the objectives of the Board of Examinations and Evaluation, and to ensure that the objects of the university are accomplished;

(*u*) exercise such other powers and perform such other duties as prescribed by or under this Act or assigned to him by the Vice-Chancellor and Pro-Vice-Chancellor, from time to time.

Finance and  
Accounts  
Officer.

**18.** (1) The Finance and Accounts Officer shall be the principal finance, accounts and audit officer of the university. He shall be a full-time salaried officer and shall work directly under the superintendence, direction and control of the Vice-Chancellor.

(2) The Finance and Accounts Officer shall be a person who is a chartered accountant or a cost accountant, with professional experience of not less than five years.

(3) In case the person possessing the qualifications and experience as specified in sub-section (2) cannot be appointed, the Finance and Accounts Officer may be appointed from amongst the Government Officers of the State Finance and Accounts Service, holding the post not below the rank of Deputy Director.

(4) The Finance and Accounts Officer shall be appointed by the Vice-Chancellor on the recommendation of the Selection Committee constituted for the purpose under this Act.

(5) The appointment of the Finance and Accounts Officer shall be for a term of five years or till the age of superannuation, whichever is earlier, and he shall not be eligible for re-appointment in that university.

(6) The Finance and Accounts Officer shall,—

(*a*) exercise general supervision over the funds of the university and advise the Vice-Chancellor as regards the finances of the university;

(*b*) hold and manage the funds, property and investments, including trust and endowed property, for furthering the objects of the university, with the approval of the Vice-Chancellor;

(*c*) ensure that the limits fixed by the university for recurring and non-recurring expenditure for a year are not exceeded, and that all allocations are expended for the purposes for which they are granted or allotted;

(*d*) keep watch on the state of the cash and bank balances and investments;

(*e*) ensure effective revenue management by keeping watch on the process and progress of collection of revenue, and advise the Vice-Chancellor on the methods to be employed in this regard;

(*f*) perform the duties under clauses (*a*) to (*e*) as per the Maharashtra Universities Account Code;

(*g*) get the accounts of the university audited, regularly;

(h) ensure that the registers of buildings, land, equipment, machinery and other assets are maintained up-to-date and that the physical verification and reconciliation of these assets and other consumable material in all offices, conducted colleges, workshops and stores of the university are conducted regularly;

(i) propose to the Vice-Chancellor that explanation be called for unauthorized expenditure or other financial irregularities from any academic member or non-vacation academic staff or an officer of the university of the rank of Assistant Registrar or equivalent and above;

(j) propose to the Registrar that explanation be called from any non-academic member of the university, other than the teacher, non-vacation academic staff and an officer of the university of the rank of Assistant Registrar or equivalent and above, for unauthorized expenditure or irregularities in any particular case, and recommend disciplinary action against the persons in default;

(k) call for, from any office, centre, laboratory, conducted college, department of the university or university institution, any information and returns that he thinks necessary for the proper discharge of his financial responsibilities;

(l) maintain the minutes of the meetings of the Finance and Accounts Committee;

(m) be responsible for preparation and maintenance of accounts by double entry accounting system, on accrual basis, presenting the annual financial estimates (budget), statement of accounts and audit reports, to the Finance and Accounts Committee and to the Management Council;

(n) prepare financial reports as required by the various authorities or bodies of the university, the State Government, the Central Government, the Central Educational Commissions or Councils, Commission, University Grants, Commission and All India Council for Technical Education and any such body providing funds to the university;

(o) exercise such other powers and perform such other duties as prescribed by or under this Act or assigned to him by the Vice-Chancellor and Pro-Vice-Chancellor, from time to time.

**19.** (1) The Director of Sub-campus shall be a full time officer who shall work under the superintendence, direction and control of the Vice-Chancellor.

Director of  
Sub-Campus  
University.

(2) The Director of Sub-campus shall be a person who is holding the post of professor or principal or equivalent position in any university or institute of national repute engaged in teaching, research and development activities, with not less than fifteen years teaching or research or administrative experience.

(3) The appointment of the Director of Sub-Campus shall be made by the Vice-Chancellor on the recommendation of the selection committee constituted for the purpose under this Act.

(4) The Appointment of the Director of Sub-Campus shall be for a term of five years or till the age of super-annuation, whichever is earlier, and he shall be eligible for re-appointment, by selection on the recommendation of a selection committee constituted for the purpose, for only one more term of five years in the university in which he is serving.

(5) The Director of Sub-Campus shall,—

- (a) be the chief academic and administrative officer of the Sub-Campus;
- (b) oversee and monitor the administration of the academic programmes of the colleges and recognized institutions in the district;
- (c) oversee and monitor general administration of the Sub-Campus of the university and ensure efficiency and good order of the university departments or schools or institutions on the Sub-Campus;
- (d) act as a link between the university, colleges and recognized institutions in the district, as well as departments, schools or institutions on the Sub-Campus of the university;
- (e) ensure that appropriate actions as are needed for maintenance of quality of teaching, as specified by the Internal Quality Assurance Cell and the university authorities, are initiated, records thereof are maintained, teachers appraisal by students is carried out and reports thereof are sent to university authorities;
- (f) co-ordinate evaluation, academic training workshops or seminars, quality measurement and other academic, administrative, financial and related activities in the district and on the Sub-campus;
- (g) ensure establishment of inter-institutional and intra-institutional information and communication technology linkages among the affiliated colleges and recognized institutions in the district;
- (h) ensure that the decisions of the colleges or university departments, schools, institutions on the Sub-Campus and their functioning is not inconsistent with this Act, Statutes and Regulations;
- (i) organize workshops and training programmes for the benefit of the teaching and support staff in the district and on the Sub-Campus;
- (j) ensure that financial discipline is maintained and expenditures of the campus are within the budgetary provisions recommended by the Sub-Campus committee and sanctioned by the Finance and Accounts Committee of the university;
- (k) ensure that the annual audited accounts related to the Sub-Campus are prepared and sent to the university at the end of each financial year;
- (l) undertake any other task that may be assigned to him by the university authorities to ensure that the objectives of the university are accomplished;
- (m) exercise such other powers and perform such other duties as prescribed by or under this Act or assigned to him by the Vice-Chancellor and Pro-Vice-Chancellor, from time to time.

Director of  
Innovation,  
Incubation  
and  
Linkages.

**20.** (1) The Director of Innovation, Incubation and Linkages shall be a full time salaried officer who shall be responsible for creation and cultivation of an enabling environment to propagate the concept of innovation, for converting innovative ideas into working models through a process of incubation which shall finally lead to creation of an enterprise and to cultivate, establish, maintain and strengthen the link of the university with premier national and international universities and institutions. He shall work directly under the superintendence, direction and control of the Vice-Chancellor.

(2) The qualifications and experience for the purpose of selection of the Director of the Innovation, Incubation and Linkages shall be as may be specified by the State Government, by an Order published in the *Official Gazette*.

(3) The Appointment of Director of Innovation, Incubation and Linkages shall be made by the Vice-Chancellor on the recommendation of the selection committee constituted for the purpose under this Act.

(4) The Appointment of the Director of Innovation, Incubation and Linkages shall be for a term of five years or the age of superannuation, whichever is earlier, and he shall be eligible for re-appointment by selection on the recommendation of a selection committee constituted for the purpose, for only one more term of five years in the university in which he is serving.

(5) The Director of Innovation, Incubation and Linkages shall,—

(a) be the principal officer who shall lead and provide vision to the Centre for Innovation, Incubation and Enterprise with his dynamism and enterprise;

(b) spearhead the awareness and training programmes for imparting education on intellectual property rights and aspects associated therewith;

(c) organize training programmes for creating awareness on the importance of entrepreneurship;

(d) organize and create support system for cultivation and incubation of good ideas into a scalable mode that would eventually culminate into the establishment of small, medium and large industry;

(e) work towards creating a liaison with national and international bodies and agencies involved in creating and developing entrepreneurial skills in students;

(f) take all steps to facilitate colleges to establish linkages with knowledge based and other types of industries;

(g) conduct training programmes to guide the young entrepreneurs in operational aspects, legal aspects, intellectual property rights, patent related issues, business model creation and financial aspects;

(h) implement the policies and strategies for promotion of international linkages with premier national and international universities and institutions, as envisaged by the Board of National and International Linkages and the university authorities;

(i) process applications for visits of teachers and students from university departments, institutions, conducted colleges, colleges and recognized institutions to national and international universities or institutions and assist them on logistic support for such visits;

(j) oversee and monitor administration of Foreign Students Assistance Cell which gives facility of a Single Window Operation to the foreign students;

(k) process the applications received from foreign students for their visits to other parts of India;

(l) supervise the working of the Migrant Indian Students' Cell established for providing Single Window Operation for students coming from other parts of the country;

(m) undertake any other task that may be assigned to him by the university authorities, to ensure that the objectives of the Board for Innovation, Incubation and Enterprise and Board of National and International Linkages are accomplished;

(n) exercise such other powers and perform such other duties, as prescribed by or under this Act or assigned to him by the Vice-Chancellor and Pro-Vice-Chancellor, from time to time.

Director,  
Knowledge  
Resource  
Center.

**21.** (1) Director, Knowledge Resource Center shall be a full time salaried officer of the university and shall be in-charge of the Knowledge Resource Centre in the university. He shall work directly under the superintendence, direction and control of the Vice-Chancellor.

(2) The qualifications, experience, emoluments and terms and conditions of service of the Director, Knowledge Resource Center shall be as recommended by the University Grants Commission, in the case of university librarian and adopted by the State Government.

(3) The appointment of the Director Knowledge Resource Center shall be made by the Vice-Chancellor on the recommendation of the selection committee constituted for the purpose.

(4) The Director Knowledge Resource Center shall,—

(a) be a Member-Secretary of the Knowledge Resource Centre Committee and shall ensure proper implementation of the decisions taken by the Knowledge Resource Centre Committee;

(b) be the custodian of all books, periodicals, manuscripts, journals in print, audio and digital format, and equipment in the Knowledge Resource Center;

(c) evolve and implement such processes and procedures to ensure that the books, periodical, manuscripts, journals and equipment in the Knowledge Resource Centre are not lost or damaged, and no irregularities take place in the Knowledge Resource Center;

(d) cause periodical verification of stock, prepare appropriate report that includes losses, and place it before the Knowledge Resource Center Committee;

(e) be responsible for the development, modernization, up keeping and management of university Knowledge Resource Center;

(f) render assistance and guidance to the concerned officer at Knowledge Resource Center on the Sub-Campus of the university;

(g) render assistance and advice to libraries and librarians of affiliated colleges and recognized institutions by conducting annual meeting of the librarians of affiliated colleges and recognized institutions;



(h) conduct training programmes and workshops to update the skills and knowledge of librarians of affiliated colleges and recognized institutions;

(i) create awareness among the students of various departments of the university regarding the availability of resources, information, search techniques and databases through the information literacy programme;

(j) undertake any other task assigned to him by the university authorities to ensure that the objectives of Knowledge Resource Center are accomplished;

(k) exercise such other powers and perform such other duties as prescribed by or under this Act or assigned to him by the Vice-Chancellor and Pro-Vice-Chancellor, from time to time.

**22.** (1) The Director of Lifelong Learning and Extension shall be a full time salaried officer of the university and shall be responsible to carry out the activities of the Board of Lifelong Learning and Extension. He shall work directly under the superintendence, direction and control of the Vice-Chancellor.

Director  
of  
Lifelong  
Learning  
and  
Extension.

(2) The qualifications, experience, emoluments and terms and conditions of service of the Director of Lifelong Learning and Extension shall be as recommended by the University Grants Commission and adopted by the State Government.

(3) The Director of Lifelong Learning and Extension shall be appointed by the Vice-Chancellor on the recommendation of the selection committee constituted for the purpose under this Act.

(4) The appointment shall be for a term of five years or till the age of superannuation, whichever is earlier and he shall be eligible for reappointment in the manner provided in sub-section (3) for only one more term of five years in the university in which he is serving.

(5) The Director of Lifelong Learning and Extension shall be the *ex-officio* head of the Department of Lifelong Learning and Extension.

(6) The Director of Lifelong Learning and Extension shall,—

(a) be responsible for implementation of policies and recommendations of the Board of Lifelong Learning and Extension;

(b) promote research in the field of lifelong learning, value education, life skills for adults and senior citizens, and for longevity;

(c) organize lower level skills development programmes for training female and male nurses to handle elderly patients or terminally ill patients;

(d) organize the teaching programmes which include certificate and diploma programmes for graduate students and advanced diploma programmes at post-graduate level in value education and longevity;

(e) organize post-graduate teaching programmes exclusively in the domain of value education and life skills for adults and senior citizens;

(f) organize and co-ordinate awareness activities for adults and senior citizens on life skills for coping with old age, information on social organization and Government Schemes for elderly persons and briefing on home for the aged;

(g) undertake any other task as may be assigned by the university authorities so as to carry out objectives of the Board for Lifelong Learning and Extension;

(h) exercise such other powers and perform such other duties as prescribed by or under this Act or assigned to him by the Vice-Chancellor and Pro-Vice-Chancellor, from time to time.

Director of  
Students'  
Develop-  
ment and  
Director of  
National  
Service  
Scheme.

**23.** (a) (1) The Director of Students' Development shall be nominated by the Vice-Chancellor, from amongst the teachers having minimum aggregate teaching experience of ten years and desired exposure in the field of extra-curricular and extension activities. He shall work directly under the superintendence, directions and control of the Vice-Chancellor.

(2) The emoluments, tenure, and terms and conditions of service shall be as prescribed by the Statutes.

(3) The Director of Students' Development shall,—

(a) work towards promotion of cultural, recreational and welfare activities of students in colleges, institutions and university departments;

(b) conduct leadership training programmes for students;

(c) ensure that there are mentors and counselling cells for the young students in colleges, institutions and university departments;

(d) organize anti-ragging committees and squads and ensure that all necessary measures are taken to prevent ragging in the university, colleges and the institutions;

(e) look into the grievances and general welfare of the students;

(f) help in building-up the all-round personality of students and to groom them to be future leaders and confident adults;

(g) organize cultural and recreational activities jointly with regional, national and international bodies;

(h) promote the interest of the youth and develop their skills for appreciation of the fine and performing arts, pure arts and literary skills;

(i) organize university, state, national and international level competitions, skills development workshops and interactive programmes in various fields for the students;

(j) train the students for state, national and international level competitions in various cultural activities;

(k) conduct elections to the University Students' Council;

(l) to prepare the report of the Board of Students' Development to be submitted before the Senate;

(m) undertake any other task assigned to him by the university authorities to carry out objectives of the Board of Students' Development;

(n) exercise such other powers and perform such other duties as prescribed by or under this Act or assigned to him, by the Vice-Chancellor and Pro-Vice-Chancellor, from time to time.

(b) (1) the Director of National Service Scheme shall be nominated by the Vice-Chancellor from amongst the teachers having minimum aggregate teaching experience of ten years, experience of at least three years as NSS Programme Officer and desired exposure in the field of National Service Scheme activities.

(2) The emoluments tenure and terms and conditions of service shall be as prescribed by the Statutes.

(3) The Director of National Service Scheme shall,—

(i) work towards promotion, co-ordination and conduct of different activities under National Service Scheme in colleges, institutions and university departments;

(ii) organize university, State, National and International level workshops, seminars, camps, competitions for National Service Scheme volunteers;

(iii) train the students for State, National and International competition;

(iv) undertake any other task assigned to him by the State National Service Scheme co-ordinator and the university authorities to carry out the objectives of National Service Scheme;

(v) exercise such other powers and perform such other duties as prescribed by or under this Act or assigned to him by the Vice-Chancellor and Pro-Vice-Chancellor, from time to time.

**24.** (1) The Director of Sports and Physical Education shall be a full time Director, and Physical Education salaried officer responsible for promoting the culture of sports and supervising sports related activities in the university, colleges and recognized institutions. He shall work under the superintendence, direction and control of the Vice-Chancellor.

Director of  
Sports and  
Physical  
Education

(2) The qualifications and experience for the purpose of selection of the Director of Sports and Physical Education shall be such as may be specified by the State Government, by an order published in the *Official Gazette*.

(3) The Director of Sports and Physical Education shall be appointed by the Vice-Chancellor on the recommendation of the selection committee constituted for the purpose under this Act.

(4) The appointment of the Director of Sports and Physical Education shall be for a term of five years or the age of superannuation, whichever is earlier, and he shall be eligible for re-appointment by selection on the recommendation of a selection committee constituted for the purpose, for only one more term of five years in the university in which he is serving.

(5) The Director of Sports and Physical Education shall,—

(a) cultivate excellence in various domains of sports and also to promote a spirit of healthy competition;

(b) promote sports, culture and organize activities in the field of sports in colleges, institutions and university departments;

(c) co-ordinate and organize activities related to various sports jointly with regional and national bodies;

(d) organize university level competitions, sports skill development camps in various sports on the university campus;

(e) train students for regional, national and international competitions in various sports;

(f) to prepare the report of the Board of Sports and Physical education to be submitted before the Senate;

(g) undertake any other task that may be assigned to him by the university authorities, so as to carry out objectives of the Board of Sports and Physical education;

(h) exercise such other powers and perform such other duties as prescribed by or under this Act or assigned to him by the Vice-Chancellor and Pro-Vice-Chancellor, from time to time.

Officers, members of authorities, bodies and employees of university to be public servants.

**25.** All salaried officers, members of the authorities, committees or bodies, teachers of the university and other employees of the university, shall be deemed to be public servants within the meaning of section 21 of the Indian Penal Code.

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## CHAPTER IV

### AUTHORITIES OF THE UNIVERSITY

Authorities of University.

**26.** The following shall be the authorities of the university, namely:

- (1) the Senate;
- (2) the Management Council;
- (3) the Academic Council;
- (4) the Faculty;
- (5) the Board of Deans;
- (6) the Board of Sub-campus of the university;
- (7) the Board of Studies;
- (8) the Board of University Departments and Inter-disciplinary studies;
- (9) the Board of Post-Graduate Education in Colleges;
- (10) the Board of Lifelong Learning and Extension;
- (11) the Board of Examinations and Evaluation;
- (12) the Board of Information Technology;
- (13) the Board of National and International Linkages;
- (14) the Board for Innovation, Incubation and Enterprise;
- (15) the Board of Students' Development;
- (16) the Board of Sports and Physical Education;
- (17) the Board of Research;

(18) such other bodies of the university as are designated by the Statutes, to be the authorities of the university.

**27.** Notwithstanding anything contained in any other provisions of this Act, in consultation with the Chancellor, the State Government shall, by an order published in the *Official Gazette*, specify the eligibility conditions for being elected, nominated or co-opted as a member of any authority of the university.

Power of State Government to specify eligibility conditions for being member of any authority of university.

**28.** (1) The Senate shall be the principal authority for all financial estimates and budgetary appropriations and for providing social feedback to the university on current and future academic programmes.

Senate.

(2) The Senate shall consist of the following members, namely:—

- (a) the Chancellor - Chairperson;
- (b) the Vice-Chancellor;
- (c) the Pro-Vice-Chancellor;
- (d) the Deans of Faculties;
- (e) the Director of Board of Examinations and Evaluation;
- (f) the Finance and Accounts Officer;
- (g) the Directors of Sub-campus of the university;
- (h) the Director, Innovation, Incubation and Linkages;
- (i) the Director of Higher Education or his nominee not below the rank of Joint Director;
- (j) the Director of Technical Education or his nominee not below the rank of Joint Director;
- (k) the Director Knowledge Resource Center of the university;
- (l) the Director of Board of Students' Development;
- (m) the Director of Sports and Physical Education;
- (n) the Director of Board of Lifelong Learning and Extension;
- (o) ten Principals of affiliated, conducted, autonomous colleges which are accredited by National Assessment and Accreditation Council (NAAC) or National Board of Accreditation, (NBA), as the case may be, to be elected by the collegium of principals from amongst themselves; of whom one each shall be a person belonging to Scheduled Castes, Scheduled Tribes, De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes, Other Backward Classes, and one shall be a woman;

(p) six representatives of Management - to be elected from among the collegium of management representatives of the affiliated colleges or institutions out of whom one shall be from Scheduled Castes or Scheduled Tribes or Denotified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Classes category, by rotation, and one shall be woman :

Provided that, such representatives of management to be elected shall be the representatives of management of colleges which are accredited by National Assessment and Accreditation Council or National Board of Accreditation as the case may be :

Provided further that, where a management conducts one or more Colleges or institutions, only one representative of such management shall be eligible for being included in collegium of Management Representatives;

(q) the president and the secretary of the University Students' Council;

(r) ten teachers other than principals and directors of recognised institutions to be elected by the collegium of teachers from amongst themselves of whom one each shall be a person belonging to Scheduled Castes, Scheduled Tribes, De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes, Other Backward Classes, and one shall be a woman;

(s) three teachers to be elected by the collegium of University teachers from amongst themselves, of whom one shall be a person belonging to the Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Classes, by rotation, and one shall be a woman;

(t) ten registered graduates having graduated at least five years prior to the date of nomination, to be elected from amongst the collegium of registered graduates, of whom one each shall be a person belonging to Scheduled Castes, Scheduled Tribes, De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes, Other Backward Classes, and one shall be a woman :

Provided that, the registered graduates shall not include the graduates falling in or covered by the category of teachers (regular or on contract basis, irrespective of their teaching experience), principals, heads of the departments, management or any other categories mentioned in this sub-section;

(u) ten persons nominated by the Chancellor, of whom four shall be from the field of agriculture, social work, co-operative movement, legal, financial, banking and cultural activities and of the remaining six persons, one is from the industry, one is an educationist, one is a scientist, one is a person from performing and fine arts or literature or sports, one is from an organization involved in Environment or Preservation of Nature related tasks, and one is from an organization involved in women's development or senior citizens welfare or communications and media;

(v) two persons, nominated by the Vice-Chancellor one shall be a non-teaching employee of the university and one shall be from amongst the non-teaching employees of the affiliated colleges or recognized institutions;

(w) two Members of Legislative Assembly nominated by Speaker of Legislative Assembly for a tenure of two and half years;

(x) one Member of Legislative Council nominated by Chairman of Legislative Council for a tenure of two and half years;

(y) one Member of Municipal Council or Municipal Corporation to be nominated by Vice-Chancellor by rotation for a tenure of one year;

(z) one representative of the Education Committees of Zilla Parishads within the university area, nominated by the Education Committee for the term of one year, by rotation;

(za) the Registrar - Member-Secretary.

(3) The Chancellor shall normally preside over the senate and in his absence the Vice-Chancellor shall preside.

(4) The Senate shall meet at least twice a year on the date to be fixed by the Chancellor. One of the meetings shall be the annual meeting.

**29.** The Senate shall transact the following business at its meeting, namely:—

Functions  
and duties  
of Senate.

(a) to give suggestions to the university authorities on improvements that can be made in all areas and domains that are an integral part of the university, namely, academics, research and development, administration and governance;

(b) to review current academic programmes and collaborative programmes;

(c) to suggest new academic programmes consistent with the societal requirements in higher education;

(d) to suggest measures for improvement and development of the university;

(e) to confer, on the recommendation of the Management Council, honorary degrees or other academic distinctions;

(f) to review broad policies and programmes of the university and suggest measures for its improvement and development;

(g) to receive, discuss and approve the annual financial estimate (budget), the annual report, accounts, audit reports and their satisfactory compliances along with its certification by the auditor and the disciplinary or otherwise action taken report in this regard by the University;

(h) to approve comprehensive perspective plan and annual plan for the location of colleges and institutions of higher learning, as recommended by the Academic Council;

(i) to review and adopt the report of students' grievance redressal report to be presented by Registrar of the University;

(j) to review and adopt the reports of the Board of Students' Development and Board of Sports to be presented by the concerned directors;

(k) to give suggestions to the University authorities on improvements that can be made in the area and domains of student welfare, sports, cultural activities of the University;

(l) to make, amend or repeal statutes.

Management  
Council.

**30.** (1) The Management Council shall be the principal executive and policy making authority of the university and shall be responsible for administering the affairs of the university and carrying out such duties, which are not specifically assigned to any other authority.

(2) There shall be not less than four meetings of the Management Council in a year.

(3) The procedure for conduct of business to be followed at a meeting including the quorum at the meeting and such other matters in relation to meetings as may be necessary, shall be such as may be prescribed by the Statutes.

(4) The Management Council shall consist of following members, namely:—

(a) the Vice-Chancellor-Chairperson;

(b) the Pro-Vice-Chancellor;

(c) one eminent person from the field of education, industry, agriculture, commerce, banking, finance, social, cultural and other allied fields to be nominated by the Chancellor;

(d) two Deans to be nominated by the Vice-Chancellor for tenure of two and half year;

(e) One head or Director, nominated by the Vice-Chancellor from amongst the heads or Directors of University Departments or University institutions for a tenure of one year, by rotation:

Provided that, in rotating the heads or Directors amongst Departments or University institutions, the earlier Departments or University institutions, which were given an opportunity of representation shall be ignored;

(f) two principals to be elected by the Senate from amongst the principals who are the members of the Senate, out of whom one shall be elected from amongst the principals who have been elected from Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Class categories, by rotation;

(g) two teachers who are not principals or directors of recognised institutions to be elected by the Senate from amongst the teachers and university teachers who are the members of the Senate, out of whom one shall be elected from amongst the teachers and university teachers who have been elected from Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Class categories, by rotation;

(h) two representatives of managements to be elected by Senate from amongst the representatives of management who are members of Senate, and further provided that same management shall not have second consecutive institutional representation:

Provided that, out of the two representatives under this clause, one member shall be elected by rotation, from amongst the Scheduled Castes or Scheduled Tribes, or De-notified Tribes (*Vimukta Jatis*) or Other Backward Class;



(i) two registered graduates elected by Senate from amongst elected registered graduate members of Senate, out of whom one shall be elected from amongst the registered graduates who have been elected from Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Class categories, by rotation;

(j) two members elected by the Academic Council from amongst its members, one of whom shall be from amongst the elected teachers who are members of the Council and another shall be a woman;

(k) one eminent-expert from the institute or organization of National repute to be nominated by the Vice-Chancellor in consultation with the Chancellor;

(l) the Secretary, Higher Education or his nominee not below the rank of Deputy Secretary or Joint Director of Higher Education;

(m) the Director of Higher Education or his nominee, not below the rank of Joint Director of Higher Education;

(n) the Director of Technical Education or his nominee not below the rank of Joint Director of Technical Education;

(o) the Registrar-Member-Secretary;

[<sup>1</sup> Provided that, for the election of the candidate from the reserved categories, under clauses (f), (g), (h) and (i), for the initial term of Management Council, immediately after the commencement of this Act, point of rotation for reserved categories under the said clauses shall be decided by drawing of lots by Vice-Chancellor, and while drawing of lots, it shall be ensured that the person belonging to each reserved category shall have representation on the Management Council.]

(5) The Finance and Accounts Officer and the Director, Board of Examinations and Evaluation shall be invitees of the Management Council, but they shall have no right to vote.

(6) President of the university students council shall be invitee, who shall attend the meeting as and when invited:

Provided that, such President shall be invited at least in every three months to discuss the issues related to the students' development, welfare and grievances.

**31.** The Management Council shall have the following powers and duties, namely:—

(a) to review and deliberate on short and long term reforms in academic, research and development activities, finances, management and governance that are taking place at the national and global level with a view to allow them to percolate into the university;

(b) to study and decide upon the operative mechanism for the reforms that would be recommended by the Commission in all the domains of the university;

(c) to make such provisions, as may enable colleges and institutions to undertake specialized studies and courses, and where necessary or desirable, organize and make provision for common laboratories, libraries, museums and equipment for teaching and research;

(d) to establish departments, colleges, schools, centres, institutions of higher learning, research and specialized studies, on the recommendation of the Academic Council;

(e) to recommend to the senate, the draft of statutes or amendment or repealment of statutes for approval;

Powers and duties of Management Council.

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1. This proviso was added by Mah. 27 of 2018 s. 2.

(f) to make, amend or repeal ordinances and regulations;

(g) to control and arrange for administration of assets and properties of the university;

(h) to discuss and approve with modifications, if any, the annual financial estimates or budget, that is to say the fund which may be received from State Government, university funds and other funding agencies separately, as received from the Finance and Accounts Committee;

(i) to consider proposals to enter into, amend, carry out and cancel contracts on behalf of the university;

(j) to determine the form of common seal for the university and provide for its use;

(k) to accept, on behalf of the university the transfer of any trusts, bequests, donations and transfer of any movable, immovable and intellectual property to the university;

(l) to transfer by sale or otherwise, any movable or intellectual property rights on behalf of the university;

(m) to transfer by sale or lease or contract any immovable property to other organization with the prior permission of the State Government:

Provided that, any immovable property may be permitted to be used for the specific period, for the purpose of providing essential physical facilities for accomplishment of objects of the university, such as bank, canteen, post office, mobile towers, etc., without prior approval of the State Government;

(n) to create immovable assets in the form of land, building and other infrastructure out of reserve funds, for its campus and sub-campus;

(o) to borrow, lend or invest funds on behalf of the university as recommended by the Finance and Accounts Committee;

(p) to lay down policy for administering funds at the disposal of the university for specific purposes;

(q) to provide buildings, premises, furniture, equipment and other resources needed for the conduct of the work of the university;

(r) to recommend the conferment of honorary degrees and academic distinctions;

(s) to institute and confer such degrees, diplomas, certificates and other academic distinctions as recommended by the Academic Council and arrange for convocation for conferment of the same, as provided by the Ordinances;

(t) to institute fellowship, travelling fellowship, scholarship, studentship, exhibitions, awards, medals and prizes and prescribe Regulations for their award;

(u) to make Regulations for collaborations with other universities, institutions and organizations for mutually beneficial academic programmes recommended by the Board of Deans;

(v) to create posts of university teachers and non-vacation academic staff from the funds of the university and from the funds received from other funding agencies, on the recommendation of the Academic Council, as and when required, and prescribe their qualifications, experience and pay-scales;

(w) to create posts of officers, non-teaching skilled, administrative, ministerial staff and other posts from the funds of the university and from the funds received from other funding agencies, as and when required, and prescribe their qualifications, experience and pay-scales;

(x) to prescribe honoraria, remunerations, fees and travelling and other allowances for paper-setters and other examination staff, visiting faculty, and fees or charges for any other services rendered to the university;

(y) to recommend to the Academic Council the comprehensive perspective plan and annual plan for the location of colleges and institutions of higher learning, as prepared by the Board of Deans;

(z) to consider and approve proposals for change or transfer of management and shifting of locations of colleges and institutions, as prescribed in the Statutes;

(za) to receive and consider report of the development activities of the university received from the Registrar every six months;

(zb) to confer autonomous status on university departments, university institutions, affiliated colleges and recognized institutions on the recommendation of the Academic Council, as per the Statutes;

(zc) to assess and approve proposals for academic programmes received from the Academic Council;

(zd) to consider and adopt the annual report, annual accounts and audit report in respect of State Government funds, university funds and funds received from other agencies separately;

(ze) to cause an inquiry to be made in respect of any matter concerning the proper conduct, working and finances of colleges, institutions or departments of the university;

(zf) to delegate, any of its powers, except the power to make, amend or repeal Statutes and Ordinances, to the Vice-Chancellor or such officer or authority of the university or a committee appointed by it, as it thinks fit;

(zg) to define the functions, duties, powers and responsibilities of non-teaching employees in the university, in respect of the posts created from the funds of the university and from the funds received from other funding agencies;

(zh) to deal with the cases related to the violation of prescribed fees according to the provisions of the Maharashtra Educational Institutions (Prohibition of Capitation Fee) Act, 1987 and other relevant Acts;

(zi) to accept donations, gifts and other forms of financial support from alumni, philanthropists, industries and other stakeholders and prescribe the procedure to be followed by the university for accepting such donations, gifts, etc;

(zj) to impose penalties upon the erring colleges or recognized institutions after following the procedure laid down by the Statutes;

(zk) to recommend to the State Government through the Vice-Chancellor to appoint an Administrative Board for the affiliated college to run the management of such college in case of disputes regarding the management of such colleges, till the dispute is statutorily resolved. The constitution of this board and the process of its appointment shall be as prescribed by the Statutes. The decision of the State Government in this regard shall be final and binding;

(zl) to develop and adopt students' charter.

Academic  
Council.

**32.** (1) The Academic Council shall be the principal academic authority of the university and shall be responsible for regulating and maintaining the standards of teaching, research and evaluation in the university. It shall also be responsible for laying down the academic policies in regard to maintenance and improvement of standards of teaching, research, extension, collaboration programmes in academic matters and evaluation of workload of the teachers.

(2) The Academic Council shall meet not less than four times in a year.

(3) The Academic Council shall consist of the following members, namely:—

(a) the Vice-Chancellor, Chairperson;

(b) the Pro-Vice-Chancellor;

(c) Deans of Faculties and Associate Deans (if any);

(d) Directors of Sub-campus;

(e) Director Innovation, Incubation and Linkages;

(f) the Vice-Chancellor shall nominate the following members, as per the recommendations of the search committee appointed by him for this purpose, in consultation with the Chancellor, namely:—

(i) eight Principals of conducted, autonomous or affiliated colleges which are accredited by the National Assessment and Accrediation Council (NAAC) or National Board of Accreditation (NBA), as the case may be of whom one shall be woman and one shall be a person belonging Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Class, by rotation;

(ii) two professors out of whom one shall be a person belonging Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Class, by rotation;

(iii) one head of a recognized institution;

(g) two teachers, representing each faculty, with not less than fifteen years of teaching experience to be elected by the collegiums of teachers from amongst themselves out of whom one each shall be a person belonging Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*)/ Nomadic Tribes or Other Backward Class provided that the reservation per faculty shall be decided by drawing lots:

Provided that, out of the teachers representing each faculties, under this clause, one shall be a woman, to be decided by drawing lots.

(h) one representative of management nominated by the Senate, from amongst the representatives of managements, who are the members of Senate;

(i) Eight eminent experts from the institutes or organizations of national repute, such as Indian Institute of Technology, Indian Institute of Science Education and Research, Indian Institute of Management, Indian Space Research Organization, Institute of Chartered Accountants of India, Institute of Cost Accountants of India, Institute of Company Secretaries of India, Indian Council for Social Research, Industrial Associations, Indian Olympic Association and allied fields and as much as possible representing all the faculties, nominated by the Chancellor;

(j) the Director of Higher Education or his nominee, not below the rank of the Joint Director, Higher Education;

(k) the Director of Technical Education or his nominee, not below the rank of the Joint Director, Technical Education;

(l) Director, Board of Examinations and Evaluation;

(m) Chairpersons of Board of Studies;

(n) Registrar-Member Secretary.

**33.** (1) The Academic Council shall have the following powers and duties, namely:—

Powers and duties of Academic Council.

(a) to ensure that the university becomes a vibrant hub for promotion of research and development, interactions and linkages with industries, cultivation of intellectual property rights and entrepreneurship and incubation of knowledge linked industries;

(b) to consider and approve with modifications, if any, the matters referred to it by the Board of Studies through the faculty;

(c) to ensure that there are choice based credit systems for all certificates, diplomas, degrees, post-graduate programmes and other academic distinctions;

(d) to ensure that the spirit of research and entrepreneurship percolates to all colleges and recognized institutions of the university;

(e) to approve fees, other fees and charges as recommended by the Board of Deans through the fee fixation committee;

(f) to recommend to the Management Council, the institution of degrees, diplomas, certificates and other academic distinctions;

(g) to propose draft of Ordinances relating to the academic matter to the Management Council;

(h) to make, amend or repeal Ordinances and Regulations relating to academic matters;

(i) to allocate subjects to the faculties;

(j) to prescribe qualifications and norms for appointment of paper-setters, examiners, moderators and others, concerned with the conduct of examinations and evaluation;

(k) to consider and make recommendations to the Management Council for creation of posts of university teachers and non-vacation academic staff, required by the university from the funds of the university and from the funds received from other funding agencies and prescribe their qualifications, experience and pay-scales;

(l) to prescribe norms for recognition of any member of the staff of an affiliated college or recognized institution as a teacher of the university, in consonance with the norms of the University Grants Commission and the State Government;

(m) to prescribe norms for granting affiliation, continuation of affiliation, extension of affiliation to colleges, and recognition, continuation of recognition, extension of recognition to institutions of higher learning and research or specialized studies;

(n) To grant affiliation to colleges or institutions in accordance with the provisions of this Act, the Statutes, Ordinances and Regulations;

(o) to accord recognition to various certificate, diploma, advanced diploma and degrees programmes run by private skills education providers and empowered autonomous skills development colleges, in consonance with the norms of the University Grants Commission and the State Government;

(p) to recommend to the senate the comprehensive perspective plan as prepared by the Board of Deans and recommended by the Management Council;

(q) to approve annual plan for the location of colleges and institutions of higher learning, as prepared by the Board of Deans and recommended by the Management Council;

(r) to recommend to the Management Council conferment of autonomous status on institutions, departments, affiliated or conducted colleges and recognized institutions in accordance with the provisions of the Statutes;

(s) to approve new courses, inter-disciplinary courses and short-term training programmes referred to it by the Board of Deans;

(t) to approve the course syllabi, paper-setters, examiners and moderators paper-setters, and evaluation schemes of various courses recommended by the faculty concerned;

(u) to advise the university on all academic matters and submit to the Management Council feasibility reports on academic programmes recommended by the Senate at its previous annual meeting;

(v) to create policy, procedure and practice for choice based credit system for all academic programmes;

(w) to create policy for mobility of students among various universities of the State and also lay down the policy for giving flexibility to choose and learn different course modules among different faculties in a university or other universities in the State;

(x) to work out the procedures, policies and practices to introduce more flexible approach to education and of 'adaptive pace of learning' with minimum and maximum duration for completion of a degree and other academic programmes;

(y) to ensure that the research projects are an integral part of choice based modules for post-graduate programmes;

(z) to prepare academic calendar of the university for the subsequent academic year as per the guidelines from the University Grants Commission and the State Government, three months before the expiry of the current academic year;

(za) to recommend to the Management Council establishment of departments, colleges, schools, centres, institutions of higher learning, research and specialized studies;

(zb) to exercise such other powers and perform such other duties as may be conferred or imposed on it by or under this Act, the Statutes, Ordinances and Regulations.

(2) The Academic Council shall refer all matters or decisions involving financial implications to the Management Council for approval.

**34.** (1) The faculty shall be the principal academic co-ordinating authority of the university in respect of studies and research in relation to the subjects included in the respective faculty and also in respect of studies and research in multi-faculties. Faculty.

(2) The university shall have the following faculties, namely:—

- (i) Faculty of Science and Technology;
- (ii) Faculty of Commerce and Management;
- (iii) Faculty of Humanities;
- (iv) Faculty of Inter-disciplinary Studies.

(3) Each faculty shall comprise of such subjects as prescribed by the Statutes.

(4) A faculty shall consist of the following members, namely :—

- (a) the Dean of the faculty - *ex-officio* Chairperson;
- (b) the Associate Dean, if nominated under sub-section (5) of section 15;
- (c) Chairpersons of each Board of Studies for the subjects comprised in the faculty;
- (d) one person, nominated by each Board of Studies, who is an approved teacher and is otherwise eligible to be nominated as a member of the Board of Studies;

(e) five special invitees, who are eminent scholars with proven academic achievements and industrial or professional exposure in the subjects within the faculty, to be nominated by the Pro-Vice-Chancellor in consultation with the Dean of the faculty.

Powers and  
duties of  
Faculty.

**35.** The faculty shall have the following powers and duties, namely:—

(a) to consider the report on any matter referred to it by the Management Council, Academic Council or Board of Deans;

(b) to create time bound operative mechanism for implementation of the academic policy decisions;

(c) to consider and recommend with modifications, if any, to the Academic Council, the matters referred to it by the Board of Studies;

(d) to recommend to the Academic Council the course syllabi, course structures and evaluation schemes of various courses, as forwarded by the Board of Studies;

(e) to study and certify the curricula made by the autonomous colleges, empowered autonomous colleges or cluster of institutions;

(f) to recommend to the Board of Deans the requirements regarding the conduct of post-graduate or under-graduate teaching, research, training and instruction, in university departments or institutions, affiliated colleges and recognized institutions, including the manpower requirement;

(g) to consider and recommend to the Board of Deans, new courses, interdisciplinary courses and short-term training programmes referred to it by the Boards of Studies or the Board of University Departments and Inter-disciplinary Studies;

(h) to ensure that guidelines framed by the Academic Council in relation to teaching, research, training and instruction are implemented;

(i) to plan and organize inter-departmental and inter-faculty programmes in consultation with the Board of Deans, Boards of Studies and the Board of University Departments and Inter-disciplinary Studies;

(j) to recommend to the Academic Staff College and the Academic Council, conduct of refresher and orientation programmes for teachers of affiliated colleges and university departments, especially for the revised or newly introduced or inter-disciplinary courses of study, training and advance training, field exposure and deputation;

(k) to prepare and submit the annual report of the functioning of the faculty to the Vice-Chancellor;

(l) to undertake any other task in respect of studies and research in relation to the subjects included in the faculty and also in multi-faculties, as may be assigned to it by the university authorities.

Board of  
Deans.

**36.** (1) There shall be a Board of Deans to co-ordinate, oversee, implement and to supervise the academic activities of the university. It shall be responsible to plan the development of the university in academics, research and development, entrepreneurship, intellectual property rights, incubation of industries and linkages with industries for integrated planning. It shall also plan, monitor, guide and co-ordinate under-graduate and post-graduate academic programmes and development of affiliated colleges.



(2) The Board of Deans shall consist of the following members, namely:—

- (a) the Pro-Vice-Chancellor, Chairperson;
- (b) the Deans of faculties;
- (c) the Director of Innovation, Incubation and Linkages.

**37.** (1) The Board of Deans shall have the following powers and duties, namely:—

Powers and  
Duties of  
Board of  
Deans

(a) to make recommendations to the Academic Council for the conduct of post-graduate courses in university departments and post-graduate departments in colleges and recognized institutions;

(b) to consider and recommend to the Academic Council, new courses, inter-disciplinary courses and short-term training programmes referred to it by the faculty;

(c) to control, regulate and co-ordinate research activities to maintain standards of teaching and research in the university departments and post-graduate departments in colleges and recognized institutions;

(d) to recommend to the Academic Council, the norms of recognition of post-graduate teachers and research guides in colleges and recognized institutions;

(e) to grant recognition to the post-graduate teachers and research guides as recommended by the Research and Recognition Committee in accordance with the norms prescribed by the Academic Council;

(f) to recommend to the Vice-Chancellor recognition of private skills education providers and empowered autonomous skills education colleges by following the procedure as prescribed under this Act;

(g) to consider and recommend to the Academic Council the proposals submitted by the private skills education providers and empowered autonomous skills development colleges in respect of starting new certificate, diploma, advanced diploma and degree programmes and designing the curricula thereof;

(h) to prepare a comprehensive perspective plan of five years for integrating therein the plan of Development in a manner ensuring equitable distribution of facilities for higher education, as per the guidelines framed by the Commission;

(i) to prepare the annual plan for the location of colleges and institutions of higher learning, in consonance with the perspective plan;

(j) to conduct academic audit of the university departments, institutions, affiliated colleges, autonomous university departments and institutions, empowered autonomous colleges, cluster of institutions, empowered autonomous skills development colleges and recognized institutions, which shall be carried out by an Academic Audit Committee, having an equal number of internal and external members;

(k) to oversee the continuation of affiliation to colleges and continuation of recognition to institutions through a system of academic audit;

(l) to recommend proposals to the Academic Council for the establishment of conducted colleges, schools, departments, institutions of higher learning, research and specialized studies, academic services units, libraries, laboratories and museums in the university;

(m) to consider and make recommendations to the Academic Council for creation of posts of university teachers and non-vacational academic staff required by the university, from the funds of the university and from the funds received from other funding agencies, and prescribe their qualifications, experience and pay-scales;

(n) to make proposal to the Management Council for the institution of fellowship, travelling fellowship, scholarship, studentship, medals and prizes and make regulations for their award;

(o) to recommend to the Management Council through the Academic Council, the proposal for the conduct of inter-faculty and area or regional studies, common facilities, such as instrumentation centers, workshops, hobby centers, museums, etc.;

(p) to recommend to the Academic Council the proposals to prescribe fees, other fees and charges through a Fee Fixation Committee;

(q) to draft Ordinances and place them before the Management;

(r) to draft regulations and place them before the Management Council and the Academic Council, as the case may be, for its approval.

(2) The Board of Deans shall appoint a Research and Recognition Committee for each Board of Studies,-

(a) The Research and Recognition Committee shall consist of the following members, namely :-

(i) the Pro-Vice-Chancellor, *Ex-officio* Chairman;

(ii) Dean of the faculty concerned and Associate Dean of the concerned group of subjects, if any;

(iii) the Chairperson, Board of Studies;

(iv) two experts in the subject, to be nominated by the Vice-Chancellor, not below the rank of Professor, who have successfully guided at least three Doctorate of Philosophy (Ph.D.) students and have published research work in recognized or reputed national or international journals, anthologies, etc., one of whom shall be from outside the university;

(b) the Research and Recognition Committee shall have the following powers and duties, namely:—

(i) to approve the topic of thesis or dissertation in the subject;

(ii) to recommend to the Vice-Chancellor a panel of referees for thesis or dissertations for awarding post-graduate, doctorate and higher degrees, based on the criteria as approved by the Academic Council;

(iii) to recommend to the Board of Deans, by following appropriate process, names of post-graduate teachers, research scientists in the recognized research and other institutions, active research and development experts having of not less than ten years' experience in research and development laboratories or centres in variety of industries, for recognition as approved research guides;

(iv) to undertake any other task in academic and research and development matters, as may be assigned to it by the Board of Deans, the Faculty and the Academic Council.

**38.** (1) There shall be a Board of sub-campuses of the university to organize the task and activities of the sub-campuses. It shall consist of the following members, namely:—

Board of Sub-campuses of University.

(a) the Pro-Vice-Chancellor, Chairperson;

(b) the Deans of faculties;

(c) the Finance and Accounts Officer;

(d) the Directors of all Sub-Campuses;

(e) the Director, Innovation, Incubation and Linkages;

(f) two members of the Management Council, to be nominated by the Vice-Chancellor, one of whom shall be a principal and the other shall be a representative of the management;

(g) the Director, Board of Examinations and Evaluation;

(h) the Director, Board of Students' Development;

(i) the Director, Sports and Physical Education;

(j) one Principal, one Teacher, one management representative from the affiliated, autonomous colleges within the jurisdiction of each sub-campus to be nominated by the Management Council;

(k) the Registrar - Member-Secretary.

(2) The Board of Sub-Campuses of the university shall meet at least three times in a year.

**39.** The Board of Sub-Campuses of the university shall have the following powers and duties, namely:—

Powers and Duties of Board of Sub-Campuses of the University.

(a) to co-ordinate the under-graduate and post-graduate educational activities in the district;

(b) to ensure implementation of various academic, administrative and governance mechanisms of the parent university;

(c) to co-ordinate the intra-institutional and inter-institutional information and communication technology linkages among the institutions of higher education in the district;

(d) to carry out in association with colleges workshops and training programmes for the benefit of teachers and non-teaching employees;

(e) to co-ordinate the examination and evaluation related activities in the district;

(f) to co-ordinate creation of research plans, development plans and other fund raising activities for the colleges and institutions in the district and establish links with the central office of the parent university;

(g) to co-ordinate teaching and learning activities at post-graduate level amongst the colleges and institutions, and render necessary assistance in this regard;

(h) to work as a district level gateway of the university for all academic and administrative tasks of students, research students, teachers, supporting staff and other members of the society;

(i) to prepare financial needs and annual financial estimates (budget) for the financial year and submit it to the central office of the parent university;

(j) to undertake any other task as may be assigned by the university authorities so as to carry out objectives of the university.

Board  
of  
Studies.

**40.** (1) There shall be a Board of Studies for every subject or group of subjects prescribed by the Statutes. The Board of Studies shall be the primary academic body of the university.

(2) The Board of Studies shall consist of the following members, namely:—

(a) head of the university department or institution in the relevant subject:

Provided that, where there is no university department in the subject, the Board shall, at its first meeting co-opt the head of the department who is recognized for imparting teaching to post graduate students in an affiliated college or a recognized institution having post graduate teaching in that subject;

(b) six teachers having minimum ten years teaching experience, nominated by the Vice-Chancellor in consultation with the Dean of the respective faculty, from the following categories, namely :—

(i) one teacher from amongst the full time teachers of the university departments in the relevant subject;

(ii) two teachers from amongst recognized post-graduate teachers in affiliated colleges, or recognized institutions or post-graduate centers offering post-graduate programme in the concerned subject;

(iii) three teachers from affiliated colleges and recognized institutions other than heads of departments;

(c) three heads of departments from affiliated colleges and recognized institutions to be elected from amongst the collegiums of heads of departments of affiliated colleges and recognized institutions.

(d) the Board of Studies, at its first meeting, shall,-

(i) Subject to the provisions of section 65, elect one of the members as a chairperson of the board of the studies from amongst its members :

Provided that the member to be elected as a chairperson of Board of Studies shall be a post graduate recognized teacher imparting teaching to post graduate students; and thereafter co-opt -

(ii) one professor from other universities; and

(iii) four experts as under :-

(A) a person holding a rank not lower than that of Assistant Director, in national laboratories or institutions; or recognized institutions or industry or experts in the related field having published at least one reference book in the subject; or at least three research papers in recognized national or international journals;

(B) an eminent scholar in the subject;

(C) an eminent person from the subject-related industries or association or professional body;

(D) person having at least ten years working or ownership or advisory or consultancy experience in the field relevant to the subject.

(E) top rankers of the Final Year Graduate and Final Year Post Graduate examination of previous year of the concerned subject as invitee members for discussions on framing or revision of syllabus of that subject or group of subjects for one year.

**41.** The Board of Studies shall have the following powers and duties, namely :—

(a) to recommend to the Management Council through the faculty or faculties concerned and the Academic Council, the introduction of new diplomas and degrees;

(b) to recommend to the Management Council through the faculty or faculties concerned and the Academic Council, the discontinuation of diplomas and degrees which have become irrelevant;

(c) to recommend to the faculty concerned, the course syllabi, course structures and evaluation schemes of various courses;

(d) to recommended to the reference books or supplementary reading books and such other material useful for study of the course;

(e) to recommend to the faculty, modifications in respect of addition or deletion or updating of courses;

(f) to prepare the panels of paper-setters, examiners and moderators for the university examinations and evaluation, based on the criteria laid down by the Academic Council and recommend them to the Board of Examination and Evaluation;

Powers and duties of Board of Studies.

(g) to suggest to the Dean of the faculty concerned, organization of orientation and refresher courses in the subject in the summer or winter vacations;

(h) to prepare the requirements with regard to library, laboratory, equipment in respect of courses concerned;

(i) to suggest extension programmes with respect to the courses introduced;

(j) to understand the requirements of industry or corporate or society at large and to incorporate them into the syllabi to make the teaching-learning process relevant to the needs of the time;

(k) to encourage learning by collaboration and participation by using information and communication technology tools;

(l) to design curricula, add vocational content to every discipline and to prescribe the minimum period to pursue skill development programme and the level of proficiency expected;

(m) to ratify curricula, all processes and practices developed by the autonomous colleges, university departments or institutions, autonomous recognized institutions, empowered autonomous colleges or cluster of institutions, empowered skills development colleges, and recommendations in respect of recognition of teachers or experts.

Board of  
University  
Depart-  
ments and  
Interdisci-  
plinary  
studies.

**42.** (1) There shall be a Board of University Departments and Interdisciplinary Studies to promote interdisciplinary education and research on campus and also network with national and international institutions and create an academic and research and development environment that allows free flow of ideas amongst several disciplines.

(2) The Board of University Departments and Interdisciplinary Studies shall consist of the following members, namely:-

(a) the Pro-Vice-Chancellor, Chairperson;

(b) the Deans of faculties and Associate Deans, if any;

(c) four experts, to be nominated by the Vice-Chancellor from other universities or national level research and development laboratories, one each having minimum experience of five years as a professor or equivalent position in research and development laboratories, in each of the disciplines of science, technology, humanities, commerce and management and interdisciplinary studies;

(d) four heads of departments or senior professors representing various subjects or disciplines in an equitable manner, to be nominated by the Vice-Chancellor.

(3) The Dean of Faculty of Interdisciplinary Studies shall act as a Member-Secretary.

(4) The Board shall meet at least three times a year.

**43.** The Board of University Departments and Interdisciplinary Studies shall have the following powers and duties, namely:—

Powers and duties of Board of University Departments and Interdisciplinary studies.

(a) to devise long term policy and strategy for promotion of quality post-graduate education on university campus;

(b) to prepare a comprehensive development plan for post-graduate education in university departments;

(c) to work on annual financial estimates (budget) for university departments;

(d) to co-ordinate the research and development activities with the Board of Research;

(e) to establish linkages with foreign and Indian premier teaching and research and development institutions or universities for strengthening of teaching and research and development activities on the campus of the university;

(f) to work in tandem with the Board of National and International Linkages to collaborate with national and international agencies, universities (including deemed or self-financed universities) and institutions for sharing of academic resources, running joint teaching programmes, running joint degree programmes with national and international universities or institutions;

(g) to promote interdisciplinary teaching programmes on the campus by co-ordinating amongst teachers and also to make policy for sharing of academic and research and development infrastructure;

(h) to promote the choice based credit system in the university departments, the affiliated colleges and recognized institutions;

(i) to work out and initiate use of technology in delivery of education;

(j) to promote the face-to-face and e-learning process in classroom teaching, use of mini-research and maxi research projects as an integral part of post-graduate learning;

(k) to initiate new approaches and methodology for assessing learning by students as a continuous online process;

(l) to recommend to the Vice-Chancellor,—

(i) the posts of university teachers (including aided posts and the posts for the purposes of sub-section (2) of section 8) to be filled by selection, who possess the prescribed minimum and additional qualification;

(ii) emoluments and the number of posts to be filled ; and

(iii) the number of posts under sub-clause (i), which may be reserved for the persons belonging to the Scheduled Castes or Scheduled Tribes, *Vimukta Jatis* (De-Notified Tribes) or Nomadic Tribes or Other Backward Classes.

(m) to undertake any other task as may be assigned by the university authorities to carry out the objectives of the Board of University Departments and Interdisciplinary Studies and of the university.

Board of  
Post-  
Graduate  
Education  
in Colleges.

**44.** (1) There shall be a Board of Post-Graduate Education in Colleges with broad objectives of initiating and strengthening of quality post-graduate programmes in various disciplines of learning in colleges.

(2) The Board of Post-Graduate Education in Colleges shall meet not less than four times in a year, two of which shall necessarily be in the month of September or October and December or January, each year.

(3) The Board of Post-Graduate Education in Colleges shall consist of the following members, namely:—

(a) the Pro-Vice-Chancellor - Chairperson;

(b) the Deans of faculties and Associate Deans, if any;

(c) one faculty-wise expert from other universities, nominated by the Vice-Chancellor, each having minimum experience of five years as a professor;

(d) three faculty-wise heads of departments in colleges, with minimum experience of five years as a recognized post-graduate teacher, from post-graduate centres in colleges, preferably from different districts to be nominated by the Vice-Chancellor;

(e) Directors of all sub-campuses;

(f) Deputy Registrar of the administrative section concerned, shall act as the Secretary of the Board.

(4) The Board of Post-Graduate Education in Colleges shall have the following powers and duties, namely :—

(a) to recommend creation of a new post-graduate centre in a particular discipline or a new course in the existing post-graduate centre in an affiliated college;

(b) to create synergy for the growth of the post-graduate centers at district level through district sub-campuses;

(c) to initiate and encourage the use of technology in a blended form of education in the post-graduate centers;

(d) to propagate and keep track of quality enhancement in post-graduate centers by initiating teachers capacity enhancement activities;

(e) to initiate research and development activities in post-graduate centers;

(f) to undertake any other task as may be assigned by the university authorities so as to carry out objectives of the Board of Post-Graduate Education in Colleges.

Board of  
Lifelong  
Learning  
and  
Extention.

**45.** (1) There shall be a Board for Lifelong Learning and Extension to create skilled and learned human power through its various degree level programmes and skills development programmes.

(2) The Board for Lifelong Learning and Extension shall meet at least twice in a year.



(3) The Board for Lifelong Learning and Extension shall consist of the following members, namely:—

- (a) the Vice-Chancellor - Chairperson;
- (b) the Pro-Vice-Chancellor;
- (c) the Deans of faculties;
- (d) three eminent experts, nominated by the Vice-Chancellor, working in the domain of lifelong learning skills, value education and in field of longevity;
- (e) two teachers from university departments, nominated by the Vice-Chancellor, who are actively engaged in innovation, research and development;
- (f) two teachers from the colleges, nominated by the Vice-Chancellor, who are actively engaged in innovation, research and development and extension;
- (g) the Director, Centre of Lifelong Learning and Extension-Member-Secretary.

**46.** (1) The Board of Lifelong Learning and Extension shall have the following powers and duties, namely:-

- (a) to create synergy at policy and operative level mechanism for co-existence and co-operation between various teaching, research and development institutions and various regional and national bodies and governmental agencies in the domain of lifelong learning, value education and life skills for senior citizens;
- (b) to supervise and monitor the activities of an independent Centre for Life-long Learning and Extension that shall be set up by the university to carry out the objectives of the Board;
- (c) to look into budgets and financial needs of the Centre for Lifelong Learning and Extension;
- (d) to prepare an annual programme of activities of the Centre for Lifelong Learning and Extension and to review the same periodically;
- (e) to submit an annual report to the Management Council;
- (f) to undertake any other task that may be assigned by the university authorities to carry out the objectives of the Board of Lifelong Learning and Extension.

(2) There shall be a Department of Lifelong Learning and Extension headed by the Director, to carry out the objectives of the Board of Lifelong Learning and Extension.

**47.** (1) The Board of Examinations and Evaluation shall be the authority to deal with all matters relating to examinations and evaluation. The Board of Examinations and Evaluation shall also oversee the conduct of examinations in the autonomous colleges, institutions, university departments and university institutions.

(2) The Board of Examinations and Evaluation shall meet at least twice in an academic year.

Powers and duties of Board of Lifelong Learning and Extension.

Board of Examinations and Evaluation.

(3) The Board of Examinations and Evaluation shall consist of the following members, namely:—

- (a) the Vice-Chancellor - Chairperson;
- (b) the Pro-Vice-Chancellor;
- (c) the Deans of Faculties and Associate Deans, if any;
- (d) two Principals other than Dean, nominated by the Management Council;
- (e) one professor of the university departments, to be nominated by the Management Council;
- (f) one teacher from affiliated Colleges other than heads of Departments or Principals with the minimum teaching experience of fifteen years to be nominated by Management Council;
- (g) one expert in the field of evaluation in computerized environment, nominated by the Vice-Chancellor;
- (h) one expert not below the rank of Deputy Registrar of other Statutory University from the State of Maharashtra who has experience related to examination work in computerized environment as an invitee to be nominated by Vice-Chancellor;
- (i) Director of Higher Education or his nominee not below the rank of Joint Director;
- (j) Director, Board of Examinations and Evaluation - Member- Secretary.

Powers and duties of Board of Examinations and Evaluation.

**48.** (1) The Board of Examinations and Evaluation shall have the following powers and duties, namely:—

(a) to devise policy, mechanism and operational strategies to do the tasks relating to assessment of performance of students efficiently and in a time bound manner;

(b) to ensure proper organization of examinations and tests of the university, including moderation, tabulation, evaluation and timely declaration of results:

Provided that, the Board of Examinations and Evaluation shall, for the purposes of this clause, give effect to the recommendations of the Board of Students' Development and the Board of Sports and Physical Education, regarding alternative arrangements.

(c) to prepare the financial estimates relating to examinations and evaluation for incorporation in the annual financial estimates (budget) of the university and shall submit the same to the Finance and Accounts Committee;

(d) to arrange for strict vigilance during the conduct of examinations so as to avoid use of unfair means by the students, teachers, invigilators, supervisors, etc.;

(e) to establish procedures and devise operative mechanism for credit assessment in the modular structure by the teachers and use computer technology for the entire process of assessment and evaluation including creating and effectively using a repository of question banks;

(f) to ensure that the assessment of answer books for award of degrees, diplomas or certificates shall be done centrally through central assessment system by following system of masking and de-masking of answer books or any other alternative system for ensuring the objective of secrecy;

(g) to undertake examination and evaluation reforms in order to make examination and evaluation system more efficient;

(h) to appoint paper-setters, examiners and moderators from amongst the persons included in the panels prepared by the respective Boards of Studies and, where necessary, having regard to the recommendations made by the committee under clause (b) of sub-section (5), remove them or debar them;

(i) to approve detailed programme of examinations and evaluation as prepared by the Director, Board of Examinations and Evaluation;

(j) to consider the reports of review of results of university examinations forwarded by the Director, Board of Examinations and Evaluation;

(k) to hear and decide the complaints relating to conduct of examinations and evaluation;

(l) to exercise such other powers in relation to examinations and evaluation as may be assigned to it by or under this Act.

(2) In case of any emergency requiring immediate action to be taken, the Chairperson of the Board of Examinations and Evaluation or any other officer or person authorized by him in that behalf, shall take such action as he thinks fit and necessary, and shall report the action taken by him at the next meeting of the Board.

(3) (a) In order to appoint paper-setters, examiners and moderators, the Board of Examinations and Evaluation shall constitute committees for every subject consisting of, -

(i) the Dean of the concerned faculty - Chairperson;

(ii) Associate Dean, if any;

(iii) the Chairperson of the Board of Studies concerned;

(iv) two members of the Board of Studies, nominated by it from amongst its members of whom at least one shall be a post-graduate teacher;

(v) the Director of Board of Examinations and Evaluation shall act as a Secretary of such committee.

(b) The committee shall prepare lists of persons for various examinations and tests, included in the panels to be prepared by the Board of Studies and shall submit them to the Pro-Vice-Chancellor, who shall submit the same with his recommendations, if any, to the Board of Examinations and Evaluation, which shall then appoint paper-setters, examiners and moderators, and where necessary referees.

(c) No member of the Board of Examinations and Evaluation or the committees constituted under this section shall be appointed as a paper-setter, examiner, moderator or referee:

Provided that, the Pro-Vice-Chancellor shall have power to appoint a member of the Board of Examinations and Evaluation or the committees constituted under this section, as a paper-setter, examiner, moderator or referee where no teacher relating to such subject who is not a member of the Board of Examinations and Evaluation or the committees is available.

(4) It shall be obligatory on every teacher and on the non-teaching employee of the University, affiliated, conducted colleges, community colleges or recognized institutions to render necessary assistance and service in respect of examinations of the university and evaluation of students as prescribed by statutes. If any teacher or non-teaching employee fails to comply with the order of the university or college or institution, in this respect, it shall be treated as misconduct and the employee shall be liable for disciplinary action. In case of failure on the part of the teacher or non-teaching employee of any affiliated college, conducted college, community college or recognized institution, to comply with the order of the university in this respect, the Vice-Chancellor shall have power to take an appropriate action against them, which may include imposing penalties including suspension of approval to the appointment of a teacher, as may be prescribed by the Statutes.

(5) (a) In order to investigate and take disciplinary action for failure to comply with the order of the university for rendering assistance or service in respect of examinations by or on behalf of the university or evaluation of students or malpractices and lapses on the part of candidates, paper-setters, examiners, moderators, referees, teachers or any other persons connected with the conduct of examinations including the pre-examination stage and the post-examination stage or at any stage whatsoever, the Board of Examinations and Evaluation shall constitute a committee of not more than five persons of whom one shall be the Chairperson;

(b) Such committee shall submit its report and recommendations to the Vice-Chancellor, who may direct the Director, Board of Examinations and Evaluation, the disciplinary action to be taken against the person or persons involved in the malpractices, directly or indirectly, and the Director, Board of Examinations and Evaluation shall proceed to implement the decision of the Vice-Chancellor.

Board of  
Information  
Technology.

**49.** (1) There shall be a Board of Information Technology to create an umbrella structure to professionally manage the selection, deployment and use of application software and technology in Academics, Finances and Administration, address the issues relating to use of the right kind of technology, software, hardware and connectivity to deploy technology in all domains of activities and associated tasks of the university and to project the funds required for that purpose.

(2) The Board of Information Technology shall meet at least three times in a year.

(3) The Board of Information Technology shall consist of the following members, namely:—

- (a) the Vice-Chancellor - Chairperson;
- (b) the Pro-Vice-Chancellor;
- (c) the Deans of faculties and Associate Deans, if any;
- (d) the Director of Board of Examinations and Evaluation;
- (e) the Finance and Accounts Officer;
- (f) one professor from university departments having knowledge and expertise in the domain of software and hardware, nominated by the Vice-Chancellor;
- (g) two experts in the field of information and communication technology, nominated by the Vice-Chancellor, one of whom shall be an expert in software and the other in the field of hardware;
- (h) the Registrar;
- (i) the Dean of Faculty of Science and Technology shall act as a Member-Secretary.

**50.** The Board of Information Technology shall have the following powers and duties, namely: —

- (a) to plan information technology services through information technology infrastructure;
- (b) to decide the annual budget of the university for creating technology related infrastructure;
- (c) to devise strategy for creation of virtual classrooms and laboratory infrastructure;
- (d) to lay down the policy for networking in the various campuses of the university;
- (e) to lay down the policy for generating financial resources in the field of higher education, research and development and allied projects or programmes;
- (f) to advise and assist the university to create inter-university and intra-university networks for connecting university administration, departments and colleges;
- (g) to assist the university to be part of the national knowledge grid;
- (h) to assist the university network, for connecting it with other universities in the State;
- (i) to ensure quality and efficiency in the various levels of information technology infrastructure and services within parameters defined by the university;
- (j) to devise a policy and strategy plan for use of technology in all aspects connected with academics, evaluation, finances and administration;

Powers and duties of Board of Information Technology.

(k) to monitor use of technology in administration, finances and evaluation activities of the university;

(l) to devise strategy and technology, financial requirement and operative level mechanism for use of information-flow-line for integrating face-to-face and e-learning objects and also for creation of virtual lecture and laboratory infrastructure;

(m) to work out an approach and operating plan for creation of a repository of data on students, teachers, technical and other staff and other relevant information;

(n) to advise on purchase of software, hardware and networking for university departments and university system as a whole;

(o) to assist and advise the use of technology in blended learning, making of e-learning objects, and teachers training in use of multi-media;

(p) to work out appropriate policy and procedure for creation of a Data Repository Cell for creation, up-gradation and maintenance of data on students, teachers as well as other staff members in the institutions and give a Unique Identification Number;

(q) to undertake any other task as may be assigned by the university authorities so as to carry out objectives of the Board of Information Technology.

Board of  
National  
and  
International  
Linkages.

**51.** (1) There shall be a Board of National and International Linkages to cultivate, establish, maintain and strengthen the link of the university with premier national and international universities and institutions.

(2) The Board shall meet at least three times in a year.

(3) The Board of National and International Linkages shall consist of the following members, namely:-

(a) the Vice-Chancellor - Chairperson;

(b) the Pro-Vice-Chancellor;

(c) the Deans of faculties and Associate Deans, if any;

(d) one member of the Management Council, from amongst its elected members, nominated by the Vice-Chancellor;

(e) one senior professor, nominated by the Vice-Chancellor from the university post-graduate Department;

(f) two principals, of whom one shall be from autonomous or empowered autonomous colleges or empowered autonomous institutions and one shall be from affiliated colleges to be nominated by the Vice-Chancellor;

(g) one expert from industries having proven expertise about National and International linkages to be nominated by Commission;

(h) the Director, Innovation, Incubation and Linkages-Member-Secretary.

**52.** The Board of National and International Linkages shall have the following powers and duties, namely:—

Powers and Duties of Board of National and International Linkage.

(a) to work on long term policy and strategy for promotion of inter-linkages with premier national and international universities and institutions;

(b) to evolve a process to collaborate with national and international agencies, universities, colleges and institutions for sharing of academic resources, running joint research and development and teaching programmes, running joint degree programmes with national and international universities, colleges and institutions;

(c) to evolve mechanism for visits of teachers or research and development scientists or experts from industry and other entities, to the university departments, colleges and institutions and vice-versa, and also to work out the details on logistic support for such visitors;

(d) to evolve mechanism for visits of teachers and students from university departments, colleges and institutions to national and international universities, colleges or institutions and *vice-versa*, and also to work out details on budgetary provisions and logistic support for such visits;

(e) to evolve a mechanism to assist foreign students and migrant Indian students, their admissions and completion of other statutory formalities;

(f) to organize cultural and other activities such as visits of foreign students and migrant Indian students to other parts of India;

(g) to make arrangements for other logistic infrastructure, if any, created by the university for foreign students and migrant Indian students;

(h) to work out budgetary provision for activities of the Board and for providing various services to foreign students and migrant Indian students;

(i) to undertake any other task as may be assigned by the university authorities so as to carry out objectives of the Board of National and International Linkages.

**53.** (1) There shall be a Board of Innovation, Incubation and Enterprise for creation and cultivation of an enabling environment to propagate the concept of innovation and to convert the innovative ideas into working models through a process of incubation which shall finally lead to the creation of enterprise.

Board of Innovation, Incubation and Enterprise.

(2) The university shall establish an independent Centre for Innovation, Incubation and Enterprise to carry out the objectives of the Board for Innovation, Incubation and Enterprise. The Centre shall exercise the powers and perform the duties as may be assigned by the Board, from time to time.

(3) The Board for Innovation, Incubation and Enterprise shall consist of the following members, namely:-

(a) the Vice-Chancellor - Chairperson;

(b) the Pro-Vice-Chancellor;

(c) the Deans of faculties and Associate Deans, if any;

(d) five prominent industrialists, nominated by Commission from manufacturing, information and communication technology, bio-sciences and technology, agro-industries and service industries;

(e) one senior manager from the lead bank of the District in which head quarter of the University is located to be nominated by Vice-Chancellor;

(f) two teachers from university departments or university institutions, who are active in innovation, research and development nominated by the Vice-Chancellor;

(g) two teachers, nominated by the Vice-Chancellor, from colleges who are active in innovation, research and development;

(h) the representative of Department of Information and Technology, not below the rank of the Deputy Secretary;

(i) the Director, Innovation, Incubation and Linkages - Member-Secretary.

(4) There shall be minimum three meetings of the Board to be conducted in the year.

Powers and duties of Board of Innovation, Incubation and Enterprise.

**54.** The Board of Innovation, Incubation and Enterprise shall have the following powers and duties, namely:-

(a) to create synergy at policy and operative level mechanism for co-existence and co-operation between various research and development activities in university departments, colleges and various industries in the State and in other States;

(b) to create synergy through operative policy mechanism and support system for incubation of good ideas such as product, process, service and innovation, into a scalable mode so as to establish small, medium and large industries;

(c) to establish a system to support protection of intellectual property rights at national and global level;

(d) to establish a system so as to guide and help young entrepreneurs in operational, legal, business model creation and financial support;

(e) to project and plan the activities to be carried out by the Centre for Innovation, Incubation and Enterprise;

(f) to prepare annual programmes of activities of the Centre for Innovation, Incubation and Enterprise and review the same periodically;

(g) to prepare the annual budget of the Centre for Innovation, Incubation and Enterprise;

(h) to oversee and monitor the activities of the Centre for Innovation, Incubation and Enterprise;

(i) to submit an annual report of working of Centre for Innovation, Incubation and Enterprise to the Management Council;

(j) to undertake any other task as may be assigned by the university authorities to carry out the objectives of the Board for Innovation, Incubation and Enterprise.



**55.** (1) There shall be a Board of Students' Development to plan and oversee the various cultural and welfare activities of the students in colleges, institutions and university departments. The activities of the Board of Student's Development shall be carried out by the Director of Students' Development.

Board of Students' Development.

(2) The Board of Students' Development shall consist of the following members, namely:-

- (a) the Vice-Chancellor - Chairperson;
- (b) the Pro-Vice-Chancellor;
- (c) one professional, nominated by the Vice-Chancellor, in the field of Performing Arts;
- (d) one professional, nominated by the Vice-Chancellor in the field of Art and Fine Arts;
- (e) two teachers, nominated by the Vice-Chancellor involved in cultural or welfare activities out of whom one shall be woman;
- (f) office bearers of University Students Council;
- (g) District Co-ordinators of Culture and Student Welfare for each district to be nominated by Management Council;
- (h) Director of National Service Scheme (NSS) of the University;
- (i) the Director, Board of Students' Development, Member- Secretary.

**56.** (1) The Board of Students Development shall have the following powers and duties, namely :-

Powers and duties of Board of Student's Development.

- (a) to take necessary steps for promotion of culture and students' development activities in colleges and university departments;
- (b) to establish links with regional and national bodies in the various cultural activities and to promote various activities jointly with them;
- (c) to take up activities in colleges and university departments to promote interest and skills for appreciation in the field of performing arts, pure art and painting skills;
- (d) to hold university level competitions, skills development workshops, interactive activities in order to bring the society closer to the colleges, institutions and university;
- (e) to establish rapport with groups (excluding political parties), societies and other professional bodies so as to involve them in the activities of Board of Students Development;
- (f) to devise, develop and implement innovative schemes of students development including Earn and Learn Scheme, Education Loan, Vice-Chancellors Aid Fund, Endowment Schemes, Student Exchange Schemes, etc;
- (g) to devise a mechanism of grievance redressal of student and prevention of sexual harassment and ragging of students and to prepare and submit the Annual Report of the Board to Senate for approval;

(h) to devise a mechanism to implement recommendations of the Commission as regards students' development and culture.

(i) to take necessary measures to ensure participation of well-trained teams in various regional, national and international level competitions, and cultural, recreational and other activities.

(j) to devise, develop and implement schemes of career counselling, psychological counselling and rehabilitation and upliftment of differently-abled students.

(k) to co-ordinate activities of National Service Scheme(NSS)and National Cadet Corps (NCC) in university and affiliated Colleges.

(l) to recommend to competent authority to make alternative arrangements regarding examinations for students participating in the inter-university or national or international sports, cultural competitions or NCC, NSS events during the relevant schedules of examinations as prescribed by Ordinances.

(m) to undertake any other task as may be assigned by the university authorities so as to carry out objectives of the Board of Students' Development and Students' Development Cell.

(2) There shall be a Students' Development Cell and Students Grievance Redressal Cell in the university and in the colleges and recognized institutes to devise an operational level mechanism to assist the Students and provide for prompt redressal of students grievances. These Cells shall be as under,-

(a) Students' Development Cell,-

to assist students on the issues and difficulties in various facets related to their day to day life and other aspects connected with their academic world, personality development and healthy campus life. Such cell in the university shall be headed by Director, Students' Development. The Cell shall consist of other seven members nominated by Vice-Chancellor from amongst the Teachers on the Campus and President and Secretary of the Students Council to be the ex-officio members. There shall be Students' Development Cell in each college and recognized Institution which shall be headed by Vice-Principal or Senior Teacher Nominated by the Principal and other four members shall be nominated by the Principal to include Teachers, Female Teacher, Social Worker, Counselor and office bearers of College Students Council to be the ex-officio members.

(b) Students Grievance Redressal Cell,-

there shall be Students Grievance Redressal Cell at the University and each college and recognized institutions to resolve the Grievances of Students and to suggest to the higher authorities different ways and means to minimize and prevent such grievances. The functional mechanism of working of Students Grievance Redressal Cell shall be as prescribed by Statutes, prepared in accordance with the provisions of the University Grants Commission (Grievance Redressal) Regulations, 2012, or any other regulations for the time being in force.

**57.** (1) There shall be a Board of Sports and Physical Education in the university to promote the culture of sports and look after sports related activities. The activities of the Board shall be carried out by the Director of Sports and Physical Education.

Board of Sports and Physical Education.

(2) The Board of Sports and Physical Education shall consist of the following members, namely:-

- (a) the Vice-Chancellor - Chairperson;
- (b) the Pro-Vice-Chancellor;
- (c) three professionals, nominated by the Vice-Chancellor with established credibility in different fields of sports;
- (d) District Sports Officer of the district where the University Head Quarter is located;
- (e) one teacher from the university department of Physical Education, nominated by the Management Council;
- (f) two sports teachers, from affiliated, conducted or autonomous colleges, nominated by the Management Council;
- (g) Zonal or Divisional president (principal of the host college) and secretary (director physical education of the host college) with the tenure of one year;
- (h) the President, Secretary of the University Student Council;
- (i) one student member from sports of University Student Council nominated by the President of University Students Council under sub-clause (v) of clause (b) of sub-section (4) of section 99;
- (j) the Director, Sports and Physical Education - Member-Secretary.

**58.** The Board of Sports and Physical Education shall have the following powers and duties, namely:-

Powers and duties of Board of Sports and Physical Education.

- (a) to take necessary steps for promotion of sports culture and activities in the field of sports in colleges and university departments;
- (b) to establish links with regional and national bodies in the various sports and to promote various activities jointly with them;
- (c) to establish rapport with groups, societies and other professional bodies so as to involve them in the activities of Board of Sports and Physical Education;
- (d) to take up activities in colleges, recognized institutions and university departments to promote interest and also skills in various sports as per the policy of the university and also national policies in the field of sports;
- (e) to hold university level competitions, sports skills development camps, interactive activities and also training workshops in various sports in order to bring the society closer to the colleges, institutions and university;
- (f) to encourage participation in regional, national and international level activities and competitions through well trained teams in various sports;

(g) to recommend to competent authority to make alternative arrangements regarding examinations of students participating in the inter-university or national or international sports tournaments or events during the relevant schedules of examinations as prescribed by Ordinances;

(h) to undertake any other task as may be assigned by the university authorities so as to carry out the objectives of the Board of Sports and Physical Education.

**59.** (1) There shall be a Board of Research to cultivate, promote and strengthen research activities and also to plan, co-ordinate, supervise and to raise finances for research activities in university departments, colleges and recognized institutions.

Board of  
Research.

(2) The Board of Research shall consist of the following members, namely :-

(a) the Vice-Chancellor - Chairperson;

(b) the Pro-Vice-Chancellor;

(c) the Deans of faculties and Associate Deans, if any;

(d) four eminent researchers, of national or international repute nominated by the Vice-Chancellor, with proven experience; one each from pure and applied sciences and technology, humanities, commerce, accounts and finances, and interdisciplinary studies;

(e) two teachers, nominated by the Vice-Chancellor from university departments;

(f) two teachers, nominated by the Vice-Chancellor, from colleges or recognized institutions having a strong base in research culture;

(g) eight eminent persons from different areas of Science, Commerce, Agriculture, Banking, Finance, Industry, Intellectual Property Rights, etc., who are conversant with the global trends as well as regional issues to be nominated by Chancellor;

(h) the Director, Innovation, Incubation and Linkages -Member-Secretary.

(3) The Board of Research shall meet at least three times in a year.

**60.** The Board of Research shall have the following powers and duties, namely:-

Powers and  
duties of  
Board of  
Research.

(a) to work on long term policy and strategy for promotion of research culture in the university, colleges and recognized institutions;

(b) to advise and encourage the teachers to take up research in emerging areas at individual and group level;

(c) to promote inter-disciplinary research programmes by co-ordinating amongst teachers and also to make and articulate policies for sharing of research and development infrastructure;

(d) to encourage the university departments, colleges and recognized institutions to hold research seminars in all disciplines for the research students;

(e) to publish research journals, monographs for different disciplines;

(f) to decide upon policy for maintenance of standards of research for Ph.D. degrees, in consonance with the norms of the University Grants Commission and other regulatory bodies;

(g) to work on creation of research and development data base for work done in university departments, colleges and recognized institutions in a stand-alone mode or as group activity or in collaboration with industries and other research and development laboratories;

(h) to work out and initiate research in delivery of education, pedagogy of face-to-face and e-learning, impact of e-learning and virtual classrooms on learning and understanding of students, open distance learning and conventional education;

(i) to make efforts and also assist the teachers, university departments, colleges and recognized institutions to raise the funds for research activities;

(j) to work out the budget for research activities of the university;

(k) to mobilize money from the industry for enhancing research activities;

(l) to identify problems and issues related to the region within the jurisdiction of the university and to take special initiative to address such issues through systematic research;

(m) to work on long-term policies and strategies for creating synergy between researchers and industries resulting into promotion of knowledge and technology transfer and productive conversion of research;

(n) to encourage industries to promote, adopt and participate in the basic and applied research projects;

(o) to establish central research laboratories with the help of participation of national and international industries;

(p) to undertake any other task as may be assigned by the university authorities so as to carry out objectives of the Board of Research.

**61.** The constitution, powers, functions and duties of the authorities of the university, not laid down under any of the provisions of this Act shall be as prescribed by the Statutes.

Powers, functions and duties of Authorities.

**62.** (1) The term of every authority constituted under this Act shall commence on 1st September and shall be of five years from the said date and the term of the members of every authority shall expire on the expiry of the said period of five years, irrespective of the date on which a member has entered upon his office.

Term of office of members of Authority.

(2) The process of election, nomination and co-option shall be commenced at least three months before expiry of the term of the authority and shall be completed not later than 30th November in that year :

<sup>1</sup>[Provided that, for the initial term of the authorities of the Universities, immediately after the commencement of this Act, the process of election, nomination and co-option shall be completed not later than 31st May 2018.]

**63.** Notwithstanding anything contained in this Act or the Statutes made thereunder, where a person, elected, nominated, appointed or co-opted, as the case may be, as an officer of university or a member of any of the authority or bodies of the university by virtue of his being eligible to be so elected, nominated, appointed or co-opted as such an officer or a member under any of the categories of officers or members specified by or under the relevant provisions of this Act in relation to such office, authority or body, he shall cease to be such an officer of the university or a member of such an authority or a body as soon as he ceases to belong to such category and shall be deemed to have vacated his office as such officer or member.

Cessation of membership.

1. This proviso was added by Mah. 27of 2018, s.3.

Disqualifi-  
cation for  
membership  
of authority.

**64.** A person shall be disqualified for being a member of any of the authorities, bodies and committee of university and voting to the authorities, bodies and committees, if he-

- (a) is of unsound mind and stands so declared by a competent court; or
- (b) is an undischarged insolvent; or
- (c) has been convicted of any offence involving moral turpitude; or
- (d) is conducting or engaging himself in private tuitions or private coaching classes; or
- (e) has been punished for indulging in or promoting unfair practices in the conduct of any examination and evaluation, in any form, anywhere; or
- (f) has willfully omitted or refused to carry out the provisions of this Act, Statutes or Ordinances, or has acted in any manner detrimental to the interests of the university; or
- (g) has been punished in any form, by the competent authority for committing a misconduct; or
- (h) discloses or causes to disclose to the public, in any manner whatsoever, any confidential matter, in relation to the examination and evaluation, the knowledge of which he has come to be in possession, due to his official position:

Provided that, the right of voting of the person in respect of clauses (e) and (g) shall remain suspended during the term of punishment under the said clauses.

Ineligibility  
for second  
consecutive  
term.

**65.** No person shall be a member of Management Council or Chairman of Board of Studies, for a second consecutive term whether, as an elected, nominated or co-opted member, as the case may be:

Provided that, any person who was the member of the Management Council of the university or Chairman of the Board of Studies, for the first time whether as elected, nominated or co-opted member, as the case may be, on the date of commencement of this Act, shall not be deemed to have enjoyed the consecutive term if he is nominated or elected or co-opted for the first time after the commencement of this Act.

Conclusive-  
ness of  
decision of  
authority.

**66.** Save as otherwise provided by or under the provisions of this Act, each authority of the university while acting and exercising its powers and discharging functions or duties assigned to it by or under the provisions of this Act, shall have the exclusive jurisdiction to deal with and decide the matters assigned to it and discharging functions or duties assigned to it by or under the provisions of this Act.

Election to  
be by  
proportional  
representation.

**67.** (1) Every election to any authority or body of the university under this Act, except the elections to the post referred in clauses (a) to (e) of sub-section (2) and clauses (a) to (e) of sub-section (3) of section 99, shall be held by ballot in accordance with the system of proportional representation by means of the single transferable vote and as prescribed by the Statutes.

(2) The other details relating to elections not specified in the Act shall be as prescribed by the Statutes.

**68.** (1) A member, other than an *ex-officio* member, may resign by writing under his signature. A nominee of the Chancellor may resign by addressing to the Chancellor, and any other member may resign by addressing to the Vice-Chancellor. The person shall cease to be a member upon his resignation being accepted by the Chancellor or the Vice-Chancellor, as the case may be, or upon expiry of thirty days from the date of resignation, whichever is earlier.

Resignation  
of  
membership.

(2) If a person nominated, elected, appointed or co-opted to any authority or body remains absent without prior permission of the authority or body for three consecutive meetings, he shall be deemed to have vacated his membership and he shall cease to be a member from the date of the third such meeting in which he has remained absent:

Provided that, such member should have attended at least one meeting in the previous year.

**69.** (1) Save as otherwise provided by this Act, all matters with regard to the conduct of meetings of the authorities, bodies or committees, if any, constituted by the university, shall be such as may be prescribed by the Statutes.

Meeting of  
authorities.

(2) A meeting of an authority or body shall be convened on the date determined by the Chairperson by a notice issued by its Secretary.

(3) Except as otherwise provided, the quorum for a meeting shall ordinarily be one-third of the number of the sitting members. If there is no quorum, the meeting shall be adjourned by the Chairperson to a specific time on the same day, or on a later date and no quorum shall be necessary for such adjourned meeting. No quorum shall be necessary on the following day of the continued meeting.

(4) Where no provision is made by or under the Statutes for a President or Chairperson to preside over a meeting of any authority or body of the university or when the President or the Chairperson so provided for is absent and no provision is made for any other person to preside, the members present shall elect a person from amongst themselves to preside at the meeting.

(5) Save as otherwise provided, all items, questions, matters or proposals on the agenda shall be decided by a majority of votes of members present. The Chairperson shall have a vote. In case of equality of votes, the Chairperson shall have the casting vote. The secretary, if not a member, shall have the right to participate in the deliberations but shall not have the right to vote.

**70.** (1) When any vacancy occurs in the office of a member, other than an *ex-officio* member or, a member nominated by the Chancellor, of any authority or other body of the university except Management Council before the expiry of his normal term, the vacancy shall be filled by nomination of a person by the Standing Committee constituted under sub-section (3) who is otherwise eligible to be elected on the said authority or body from the same category.

Casual  
vacancy and  
Standing  
Committee  
to fill  
vacancies.

(2) In case, any vacancy occurs in the office of a member, other than an *ex-officio* member of Management Council of the university, it shall be filled as soon as possible, by nomination or election or co-option, as the case may be, of

a person by the authority, body or the officer concerned. The person so nominated, elected or co-opted shall be a person who is otherwise eligible to be nominated, elected or co-opted on the said authority or body from the same category. The person so nominated, elected or co-opted shall hold office only so long as the member in whose place he has been nominated, elected or co-opted shall have held it, if the vacancy had not occurred.

(3) The constitution of the Standing Committee for filling in the vacancies mentioned in sub-section (1) shall be as follows, namely :-

- (a) Pro-Vice-Chancellor - Chairman;
- (b) Chancellor's nominee on Management Council;
- (c) one dean nominated by Management Council;
- (d) one elected member of the Management Council nominated by that Council;
- (e) one principal nominated by Senate from amongst its members;
- (f) one teacher nominated by Senate from amongst its members;
- (g) one graduate nominated by Senate from amongst its members;
- (h) Registrar - Member-Secretary.

(4) The term of the Standing Committee shall commence on 1st September and shall be of five years from the said date. The term of the members shall expire on the expiry of the said period of five years, irrespective of the date on which a member has entered upon his office.

## CHAPTER V

### THE STATUTES, ORDINANCES AND REGULATIONS

Statutes and their subject matters.

**71.** Subject to the provisions of this Act, the Statutes may provide for all or any of the following matters, namely:-

- (1) conferment of honorary degrees and academic distinctions;
- (2) establishment and maintenance of the sub-campuses university departments, institutions, conducted colleges, institutions of higher learning, research or specialized studies and hostels;
- (3) constitution, powers, duties and functions of authorities of the university not laid down under any of the provisions of this Act;
- (4) abolition of university departments or institutions and conducted colleges;
- (5) rules of procedure for conduct of business at the meetings of authorities of the university;
- (6) appropriation of funds of the university for furtherance of the objects of the university;
- (7) norms for grant of autonomy to university departments or institutions, affiliated colleges and recognized institutions, subject to the approval of the State Government;



(8) acceptance and management of trusts, bequests, donations, endowments and grants from individuals or organizations;

(9) disciplinary action against defaulting teachers, officers and other employees of the university, affiliated colleges and recognized institutions other than the colleges or institutions managed and maintained by the State Government or Central Government or local authorities;

(10) conditions of residence, conduct and discipline of the students of the university, colleges and recognized institutions, and the action to be taken against them for breach of discipline or misconduct, including the following :-

(a) use of unfair means in an examination, or abetment thereof;

(b) refusal to appear or give evidence in any authorized inquiry by an officer in charge of an evaluation and examination, or by any officer or authority of the university; or

(c) disorderly or otherwise objectionable conduct, whether within or outside the university;

(11) mechanism and procedure for redressal of grievances of the students;

(12) functions and duties of Students' Council in university, colleges and recognized institutions;

(13) procedure for conduct of elections to various authorities and bodies;

(14) conditions and procedure for grant of approval to the appointments of the teachers in the colleges and recognized institutions and suspension or withdrawal thereof;

(15) inspection of colleges, recognized institutions, halls and hostels;

(16) procedure to be followed while granting permission for transfer of management;

(17) norms and Procedure to be followed while nominating members on authorities, boards and committees by the Vice-Chancellor under this Act;

(18) norms of grant and withdrawal of affiliations to colleges and institutions;

(19) transferring, in public interest, of the management of a college or institution by the university and the conditions for such transferring, subject to the approval of the State Government;

(20) qualifications, recruitment, code of conduct, terms of office, duties and conditions of service including periodic training and advance training, field exposure, deputation, assessment of teachers, officers and other employees of the university and affiliated colleges except those colleges or institutions which are maintained by the State or Central Government or local authority, retirement benefits and the manner of termination of their services as approved by the State Government, provided that these shall not be in contravention of State Government policies in this regard;

(21) procedure to be followed for purchases under sub-section (7) of section 98;

(22) any matter which is to be prescribed by Statutes or which is necessary to give effect to the provisions of this Act.

Statutes how  
made.

**72.** (1) The Statutes may be made, amended or repealed by the Senate in the manner hereinafter provided.

(2) The Statute Committee shall be constituted by Management Council as under :-

(a) One member of Management Council from amongst the elected members of that Council - as Chairman,

(b) One Dean,

(c) One Professor of university department or affiliated colleges,

(d) One Principal of affiliated college,

(e) Registrar of the university,

(f) Law Officer of the university as Member-Secretary.

Such Statute Committee shall prepare and propose draft Statutes concerning the matters referred to in the last preceding section and shall present to the Management Council for its recommendations to senate.

(3) The Management Council, if it thinks necessary, may obtain the opinion of any officer, authority or body of the university with regard to any draft Statute which is before it for consideration.

(4) Every Statute passed by the Senate shall be submitted to the Chancellor who may give or withhold his assent thereto or send it back to the Management Council for reconsideration. The Chancellor may send the draft Statutes to the State Government for its views, if there are implications, financial or otherwise, on the part of the State Government in the implementation of such Statutes.

(5) No Statute passed by the Senate shall be valid or shall come into force until assented to by the Chancellor.

(6) Notwithstanding anything contained in the foregoing sub-sections, the Chancellor, either *suomotu* or on the advice of the State Government, may, direct the university to make provisions in the Statutes in respect of any matter specified by him and if the Senate fails to initiate adopt the direction within sixty days of its receipt, the Chancellor may, after considering the reasons, if any, communicated by the Senate for its inability to comply with such direction, make or amend the Statutes in that respect, suitably.

(7) The Senate may take into consideration the draft of a statute either of its own motion or on a proposal by the management council. In the case of a draft which is not proposed by the management council, the senate, before considering the same, shall obtain the opinion of the management council:

Provided that, if the management council fails to submit its opinion within three months from the date it receives the draft, the senate may proceed to take the draft into consideration.

(8) The Senate if it thinks necessary may also obtain the opinion of any officer, authority or body of the university in regard to any draft statute which is before it for consideration:

Provided that, any such draft statute pertains to academic matters, the senate shall obtain the opinion of the academic council before considering the same.

(9) The Management Council shall recommend the draft statutes to senate for approval and every statute passed by the senate shall be submitted to the Chancellor.

(10) Notwithstanding anything contained in the foregoing sub-sections, the State Government shall have power to prescribe uniform Statutes on the subjects through publication in the *Official Gazette*, which shall be binding on the universities.

73. Subject to the provisions of this Act, the Ordinances may provide for all or any of the following matters, namely:-

Ordinances  
and their  
subject  
matters.

(1) conditions under which students shall be admitted to courses of study for degrees, diplomas, certificates and other academic distinctions;

(2) Norms and process of fixation of fees, other fees and charges for courses and programs to be adopted by fee fixation committee under this Act;

(3) fees for affiliation and recognition to colleges and institutions;

(4) conditions governing the appointment and duties of examiners;

(5) conduct of examinations, other tests and evaluation, and the manner in which the candidates may be assessed or examined by the examiners;

(6) recognition of teachers of the university and the conditions subject to which persons may be recognized as qualified to give instruction in the university departments, colleges and recognized institutions;

(7) norms to be observed and enforced by colleges and recognized institutions regarding transfer of students;

(8) The constitution, powers, duties and functions of the Equal Opportunity Cell including provisions for establishing a Cell in accordance with the provision of the Persons with Disabilities (Equal Opportunity, Protection of Rights and Full Participation) Act, 1995 and the guidelines and directives of the University Grants Commission issued from time to time;

(9) Mechanism for prevention of ragging of students of university and affiliated colleges;

(10) Mechanism for prevention of sexual harassment of teachers, employees, students of university and affiliated colleges and redressal of grievances relating to sexual harassment, incidences and penalty for those who indulge in sexual harassment, in accordance with the provisions of the Sexual Harassment of Women at Work place (Prevention, Prohibition and Redressal) Act, 2013;

(11) any academic matter which, by or under this Act or the Statutes is to be prescribed by the Ordinance or which is necessary to give effect to the provisions of this Act.

1 of  
1996.

14 of  
2013.

Ordinances  
and their  
making.

**74.** (1) The Management Council may make, amend or repeal Ordinances in the manner hereinafter provided.

(2) The Board of Deans shall prepare and propose draft Ordinances concerning the matters referred to in section 73.

(3) No Ordinance concerning academic matters shall be made, amended or repealed by the Management Council unless a draft thereof has been proposed by the Academic Council.

(4) All Ordinances made by the Management Council shall have effect from the date of the meeting or from such date as it may direct, but every Ordinance so made shall be submitted to the Chancellor within two weeks from the date of the meeting. The Chancellor shall have the power to direct the Management Council, within four weeks of the receipt of the Ordinance, to suspend its operation, and he shall, as soon as possible, inform the Management Council of his objection to it. He may, after receiving the comments of the Management Council, either withdraw the order suspending the Ordinance or disallow the Ordinance, and his decision shall be final.

Regulations.

**75.** (1) Subject to the provisions prescribed by or under this Act, Management Council may make Regulations consistent with this Act, Statutes and Ordinances, for,-

(a) institution of fellowship, travelling fellowship, scholarship, studentship, medals and prizes and for their award;

(b) collaborations with other universities, institutions and organizations for mutually beneficial academic programmes;

(c) the conditions under which students shall be admitted to courses of study for degrees, diplomas, certificates and other academic distinctions;

(d) preservation of record of the university;

(e) providing for all or any of the matters which, by or under this Act, Statutes or Ordinances, are to be or may be provided by Regulations;

(f) all non-academic matters for which provision is, in the opinion of the Management Council, necessary for the purposes of this Act, Statutes or Ordinances.

(2) Subject to the provisions prescribed by or under this Act, the Academic Council may make Regulations relating to the academic matters, consistent with this Act, Statutes and Ordinances.

(3) The Board of Deans shall draft and place for approval of the Management Council or the Academic Council, as the case may be, the Regulations, providing for the matters referred to in sub-sections (1) and (2) and for all or any of the matters which, by or under this Act, Statutes or Ordinances, are to be or may be provided by Regulations.

## CHAPTER VI

**MAHARASHTRA STATE COMMISSION FOR HIGHER  
EDUCATION AND DEVELOPMENT**

**76.** (1) There shall be established the Maharashtra State Commission for Higher Education and Development.

Maharashtra  
State  
Commission  
for Higher  
Education  
and  
Development.

(2) The composition of the Commission shall be as follows, namely:-

- |   |                   |
|---|-------------------|
| (a) the Chief Minister  | Chairperson;      |
| (b) the Minister for Higher and Technical Education   | Vice-Chairperson; |
| (c) the Minister for Finance  | Member;           |
| (d) the Minister for Medical Education  | Member;           |
| (e) the Minister for Industries   | Member;           |
| (f) the Minister for Skill Development and Entrepreneurship   | Member;           |
| (g) the Minister of State for Higher and Technical Education  | Member;           |
| (h) the Leaders of Opposition in the State Legislative Council and Assembly   | Members;          |
| (i) three members of the Maharashtra Legislative Assembly, nominated by the Speaker of the Maharashtra Legislative Assembly   | Members;          |
| (j) two members of the Maharashtra Legislative Council, nominated by the Chairman of the Maharashtra Legislative Council  | Members;          |
| (k) two eminent industrialists to be nominated by Chancellor  | Members;          |
| (l) one eminent professional from the domain of finance or commerce or education or law and judiciary, having experience of creation of education linkages with real life situations, nominated by the Chancellor | Member;           |
| (m) two Scientists or Technocrats or Social Leaders for their eminence in Techno-social-Development work nominated by the Chancellor  | Members;          |
| (n) one educationist having experience in reforms in the nature, role and delivery of education, nominated by the Chancellor  | Member;           |
| (o) two Vice-Chancellors of the Public and Private Universities in the State nominated by the Chancellor  | Members;          |
| (p) two Principals nominated by the Chancellor for their contributions in linking of education with social development,   | Members;          |
| (q) two senior eminent teachers from universities or colleges with the minimum Teaching and Research experience of fifteen years nominated by the Chancellor.   | Members;          |
| (r) the Secretary, Higher and Technical Education Department  | Member;           |
| (s) the Secretary, Medical Education and Drugs Department   | Member;           |
| (t) the Secretary, Planning Department  | Member;           |

(u) the Secretary, Finance Department	Member;
(v) the Secretary, School Education Department	Member;
(w) the Secretary, Industries Department	Member;
(x) the Secretary, Skill Development and Entrepreneurship Development Department	Member;
(y) the Director of Technical Education	Member;
(z) the Director of Higher Education	Member;
(za) the Director of Medical Education and Research	Member;
(zb) the Joint Secretary, Western Regional Office of University Grants Commission	Member;
(zc) the Chief Executive Officer of the Commission	Member-Secretary;

Provided that, if the Chief Minister holds the portfolio of Higher and Technical Education, Industries, Medical Education, Skill Development and Entrepreneurship or Finance he may appoint any other Minister as a member.

(3) Term of office of the appointed members of the Commission shall be of five years and shall be co-terminus with the term of the Legislative Assembly.

(4) The Commission shall meet at least twice in a year.

(5) The Commission shall be the authority of the State Government in charge of, and responsible for, the higher education in the State. The Commission shall be the planning, monitoring, co-ordinating and evaluating authority and shall act as a think-tank for higher education, including technical, medical, management, professional education and emerging fields in the education such as Bio-Sciences and Technology and those which would emerge on the horizon of knowledge in future. The Commission shall create synergy between various stakeholders namely, the State Government, public and private universities, private skills education providers and industries.

Functions  
and duties  
of the  
Commission.

**77.** (1) The functions and duties of the Commission shall be as follows, namely:-

(a) to prepare guidelines for perspective plan of five years for each university for the location of colleges and institutions of higher learning in a manner ensuring equitable distribution of facilities for higher education, in consultation with the respective university;

(b) to approve comprehensive perspective plan submitted by the university;

(c) to advise the State Government on exploring new ways and means for raising of additional resources and allocation of funds for public and private universities, and for education information and communication technology network;

(d) to create synergy at policy and operative level mechanism for co-existence and co-operation between different types of educational institutions in the domain of pure, technical and professional education at core and domain specific skills level in the State;

(e) to understand and keep track of developments that are taking place at national and global level in delivery of education, use of technology in education, administration and governance of education and evolve an appropriate policy and strategy for the educational systems in the State to be in phase with these changes;

(f) to create synergy through operative policy for research culture in pure and applied domains in all subjects in various disciplines and across different disciplines in educational institutions and also research culture needs and demands of industries;

(g) to create a policy and strategy for sharing of academic and knowledge resources infrastructure amongst various educational institutions and the State, Central and industry research and development laboratories;

(h) to establish and maintain educational information communication network in tandem with the national grid and also enhance the geographical reach so as to bring each and every educational institution into the educational information communication network and to keep track of technology changes and upgrade the network from time to time;

(i) to establish linkages with National Knowledge Commission, the Ministry of Information and Communication Technology and Human Resources Development;

(j) to create a repository of e-learning objects and virtual experiments and support material in digital format for teaching-learning processes in frontline environment;

(k) to develop a policy and strategy for percolation of use of technology for administration, evaluation and governance of educational institutions and to promote establishment of an e-platform to carry out these tasks by use of information and communication technology;

(l) to explore the scope for sharing research journals, research and technology reviews and other such material that enhances scope and quality of research by use of Information and Communication Technology through creation of network of various knowledge resource centers in educational and research and development institutions in the State and also at national level;

(m) to prepare programmes in the various subjects in the sphere of higher education, keeping in view the overall priorities, perspectives and needs of the society and expectations from higher education;

(n) to advise the State Government in respect of determining and maintaining uniformity of standards of education in the universities;

(o) to advise on promoting co-operation and co-ordination of the various educational institutions among themselves and explore the scope for interaction between the universities on the one hand, and industry and other organizations on the other hand;

(p) to suggest ways and means of raising additional resources for higher education from industry and other sources;

(q) to advise on inter-university programmes for various activities undertaken by the universities;

(r) to advise on programmes for greater co-operation and interaction and exchange of university teachers, college teachers and the teachers of university departments;

(s) to initiate inter-university programme for various activities related to teaching, research and extension in the field of higher education;

(t) to take into consideration various suggestions, advises and specific recommendations for making academic, administrative, governance and financial synergy more conducive for growth and sustenance of quality in colleges, educational institutions and universities, and to devise mechanisms to bring them into practice;

(u) to devise and implement approaches for enhancing of knowledge and use of technology in teaching-learning processes for teachers;

(v) to create platform for academicians with experience in education and research that would form a core for reforms and also operating mechanism in academic frame-work, course work, delivery methodologies, evaluation of students;

(w) to make recommendations regarding performance based appraisal system using key performance indicators for principals, heads of institutions and departments and academic performance indicators for teachers in the university and institutions of higher education;

(x) to recommend necessary steps to restructure institutions of higher learning whose performance is consistently poor in the areas of academic, governance and infrastructure;

(y) to interact with national and global assessment and accreditation agencies and to carry systemic total quality assessment and programme-wise assessment processes in colleges, educational institutions and universities;

(z) to create a data base of teachers, academic and industry experts, colleges, educational institutions and universities in the State;

(za) to create a data base of Indian students by making use of the unique identification number when they join a college at entry level;

(zb) to establish information collection and data creation cell for foreign students;

(zc) to keep information on annual financial estimates of the universities, their generation of finances through other streams, research and development, consultancy, training-cum-skills development programmes, special programmes for foreign students and any other similar activities and to devise various streams for generation of financial resources so as to strengthen their financial position;

(zd) to take steps and recommend to the State Government and to the universities the steps that may be taken to remove the regional imbalance, and to make higher education available to backward classes, rural and tribal communities, women and any such specified groups;

(ze) to review co-operation and interaction among all educational institutions in the State for sharing of academic and other support infrastructure and suggest ways and means to make it more efficient and effective;



(zf) to review the approach and methods adopted by the colleges and universities, both public and private, for integrating education with social development and to study the impact of such an approach on social development and suggest ways and means to make it more efficient and effective;

(zg) to consider the report of the Maharashtra State Rashtriya Uchchar Shiksha Abhiyan Council, made under sub-section (4) of section 78;

(zh) develop the vision plan with specific annual outcomes keeping in view the goals of academic excellence, administrative reforms and financial improvements.

(2) There shall be Board of Management to carry out the functions and duties of Commission as under:-

- |  |                     |
|--|---------------------|
| (a) Minister, Higher and Technical Education   | - Chairperson;      |
| (b) Minister of State, Higher and Technical Education  | - Vice-Chairperson; |
| (c) Secretary, Higher Education and Technical Education Department   | - Member;           |
| (d) Eminent Educationist of National and Global Repute nominated by the Chancellor                                     | - Member;           |
| (e) Advisor, Planning and Co-ordination  | - Member;           |
| (f) Advisor, Quality and Excellence Assurance  | - Member;           |
| (g) Advisor, Open Education Resources and Teacher Training   | - Member;           |
| (h) Advisor, Networking and Support Services   | - Member;           |
| (i) Advisor, Finances and Resources Generation   | - Member;           |
| (j) Advisor, Examination and Evaluation  | - Member;           |
| (k) one renowned Industrialist nominated by Chancellor   | - Member;           |
| (l) one Vice-Chancellor of Public Universities nominated by Chancellor   | - Member;           |
| (m) one Professional Expert from the field of Finance, Accounting, Legal and other allied area nominated by Chancellor | - Member;           |
| (n) one Principal of NAAC accredited A graded College with proven excellence nominated by Chancellor                   | - Member;           |
| (o) one Professor from University or College nominated by Chancellor   | - Member;           |
| (p) the Director of Higher Education   | - Member;           |
| (q) the Director of Technical Education  | - Member;           |
| (r) the Chief Executive Officer of Commission  | - Member-Secretary. |

(3) There shall be a Secretariat of the Commission which shall be responsible for administration of the Commission and for execution of the policies, plans and recommendations of the Commission. The Secretariat shall consist of the Chief Executive Officer, other officers and staff as may be required.

(4) The Chief Executive Officer of the commission shall be appointed by the Government and work directly under the superintendence, direction and control of the State Government.

(5) The emoluments, terms and conditions of service qualification and mode of appointment of the Chief Executive Officer and the staff of the Secretariat shall be such as may be determined by the State Government.

(6) The Chief Executive Officer shall,-

(i) be the principal executive officer of the Secretariat of the Commission responsible for carrying out all functions and duties of the Commission;

(ii) lead, oversee and monitor the administration and entire activities of the Secretariat and the Commission;

(iii) be responsible for execution of the policies, plans and recommendations of the Commission;

(iv) establish technology driven operational mechanism for execution of policies, plans and recommendations of the Commission;

(v) establish linkages and co-ordination with Vice-Chancellors of public and private universities, principals and management of all educational institutions in the State;

(vi) convene meeting of the Commission as per the directions of the Chancellor;

(vii) convene seminars, workshops, meetings as may be necessary to fulfill and carry out the function and duties of the Commission;

(viii) prepare annual financial estimates and statement of financial requirements for the Commission for submission to the Department of Higher Education;

(ix) prepare annual report, annual audit reports of the Commission;

(x) get accounts of the Secretariat and the Commission audited regularly;

(xi) be the appointing and disciplinary authority of the officers and other staff of the Secretariat working under him;

(xii) prepare rules of terms and conditions of service for employees of the Secretariat;

(xiii) exercise such other functions, powers and duties as may be conferred upon him by the Chancellor;

(xiv) do all such activities so as to fulfill objectives, functions and duties of the Commission;

(xv) undertake any other task as may be assigned by the Commission and the State.

(7) The selection and appointment of Advisors on the Board of Management shall be as specified by the State Government by an order published in the *Official Gazette*.

(8) Nothing in this section shall empower the Commission to carry out any executive functions in the management of the affairs of the university.

**78.** (1) There shall be a Council to be called as the Maharashtra State Rashtriya Uchhatrar Shiksha Abhiyan Council (hereinafter referred to as "RUSA").

Maharashtra  
State  
Rashtriya  
Uchhatrar  
Shiksha  
Abhiyan  
Council.

(2) The Council under sub-section (1) shall be a body corporate, having perpetual succession and a common Seal and may by the name sue or be sued.

(3) The State Government may, by notification in the *Official Gazette* specify the composition, functions and responsibilities of the council under sub-section (1), which shall be in conformity with the guidelines of RUSA of the Government of India :

Provided that, every such notification shall be laid as soon as may be, after it is issued, before each House of the State Legislature.

(4) The Council under sub-section (1) shall forward a yearly report of its activities, to the Commission under section 76.

## CHAPTER VII

### GRIEVANCES OF TEACHERS AND EMPLOYEES

**79.** (1) There shall be a Grievances Committee in each university to deal with all types of grievances ; except grievances against the State Government including its officials, of teachers and other employees of the university, affiliated and autonomous colleges and recognized institutions, other than those managed and maintained by the State Government, Central Government or a local authority; which are not within the jurisdiction of the University and College Tribunal.

Grievances  
Committee.

(2) The university shall establish a Grievances Redressal Cell headed by the officer of the university not below the rank of the Assistant Registrar for providing administrative assistance to the Grievances Committee.

(3) The Grievances Committee shall consist of the following members, namely :-

(a) retired Judge not below the rank of the District Judge, nominated by the Vice- Chancellor - Chairperson ;

(b) one Dean, nominated by the Vice-Chancellor;

(c) Chancellor's nominee on the Management Council;

(d) Registrar;

(e) one teacher belonging to Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Classes and one non-teaching employee nominated by the Senate from amongst its members;

(f) Law Officer of the University - Member-Secretary.

(4) The nomination of a retired Judge as the Chairperson and of a Dean as the member of the Grievances Committee, shall be for such period, not exceeding three years in aggregate, as the Vice-Chancellor may from time to time, in each case decide.

(5) The retired Judge nominated as the Chairperson of the Grievances Committee shall be entitled for remuneration and conveyance charges, as may be determined by the university.

(6) The Grievances Committee shall hear, settle and decide grievances as per the law, as far as may be practicable, within three months, from the date of filing of the complaint.

(7) It shall be lawful for the Grievances Committee to entertain and decide grievances or complaints relating to service of the employees, which are not within the jurisdiction of the Tribunal, after giving reasonable opportunity of being heard to both the parties.

University  
and College  
Tribunal.

**80.** (1) There shall be one or more university and college tribunals for one or more universities in the State, governed by this Act as well as the Maharashtra Agricultural Universities (Krishi Vidyapeeths) Act, 1983, the Maharashtra Animal and Fishery Sciences University Act, 1998 and the Maharashtra University of Health Sciences Act, 1998, for adjudication of disputes between the employees of these universities and their respective university and between the employees of the affiliated or autonomous colleges or recognized institutions of these universities, other than those managed and maintained by the State Government, Central Government or local authority and their respective managements, with regard to the matters specified in sub-section (1) of section 81.

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of  
1998.  
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X of  
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(2) The Tribunal shall consist of the Presiding Officer, to be appointed by the State Government.

(3) A person shall not be qualified to be appointed as a Presiding Officer of a Tribunal, unless,-

(a) he is or has been a Judge of High Court; or

(b) is qualified to be appointed as a Judge of High Court:

Provided that, a person to be appointed under clause (b) shall be from amongst the panel of three persons recommended by the Chief Justice of High Court of Judicature at Bombay.

(4) The appointment of a person as a Presiding Officer of the Tribunal shall be on a full time basis and for such period not exceeding three years in aggregate, as the State Government may, from time to time, in each case decide.

(5) The remuneration and other conditions of service of the Presiding Officer shall be as determined by the State Government.

(6) The university shall make available to the Tribunal such ministerial staff as may be necessary for the discharge of its functions under this Act.

(7) All expenditure on account of the remuneration, pension, provident fund contribution, leave allowance and other allowances and facilities which may be admissible to the Presiding Officer and the staff placed at his disposal shall be borne by the university or universities in such proportion as the State Government may by order specify.

(8) The Presiding Officer may, by writing under his signature resign from his office and shall cease to hold his office on the acceptance of his resignation by the State Government or from the date of expiry of thirty days from the date of resignation, whichever is earlier.

(9) If any vacancy other than a temporary vacancy, occurs in the office of Presiding Officer of a Tribunal, the State Government shall, as soon as possible but in any case within three months, appoint another qualified person to fill the vacancy. In case of a temporary vacancy, the State Government may give the charge to the Presiding Officer of the other Tribunal until the Presiding Officer resumes duty. Any proceedings pending before the former Presiding Officer may be continued and disposed of by his successor from the stage at which they were when the vacancy occurred.

**81.** (1) Notwithstanding anything contained in any law or contract for the time being in force, any teacher or other employee in the university governed by this Act or in affiliated college or recognized institution of any of these universities, other than that managed and maintained by the State Government, Central Government or a local authority, who is-

Right of appeal.

(a) dismissed or removed or whose services are otherwise terminated or who is compulsorily retired or who is reduced in rank by the university or management and who is aggrieved; or

(b) aggrieved by the decision of the Grievances Committee established under this Act;

shall have a right of appeal and any appeal against any such order or decision shall lie to the Tribunal:

Provided that, no such appeal shall lie to the Tribunal in any case where the matter has already been decided or pending before a Court or Tribunal on the date of commencement of this Act or where the order of dismissal, removal, otherwise termination of service, compulsory retirement or reduction in rank, or decision of the Grievances Committee was passed at any time before the date on which this Act comes into force and in which case the period for filing an appeal has expired.

(2) Such appeal shall be made by the employee to the Tribunal, within thirty days from the date of receipt by him of the order of dismissal, removal, otherwise termination of services, compulsory retirement or reduction in rank, or of decision of the Grievances Committee, as the case may be:

Provided that, where such order was made before the date of commencement of this Act, such appeal may be made if the period of thirty days from the date of receipt of such order or decision has not expired.

(3) Notwithstanding anything contained in sub-section (2), the Tribunal may entertain an appeal made to it after the expiry of the said period of thirty days, if it is satisfied that the appellants had sufficient cause for not preferring the appeal within that period.

(4) Every appeal shall be accompanied by a fee as prescribed which shall not be refundable and shall be credited to the university fund:

Provided that, it shall be lawful for the State Government to revise, by notification in the *Official Gazette*, such fees as it may deem fit, from time to time.

General  
power and  
procedure of  
Tribunal.

**82.** (1) For the purposes of hearing and disposal of appeals, the Tribunal shall have the same powers as are vested in an appellate court under the Code of Civil Procedure, 1908, and shall also have the power to stay the operation of any order against which an appeal is made, on such conditions as it may think fit to impose and such other powers as are conferred on it by or under this Act.

V of  
1908.

(2) The Presiding Officer of the Tribunal shall decide the procedure to be followed by the Tribunal for the disposal of its business including the place or places at which and the hours during which it shall hold its sittings.

(3) Every appeal shall be decided as expeditiously as possible. In every case, endeavor shall be made by the Tribunal to decide an appeal within three months from the date on which the Tribunal receives it. If the Tribunal is unable to dispose of any appeal within this period, it shall record the reasons therefor.

Powers of  
Tribunal to  
give  
appropriate  
relief and  
directions.

**83.** (1) On receipt of an appeal, where the Tribunal after giving reasonable opportunity of being heard to both parties, is satisfied that the appeal does not pertain to any of the matters specified in sub-section (1) of section 81 or is not maintainable, or there is no sufficient ground for interfering with the order of the university or management or decision of the Grievances Committee, it may dismiss the appeal.

(2) Where the Tribunal, after giving reasonable opportunity to both the parties of being heard, decides in any appeal that the order of dismissal, removal, otherwise termination of service, compulsory retirement or reduction in rank, or the decision of the Grievances Committee, was in contravention of any law, contract or conditions of service for the time being in force or was otherwise illegal or improper, the Tribunal may set aside the order of the university or the management, or decision of the Grievances Committee, as the case may be, partially or wholly, and direct the university or the management,-

(a) to reinstate the employee on the same post or on a lower post as it may specify;

(b) to restore the employee to the rank which he held before reduction or to any lower rank as it may specify;

(c) to give arrears of emoluments, dues and other monetary benefits to the employee for such period as it may specify;

(d) to award such lesser punishment as it may specify in lieu of dismissal, removal, otherwise termination of service, compulsory retirement or reduction in rank, as the case may be;

(e) where it is decided not to reinstate the employee or in any other appropriate case, to give such sum to the employee, not exceeding his emoluments for six months, by way of compensation, regard being had to loss of employment and possibility of getting or not getting suitable employment thereafter, as it may specify; or

(f) to give such other relief to the employee and to observe such other conditions as it may specify, having regard to the circumstances of the case.

(3) It shall be lawful for the Tribunal to recommend to the State Government that any dues directed by it to be paid to the employee may be deducted from the grant payable to the university or, as the case may be, the management and be paid to the employee directly.

(4) Any direction issued by the Tribunal under sub-section (2) shall be communicated to both parties in writing and shall be complied with by the university or management within the period specified in the direction, which shall not be less than two months from the date of its receipt by the university or management.

**84.** Notwithstanding anything contained in any law or contract for the time being in force, the decision of the Tribunal on an appeal entertained and disposed of by it shall be final and binding on the employee and the university or management, as the case may be, and no suit, appeal or other legal proceeding shall lie in any court or before any other Tribunal or authority, in respect of the matters decided by the Tribunal.

Decision of Tribunal to be final and binding.

**85.** (1) If the university or management, as the case may be, fails, without any reasonable cause, to comply with any direction issued by the Tribunal under section 83 within the period specified in the direction, or within such further period as may be allowed by the Tribunal, the university or management, as the case may be, shall on conviction, be punished-

Penalty to management for failure to comply with directions of Tribunal.

(a) for the first contravention, with fine which may extend to one lakh rupees:

Provided that, in the absence of special and adequate reasons to the contrary to be recorded in the judgment of the Tribunal, the fine shall not be less than ten thousand rupees;

(b) for the second and subsequent contraventions, with fine which may extend to five lakh rupees for each such contravention:

Provided that, in the absence of special and adequate reasons to the contrary to be recorded in the judgment of the Tribunal, the fine shall not be less than five thousand rupees:

Provided further that, when the direction issued by the Tribunal is not complied with, within the period stipulated in the direction or within such further period as allowed by the Tribunal, and when the contravention is a continuing one, the convicted person shall be punished with a further fine of rupees five hundred per day during which such contravention continues after conviction.

(2)(a) Where the university or, as the case may be, management committing the contravention under this section is a society, every person who at the time such contravention has been committed, was in charge of and was responsible to the society, for the conduct of the affairs of the society, as well as the society, shall be deemed to be guilty of the contravention and shall be liable to be proceeded against and punished accordingly:

Provided that, nothing contained in this sub-section shall render any person liable to the punishment, if he proves that the contravention was committed without his knowledge or that he had exercised all the diligence to prevent commission of such contravention.

(b) Notwithstanding anything contained in clause (a), where the contravention has been committed by a society and it is proved that the contravention has been committed with the consent or connivance of, or is attributable to any neglect on the part of the Management Council of the university or any president, chairperson, secretary, member, principal or manager or other officer or servant of the society, such Management Council, president, chairperson, secretary, member, principal or manager or other officer or servant concerned, shall be deemed to be guilty of the contravention and shall be liable to be proceeded against and punished accordingly.

*Explanation.-* For the purposes of this section, society means a society registered under the Societies Registration Act, 1860 or a public trust registered under the Maharashtra Public Trusts Act, or any other body corporate, and includes an association or body of persons, by whatever name called, under whose management one or more colleges or institutions are conducted and admitted to the privileges of the university.

XXI  
of  
1860.  
XXIX  
of  
1950.

## CHAPTER VIII

### ADMISSIONS, EXAMINATIONS, EVALUATION AND OTHER MATTERS RELATING TO STUDENTS

Admissions. **86.** Subject to the reservation policy of the State Government for the weaker sections of the society, admissions to all courses in the university departments, affiliated colleges and recognized institutions shall be made on the basis of competitive merit in accordance with the rules, if any, made by the State Government and published in the *Official Gazette*, or Ordinances made by the university:

Provided that, where model rules have been framed by the State Government in the interest of students throughout the State, the university shall adopt the same and such rules shall be published by the university before the commencement of the academic session:

Provided further that, having regard to the maintenance of discipline, the authority concerned shall have the power to refuse admission to a student, except at the entry point of any academic programme.

Disputes  
relating to  
admission.

**87.** All the disputes relating to admissions to University Departments, affiliated colleges or recognized institutions shall be adjudicated by the University Students Grievance Redressal Cell as per sub-clause (b) of sub-section (2) of section 56.

Examinations  
and  
evaluation.

**88.** Before the end of each academic year, the university shall prepare and publish a schedule of examinations for the next academic year and choice based credit system of evaluations for each and every course where ever applicable, conducted by itself or by any affiliated college or recognized institutions within its jurisdiction



and shall strictly adhere to the schedule. Failing which the concerned authority or officer of the university shall have to make a reasoned report to Chancellor's Office within thirty days and the directions or decisions of the Chancellor in this regard shall be final and binding.

*Explanation. I.-* "Schedule of Examinations" means a table giving details about the time, day and date of the commencement of each paper which is a part of a scheme of examinations and shall also include the details about the practical examinations.

*Explanation. II.-* "Choice based credit system" means an evaluation wherein modules taken by students shall be assessed immediately upon completion of required academic work as a part of continuous assessment or at the end of a semester:

Provided that, in case the university is unable to follow the said schedule due to reasons and circumstances beyond its control it shall, as soon as practicable, submit a report to the Chancellor and to the State Government incorporating the detailed reasons for making a deviation from the published schedule.

**89.** The university shall strive to declare the results of every examination conducted by it within thirty days from the last date of the examination for that particular course and shall in any case declare the results latest within forty-five days thereof:

Declaration of results.

Provided that, if for any reasons whatsoever, the university is unable to finally declare the results of any examination and evaluation within the aforesaid period of forty-five days, Director, Board of Examinations and Evaluation shall prepare a detailed report incorporating the reasons for such delay submit the same through Vice-Chancellor to Chancellor and to the State Government, and the direction of the Chancellor in this regard shall be final and binding.

**90.** No examination or evaluation or the results of an examination or evaluation shall be held invalid only for the reasons that the university has not followed the schedule as stipulated in sections 88 and 89, as the case may be.

Examinations and evaluation not invalid for non-compliance with Schedule.

**91.** The university shall frame appropriate Statutes, Ordinances and Regulations to ensure that the students selected to represent their classes, colleges or the university, as the case may be, for sports, culture and all other extra-curricular activities are selected entirely on the basis of merit, through open merit competition alone and on no other basis.

Sports and extra-curricular activities.

CHAPTER IX  
COMMITTEES AND COUNCILS

Committees  
and  
Councils.

**92.** The following shall be the Committees and Councils constituted under this Act, namely:-

- (i) Advisory Council;
- (ii) Finance and Accounts Committee;
- (iii) Internal Quality Assurance Committee;
- (iv) Knowledge Resource Committee;
- (v) College Development Committee;
- (vi) Purchase Committee;
- (vii) Students' Council;
- (viii) Buildings and Works Committee;
- (ix) Fee Fixation Committee; and
- (x) Alumina Committee.

Advisory  
Council.

**93.** (1) The Advisory Council shall consist of following members -

(a) to be nominated by the Chancellor,-

(i) An eminent industrialist who has proven wide experience in the changing scenario of opportunities for youth and global trends in academy-industry interaction-Chairman;

(ii) An eminent scientist of repute with experience of working with national and global entities that deal with policy and approaches in research and development-Member;

(iii) An eminent social leader who has experience of working with the masses and understands the linkages between education and social transformations-Member;

(iv) An eminent educationist who is conversant with new trends in the world of higher education-Member;

(v) An Information Communication Technology (ICT) expert who has wide experience at the national and international level in the higher and professional education-Member;

(b) *ex-officio* :

(vi) the Vice-Chancellor - Member;

(vii) the Pro Vice-Chancellor -Member- Secretary.

(2) The powers and duties of the Council shall be as follows:-

(i) to advise to the Vice-Chancellor through generation of reports and action plans in academic, research and development, administration, generation of financial resources and governance so as to make a University academically vibrant, administratively efficient and financially a strong system;

(ii) to devise a mechanism and approach for monitoring of the working of the University system as a whole and to keep track of the activities and provide information and critical analysis and comments on the progress and impact of the activities on the working of Universities and its identity in the Society;

(iii) to advise the University regarding strategic perspective planning;

(iv) to take up any other task that the Chairman of the Council shall find of importance for the growth of the University;

(v) to make periodic report on the development, progress, working of University to the Chancellor;

(vi) to keep track of various reforms and policies thereon as devised by the Commission.

(3) The Advisory Council shall meet at least two times in a year.

**94.** (1) There shall be a Finance and Accounts Committee to plan, coordinate and oversee the financial operations of the university. It shall examine the accounts, the progress of expenditure and all new proposals involving fresh expenditure in the light of the provisions available.

Finance and  
Accounts  
Committee.

(2) The Finance and Accounts Committee shall consist of the following members, namely:-

(a) the Vice-Chancellor-Chairperson;

(b) the Pro-Vice-Chancellor;

(c) the Director of Accounts and Treasuries or his representative, not below the rank of Deputy Director of Accounts and Treasuries;

(d) the Chancellor's nominee from the Management Council;

(e) one person from the Academic Council, nominated by the Vice-Chancellor;

(f) two experts nominated by the Management Council, one of whom shall be a Chartered Accountant who is an expert in the field of accounting and auditing and the other shall be an expert in the area of finance;

(g) the Registrar;

(h) the Finance and Accounts Officer - Member-Secretary.

(3) The quorum for a meeting of the committee shall be four.

(4) All members of the committee other than *ex-officio* members shall hold office for a term of five years and shall not be eligible for a second consecutive term.

(5) The committee shall meet at least four times in a year.

(6) The Finance and Accounts Committee shall,-

(a) examine and consider Annual Statement of Accounts, Audited final statement of accounts and Audit Report and its compliance report, and the annual financial estimates to be presented by the Finance and Accounts Officer and recommend the same to the Management Council and thereafter to the Senate for approval;

(b) examine the progress of expenditure and all new proposals involving fresh expenditure in the light of the provisions available;

(c) recommend to the Management Council the limits for the total recurring and non-recurring expenditure for the year, based on the income and resources of the university, including the proceeds of loans for productive work;

(d) recommend to the Management Council productive investment and management of university assets and resources;

(e) explore the possibilities of, augmenting further the resources for the development of the university;

(f) take necessary steps to have the university accounts audited by auditors appointed by the Management Council;

(g) advise the Management Council on matters related to the administration of the property and the funds of the university;

(h) ensure proper implementation of the orders issued by the State Government from time to time, in respect of funds, assets, and other resources received from the State Government;

(i) advise on financial matters referred to it by the Management Council, Academic Council or any other authority, body or committee or any officer of the university;

(j) report to the Vice-Chancellor any lapse or irregularity in financial matters which comes to its notice so that he may take suitable prompt actions after assessing the seriousness of the matter or refer it to the Management Council;

(k) ensure that the annual accounts of the university, colleges and institutions are open for audit by the auditors appointed by the State Government;

(l) study various reforms suggested by the Commission for management of financial resources, maintenance of accounts and use of modern technologies to enhance the efficiency in accounts maintenance and audit procedures;

(m) carry out any other functions and tasks as may be assigned by the university authorities.

Internal  
Quality  
Assurance  
Committee.

**95.** (1) There shall be an Internal Quality Assurance Committee in the university to plan, guide and monitor quality assurance and quality enhancement in all the academic activities of the university.

(2) The Internal Quality Assurance Committee in the university shall be constituted and function as per the guidelines of the University Grants Commission and State Government issued, from time to time.

(3) The Annual Quality Assurance Report shall be approved by the Management Council of the University for the follow up action for the necessary quality enhancement measures. The university shall regularly submit the Annual Quality Assurance Report to the National Assessment and Accreditation Council or other accreditation bodies.

(4) There shall be an Internal Quality Assurance Committee in each college and recognized institution that shall be constituted and function as per the guidelines of the University Grants Commission and State Government issued, from time to time.

(5) The colleges and recognized institutions shall regularly submit their Annual Quality Assurance Reports to the affiliating university, State level quality assurance bodies and national accreditation bodies.

(6) The university shall monitor the functioning of Internal Quality Assurance Committees in the colleges and recognized institutions within its jurisdiction.

**96.** (1) There shall be a Knowledge Resource Committee for administering, organizing and maintaining the Knowledge Resource Centre, print and electronic material and related services of the university.

Knowledge  
Resource  
Committee.

(2) The Knowledge Resource Committee shall consist of the following members, namely :-

(a) the Vice-Chancellor - Chairperson;

(b) one Dean of faculty, nominated by the Vice-Chancellor;

(c) one head of the university department or university institution nominated by the Vice-Chancellor;

(d) two members nominated by the Vice-Chancellor, of whom one shall be from industry and the other shall be librarian from a national level organization;

(e) the Registrar;

(f) the Finance and Accounts Officer;

(g) the Director Knowledge Resource Center - Member - Secretary.

(3) All nominated members of the Knowledge Resource Committee, other than the *ex-officio* members, shall hold office for a period of three years.

(4) The Knowledge Resource Committee shall meet at least three times in a year.

(5) The Knowledge Resource Committee shall,-

(a) provide for proper organization and support for the functioning of the Knowledge Resource Centre, documentation services and maintenance of records in analogue and digital form;

(b) provide the approach and operational plan for modernization and improvement of Knowledge Resource Centre and documentation services in both analogue and digital format;

(c) recommend to the Academic Council fees and other charges for the services and use of the Knowledge Resource Centre by students and others;

(d) prepare the annual budget and proposal for development of the Knowledge Resource Centre for approval of the Management Council;

(e) submit the annual report on the functioning of the Knowledge Resource Centre to the Vice-Chancellor;

(f) establish a network with regional, national and international libraries and information centers;

(g) hold the information pertaining to all administrative, governance, academic and other documents and information and data pertaining to the working of colleges, university departments or institutions and administrative offices of the university and related to assessment and accreditation of colleges, recognized institutions and the university;

(h) undertake any other task as may be assigned by the university authorities so as to carry out objectives of the Knowledge Resource Centre.

College  
Development  
Committee.

**97.** (1) There shall be a separate College Development Committee for every affiliated, autonomous, empowered autonomous college or recognized institution, consisting of the following members, namely :-

- (a) Chairperson of the management or his nominee *ex-officio* Chairperson;
- (b) Secretary of the management or his nominee;
- (c) one head of department, to be nominated by the principal or the head of the institution;
- (d) three teachers in the college or recognized institution, elected by the full-time amongst themselves out of whom at least one shall be woman;
- (e) one non-teaching employee, elected by regular non-teaching staff from amongst themselves;
- (f) four local members, nominated by the management in consultation with the principal, from the fields of education, industry, research and social service of whom at least one shall be alumnus;
- (g) Co-ordinator, Internal Quality Assurance Committee of the college;
- (h) President and Secretary of the College Students' Council;
- (i) Principal of the college or head of the institution-Member-Secretary.

(2) For a college or institution managed and maintained by the State Government, the College Development Committee shall consist of the following members, namely:-

- (a) Principal of the college or head of the institution - Chairman.
- (b) Joint Director designated by the Director of Higher Education, *ex-officio* Member;
- (c) three teachers in the college or recognized institutions, elected by the full-time approved teachers from amongst themselves;
- (d) one non-teaching employee, elected by the regular non-teaching staff from amongst themselves;
- (e) four local members, nominated by the Director of Higher Education in consultation with the principal, from the fields of education, industry, research and social service and having minimum post-graduate degree of whom at least one shall be alumnus;
- (f) Co-ordinator, Internal Quality Assurance Committee of the college, *ex-officio*;
- (g) President and Secretary of the College Students Council ; and

(h) one head of department, nominated by the principal or the head of the institution-Member-Secretary.

(3) The College Development Committee shall meet at least four times in a year.

(4) Elected and Nominated members shall have a term of five years from the date of election or nomination. If any vacancy occurs in the office of such member, the vacancy shall be filled within three months by the Principal and the member so appointed shall hold office for the residual term for which the earlier member shall have held the office if the vacancy had not occurred.

(5) The College Development Committee shall,-

(a) prepare an overall comprehensive development plan of the college regarding academic, administrative and infrastructural growth, and enable college to foster excellence in curricular, co-curricular and extra-curricular activities;

(b) decide about the overall teaching programmes or annual calendar of the college;

(c) recommend to the management about introducing new academic courses and the creation of additional teaching and administrative posts;

(d) take review of the self-financing courses in the college, if any, and make recommendations for their improvement;

(e) make specific recommendations to the management to encourage and strengthen research culture, consultancy and extension activities in the college;

(f) make specific recommendations to the management to foster academic collaborations to strengthen teaching and research;

(g) make specific recommendations to the management to encourage the use of information and communication technology in teaching and learning process;

(h) make specific recommendations regarding the improvement in teaching and suitable training programmes for the employees of the college;

(i) prepare the annual financial estimates (budget) and financial statements of the college or institution and recommend the same to the management for approval;

(j) formulate proposals of new expenditure not provided for in the annual financial estimates (budget);

(k) make recommendations regarding the students' and employees' welfare activities in the college or institution;

(l) discuss the reports of the Internal Quality Assurance Committee and make suitable recommendations;

(m) frame suitable admissions procedure for different programmes by following the statutory norms;

(n) plan major annual events in the college, such as annual day, sports events, cultural events, etc.

(o) recommend the administration about appropriate steps to be taken regarding the discipline, safety and security issues of the college or institution;

(p) consider and make appropriate recommendations on inspection reports, local inquiry reports, audit report, report of National Assessment and Accreditation Council, etc.;

(q) recommend the distribution of different prizes, medals and awards to the students;

(r) prepare the annual report on the work done by committee for the year ending on the 30th June and submit the same to the management of such college and the university;

(s) perform such other duties and exercise such other powers as may be entrusted by the management and the university.

Purchase  
Committee.

**98.** (1) There shall be a Purchase Committee for dealing with all matters pertaining to all purchases of the university, in respect of such items where individual cost of each item exceeds rupees ten lakhs at a time.

(2) The committee shall consist of the following members, namely:-

(a) the Vice-Chancellor - Chairperson;

(b) the Pro-Vice-Chancellor;

(c) Chancellor's nominee on Management Council;

(d) two heads of university departments or university institutions nominated by the Management Council;

(e) one member of the Management Council nominated by the Council from amongst the elected members of the Council;

(f) one expert, nominated by the Vice-Chancellor preferably in the area of Material Management from the Industry;

(g) the Registrar ; and

(h) the Finance and Accounts Officer-Member-Secretary.

(3) During the absence of the Finance and Accounts Officer, the Registrar shall act as the Secretary of the Committee.

(4) The Purchase Committee shall invite the head of the university department or university institution, for which the purchases are to be made.

(5) All members of the committee, other than *ex-officio* members shall hold office for a term of three years and shall not be eligible for a second consecutive term in the same university.

(6) All matters pertaining to all purchases of the University in respect of such items where individual cost of each item is not more than rupees ten lakhs at a time, shall be as prescribed by the Statutes.

(7) The powers and duties of the Purchase Committee and the procedure for its meetings shall be as prescribed by the Statutes.

Students  
Council.

**99.** (1) There shall be a University Students Council as specified in clause (b) of sub-section (4), a university department Students Council for the departments of the university and a college Students Council for each conducted college or institution of the University and each affiliated college, to look after the welfare of the students and to promote and co-ordinate the extra-curricular activities of different student's associations for better corporate life. The Councils shall not engage in political activities.



(2) The University Department Students Council shall consist of the following members, namely :-

(a) President, elected by an electoral college consisting of students who are engaged in full time studies in all university departments;

(b) Secretary, elected by an electoral college consisting of students who are engaged in full time studies in all university departments;

(c) one lady representative, elected by an electoral college consisting of students who are engaged in full time studies in all university departments;

(d) one representative belonging to Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Classes, elected by an electoral college consisting of students who are engaged in full time studies in all university departments;

(e) one student from each department, elected by an electoral college consisting of students who are engaged in full time studies in that department;

(f) one student each from (a) National Service Scheme, (b) National Cadet Corps, (c) Sports and (d) Cultural activities, nominated by the Vice-Chancellor from the students who are engaged in National Service Scheme, National Cadet Corps, Sports and Cultural activities, respectively, on the basis of prescribed criteria;

(g) Director, Students Development shall be an *ex-officio* member.

(3) The College Students Council for each institution, conducted college or affiliated college shall consist of the following members, namely :-

(a) President, elected by an electoral college consisting of students who are engaged in full time studies in that college;

(b) Secretary, elected by an electoral college consisting of students who are engaged in full time studies in that college;

(c) one lady representative, elected by an electoral college consisting of students who are engaged in full time studies in that college;

(d) one representative belonging to Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta-Jatis*) or Nomadic Tribes or Other Backward Classes, by rotation, elected by an electoral college consisting of students who are engaged in full time studies in that college:

Provided that the University shall decide the category of reservation for each college for the purpose of this clause by drawing lots;

(e) one student from each class, elected by an electoral college consisting of students who are engaged in full time studies in that class;

(f) one student each from (a) National Service Scheme, (b) National Cadet Corps, (c) Sports and (d) Cultural activities, nominated by the Principal from the students who are engaged in National Service Scheme, National Cadet Corps, Sports and Cultural activities, respectively, on the basis of prescribed criteria;

(g) one senior teacher as coordinator of the Students Council appointed by the principal of the college and Director, Sports and Physical Education, NSS Programme Officer and NCC Officer as permanent invitees.

(4) (a) There shall be University Students Association consisting of the following members, namely :-

(i) Presidents of the University Department Students Council and each College Students Council;

(ii) Secretaries of the University Department Students Council and each College Students Council;

(iii) Lady representatives of the University Department Students Council and each College Students Council;

(iv) Student representatives, belonging to Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Classes of the University Department Students Council and each College Students Council.

(b) The University Students Council shall consist of the following members, namely :-

(i) President, elected by the members of University Students Association from amongst themselves;

(ii) Secretary, elected by the members of University Students Association from amongst themselves;

(iii) one Lady Representative, elected by the members of University Students Association from amongst themselves;

(iv) one Representative belonging to Scheduled Castes or Scheduled Tribes or Denotified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Classes or Special Backward Category, by rotation, elected by the members of University Students Association from amongst themselves;

(v) one student each from (a) National Service Scheme, (b) National Cadet Corps (c) Sports and (d) Cultural activities nominated by the President of the University Students' Council in consultation with the Director, Students Development from amongst the students of the University Departments and affiliated colleges who are engaged in National Service Scheme, National Cadet Corps, Sports and Cultural activities respectively on the basis of prescribed criteria;

(vi) Director Board of Student Development, Director Sports and Physical Education, Director Board of Lifelong Learning and extension shall be permanent invitees.

(5) The first meeting of the University Students Council shall be presided over by the Vice-Chancellor and shall be attended by such other officers as he may deem fit.

(6) A student shall be eligible to be, or continue to be, a member of any of the Students Councils, only if he is enrolled as a full time student.

(7) During the period of election no person, other than a student on the rolls of college or institutions or University, shall be permitted to take part in the election process in any capacity. Any student or a candidate violating this condition shall be liable for disciplinary action against him in addition to the revocation of his candidature.

(8) The budget, frequency of meeting of the University Department Students Council, Students Council for each institution, conducted college or affiliated college and University Students Council shall be as may be prescribed by the Statutes.

(9) The election of the student members of the Students Councils shall be made every year, as soon as possible after the commencement of the academic year, on a date as may be prescribed. The term of office of the elected student members shall begin with effect from the date of election and shall extend up to the last day of the academic year, unless they have, in the meantime, incurred any of the disqualifications specified by or under the Act, and shall then expire.

(10) One third of the members of the Students Council shall constitute the quorum. The procedure for conduct of business of the meetings and such other matters shall be such as may be prescribed by the Statutes. The Council shall meet at least once in every three months.

(11) The procedure for election, the powers and duties, authority for the conduct of election, mechanism for conduct of such elections, code of conduct for the candidates and election administrators and grievances redressal mechanism in respect of such election shall be such as may be specified by the State Government, by orders published in the *Official Gazette*.

(12) The provisions of this sections shall come into effect from such date after issuing the order under sub-section (11), as specified by the State Government in such order.

<sup>1</sup>[99A. Notwithstanding anything contained in section 99, for the academic year 2017-18, with regard to the constitution of Students' Council the following provisions shall apply :-

Temporary provisions for Constitution of Students' Council.

(1) There shall be a University Students' Council as specified in sub-section (4), a University Department Students' Council for the departments of the University and a Students' Council for each conducted college or institution of the University and each affiliated college, to look after the welfare of the students and to promote and co-ordinate the extracurricular activities of different students' associations for better corporate life. The Councils shall not engage in political activities.

(2) (a) The University Department Students' Council shall consist of the following members, namely :—

- (i) Vice-Chancellor — President;
- (ii) Director of Students' Development — Chairman;
- (iii) Director of Sports and Physical Education;
- (iv) Director of National Service Scheme;

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1. Section 99A was added by Mah. 27 of 2018, s. 4.

(v) One student from each university department who has shown academic merit at the preceding degree examination and is engaged in full time studies in a university, institution or department or conducted college, nominated by the Vice-Chancellor;

(vi) Two lady students nominated by the Pro-Vice-Chancellor and if there is no Pro-Vice-Chancellor, the Vice-Chancellor shall nominate two lady students.

(b) the Students Council for each institution, conducted college or affiliated college shall consist of the following :—

(i) Principal-Chairman;

(ii) One lecturer, nominated by the Principal;

(iii) Teacher in charge of National Cadet Corps;

(iv) National Service Scheme Programme Officer;

(v) One student from each class, who has shown academic merit at the examination held in the preceding year and who is engaged in full-time studies in the college, nominated by the Principal;

(vi) Director of Sports and Physical Education, if any;

(vii) One student from each of the following activities, who has shown outstanding performance, nominated by the Principal, namely :—

(1) Sports;

(2) National Service Scheme and Adult Education;

(3) National Cadet Corps;

(4) Cultural Activities;

(viii) Two lady students nominated by the principal :

Provided that, two of the students from the categories (vii) and (viii) shall be those belonging to the Scheduled Castes or Scheduled Tribes or De-notified Tribes (Vimukta Jatis) or Nomadic Tribes or Other Backward Classes.

(3) The student member's of both these Councils shall elect, from amongst themselves, the Secretary of their respective Council.

(4) (a) There shall be University Students' Council consisting of not more than fifteen persons, nominated through selection, from amongst Secretaries of the respective councils under sub-section (3), as prescribed by the Statutes existing immediately prior to the date of commencement of this Act :

Provided that, at least one seat each be reserved for students belonging to—

(i) Scheduled Castes;

(ii) Scheduled Tribes;

(iii) De-notified Tribes (Vimukta Jatis) or Nomadic Tribes;

(iv) Other Backward Classes; and

(v) One seat for women students,

remaining seats being distributed district-wise :

Provided further that, for the purpose of nomination through selection details based on academic performance, participation in National Cadet Corps, National Service Scheme and Adult Education, Cultural Activities or such other activities

as may be prescribed by the Statutes existing immediately prior to the date of commencement of this Act.

(b) The University Students' Council so formed shall elect its own President and Secretary.

(c) Every meeting of the University Students' Council shall be presided over by the Vice-Chancellor and shall be attended by such other officers as may be prescribed.

(5) A student shall be eligible to be, or continue to be, a member of any of the Students' Council, only if he is enrolled as a full time student.

(6) The nomination of the student members of the Students' Council shall be made for the academic year 2017-2018 on the date to be fixed by the Management Council. The term of office of the nominated student members shall begin with effect from the date of nomination and shall extend upto the last day of the academic year, unless they have, in the meantime, incurred any of the disqualifications specified by or under the Act; and shall then expire.

(7) One third of the members of the Council shall constitute the quorum. The rules and procedure for conduct of business of the meetings and such other matters shall be such as may be prescribed. The Council shall meet at least once in every three months.]

**100.** (1) There shall be a Buildings and Works Committee to carry out several minor and major infrastructure development activities of the university efficiently and in a time bound manner.

Building and  
Works  
Committee.

(2) The Buildings and Works Committee shall consist of the following members namely :-

(a) the Vice-Chancellor - Chairperson;

(b) the Pro - Vice - Chancellor;

(c) Chancellor's nominee on the Management Council;

(d) Chief Engineer of the Public Works Department in charge of the region in which the university is situated, or his nominee not below the rank of Executive Engineer from that region;

(e) one eminent engineer, nominated by the Vice-Chancellor from the private sector;

(f) an eminent Architect, nominated by the Vice-Chancellor from the private sector;

(g) the Registrar;

(h) the Finance and Accounts Officer;

(i) the Executive Engineer of the University-Member-Secretary.

(3) All members of the committee, other than *ex-officio* members shall hold office for a term of five years and shall not be eligible for a second consecutive term.

(4) If any vacancy occurs in the office of a member, the same shall be filled within one month by the Vice-Chancellor and the member so appointed shall hold office for the residual term for which the earlier member shall have held the office if the vacancy had not occurred.

(5) The Buildings and Works committee shall,-

(a) under direction and overall superintendence of the Management Council, be responsible for the execution of all types of works, including major works to be executed through the agency of the Public Works Department;

(b) accord administrative approval and financial sanction, subject to availability of funds in the budget, to the maintenance work;

(c) recommend and obtain administrative approval and expenditure sanction of the Management Council in respect of all minor and major works;

(d) recommend to the Management Council through the Finance and Accounts Committee, a 'Programme of Works' to be executed in the ensuing year, specifying maintenance works, minor works and major works, separately;

(e) prepare a panel of ten to twelve Architects and other specialized consultants of proven experience and merit for the university works and get the same approved by Management Council. Such panel shall be subject to the approval of the Chancellor who may make such modifications in it as he deems fit;

(f) on getting administrative approval and expenditure sanction of the Management Council to minor and major works, to get the plans and estimates of such works prepared from the Executive Engineer of the university or the Architect selected for a project, borne on the panel of approved Architects of the university;

(g) maintain a list of approved contractors on the basis of their technical experience and financial capability for execution of maintenance works and minor works;

(h) be responsible for making technical scrutiny as may be considered necessary by it;

(i) be responsible, after careful scrutiny, for the acceptance of tenders received for maintenance works and major works;

(j) exercise general supervision over the work of the technical staff of the university, and in particular, ensure that essential records and data are maintained up-to-date and that the rejected tenders are retained for a reasonable period;

(k) ensure that the Executive Engineer of the university certifies the completion of works in accordance with the designs finally approved by the architect, if appointed, in respect of maintenance works and minor works;

(l) associate and deliberate with the consulting Architects, as and when necessary;

(m) settle rates not covered by the tender and settle claims and disputes with contractors in respect of maintenance works and minor works :

Provided that, the rates or claims or disputes shall be settled by the Public Works Department in respect of major works entrusted to that Department, subject to the condition that if the decision in respect of any such claims or disputes is likely to cause excess over the approved estimated cost of the project, prior sanction of the Management Council shall be obtained to such an excess amount;

(n) exercise such other powers and perform such other duties as may be conferred upon it by the Statutes.

(6) The Chairperson of the committee shall, in respect of maintenance and minor works, have the power to sanction the payment of monthly Running Account Bills of a work, subject to such bill having been examined by the Architect, where appointed, and certified as 'fit for payment' by the Executive Engineer of the university. The bills so paid shall be put up for approval of the committee at its next meeting.

(7) If there are reasonable grounds for the Chairperson of the committee to believe that there is an emergency which requires immediate action to be taken, he may exercise the powers of the committee. Such cases shall be reported by the Chairperson at the next meeting of the committee.

(8) Procedure for the execution of all types of works in the university and procedure for conduct of business at the meetings of the committee shall be as prescribed by the Statutes.

**101.** (1) There shall be a Fee Fixation Committee to work out the real cost of delivery of each and every under-graduate and post-graduate courses or programmes run by the university, colleges and recognized institutions, other than autonomous colleges and autonomous institutions and those managed and maintained by the State Government, Central Government and local authorities.

Fee fixation  
Committee.

(2) The Fee Fixation Committee shall decide the tuition fees, other fees and charges for various courses or programmes as recommended by the board of Deans, and recommend it to the academic Council for approval.

(3) The Fee Fixation Committee shall consist of the following members, namely :-

(a) a retired Vice-Chancellor or an eminent educationist having wide experience in the field of education, who shall not be connected with the university or any college or institution under its jurisdiction as the Chairperson;

(b) the Dean of the faculty concerned;

(c) Chancellor's nominee on the Management Council;

(d) one finance expert nominated by the Vice-Chancellor, preferably a Chartered Accountant, not connected with the university or college or institutions under its jurisdiction;

(e) one legal expert nominated by the Vice-Chancellor, not connected with the university or college or institution under its jurisdiction;

(f) Registrar or his nominee not below the rank of Deputy Registrar - Member Secretary.

(4) The quorum for a meeting of the committee shall be three.

(5) All members of the committee, other than *ex-officio* members shall hold office for a term of five years and shall not be eligible for a second consecutive term.

(6) Notwithstanding anything contained above, the State Government may evolve the Statutory Mechanism of fixation and regulation of fees which shall be binding on different types of colleges and recognized institutions as specified by the State Govt. in this regard.

(7) The tuition fees, other fees, and charges for various courses or programmes as recommended by fee fixation committee and finally approved by the Academic Council shall be applicable in general. Provided that, any college or recognized institution other than autonomous college and autonomous institution and those managed and maintained by the State Government, Central Government and Local Authorities which intends to charge different fees other than those prescribed and approved by Academic Council may submit the proposal to the fee fixation committee and the fee fixation committee shall decide the tuition fee, other fees and charges for the specific course or programme for such college or institution on the basis of assessment and evaluation of different additional facilities provided by such applicant college or recognized institutions. The decision of fee fixation committee in this regard shall be final and binding on the applicant college or institution.

(8) The committee shall meet at least twice a year to examine and consider the fee fixation proposals on the basis of the norms as prescribed in Ordinance, and shall hold as many meetings as needed. The committee shall decide tuition fees, other fees and charges for various courses or programmes, at least six months before the commencement of academic year.

Selection  
and  
appointment  
of  
university  
teachers.

**102.** (1) Subject to the provisions of this Act, Statutes and Ordinances, the Vice-Chancellor shall appoint according to the order of merit and recommendations made by the selection committee, a university teacher.

(2) The selection committee for making recommendations for appointment of university teachers shall consist of the following members:-

(a) the Vice-Chancellor or the Pro-Vice-Chancellor upon directions of the Vice-Chancellor-Chairman;

(b) one person, not below the rank of professor, nominated by the Chancellor;

(c) the Dean of the Faculty concerned as a Member Secretary;

(d) the Head of the university department or a head of the concerned School of multidisciplinary institution, nominated by the Vice-Chancellor;



(e) not less than three experts nominated by the Management Council out of a panel of not less than six names of experts not connected with the university recommended by the Academic Council, who have special knowledge of the subject for which the teacher is to be selected;

(f) one person not below the rank of Professor or Principal belonging to Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Classes, nominated by the Chancellor;

(g) one principal who is a member of Management Council to be nominated by the Management Council;

(h) Director, Higher Education or his nominee not below the rank of Joint Director;

(i) Director, Technical Education or his nominee not below the rank of Joint Director :

Provided that, a head referred to in clause (d), who is an Associate Professor shall be a member of the selection committee for the selection to the Assistant Professor.

(3) Every post of a university teacher, to be filled by selection, shall be duly and widely advertised, according to the draft approved by the Vice-Chancellor, together with particulars of the minimum and additional qualifications, as prescribed, the emoluments and number of posts to be filled, the number of posts which are reserved for the members of the Scheduled castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Classes, to be determined by the Vice-Chancellor on the recommendation of the Board of University Department and Inter Disciplinary Studies, and reasonable time, shall be allowed within which the applicants may, in response to the advertisement, submit their applications.

(4) The date of the meeting of every selection committee shall be so fixed as to allow a notice of at least thirty days of such meeting, be in given to each member; and the particulars of each candidate shall be sent to each member of the selection committee so as to reach him at least seven days before the date of meeting :

Provided that, for the post of professor, the selection committee may in preference to the candidates who have applied and appeared before it, recommend for appointment, with all the requisite details, the name of any other person who may not have applied or appeared before it, but who is duly qualified and has to his credit exceptionally high academic achievements or proficiency in the specialization or has extraordinary academic contribution, to be recorded in writing.

(5) The quorum to constitute a meeting of every selection committee shall be four members, of whom at least two shall be persons nominated under clause (e) of sub-section (2).

(6) If, on petition by any person directly affected, or *suo motu*, the Chancellor, after making or having made such inquiries or obtaining or having obtained such explanations, including explanations from the teachers whose appointments are likely to be affected, as may be or may have been necessary, made by any authority or officer of the university at any time was not in accordance with the law at that time in force, the Chancellor, may, by order, notwithstanding anything contained in the contract relating to the conditions of service of such teacher, direct the Vice-Chancellor to terminate his appointment after giving him one month's notice or one month's salary in lieu of such notice, and the Vice-Chancellor shall forthwith comply and take steps for a fresh selection to be made. The person whose appointment has been so terminated shall be eligible to apply again for the same post.

(7) Any order made by the Chancellor, under the last preceding sub-section shall be final and a copy of the order shall be served on the teacher concerned by the Vice-Chancellor within three days from its receipt.

(8) It shall be the duty of the Vice-Chancellor, to ensure that no payment whatsoever is made to any person, by way of salary or allowance, from the funds of the university, for any period after the termination of his services, and any authority or officer authorizing or making any such payment shall be liable to reimburse the amount so paid to the university.

(9) The Vice Chancellor shall before proceeding to fill in the vacancies of aided University Teachers in accordance with the prescribed procedure shall ascertain from Director of Higher Education whether there is any suitable person available on the list of surplus aided University teachers as maintained by the Director of Higher Education for absorption in other Universities and in the event of such aided teacher being available, the Vice-chancellor shall appoint that teacher.

Filling  
temporary  
vacancies of  
university  
teachers.

**103.** (1) Where an appointment is to be made on a temporary vacancy of teacher of the university because of resignation, leave or any reason, whatsoever, the appointment shall be made, if the vacancy is for a period of more than one year, on the recommendation of the selection committee in accordance with the provisions of section 102. The quorum for the selection committee shall be three :

Provided that, if, the vacancy is for a period of less than one year or if, the Vice-Chancellor is satisfied that in the interest of teaching, it is necessary to fill in the vacancy immediately, he may make the appointment of person duly qualified, for a period not exceeding one year on the recommendation of a local selection committee.

(2) Local selection committee shall consist of the following members, namely:-

- (a) the Vice-Chancellor, Chairperson;
- (b) the Dean of the faculty concerned;
- (c) the head of the department concerned;
- (d) one expert nominated by the Vice-Chancellor :

Provided that, where the head of the department is also the Dean, the Vice-Chancellor shall nominate two persons instead of one;

(e) one member, belonging to Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Classes or Special Backward Category, not below the rank of Principal or Professor nominated by the Vice-Chancellor;

(f) one principal or professor who is a member of Management Council to be nominated by the Management Council;

(g) the Director, Higher Education or his nominee, not below the rank of Joint Director of Higher Education; and

(h) the Director, Technical Education or his nominee, not below the rank of Joint Director of Technical Education:

Provided that, before the expiry of one year as aforesaid, the Vice-Chancellor shall take steps to fill up the post by appointment in accordance with the provisions of section 102.

**104.** The selection committee for selection of Principals of conducted colleges or directors or heads of university institutions or post-graduate centres or sub-centres maintained by the university, shall consist of the following members, namely:-

Appointment and selection of principal of conducted colleges.

(a) the Vice-Chancellor - Chairperson;

(b) Chancellor's nominee on the Management Council;

(c) two experts, nominated by the Management Council and one expert nominated by the Academic Council, who are not connected with the university, colleges or institutions under its jurisdiction;

(d) one member belonging to Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes or Other Backward Classes not below the rank of Principal or Professor nominated by the Vice-Chancellor;

(e) one principal who is a member of Management Council to be nominated by the Management Council;

(f) the Director, Higher Education or his nominee, not below the rank of Joint Director of Higher Education;

(g) the Director, Technical Education or his nominee, not below the rank of Joint Director of Technical Education.

**105.** (1) There shall be a selection committee for making recommendations of suitable candidates for appointment to the posts of-

Selection committees for officers and employees of university principals, teachers and other employees of affiliated colleges.

(a) Deans;

(b) Directors of Sub-Campuses of the university;

(c) Registrar;

(d) Director, Board of Examinations and Evaluation;

(e) Finance and Accounts officer;

(f) Director of Sports and Physical Education;

(g) Director of Innovation, Incubation and Linkages;

(h) Director of Lifelong Learning and Extension.

(2) The Selection Committee shall consist of-

- (a) the Vice-Chancellor, Chairperson;
- (b) the Chancellor's nominee on the Management Council;
- (c) two experts having special knowledge in the field related to the post to be filled, who are not connected with the university or affiliated college or recognized institution under its jurisdiction, nominated by the Chancellor;
- (d) one person belonging to Scheduled Castes or Scheduled Tribes or De-notified Tribes (*Vimukta Jatis*) or Nomadic Tribes, or Other Backward Classes, not below the rank of Principal or Professor nominated by the Vice-Chancellor;
- (e) one elected principal or teacher who is a member of Management Council to be nominated by the Management Council,;
- (f) the Director of Higher Education or his nominee, not below the rank of the Joint Director of Higher Education;
- (g) the Registrar, Member-Secretary :

Provided that, where he himself is a candidate for the post then in such case, the Pro-Vice-Chancellor shall be the Member-Secretary.

(3) All posts, mentioned in sub-section (1) shall be duly and widely advertised.

(4) The date of the meeting of every selection committee shall be so fixed as to allow a notice of at least thirty days of such meeting, being given to each member; and the particulars of each candidate shall be sent to each member of the selection committee so as to reach him at least seven days before the date of meeting.

(5) In case of appointment to the post referred to in sub-section (1), if, on petition by any person directly affected, or *suo motu*, the Chancellor, after making or having made such inquiries or obtaining or having obtained such explanations, including explanations from the person whose appointments are likely to be affected, as may be or may have been necessary, made by any authority or officer of the university at any time was not in accordance with the law at that time in force, the Chancellor, may, by order, notwithstanding anything contained in the contract relating to the conditions of service of such person, direct the Vice-Chancellor to terminate his appointment after giving him one month's notice or one month's salary in lieu of such notice, and the Vice-Chancellor shall forthwith comply and take steps for a fresh selection to be made. The person whose appointment has been so terminated shall be eligible to apply again for the same post.

(6) Any order made by the Chancellor, under the last preceding sub-section shall be final and a copy of the order shall be served on the person concerned by the Vice-Chancellor within three days from its receipt.

(7) It shall be the duty of the Vice-Chancellor, to ensure that no payment whatsoever is made to any person, by way of salary or allowance, from the funds of the university, for any period after the termination of his services, and any authority or officer authorizing or making any such payment shall be liable to reimburse the amount so paid to the university.

(8) The Selection Committee and mode of appointment of other officers of the university shall be prescribed by the State Government in the *Official Gazette*.

(9) The management of any affiliated college shall before proceeding to fill in vacancies of aided teachers and other aided employees in accordance with the prescribed procedure shall ascertain from the Director of Higher Education whether there is any suitable person available on the list of aided surplus persons maintained by the Director of Higher Education for absorption in other colleges and in the event of such person being available, the management shall appoint that person in accordance with the direction issued by Director of Higher Education:

Provided that, this process of absorption of surplus teachers and other employees shall be applicable to only aided teachers and aided other employees.

(10) The Selection Committee, selection process and mode of appointment of principals and teachers of affiliated colleges and recognized institutions shall be as per the guidelines, directions of the University Grants Commission as may be prescribed by the State Government in the *Official Gazette*.

**106.** In addition to the committees constituted under this Act, the authorities of the university may appoint committee with suitable terms and reference for any specific task, and such committee shall consist of members of the same authority constituting such a committee and also of such other persons as that authority may nominate.

Other  
Committees.

## CHAPTER X

### PERMISSION, AFFILIATION AND RECOGNITION

**107.** (1) The university shall prepare a comprehensive perspective plan for every five years and get the same approved by Commission. Such plan shall be prepared for the location of colleges and institutions of higher learning in a manner ensuring comprehensive equitable distribution of facilities for higher education having due regard, in particular, to the needs of unserved and under-developed areas within the jurisdiction of the university. Such plan shall be prepared by the Board of Deans and shall be placed before the Academic Council and the Senate through the Management Council.

Perspective  
Plan.

(2) The perspective plan shall include the new courses and faculties to be permitted which shall be determined by studying the social and economic needs of the region, job opportunities available and requirements of the industry and should be as per policies of and in conformity with the plans of the State Government and the National Policy for Higher Education for achieving National and State objectives of higher access, equity, excellence, research, relevance and quality.

(3) The perspective plan shall make provision for the subjects, number of new divisions and satellite centres to be permitted to the colleges and institutions of higher learning in different regions after factoring in the demand for the same and shall be in conformity with the plans of and after the approval of Commission under section 76.

(4) While preparing the perspective plan preference shall be given to the districts where Gross Enrolment Ratio is less than the national average and also to the tribal, hilly and inaccessible areas besides quality benchmarks, inclusive growth, social relevance and value education.

(5) The university shall initiate a time bound programme to prepare an annual plan every year for the location of colleges and institutions of higher learning, in consonance with the perspective plan and shall publish it before the end of academic year preceding the year in which the proposals for the opening of new colleges or institutions of higher learning are to be invited.

(6) The University shall undertake the systematic field survey within the geographical jurisdiction of the University every five years regarding the requirements of the facilities of Higher Education, types of skills needed for the local industries, trade and commerce, aspirations of youth of the region, needs of socially and economically deprived youth like female students, backward and tribal communities and such other related factors. The university shall use the findings of such field survey and develop the scientific database while preparing the perspective plan of the university.

Conditions  
of  
affiliation  
and  
recognition.

**108.** (1) The management applying for affiliation or recognition, and the management whose college or institution has been granted affiliation or recognition, shall give the following undertaking and shall comply with the following conditions,

(a) that the provisions of the Act and Statutes, Ordinances and Regulations made thereunder and the standing orders and directions of the university and State Government shall be complied with;

(b) that there shall be a separate College Development Committee provided for an affiliated college as provided by section 97 of the Act;

(c) that the number of students admitted for courses of study shall not exceed the limits prescribed by the university and the State Government, from time to time;

(d) that there shall be suitable and adequate physical facilities such as buildings, laboratories, libraries, books, equipment required for teaching and research, hostels, gymnasium, etc. as may be prescribed;

(e) that the financial resources of the college or institution shall be such as to make due provision for its continued maintenance and working;

(f) that the strength and qualifications of teachers and non-teaching employees of the affiliated colleges and recognized institutions and the emoluments and the terms and conditions of service of the staff of affiliated colleges and recognized institutions shall be such as may be specified by the university and the State Government and which shall be sufficient to make due provision for courses of study, teaching or training or research, efficiently;

(g) that the services of all teachers and non-teaching employees and the facilities of the college to be affiliated shall be made available for conducting examinations and evaluation and for promoting other activities of the university;

(h) that the directions and orders issued by the Chancellor, Vice-Chancellor and other officers of the university in exercise of the powers conferred on them under the provisions of this Act, Statutes, Ordinances and Regulations shall be mandatorily complied with;

(i) that there shall be no change or transfer of the management or shifting of location of college or institution, without prior permission of the university;

(j) that the college or institution shall not be closed without prior permission of the university;

(k) that in the event of disaffiliation or de-recognition or closure of the college or institution under section 121, the management shall abide by and execute the decision of Academic Council regarding the damages or compensation to be recovered from management.

(2) No college or institution of higher learning which is part of another university shall be considered for affiliation or recognition, as the case may be, unless a "no objection certificate" is given by the parent university.

**109.** (1) The proposal for opening of new colleges or institutions of higher learning or for starting new courses of study, subjects, faculties, additional divisions or satellite centers, shall be invited and considered by the university.

(2) No application for opening a new college or institution of higher learning, which is not in conformity with the perspective plan prepared under section 107 shall be considered by the university.

(3) (a) The Management seeking a Letter of Intent for opening a new college or institution of higher learning shall apply in a prescribed format to the Registrar of the university before the last day of September of the year preceding the year in which the Letter of Intent is sought;

(b) only those applications complying with the requirements and received within the prescribed time limit, shall be accepted and considered by the university;

(c) all such applications received within the aforesaid prescribed time limit, shall be scrutinized by the Board of Deans and be forwarded to the State Government with the approval of the Management Council on or before 30th November of the year in which such application is received by the university. The university shall submit alongwith the application, its recommendation, duly supported by relevant reasons, as are deemed appropriate by the Management Council;

(d) out of the applications recommended by the university, the State Government may grant a Letter of Intent on or before 31st January of the immediately following year after the recommendations of the university under clause (c). The Letter of Intent may be granted to such institutions as the State Government may consider fit and proper in its absolute discretion, taking into account the relevant factors, the suitability of the management seeking Letter of Intent, state level priority with regard to location of institutions of higher learning, etc. The Letter of Intent shall be communicated by the State Government to the university, on or before the date specified in this clause :

Provided, however, that in exceptional cases and for the reasons to be recorded in writing any application not recommended by the university may be approved by the State Government for grant of a Letter of Intent to college or institutions of higher learning;

Procedure  
for  
permission  
for opening  
new college  
or new  
course,  
subject,  
faculty,  
division.

<sup>1</sup>[Provided further that, for the first academic year, immediately after the commencement of this Act with a view to facilitate the Universities to decide the applications for permission for opening of new College the dates referred to in clauses (a), (c) and (d) of sub-section (3) as specified in column (2) of the Table hereto shall be read as provided in column (3) of the said Table:-

*Table*

Clauses (1)	For the date existing provision (2)	Date for the Academic Year 2017-18 (3)
(a)	Last day of September of the Year.	15th December 2017
(b)	Before 30th of November of the Year	Before 15th January 2018
(c)	Before 31st January of the immediately following year.	Before 28th February 2018]

(e) such Letter of Intent granted by the State Government shall be valid up to 31st January of the next following year. The management shall have to comply with the necessary conditions mentioned in the Letter of Intent, within such period and submit compliance report to the university with the present status of the academic and infrastructure facilities and readiness to start the institutions with required documents for final approval;

(f) such compliance report received within aforesaid time-limit, shall be scrutinized by the Board of Deans and be forwarded to the State Government with the approval of the Management Council on or before, 1st day of May in which the compliance report has been received. The recommendation of the Board of Deans and approved by the Management Council shall be duly supported by relevant reasons as are deemed appropriate by Management Council :

Provided that, if the management fails to comply with the conditions of Letter of Intent, within the time limit as specified in clause (e), the Letter of Intent shall be deemed to have been lapsed :

Provided however that, in exceptional cases and reasons to be recorded in writing, the State Government may, on application by the management duly processed by the university, extend from time to time, the validity of Letter of Intent for further period which shall not exceed twelve months in the aggregate;

(g) after considering the report of the university under clause (f), the State Government may grant final approval to such management as it may consider fit and proper in its absolute discretion, taking into account the State Government's budgetary resources, and other relevant factors, the suitability of management seeking permission to open new institution, etc. The final approval under this clause may be granted on or before 15th June, of the year in which such new college or institutions are proposed to be started. Such approval from the State Government shall be communicated to the university. Approvals granted thereafter shall be given effect by the university only in the subsequent academic year:

1. This proviso was inserted by Mah. 27 of 2018, s. 5.



Provided however that, in exceptional cases and for the reasons to be recorded in writing any compliance report on the Letter of Intent, which is not recommended by the university, may be approved by the State Government.

(4) (a) The management seeking permission to start a new course of study, subjects, faculties, additional divisions or satellite centers shall apply in a prescribed format to the Registrar of the University before the last day of the September, of the year preceding the year in which the permission is sought;

(b) only those applications complying with the requirement and received within the prescribed time limit shall be accepted and considered by the university;

(c) all such applications received within the aforesaid prescribed time limit, shall be scrutinized by the Board of Deans and be forwarded to the State Government with the approval of Management Council on or before the 1st day of April of the year, with such recommendation duly supported by relevant reasons as are deemed appropriate by the Management Council;

(d) out of the applications recommended by the university, the State Government may grant permission on or before 15th June of the year to such institutions as it may consider fit and proper in its absolute discretion, taking into account other relevant factors, the budgetary resources of the State Government and other relevant factors, the suitability of the management seeking permission, etc. The permission shall be communicated by the State Government to the university, on or before the date specified in this clause :

Provided however that, in exceptional cases and for the reasons to be recorded in writing any application not recommended by the university may be approved by the State Government.

(5) No application shall be entertained directly by the State Government for grant of Letter of Intent, under sub-section (3) or final approval under sub-section (4), as the case may be.

(6) The application for starting new course of study, subject, faculty or additional division or satellite center by existing colleges or institutions of Higher learning, shall not be forwarded to the State Government by the university, if,-

(a) they have not been accredited or re-accredited either from National Assessment and Accreditation Council or National Board of Accreditation even though they are eligible and due for being accredited or re-accredited as per the norms of accreditation agencies; and

(b) they have not complied with the conditions laid down by the State Government.

(7) Notwithstanding anything contained in this Act or any other law for the time being in force,-

(a) no management shall establish or open a new college or an institution of higher learning in the State, except with the prior permission of the State Government;

(b) no management shall start a new course of study or subjects, faculty, additional division or satellite centers except with the prior permission of the State Government.

*Explanation.-* For the purpose of this sub-section, the expressions “establish or open a new college or an institution of higher learning” and “start a new course of study, subject, faculty, additional division or satellite center” shall include establishing or opening of such college or institution of higher learning, and starting of any such course of study, subject, faculty, additional division, or satellite center, on the basis of no grant-in aid from the State Government.

(8) In case of extraordinary situations which warrant starting of new divisions of particular faculties, the State Government, with reasons to be recorded in writing, shall have the authority to declare and adopt the fast track system of grant of permission to start such new divisions and the norms and procedures related thereto :

Provided that, the procedure for grant of permission in such extraordinary situations shall be completed not later than 31st August of the Academic Year in which such new divisions are to be started :

Provided further that, the applications for starting of new divisions under the fast track system shall be duly processed by the university. On the compliance of necessary conditions, if the University recommends to the Government the proposal for starting such new divisions, then such permission shall be deemed to have been accorded by the State Government if no adverse communication of any nature is issued by the State Government upto 31st August of the Academic Year in which such new divisions are to be started.

(9) The State Government, for the purpose of giving effect to the provisions of sub-section (3) or sub-section (4), as the case may be, may by notification in the *Official Gazette*, lay down the procedure to be followed for the purposes under the said sub-sections.

Procedure  
for  
affiliation.

**110.** (1) On receipt of the permission from the State Government, the Academic Council of the university shall consider grant of first time affiliation to the new college or institution of higher learning or to the new courses of study, subjects, faculties, additional divisions, or satellite centers as the case may be.

(2) The Academic Council shall decide,-

- (a) whether affiliation should be granted or rejected;
- (b) whether affiliation should be granted in whole or part;
- (c) subjects, courses of study, the number of students to be admitted;
- (d) conditions, if any, which may be stipulated while granting or for granting the affiliation to be complied within reasonable time:

Provided that, in case of failure to comply with such conditions within such period, the affiliation granted shall be deemed to have been cancelled and no communication in this regard by the university to the management concerned shall be necessary.

(3) The Pro-Vice-Chancellor shall communicate the decision of Academic Council to the management with a copy to the Director of Higher Education, within one month from the date of communication of sanction by the State Government in respect of opening the new college or institution of higher learning or starting a new course of study, subjects, faculties or additional divisions, or satellite centers and if the application for affiliation is granted, alongwith an intimation regarding,-

(a) the courses of study, subjects, faculties or additional divisions for which affiliation is granted;

(b) the number of students to be admitted;

(c) the conditions, if any, subject to the fulfillment of which the affiliation is granted and time stipulated for compliance of such conditions.

(4) Where the college or institution is eligible and due for accreditation or re-accreditation, as the case may be, and such college fails to comply with the requirements of accreditation or re-accreditation, then no affiliation shall be granted by the university to such college or institution :

Provided that, nothing in this sub-section shall apply in respect of the affiliation for natural growth of the faculty, additional division, course of study, subject or satellite centre.

(5) No student shall be admitted by the college or institution unless the university has granted the affiliation to the college or institution of higher learning or to a new course of study, subject, faculty or additional division.

**111.** (1) The management of an institution actively engaged in conducting research or specialized studies for a period of not less than five years, and seeking recognition shall apply to the Registrar of the university before the last day of September of the year preceding the year from which the recognition is sought, with full information regarding the following matters, namely:-

Procedure  
of  
recognition  
of  
institutions.

(a) the constitution and personnel of the management;

(b) the subjects and courses of study and research Programmes for which recognition is sought;

(c) the accommodation, equipment and the number of students for whom provision has been made;

(d) the permanent, visiting and honorary staff of the institution, recognized for guiding research or recognizable for the purpose by the university; their experience, evidence of research work carried out at the institution, publications, report, monographs, books published by the institution;

(e) the fees levied, or proposed to be levied, and the provisions made for capital expenditure on buildings, equipment and for the continued maintenance and efficient working of the institution.

(2) Only those applications complying with the requirements shall be accepted and considered by the university.

(3) All such applications shall be scrutinized by the Board of Deans. The Board of Deans may call for any further information, which it thinks necessary and shall ask the management to comply with the requirements.

(4) If the Board of Deans decides to consider the application, it shall cause an inspection by a committee of persons having specialized knowledge in the subject or field concerned, for physical verification of all requirements for grant of recognition.

(5) The committee shall visit the institution and submit a report thereof to the Board of Deans, with such recommendations duly supported by relevant reasons as are deemed appropriate.

(6) After considering the report of such inquiry, and making such further inquiry, as it may think necessary, the Board of Deans shall submit to the Vice-Chancellor the proposal to grant or reject the application, in part or in whole, with such recommendations duly supported by relevant reasons as are deemed appropriate and the report of the inquiry committee.

(7) The Vice-Chancellor shall after considering the proposal submitted by the Board of Deans, may, either grant or reject it. The decision of the Vice-Chancellor in this regard shall be final and binding.

(8) The Pro-Vice-Chancellor shall communicate the decision of the Vice-Chancellor to the management with a copy to the Director of Higher Education.

(9) The process laid down in sub-sections (1) to (8) shall be completed within six months.

Procedure  
for  
recognition  
of private  
education  
provider.

**112.** (1) The management of private skills education provider seeking recognition from the university to various degree, diploma, advanced diploma and certificate courses as prescribed by the University as per the National, State level policy regarding skill qualification and education framework and to the experts engaged for conducting such courses shall apply to the Registrar in the prescribed format, with full information on the programmes run by the private skills education provider and other data as sought in the format, before the last day of September of the year preceding the year from which the recognition is sought.

(2) Only those applications complying with the requirements and received within the prescribed time-limit, shall be accepted and considered by the university.

(3) All such applications shall be scrutinized by the Board of Deans. The Board of Deans shall inform the management the discrepancies in the application or documents submitted for seeking recognition, and shall ask the management to comply with the requirements.

(4) The Board of Deans after being satisfied with the authenticity of the private skills education providers shall cause an inspection by the committee of experts in skills education, industry and academia, for the purpose of grant of recognition.

(5) The committee shall visit the institution and submit a report thereof to the Board of Deans, with such recommendations duly supported by relevant reasons as are deemed appropriate.

(6) After considering the report of such inquiry, and making such further inquiry as it may think necessary, the Board of Deans shall submit to the Vice-Chancellor the proposal to grant or reject the application, in part or in whole, with such recommendations duly supported by relevant reasons as are deemed appropriate and the report of the inquiry committee.

(7) The Vice-Chancellor shall after considering the proposal submitted by the Board of Deans, may, either grant or reject it and the decision of the Vice-Chancellor in this regard shall be final and binding.

(8) The Pro-Vice-Chancellor shall communicate the decision of the Vice-Chancellor to the management.

(9) The time schedule for the process laid down in sub-sections (2) to (8) shall be published and completed by the University up to 30th April of the year, in which private skills education provider intends to start various degree, diploma, advance diploma and certificate courses.

(10) The recognition shall be valid for a period of five years. The procedure referred to in sub-sections (1) to (8) shall apply *mutatis-mutandis*, for continuation of such recognition, from time to time.

(11) The recognized private skills education provider shall conduct assessment, declare results and recommend to the University for Award of certificate, diploma, advanced diploma and degree for different programmes.

(12) The management desirous of closing down the institution providing private skills education shall apply to the Registrar on or before the first day of August of the preceding year, stating fully the grounds for closure, and pointing out the assets in the form of buildings and equipment, their original cost, the prevailing market value and the grants so far received by it either from the University Grants Commission, the State Government or from public funding agencies.

(13) On receipt of such an application, the Vice-Chancellor shall cause to make enquiries as it may deem fit, to assess and determine whether the private skills education provider be permitted to effect the closure. The Vice-Chancellor may examine whether the closure should be avoided by transferring it to another management.

(14) If the Vice-Chancellor decides to recommend the closure, the Board of Deans shall prepare and submit to the Management Council, a report on the extent of damages or compensation to be recovered from the management and whether the assets created utilizing the funds provided by the University Grants Commission, the State Government or other public funding agencies, be transferred to other management.

(15) The Vice-Chancellor shall, with prior concurrence of the Management Council, decide whether private skills education provider be permitted the closure.

(16) The procedure to give effect to the closure shall be in phases, so as to ensure that the students already admitted to the private skills education provider are not affected, and that the first year shall be closed first and no new admission shall be effected. The procedure to phase out the closure shall be such as may be prescribed.

Recognition  
to  
empowered  
autonomous  
skills  
development  
colleges.

**113.** (1) The management of the empowered autonomous skills development college applying for recognition shall give and comply with the following undertakings, namely:-

(a) that the provisions of this Act and Statutes, Ordinances and Regulations made thereunder and the standing orders and directions of the university shall be observed;

(b) that there shall be suitable and adequate physical facilities such as buildings, classrooms with modern delivery facilities, skills development laboratories with necessary equipment, if needed, library and knowledge access facilities, information and communication technology connectivity and other facilities as may be prescribed by the university;

(c) that the financial resources of the college shall be such as to make provision for its continued maintenance and working;

(d) that there shall be core academic and technical staff, as prescribed by the university, and the emoluments and the terms and conditions of services of the staff of the college shall be such as prescribed by the university;

(e) that there shall be linkages with the industries or businesses as may be necessary to give professional experiences and also a panel of experts from industries or businesses which shall work as visiting teachers or trainers as demanded by the various programmes of that college which intends to run;

(f) that the services of all teaching staff, visiting teachers or experts, supporting and technical staff and the facilities of the college shall be made available for conducting examinations, evaluation and for promoting other activities of the university;

(g) that there shall be no change or transfer of the management without previous permission of the university;

(h) that the college shall not be closed without permission of the university;

(i) that in the event of disqualification or de-recognition or closure of the college, the college shall continue to function and discharge its duties till last batch of student's registered for various programmes are trained, assessed or evaluated, their results are declared by the university and they are given appropriate certificate of completion of the programme.

(2) The management of college seeking recognition from the university shall apply to the Registrar of the university in the prescribed format, before the last day of September of the year preceding the year from which the recognition is sought, to various degree, diploma, advanced diploma and certificate courses as prescribed by the University as per the National, State level policy regarding skills qualification and education framework providing information on the programmes proposed to be conducted in college, which shall include relevant data on curriculum, delivery process, creation of necessary academic and skills training infrastructure, linkages with appropriate industries or business, faculty and experts with their academic qualifications and domain experience and other supporting information on assessment of students and the financial details of the college seeking recognition.

(3) Only those applications complying with the requirements and received within the prescribed time-limit, shall be accepted and considered by the university.

(4) All such applications shall be scrutinized by the Board of Deans and a report thereof be forwarded to the Vice-Chancellor and the university shall inform the management, of the discrepancies in the application or documents submitted for seeking recognition and shall ask the management to comply with the requirements.

(5) The Board of Deans after being satisfied with the authenticity of the proposal, shall cause an inspection by the committee of experts in skills education, industry and academia for the purpose of grant of recognition.

(6) The committee shall visit the institution and submit a report thereof to the Board of Deans, with such recommendations duly supported by relevant reasons as are deemed appropriate.

(7) After considering the report of such inquiry, and making such further inquiry as it may think necessary, the Board of Deans shall submit to the Vice-Chancellor the proposal to grant or reject the application, in part or in whole, with such recommendations duly supported by relevant reasons as are deemed appropriate and the report of the inquiry committee.

(8) The Vice-Chancellor shall after considering the proposal submitted by the Board of Deans, may, either grant or reject it and the decision of the Vice-Chancellor in this regard shall be final and binding.

(9) The time schedule for the process laid down in sub-sections (2) to (8) shall be published and completed by the University up to 30th April of the year, in which empowered autonomous skills development college intends to start various degree, diploma, advance diploma and certificate courses.

(10) The Pro-Vice-Chancellor shall communicate the decision of the Vice-Chancellor to the management, on or before the 30th April of the year, in which the management desires to seek recognition.

(11) The recognition shall be valid for a period of five years. The procedure referred to in sub-sections (1) to (10) shall apply *mutatis-mutandis*, for continuation of recognition, from time to time.

(12) The recognized empowered autonomous skills development college shall conduct assessment, declare results and recommend to the university award of joint certificate, diploma, advanced diploma and degree for different programmes.

(13) The management desirous of closing down the empowered autonomous skills development college shall apply to the Registrar on or before the first day of August of the preceding year, stating fully the grounds for closure, and specifying the assets in the form of buildings and equipment, their original cost, the prevailing market value and the grants so far received by it either from the University Grants Commission, the State Government or from public funding agencies.

(14) On receipt of such an application, the Vice-Chancellor shall cause to make enquiries as it may deem fit, to assess and determine whether the college be permitted to effect the closure. The Vice-Chancellor may, examine whether the closure should be avoided by making provisions for transferring it to another management.

(15) If the Vice-Chancellor decides to recommend the closure, it shall prepare and submit to the Management Council, a report on the extent of damages or compensation to be recovered from the management and whether the assets created utilizing the funds provided by the University Grants Commission, the State Government or other public funding agencies, be transferred to other management.

(16) The Vice-Chancellor shall, with prior concurrence of the Management Council, decide whether the college be permitted the closure.

(17) The procedure to effect the closure shall be in phases, so as to ensure that the students already admitted to the college are not affected, and that the first year shall be closed first and no new admission shall be effected. The procedure to phase out the closure shall be such as may be prescribed.

Continuation of affiliation or recognition.

**114.** (1) The procedure prescribed in sub-sections (1) to (3) of section 110 shall apply, *mutatis-mutandis*, for the consideration of continuation of affiliation, from time to time.

(2) The procedure prescribed in section 111, for grant of recognition shall apply, *mutatis-mutandis*, for the consideration of continuation of recognition.

Extension of affiliation or recognition.

**115.** The affiliated college or recognized institution may apply for affiliation or recognition for additional courses of study. The university shall follow the procedure as prescribed in sections 108, 109, 110 and 111, so far as may be applicable.

Permanent affiliation and recognition.

**116.** The affiliated college or institution or recognized institution with at least five years standing as an affiliated or recognized institution shall apply for permanent affiliation or recognition. The Board of Deans shall consider and scrutinize the applications and make recommendation to the Academic Council. If the Academic Council is satisfied that the affiliated college or institution or recognized institution has fulfilled all the conditions of affiliation or recognition satisfactorily and has attained high academic and administrative standards as prescribed by the university and concerned regulatory bodies, from time to time, the Academic Council shall grant permanent affiliation or recognition to the college or institution, as the case may be.

Inspection of colleges and recognized institutions and report.

**117.** (1) Every affiliated college and recognized institution shall furnish such reports, returns and other particulars as the university may require for enabling it to judge the academic standards and standards of academic administration of the college or recognized institution.

(2) The Pro-Vice-Chancellor shall cause every university department or institution, affiliated college or recognized institution to be inspected, at least once in every three years, by one or more committees appointed by him in that behalf which shall consist of the following members, namely:-



(a) the Dean of the faculty concerned - Chairperson;

(b) one expert, not connected with the university or with any affiliated college or recognized institution under its jurisdiction, nominated by the Academic Council;

(c) one expert, to be nominated by the Management Council;

(d) one expert, to be nominated by the Senate:

Provided that, no member on such committee shall be connected with the management of college or institution concerned.

(3) The committee shall submit its report to the Pro-Vice-Chancellor for his consideration and for further action as may be necessary.

**118.** (1) The permission for shifting of location of a college or institution of higher learning only within the same district shall be granted.

Shifting  
college  
location.

(2) The Management Council of the university shall consider the points referred to in sub-section (3) before granting permission for shifting of location of a college.

(3) Permission shall be granted by the university after the concurrence of the State Government:

Provided that,-

(a) such shifting of location does not result in disturbing the educational development of the location from where the college is being shifted;

(b) such shifting to a new location is allowed only if such location is within the periphery of five kilometres of the location for opening a new college or institution of higher learning, as indicated in the annual perspective plan; and

(c) the infrastructure and other facilities in the new location are adequate as per the prescribed norms.

(4) If the college is being shifted from one location to another for reason of natural calamity, emergent permission shall be granted by the university and shall in due course of time be approved by the State Government.

**119.** The Management Council of the university shall consider the proposals for transfer of management of colleges and institutions, as prescribed in the Statutes subject to the permission of the State Government.

Transfer of  
management.

**120.** (1) If an affiliated college or recognized institution fails to comply with the conditions of affiliation or recognition as provided in section 108 or to allow the College Development Committee as provided in section 97 to function properly or to take action as per directions issued under the Act, or if it is conducting the college or recognized institution in a manner prejudicial to the interest of the university or the standards laid down by it, the Board of Deans may issue a notice to the management to show cause as to why the privileges conferred on the college or recognized institution by affiliation or recognition should not be withdrawn in part or in whole or modified.

Withdrawal  
of affiliation  
or  
recognition.

(2) The Board of Deans shall mention the grounds on which it proposes to take the action and shall send a copy of the notice to the principal of the college, or head of recognized institution. It shall also specify in the notice, the period, being a period which shall not be less than thirty days within which the management should file its written statement in reply to the notice.

(3) On receipt of such written statement or on expiry of the period specified in the notice issued under sub-section (1), the Board of Deans shall place before the Academic Council, the notice and the written statement, if any, with or without the motion for withdrawal or modification of such privileges.

(4) The Academic Council shall, having regard to the interest of students studying in the colleges or recognized institutions, shall recommend an action in this behalf to the Vice-Chancellor and the Vice-Chancellor shall pass the necessary order.

Closure of affiliated college or recognized institutions.

**121.** (1) No management of an affiliated college or recognized institution shall be allowed to close down the affiliated college or recognized institution without prior permission of the State Government.

(2) The management desirous of closing down the college or recognized institution shall apply to the university on or before the first day of August of the preceding year, stating fully the grounds for closure, and pointing out the assets in the form of buildings and equipment, their original cost, the prevailing market value and the grants so far received by it either from the University Grants Commission, the State Government or from public funding agencies.

(3) On receipt of such an application, the Academic Council shall cause to make inquiries as it may deem fit, to assess and determine whether the affiliated college or recognized institution be permitted to effect the closure. The Academic Council may examine whether the closure should be avoided by transferring it to another management.

(4) If the Academic Council decides to recommend the closure, it shall prepare and submit to the Management Council, a report on the extent of damages or compensation to be recovered from the management for the assets created utilizing the funds provided by the University Grants Commission, the State Government or other public funding agencies.

(5) The Academic Council shall, with prior concurrence of the Management Council and approval of the State Government decide whether the affiliated college or recognized institution be permitted the closure.

(6) The university may transfer the college or a recognized institution to another management with prior approval of the State Government and after following the procedure prescribed in that behalf.

(7) The procedure to effect the closure shall be in phases, to ensure that the students already admitted to the affiliated college or recognized institution are not affected, and that the first year shall be closed first and no new admissions shall be effected. The procedure to phase out the closure shall be such as may be prescribed.

(8) The procedure for closure of affiliated colleges, or recognized institutions, referred to in sub-sections (1) to (7) shall, *mutatis-mutandis* apply in the case of closure of faculties, courses of studies or satellite centres.

**122.** (1) A university department or institution, affiliated college or recognized institution may apply to the university for grant of autonomous status. The Management Council on the recommendation of the Academic Council may confer the autonomous status.

Autonomous university department or institutions, college or recognized institution.

(2) Autonomous university department or institution or affiliated college or recognized institution shall function with the objectives of promoting academic freedom and scholarship on the part of teachers and students which are essential to the fostering and development of an intellectual climate conducive to the pursuit of scholarship and excellence.

(3) The autonomous university department or institution or affiliated college or recognized institution, may constitute its authorities or bodies and exercise the powers and perform the functions and carry out the administrative, academic and other activities of the university, as may be prescribed by the Statutes.

(4) The autonomous university department or institution or affiliated college or recognized institution may prescribe its own courses of study, evolve its own teaching methods and hold examinations and tests for students receiving instruction in it, and recommend the university for award degrees, diplomas or certificates, after following the procedure as prescribed in the Statutes. The autonomous university department or institution or affiliated college or recognized institution shall have full academic and administrative autonomy subject to the provisions of this Act and Statutes and the guidelines issued by the University Grant Commission, from time to time.

**123.** (1) Affiliated autonomous colleges that are identified by University Grants Commission as College with Potential for Excellence or College of Excellence which have a high level grade to be prescribed by the State Government through *Official Gazette* may apply to the university for grant of empowered autonomous status. The Management Council on the recommendation of the Academic Council may confer the empowered autonomous status upon such college.

Empowered autonomous colleges.

(2) Norms and procedure for grant of the empowered autonomous status and continuation thereof, shall be as may be prescribed by the Statutes.

(3) The empowered autonomous college may constitute its authorities or bodies and exercise the powers and perform the functions and carry out the administrative, academic, financial and other activities of the university, as may be prescribed by the Statutes.

(4) The empowered autonomous college shall enjoy all such privileges in addition to the privileges enjoyed by autonomous college as may be prescribed by the statutes and guidelines of State Government and University Grants Commission.

**124.** (1) A group of affiliated autonomous colleges or recognized institutions of the same management or educational society which includes the colleges or institutions, identified by the University Grants Commission as Potential for Excellence or College of Excellence or which have a high level grade to be prescribed by the State Government through *Official Gazette* may apply to the university for grant of status of empowered autonomous cluster institutions. The Management Council on the recommendation of the Academic Council may confer the status of empowered autonomous cluster institutions upon such group of colleges or institutions.

Empowered autonomous cluster institutions.

(2) Norms and procedure for grant status of empowered autonomous cluster institutions and continuation thereof, shall be as may be prescribed by the Statutes.

(3) The empowered autonomous cluster institutions may constitute its authorities or bodies and exercise the powers and perform the functions and carry out the administrative, academic, financial and other activities of the university, as may be prescribed by the Statutes and guidelines of State Government and University Grants Commission.

## CHAPTER XI

### ENROLMENT, DEGREES AND CONVOCATIONS

Post-graduate teaching and research.

**125.** All post-graduate instruction, teaching, training, research, research collaborations and partnerships, shall normally be conducted within the university area by the university, affiliated colleges and the recognized institutions in such manner as may be prescribed.

Enrolment of students.

**126.** A person to be enrolled as student of the university shall possess such qualifications and fulfill such conditions as may be prescribed.

Disciplinary powers and discipline amongst students.

**127.** (1) All powers relating to discipline and disciplinary action in relation to the students of the university departments and institutions and colleges maintained by the university, shall vest in the Vice-Chancellor.

(2) The Vice-Chancellor may, by an order, delegate all or any of his powers under sub-section (1), as he deems fit, to such other officer as he may nominate in that behalf.

(3) The Vice-Chancellor may, in the exercise of his powers, by an order, direct that any student or students be expelled or rusticated for a specified period, or be not admitted to a course or courses of study in conducted college, institution or department of the university for a specified period, or be punished with fine, as prescribed by the university, or be debarred from taking an examination or evaluation conducted by the department, conducted college or institution maintained by the university for a specified period not exceeding five years or that the result of the student or students concerned in the examination or evaluation in which he or they have appeared, be cancelled :

Provided that, the Vice-Chancellor shall give reasonable opportunity of being heard to the student concerned, if expulsion is for a period exceeding one year.

(4) Without prejudice to the powers of the Vice-Chancellor, the principals of conducted colleges, heads of university institutions and the heads of departments of the university shall have authority to exercise all such powers over the student in their respective charge as may be necessary for the maintenance of proper discipline.

(5) Provisions as regards discipline and proper conduct for students of the university and the action to be taken against them for breach of discipline or misconduct, shall be as may be prescribed by the Statutes, which shall apply to the students of all its conducted colleges and university departments or institutions, affiliated colleges and recognized institutions.

(6) Statutes relating to discipline and proper conduct for students, and the action to be taken against them for breach of discipline or misconduct, shall also be published in the prospectus of the university, affiliated college or recognized institution and every student shall be supplied with a copy of the same. The principals of the colleges and heads of the institutions, maintained by the university and affiliated colleges, may, prescribe additional norms of discipline and proper conduct, not inconsistent with the Statutes, as they think necessary and every student shall be supplied with a copy of such norms.

(7) At the time of admission, every student shall sign a declaration to the effect that he submits himself to the disciplinary jurisdiction of the Vice-Chancellor and the other officers and authorities or bodies of the university and the authorities or bodies of the conducted colleges, affiliated colleges and recognized institutions, and shall observe and abide by the Statutes made in that behalf and in so far as they may apply, the additional norms made by the principals of conducted colleges and heads of university institutions and affiliated colleges.

(8) All powers relating to disciplinary action against students of an affiliated college or recognized institution not maintained by the university, shall vest in the principal of the affiliated college or head of the recognized institution, and the provisions of the sub-sections (6) and (7) including the Statutes made thereunder, shall *mutatis-mutandis* apply to such colleges, institutions and students therein.

**128.** (1) The Management Council may institute and confer such degrees, diplomas, certificates and other academic distinctions as may be recommended by the Academic Council.

Degrees,  
diplomas,  
certificates  
& other  
academic  
distinctions.

(2) The Management Council may institute and confer post-doctoral degrees such as D.Sc. and D.Litt. - by Research, as may be recommended by Academic Council.

(3) The Chancellor may, on the recommendation of the Management Council and the Academic Council, supported by a majority of not less than two-third members of each such authority, present at its meeting, such majority comprising not less than one-half of the members of each such authority, withdraw the degree or diploma or certificate or any other academic distinction permanently or for such period as the Chancellor thinks fit, if such a person is convicted by a court of law for any offence involving moral turpitude or has been found to have sought admission to any degree or diploma or certificate course by fraudulent means or has been found to have obtained such degree or diploma or certificate or any other academic distinction by fraudulent means. No such action under this section shall be taken unless the person concerned is given an opportunity to defend himself.

**129.** (1) The Management Council may consider and recommend to the Senate the conferment of an honorary degree or other academic distinction on any person, without requiring him to undergo any test or examination or evaluation, on the ground solely that he, by reason of his eminent position, attainments and public service, is a fit and proper person to receive such degree or other academic distinction, and such recommendation shall be deemed to have been duly passed if supported by a majority of not less than two-thirds of the members present at the meeting of the Senate, being not less than one-half of its total membership:

Honorary  
Degree.

Provided that, the Management Council shall not entertain or consider any proposal in that behalf without the Vice-Chancellor having obtained the previous approval of the Chancellor.

(2) The Management Council may take a decision on the proposal of the Senate:

Provided that, the Senate shall not entertain or consider any proposal in that behalf without the Vice-Chancellor having obtained prior approval of the Chancellor.

Convocation. **130.** The convocation of the university shall be held at least once during an academic year in the manner prescribed by the Statutes for conferring degrees, post-graduate diplomas or for any other purpose.

Registered graduates. **131.** (1) Subject to the provisions of sub-section (2), the following persons shall be entitled to have their names entered in the register of registered graduates or deemed to be registered graduates, maintained by the university, namely:-

(a) who are graduates of the university;

(b) who are graduates of the parent university from which corresponding new university is established :

Provided that, the graduates registered in the parent university as registered graduates but residing in the jurisdiction of the new university will have to apply for registration, as registered graduates, to the new university and once registered with the new university, they will automatically cease to be the registered graduates of the parent university.

(2) A person who -

(a) is of unsound mind and stands so declared by a competent Court; or

(b) is an un-discharged insolvent; or

(c) is convicted for an offence involving moral turpitude; or

(d) has obtained a degree by fraudulent means; or

(e) is a registered graduate of any other university established by law in the State, shall not be qualified to have his name entered in the register of graduates, or be a registered graduate.

(3) Every person who intends to be a registered graduate shall make an application to the Registrar in such form and make payment of such fees as may be prescribed by the Statutes.

(4) The Vice-Chancellor shall, after making such inquiry as he thinks fit, decide whether the person is entitled to be a registered graduate. If any question arises whether a person is entitled to have his name entered in the register of graduates or be a registered graduate or is not qualified to be a registered graduate, it shall be decided by the Vice-Chancellor after making such inquiry as he thinks fit and his decision shall be final.

(5) From amongst the persons registered as registered graduates, an electoral college shall be constituted for election of members of the Senate under clause (t) of sub-section (2) of section 28, and for that purpose, an electoral roll shall be prepared as prescribed by publishing a public notice, requiring the registered graduates desirous of enrolling themselves in such electoral roll to fill in the prescribed form for such enrolment.

**132.** (1) The Vice-Chancellor may, on the recommendation of the Management Council, supported by a majority of not less than two-third of its members present at its meeting, such majority comprising not less than one-half of its members, remove the name of any person from the register of graduates for such period as the Vice-Chancellor thinks fit, for any of the reasons mentioned in sub-section (2) of section 131.

Removal of name from register of graduates.

(2) No action under this section shall be taken unless the person concerned is, as prescribed by the Statutes, given an opportunity of being heard in his defence.

## CHAPTER XII

### UNIVERSITY FUNDS, ACCOUNTS AND AUDIT

**133.** (1) The annual financial estimates (budget) of the university for ensuing financial year shall be prepared by the Finance and Accounts Officer under the direction of the Finance and Accounts Committee, at least two months before the commencement of the financial year.

Annual financial estimates.

(2) The Finance and Accounts Officer shall thereafter forward copies of annual financial estimates (budget) as approved by the Management Council and the Senate to the Chancellor, the Maharashtra State Commission for Higher Education and Development and the State Government.

(3) The Financial year of the university shall be the same as that of the State Government.

**134.** (1) The university shall establish the following funds, namely :-

University funds.

(a) general fund;

(b) salary fund,-

(i) for all posts approved by the State Government;

(ii) for all other posts separately;

(c) trust fund;

(d) development and programme fund;

(e) contingency fund;

(f) any other fund which, in the opinion of the university, is deemed necessary to establish.

(2) The following shall form part of, or be paid into, the general fund :

(a) non-salary contribution or grant, received from the State Government or Central Government or University Grants Commission;

(b) all incomes of the university from any source whatsoever, including income from fees, other fees and charges;

(c) any sums borrowed from the banks or any other agency, with the permission of the State Government;

(d) sums received from any other source or agency.

(3) The salary fund shall consist of all amounts received from the State Government, Central Government or University Grants Commission or any other endowment or contribution received towards full or part payment of the salary and allowances. No amount from this fund shall be utilized for the purpose other than payment of salary and allowances.

(4) All income or moneys from trusts, bequests, donations, endowments, subventions and similar grants shall form part of the trust fund.

(5) (a) The development and programme fund of the university shall consist of all infrastructure development grants received from the State Government, all contributions made by the University Grants Commission for development and research grants received from other funding agencies of the Central Government, United Nations and its affiliates, other international agencies, industry, banks and financial institutions or any person or institution;

(b) no amount from this fund shall be appropriated to any other fund of the university or expended for any other purpose;

(c) the development and programme fund shall be utilized in the manner consistent with the object of the programme and as per guidelines of the funding agency on expenditure and audit, to be granted and approved by the Management Council.

(6) The university shall have and maintain a contingency fund under a separate head of the university accounts which shall be used only for the purpose of meeting any unforeseen expenditure.

(7) Surplus money at the credit of these funds, including accruals thereto, which cannot immediately or at any early date be applied for the purposes aforesaid shall, from time to time, be deposited in the Nationalized or Scheduled Banks or invested in any other Equity or securities issued by the Corporations having financial participation of the State Government.

Annual  
accounts  
and audit.

**135.** (1) The accounts of the University shall be maintained on the basis and principles of double entry accounting system, and the method of accounting to be followed shall be the mercantile system by following the Maharashtra Universities Account Code as prescribed by State Government.

(2) The accounts of the university shall be audited at least once every year and in any case within four months of the close of the financial year by the auditors appointed by the Management Council from amongst the firms of Chartered Accountants whose partners have no interest in any of the authorities or affairs of the university. The university shall comply with the remarks and discrepancies as shown in the audit report in any case within one month of the receipt of such audit report, audited accounts shall be published by the university and a copy thereof, together with the copy of the auditor's report shall be submitted to the Chancellor and the State Government within one year of the close of the financial year.



(3) The audited accounts shall be published by the university and a copy thereof, together with the copy of the auditor's report and compliance report shall be submitted to the Chancellor and the State Government and shall be submitted for approval before the senate in any case within six months from the close of the financial year.

(4) The State Government shall cause the audited annual accounts of the university, received by it, to be laid before each House of the State Legislature.

(5) The State Government shall provide for conduct of the test audit or full audit of the accounts of the university at regular intervals by the auditors appointed by the State Government.

**136.** (1) The Board of Deans shall prepare the Annual Report containing the administrative, academic, research and development and other activities of the university, colleges and institutions under its jurisdiction, for each academic year and submit it to the Management Council for consideration. The Senate shall discuss and approve the Annual Report as received from the Management Council. Such report as approved by the Senate shall be submitted to the Chancellor and the State Government, within one year from the conclusion of the academic year. Annual Report.

(2) The State Government shall cause the Annual Report to be laid before each House of the State Legislature.

#### CHAPTER XIII

#### **SPECIAL PROVISIONS FOR SHREEMATI NATHIBAI DAMODAR THACKERSEY WOMEN'S UNIVERSITY**

**137.** (1) In addition to the other provisions of this Act and Statutes, the provisions set out in this section shall apply to the Shreemati Nathibai Damodar Thackersey Women's University. Special provisions for Shreemati Nathibai Damodar Thackersey Women's university.

(2) The territorial limits, within which the powers conferred upon the university by this Act shall be exercised, shall comprise the entire State :

Provided that, the university may, subject to such conditions and restrictions as it and the State Government may think fit to impose, admit any women's educational institution in any other territory to the privileges of the university, with the approval of the Government concerned.

(3) Any female student from any part of the State of Maharashtra or any other territory may register as a private student of the university or join correspondence course or any other external degree or diploma course of the university.

(4) Any society, association or body in the State seeking affiliation or recognition by the university to the college or institution started or conducted by it exclusively for women students need not seek the permission of any other university in the area of which the college or the institution, as the case may be, is to be or is located. On an application of any such society or association or body, the university may, notwithstanding anything contained in any other law for the time being in force, grant the affiliation, with the previous sanction of the State Government, or the recognition, as the case may be, without seeking permission of any other university in the area of which the college or institution, as the case may be, is to be or is located.

(5) The university may, in the interest of women's education, start or conduct a college or research institution in any territory outside the State of Maharashtra, with the approval of the Government concerned.

(6) No educational institution affiliated to or recognized by the university shall be associated in any way with, or seek admission to any privileges of, any other university established by law, except, with the permission of the university and the State Government.

(7) The Senate of the university shall have the following additional members, namely:-

(a) two representatives of women's educational associations or bodies in the State of Maharashtra, nominated by the Vice-Chancellor;

(b) two representatives of women's educational associations or bodies from outside the State admitted to the privileges of the Shreemati Nathibai Damodar Thackersey Women's University, nominated by the Vice-Chancellor;

(c) one representative of women's educational associations or bodies in other territories, nominated by the Vice-Chancellor.

(8) The university shall have powers to draw up Statutes or Ordinances or Regulations or to undertake other activities, such as running schools, polytechnics, etc.

(9) No member of the Board of Examinations or the Committees of the University shall be appointed as paper setter, examiner, moderator or referee except with the written approval of the Board under exceptional circumstances to be recorded in writing.

#### CHAPTER XIV MISCELLANEOUS

Authorities and officers responsible for damages.

**138.** (1) It shall be the duty of every authority or body and officer of the university to ensure that the interests of the university are duly safeguarded.

(2) If it is found that a damage or loss has been caused to the university by any action on the part of any authority or body or officer of the university, not in conformity with the provisions of this Act, Statutes, Ordinances or Regulations, except when done in good faith, or any failure so as to act in conformity thereof, by willful neglect or default on its or his part, such damage or loss shall be liable to be recovered from the authority or body or the concerned members thereof, jointly or severally, or from the officer concerned, as the case may be, in accordance with the procedure prescribed by the Statutes.

Membership of State Legislature and of Parliament.

**139.** (1) A teacher or a non-teaching employee shall not be disqualified for continuing as such teacher or a non-teaching employee merely on the ground that he has been elected or nominated as a member of the Legislative Assembly or of the Legislative Council of the State or of the Parliament.

(2) A teacher or a non-teaching employee elected or nominated as a member of the Legislative Assembly or of the Legislative Council of the State, or of the Parliament shall be entitled to treat the period of his membership of the Legislative Assembly or of the Legislative Council or of the Parliament as on leave without salary and allowances.

(3) A teacher or a non-teaching employee referred to in sub-section (2) shall also be entitled to count the period of his membership of the Legislative Assembly or of the Legislative Council or of the Parliament for the purposes of pension, seniority and increments.

**140.** If any question arises regarding the interpretation of any provision of this Act, or of any Statutes, Ordinance or Regulation or Rule, or whether a person has been duly elected or appointed or nominated or co-opted as a member or is entitled to be a member of any authority or body of the university, the matter may, be referred, on petition by any person or body directly affected or *suomotu* by the Vice-Chancellor to the Chancellor, who shall after taking such advice as he thinks necessary, decide the question, and his decision shall be final :

Questions regarding interpretation and disputes regarding constitution of university authority or body, etc.

Provided that, such reference shall be made by the Vice-Chancellor upon a requisition signed by not less than one fourth members of the senate.

**141.** All acts and orders done or passed in good faith by the university or any of its officers, authorities or bodies, shall subject to the other provisions of this Act, be final; and accordingly, no suit or other legal proceedings shall be instituted against, or maintained, or damages claimed from the university or its officers, authorities or bodies for anything done or passed, or purporting to have been done or passed in good faith and in pursuance of the provisions of this Act and the Statutes, Ordinances and Regulations.

Protection of Acts and orders.

**142.** Subject to the provisions of this Act and the Statutes, any officer or authority of the university may, by order, delegate his or its powers, except the power to make Statutes, Ordinances and Regulations to any other officer or authority under his or its control, and subject to the condition that the ultimate responsibility for the exercise of the powers so delegated shall continue to vest in the officer or authority delegating them.

Delegation of powers.

**143.** No act or proceeding of the Senate or the Management Council or the Academic Council or any other authority or anybody or committee of the university, including a committee appointed by the Chancellor for the appointment of a Vice-Chancellor, shall be deemed to be invalid at any time merely on the ground that -

Acts and proceedings not invalid merely on ground of defect in constitution, vacancies, irregularity in procedure, etc.

(a) any of the members of any such authority, body or committee are not elected, appointed, nominated or co-opted or for any other reason are not available to take office at the time of the constitution or to attend any meeting thereof or any person is a member in more than one capacity or there is any other defect in the constitution thereof or there are one or more vacancies in the offices of members thereof;

(b) there is any irregularity in the procedure of any such authority, body or committee not affecting the merits of the matter under consideration, and the validity of such act or proceeding shall not be questioned in any court or before any authority or officer merely on any such ground.

## CHAPTER XV

## ESTABLISHMENT OF NEW UNIVERSITIES

Issue of order providing for matters when a new university is constituted.

**144.** When any new university is constituted by a notification in the *Official Gazette* under sub-section (2) of section 3, or a cluster university under sub-section (6) of that section, the State Government may, notwithstanding anything contained in this Act, by one or more orders published in the *Official Gazette*, provide for all or any of the following matters, namely:-

(a) the appointment of the first Vice-Chancellor and other officers of the university and the term for which they shall be appointed;

(b) the constitution of the first Management Council and Academic Council in such manner as it thinks fit and the term for which it shall function;

(c) the continuance or application of such Statutes, Ordinances and Regulations with such modifications as it may specify :

Provided that, the Competent Authority of the new university shall adopt such statutes, ordinances and regulations, either *in toto* or with such modifications as deemed fit, within a period of two years from its establishment.

(d) the exercise of option by the registered graduates of any of the then existing universities to continue to remain registered graduates of the same universities or to get registered with the new university;

(e) the continuance or discontinuance of membership of the Management Council, the Academic Council and other authorities, bodies and committees of the existing universities constituted under this Act;

(f) the filling in the vacancies caused by discontinuance of the members of authorities or bodies or committees of the existing university;

(g) the continuance of affiliation of the colleges or the recognition of the institutions by the new university to which the area is added and discontinuance of the same by the existing university from which the area is carved out;

(h) the transfer of any of the employees of the existing university to the new university and the terms and conditions of service applicable to such employees or termination of the service of the employees of the existing university by giving such terminal benefits as the State Government deems fit :

Provided that, the terms and conditions of service of any employee so transferred shall not be varied to his disadvantage;

(i) transfer of assets, that is to say, the property, movable or immovable, right, interest of whatsoever kind acquired, and the liabilities and obligations incurred, before the issue of any such order; and

(j) such other supplemental, incidental and consequential provisions as the State Government may deem necessary.

CHAPTER XVI  
TRANSITORY PROVISIONS

**145.** Save as otherwise provided by or under this Act, every person holding office either as an officer or the employee, whether teaching or other employee, of any university on the date immediately before the commencement of this Act shall continue to hold office on the same terms and conditions as were applicable to him immediately before such date, and shall exercise such powers and perform such duties as are conferred on them by or under this Act.

Continuance of existing officers and employees of university.

**146.** <sup>1</sup>[(1) Every authority of an existing university shall, as soon as practicable, but not later than 31st May 2018, be reconstituted in accordance with the provisions of this Act. Every such authority shall, be deemed to be reconstituted with effect from such date as the Vice-Chancellor may, from time to time, specify by notification.]

Provisions relating to continuance and constitution of authorities.

(2) Every person holding office as a member of any authority immediately before the commencement of this Act shall, on the date of such commencement, continue to hold the said office and the authority with such members shall exercise the powers and perform the duties conferred on it by or under this Act, until the date on which the authority is deemed to be re-constituted or a period of six months from the date of commencement of this Act expires, whichever is later.

(3) On the date on which any authority is deemed to be re-constituted or on which a period of six month expires, whichever is earlier, every member of an authority of an existing university who is continued in office under this section shall be deemed to have vacated his office.

(4) If on the date of commencement of this Act, any authority or body cannot be constituted in accordance with the provisions of this Act, the Vice-Chancellor may, after approval of the Chancellor take such measures for interim constitution of such authority or body.

(5) The term of such authority or body constituted under sub-section (4) shall be for a period of one year from its constitution or till such authority or body is duly constituted under this Act, whichever is earlier.

(6) For the removal of doubt, it is hereby declared that on expiry of a period of one year of the interim constitution of such authority or body, such authority or body shall cease to function.

Mah.  
XXXV  
of  
1994.

**147.** (1) On and from the date of commencement of this Act, the Maharashtra Universities Act, 1994 shall stand repealed.

Repeal and savings.

(2) Notwithstanding the repeal of the said Act,-

(a) any person holding office immediately before the commencement of this Act as Vice-Chancellor of the university shall, on such commencement, continue to hold the said office till his term of office as Vice-Chancellor of that university would have expired had he continued to be as such unless he ceases to be the Vice-Chancellor by reason of death, resignation or otherwise before the expiry of his term of office as aforesaid and shall exercise all the powers and perform all the duties conferred and imposed on the Vice-Chancellor of the respective university by or under this Act;

<sup>1</sup>. Sub-section (1) was substituted by Mah. 27 of 2018, s. 6.

(b) all colleges which stood affiliated to the university immediately before the commencement of this Act, shall be deemed to be affiliated to that university under this Act till their affiliation is withdrawn by that university under this Act;

(c) all other educational institutions which were entitled to any privileges of the university shall be entitled to similar privileges of that university;

(d) all property, movable or immovable, and all rights, interest of whatsoever kind, powers and privileges of the university shall stand transferred to and shall, without further assurance, vest in, that university and be applied to the objects and purposes for which that university is constituted;

(e) all benefactions accepted or received by the university and held by it immediately before the commencement of this Act, shall be deemed to have been accepted or received or held by that university under this Act, and all the conditions on which such benefactions were accepted or received or held shall be deemed to be valid under this Act, notwithstanding that such conditions may be inconsistent with any of the provisions of this Act;

(f) all debts, liabilities and obligations incurred before the commencement of this Act, and lawfully subsisting against the university, shall be discharged and satisfied by that university;

(g) any will, deed or other document made before the commencement of this Act, which contains any bequest, gift, term or trust in favour of the university shall be deemed to have been made thereunder and for the purposes of this Act in favour of that university;

(h) all references in any enactment or other instruments issued under any enactment to the university before the commencement of this Act, shall be deemed to have been construed under and for the purposes of this Act;

(i) the appointment of examiners validly made under the said Act and subsisting immediately before the commencement of this Act, shall be deemed to have been made under and for the purposes of this Act for the respective university, and such examiners shall continue to hold office and to act until fresh appointments are made under this Act;

(j) the teachers, who were recognized teachers of the university under the said Act immediately before the commencement of this Act, shall be deemed to be recognized teachers of that university under and for the purposes of this Act and shall continue to be such recognized teachers until fresh recognitions are granted under this Act;

(k) the registered graduates, whose names were entered in the register of graduates maintained by the university immediately before the commencement of this Act, shall be deemed to be the registered graduates of that university under and for the purposes of this Act and the register so maintained and the registered graduates whose names are so entered therein, shall continue to be the register maintained by that university, and the registered graduates to be the registered graduates of that university;

(l) all Statutes and Ordinances made under the said Act in respect of the university shall, in so far as they are not inconsistent with the provisions of this Act, continue to be in force and be deemed to have been made under this Act in respect of that university, until they are superseded or modified by the Statutes or Ordinances, as the case may be, made under this Act;

(m) all Regulations made under the said Act in respect of the university shall, in so far as they are not inconsistent with the provisions of this Act, continue to be in force and be deemed to have been made under this Act by the that university, until they are superseded or modified by the Regulations, made under this Act;

(n) a standard code, if any, prescribed under the said Acts shall be deemed to have been prescribed under this Act and shall, save as otherwise provided by or under this Act, continue to remain in force, until it is superseded in accordance with the provisions of this Act;

(o) all notices and orders made or issued by any authority under the said Act or by the State Government shall, in so far as they are not inconsistent with the provisions of this Act, continue to be in force and be deemed to have been made or issued by that authority or by the State Government until they are superseded or modified under this Act;

(p) the Tribunal constituted under the said Act and existing on the date of commencement of this Act shall continue to function as such under this Act and all the disputes or matters or appeals pending before such Tribunal shall be dealt with and disposed of by such Tribunal :

Provided that, no Statutes, Ordinances, Regulations, Notices or orders made or issued under the said Act, repealed by this section and in force immediately before the commencement of this Act, shall be deemed to be inconsistent with the provisions of this Act by reason only that the power to make or issue such Statute, Ordinance, Regulation, Notice or Order under this Act vests in a different authority or body or officer, or that the subject matter thereof is permissible only under a different form of subordinate legislation or instrument to be made, under this Act.

**148.** (1) If any difficulty arises in giving effect to the provisions of this Act, the State Government may, as occasion arises, by Order published in the *Official Gazette*, do anything, not inconsistent with the provisions of this Act, which appears to it to be necessary or expedient for the purpose of removing the difficulty :

Removal of difficulties.

Provided that, no such Order shall be made after the expiry of the period of two years from the date of commencement of this Act.

(2) Every Order made under sub-section (1) shall be laid, as soon as may be, after it is made, before each House of the State Legislature.

**SCHEDULE****PART I**

[See sections 3 (1) and 6 (1)]

Name of the University (1)	University Area (2)
1. The University of Mumbai, Mumbai	Districts of - (1) City of Mumbai (2) Mumbai Suburban (3) Raigad (4) Thane (5) Palghar (6) Ratnagiri (7) Sindhudurg
2. The Savitribai Phule Pune University, Pune	Districts of - (1) Pune (2) Ahmednagar (3) Nashik
3. The Shivaji University, Kolhapur	Districts of - (1) Kolhapur (2) Sangli (3) Satara
4. The Dr. Babasaheb Ambedkar Marathwada University, Aurangabad	Districts of - (1) Aurangabad (2) Jalna (3) Beed (4) Osmanabad
5. The Rashtra Sant Tukdoji Maharaj University, Nagpur	Districts of - (1) Nagpur (2) Bhandara (3) Gondia (4) Wardha
6. The Shreemati Nathibai Damodar Thackersey Women's University, Mumbai	The State of Maharashtra



Name of the University (1)	University Area (2)
7. The Sant Gadge Baba University, Amravati	Districts of - (1) Amravati (2) Akola (3) Buldhana (4) Yavatmal (5) Washim
8. <sup>1</sup> [The Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon]	Districts of - (1) Jalgaon (2) Dhule (3) Nandurbar
9. The Swami Ramananda Teerth Marathwada University, Nanded	Districts of - (1) Nanded (2) Parbhani (3) Latur (4) Hingoli
10. The Solapur University, Solapur	District of Solapur
11. The Gondwana University, Gadchiroli	Districts of - (1) Gadchiroli (2) Chandrapur

## PART II

[See section 3 (2)]

Name of the University (1)	University Area (2)
-------------------------------	------------------------

<sup>1</sup>. These words were substituted for the words "The North Maharashtra University, Jalgaon" by Mah. 48 of 2018, s. 2, w.e.f. 11-8-2018.

GPK.-H 391-3927(Bks.) Cr<sup>4</sup>-10.2018

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अखिल भारतीय  
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(भारत सरकार का एक विधिक संस्थान)

डी. ० नई दिल्ली ताउप एकाडेमन, प्राग १, नई दिल्ली ११००४९  
दूरभाष ४६२९९०८, ४६२०६३७, ४६२०६४३, ४६२०८१५

No.F.27-23/92-AICTE

ALL INDIA COUNCIL FOR  
TECHNICAL EDUCATION

(A STATUTORY BODY OF THE GOVERNMENT OF INDIA)

D-42, N.D.S.E. FARE NEW DELHI 110019  
PHONE: 4629908, 4620637, 4620643, 4620815

July 14, 1993.

To,

The Secretary,  
Higher & Technical Education  
& Employment Department,  
Govt. of Maharashtra,  
Mantralaya Annexe,  
Bombay-400 032.

Sub : Approval to Fr. Conceicao Rodrigues College of Engineering,  
Bandra(W), Bombay, Maharashtra.

Sir,

I am to state that, on consideration of the report of the Expert Committee which assessed the proposal on 22.12.92; the recommendations of the 8th Meeting of the Standing Committee held on 28.3.93; the compliance report from the Management vide their letter dated 5th May, 1993; and the recommendations of the Western Regional Committee at its Meeting held on 26.6.93, the All India Council for Technical Education (AICTE) has accorded approval to Fr. Conceicao Rodrigues College of Engineering, Bandra(W), Bombay to conduct the following degree courses with the intake capacity shown against each:

(i) Production Engineering	60 (Sixty)
(ii) Electronics Engineering	60 (Sixty)
(iii) Computer Engineering	60 (Sixty)
	<hr/>
	180 (One Hundred and Eight only)

The above approval is subject to fulfilment of the following conditions:

- (i) The Management should construct an additional area of 2500 sqm. by June, 1994.
- (ii) The Management should invest an additional sum of Rs.30 lakhs during the next two years on purchase of laboratory equipments and other facilities as per the recommendations of the Western Regional Committee.
- (iii) The Management should appoint the additional staff to ensure that the remaining faculty positions are filled up during the course of the year.

*Nandhugan*  
14/7/93

*W. Watta*  
14.7.93

- (iv) After shifting of the library and the reading room to the new premises, additional books may be provided in consultation with the Western Regional Committee.
- (v) The College should conduct the courses after obtaining the permission of the State Government and affiliation from the University of Bombay.
- (vi) The Management including the Governing Body of the College shall be constituted and the Chairman of the Body appointed as per the guidelines of the AICTE.
- (vii) The Management shall provide additional infrastructural and instructional facilities to run the courses as per AICTE norms and standards under guidelines from the Western Regional Committee.
- (viii) The teaching staff be recruited on an All India basis by open selection and as per procedure, qualifications, experience etc. as prescribed by the AICTE from time to time. State-based selection would be permissible for such posts for which the State Govt. prescribes "State-Based Selection" as a general policy.
- (ix) The admissions shall be made on merit and as per the guidelines issued by the AICTE from time to time.
- (x) The tuition and other fees shall be within the overall criteria prescribed by the AICTE. No capitation fee will be charged from students/guardians of the students in any form for admission.
- (xi) The AICTE scales of pay should be granted to the teaching faculty.
- (xii) The accounts of the College shall be audited by a Chartered Accountant and be open for inspection by the AICTE or anybody authorised by it.
- (xiii) The College or the Management shall not alter the approved intakes under any circumstances without the prior approval of the AICTE.
- (xiv) The College or the Management shall neither close any of the approved courses nor start any new course in the College without the prior approval of the AICTE.
- (xv) The College and the Management shall follow strictly any further conditions as may be laid down by the AICTE from time to time.

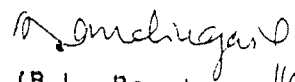
*M. G. Chhajjani*  
14/3/93

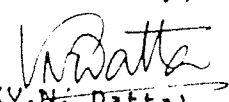
This approval is also subject to full compliance with the SCHEME as prescribed by the Supreme Court in its judgement dated 4.2.1993 on W.P.(C) No.607 of 1992 with other WPs in the case of Unnikrishnan, J.P. and others etc. etc. vs State of Andhra Pradesh and others etc. etc. and the related guidelines and criteria as may be issued by the AICTE, UGC or the Central Government from time to time as applicable to the College.

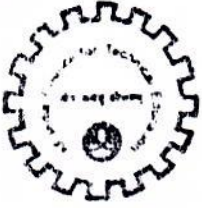
In the event of non-compliance by the College or the Management with regard to the above conditions and, the guidelines & norms laid down by the AICTE from time to time, the AICTE or a body or a person authorised by it will be free to take measures for withdrawal of its approval or recognition, without consideration of any related issues and that all liabilities arising due to such withdrawal of approval would be that of the College and or the Management.

A Committee of the Western Regional Committee (WRC) will visit the College in June, 1994 to assess the further progress made by the College and to make recommendations thereon for consideration of the WRC and the AICTE.

I am to request you to take further necessary action as indicated above and to communicate the progress made in this behalf to the Western Regional Committee (WRC) under intimation to the AICTE.

  
(B.L. Rama) 14/7/93  
Under Secretary (Tech.)

Yours faithfully,  
  
(V.N. Datta)  
Officer on Special Duty  
14.7.93



अखिल भारतीय तकनीकी शिक्षा परिषद्  
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION  
(भारत सरकार का एक सांविधिक संस्थान) (A STATUTORY BODY OF THE GOVERNMENT OF INDIA)

F.No.441/MS-319/E&T(PG)/96

December 30, 1996

The Secretary (Education & Employment)  
Govt. of Maharashtra, Mantralaya Annexure  
BOMBAY - 400 031.

Sub : AICTE APPROVAL FOR CONDUCT OF POST-GRADUATE (PG)  
COURSE(S).

Sir,

I am to state that on consideration of the recommendations made by the AICTE Task-Force constituted to assess the proposals for approval of new or on-going Post-graduate programmes and Expert Committee which visited the institution and subsequent decision by the All India Board of Post Graduate Education in Engineering & Technology, the All India Council for Technical Education (AICTE) has accorded approval to Fr. Conceicao Rodrigues College of Engineering, Bandra(W), Bombay, Maharashtra to conduct the following PG Course(s), from the academic year 1997-98 :

Department	Specialization/ Degree	Annual Intake	Full time/ Part time
Production Engg.	Manufacturing Engg. (M.E.) (Instead of proposed Nomenclature- "Manufacturing Tech.& Management")	10	Part-time

The approval given above is subject to the conditions given below:

- (1) No new PG courses in Engg /Tech /Arch /Planning /F /Management /Applied Arts & Crafts shall be started by Institution without prior approval of the AICTE.
- (2) The intake for the above course shall not be increased or decreased without the prior approval of the AICTE.
- (3) The reservations for SC/ST candidates etc. shall be over and above the intake, if such reservations are provided by the Institution as per State/Central Government's Policy.
- (5) No scholarships / any other financial assistance will be provided by the AICTE / MHRD for conduct of the above programme(s).

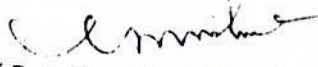


- (6) The following minimum facilities must be created before starting the programme(s) :
- a) Equipment : Minimum additional Rs.10.00 lacs should be spent for purchase of equipment relating to the area of the programme.
  - b) Faculty : One Professor and one Asst. Professor must be recruited for each specialised area of the Post Graduate programme, in addition to the other faculty available.
  - c) Visiting Faculty : A minimum of Rs.20,000/- must be spent for each programme in a year on visiting faculty from reputed institutions and the industries.
  - d) Library Books : At least Rs.10,000/- should be spent for each programme every year for purchase of books and or subscription to reputed journals.
  - e) Computer facilities : There must be at least 10 additional terminals or five PCs for each area of specialisation.
- (7) The course must be redesigned and improved in consultation with the University.
- (8) The admission to the above PG Programme(s) should be made in accordance with the AICTE guidelines given as Annexure-I to this letter.

  
(Dr.N. K. KOLE)  
Dy. Director

Copy to:-

- (1) The Principal, Fr. Conceicao Rodrigues College of Engineering, Fr. Agnel Ashram, Bandra(W), Bombay- 400 050, Maharashtra
- (2) The Registrar, University of Bombay, University Road, Fort, Bombay- 400 032.
- (3) The Regional Officer, AICTE, 2nd Floor, Industrial Assurance Building, Nariman Road, Bombay - 400 032.
- (4) Guard file (AICTE).

  
(Dr.N. K. KOLE)  
Deputy Director

GUIDELINES FOR ADMISSION TO PART-TIME PG  
DEGREE PROGRAMMES.

(Ref: 10th Meeting of the EC of the AICTE held on  
24.05.95)

The following guidelines are laid down for admission to part-time PG degree courses in various disciplines of Engineering/ Technology/ Pharmacy/ Architecture/ Planning etc.:

- (i) The candidates who possess Bachelor's degree in Engineering / Technology / Pharmacy / Architecture / Planning / (or equivalent) from AICTE approved institutions with at least 55% marks in aggregate will be eligible for admission.

The minimum percentage of marks may be waived for those who are teachers either in Engineering Colleges or Polytechnics joined before 28.2.1989, the date on which the circular was issued prescribing the AICTE pay scales and qualifications.

Preference should be given to those candidates who are GATE qualified.

- (ii) The candidates must have a minimum two years' of full-time work experience in a registered firm/company/ industry/ educational and research institutions/ any Government Departments or Government Autonomous Organisations in the relevant field in which admission is being sought.
- (iii) There will not be any age restriction. However, preference should be given to those who are below 45 years of age.
- (iv) The mode of selection shall be such that merit is the sole criterion. No capitation fee or donation will be charged for admission.
- (v) The fee structure should be as decided by the concerned institutions.

(Signature)  
(N. K. Kole.)

Received on  
5-8-04  
R

13



अखिल भारतीय तकनीकी शिक्षा परिषद्  
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION  
(भारत सरकार का एक सांविधिक निकाय) (A STATUTORY BODY OF THE GOVT. OF INDIA)

PROF. K. SUBRAMANIAN,  
ADVISER (PGE&R)

ECE-0063  
F.No.: PG/MS/M.E./2004/ECE-0063  
Date : 22.07.2004

The Secretary,  
Higher Technical Education & Employment Dept.  
Govt. of Maharashtra,  
Mantralaya, Mumbai - 400 032  
Maharashtra

Sub: AICTE approval to FR. CONCEICAO PRODRIGUES COLLEGE OF ENGINEERING FR. AGNEL ASHRAM, BAND STAND, BANDRA(W), MUMBAI 400 050 for the conduct of P.G. Course.

Sir,

I am directed to state that based on the recommendation of the Expert Committee, the Evaluation Committee constituted by the Council, Regional Committee and the subsequent decision by EC Sub-Committee, All India Council for Technical Education (AICTE) is pleased to accord approval to FR. CONCEICAO PRODRIGUES COLLEGE OF ENGINEERING FR. AGNEL ASHRAM, BAND STAND, BANDRA(W), MUMBAI 400 050 for the academic year 2004-05, for the PG Course(s) as per intake given below:

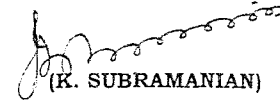
COURSE(S)	APPROVED INTAKE				LEVEL	DURATION (YEARS)	PERIOD OF APPROVAL
	General Category	Sponsored	SC/ST	TOTAL			
ELECTRONICS	10	05	03	18	M.E.	2 Years	2004-06

The approval has been accorded subject to fulfillment of general conditions as per norms and standards prescribed by AICTE and also specific conditions (if any, given).

The council may inspect/visit the institution any time it may deem fit to assess if the Norms & Standards as stipulated by AICTE are fulfilled and/or to verify the progress/compliance.

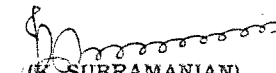
The admission will be made in accordance with the AICTE guidelines given as Annexure - I to this letter.

In the event of infringement/contravention or non-compliance of the norms and standards as prescribed by the AICTE, the Council shall take further action to withdraw approval and the liability arising out of such withdrawal of approval will be solely that of Management/Trust/Society and/or Institution.

  
(K. SUBRAMANIAN)

Copy to :-

1. The Director/Principal,  
FR. CONCEICAO PRODRIGUES COLLEGE OF ENGINEERING  
FR. AGNEL ASHRAM,  
BAND STAND,  
BANDRA(W), MUMBAI  
-400 050
2. The Regional Officer, WRO, AICTE, Industrial Assurance Building, 2nd Floor, Nariman Road,  
Mumbai - 400 020
3. Guard File (AICTE)
4. Office Copy

  
(K. SUBRAMANIAN)  
Adviser (PGE&R)



Received on  
9-8-04  
R

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अखिल भारतीय तकनीकी शिक्षा परिषद्  
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION  
(भारत सरकार का एक सांविधिक निकाय) (A STATUTORY BODY OF THE GOVT. OF INDIA)

PROF. K. SUBRAMANIAN,  
ADVISER (PGE&R)

MECH-023  
F.No.: PG/MS/M.E./2004/MECH-23  
Date : 22.07.2004

The Secretary,  
Higher Technical Education & Employment Dept.  
Govt. of Maharashtra,  
Mantralaya, Mumbai - 400 032  
Maharashtra

Sub: AICTE approval to FR. CONCEICAO PRODRIGUES COLLEGE OF ENGINEERING FR. AGNEL ASHRAM, BAND STAND, BANDRA(W), MUMBAI 400 050 for the conduct of P.G. Course.

Sir,

I am directed to state that based on the recommendation of the Expert Committee, the Evaluation Committee constituted by the Council, Regional Committee and the subsequent decision by EC Sub-Committee, All India Council for Technical Education (AICTE) is pleased to accord approval to **FR. CONCEICAO PRODRIGUES COLLEGE OF ENGINEERING FR. AGNEL ASHRAM, BAND STAND, BANDRA(W), MUMBAI 400 050** for the academic year 2004-05, for the PG Course(s) as per intake given below:


COURSE(S)	APPROVED INTAKE				LEVEL	DURATION (YEARS)	PERIOD OF APPROVAL
	General Category	Sponsored	SC/ST	TOTAL			
CAD/CAM	10	05	03	18	M.E.	2 Years	2004-06

The approval has been accorded subject to fulfillment of general conditions as per norms and standards prescribed by AICTE and also specific conditions (if any, given).

The council may inspect/visit the institution any time it may deem fit to assess if the Norms & Standards as stipulated by AICTE are fulfilled and/or to verify the progress/compliance.

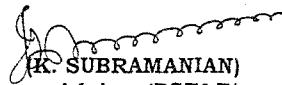
The admission will be made in accordance with the AICTE guidelines given as Annexure - I to this letter.

In the event of infringement/contravention or non-compliance of the norms and standards as prescribed by the AICTE, the Council shall take further action to withdraw approval and the liability arising out of such withdrawal of approval will be solely that of Management/Trust/Society and/or Institution.

  
(K. SUBRAMANIAN)

Copy to :-

1. The Director/Principal,  
FR. CONCEICAO PRODRIGUES COLLEGE OF ENGINEERING  
FR. AGNEL ASHRAM,  
BAND STAND,  
BANDRA(W), MUMBAI  
-400 050
2. The Regional Officer, WRO, AICTE, Industrial Assurance Building, 2nd Floor, Nariman Road,  
Mumbai - 400 020
3. Guard File (AICTE)
4. Office Copy

  
(K. SUBRAMANIAN)  
Adviser (PGE&R)



अखिल भारतीय तकनीकी शिक्षा परिषद्  
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION  
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(Prof. M.K. Venkatesha)  
Adviser (UG/PG)

F.No.: PG/MS/M.E/2004/ECE-0063

M.TECH-023

Date : 23.02.2005

TO,  
The Secretary  
Higher Technical Education,  
Education Dept. Govt. of Maharashtra,  
Mantralay, Mumbai - 400 032  
Maharashtra

**REVALIDATION**

Sub: Revalidation of AICTE approval to **FR. CONCEICAO RODRIGUES COLLEGE ENGINEERING FR. AGNEL ASHRAM BANDRA, MUMBAI - 400 050.** for the conduct of P.G Course.

Sir,

In continuation of our earlier letter of even no. dated 22.07.2004, I am directed to state that All India Council for Technical Education (AICTE) is pleased to accord revalidation of approval of PG course to **FR. CONCEICAO RODRIGUES COLLEGE ENGINEERING FR. AGNEL ASHRAM BANDRA, MUMBAI - 400 050** for the academic year 2005-06, for the PG Course(s) as per intake given below:

COURSE(S)	APPROVED INTAKE				LEVEL	DURATION (YEARS)	PERIOD OF APPROVAL
	General Category	Sponsored	SC/ST	TOTAL			
Electronics	10	05	03	18	ME	2 Years	2005-06
CAD/CAM	10	05	03	18	ME	2 Years	2005-06

The approval has been accorded subject to fulfillment of general conditions as per norms and standards prescribed by AICTE and also specific conditions (if any, given).

**The Council may inspect/visit the institution any time it may deem fit to assess if the Norms & Standards as stipulated by AICTE are fulfilled and/or to verify the progress/compliance.**

The admission will be made in accordance with the AICTE guidelines given as Annexure - I to this letter.

In the event of infringement/contravention or non-compliance of the norms and standards as prescribed by the AICTE, the Council shall take further action to withdraw approval and the liability arising out of such withdrawal of approval will be solely that of Management/Trust/Society and/or Institution.

Thanking you,

Yours faithfully

M K COO Venkatesha  
23.02  
(Prof. M.K. Venkatesha)  
Adviser UG/PG

Copy to :-

1. The Director/Principal,  
FR. Conceicao Rodrigues  
College of Engineering  
FR. Agnel Ashram, Bandra  
Mumbai - 400 050.
2. The Registrar,  
University of Mumbai  
Fort , Mumbai - 400 001.
3. The Regional Officer,  
WRO, AICTE, Industrial Assurance  
Building 2nd Floor, Nariman Road  
Mumbai - 400 050.
4. Guard File (AICTE)
5. Office Copy

M K COO Venkatesha  
23.02  
(Prof. M.K. Venkatesha)



अखिल भारतीय तकनीकी शिक्षा परिषद्  
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION  
(भारत सरकार का एक संवैधानिक संस्थान) (A STATUTORY BODY OF THE GOVERNMENT OF INDIA)

*(Handwritten initials)*

PROF. B.G. SARGAMESHWARA  
ADVISED (E&T)

No. F. 740-29-2131E/PC/95

Aug. 28, 1998

The Secretary,  
Higher & Technical Education & Employment Department,  
Govt. of Maharashtra, Mantralaya,  
Mumbai - 400 032.

Sub.: Extension of AICTE approval to the existing FR. CONCEICAO RODRIGUES COL OF ENGG. FATHER ANGEL ASHRAM BUS STAND, BANDRA(W) BOMBAY-56.  
for conducting degree courses.

Sir,

I am directed to state that on consideration of the observations made by the Monitoring Committee and the recommendations made by the Western Regional Committee, the All India Council for Technical Education (AICTE), has extended its earlier approval accorded to FR. CONCEICAO RODRIGUES COL OF ENGG. FATHER ANGEL ASHRAM BUS STAND, BANDRA(W) BOMBAY-56. upto 1998-1999 for conduct of following courses with an annual intake as given below :

COURSE(S)	LEVEL	INTAKE
COMPUTER ENGINEERING	DEGG	60
ELECTRONICS ENGINEERING	DEGG	60
PRODUCTION ENGINEERING	DEGG	60
TOTAL		180

The approval is subject to fulfilment of Norms & Standards and guidelines as stipulated by AICTE. The Council shall inspect the institution for verification of facilities/compliances of conditions stipulated in this letter during November/December of the last approved academic year.

The Management/Institute/Trust or Society shall not announce admissions directly under any circumstances and shall lawfully abide by the Admission Regulations notified by the AICTE vide GSR 476(E) dated 20.05.1994 based on the Hon'ble Supreme Court Judgement dated 04.02.1993 with regard to WP (C) No. 607 of 1992 in the case of Unai Krishnan JP and others etc. V/s. State Government of Andhra Pradesh and others etc. and later judgements.

In the event of infringement/contravention or non-compliance of any of the conditions, guidelines, norms, and regulations prescribed by the AICTE from time to time the AICTE or a body or person(s) authorised by it shall be free to take measures for withdrawal of the approval or recognition without consideration of any related issues and that liabilities arising out of such withdrawal would be solely that of the Management/Trust/Society and/or Institutions. AICTE may inspect the institution at any time it may deem fit to note progress.

You are requested to kindly take appropriate action to implement the decision of the AICTE and communicate the progress made in this regard to the Western Regional Committee of the AICTE under intimation to this office.

Yours faithfully

*(Handwritten signature)*  
B.G. Sargameshwara



No.F.740-89-213(E)/RC/95

Copy to :

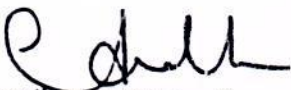
1. THE REGIONAL OFFICER, ALL INDIA COUNCIL FOR TECHNICAL EDUCATION, WESTERN REGIONAL OFFICE, 2ND FLOOR, INDUSTRIAL ASSURANCE BUILDING, VIR NARIMAN ROAD, OPPOSITE CHURCH GATE STATION, MUMBAI - 400 020.

He is requested to monitor compliance with conditions as laid down in this approval letter and keep the Western Regional Committee and the AICTE informed of the same.

2. THE DIRECTOR OF TECHNICAL EDUCATION, GOVT. OF MAHARASHTRA, 3. MAHAPALIKA MARG, MUMBAI - 400 001.

He is requested to monitor compliance with the conditions as laid down in this approval letter and keep the WRC and the AICTE informed of the same.

3. THE PRINCIPAL, FR. CONCEICAO RODRIGUES COL OF ENGG, FATHER ANGEL ASHRAM BUS STAND, BANDRA(W) BOMBAY-50, ,
4. THE REGISTRAR, BOMBAY UNIVERSITY.
5. Gaurd File.

  
(Aradhana Chopra)  
Asstt. Director





अखिल भारतीय तकनीकी शिक्षा परिषद्  
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION  
(An Autonomous Body of the Govt. of India by Parliament Act (52), 1987)

Tel.(011) 3379010-13  
3379015-18  
Telefax : 011-3379023

प्रो. बी. जी. संगमेश्वर  
Prof. B. G. Sangameshwara  
सलाहकार  
Advisor

*File*

F.No.740-89-213(E)/RC/95

June 28, 1999

To  
The Principal Secretary,  
Higher & Technical Education  
and Employment Department  
Govt. of Maharashtra  
Mantralaya Annexev,  
Mumbai - 400 032..

Sub.:Extension of AICTE approval to FR. CONCEICAO RODRIGUES COL OF ENGG FATHER ANGEL ASHRAM BUS STAND, BANDRA(W) BOMBAY-50 for conduct of Degree course(s) in Engineering & Technology for the academic year(s) 1999-2002.

Sir,

I am directed to state that on consideration of the reports of the Expert Committee and in consultations with the concerned agencies in this regard, the All India Council for Technical Education (AICTE), is pleased to accord approval to FR. CONCEICAO RODRIGUES COL OF ENGG FATHER ANGEL ASHRAM BUS STAND, BANDRA(W) BOMBAY-50, only for the course(s) and intake capacity as given below :

Course(s)	Existing Intake	New Approved/ Revised Intake	Duration (years)
COMPUTER ENGINEERING	60	60	4
ELECTRONICS ENGINEERING	60	60	4
PRODUCTION ENGINEERING	60	60	4
TOTAL	180	180	

This approval has been accorded subject to fulfillment of norms & standards of the Council and specific conditions as per Annexure I.

- 1/ -



अखिल भारतीय तकनीकी शिक्षा परिषद्, नई दिल्ली  
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION, New Delhi

Continuation Sheet .....

F.No.740-89-213(E)/RC/95

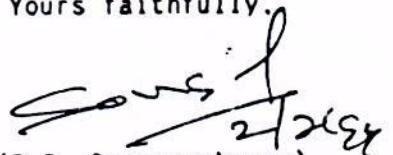
The admission will be made in accordance with Regulations notified by the AICTE vide GSR 476(E) dated 20.05.1994 based on the Hon'ble Supreme Court judgement dated 04.02.1993 with regard to WP(C) No. 607 of 1992 in the case of Unnikrishnan JP and other etc. V/s. State Government of Andhra Pradesh and others etc. and later judgements. No Management/Institute/Trust or Society shall announce admissions directly under any circumstances. Any action contrary to this provision taken by the institute will make it liable to be derecognised.

Further, in the event of infringement/contravention or non-compliance of the norms & standards prescribed by the AICTE during the last approved academic year, the Council shall take further action to withdraw approval to this case for admission during subsequent academic year and the liability arising out of such withdrawal of approval will be solely that of Management/Trust/Society and/or Institutions.

The Council reserves the right to visit the institution any time it may deem fit to note the progress.

You are requested to kindly monitor the progress made by this institution for fulfillment of the Norms & Standards of the Council & keep the concerned Regional Committee and AICTE informed.

Yours faithfully,

  
(B.G. Sangameshwar)

COPY TO :

1. Regional Officer, Western Regional Office. All India Council for Technical Education, Industrial Assurance Building, 2nd Floor, Nariman Road, Mumbai - 400 020.

He is requested to closely monitor the compliance of norms & standards stipulated by the Council and keep the concerned Regional Committee and the AICTE informed of the same.

The infrastructural and other facilities shall be reviewed during the last approved academic year and recommendations of the concerned Regional Committee be made available to the AICTE.


2. The Director of Technical Education, Govt. of Maharashtra, 3, Mahapalika Marg, Mumbai - 400 020.

3. DIRECTOR/PRINCIPAL, FR. CONCEICAO RODRIGUES COL OF ENGG FATHER ANGEL ASHRAM BUS STAND, BANDRA(W) BOMBAY-50 MAHARASHTRA.

4. The Registrar, BOMBAY UNIVERSITY

He is requested to complete the process of affiliation for facilitating admissions in the course(s) and intake approved by the Council.

5. Guard File.

  
(Aradhana Chopra)  
Asstt. Director (E&T)



## ANNEXURE - I

NAME OF THE INSTITUTION :

LEVEL : DEGREE ENGG.

**FR. CONCEICAO RODRIQUES,  
COLLEGE OF ENGG.,  
FR. AGNEL ASHRAM, BAND STAND,  
BANDRA(W), MUMBAI - 400050.**

**FACULTY :**

The Institution should possess all faculty members as per AICTE norms such as in the required numbers/ratio, & strictly as per the essentiality of qualification & experience etc.

The total faculty ratio with respect to various levels of faculty such as H.O.D/ Sr.Lecturers / Lecturers should be as per the minimum norms of the AICTE & any inadequacies should be made up immediately in all the course(s)/disciplines & confirmed.

**LIBRARY :**

The Institution should provide all important National and International Technical Journals Magazines and periodicals as per AICTE norms. Any shortage shall be immediately overcome by additional subscription and investment.

**FINANCIAL STANDING :**

The Institution should incur adequate expenditure on per student training cost as per AICTE norms.

The Institution shall incur appropriate expenditure as per AICTE's Norms, on all major recurring items such as on salary, remuneration of Faculty / Staff, consumable, any surplus accrued out of the Revenue / Income of the Institution shall not be diverted for any other purposes other than what permissible.





अखिल भारतीय तकनीकी शिक्षा परिषद्  
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION  
(भारत सरकार का एक सांविधिक संस्थान) (A STATUTORY BODY OF THE GOVERNMENT OF INDIA)

F.No 740-89-213(E)/RC/95  
Date: June 18, 2001

To

Secretary,  
Higher & Technical Education & Employment Department  
Govt. of Maharashtra  
Mantralaya, Mumbai - 400 032

Subject: Extension of Approval FR. CONCEICAO RODRIGUES COLLEGE OF ENGG, FATHER ANGEL ASHRAM, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050, . . . for conduct of Degree (Engg.) programmes.

Sir,

I am directed to state that on consideration of the reports of the Expert Committee and on consultations with the concerned agencies in this regard, the All India Council for Technical Education (AICTE), is pleased to accord extension of approval to FR. CONCEICAO RODRIGUES COLLEGE OF ENGG, FATHER ANGEL ASHRAM, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050, . . . only for the course(s) and intake capacity as given below with the specific conditions that admission shall be made through the Central Counseling by the Govt. of Maharashtra only:

COURSE(S)	PREVIOUS APPROVED INTAKE	REVISED APPROVED INTAKE	PERIOD OF APPROVAL
COMPUTER ENGINEERING	120	120	2001-2002
ELECTRONICS ENGINEERING	60	60	2001-2002
INFORMATION TECHNOLOGY	30	30	2001-2002
PRODUCTION ENGINEERING	60	60	2001-2002
TOTAL	270	270	

This approval has been accorded subject to fulfillment of norms & standards of the Council for the course(s) and intake approved above

Further the observations and specific conditions (if any) of the expert committee are annexed with this letter. The institution shall fulfill all the conditions without any delay. Non-fulfillment of the specific conditions will lead to withdrawal of approval without need of any more opportunity, as the institution is well aware of the deficiencies.

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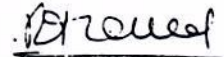
740-89-213(E)/RC/95

Further . in the event of infringement/contravention or non-compliance of the norms & standards prescribed by the AICTE during the last approved academic year, the Council shall take further action to withdraw approval to this case for admission during subsequent academic year and the liability arising out of such withdrawal of approval will be solely that of Management / Trust /Society and/or institutions .

The Council reserves the right to visit the Institution any time it may deem fit to verify the compliance of norms and standards of AICTE.

You are requested to kindly monitor the progress made by this institution for fulfillment of the norms & standards of the Council & keep the concerned Regional Committee and AICTE informed.

Yours faithfully

  
(Prof. R.S. Gaud)  
Adviser (E&T)

copy to:

1. The Regional Officer, WRO, AICTE, 2nd Floor, Industrial Assurance Building, Opp : Churchgate Railway Station, Veer Nariman Road, Mumbai- 400 020, Maharashtra

He is requested to monitor compliance with the norms & standards and conditions stipulated by the Council and keep the concerned Regional Committee and the AICTE informed of the same

He is also requested to ensure the receipt of notarised undertaking as specified by the Council from the institution / management concerned within the stipulate time frame.

2. The Director of Technical Education, Govt. of Maharashtra, Mumbai - 400 001
3. The Registrar, BOMBAY UNIVERSITY

He is requested to complete the process of affiliation for facilitating admissions.

4. The Principal, FR. CONCEICAO RODRIGUES COLLEGE OF ENGG FATHER ANGEL ASHRAM, P.B. NO.: 6656, BUS STAND BANDRA(W), BOMBAY - 400 050
5. Guard File.



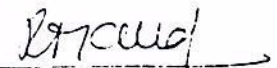


740-89-213(E)/RC/95

NAME OF INSTITUTE	COURSE/PROGRAMME
FR. CONCEICAO RODRIGUES COLLEGE OF ENGG FATHER ANGEL ASHRAM, P.B. NO.: 6656, BUS STAND BANDRA(W), BOMBAY - 400 050	DEGREE IN ENGINEERING AND TECHNOLOGY

SPECIFIC CONDITIONS TO BE COMPLIED WITHIN THREE MONTHS:

- THE INSTITUTION SHOULD POSSESS LAND AS PER AICTE NORMS EXCLUSIVELY FOR ENGINEERING COLLEGE (DEG).
- THE TOTAL TEACHING FACULTY WITH RESPECT TO VARIOUS LEVELS OF FACULTY SUCH AS PRINCIPAL/H.O.D./PROFESSORS/A.P./LECTURERS SHOULD BE AS PER AICTE NORMS.
- COMPUTING FACILITIES SHOULD BE STRENGTHENED AND LEGAL SOFTWARE BE PURCHASED.
- INSTRUCTIONAL AREA INADEQUATE, *to be improved*



ADVISER(E&T)





अखिल भारतीय तकनीकी शिक्षा परिषद्  
**ALL INDIA COUNCIL FOR TECHNICAL EDUCATION**  
(भारत सरकार का एक सांविधिक संस्थान) (A STATUTORY BODY OF THE GOVERNMENT OF INDIA)

20.  
F.No: 740-89-213(E)/RC/95  
Date: 14-06-2002

To

Secretary,  
Higher & Technical Education & Employment Department,  
Govt. of Maharashtra,  
Mantralaya, Mumbai - 400 032

**Subject:** Increase in Intake/ Additional Course/ Extension of Approval, to FR. CONCEICAO RODRIGUES COLLEGE OF ENGG. FATHER ANGEL ASHRAM, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050, , , for conduct of **DEGREE(ENGG)** programmes.

Sir,

I am directed to state that the All India Council for Technical Education (AICTE), is pleased to accord extension of approval to FR. CONCEICAO RODRIGUES COLLEGE OF ENGG. FATHER ANGEL ASHRAM, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050. . . . for the course(s) and intake capacity as given below with the specific conditions that admission shall be made through the Central Counseling by the Govt. of **Maharashtra** only:

COURSE (S)	PREVIOUS APPROVED INTAKE	REVISED APPROVED INTAKE	PERIOD OF APPROVAL
PRODUCTION ENGINEERING	60	60	2002-05
ELECTRONICS ENGINEERING	60	60	2002-05
COMPUTER ENGINEERING	120	120	2002-05
INFORMATION TECHNOLOGY	30	30	2002-05
<b>TOTAL</b>	<b>270.</b>	<b>270.</b>	

This approval has been accorded subject to fulfillment of specific conditions, which will be communicated separately and Norms, Standards & General Conditions as stipulated by Council in Annexure-I.

Further, in the event of infringement/contravention or non-compliance of the norms & standards prescribed by the AICTE during the last approved academic year, the Council shall take further action to withdraw approval to this case for admission during subsequent academic year and the liability arising out of such withdrawal of approval will be solely that of Management / Trust / Society and/or institutions.

Contd...2/-

*RA*

*Amn*



20.

F.No:740-89-213(E)/RC/95

The Council reserves the right to visit the Institution any time it may deem fit to verify the compliance of norms and standards of AICTE.

You are requested to kindly monitor the progress made by this institution for fulfillment of the norms & standards of the Council & keep the concerned Regional Committee and AICTE informed.

Yours faithfully

(P.N.RAZDAN)  
Adviser (UG)

copy to:

1. The Regional officer. W.R.O., AICTE, 2<sup>nd</sup> Floor, Industrial Assurance Bldg., Opp. Churchgate Railway Station, Veer Nariman Road. Mumbai - 400 020, Maharashtra.

He is requested to monitor compliance with the norms & standards and conditions stipulated by the Council and keep the concerned Regional Committee and the AICTE informed of the same.

He is also requested to ensure the receipt of notorised undertaking as specified by the Council from the institution / management concerned within the stipulate time frame.

2. Director of Technical Education. Govt. of Maharashtra.

3. The Registrar. BOMBAY UNIVERSITY.

He is requested to complete the process of affiliation for facilitating admissions.

- ✓ The Principal.  
**FR. CONCEICAO RODRIGUES COLLEGE OF ENGG,**  
**FATHER ANGEL ASHRAM,**  
**P.B. NO.: 6656, BUS STAND,**  
**BANDRA(W), BOMBAY - 400 050,**  
**MAHARASHTRA,**

5. Guard File.

  
(P.N.RAZDAN)  
Adviser (UG)

(Notarized Undertaking to be submitted duly signed on a non-judicial stamp paper)

I/We hereby undertake on behalf of the ..... (Name of Trust/ Society) to follow and fulfill the following of ..... (Name of the Institution) vide AICTE letter No. .... dated ..... We hereby bind, ourself not violate in this context including based on orders of the State Govt. or the affiliating University. :

1. The admissions shall be made only after required teachers are recruited and adequate infrastructure and all other facilities are created as per norms and guidelines of the AICTE/Govt. of India/ State Govt. and obtaining the affiliation from the concerned University in case of degree programs. The Institute shall fulfill all specific conditions(if any) as laid down in this letter and revised by the AICTE from time to time. We are aware that following all the norms of AICTE as amended from time to time will be our responsibility.
2. The admission to the approved program shall be made only once in a year for approved intake capacity only and no increase in intake over and above the intake mentioned in this letter shall be made.
3. The approved course shall commence as per the academic calendar of the affiliating university or in the month of July - August of each academic year.
4. The curriculum of the course, the procedure for evaluation/ assessment of students shall be in accordance with the norms prescribed by the AICTE/ affiliating agency.
5. The faculty strength and quality shall be maintained by the institute as per qualifications and pay scale prescribed by AICTE from time to time. The selection of faculty shall be made by a selection committee having representation from the State Govt./University and AICTE.
6. The tuition fee and other charges shall be charged as prescribed by the competent authority (i.e. State Level Committee constituted by AICTE as stipulated in GSR 476(E)). The institutions will furnish a declaration giving the actual fees collected from the students. We are aware that collecting the fees over and above the fixed by Competent Authority will be a violation leading to withdrawal of approval by AICTE.
7. All academic and physical infrastructural facilities shall be continued to be provided/ updated by the institution with the state of art. latest equipments.
8. No new course(s) shall be started in the same premises and no increase shall be made in the intake of other existing courses without prior concurrence of the AICTE.
9. The Governing body and Advisory body of the institute shall be constituted as per Guidelines prescribed by the AICTE from time to time.
10. The location and name of institution shall not be changed after the date of issue of first approval letter. The name and title of the institution shall not violate "The Emblems and Names (Prevention of improper use) act 12 (1950) of Government of India.
11. No change in the composition of society/ trust shall be permitted without AICTE's prior concurrence.
12. The institution shall furnish requisite documents and reports as desired by AICTE and its original from time to time.
13. The administrative, academic and financial records including accounts shall be maintained for this institution separately. The accounts shall be audited annually by a Chartered Accountant and all the records and reports shall be open for inspection by the AICTE or anybody authorized by it.



14. The Council may decide to send an Expert Committee or authorise any officer of AICTE including surprise visit to the institute to verify the compliance of the conditions as laid-down and any other specific conditions to make necessary recommendations for further extension of AICTE approval to the conduct of the approved course(s).
15. The information furnished in respect of the proposal are factual and correct. In the event of any information is found to be false, misleading or suppressed at a later date the approval accorded may be withdrawn by the AICTE in pursuance of Clause 12 of AICTE Regulations, 1994.
16. In the event of non-compliance by the Society with regard to Act, Gazette Regulations/ Guidelines, norms and conditions laid down by AICTE from time to time, the AICTE or a body or a person authorized by it will be free to take measures for withdrawal of its approval without consideration of any related issues and that all liabilities arising out of such a withdrawal would solely be that of the concerned Society.
17. The institute by virtue of the approval given by AICTE shall not automatically become claimant to any financial grant or assistance from the Central or State Government.
18. The institute shall observe all instructions/ guidelines issued by the AICTE and its regional office regarding mode of selection of candidates for admissions prescribing fees and on all matters having relevance to maintaining high quality and standards of teaching learning process in the institution. No capitation shall be charged and no charges other than the fee fixed by the Competent Authority shall be levied on students here agree to furnish a certificate to the effect on the last date of admissions during every academic year.
19. The Institution shall be liable to bear all expenses payable to the students admitted to academic programs due to discontinuation of the institution by its own will or by AICTE including all demurrages incurred due to loss of time already pursued by the admitted students in the programs. The Institution shall also be responsible for suitable demurrages to the faculty and staff recruited in it.
20. The management of the college shall fully comply with the "SCHEME" as prescribed by the Supreme Court in its judgment dated 4.2.93 with regard to WP(c) No. 607 of 1992 in the case of Unnikrishnan and others vs. State of Andhra Pradesh and others and the related guidelines and criteria as may be issued by the AICTE, UGC or the Central Government from time to time.
21. The institution will not indulge in advertisements which could be construed as commercialization of Technical Education.
22. The institutions shall not collaborate or associate with any other institution or University neither Indian nor foreign to award one or more joint degrees or diplomas to the students admitted to the AICTE approved program.
23. Each institution shall submit to AICTE through its Regional Office, a list of candidates admitted to the approved program(s) after finalizing admission (latest by August 31 of each year) giving names, percentage of marks in qualifying examinations and score in written test in addition to the above mentioned particulars like score in group discussion and interview with relative weightage and criteria of admission followed, constitution of admission committee in respect of MBA and MCA programmes. A declaration shall be submitted to the effect that the institute indulged in no deviation from the norms of AICTE including actual intake in the institution.

Date :  
Place :

Signature  
(Chairman/President  
of Trust/ Society)



12/5/03  
3.3



अखिल भारतीय तकनीकी शिक्षा परिषद्  
**ALL INDIA COUNCIL FOR TECHNICAL EDUCATION**  
(भारत सरकार का एक सांविधिक संस्थान) (A STATUTORY BODY OF THE GOVERNMENT OF INDIA)

S.No.11

F.No.: 740-89-213(E)/RC/95

Date: 30.04.2003

To

**The Secretary  
Higher & Technical Education  
& Employment Department  
Govt. of Maharashtra  
Mantralaya, Mumbai - 400 032.  
MAHARASHTRA.**

**Sub: Extension of approval of AICTE to FR. CONCEICAO RODRIQUES COLLEGE OF ENGG, FATHER ANGEL ASHRAM, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050, for the academic year 2003-04.**

Sir/Madam,

The Application/ Proposal and/ or the Compliance Report received from FR. CONCEICAO RODRIQUES COLLEGE OF ENGG, FATHER ANGEL ASHRAM, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050, has been processed as per laid down procedure, guidelines, policy and/ or norms & standards of AICTE, mentioned in AICTE Regulations and/ or "AICTE Hand Book for Approval Process".

I am directed to state that the All India council for Technical Education (AICTE) is pleased to accord approval to FR. CONCEICAO RODRIQUES COLLEGE OF ENGG, FATHER ANGEL ASHRAM, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050, for extension of AICTE Approval/ Introduction of new course(s)/ Variation in intake (Increase/ Decrease), as applicable for **under-graduate degree level course(s) in Engineering /Technology** with annual intake for each course as given below :

FULL TIME COURSE(S)	EXISTING ANNUAL INTAKE	REVISED APPROVED INTAKE	ENTRY LEVEL	DURATION (YEARS)	PERIOD OF APPROVAL
COMPUTER ENGINEERING	120	120	10+2	4	2003-05
ELECTRONICS ENGINEERING	60	60	10+2	4	2003-05
INFORMATION TECHNOLOGY	30	30	10+2	4	2003-05
PRODUCTION ENGINEERING	60	60	10+2	4	2003-05
<b>Total Annual Intake</b>	<b>270</b>	<b>270</b>			

Majisyl

Retrieved



The approval accorded above is subject to fulfillment of the following Conditions:

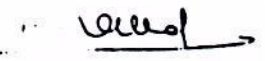
1. All full time faculty members as per AICTE Norms must be recruited before making admissions.
2. The Institution must have Affiliation to a University for the above courses before making admissions. In the absence of such Affiliation, this Letter of approval shall be treated as Withdrawn. (Order of the High Court of Madras in W.P. No. 33256 of 2002 and other Batch of Petitions).
3. All the required Laboratories/ Workshops/ Machineries/ Equipment, as per approved syllabi of the affiliating University, must be operational before making admissions.
4. The approved course(s) shall commence as per the academic calendar of the Affiliating University.
5. If this Letter of approval is received by you after the closing date of State / National Level Central Counseling for Admissions in the concerned State / Union Territory, this Letter of approval will not be valid for making any admission during the above specified academic year, and shall be treated as withdrawn.
6. No excess admission shall be made by the Institution during any academic year.
7. The approval is valid only for the academic year 2003-2004. If no further extension of AICTE approval is received beyond the academic year 2003-2004, this Approval Letter will not be valid for making any admission for the subsequent years.
8. Name of the Institution, Name of the Society/Trust, are not allowed to be changed without prior approval of AICTE. The name and title of the institution should be such that "the Emblems and Names (Prevention of improper use) Act 12 (1950)" of Government of India, is not violated in any manner.  
  
The use of word "Indian" and /or "National" and/or "All India" and/or "All India Council" and/or Commission" in any part of the name of a Technical Institution and/ or any name whose abbreviated form leads to "IIM"/ "IIT"/"IISC"/"IIIT"/ "AICTE"/ "UGC" shall not be permitted. These restrictions will not be applicable for those institutions which are established with the name approved by the Govt. of India.
9. In exercise of power conferred under 10(p) of the AICTE Act, AICTE may inspect the Institution any time it may deem fit to verify the progress/ compliance or for any other purpose.
10. Any other condition(s) as may be specified by AICTE from time to time.

It may please be noted that consequent to judgement of Hon'ble Supreme Court delivered on 31/10/2002 in TMA Pai Case, the AICTE had issued interim policy regulations, which has been notified in the Gazette of India on 20/03/2003. All the provisions contained in the interim policy regulations shall be applicable for the academic year 2003-2004 in respect of all the AICTE approved institutions.

740 89 213(E)/RC/95

**In the event of infringement/ contravention or non-compliance of the above conditions and/or the provision of AICTE Act & Regulations/ Guidelines/ Norms & Standards as prescribed by AICTE, further actions leading to 'Reduced Intake' or 'No Admission or Withdrawal of Approval, may be taken by AICTE and the liability arising out of such actions will be solely that of the Management of the Institution.**

Your faithfully,

  
(Prof. S. Gaud)  
Adviser (UG)

**Encl: Suggested Improvements (Specific Conditions)**

**Copy to:**

1. The Regional Officer, Western Regional Office, AICTE, Industrial Assurance Building, 11nd Floor, Veer Nariman Road, Opp. Churchgate Rly. Station, Mumbai - 400 020.
2. The Registrar, BOMBAY UNIVERSITY.
3. The Principal  
**FR. CONCEICAO RODRIQUES COLLEGE OF ENGG,  
FATHER ANGEL ASHIRAM, P.B. NO.: 6656,  
BUS STAND, BANDRA (W), BOMBAY - 400 050,**
4. The Director of Technical Education  
Govt. of Maharashtra  
3, Mahapalika Marg,  
Mumbai - 400 001.
5. Guard File, Bureau (UG).



## DEGREE LEVEL COURSES IN ENGINEERING & TECHNOLOGY

<b>W.R.O. REF. NO.</b>	DEG 22-1194	<b>ADDITIONAL COURSE(S) / VARIATION IN INTAKE</b>	<b>SR.NO.</b>	<b>II</b>
<b>REGION:</b>	WESTERN	<b>STATE:</b>	MAHARASHTRA	
<b>Name and Address of the Institution as per the AICTE approval letter for academic year 2002-2003</b>	<b>Name of the Institution being changed without prior approval of AICTE</b>	<b>Location of the Institution being changed without prior approval of AICTE (operational address)</b>		
FR.CONCEICAO RODRIQUES, COLLEGE OF ENGINEERING, FATHER AGNEL ASHIRAM, POST BOX NO 6656, BANDSTAND, BANDRA, (W), MUMBAI - 400 050				

### **SUGGESTED IMPROVEMENTS**

#### **Building**

- Overall built up area provided for instructional purpose, laboratory, workshop, computer center and administrative area required to be increased to meet the requirements of AICTE norms for existing courses and /or additional courses/variation in intake proposed.
- Built up area/ building provided for the academic and administrative purpose is being shared and combined with other courses need to be separated confirmed.
- The building classrooms / laboratories / workshop / computer center / library should be provided with adequate ventilation and lighting for conducive working.

#### **Laboratories / workshops**

- **Laboratories:** each laboratory must be equipped with more number of sets of equipments and should replace old and out dated equipments with latest technology equipments as per syllabus and curriculum.
- **Workshop:** equipments provided in workshop should be increased to avoid overcrowding of the students. State of art and latest technology machines should be provided by replacing the out dated machines and equipments.

#### **Computer center:**

- Central computing facility including departmental computer laboratories must be strengthened as per AICTE norms immediately. Relevant licensed software's as per the curriculum should be provided. Internet connectivity should be improved with higher bandwidth and more number of computers should be provided with proper networking to access Internet services. Number of peripherals must be strengthened with immediate effect.

#### **Library**

- Adequate number of books with required volumes and titles, national and international technical journals and periodicals should be provided for each course/discipline and digital library must be provided.

#### **Faculty**

- Permanent, university approved, regular and qualified principal must be appointed immediately
- University approved regular faculty should be appointed as per students/teacher ratio on a permanent basis w.r.t. approved intake.
- Total faculty ratio with respect to various level of faculty such as head of the department/ professor/assistant professor/lecturer should be provided in all the courses / discipline and confirmed.
- Implementation of fifth pay commission scales and allowances to teaching and non-teaching staff should be confirmed.
- The institution shall maintain proper records and rolls of acquaintance of payment and the records shall be verified by competent authorities whenever called for.

#### **Funds**

- Institution should not pay rent/transfer any amount of money/loan to the society of any institution on any account.
- Any surplus accrued out of the revenue/income of the institution should be utilized properly for development of institutional facilities.
- The institution shall incur adequate expenditure on per student training cost as per AICTE norms.
- The institution must incur appropriate expenditure as per AICTE norms on all major recurring and non-recurring items such as salary, remuneration of faculty/staff, consumables and equipments

**Regional Officer,  
WRO, Mumbai**

**Adviser,  
AICTE, New Delhi**





अखिल भारतीय तकनीकी शिक्षा परिषद्  
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION  
(भारत सरकार का एक सांविधिक निकाय) (A STATUTORY BODY OF THE GOVT OF INDIA)

Date : 12.07.2005

To  
The Secretary  
Higher & Technical Education & Department  
Govt. of Maharashtra  
Mantralaya Annexe  
Mumbai - 400032

Sub: Grant of AICTE Approval for extension and restoration of intake for 2005-06 in the State of Maharashtra - The directions of the Hon'ble Bombay High Court in the W.P. No. 3916/2001

Please refer to your letter Ref MS 2005(328/05)TE-1 dated 28th June 2005 addressed to the Chairman AICTE on the above subject.

In this regard I am to bring to your notice that the Council has this year taken a policy decision to reduce seats in those institutions which suffered from an acute faculty shortage. The detailed policy of the Council in this regard is available on the official website [www.aicte.ernet.in](http://www.aicte.ernet.in). While effecting this reduction, the Council, as a matter of policy, has given the institutions in all States a fair opportunity to rectify the deficiency of faculty by way of recruitments and apply for restoration by 7<sup>th</sup> July, 2005.

In accordance with the above policy decision, institutions from various States have applied for restoration after having recruited the requisite faculty. The Council is allowing restoration in all such cases where recruitments have been found to be in order.

Several institutions in Maharashtra State have also submitted their appeals to the Council before 30<sup>th</sup> June, 2005 which have since been decided and decision regarding restoration duly conveyed to the State Government. However it has been observed that several institutions in Maharashtra State have continued to send the appeals till 7<sup>th</sup> July, 2005 for restoration in accordance with Council's Policy to entertain such appeals.

The Council has examined the appeals received till 7<sup>th</sup> July, 2005 from institutions in Maharashtra State and found that the following institutions are eligible for restoration in terms of the policy applied to all the States for the year 2005-06. Detailed information is given in enclosed Annexure-I for existing institutions and Annexure-II for new institutions.

The State Government may like to take an appropriate view in the matter in the light of the directions of the Hon'ble High Court of Mumbai in the writ Petition No. 3916/2001

Yours faithfully

Prof. S. Venkateswara Rao  
Address: 1113/23



Annexure - I

Dr. Dnyaneshwar Mkhalra Sanatha's College Of Engineering And Technology, Near Old Airport, At Post Ashta, Tal. Waiwa, Dist. Sangli - 415 301.	Information Technology Computer Sc. & Engineering	70	60
Samarth Samaj's Shivajirao S. Jondhale College Of Engg. Shil Kalyan Road, Sonarpada, Dombivili (E), Dist. Thane-421202	Computer Technology Production Engineering	60 30	90 60
Fr. Conceicao Rodrigues College Of Engg. Father Angel Ashram, P.B. No.: 6636, Bus Stand, Bandra(W), Bombay - 400 050	Computer Engineering	90	120
Anjuman Hami-E-Islam's Anjuman College Of Engineering, Sadar, Nagpur., Temp.Add: Premises Of Anjuman Poly., Sadar, Nagpur.	Electronics & Power Engineering Electronics & Tele Comm. Engg. Mechanical Engineering Computer Sc. & Engg.	45 45 45 30	60 60 60 60
Manjara Charitable Trust Col Of Engg Survey-161, B/H Hdfe Bank, Juhu Varsova Link Road,, Varsova, Andheri (W), Mumbai-400 053.	Information Technology	30	60

Western (Maharashtra)

Programme : MBA

Name & Address of the Institution	Course(s)	Reduced Intake for the year 2005-2006	Restored Intake Proposed for the year 2005-2006 based on the appeals received after 30.06.2005
Gondia Education Society's Department Of Management Science & Research L.M.Patel College Bhandara, 441 204	M. B. A.	00	60
C.P. Bera Education Society Department Of Advance Studies & Research C.P. And Bera E.S. College Tulsiwadi Nagpur, 440 002	M. B. A. M.L.R. & P.M.	60 00	60 30
Shri Shriyaji Edu. Soc Dhanwate National Department Of Management Studies & Research Tulsiwadi Nagar, Nagpur, Nagpur, 440 012	M. B. A.	60	60

## REDUCED INTAKE CATEGORY

F.No.: 740-89-213(E)/RC/95

Date : 08.06.2005

To  
The Secretary,  
Higher & Technical Education  
and Employment Department  
Govt. of Maharashtra, Mantralaya,  
Mumbai - 400 032.  
MAHARASHTRA

**Sub: Extension of approval to FR. CONCEICAO RODRIGUES COLLEGE OF ENGG, FATHER ANGEL ASHRAM, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050, for the year 2005-06-reg.**

As you are aware, All India Council for Technical Education has been mandated under the AICTE Act, 1987 to ensure **maintenance of norms and standards** with regard to technical education in the country. In exercise of this mandate, the Council insists on fulfillment of the minimum requirements prescribed for imparting technical education by the institution so that **quality** is not compromised and stakeholders are satisfied. The Council also undertakes an **annual Inspection** of the institutions and conveys deficiencies to them for **rectification**.

It has been observed however that notwithstanding the Council's **repeated advice** to comply with minimum norms and standards, many institutions continue to be **complacent** about taking steps to remedy the deficiencies. Such institutions suffer from **critical deficiencies** of faculty and other requirements. Feedback of students with regard to quality of education imparted by such institutions has evoked grave concern. The Expert Committees, following **holistic appraisal** during inspections, have also pointed out severe shortcomings in key areas.

Your institution has several deficiencies, which are listed in **Annexure-A** for your perusal. These deficiencies have rendered the institution liable for strict punitive action. However, the Council has decided to take a lenient view and put only the course(s) which suffer from the most critical deficiency i.e. **shortage of faculty** in the reduced intake category. The approved course(s) along with recommended intake for the year 2005-06 in respect of **FR. CONCEICAO RODRIGUES COLLEGE OF ENGG, FATHER ANGEL ASHRAM, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050,** is as under:-

COURSE (S)	APPROVED INTAKE 2004-05	APPROVED INTAKE 2005-06
PRODUCTION ENGINEERING	60	60
ELECTRONICS ENGINEERING	60	60
COMPUTER ENGINEERING	120	90
INFORMATION TECHNOLOGY	30	30
M.E. - MECHANICAL ENGINEERING	18	18
M.E. - ELECTRONICS ENGINEERING	18	18
M.E. - PRODUCTION ENGINEERING (PT)	10	10
<b>TOTAL</b>	<b>316</b>	<b>286</b>



**Note:- Additional intake / new courses / PIO quota not granted on account of deficiencies in running of existing courses with existing sanctioned intake (wherever applicable).**

The Council is committed to facilitating the institutions to come up to the expectations of the stakeholders through rectification of deficiencies. It has therefore been decided by the Council to give yet another opportunity to rectify at least the deficiency of faculty irrespective of the cadre ratio for consideration of restoration of UG course(s) in Engineering & Technology / Pharmacy / MBA and MCA. However, for restoration of intake at PG level in Engineering & Technology and Pharmacy, a minimum of one faculty with Ph.D. qualification and two with postgraduate qualifications in the respective discipline would be essential.

In case the institution is able to recruit the required faculty for individual course and intimate the Council regarding the same in the **enclosed Proforma (with a copy to the concerned Regional Office)** latest by 7<sup>th</sup> July, 2005, the Council would favorably consider proportionately restoring intake in course(s) where it has been reduced as soon as the appeal received by the Council.

Please note that the Council may independently verify the factual status in respect of recruitment of faculty. The institution shall be liable for strict action including action under the relevant provisions of Indian Penal Code in case false information is furnished to the Council on recruitment of faculty.

It may also be noted that relaxation in respect of rectification of deficiencies in terms of faculty is applicable only for the purpose of **restoration of intake** for the academic year 2005-06. All other deficiencies including appointment of faculty have to be complied with by 31/08/2005 for extension of approval for the year 2006-07.

A compliance report indicating rectification of **all the deficiencies** including details of faculty recruited for each course must be received by the Council latest by 31<sup>st</sup> August, 2005 to entitle your institution for extension of approval for the year 2006-07. The compliance report must be accompanied with a visiting processing fee as prescribed by the Council in the form of a demand draft in favour of Member Secretary, AICTE payable at New Delhi. In the absence of the processing / visiting fee, the compliance report may not be entertained.

Following the compliance report, the Council would verify the status in respect of rectification of deficiencies through physical inspection without any prior intimation. The institution should therefore be prepared for random inspection without any prior notice. Extension of approval for the year 2006-07 shall be dependent on the compliance report and the outcome of the surprise inspection.

**Enclosure:- Annexure-A**

**Yours faithfully**

**(Dr P. Venkateswara Rao)  
Adviser (UG/ PG)**

**Copy to :**

1. The Principal.  
**FR. CONCEICAO RODRIGUES COLLEGE OF ENGG,  
FATHER ANGEL ASHRAM,  
P.B. NO.: 6656, BUS STAND,  
BANDRA(W), BOMBAY - 400 050,**
2. The Western Regional office. Regional Office. AICTE. Industrial Assurance Building, 2<sup>nd</sup> Floor. Veer Nariman Road. Opp. Churugate Rly. Station, Mumbai – 400 020..
3. Director of Technical Education. Govt. of Maharashtra. 3. Mahapalika Marg. Mumbai–400 001
4. The Registrar. BOMBAY UNIVERSITY  
He is requested to complete the process of affiliation for facilitating admissions.
5. Guard File.

**Note:**

- a) The institute was found to be having deficiencies in faculty and the cadre ratio in other existing programmes also. However, in view of the Policy of the Council to relax 25% faculty requirement for the academic year 2005-06, the existing intake was not reduced. You are required to fulfill the faculty requirement as per norms by 31<sup>st</sup> August 2005 and submit the compliance for the same (where ever applicable).
- b) The calculation of required faculty strength for every course is based on 1:15 ratio of the total sanctioned intake for Pharmacy, MBA, MCA, HMCT and B.F.A. However, for the Engg. Courses, intake of first year have been exempted where the faculty for basic sciences and humanities is expected to teach. (Calculation is based on total sanctioned intake from II<sup>nd</sup> year to IV<sup>th</sup> year).

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION  
NEW DELHI

PROGRAMME: ENGINEERING

NAME OF TRUST	NAME OF INSTITUTION
AGNEL CHARITIES AGNEL ASHRAM,BAND STAND BANDRA(WEST). MUMBAI-400 050	FR.CONCEICAO RODRIGUES COLLEGE OF ENGINEERING FATHER ANGEL ASHRAM,BAND STAND P.B. NO: 6656, BUS STAND. BANDRA(WEST) MUMBAI-400 050

DEFICIENCIES

**FACULTY POSITION :**

Programme	Number of Faculty Position	Number of Faculty Available	Shortfall in Numbers
COMPUTER ENGG.	24	13	11
INFORMATION TECHNOLOGY	12	08	04

**LAND:**

- Land area is short by 40%.

**BUILT - UP AREA :**

- Built-up area is short by 35%

**COMPUTER :**

- No. of computers is short by 48%



**FORM I**

S. No	Name of course	Sanctioned Intake for 2004-05	Sanctioned Intake for 2005-2006	No of Professors	No of Asst. Professors	No of Lecturers	Total No of faculty members
1.							
2.							
3.							
4.							

**FORM II****(Details of Individual faculty member)**

Name :  
Designation :  
Date of Birth :  
Academic Qualifications :  
Previous Experience (In Detail) :  
Name & Details of the Previous Employer :  
Last Pay drawn :  
Other Credentials :  
Course for which Employed :

Above details to be supported by the following mandatory documents:

1. All supporting attested documents in respect of above information.
2. An attested copy of appointment letter.
3. Attested copies of consent letter and the joining report of Faculty members.
4. Photograph of the Faculty member, signed and attested by the Chairman / President of the Trust / Society.

Kindly note that the faculty members recruited must be eligible as per AICTE norms.



अखिल भारतीय तकनीकी शिक्षा परिषद्  
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION  
(भारत सरकार का एक सांविधिक निकाय) (A STATUTORY BODY OF THE GOVT. OF INDIA)

F. No. 740-89-213(E)/RC/95  
May 10, 2006

To,

The Director/Principal  
FR. CONCEICAO RODRIGUES COLLEGE OF ENGG  
FATHER ANGEL ASHRAM, BAND STAND, P.B. NO.: 6656,  
BUS STAND, BANDRA(W), BOMBAY - 400 050

Sub: AICTE approval to FR. CONCEICAO RODRIGUES COLLEGE OF ENGG FATHER ANGEL ASHRAM, BAND STAND, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050 for extension of approval for the academic year 2006-07.

Sir,

As per the Regulations notified by the Council vide F.No. 37-3/Legal/2004 dated 28<sup>th</sup> November 2005 and norms, standards, procedures and conditions prescribed by the Council from time to time and based on the recommendations of the Appraisal Committee/ Expert Committee, I am directed to convey that your institution has been placed under **Reduced Intake Category** as per the details given below:

Name of the Course(s)	Existing Intake	Revised Intake	Period of approval
COMPUTER ENGINEERING	120	60	2006-2007
ELECTRONICS ENGINEERING	60	60	
INFORMATION TECHNOLOGY	30	30	
M.E. ELECTRICAL ENGG.	18	18	
M.E. MECHANICAL ENGG.	18	18	
M.E. PRODUCTION ENGG. (PT)	10	10	
PRODUCTION ENGINEERING	60	60	
<b>Total</b>	<b>316</b>	<b>256</b>	

The major deficiencies for placing your institution under **Reduced Intake Category** are as given below:

**Built-up Area**

- ❖ There is shortfall of built up area by 42.47% as only 8022 sq.m is available against the requirement of 13946.4 sq.m

Contd.2/-

इंदिरा गांधी खेल परिसर, इन्द्रप्रस्थ एस्टेट, नई दिल्ली - 110002

Indira Gandhi Sports Complex, I. P. Estate, New Delhi-110 002

दूरभाष / Phone : 23392506, 63-65-68, 71, 73-75 फैक्स / Fax : 011-23392554

वैबसाइट / Website : www.aicte.ernet.in



In case your institution is interested for restoration of intake after rectification of the deficiencies mentioned above, you are advised to refer to the restoration policy (Important notice, Approvals 2006-07) given on the AICTE website. It may further be noted that all the above-mentioned deficiencies are required to be rectified by **31<sup>st</sup> May 2006** for consideration of restoration of intake proportionately (minimum of 75% required faculty in the relevant discipline should be appointed by 31st May 2006 for restoration of intake only).

However, your institution is also found to be suffering from the deficiencies mentioned below which need to be rectified by 31<sup>st</sup> August 2006

### **Faculty**

- ❖ No Ph.d qualified faculty available for ME Mech. Engg. & ME Production Engg. Courses.
- ❖ Faculty with proper cadre ratio, requisite qualifications and experience to be appointed in all the disciplines as per AICTE norms.

*Note: The mandatory disclosure in prescribed format if not hosted on the website should be hosted by 31<sup>st</sup> May, 2006, failing which action would be initiated as per the rules and regulations of the AICTE including No Admission / Withdrawal of approval.*

The institution is required to submit two copies of the Compliance Report, indicating the rectification of deficiencies along with mandatory disclosure and details of faculty recruited for each course in the prescribed format (available at AICTE Website [www.aicteernet.in](http://www.aicteernet.in)) to the concerned Regional Office latest by 31<sup>st</sup> August 2006 for consideration of approval beyond the session 2006-07.

The Compliance Report must be accompanied with a processing fee of Rs. 40,000/- in the form of demand draft in the favour of Member Secretary, AICTE, payable at New Delhi. In the absence of processing fee the Compliance Report will not be entertained. Following the Compliance report, the Council would verify the status in respect of rectification of deficiencies through surprise random inspection without any prior notice.



The above approval is subject to the fulfillment of the following general conditions:

- 1 That the management shall provide adequate funds for development of land and for providing related infrastructural, instructional and other facilities as per norms and standards laid down by the Council from time to time and for meeting recurring expenditure.
2. (a) That the admission shall be made only after adequate infrastructure and all other facilities are provided as per norms and guidelines of the AICTE.
- (b) That the admissions shall be made in accordance with the regulations notified by the Council from time to time.
- (c) That the curriculum of the course, the procedure for evaluation/ assessment of students shall be in accordance with the norms prescribed by the AICTE.
- (d) That the Institution shall not allow closure of the Institution or discontinuation of the course(s) or start any new course(s) or alter intake capacity of seats without the prior approval of the Council.
- (e) **That no excess admission shall be made by the Institution over and above the approved intake under any circumstances. In case any excess admission is reported to the Council, appropriate penal action including withdrawal of approval shall be initiated against the Institution**
- (f) **That the institutions shall not have any collaborative arrangements with any Indian and/ or Foreign Universities for conduct of technical courses other than those approved by AICTE without obtaining prior approval from AICTE. In case any violation is reported to the Council, appropriate penal action including withdrawal of approval shall be initiated against the Institution**
- (g) **That the Institution shall not conduct any course(s) in the field of technical education in the same premises/ campus and / or in the name of the Institution without prior permission/ approval of AICTE. In case any violation is reported to the Council, appropriate penal action including withdrawal of approval shall be initiated against the Institution**
- (h) **The institution shall not conduct any non-technical course(s) in the same premises/ campus under any circumstances. In case any violation is reported to the Council, appropriate penal action including withdrawal of approval shall be initiated against the Institution**
- 3 That the institution shall operate only from the approved location, and that the institution shall not open any off campus study centers/ extension centers directly or in collaboration with any other institution/ university/ organization for the purpose of imparting technical education without obtaining prior approval from the AICTE.

- 4 That the tuition and other fees shall be charged as prescribed by the Competent Authority within the overall criteria prescribed by the Council from time to time. No capitation fee shall be charged from the students/ guardians of students in any form.
- 5 That the accounts of the Institution shall be audited annually by a certified Chartered Accountant and shall be open for inspection by the Council or any body or persons authorized by it.
- 6 That the Director/ Principal and the teaching and other staff shall be selected according to procedures, qualifications and experience prescribed by the Council from time to time and pay scales are as per the norms prescribed by the Council from time to time.
- 7 (a) That the institution shall furnish requisite returns and reports as desired by AICTE in order to ensure proper maintenance of administrative and academic standards.
  - (b) That the technical institution shall publish an information booklet before commencement of the academic year giving details regarding the institution and courses/ programmes being conducted and details of infrastructural facilities including faculty etc. in the form of mandatory disclosure. The information booklet may be made available to the stakeholders of the technical education on cost basis. The mandatory disclosure information shall be put on the Institution Website. The information shall be revised every year with updated information about all aspects of the institution.
  - (c) That it shall be mandatory for the technical institution to maintain a Website providing the prescribed information. The Website information must be continuously updated as and when changes take place.
  - (d) That a compliance report in the prescribed format along with mandatory disclosures on fulfillment of the above conditions, shall be submitted each year by the Institution within the time limit prescribed by the Council from time to time **i.e. 31<sup>st</sup> August 2006 for the current year.**
  - (e) That if Technical Institution fails to disclose the information or suppress and/ or misrepresent the information, appropriate action could be initiated including withdrawal of AICTE approval.
- 8 That all the laboratories, workshops etc. shall be equipped as per the syllabi of the concerned affiliated University and shall be in operational condition before making admissions.
- 9 That a library shall be established with adequate number of titles, books, journals (both Indian & Foreign) etc as per AICTE norms.
- 10 That a computer center with adequate number of terminals, Printers etc. shall be established as per AICTE norms.
- 11 AICTE may carry out random inspections round the year for verifying the status of the Institutions to ensure maintenance of norms and standards.
- 12 That the AICTE may also conduct inspections with or without notifying the dates to verify specific complaints of mis-representation, violation of norms and standards, mal-practices etc.



- 13 That the Institution by virtue of the approval given by Council shall not automatically become claimant to any grant-in-aid form the Central or State Government.
- 14 That the Management shall strictly follow further conditions as may be specified by the Council from time to time.
- 15 In the event of non-compliance by the **FR. CONCEICAO RODRIGUES COLLEGE OF ENGG FATHER ANGEL ASHRAM, BAND STAND, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050** with regard to guidelines, norms and conditions prescribed from time to time the Council shall be free to take measures for withdrawal of its approval or recognition, without consideration of any related issues and that all liabilities arising out of such withdrawal would solely be that of **FR. CONCEICAO RODRIGUES COLLEGE OF ENGG FATHER ANGEL ASHRAM, BAND STAND, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050** .

Yours faithfully,



(Harish C. Rai)  
Adviser- UG/PG (E&T)

**Copy to:**

1. The Regional officer , Western Regional Office,  
AICTE, Industrial Assurance  
Building, 2<sup>nd</sup> Floor, Veer Nariman Road,  
Opp. Chrucagate Rly. Station,  
Mumbai-400020
2. Guard File (AICTE)



अखिल भारतीय तकनीकी शिक्षा परिषद्  
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION  
(भारत सरकार का एक सांविधिक निकाय) (A STATUTORY BODY OF THE GOVT. OF INDIA)

To,  
The Secretary, Higher & Technical Education,  
and Employment Department,  
Govt. of Maharashtra, Mantralaya,  
Mumbai-400032, Maharashtra

F. No. 740-89-213(E)/RC/95  
Date: 12/07/2006

Sub: **CORRIGENDUM**  
Extension of Approval to FR. CONCEICAO RODRIGUES COLLEGE OF ENGG FATHER ANGEL ASHRAM, BAND  
STAND, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050 for the year 2006-2007—Reg.

Sir,

This is in partial modification to Council's earlier letter of even no. dated 10/05/2006. The nomenclature of the PG Programme in Electrical Engg. as mentioned in the said letter may kindly be read as Electronics Engineering.

With the above, the approved courses/intake of the FR. CONCEICAO RODRIGUES COLLEGE OF ENGG FATHER ANGEL ASHRAM, BAND STAND, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050 for the year 2006-07 is as under:

Name of the Course(s)	Approved Intake 2006-07	Period of approval
COMPUTER ENGINEERING	60	2006-2007
ELECTRONICS ENGINEERING	60	
INFORMATION TECHNOLOGY	30	
M.E. ELECTRONICS ENGG.	18	
M.E. MECHANICAL ENGG.	18	
M.E. PRODUCTION ENGG. (PT)	10	
PRODUCTION ENGINEERING	60	
<b>Total</b>	<b>256</b>	

All the other conditions as mentioned in council's letter referred above remain unchanged.  
Inconvenience caused is highly regretted.

Yours faithfully

  
(Harish C. Rai)  
Adviser- UG/PG (E & T)

Copy to:

1. The Regional Officer, Western Regional Office, AICTE,  
Industrial Assurance Building 2<sup>nd</sup> Floor, Veer Nariman Road,  
Opp. Chrucagate Rly. Station, Mumbai-400020
2. The Registrar
3. The Principal, FR. CONCEICAO RODRIGUES COLLEGE OF ENGG  
FATHER ANGEL ASHRAM, BAND STAND, P.B. NO.: 6656,  
BUS STAND, BANDRA(W), BOMBAY - 400 050
4. Director of Technical Education, Govt. of Maharashtra  
3, Mahapalika Marg, Mumbai-400001
5. Guard File Bureau (UG/PG).





Received on  
19.7.2007  
S

अखिल भारतीय तकनीकी शिक्षा परिषद्  
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION  
(भारत सरकार का एक सांविधिक निकाय) (A STATUTORY BODY OF THE GOVT. OF INDIA)

F. No. 740-89-213(E)/RC/95

Date: 16/07/2007

To,  
The Secretary, Higher & Technical Education,  
and Employment Department,  
Govt. of Maharashtra, Mantralaya,  
Mumbai-400032, Maharashtra

Sub: Extension of approval to **FR. CONCEICAO RODRIGUES COLLEGE OF ENGG FATHER ANGEL ASHRAM, BAND STAND, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050** for the academic year 2007-08.

Sir,

As per the Regulations notified by the Council vide F.No. 37-3/Legal/2004 dated 14<sup>th</sup> September 2006 and norms, standards, procedures and conditions prescribed by the Council from time to time and based on the recommendations of Appraisal Committee / Expert Committee, I am directed to convey the extension of approval of the Council to **FR. CONCEICAO RODRIGUES COLLEGE OF ENGG FATHER ANGEL ASHRAM, BAND STAND, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050** for conduct of the following courses with the intake indicated below:

Name of the Course(s)	Existing Intake	Revised Intake	Period of approval
COMPUTER ENGINEERING	60	60	2007- 08
ELECTRONICS ENGINEERING	60	60	
INFORMATION TECHNOLOGY	30	30	
M.E. ELECTRONICS ENGG.	18	18	
M.E. MECHANICAL ENGG.	18	18	
M.E. PRODUCTION ENGG. (PT)	10	10	
PRODUCTION ENGINEERING	60	60	
TOTAL	256	256	

The above approval is subject to rectification of the following observations / deficiencies / specific conditions by 31<sup>st</sup> August 2007.

➤ **Faculty :**

- ❖ Faculty with proper cadre ratio, requisite qualifications and experience to be appointed in all the disciplines as per AICTE norms.
- ❖ AICTE pay scales to be implemented for all faculty members.
- ❖ The faculty shortfall in various branches is as follows:

Course (s)	Faculty required	Faculty available	Shortfall Number
COMPUTER ENGINEERING	24	21	3
BASIC SC. & HUM.	14	8	6

➤ **BUILT-UP AREA:**

	Required	Available	Shortfall Number
Total Built-Up Area	12776	9817	2959
Instructional Area	6552	6487	65

- ❖ The construction process of the building under construction to be expedited.

➤ **Others**

- ❖ The institution shall not make any excess admission or admission under the PIO / Foreign National category without the prior approval of AICTE.

Contd.. 2/-



**Note: The mandatory disclosure in prescribed format is required to be hosted on the website as per AICTE requirements, failing which, action would be initiated as per the rules and regulations of the AICTE including No Admission / Withdrawal of approval.**

The institution is required to submit two copies of the Compliance Report, indicating the rectification of deficiencies along with mandatory disclosure and details of faculty recruited for each course in the prescribed format (available at AICTE Website [www.aicte.ernet.in](http://www.aicte.ernet.in)) to the concerned Regional Office latest by 31<sup>st</sup> August 2007 for consideration of approval beyond the session 2007-08.

The Compliance Report must be accompanied with a processing fee of Rs. 40,000/- in the form of demand draft in the favour of Member Secretary, AICTE, payable at New Delhi. In the absence of processing fee the Compliance Report will not be entertained. Following the Compliance report, the Council would verify the status in respect of rectification of deficiencies through surprise random inspection without any prior notice.

The above approval if granted after rectification of deficiencies would be subject to the fulfillment of the following general conditions:

- 1 That the management shall provide adequate funds for development of land and for providing related infrastructural, instructional and other facilities as per norms and standards laid down by the Council from time to time and for meeting recurring expenditure.
2. (a) That the admission shall be made only after adequate infrastructure and all other facilities are provided as per norms and guidelines of the AICTE.
  - (b) That the admissions shall be made in accordance with the regulations notified by the Council from time to time.
  - (c) That the curriculum of the course, the procedure for evaluation/ assessment of students shall be in accordance with the norms prescribed by the AICTE.
  - (d) That the Institution shall not allow closure of the Institution or discontinuation of the course(s) or start any new course(s) or alter intake capacity of seats without the prior approval of the Council.
  - (e) **That no excess admission shall be made by the Institution over and above the approved intake under any circumstances. In case any excess admission is reported to the Council, appropriate penal action including withdrawal of approval shall be initiated against the Institution**
  - (f) That the institutions shall not have any collaborative arrangements with any Indian and/ or Foreign Universities for conduct of technical courses other than those approved by AICTE without obtaining prior approval from AICTE. In case any violation is reported to the Council, appropriate penal action including withdrawal of approval shall be initiated against the Institution
  - (g) That the Institution shall not conduct any course(s) in the field of technical education in the same premises/ campus and / or in the name of the Institution without prior permission/ approval of AICTE. In case any violation is reported to the Council, appropriate penal action including withdrawal of approval shall be initiated against the Institution
  - (h) The institution shall not conduct any non-technical course(s) in the same premises/ campus under any circumstances. In case any violation is reported to the Council, appropriate penal action including withdrawal of approval shall be initiated against the Institution



- 3 That the institution shall operate only from the approved location, and that the institution shall not open any off campus study centers/ extension centers directly or in collaboration with any other institution/ university/ organization for the purpose of imparting technical education without obtaining prior approval from the AICTE.
- 4 That the tuition and other fees shall be charged as prescribed by the Competent Authority within the overall criteria prescribed by the Council from time to time. No capitation fee shall be charged from the students/ guardians of students in any form.
- 5 That the accounts of the Institution shall be audited annually by a certified Chartered Accountant and shall be open for inspection by the Council or any body or persons authorized by it.
- 6 That the Director/ Principal and the teaching and other staff shall be selected according to procedures, qualifications and experience prescribed by the Council from time to time and pay scales are as per the norms prescribed by the Council from time to time.
- 7 (a) That the institution shall furnish requisite returns and reports as desired by AICTE in order to ensure proper maintenance of administrative and academic standards.  
(b) That the technical institution shall publish an information booklet before commencement of the academic year giving details regarding the institution and courses/ programmes being conducted and details of infrastructural facilities including faculty etc. in the form of mandatory disclosure. The information booklet may be made available to the stakeholders of the technical education on cost basis. The mandatory disclosure information shall be put on the Institution Website. The information shall be revised every year with updated information about all aspects of the institution.  
(c) That it shall be mandatory for the technical institution to maintain a Website providing the prescribed information. The Website information must be continuously updated as and when changes take place.  
(d) That a compliance report in the prescribed format along with mandatory disclosures on fulfillment of the above conditions, shall be submitted each year by the Institution within the time limit prescribed by the Council from time to time i.e. **31<sup>st</sup> August 2007 for the current year.**  
(e) That if Technical Institution fails to disclose the information or suppress and/ or misrepresent the information, appropriate action could be initiated including withdrawal of AICTE approval.
- 8 That all the laboratories, workshops etc. shall be equipped as per the syllabi of the concerned affiliated University and shall be in operational condition before making admissions.
- 9 That a library shall be established with adequate number of titles, books, journals (both Indian & Foreign) etc as per AICTE norms.
- 10 That a computer center with adequate number of terminals, Printers etc. shall be established as per AICTE norms.
- 11 AICTE may carry out random inspections round the year for verifying the status of the Institutions to ensure maintenance of norms and standards.
- 12 That the AICTE may also conduct inspections with or without notifying the dates to verify specific complaints of mis-representation, violation of norms and standards, mal-practices etc.
- 13 That the Institution by virtue of the approval given by Council shall not automatically become claimant to any grant-in-aid form the Central or State Government.
- 14 That the Management shall strictly follow further conditions as may be specified by the Council from time to time.

15. In the event of non-compliance by the FR. CONCEICAO RODRIGUES COLLEGE OF ENGG FATHER ANGEL ASHRAM, BAND STAND, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050 with regard to guidelines, norms and conditions prescribed from time to time the Council shall be free to take measures for withdrawal of its approval or recognition, without consideration of any related issues and that all liabilities arising out of such withdrawal would solely be that of FR. CONCEICAO RODRIGUES COLLEGE OF ENGG FATHER ANGEL ASHRAM, BAND STAND, P.B. NO.: 6656, BUS STAND, BANDRA(W), BOMBAY - 400 050 .

Yours faithfully,



(Harish C. Rai)

Adviser- UG/PG (E&T)

**Copy to:**

1. Director of Technical Education, Govt. of Maharashtra  
3, Mahapalika Marg, Mumbai-400001.
2. The Registrar, BOMBAY UNIVERSITY  
(He is requested to complete the process of affiliation for facilitating admissions).
3. The Regional officer , Western Regional Office, AICTE,  
Industrial Assurance Building 2<sup>nd</sup> Floor, Veer Nariman Road,  
Opp. Chrucagate Rly. Station, Mumbai-400020
4. ✓ The Principal,  
FR. CONCEICAO RODRIGUES COLLEGE OF ENGG  
FATHER ANGEL ASHRAM, BAND STAND, P.B. NO.: 6656,  
BUS STAND, BANDRA(W), BOMBAY - 400 050  
(Relevant AICTE regulations / notifications / guidelines pertaining to Admission, Fees and Tuitions  
Fees waiver schemes are also annexed).
5. Guard File (UG/PG).





Received on  
17-6-2008  
M. Kulkarni

# अखिल भारतीय तकनीकी शिक्षा परिषद् ALL INDIA COUNCIL FOR TECHNICAL EDUCATION

(भारत सरकार का एक सांविधिक निकाए) (A STATUTORY BODY OF THE GOVT. OF INDIA)

F. No. 740-89-213(E)/RC/95

May 2, 2008

To,  
The Principal Secretary,  
Higher & Technical Education and Employment Development,  
Govt. of Maharashtra,  
Mantralaya, Mumbai - 400 032

Sub: Extension of approval to **SOCIETY OF ST.FRANCIS XAVIER, PILAR, FR.CONCEICAO RODRIGUES COLLEGE OF ENGINEERING, FATHER ANGEL ASHRAM, BAND STAND P.B. NO: 6656, BUS STAND, BANDRA WEST, MUMBAI - 400 050.**

Sir,

As per the Regulations notified by the Council vide F.No. 37-3/Legal/2006 dated 14<sup>th</sup> September 2006 and norms, standards, procedures and conditions prescribed by the Council from time to time and based on the recommendations of Appraisal Committee/Expert Committee, I am directed to convey the extension of approval of the Council to **SOCIETY OF ST.FRANCIS XAVIER, PILAR, FR.CONCEICAO RODRIGUES COLLEGE OF ENGINEERING, FATHER ANGEL ASHRAM, BAND STAND P.B. NO: 6656, BUS STAND, BANDRA WEST, MUMBAI - 400 050** for conduct of the following courses with the intake indicated below:

Name of the Course(s)	Existing Intake	Revised Intake	Period of approval
COMPUTER ENGINEERING	60	60	2008-11*
ELECTRONICS ENGINEERING	60	60	
INFORMATION TECHNOLOGY	30	30	
M.E. ELECTRONICS ENGG.	18	18	
M.E. MECHANICAL ENGG.	18	18	
M.E. PRODUCTION ENGG. (PT)	10	10	
PRODUCTION ENGINEERING	60	60	
<b>Total</b>	<b>256</b>	<b>256</b>	

\* The compliance Report along with requisite processing fee is required to be submitted every year by 31<sup>st</sup> August irrespective of the period of approval.

The above approval is subject to rectification of the following observations / deficiencies / specific conditions by 31<sup>st</sup> August 2008.

➤ Faculty :

- ❖ No Ph.D qualified faculty in M.E. Electronics Engg.
- ❖ Overall faculty is short by 5%.
- ❖ The faculty shortfall in various branches is as follows:

Course (s)	Faculty required	Faculty available	Shortfall No.
BASIC SCIENCE & HUM.	14	08	06

➤ BUILT-UP AREA:

	Required	Available	Shortfall Number
Total Built-Up Area	12074	11483	591(5%)

➤ Others :

- ❖ The deficiencies communicated in the last approval letter are not fully complied with.
- ❖ Infrastructural facilities in terms of Built up Area/equipments /machinery, faculty, library etc to made available as per AICTE norms/syllabus.

7वाँ तल, चन्द्रलोक भवन, जनपथ नई दिल्ली-110001

7th Floor, Chander Lok Building, Janpath, New Delhi-110001

Phone : 011-2372415/57 Fax : 011-23724183 Website : www.aicte.ernet.in

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**Note: The mandatory disclosure in prescribed format is required to be hosted on the website as per directions in the AICTE website failing which, action would be initiated as per the rules and regulations of the AICTE including No Admission / Withdrawal of approval.**

The institution is required to submit two copies of the Compliance Report, indicating the rectification of deficiencies along with mandatory disclosure and details of faculty recruited for each course in the prescribed format (available at AICTE Website [www.aicteernet.in](http://www.aicteernet.in)) to the concerned Regional Office latest by 31<sup>st</sup> August 2008 for consideration of approval beyond the session 2008-09. It may be noted that all the institutions are required to submit the compliance Report alongwith requisite processing fee by 31<sup>st</sup> August every year irrespective of the period of approval .

The Compliance Report must be accompanied with a processing fee of Rs. 40,000/- in the form of demand draft in the favour of Member Secretary, AICTE, payable at New Delhi. In the absence of processing fee the Compliance Report will not be entertained. Following the Compliance report, the Council would verify the status in respect of rectification of deficiencies through surprise random inspection without any prior notice.

The above approval if granted after rectification of deficiencies would be subject to the fulfillment of the following general conditions:

- 1 That the management shall provide adequate funds for development of land and for providing related infrastructural, instructional and other facilities as per norms and standards laid down by the Council from time to time and for meeting recurring expenditure.
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(c) That the curriculum of the course, the procedure for evaluation/ assessment of students shall be in accordance with the norms prescribed by the AICTE.  
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- (e) That if Technical Institution fails to disclose the information or suppress and/ or misrepresent the information, appropriate action could be initiated including withdrawal of AICTE approval.
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- 12 That the AICTE may also conduct inspections with or without notifying the dates to verify specific complaints of mis-representation, violation of norms and standards, mal-practices etc.
- 13 That the Institution by virtue of the approval given by Council shall not automatically become claimant to any grant-in-aid from the Central & State Government.
- 14 That in the event of student/candidate withdrawing before the starting of the course, the wait listed candidates should be given admission against the vacant seat. The entire fee collected from the student, after a deduction of the processing fee of not more than Rs. 1000/- (Rupees one thousand only) shall be refunded and returned by the Institution/University to the student/candidate withdrawing from the programme. It would not be permissible for Institutions and Universities to retain the School/Institution Leaving Certificate in original to force retention of admitted students (See Public Notice aicte/DPG/03(01)/2008)
- 15 The Institute shall take appropriate measures for prevention of ragging in any form, in the light of directions of Supreme Court of India in Writ Petition No. © 656/1998. In case of failure to prevent the instances of ragging by the institutions, the Council shall take appropriate action including withdrawal of approval .
- 16 That the Management shall strictly follow further conditions as may be specified by the Council from time to time.

17. In the event of non-compliance by the **SOCIETY OF ST.FRANCIS XAVIER, PILAR, FR.CONCEICAO RODRIGUES COLLEGE OF ENGINEERING, FATHER ANGEL ASHRAM, BAND STAND P.B. NO: 6656, BUS STAND, BANDRA WEST, MUMBAI - 400 050** with regard to guidelines, norms and conditions prescribed from time to time the Council shall be free to take measures for withdrawal of its approval or recognition, without consideration of any related issues and that all liabilities arising out of such withdrawal would solely be that of **SOCIETY OF ST.FRANCIS XAVIER, PILAR, FR.CONCEICAO RODRIGUES COLLEGE OF ENGINEERING, FATHER ANGEL ASHRAM, BAND STAND P.B. NO: 6656, BUS STAND, BANDRA WEST, MUMBAI - 400 050**.

Yours faithfully,



(Harish C. Rai)

Adviser- UG/PG (E&T)

Copy to:

1. Director of Technical Education,  
Govt. of Maharashtra  
3, Mahapalika Marg, Mumbai-400001.
2. The Registrar, MUMBAI UNIVERSITY  
(He is requested to complete the process of affiliation for facilitating admissions).
3. AICTE-Western Regional Office  
2nd Floor, Industrial Assurance Building,  
V.N.Road, opp. Church gate Rly. Station,  
Church gate, Mumbai-400 020.
4. The Principal,  
**SOCIETY OF ST.FRANCIS XAVIER, PILAR  
FR.CONCEICAO RODRIGUES COLLEGE OF ENGINEERING,  
FATHER ANGEL ASHRAM BAND STAND,  
P.B. NO: 6656, BUS STAND, BANDRA WEST,  
MUMBAI - 400 050**
5. Guard File (UG/PG).



**ALL INDIA COUNCIL FOR TECHNICAL EDUCATION**  
**STATUS OF APPROVAL FOR AICTE APPROVED ENGINEERING & TECHNOLOGY**  
**INSTITUTIONS FOR THE YEAR 2009-10**

REGION: WEST

STATE: MAHARASHTRA

Sl.No.	Name & Address of the Institution/ Year of Establishment/ Status / Head of the Institution	Course(s)	Approved Intake 2008- 09	Approved Intake 2009- 10
	1999 / PRIVATE <b>Dr.A.J.Patil/30-04-65/ Ph.D</b> <b>Electronics</b> Email: ssjcoe_jal@sancharnet.in Web: www.ssjcoejalgoan.net O - (0257) O-2261136/ 2263036			
155.	SINDHUDURG SHIKSHAN PRASARK MANDAL COLLEGE OF ENGINEERING A/P HERKUL(BUDRUK) TAL: KANKAVALI SINDHUDURG - 416 602  1999 / PRIVATE <b>DR.P.S.Kadam/01-06-52/ Ph.D (Civil)</b> Email: sspmcoe@sancharnet.in Web: www.sspmcoe.com O - (02367) O-231775/ 233812 F - F-231525	COMPUTER ENGINEERING ELECTRICAL ENGINEERING ELECTRONICS & TELE COMM. ENGG. <b>Total</b>	60 60 120 <b>240</b>	60 60 120 <b>240</b>
156.	SINHGAD TECHNICAL EDUCATION SOCIETY SINHGAD INSTITUTE OF TECHNOLOGY GAT NO.309,310 & 314 PUNE-BOMBAY EXPRESS HIGHWAY, KUSGAON(BK), LONAWALA ,PUNE - 410 401  2004 / PRIVATE <b>Prof. S.S.Inamdar/31-01-65/Ph.D</b> Email: stes@pn2.vsnl.net.in Web: www.sinhgad.edu O - (02114-280261, 304355-353 Fax- 02114-280210	COMPUTER ENGINEERING ELECTRONICS & TELECOMM. ENGG. INFORMATION TECHNOLOGY MECHANICAL ENGINEERING MCA <b>Total</b>	120 120 60 60 60 <b>420</b>	120 120 60 60 60 <b>420</b>
157.	SINHGAD TECHNICAL EDUCATION SOCIETY SINHGAD ACADEMY OF ENGINEERING KONDHAWA(BK) SASWAD ROAD PUNE - 411048  2005 / PRIVATE <b>Dr.Avinash Ganesh Khakrat/ 30-03- 55/ Ph.d</b> Email: sae.principal@rediffmail.com Web: www.sinhgad.edu O - 020-26934441,26934550 F - 020-26934297	COMPUTER ENGINEERING ELECTRONICS & TELE COMM. ENGG. INFORMATION TECHNOLOGY MECHANICAL ENGINEERING <b>Total</b>	60 120 60 60 <b>300</b>	60 120 60 60 <b>300</b>
158.	SOCIETY OF ST.FRANCIS XAVIER, PILAR FR.CONCEICAO RODRIGUES COLLEGE OF ENGINEERING FATHER AGNEL ASHRAM, BAND STAND, P.B. NO: 6656, BANDRA WEST, MUMBAI - 400 050	COMPUTER ENGINEERING ELECTRONICS ENGINEERING INFORMATION TECHNOLOGY PRODUCTION ENGINEERING M.E. ELECTRONICS ENGG. M.E. MECHANICAL ENGG. M.E. PRODUCTION ENGG. (PT) <b>Total</b>	60 60 30 60 18 18 10 <b>256</b>	60 60 30 60 18 18 10 <b>256</b>



**ALL INDIA COUNCIL FOR TECHNICAL EDUCATION  
STATUS OF APPROVAL FOR AICTE APPROVED ENGINEERING & TECHNOLOGY  
INSTITUTIONS FOR THE YEAR 2009-10**

REGION: WEST

STATE: MAHARASHTRA

Sl.No.	Name & Address of the Institution/ Year of Establishment/ Status / Head of the Institution	Course(s)	Approved Intake 2008- 09	Approved Intake 2009- 10
--------	--	-----------	--------------------------------	--------------------------------

	1984 / PRIVATE  <b>Dr.A.S. Deshpande/ 19-02-64/ Ph.D CAD/CAM</b> Email: <a href="mailto:crce@frcrce.ac.in">crce@frcrce.ac.in</a> Web: <a href="http://www.frcrce.ac.in">www.frcrce.ac.in</a>  O - (022-26423841/ 26423841/42/004. F - F-26516831			
159.	THE BOMBAY SALESIAN SOCIETY DON-BOSCO INSTITUTE OF TECHNOLOGY PREMIER AUTOMOBILE ROAD KURLA(W) MUMBAI - 400 070  2001 / PRIVATE  <b>Dr.N.G.Joag/19-05-54/Ph.D Chemical</b> Email: <a href="mailto:dbit@donbosco.coit.ac.in">dbit@donbosco.coit.ac.in</a> Web: <a href="http://www.donbosco.coit.ac.in">www.donbosco.coit.ac.in</a> O - (022) O-24180314/16/ 17 F - F-24145226	COMPUTER ENGINEERING ELECTRONICS & TELE COMM. ENGG. INFORMATION TECHNOLOGY MECHANICAL ENGG. <b>Total</b>	60 90 60 60 <b>270</b>	60 90 60 60 <b>270</b>
160.	THE BOMBAY XAVIERIAN CORPORATION PVT.LTD. XAVIER INSTITUTE OF ENGINEERING C/o St.XAVIER'S TECHNICAL INSTITUTE MAHIM CAUSEWAY, MAHIM, MUMBAI - 400016  2005 / PRIVATE  <b>Prof. R B Gowardhan/ 28-06-62/Ph.D Env. Engg</b> Email: <a href="mailto:office@xaviertech.com">office@xaviertech.com</a>  O - 022-24451961, 24455937 F - 022-24462267	COMPUTER SC. & ENGG. ELECTRONICS & TELE COMM. ENGG. INFORMATION TECHNOLOGY <b>Total</b>	60 60 60 <b>180</b>	60 60 60 <b>180</b>
161.	THE NAGPUR PALLOTTINE SOCIETY ST.VINCENT PALLOTTI COLLEGE OF ENGG. & TECHNOLOGY GAVSI MANAPUR WARDHA ROAD NAGPUR - 441 108  2004 / PRIVATE  <b>Prof. R.B.Gowardhan/02-03- 59/M.Tech</b> Email: <a href="mailto:info@stvincentngp.com">info@stvincentngp.com</a> Web: <a href="http://www.stvincentngp.com">www.stvincentngp.com</a> O - (0712) 261711,261712 F - 0712-261632	COMPUTER ENGINEERING ELECTRICAL ENGINEERING ELECTRONICS & TELECOMM. ENGG. MECHANICAL ENGINEERING INFORMATION TECHNOLOGY <b>Total</b>	60 60 60 120 60 <b>360</b>	60 60 60 120 60 <b>360</b>
162.	THE SHETKARI SHIKSHAN MANDAL PADMABHOOSHAN VASANTDADA PATIL INSTITUTE OF TECH. S.V.NO.33/22, BAVADHAN (KHURD)MULASHI,	COMPUTER SCIENCE & ENGINEERING ELECTRONICS & TELECOMM. ENGG. MECHANICAL ENGINEERING MBA <b>Total</b>	60 120 60 60 <b>300</b>	60 120 60 60 <b>300</b>



All India Council for Technical Education

(A Statutory body under Ministry of HRD, Govt. of India)

7th Floor, Chandralok Building, Janpath, New Delhi- 110 001

PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 www.aicte-India.org

## CORRIGENDUM

No: Western Region, Maharashtra/1-4317814 /2010/EOA

November 08 ,2010

Following amendment is made to the Council's letter No. Western Region, Maharashtra/1-4317814 /2010/EOA dated: August 23, 2010 regarding Grant of Approval to

**SOCIETY OF ST.FRANCIS XAVIER, PILAR, FR.CONCEICAO RODRIGUES COLLEGE OF ENGINEERING, FR. AGNEL ASHRAM, BAND STAND, BANDRA (WEST), MUMBAI-400 050 MAHARASHTRA**

for the academic year 2010-11 :-

In Table indicating name of programme and intake for the year 2010-11

1.

For Sr. No	Program	Level	Shift	Course	Intake 2009-10	Intake 2010-11
1	Engg/Tech.	UG	First Shift	PRDUCTION ENGINEERING	60	60
3	Engg/Tech.	UG	First Shift	ELECTRICAL / ELECTRICAL & ELEX	60	60
4	Engg/Tech.	UG	First Shift	COMPUTER SCIENCE & ENGINEERING	60	60
5	Engg/Tech.	PG	First Shift	PRDUCTION ENGINEERING	10	10
6	Engg/Tech.	PG	First Shift	MECHANICAL ENGG.	18	18
7	Engg/Tech.	PG	First Shift	ELECTRICAL / ELECTRICAL & ELEX	18	18

Read Sr. No	Program	Level	Shift	Course	Intake 2009-10	Intake 2010-11
1	Engg/Tech.	UG	First Shift	PRODUCTION ENGINEERING	60	60
3	Engg/Tech.	UG	First Shift	ELECTRONICS ENGG.	60	60
4	Engg/Tech.	UG	First Shift	COMPUTER ENGINEERING	60	60
5	Engg/Tech.	PG	First Shift	PRODUCTION ENGINEERING (PT)	10	10
6	Engg/Tech.	PG	First Shift	MECHANICAL ENGG. (CAD/CAM)	18	18
7	Engg/Tech.	PG	First Shift	ELECTRONICS ENGG.	18	18

2. Other entries remain unchanged.

(Dr. S.G.Bhirud)  
Director

To,

The Secretary  
Higher & Technical Education & Employment Deptt.,  
Govt. of Maharashtra, Mantralaya, Mumbai - 400 032.

Copy To:

1. The Regional Officer, Western Region, Mumbai, Maharashtra.
2. The Director of Technical Education, Govt. of Maharashtra, Mumbai.
3. Guard File (AICTE)
4. The Registrar, Affiliating University
5. The Principal / Director, SOCIETY OF ST.FRANCIS XAVIER, PILAR, FR.CONCEICAO RODRIGUES COLLEGE OF ENGINEERING, FR. AGNEL ASHRAM, BAND STAND, BANDRA (WEST), MUMBAI-400 050 MAHARASHTRA

**WESTERN REGIONAL OFFICE**

**All India Council for Technical Education**  
(A Statutory body under Ministry of India)  
2nd Floor, Chandralok Building,  
V. N. Road off Chhatrapati Rly. Station,  
Churchgate, Mumbai - 400 020.

FR. CRCE - BANDRA INWARD MAIL	
Inward No.	438
Date	12-11-2010
Sign	

S.J





**All India Council for Technical Education**  
(A Statutory Body under Ministry of HRD, Govt of India)

7th floor, Chandralok Building, Janpath, New Delhi 110 001  
Phone : 11 23724151-57 FAX : 11 23724183 www.aicte-india.org

No. : Western Region, Maharashtra/1-4317814/2010/EOA

August 23, 2010

To,  
Secretary Tech. & Higher Education Deptt. Govt. of Maharashtra,  
Mantralaya, Annexe Building, Mumbai-400032

Sub. : Extension of approval for the academic year 2010-11.

Sir,

In terms of the Regulations notified by the Council vide F. No. 37-3/Legal/2010 and norms, standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the extension of approval of the Council to .

**SOCIETY OF ST. FRANCIS XAVIER PILAR, FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING, FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W), MUMBAI, MAHARASHTRA, PIN : 400050**

for conduct of the following courses with the intake indicated below in the academic year 2010-11:

Sr. No.	Program	Level	Shift	Course	Intake 2009-10	Intake 2010-11
1	Engg. / Tech.	UG	First Shift	PRDUCTION ENGINEERING	60	60
2	Engg. / Tech.	UG	First Shift	INFORMATION TECHNOLOGY	30	60
3	Engg. / Tech.	UG	First Shift	ELECTRICAL / ELECTRICAL & ELEX	60	60
4	Engg. / Tech.	UG	First Shift	COMPUTER SCIENCE & ENGINEERING	60	60
5	Engg. / Tech.	PG	First Shift	PRDUCTION ENGINEERING	10	10
6	Engg. / Tech.	PG	First Shift	MECHANICAL ENGINEERING	18	18
7	Engg. / Tech.	PG	First Shift	ELECTRICAL / ELECTRICAL & ELEX	18	18

The above mentioned approval is subject to the condition that :

**SOCIETY OF ST. FRANCIS XAVIER PILAR, FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING, FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W), MUMBAI, MAHARASHTRA, PIN : 400050**

shall follow and adhere to the regulations, guidelines and directions issued by AICTE from time to time and the undertaking / affidavit given by the institution along with the application submitted by the institution on portal and hard copy to Regional Office.

Anti Ragging - The approval is subject to the institutions strictly complying with all the provisions made under the Anti ragging regulation notified by council vide F.No. 37/Legal/AICTE/2009 dated 1-7-2009 failing which, it will be liable to any action defined under clause 9(4) of this regulation.

Yours faithfully,

Dr. S. G. Bhirud  
Director

**WESTERN REGIONAL OFFICE**  
OF  
**All India Council For Technical Education**  
(A Statutory Body of Govt of India)  
1st Floor, Industrial Assurance Bldg.  
V N Road Opp Churchgate Rly Station,  
Churchgate, Mumbai - 400 020.







**All India Council for Technical Education**  
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7th floor, Chandralok Building, Janpath, New Delhi 110 001  
Phone : 11 23724151-57 FAX : 11 23724183 www.aicte-india.org

Copy to :

1. The Regional Office, Western Region, Maharashtra
2. The Director of Technical Education, Govt. of ~~Delhi~~ <sup>M.S.</sup>
3. Guard File (AICTE)
4. The Registrar, Affiliating University

✓ The Principal / Director,

SOCIETY OF ST. FRANCIS XAVIER PILAR, FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING, FR. AGNEL ASHRAM, BANDSTAND,  
BANDRA(W), MUMBAI, MAHARASHTRA. PIN : 400050





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PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 www.aicte-India.org

F.No. Western/1-398867541/2011/EOA

Date: 01-09-2011

To,  
The Secretary,  
Tech. & Higher Education Deptt.  
Govt. of Maharashtra, Mantralaya,  
Annexe Building, Mumbai-400032

FR. CRCE - BANDRA INWARD MAIL	
Inward No.	280
Date	3-9-2011
Sign	

Sub: Extension of approval for the academic year 2011-12.  
Ref : Application of the Institution for Extension of Approval for the Year 2011-12

Sir/Madam,

In terms of the Regulations notified by the Council vide F.No. 37-3/Legal/2011 dated 10/12/2010 and norms, standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the extension of approval of the Council to

Regional Office	Western	Application Id	1-398867541
		Permanent Id	1-4317814
Name of the Institute	FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING	Institute Address	FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W),MUMBAI,MUMBAI SUBURBAN,Maharashtra,400050
Name of the Society/Trust	SOCIETY OF ST. FRANCIS XAVIER, PILAR	Society/Trust Address	FR. AGNEL ASHRAM, BANDSAND BANDRA (WEST),MUMBAI,MUMBAI SUBURBAN,Maharashtra,400050
Institute Type	Unaided - Private		

to conduct following courses with the intake indicated below for the academic year 2011-12

Application Id: 1-398867541			Course	Full/Part Time	Affiliating Body	Intake 2010-11	Intake Approved for 11-12	NRI	PIO	Foreign Collaboration
Program	Shift	Level								
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	MECHANICAL ENGINEERING	FULL TIME	Mumbai University	18	18	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	PRODUCTION ENGINEERING	FULL TIME	Mumbai University	60	60	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University	60	60	No	No	No

Application Number : 1-398867541

Page 1 of 3

Note: This is a Computer generated Extension of Approval Letter. No signature is required.

Date of printing: 02-09-2011





Application Id: 1-398867541			Course	Full/Part Time	Affiliating Body	Intake 2010-11	Intake Approved for 11-12	NRI	PIO	Foreign Collaboration
Program	Shift	Level								
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	COMPUTER ENGINEERING	FULL TIME	Mumbai University	60	60	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	INFORMATION TECHNOLOGY	FULL TIME	Mumbai University	60	60	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	PRODUCTION ENGINEERING	PART TIME	Mumbai University	10	10	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University	18	18	No	No	No

The above mentioned approval is subject to the condition that FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING shall follow and adhere to the Regulations, guidelines and directions issued by AICTE from time to time and the undertaking / affidavit given by the institution along with the application submitted by the institution on portal.

In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

Strict compliance of Anti-Ragging Regulation:- Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 37-3/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

(Dr. K P Isaac)



All India Council for Technical Education  
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7th Floor, Chandralok Building, Janpath, New Delhi- 110 001  
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Member Secretary, AICTE

Copy to:

1. **The Regional Officer,**  
All India Council for Technical Education  
Industrial Assurance Building  
2nd Floor, Nariman Road  
Mumbai - 400 020, Maharashtra
2. **The Director Of Technical Education,**  
Maharashtra
3. **The Registrar,**  
Mumbai University
4. **The Principal / Director,**  
FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING  
FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W),  
MUMBAI, MUMBAI SUBURBAN,  
Maharashtra, 400050
5. **The Secretary / Chairman,**  
SOCIETY OF ST. FRANCIS XAVIER, PILAR  
FR. AGNEL ASHRAM,  
BANDSAND  
BANDRA (WEST),  
MUMBAI, MUMBAI SUBURBAN,  
Maharashtra, 400050
6. **Guard File(AICTE)**





All India Council for Technical Education  
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PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 www.aicte-India.org

F.No. Western/1-692109251/2012/EOA

Date: 10 May 2012

To,  
The Secretary,  
Tech. & Higher Education Deptt.  
Govt. of Maharashtra, Mantralaya,  
Annexe Building, Mumbai-400032

S.P.  
17/05/12

Sub: Extension of approval for the academic year 2012-13

Ref: Application of the Institution for Extension of approval for the academic year 2012-13

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2010 notified by the Council vide notification number F-No.37-3/Legal/2010 dated 10/12/2010 and amendment vide notification number F-No.37-3/Legal/2011 dated 30/09/2011 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

Regional Office	Western	Application Id	1-692109251
		Permanent Id	1-4317814
Name of the Institute	FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING	Institute Address	FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
Name of the Society/Trust	SOCIETY OF ST. FRANCIS XAVIER, PILAR	Society/Trust Address	FR. AGNEL ASHRAM, BANDSAND BANDRA (WEST), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
Institute Type	Unaided - Private		

Opted for change from Women to Co-ed	No	Opted for change of name	No	Opted for change of site	No
Change from Women to Co-ed approved	Not Applicable	Change of name Approved	Not Applicable	Change of site Approved	Not Applicable

to conduct following courses with the intake indicated below for the academic year 2012-13

Application Number: 1-692109251\*

Page 1 of 4

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Letter Printed On: 17 May 2012.

Printed By : AE223261



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Application Id: 1-692109251			Course		Affiliating Body					
Program	Shift	Level		Full/Part Time		Intake 2011-12	Intake Approved for 12-13	NRI	PIO	Foreign Collaboration
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	MECHANICAL ENGINEERING	FULL TIME	Mumbai University	18	18	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	PRODUCTION ENGINEERING	FULL TIME	Mumbai University	60	60	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University	60	60	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	COMPUTER ENGINEERING	FULL TIME	Mumbai University	60	60	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	INFORMATION TECHNOLOGY	FULL TIME	Mumbai University	60	60	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	PRODUCTION ENGINEERING	PART TIME	Mumbai University	10	10	No	No	No





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PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 [www.aicte-india.org](http://www.aicte-india.org)

Application Id: 1-692109251			Course	Full/Part Time	Affiliating Body	Intake 2011-12	Intake Approved for 12-13	NRI	PIO	Foreign Collaboration
Program	Shift	Level								
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University	18	18	No	No	No

The above mentioned approval is subject to the condition that FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING shall follow and adhere to the Regulations, guidelines and directions issued by AICTE from time to time and the undertaking / affidavit given by the institution along with the application submitted by the institution on portal.

In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

Strict compliance of Anti-Ragging Regulation:- Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 37-3/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

(Dr. K P Isaac)

Member Secretary, AICTE

Copy to:

- The Regional Officer,**  
All India Council for Technical Education  
Industrial Assurance Building  
2nd Floor, Nariman Road  
Mumbai - 400 020, Maharashtra
- The Director Of Technical Education.**  
Maharashtra
- The Registrar,**  
Mumbai University
- The Principal / Director,**  
FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING  
FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W),  
MUMBAI.MUMBAI SUBURBAN.  
Maharashtra.400050

Application Number: 1-692109251\*

Page 3 of 4

Note: This is a Computer generated Extension of Approval Letter. No signature is required.

Letter Printed On:17 May 2012.

Printed By : AE223261





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PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 [www.aicte-India.org](http://www.aicte-India.org)

5. **The Secretary / Chairman,**  
SOCIETY OF ST. FRANCIS XAVIER, PILAR  
FR. AGNEL ASHRAM,  
BANDSAND  
BANDRA (WEST),  
MUMBAI.MUMBAI SUBURBAN,  
Maharashtra.400050
  
6. **Guard File(AICTE)**



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F.No Western/1-1341235462/2013/EOA

Date: 19-Mar-2013

To,  
The Secretary,  
Tech. & Higher Education Deptt.  
Govt. of Maharashtra, Mantralaya,  
Annexe Building, Mumbai-400032

Sub: Extension of approval for the academic year 2013-14

Ref: Application of the Institution for Extension of approval for the academic year 2013-14

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2012 notified by the Council vide notification number F-No.37-3/Legal/2012 dated 27/09/2012 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

Regional Office	Western	Application Id	1-1341235462
		Permanent Id	1-4317814
Name of the Institute	FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING	Institute Address	FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
Name of the Society/Trust	SOCIETY OF ST. FRANCIS XAVIER, PILAR	Society/Trust Address	FR. AGNEL ASHRAM, BANDSAND BANDRA (WEST), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
Institute Type	Unaided - Private		

Opted for change from Women to Co-ed	No	Opted for change of name	No	Opted for change of site	No
Change from Women to Co-ed approved	Not Applicable	Change of name Approved	Not Applicable	Change of site Approved	Not Applicable

to conduct following courses with the intake indicated below for the academic year 2013-14

<b>FR. CRCE - BANDRA</b> <b>INWARD MAIL</b>	
inward No	104
Date	21-3-2013
Sign	<i>[Signature]</i>

*S.X*

Application Number: 1-1341235462\*

Page 1 of 3

Note: This is a Computer generated Extension of Approval Letter. No signature is required.

Letter Printed On: 21 March 2013.

Printed By : AE223261



All India Council for Technical Education  
(A Statutory body under Ministry of HRD, Govt. of India)

7th Floor, Chandralok Building, Janpath, New Delhi- 110 001  
PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 [www.aicte-India.org](http://www.aicte-India.org)

Application Id: 1-1341235462			Course	Full/Part Time	Affiliating Body	Intake 2012-13	Intake Approved for 13-14	NRI	PIO	Foreign Collaboration
Program	Shift	Level								
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University, Mumbai	18	18	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	MECHANICAL ENGINEERING	FULL TIME	Mumbai University, Mumbai	18	18	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	PRODUCTION ENGINEERING	PART TIME	Mumbai University, Mumbai	10	10	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	COMPUTER ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	INFORMATION TECHNOLOGY	FULL TIME	Mumbai University, Mumbai	60	60	No	No	No
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	PRODUCTION ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	No	No	No

- Validity of the course details may be verified at [www.aicte-india.org>departments>approvals](http://www.aicte-india.org/departments>approvals)

The above mentioned approval is subject to the condition that FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING shall follow and adhere to the Regulations, guidelines and directions issued by AICTE from time to time and the undertaking / affidavit given by the institution along with the application submitted by the institution on portal.

In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

Application Number: 1-1341235462\*

Page 2 of 3

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Letter Printed On: 21 March 2013.

Printed By : AE223261





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PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 [www.aicte-India.org](http://www.aicte-India.org)

**Strict compliance of Anti-Ragging Regulation:-** Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 37-3/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

(Dr. Kuncheria P. Isaac)

Member Secretary, AICTE

Copy to:

1. **The Regional Officer,**  
All India Council for Technical Education  
Industrial Assurance Building  
2nd Floor, Nariman Road  
Mumbai - 400 020, Maharashtra
2. **The Director Of Technical Education,**  
Maharashtra
3. **The Registrar,**  
Mumbai University, Mumbai
4. **The Principal / Director,**  
FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING  
FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W),  
MUMBAI, MUMBAI SUBURBAN,  
Maharashtra, 400050
5. **The Secretary / Chairman,**  
SOCIETY OF ST. FRANCIS XAVIER, PILAR  
FR. AGNEL ASHRAM,  
BANDSAND  
BANDRA (WEST),  
MUMBAI, MUMBAI SUBURBAN,  
Maharashtra, 400050
6. **Guard File(AICTE)**



All India Council for Technical Education  
(A Statutory body under Ministry of HRD, Govt. of India)

7th Floor, Chandralok Building, Janpath, New Delhi- 110 001  
PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 [www.aicte-India.org](http://www.aicte-India.org)

F.No. Western/1-2013004110/2014/EOA

Date: 04-Jun-2014

To,  
The Secretary,  
Tech. & Higher Education Deptt.  
Govt. of Maharashtra, Mantralaya,  
Annexe Building, Mumbai-400032

Sub: Extension of approval for the academic year 2014-15

Ref: Application of the Institution for Extension of approval for the academic year 2014-15

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2012 notified by the Council vide notification number F-No.37-3/Legal/2012 dated 27/09/2012 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

Regional Office	Western	Application Id	1-2013004110
		Permanent Id	1-4317814
Name of the Institute	FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING	Institute Address	FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
Name of the Society/Trust	SOCIETY OF ST. FRANCIS XAVIER, PILAR	Society/Trust Address	FR. AGNEL ASHRAM, BANDSAND BANDRA (WEST), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
Institute Type	Unaided - Private		

Opted for change from Women to Co-ed	No	Opted for change of name	No	Opted for change of site	No
Change from Women to Co-ed approved	Not Applicable	Change of name Approved	Not Applicable	Change of site Approved	Not Applicable

to conduct following courses with the intake indicated below for the academic year 2014-15

Application Number: 1-2013004110\*

Page 1 of 4

Note: This is a Computer generated Letter of Approval.No signature is required.

Letter Printed On:5 June 2014

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Application Id: 1-2013004110			Course	Full/Part Time	Affiliating Body	Intake 2013-14	Intake Approved for 14-15	NRI Approval status	PIO Approval status	Foreign Collaboration Approval status
Program	Shift	Level								
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University, Mumbai	18	18	No	No	N
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	MECHANICAL ENGINEERING	FULL TIME	Mumbai University, Mumbai	18	18	No	No	N
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	PRODUCTION ENGINEERING	PART TIME	Mumbai University, Mumbai	10	10	No	No	N
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	COMPUTER ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	No	No	N
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	No	No	N
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	INFORMATION TECHNOLOGY	FULL TIME	Mumbai University, Mumbai	60	60	No	No	N
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	PRODUCTION ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	No	No	N

- Validity of the course details may be verified at [www.aicte-india.org>departments>approvals](http://www.aicte-india.org/departments/approvals)

The above mentioned approval is subject to the condition that FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING shall follow and adhere to the Regulations, guidelines and directions issued by AICTE from time to time and the undertaking / affidavit given by the institution along with the application submitted by the institution on portal and subsequently upload and update the student/ faculty/ other data on portal as per the time schedule which will be intimated by AICTE.



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7th Floor, Chandralok Building, Janpath, New Delhi- 110 001  
PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 [www.aicte-india.org](http://www.aicte-india.org)

In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

Strict compliance of Anti-Ragging Regulation:- Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 37-3/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

(Dr. Kuncheria P. Isaac)  
Member Secretary, AICTE

Copy to:

1. **The Regional Officer,**  
All India Council for Technical Education  
Industrial Assurance Building  
2nd Floor, Nariman Road  
Mumbai - 400 020, Maharashtra
2. **The Director Of Technical Education,**  
Maharashtra
3. **The Registrar,**  
Mumbai University, Mumbai
4. **The Principal / Director,**  
FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING  
FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W),  
MUMBAI,MUMBAI SUBURBAN,  
Maharashtra,400050
5. **The Secretary / Chairman,**  
SOCIETY OF ST. FRANCIS XAVIER, PILAR  
FR. AGNEL ASHRAM,  
BANDSAND  
BANDRA (WEST),  
MUMBAI.MUMBAI SUBURBAN,  
Maharashtra,400050
6. **Guard File(AICTE)**

Application Number: 1-2013004110\*

Page 3 of 4

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Letter Printed On:5 June 2014

Printed By : ae223261





F.No. Western/1-2450713534/2015/EOA

Date: 07-Apr-2015

To,  
The Secretary,  
Tech. & Higher Education Deptt.  
Govt. of Maharashtra, Mantralaya,  
Annexe Building, Mumbai-400032

**Sub: Extension of approval for the academic year 2015-16**

Ref: Application of the Institution for Extension of approval for the academic year 2015-16

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2012 notified by the Council vide notification number F-No.37-3/Legal/2012 dated 27/09/2012 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

Regional Office	Western	Application Id	1-2450713534
		Permanent Id	1-4317814
Name of the Institute	FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING	Institute Address	FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
Name of the Society/Trust	SOCIETY OF ST. FRANCIS XAVIER, PILAR	Society/Trust Address	FR. AGNEL ASHRAM, BANDSAND BANDRA (WEST), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
Institute Type	Unaided - Private		

Opted for change from Women to Co-ed	No	Opted for change of name	No	Opted for change of site	No
Change from Women to Co-ed approved	Not Applicable	Change of name Approved	Not Applicable	Change of site Approved	Not Applicable

To conduct following courses with the intake indicated below for the academic year 2015-16



Application Id: 1-2450713534			Course	Full/Part Time	Affiliating Body	Intake 2014-15	Intake Approved for 15-16	NRI Approval status	PIO Approval status	Foreign Collaboration Approval status
Program	Shift	Level								
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University, Mumbai	18	18	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	MECHANICAL ENGINEERING	FULL TIME	Mumbai University, Mumbai	18	18	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	PRODUCTION ENGINEERING	PART TIME	Mumbai University, Mumbai	10	10	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	COMPUTER ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	INFORMATION TECHNOLOGY	FULL TIME	Mumbai University, Mumbai	60	60	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	PRODUCTION ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	NA	NA	NA

Note: Validity of the course details may be verified at [www.aicte-india.org](http://www.aicte-india.org)>departments>approvals

The above mentioned approval is subject to the condition that FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING shall follow and adhere to the Regulations, guidelines and directions issued by AICTE from time to time and the undertaking / affidavit given by the institution along with the application submitted by the institution on portal.



All India Council for Technical Education  
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7th Floor, Chandralok Building, Janpath, New Delhi- 110 001  
PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 [www.aicte-India.org](http://www.aicte-India.org)

In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

Strict compliance of Anti-Ragging Regulation:- Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 37-3/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

**Dr. Avinash S Pant**  
**Actg Chairman, AICTE**

Copy to:

1. **The Regional Officer,**  
All India Council for Technical Education  
Industrial Assurance Building  
2nd Floor, Nariman Road  
Mumbai - 400 020, Maharashtra
2. **The Director Of Technical Education,**  
Maharashtra
3. **The Registrar,**  
Mumbai University, Mumbai
4. **The Principal / Director,**  
FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING  
FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W),  
MUMBAI,MUMBAI SUBURBAN,  
Maharashtra,400050
5. **The Secretary / Chairman,**  
SOCIETY OF ST. FRANCIS XAVIER, PILAR  
FR. AGNEL ASHRAM,  
BANDSAND  
BANDRA (WEST),  
MUMBAI,MUMBAI SUBURBAN,  
Maharashtra,400050
6. **Guard File(AICTE)**



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PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 [www.aicte-India.org](http://www.aicte-India.org)

F.No. Western/1-2809252300/2016/EOA

Date: 05-Apr-2016

To,

The Secretary,  
Tech. & Higher Education Deptt.  
Govt. of Maharashtra, Mantralaya,  
Annexe Building, Mumbai-400032

**Sub: Extension of approval for the academic year 2016-17**

Ref: Application of the Institution for Extension of approval for the academic year 2016-17

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2012 notified by the Council vide notification number F-No.37-3/Legal/2012 dated 27/09/2012 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

Regional Office	Western	Application Id	1-2809252300
Name of the Institute	FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING	Permanent Id	1-4317814
Name of the Society/Trust	SOCIETY OF ST. FRANCIS XAVIER, PILAR	Institute Address	FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
Institute Type	Unaided - Private	Society/Trust Address	FR. AGNEL ASHRAM, BANDSAND BANDRA (WEST),MUMBAI,MUMBAI SUBURBAN,Maharashtra,400050

Opted for change from Women to Co-ed and Vice versa	No	Opted for change of name	No	Opted for change of site	No
Change from Women to Co-ed approved and Vice versa	Not Applicable	Change of name Approved	Not Applicable	Change of site Approved	Not Applicable

To conduct following courses with the intake indicated below for the academic year 2016-17

Application Id: 1-2809252300			Course	Full/Part Time	Affiliating Body	Intake 2015-16	Intake Approved for 2016-17	NRI Approval status	PIO / FN / Gulf quota Approval status	Foreign Collaboration/Twining Program Approval status*
Program	Shift	Level								
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUA	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University, Mumbai	18	18	NA	NA	NA



GY		TE								
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	MECHANICAL ENGINEERING	FULL TIME	Mumbai University, Mumbai	18	18	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	PRODUCTION ENGINEERING	PART TIME	Mumbai University, Mumbai	10	10	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	COMPUTER ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	INFORMATION TECHNOLOGY	FULL TIME	Mumbai University, Mumbai	60	60	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	PRODUCTION ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	NA	NA	NA

The above mentioned approval is subject to the condition that FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING shall follow and adhere to the Regulations, guidelines and directions issued by AICTE from time to time and the undertaking / affidavit given by the institution along with the application submitted by the institution on portal.

In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

Strict compliance of Anti-Ragging Regulation:- Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 37-3/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

**Note: Validity of the course details may be verified at [www.aicte-india.org](http://www.aicte-india.org)**



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7th Floor, Chandralok Building, Janpath, New Delhi- 110 001  
PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 [www.aicte-India.org](http://www.aicte-India.org)

**Dr. Avinash S Pant**  
**Vice - Chairman, AICTE**

Copy to:

1. **The Regional Officer,**  
All India Council for Technical Education  
Industrial Assurance Building  
2nd Floor, Nariman Road  
Mumbai - 400 020, Maharashtra
2. **The Director Of Technical Education,**  
Maharashtra
3. **The Registrar,**  
Mumbai University, Mumbai
4. **The Principal / Director,**  
FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING  
FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W),  
MUMBAI, MUMBAI SUBURBAN,  
Maharashtra, 400050
5. **The Secretary / Chairman,**  
SOCIETY OF ST. FRANCIS XAVIER, PILAR  
FR. AGNEL ASHRAM,  
BANDSAND  
BANDRA (WEST),  
MUMBAI, MUMBAI SUBURBAN,  
Maharashtra, 400050
6. **Guard File(AICTE)**



# All India Council for Technical Education

(A Statutory body under Ministry of HRD, Govt. of India)

Nelson Mandela Marg Vasant Kunj, New Delhi-110067

PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 [www.aicte-India.org](http://www.aicte-India.org)

F.No. Western/1-3323625549/2017/EOA

Date: 10-Apr-2017

To,

The Secretary,  
Tech. & Higher Education Deptt.  
Govt. of Maharashtra, Mantralaya,  
Annexe Building, Mumbai-400032

**Sub: Extension of approval for the academic year 2017-18**

Ref: Application of the Institution for Extension of approval for the academic year 2017-18

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2016 notified by the Council vide notification number F.No.AB/AICTE/REG/2016 dated 30/11/2016 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

Permanent Id	1-4317814	Application Id	1-3323625549
Name of the Institute	FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING	Institute Address	FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
Name of the Society/Trust	SOCIETY OF ST. FRANCIS XAVIER, PILAR	Society/Trust Address	FR. AGNEL ASHRAM, BANDSAND BANDRA (WEST), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
Institute Type	Unaided - Private	Region	Western

Opted for change from Women to Co-ed and Vice versa	No	Opted for change of name	No	Opted for change of site	No
Change from Women to Co-ed approved and Vice versa	Not Applicable	Change of name Approved	Not Applicable	Change of site Approved	Not Applicable
Opted for Conversion from degree to diploma	No	Opted for Conversion from diploma to degree	No	Conversion (degree to diploma or vice-versa) Approved	Not Applicable

To conduct following courses with the intake indicated below for the academic year 2017-18

Application Id: 1-3323625549			Course	Full/Part Time	Affiliating Body	Intake Approved for 2016-17	Intake Approved for 2017-18	NRI Approval status	PIO / FN / Gulf quota/ OCI/ Approval status	Foreign Collaboration/Twining Program Approval status*
Program	Shift	Level								
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University, Mumbai	18	18	NA	NA	NA





# All India Council for Technical Education

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Nelson Mandela Marg Vasant Kunj, New Delhi-110067

PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 [www.aicte-India.org](http://www.aicte-India.org)

GY		TE								
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	MECHANICAL ENGINEERING	FULL TIME	Mumbai University, Mumbai	18	18	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	COMPUTER ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	ELECTRONICS ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	INFORMATION TECHNOLOGY	FULL TIME	Mumbai University, Mumbai	60	60	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st Shift	UNDER GRADUATE	PRODUCTION ENGINEERING	FULL TIME	Mumbai University, Mumbai	60	60	NA	NA	NA

The above mentioned approval is subject to the condition that

FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING

shall follow and adhere to the Regulations, guidelines and directions issued by AICTE from time to time and the undertaking / affidavit given by the institution along with the application submitted by the institution on portal.

Course(s) Applied for Closure by the Institute for the AY 2017-18:

Application Id: 1-3323625549			Name of the Course	Full/Part Time	Affiliating Body	Course Closure Status
Program	Shift	Level				
ENGINEERING AND TECHNOLOGY	1st Shift	POST GRADUATE	PRODUCTION ENGINEERING : (Last Approved Intake 10)	PART TIME	Mumbai University, Mumbai	Approved

In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.



# All India Council for Technical Education

(A Statutory body under Ministry of HRD, Govt. of India)

Nelson Mandela Marg Vasant Kunj, New Delhi-110067

PHONE: 23724151/52/53/54/55/56/57 FAX: 011-23724183 [www.aicte-india.org](http://www.aicte-india.org)

Strict compliance of Anti-Ragging Regulation:- Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 37-3/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

**Note: Validity of the course details may be verified at [www.aicte-india.org](http://www.aicte-india.org)**

**Prof. A.P Mittal**  
**Member Secretary, AICTE**

Copy to:

- 1. The Regional Officer,**  
All India Council for Technical Education  
Industrial Assurance Building  
2nd Floor, Nariman Road  
Mumbai - 400 020, Maharashtra
- 2. The Director Of Technical Education\*\*,**  
Maharashtra
- 3. The Registrar\*\*,**  
Mumbai University, Mumbai
- 4. The Principal / Director,**  
FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING  
FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W),  
MUMBAI, MUMBAI SUBURBAN,  
Maharashtra, 400050
- 5. The Secretary / Chairman,**  
SOCIETY OF ST. FRANCIS XAVIER, PILAR  
FR. AGNEL ASHRAM,  
BANDSAND  
BANDRA (WEST),  
MUMBAI, MUMBAI SUBURBAN,  
Maharashtra, 400050
- 6. Guard File(AICTE)**

**Note: \*\* - Approval letter copy will not be communicated through post/email. However, provision is made in the portal for downloading Approval letter through Authorized login credentials allotted to concerned DTE/Registrar.**

# All India Council for Technical Education

(A Statutory body under Ministry of HRD, Govt. of India)

Nelson Mandela Marg, Vasant Kunj, New Delhi-110070 Website: [www.aicte-india.org](http://www.aicte-india.org)



## APPROVAL PROCESS 2018-19

### Extension of Approval (EoA)

F.No. Western/1-3508330114/2018/EOA

Date: 10-Apr-2018

To,

The Secretary,  
Tech. & Higher Education Deptt.  
Govt. of Maharashtra, Mantralaya,  
Annexe Building, Mumbai-400032

#### Sub: Extension of Approval for the Academic Year 2018-19

Ref: Application of the Institution for Extension of approval for the Academic Year 2018-19

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2016 notified by the Council vide notification number F.No.AB/AICTE/REG/2016 dated 30/11/2016 and amended on December 5, 2017 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

<b>Permanent Id</b>	1-4317814	<b>Application Id</b>	1-3508330114
<b>Name of the Institute</b>	FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING	<b>Name of the Society/Trust</b>	SOCIETY OF ST. FRANCIS XAVIER, PILAR
<b>Institute Address</b>	FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050	<b>Society/Trust Address</b>	FR. AGNEL ASHRAM, BANDSAND BANDRA (WEST), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
<b>Institute Type</b>	Unaided - Private	<b>Region</b>	Western

<b>Opted for Change from Women to Co-Ed and vice versa</b>	No	<b>Change from Women to Co-Ed and vice versa Approved or Not</b>	NA
<b>Opted for Change of Name</b>	No	<b>Change of Name Approved or Not</b>	NA
<b>Opted for Change of Site</b>	No	<b>Change of Site Approved or Not</b>	NA
<b>Opted for Conversion from Degree to Diploma or vice versa</b>	No	<b>Conversion for Degree to Diploma or vice versa Approved or Not</b>	NA
<b>Opted for Organization Name Change</b>	No	<b>Change of Organization Name Approved or Not</b>	NA

#### To conduct following Courses with the Intake indicated below for the Academic Year 2018-19

Program	Shift	Level	Course	FT/PT+	Affiliating Body (Univ/Body)	Intake Approved for 2018-19	NRI Approval Status	PIO / FN / Gulf quota/ OCI/ Approval Status	Foreign Collaboration / Twinning Program Approval Status*
ENGINEERING AND TECHNOLOGY	1st	POST GRADUATE	MECHANICAL ENGINEERING	FT	Mumbai University, Mumbai	18	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st	UNDER GRADUATE	PRODUCTION ENGINEERING	FT	Mumbai University, Mumbai	60	NA	NA	Foreign Approved
ENGINEERING AND	1st	UNDER GRADUATE	ELECTRONICS ENGINEERING	FT	Mumbai University, Mumbai	60	NA	NA	Foreign Approved

TECHNOLOGY									Foreign Approved
ENGINEERING AND TECHNOLOGY	1st	UNDER GRADUATE	COMPUTER ENGINEERING	FT	Mumbai University, Mumbai	60	NA	NA	NA
ENGINEERING AND TECHNOLOGY	1st	UNDER GRADUATE	INFORMATION TECHNOLOGY	FT	Mumbai University, Mumbai	60	NA	NA	Foreign Approved
ENGINEERING AND TECHNOLOGY	1st	POST GRADUATE	ELECTRONICS ENGINEERING	FT	Mumbai University, Mumbai	18	NA	NA	NA
									Foreign Approved

+FT –Full Time,PT-Part Time  
# Punitive Action against the Institute

In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

Strict compliance of Anti-Ragging Regulation: - Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 37-3/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

**Prof. A.P Mittal**  
**Member Secretary, AICTE**

Copy to:

1. The Regional Officer,  
All India Council for Technical Education  
Industrial Assurance Building  
2nd Floor, Nariman Road  
Mumbai - 400 020, Maharashtra
2. The Director Of Technical Education\*\*,  
Maharashtra
3. The Registrar\*\*,  
Mumbai University, Mumbai
4. The Principal / Director,  
FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING  
FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W),  
MUMBAI,MUMBAI SUBURBAN,  
Maharashtra,400050
5. The Secretary / Chairman,  
SOCIETY OF ST. FRANCIS XAVIER, PILAR  
FR. AGNEL ASHRAM,  
BANDSAND  
BANDRA (WEST),  
MUMBAI,MUMBAI SUBURBAN,  
Maharashtra,400050
6. Guard File(AICTE)

Note: Validity of the Course details may be verified at <http://www.aicte-india.org/>

\*\* Individual Approval letter copy will not be communicated through Post/Email. However, consolidated list of Approved Institutions(bulk) will be shared through official Email Address to the concerned Authorities mentioned above.

# All India Council for Technical Education

(A Statutory body under Ministry of HRD, Govt. of India)

Nelson Mandela Marg, Vasant Kunj, New Delhi-110070 Website: [www.aicte-india.org](http://www.aicte-india.org)



## APPROVAL PROCESS 2019-20

### Extension of Approval (EoA)

F.No. Western/1-4263268818/2019/EOA

Date: 29-Apr-2019

To,

The Secretary,  
Tech. & Higher Education Deptt.  
Govt. of Maharashtra, Mantralaya,  
Annexe Building, Mumbai-400032

**Sub: Extension of Approval for the Academic Year 2019-20**

Ref: Application of the Institution for Extension of approval for the Academic Year 2019-20

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2018 notified by the Council vide notification number F.No.AB/AICTE/REG/2018 dated 31/12/2018 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

<b>Permanent Id</b>	1-4317814	<b>Application Id</b>	1-4263268818
<b>Name of the Institute</b>	Fr. Conceicao Rodrigues College Of Engineering	<b>Name of the Society/Trust</b>	SOCIETY OF ST. FRANCIS XAVIER, PILAR
<b>Institute Address</b>	FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050	<b>Society/Trust Address</b>	FR. AGNEL ASHRAM, BANDSAND BANDRA (WEST), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
<b>Institute Type</b>	Unaided - Private	<b>Region</b>	Western

<b>Opted for Change from Women to Co-Ed and vice versa</b>	No	<b>Change from Women to Co-Ed and vice versa Approved or Not</b>	NA
<b>Opted for Change of Name</b>	No	<b>Change of Name Approved or Not</b>	NA
<b>Opted for Change of Site/Location</b>	No	<b>Change of Site/Location Approved or Not</b>	NA
<b>Opted for Conversion from Degree to Diploma or vice versa</b>	No	<b>Conversion for Degree to Diploma or vice versa Approved or Not</b>	NA
<b>Opted for Organization Name Change</b>	No	<b>Change of Organization Name Approved or Not</b>	NA
<b>Opted for Merger of Institution</b>	No	<b>Merger of Institution Approved or Not</b>	NA
<b>Opted for Introduction of New Program/Level</b>	No	<b>Introduction of Program/Level Approved or Not</b>	NA

**To conduct following Courses with the Intake indicated below for the Academic Year 2019-20**

Program	Shift	Level	Course	FT/PT+	Affiliating Body (Univ/Body)	Intake Approved for 2019-20	NRI Approval Status	PIO / FN / Gulf quota/ OCI/ Approval Status
ENGINEERING AND TECHNOLOGY	1st	POST GRADUATE	MECHANICAL ENGINEERING	FT	Mumbai University, Mumbai	18	NA	NA
ENGINEERING AND	1st	UNDER GRADUATE	PRODUCTION	FT	Mumbai University, Mumbai	60	NA	NA

TECHNOLOGY		TE	ENGINEERING					
ENGINEERING AND TECHNOLOGY	1st	UNDER GRADUATE	ELECTRONICS & COMPUTER SCIENCE	FT	Mumbai University, Mumbai	60	NA	NA
ENGINEERING AND TECHNOLOGY	1st	UNDER GRADUATE	COMPUTER ENGINEERING	FT	Mumbai University, Mumbai	120	NA	NA
ENGINEERING AND TECHNOLOGY	1st	UNDER GRADUATE	MECHANICAL ENGINEERING##	FT	Mumbai University, Mumbai	60	NA	NA

+FT –Full Time,PT-Part Time

## Approved New Courses

**Course(s) Applied for Closure by the Institute for the Academic Year 2019-20**

Program	Shift	Level	Course	FT/PT+	Affiliating Body (Univ/Body)	Course Closure Status
ENGINEERING AND TECHNOLOGY	1st	POST GRADUATE	ELECTRONICS ENGINEERING	FT	Mumbai University, Mumbai	Approved

+FT-Full Time,PT-Part Time

§ Due to non-submission of NOC's from University / Board and / or State Government

**Course(s) Approved for Merger with other Course(s) for Academic Year 2019-20**

Program	Shift	Level	Course	FT/PT+	Affiliating Body (Univ/Body)	Course Merged With
ENGINEERING AND TECHNOLOGY	1st	UNDER GRADUATE	INFORMATION TECHNOLOGY	FT	Mumbai University, Mumbai	COMPUTER ENGINEERING

+FT-Full Time,PT-Part Time

In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.

Strict compliance of Anti-Ragging Regulation: - Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 37-3/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

**It is mandatory to comply all the essential requirements as given in APH 2019-20(appendix 6)**

**NOTE: If the State Government / UT / DTE / DME has a reservation policy for admission in Technical Education Institutes and the same is applicable to Private & Self-financing Technical Institutions, then the State Government / UT/ DTE / DME shall ensure that 10 % of Reservation for EWS would be operational from the Academic year 2019-20 without affecting the percentage reservations of SC/ST/OBC/General . However, this would not be applicable in the case of Minority Institutions referred to the clause (1) of Article 30 of Constitution of India.**

**Prof. A.P Mittal  
Member Secretary, AICTE**

Copy to:

1. **The Director Of Technical Education\*\***, Maharashtra
2. **The Registrar\*\***,  
Mumbai University, Mumbai
3. **The Principal / Director**,  
Fr. Conceicao Rodrigues College Of Engineering  
Fr. Agnel Ashram, Bandstand, Bandra(W),  
Mumbai, Mumbai Suburban,  
Maharashtra, 400050
4. **The Secretary / Chairman**,  
Society Of St. Francis Xavier, Pilar  
Fr. Agnel Ashram,  
Bandsand  
Bandra (West).  
Mumbai, Mumbai Suburban,  
Maharashtra, 400050
5. **The Regional Officer**,  
All India Council for Technical Education  
Industrial Assurance Building  
2nd Floor, Nariman Road  
Mumbai - 400 020, Maharashtra
6. **Guard File(AICTE)**

Note: Validity of the Course details may be verified at <http://www.aicte-india.org/>

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\*\* Individual Approval letter copy will not be communicated through Post/Email. However, consolidated list of Approved Institutions(bulk) will be shared through official Email Address to the concerned Authorities mentioned above.



# All India Council for Technical Education

(A Statutory body under Ministry of HRD, Govt. of India)

Nelson Mandela Marg, Vasant Kunj, New Delhi-110070 Website: [www.aicte-india.org](http://www.aicte-india.org)



## APPROVAL PROCESS 2020-21

### Extension of Approval (EoA)

F.No. Western/1-7010378935/2020/EOA

Date: 15-Jun-2020

To,

The Secretary,  
Tech. & Higher Education Deptt.  
Govt. of Maharashtra, Mantralaya,  
Annexe Building, Mumbai-400032

**Sub: Extension of Approval for the Academic Year 2020-21**

Ref: Application of the Institution for Extension of Approval for the Academic Year 2020-21

Sir/Madam,

In terms of the provisions under the All India Council for Technical Education (Grant of Approvals for Technical Institutions) Regulations 2020 notified by the Council vide notification number F.No. AB/AICTE/REG/2020 dated 4<sup>th</sup> February 2020 and norms standards, procedures and conditions prescribed by the Council from time to time, I am directed to convey the approval to

<b>Permanent Id</b>	1-4317814	<b>Application Id</b>	1-7010378935
<b>Name of the Institute</b>	FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING	<b>Name of the Society/Trust</b>	SOCIETY OF ST. FRANCIS XAVIER, PILAR
<b>Institute Address</b>	FR. AGNEL ASHRAM, BANDSTAND, BANDRA(W), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050	<b>Society/Trust Address</b>	FR. AGNEL ASHRAM, BANDSAND BANDRA (WEST), MUMBAI, MUMBAI SUBURBAN, Maharashtra, 400050
<b>Institute Type</b>	Private-Self Financing	<b>Region</b>	Western

**To conduct following Courses with the Intake indicated below for the Academic Year 2020-21**

Program	Level	Course	Affiliating Body (University /Body)	Intake Approved for 2019-20	Intake Approved for 2020-21	NRI Approval Status	PIO / FN / Gulf quota/ OCI/ Approval Status
ENGINEERING AND TECHNOLOGY	POST GRADUATE	MECHANICAL ENGINEERING	Mumbai University, Mumbai	18	18	NA	NA
ENGINEERING AND TECHNOLOGY	UNDER GRADUATE	ELECTRONICS & COMPUTER SCIENCE	Mumbai University, Mumbai	60	60	NA	NA
ENGINEERING AND TECHNOLOGY	UNDER GRADUATE	COMPUTER ENGINEERING	Mumbai University, Mumbai	120	120	NA	NA

ENGINEERING AND TECHNOLOGY	UNDER GRADUATE	MECHANICAL ENGINEERING	Mumbai University, Mumbai	60	60	NA	NA
ENGINEERING AND TECHNOLOGY	UNDER GRADUATE	ARTIFICIAL INTELLIGENCE AND DATA SCIENCE	Mumbai University, Mumbai	0	60###	NA	NA

## Approved New Course(s)

\$\$ Course(s) should be offered in Emerging Area

**Course(s) Applied for Closure by the Institute for the Academic Year 2020-21**

Program	Level	Course	Affiliating Body (Univ/Body)	Course Closure Status
ENGINEERING AND TECHNOLOGY	UNDER GRADUATE	PRODUCTION ENGINEERING	Mumbai University, Mumbai	Approved

**It is mandatory to comply with all the essential requirements as given in APH 2020-21 (Appendix 6)**

**Important Instructions**

1. The State Government/ UT/ Directorate of Technical Education/ Directorate of Medical Education shall ensure that 10% of reservation for Economically Weaker Section (EWS) as per the reservation policy for admission, operational from the Academic year 2020-21 is implemented without affecting the reservation percentages of SC/ ST/ OBC/ General. However, this would not be applicable in the case of Minority Institutions referred to the Clause (1) of Article 30 of Constitution of India. Such Institution shall be permitted to increase in annual permitted strength over a maximum period of two years beginning with the Academic Year 2020-21
2. The Institution offering courses earlier in the Regular Shift, First Shift, Second Shift/Part Time now amalgamated as total intake shall have to fulfil all facilities such as Infrastructure, Faculty and other requirements as per the norms specified in the Approval Process Handbook 2020-21 for the Total Approved Intake. Further, the Institutions Deemed to be Universities/ Institutions having Accreditation/ Autonomy status shall have to maintain the Faculty: Student ratio as specified in the Approval Process Handbook. All such Institutions/ Universities shall have to create the necessary Faculty, Infrastructure and other facilities WITHIN 2 YEARS to fulfil the norms based on the Affidavit submitted to AICTE.
3. In case of any differences in content in this Computer generated Extension of Approval Letter, the content/information as approved by the Executive Council / General Council as available on the record of AICTE shall be final and binding.
4. Strict compliance of Anti-Ragging Regulation: - Approval is subject to strict compliance of provisions made in AICTE Regulation notified vide F. No. 373/Legal/AICTE/2009 dated July 1, 2009 for Prevention and Prohibition of Ragging in Technical Institutions. In case Institution fails to take adequate steps to Prevent Ragging or fails to act in accordance with AICTE Regulation or fails to punish perpetrators or incidents of Ragging, it will be liable to take any action as defined under clause 9(4) of the said Regulation.

**Prof.Rajive Kumar  
Member Secretary, AICTE**

Copy to:

1. **The Director Of Technical Education\*\*, Maharashtra**
2. **The Registrar\*\*,**

Mumbai University, Mumbai

3. **The Principal / Director,**  
FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING  
Fr. Agnel Ashram, Bandstand, Bandra(W),  
Mumbai, Mumbai Suburban,  
Maharashtra, 400050
  
4. **The Secretary / Chairman,**  
FR. AGNEL ASHRAM,  
BANDSAND  
BANDRA (WEST)  
MUMBAI, MUMBAI SUBURBAN  
Maharashtra, 400050
  
5. **The Regional Officer,**  
All India Council for Technical Education  
Industrial Assurance Building  
2nd Floor, Nariman Road  
Mumbai - 400 020, Maharashtra
  
6. **Guard File(AICTE)**

Note: Validity of the Course details may be verified at <http://www.aicte-india.org/>

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## Proofs of Collaborative Qualities (MoUs)

<b>r. No.</b>	<b>Name of the MoU / Collaboration / linkage</b>	<b>Page No.</b>
1	Brillmax Private Limited	<a href="#"><u>3-4</u></a>
2	Cloud counselage	<a href="#"><u>5-11</u></a>
3	Conbuss online manufacturing pvt.Ltd	<a href="#"><u>12-13</u></a>
4	Internshala	<a href="#"><u>14</u></a>
5	Hyfunn	<a href="#"><u>15-18</u></a>
6	Studenting Era	<a href="#"><u>19-21</u></a>
7	BUDSTA Analytics and Insights Pvt. Ltd.	<a href="#"><u>22-24</u></a>
8	Bennett University	<a href="#"><u>25-28</u></a>
9	Amazon Web Services (AWS)	<a href="#"><u>29</u></a>
10	Tata Consultancy Services (TCS)	<a href="#"><u>30-34</u></a>
11	Christiani Sharpline Technical Training Pvt. Lt.	<a href="#"><u>35-37</u></a>
12	DLINK India Ltd	<a href="#"><u>38-43</u></a>
13	Synergy Consultants Pvt. Ltd.	<a href="#"><u>44-45</u></a>
14	University of Texas at EL Paso	<a href="#"><u>46-47</u></a>
15	United Modeling & Simulation Pvt. Ltd.	<a href="#"><u>48-49</u></a>
16	L. D. College of Engineering, Gujrat	<a href="#"><u>50-52</u></a>
17	Eduvance	<a href="#"><u>53-57</u></a>
18	CodeChef	<a href="#"><u>58-60</u></a>
19	Crypto university	<a href="#"><u>61-62</u></a>
20	EC Council	<a href="#"><u>63</u></a>
21	Linux Professional Institute (LPI)	<a href="#"><u>64-77</u></a>
22	Devfolio	<a href="#"><u>78-79</u></a>
23	Veermata Jijabai Technological Institute (VJTI)	<a href="#"><u>80-81</u></a>
24	United Way	<a href="#"><u>82-83</u></a>
25	Sardar Patel Institute of Technology (SPIT)	<a href="#"><u>84-88</u></a>
26	IIRS ISRO(Collaboration)	<a href="#"><u>89</u></a>

## MEMORANDUM OF UNDERSTANDING

Between

**FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING**  
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400050.

And

**BRILLMAX PRIVATE LIMITED**  
Rangora Business Park, Taloja, Navi Mumbai – 410 208.

This Memorandum of Understanding is entered into on 4.01.2021 between, Fr. Conceicao Rodrigues College of Engineering, Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai - 400050 and Brillmax, Rangora Business Park, Taloja, Navi Mumbai – 410 208.

### 1. PREAMBLE

Collaborative efforts in engineering education have become the key to success. The TEQIP project encourages institutions to establish MOUs with neighboring institutions and industries on viable collaborative/ consultancy project with specific time-frames and well-defined outputs. The collaboration could be in the areas of joint projects of students and faculty, joint publications, joint sponsored projects from funding agencies, joint faculty and staff development programmes, joint consultancy projects with a sound revenue sharing model etc. The institutions are required to establish collaboration through MOU. The two institutions signing this MOU have agreed to work on the philosophy mentioned in this preamble.

Fr. Conceicao Rodrigues College of Engineering and Brillmax Jointly agree to exchange their expertise in the field of Technical Vocational Educations and Skill Development for mutual benefit and growth on the terms mentioned hereunder.

### 2. PURPOSE

The aim of this MOU is primarily to establish a written document under which both the institutes Fr. Conceicao Rodrigues College Of Engineering & Brillmax may enter into a written agreement to perform collaborative programmes in the areas of mutual interest.



### 3. AREA OF COLLABORATION

1. Work jointly on research projects (to be submitted to various funding agencies), consultancy assignments, faculty and staff development programmes, allow the credit transfer to PG/Ph.D. students working in these institutes etc.
2. Attend activities organized by the two institutions.
3. Start Collaborative Research Programme of mutual interests.
4. Industrial Visits
5. Developing Centre of Excellence.
6. Expert Lectures
7. Identify corporate training areas
8. Internship training
9. Provide training on software related to Mechanical Engineering

Any other activity not covered by this MOU shall be decided on a case to case basis by the two institutions.

### 4. AGREEMENT OF COLLABORATIVE PROGRAMMES

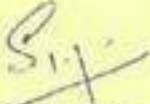
Each such collaboration undertaken by the institutes shall describe in details the following:

- The nature, scope and the time of collaborative schedule.
- The form as pursuant to Clause No.3 above.
- Any other provision as deemed to be necessary and agreed by both.

To prepare and finalize a concrete action plan and schedule for collaboration on priority areas as agreed upon by both.

This MOU shall be effective from the date of signing the same and shall remain in effect for the subsequent Five years and may be renewed or discontinued thereafter by mutual consent.

In witness where of, the Two institutions hereto have executed this agreement on the date and the year first herein above written.

  
Dr. Srijal Unnikrishnan  
Principal  
Fr. Conceicao Rodrigues College Of Engineering



For Brillmax Private Limited

Director

  
Mr. Vishal Dakshini  
Proprietor Director  
Brillmax Private Limited







### MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding (hereinafter called as the 'MOU') is entered into on this the DD<sup>th</sup> day of - Month - Two Thousand Twenty (2020),

#### BETWEEN

Fr. Conceição Rodrigues College of Engineering, Fr. Agnel Ashram, BandStand, Bandra (W), Mumbai, Maharashtra 400050, the First Party represented herein by its ~~Dr. / Mr. / Ms. /~~ ~~Full Name~~ ~~(Designation)~~ (herein after referred as 'First Party', the institution which expression, unless excluded by or repugnant to the subject or context shall include its successors - in-office, administrators, and assigns).

#### AND

Cloud Counselage Pvt. Ltd., 91 Springboard, 1 & 2 Floor, Kagalwala House, Behind Metro House, Plot No. 175, CST Road, BKC, Kalina, Mumbai - 400098, the Second Party, and represented herein by its Managing Partner, Harshada Topale (Director), (hereinafter referred to as "Second Party", company which expression, unless excluded by or repugnant to the subject or context shall include its successors - in-office, administrators and assigns).

(First Party and Second Party are hereinafter jointly referred to as 'Parties' and individually as 'Party')

#### WHEREAS:

A) First Party is a Higher Educational Institution named:

**Fr. Conceição Rodrigues College of Engineering**

B) First Party & Second Party believe that collaboration and co-operation between themselves will promote more effective use of each of their resources, and provide each of them with enhanced opportunities.

C) The Parties intent to cooperate and focus their efforts on cooperation within area of Skill Based Training, Education and Research.



Office: Cloud Counselage Pvt. Ltd., 91 Springboard, 1 & 2 Floor, Kagalwala House, Behind Metro House,  
Plot No. 175, CST Road, BKC, Kalina, Mumbai - 400098  
CIN: U72200MH2015PTC251890, GSTIN: 27AAFCC001D1ZW

- D) Both Parties, being legal entities in themselves desire to sign this MOU for advancing their mutual interest.
- E) **Cloud Counselage Pvt. Ltd.**, the Second Party is an IT & Management Consulting, Advisory & Career services company based in Mumbai, founded in February 2015
- F) The Second Party through its career services has a vision to build young skilled workforce of a million by 2022 by up skilling, providing corporate and industry exposure to the aspiring engineers for their continuous professional development. Recently they have hired 1000+ interns from 150+ colleges across Maharashtra and is now collaborating with institutions through Industry-Academic Connect initiative PAN India.

**NOW THEREFORE, IN CONSIDERATION OF THE MUTUAL PROMISES SET FORTH IN THIS MOU, THE PARTIES HERETO AGREE AS FOLLOWS:**

#### **CLAUSE 1 CO-OPERATION**

- 1.1 Both Parties are united by common interests and objectives, and they shall establish channels of communication and co-operation that will promote and advance their respective operations within the **Institution** and its related wings. The Parties shall keep each other informed of potential opportunities and shall share all information that may be relevant to secure additional opportunities for one another.
- 1.2 First Party and Second Party co-operation will facilitate effective utilization of the intellectual capabilities of the faculty of First Party providing significant inputs to them in developing suitable teaching / training systems, keeping in mind the needs of the industry, the Second Party.
- 1.3 The general terms of co-operation shall be governed by this MOU. The Parties shall cooperate with each other and shall, as promptly as is reasonably practical, enter into all relevant agreements, deeds, and



A handwritten signature in blue ink, consisting of stylized initials.

documents (the 'Definitive Documents') as may be required to give effect to the actions contemplated in terms of this MOU. The term of Definitive Documents shall be mutually decided between the Parties. Along with the Definitive Documents, this MOU shall represent the entire understanding as to the subject matter hereof and shall supersede any prior understanding between the Parties on the subject matter hereof.

- 1.4 A single point of contact (SPOC) will be designated by the First Party and the Second Party each to facilitate this co-operation.

#### CLAUSE 2 SCOPE OF THE MoU

- 2.1 The budding graduates from the institutions could play a key role in technological up-gradation, innovation and competitiveness of an industry. Both parties believe that close co-operation between the two would be of major benefit to the student community to enhance their skills and knowledge.
- 2.2 **Curriculum Design:** Second Party will give valuable inputs to the First Party in teaching / training methodology and suitably customize the curriculum so that the students fit into the industrial scenario meaningfully.
- 2.3 **Industrial Training & Visits:** Industry and Institution interaction will give an insight into the latest developments / requirements of the industries; the Second Party to permit the Faculty and Students of the First Party to visit its group companies and also involve in Industrial Training Programs for the First Party. The industrial training and exposure provided to students and faculty through this association will build confidence and prepare the students to have a smooth transition from academic to working career. The Second Party will provide its Labs / Workshops / Industrial Sites for the hands-on training of the learners enrolled with the First Party.
- 2.4 **Internships and Placement of Students:** Second Party will actively



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engage to help the delivery of the Internship and placement of the students of First Party.

- 2.5 **Research and Development:** Both Parties have agreed to carry out the joint research activities in the fields like Data science, Machine Learning, Artificial Intelligence, Robotics, etc. whenever possible.
- 2.6 **Skill Development Programs:** Second Party to train the students of First Party on the emerging technologies in order to bridge the skill gap and make them industry ready.
- 2.7 **Guest Lectures:** Second Party to extend the necessary support to deliver guest lectures to the students of the First Party on the technology trends and in-house requirements.
- 2.8 **Faculty Development Programs:** Second Party to train the Faculties of First Party for imparting industrial exposure/ training as per the industrial requirement in accordance with the schedule proposed by Second Party.
- 2.9 Both Parties to obtain all internal approvals, consents, permissions, and licenses of whatsoever nature required for offering the Programs on the terms specified herein.
- 2.10 There is no financial commitment on the part of the **College name**, the First Party to take up any program mentioned in the MoU. If there is any financial consideration, it will be dealt separately.
- 2.11 If during the operation of the MOU, circumstances may arise which call for alteration/modification to this MOU, such alteration/modification shall be mutually discussed and agreed upon in writing. Such changes will be formalized in writing as an 'Addendum' to this MOU. Any changes/amendments to this MOU not in conformance to this section shall be deemed to be void-ab-initio.

### CLAUSE 3 INTELLECTUAL PROPERTY

- 3.1 Nothing contained in this MOU shall, by express grant, implication,



A handwritten signature in blue ink, consisting of stylized initials.

Estoppel or otherwise, create in either Party any right, title, interest, or license in or to the intellectual property (including but not limited to know-how, inventions, patents, copy rights and designs) of the other Party.

#### **CLAUSE 4 VALIDITY**

- 4.1 This Agreement will be valid for until it is expressly terminated by either Party on mutually agreed terms, during which period Cloud Counselage Pvt. Ltd., the Second Party, as the case may be, will take effective steps for implementation of this MOU. Any act on the part of **Cloud Counselage Pvt. Ltd.**, the Second Party after termination of this Agreement by way of communication, correspondence etc., shall not be construed as an extension of this MOU
- 4.2 Both Parties may terminate this MOU upon 30 calendar days' notice in writing. In the event of Termination, both parties have to discharge their obligations.

#### **CLAUSE 5 RELATIONSHIP BETWEEN THE PARTIES**

- 5.1 It is expressly agreed that First Party and Second Party are acting under this MOU as independent contractors, and the relationship established under this MOU shall not be construed as a partnership. Neither Party is authorized to use the other Party's name in any way, to make any representations or create any obligation or liability, expressed or implied, on behalf of the other Party, without the prior written consent of the other Party. Neither Party shall have, nor represent itself as having, any authority under the terms of this MOU to make agreements of any kind in the name of or binding upon the other Party, to pledge the other Party's credit, or to extend credit on behalf of the other Party. However, both the parties can present this 'Industry-Academia Connect' establishment information in public domain.

#### **CLAUSE 6 FORCE MAJEURE**

- 6.1 The performance by either Party of its obligations under this MOU shall be excused for a period that is considered/ can be considered reasonable under the circumstances resulting in any failure or delay caused by any



force majeure events such as riots, war, fire explosion, state of emergency, natural disasters (for example earthquake, cyclone, hurricane, etc.), embargo or requisition or any other act of God. The Party wishing to be excused (pursuant to this clause) shall notify the other Party in writing without delay on the intervention and on the cessation thereof.

Fr. Conceição Rodrigues College of  
Engineering,  
Fr. Agnel Ashram, BandStand,  
Bandra (W), Mumbai,  
Maharashtra 400050  
(First Party)

Cloud Counselage Pvt. Ltd.  
91 Springboard, Kagalwala  
House, Plot No. 175, CST  
Road, BKC, Kalina,  
Mumbai - 400098  
(Second Party)

This undertaking is to be construed in accordance with Indian Law with exclusive jurisdiction in the Courts of **Mumbai**.



**AGREED:**

For Fr. Conceição Rodrigues  
College of Engineering



PRINCIPAL



Fr. Agnel Ashram, BandStand,  
Bandra (W), Mumbai,  
Maharashtra 400050  
(Authorized Signatory)

For Cloud Counselage Pvt. Ltd.



Director,

91 Springboard, Kagalwala House,  
Plot No. 175, CST Road, BKC,  
Kalina, Mumbai - 400098.  
(Authorized Signatory)

Organization	Fr. Conceição Rodrigues College of Engineering	Cloud Counselage Pvt. Ltd.
Address	Fr. Agnel Ashram, BandStand, Bandra, (W), Mumbai, Maharashtra 400050	91 Springboard, Kagalwala House, Plot No. 175, CST Road, BKC, Kalina, Mumbai - 400098.
Contact Details	022-67124104 (67114104) 9369005457	93720 87348
Email		harshada.topale@cloudcounselage.com
Web	<a href="http://www.frcree.ac.in/">http://www.frcree.ac.in/</a>	<a href="http://www.cloudcounselage.com">www.cloudcounselage.com</a>



## MEMORANDUM OF UNDERSTANDING

Between

**FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING**  
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400050.

And

**CONBUSS ONLINE MANUFACTURING PVT. LTD.**  
SIMSR, Office No.413, 4<sup>th</sup> Floor, RiIDL, Vidyanagari, Vidyavihar (E), Mumbai - 400077

This Memorandum of Understanding is entered into on 4.01.2021 between, Fr. Conceicao Rodrigues College of Engineering, Mumbai and Conbuss Online Manufacturing Pvt. Ltd., SIMSR, Office No.413, 4<sup>th</sup> Floor, RiIDL, Vidyanagari, Vidyavihar (E), Mumbai – 400 077.

### 1. PREAMBLE

Collaborative efforts in engineering education have become the key to success. The TEQIP project encourages institutions to establish MOUs with neighboring institutions and industries on viable collaborative/ consultancy project with specific time-frames and well-defined outputs. The collaboration could be in the areas of joint projects of students and faculty, joint publications, joint sponsored projects from funding agencies, joint faculty and staff development programmes, joint consultancy projects with a sound revenue sharing model etc. The institutions are required to establish collaboration through MOU. The two institutions signing this MOU have agreed to work on the philosophy mentioned in this preamble.

Fr. Conceicao Rodrigues College of Engineering and **Conbuss Online Manufacturing Pvt. Ltd.** jointly agree to exchange their expertise in the field of Technical Vocational Educations and Skill Development for mutual benefit and growth on the terms mentioned hereunder.

### 2. PURPOSE

The aim of this MOU is primarily to establish a written document under which both the institutes Fr. Conceicao Rodrigues College Of Engineering & **Conbuss Online Manufacturing Pvt. Ltd.** may enter into a written agreement to perform collaborative programmes in the areas of mutual interest.

### 3. AREA OF COLLABORATION

1. Work jointly on research projects (to be submitted to various funding agencies), consultancy assignments, faculty and staff development programmes, allow the credit transfer to PG/Ph.D. students working in these institutes etc.
2. Attend activities organized by the two institutions.
3. Start Collaborative Research Programme of mutual interests.
4. Industrial Visits
5. Developing Centre of Excellence.
6. Expert Lectures
7. Identify corporate training areas
8. Internship training
9. Provide training on software related to Mechanical Engineering

Any other activity not covered by this MOU shall be decided on a case to case basis by the two institutions.

### 4. AGREEMENT OF COLLABORATIVE PROGRAMMES

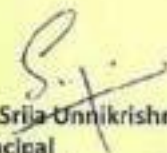
Each such collaboration undertaken by the institutes shall describe in details the following:

- The nature, scope and the time of collaborative schedule.
- The form as pursuant to Clause No.3 above.
- Any other provision as deemed to be necessary and agreed by both.

To prepare and finalize a concrete action plan and schedule for collaboration on priority areas as agreed upon by both.

This MOU shall be effective from the date of signing the same and shall remain in effect for the subsequent Five years and may be renewed or discontinued thereafter by mutual consent.

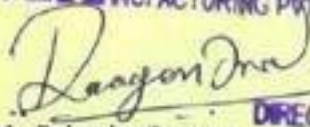
In witness where of, the Two institutions hereto have executed this agreement on the date and the year first herein above written.

  
Dr. Srija Unnikrishnan  
Principal

Fr. Conceicao Rodrigues College Of Engineering



For CONBUSS ONLINE MANUFACTURING PVT LTD

  
DIRECTOR

Mr. Rajendra Gangan  
Proprietor  
Conbuss Online Manufacturing Pvt. Ltd.





Dashboard Internships Fresh Jobs Contact us

## Thank you for registering Fr. Conceicao Rodrigues College Of Engineering

Next step - Register all your students

1. Compile the name, email address & mobile number of all your students (first year to final year) in an excel sheet
2. Submit the excel sheet with us by 15<sup>th</sup> September.
3. An Internshala account will be created for every student through which they can apply for internships

[Download sample file](#)

**Submit student details**  
Please upload Excel file (<3 MB) of student details here

[Download sample file](#)

[Activate WhatsApp](#)  
Go to Settings to activate WhatsApp



## SERVICE LEVEL AGREEMENT

### 1. SCOPE

- a) This Agreement is made and entered into as of the 2<sup>nd</sup> day of September, 2019 (the "Effective Date") by and between HYFUNI (herein known as "Service Provider") and FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING herein known as "Client") and represents a Service Level Agreement ("SLA" or "Agreement") for the provisioning of digital services (herein known as "services") as described below and required to support and sustain the management of activities for various engineering departments.

### 2. SERVICES

Type	Description
Posting	Post essential content effectively into selected networks.
Hosting	Host inter/intra events, fest and gathering onto the walls of user.
Searching	Search skill set add and create your own network.
Exploring	Explore other essential content and news directly on phones.

- a) The hereinabove mentioned services will be provided for a term of 24 months (herein known as "term of services") starting from the date of agreement with a review period of 3 months.
- b) The Client and the Service Provider shall have the right to terminate this Agreement, post first 6 months of evaluation, by giving 30 (thirty) days' notice for



any reason whatsoever.

- c) The Client will be liable to pay an amount of INR 2,000 for the tenure of the services due on the effective date.
- d) Service Provider hereby undertakes to complete all pending assignments being performed / to be performed by it for the Client hereunder prior to such a termination and continue to perform all the Services of a continuous nature till the termination becoming effective.

### 3. PROPRIETARY INFORMATION

- a) During the term of services, Service Provider may receive and otherwise be exposed to information regarding the patents, trade secrets, technology and business of the Client. Service Provider therefore agrees that all Proprietary Information whether presently existing or developed in the future, whether or not patentable or registered under copyright law, shall be the sole property of the Client and its assigns, and that the Client and its assigns shall be the sole owner of intellectual property and other rights in connection with such Proprietary Information.
- b) Proprietary Information includes, without limitation, any information created, discovered, developed, or otherwise known to the Client, all inventions, works of authorship, trade secrets, business plans, confidential knowledge, data or any other proprietary information of the Client and any information assigned or otherwise conveyed to the Client by another entity.

### 4. INDEMNITY



- a. The Client agrees to indemnify and hold harmless the Service Provider, its officers and directors, employees and its affiliates and their respective successors and assigns and each other person, if any, who controls any thereof, against any loss, liability, claim, damage and expense whatsoever (including, but not limited to, any and all expenses whatsoever reasonably incurred in investigating, preparing or defending against any litigation commenced or threatened or any claim whatsoever) arising out of or based upon any false representation or warranty or breach or failure by the undersigned to comply with any covenant or agreement made by the undersigned herein or in any other document furnished by the undersigned to any of the foregoing in connection with this transaction.

## 5. ARBITRATION

- a. Any dispute, difference or question arising out of this agreement shall be settled amicably between the parties, failing which the same shall be referred to arbitration under the Indian Arbitration Act, and the place of arbitration shall be Mumbai.

## 6. NON-COMPETE

- a. SERVICE PROVIDER hereby certifies that its performance of all of the terms of this agreement and the services will not breach or conflict with any agreement to keep the proprietary information of another entity in confidence.

## 7. DECLARATION

I UNDERSIGNED, THE AFOREMENTIONED CLIENT, DO HEREBY AGREE TO THE





TERMS OF THIS AGREEMENT AND AUTHORISE THE SERVICE PROVIDER TO USE THE ABOVE STATED INFORMATION AND ANY OTHER INFORMATION HEREINAFTER PASSED ON BY THE CLIENT IN THE INTEREST OF PROVIDING DIGITAL SERVICES ONLY TO US

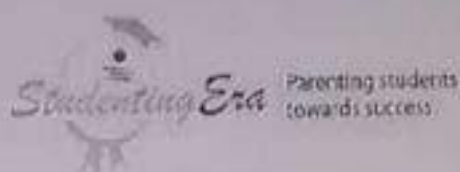
*S. P.*  
PRINCIPAL

FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING,  
Fr. Agnel Ashram, Bandstand, Bandra (W),  
Mumbai, Maharashtra 400050



*[Signature]*  
PRADIP SHINDE  
Chief Executive Officer,  
Hyfunn.





## **Agreement between Fr. Conceicao Rodrigues College of Engineering and Studenting Era to facilitate student services for registered students and academic faculty members.**

This agreement is made & entered into on 25<sup>th</sup> July 2019 between Fr. Conceicao Rodrigues College of Engineering (herein after referred to as Fr.CRCE) , located at Bandra, Mumbai and Studenting Era Private Limited, located at New Delhi & Noida (herein after referred to as "Studenting Era"). The agreement is being signed with Studenting Era as a partner to facilitate selected digital services (as per the agreed terms in the MOU signed between AICTE and Studenting Era (<https://www.aicte-india.org/education/collaborations>)for registered students and academic faculty members of the Institution.

Studenting Era is an organization which provides a one stop service portal for students covering services like skill based training, personality assessments & counseling, digital library, international student cards, employability news & assistance, projects, entrepreneurship development, webinars and various student lifestyle services. The genesis of creating "Studenting Era" is to provide students with a one stop service portal. The mission of "Studenting Era" is to create an environment, which will enable students to get access to information, services and opportunities that will enable them to enhance their career goals and objectives. Studenting Era will continue to evolve with the most diverged services which are relevant & aspirational for students, thus parenting them to success. Studenting Era is based in New Delhi with a registered office FF-4 Hansraj Complex, Sector – 31, Noida – 201301. Studenting Era services can be availed from [www.studentingera.com](http://www.studentingera.com) through a college specific tie up.

### **Context**

With an objective to improve the skills, competencies and employability of students, AICTE has identified Studenting Era as a partner (refer <https://www.aicte-india.org/education/collaborations>).

Studenting Era will offer free services to the registered students and academic faculty members.

As part of this agreement, both the parties here to agree to the following respectively:

## Studenting Era

- Studenting Era will sponsor 100% of the Membership Fee to all registered students and faculty members of the said Institution at StudentingEra portal ([www.studentingera.com](http://www.studentingera.com)).
- Studenting will feature the logo of the institution in the Studenting Era portal as Academic partner.
- Studenting Era will offer state of the art online trainings & services as per the table given below:

Sl. No.	Type of services
1	Lifetime membership to <a href="http://www.studentingera.com">www.studentingera.com</a>
2	Online certificate program on "Quantitative Aptitude"
3	Online certificate program on "Big Data"
4	Online certificate program on "Ethical Hacking"
5	Online certificate program on "Programming on C ++"
6	Online certificate program on "Python"
7	Online certificate program on "C Programming"
8	Online certificate program on "SQL"
9	Webinars on emerging Trends from Thought Leaders
10	Access to job updates and openings for freshers
11	Access to "The Hero Program"- notes sharing platform

Fr. CRCE

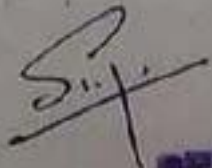
- Will acknowledge Studenting Era as a Digital Student Services Partner in their public domains like website or any as deemed fit by the said institution.
- Will facilitate Studenting Era to enroll students and faculty members for the Life Term Studenting Era Membership.

### Validity of the Agreement

- This MoU will be operational and valid for two years from the date of signing.
- Upon completion of two years, the MoU can be renewed with mutual consent of both the parties.
- Either party may terminate this agreement by providing notice of at least thirty days in advance in writing to the other party.
- If any dispute arises between both the parties on the operation and execution of the agreement, efforts shall be made to resolve the same amicably. The Courts in Delhi will have the jurisdiction in case of any major dispute.

In witness whereof, the parties hereto have caused this Memorandum of Understanding to be executed by their representatives in duplicate, each party retaining one (1) copy thereof respectively.

Accepted and Agreed:



**PRINCIPAL**



For : Fr.CRCE	For : Studenting Era
Address : Fr. Agnel Ashram Bandstand Bandra (West) Mumbai - 400050	Address : Sector - 31, Noida- 201201
Name : Dr. (Mrs) Srija Unnikrishnan	Name : Raja Dasgupta
Title : Principal	Title : CEO, Studenting Era
Date : 25 - 07 - 2019	Date : 25 - 07 - 2019





## BUDSTA Analytics & Insights Private Limited

*Transform your Data into Actionable Insights*

Analytics | Consulting | Training

### Data Science Engineering Internship with BUDSTA Analytics & Insights Private Limited

"BUDSTA Analytics & Insights Private Limited" (hereafter referred as "BUDSTA" within this document) is pleased to announce internship opportunities to Third Year Engineering students within Tr. Coucek Rao Rodrigues College of Engineering ("CRCE") for academic year 2018-19. Please find the details and projects that will be available for taking up as part of the Internship below.

#### **Internship Description:**

The Engineering intern(s) will be responsible for developing, executing and refining Data Science applications with the Python Programming language to complete the Project Objectives mentioned in Appendix I.

Selected interns will have day-to-day responsibilities which include:

1. Participating in cutting edge research in artificial intelligence & machine learning applications
2. Data mining/predictive modeling tools such as Python, Numpy, Scikit Learn, etc.
3. Imaging Algorithms and Predictive Workflows in Applications utilising deep learning
4. Summarizing statistical approaches to meet the project objectives
5. Selecting the best methodology and libraries required
6. Refine the applications with iterative feedback
7. Summarize the results and conclude in a formal report format

#### **Benefits:**

- Certificate of successful internship
- Stipend of Rs. 2500/- per month
- Letter of Recommendation

#### **Prerequisites:**

- Familiar with Python Programming Language
- Statistics and Data Science Fundamentals [training provided by BUDSTA]
- Clearing the Analytics Test & Interview
- Brief on Problem Statement [Presentation provided by BUDSTA]



## BUDSTA Analytics & Insights Private Limited

*Transform your Data into Actionable Insights*

**Analytics | Consulting | Training**

### **Commitment required:**

- 12 hours per week availability
- All work will be done on Computers within the college premises
- One professor and one employee/mentor from the company will guide the projects

### **Qualifications required:**

- Pursuit of a full-time engineering bachelor's degree
- Self-directed and motivated
- Critical thinking and engineering courses
- Technical Report Writing skills
- The requirements listed are representative of the knowledge, skill, and/or ability required.

Internship is contingent upon passing the Entrance exam and interview.  
BUDSTA is fully committed to Equal Internship Opportunity and to attracting, retaining, developing and promoting the best qualified student interns.

Yours Sincerely,

**BUDSTA ANALYTICS & INSIGHTS PRIVATE LIMITED**

**Mr. Lester S. Fernandez**  
*Managing Director*



# BUDSTA Analytics & Insights Private Limited

*Transform your Data into Actionable Insights.*

Analytics | Consulting | Training

## Appendix I

Sr. No.	Project Name	Hours Required	Internship Duration	Interns Required	Faculty/Mentor
1	Face Recognition enabled Security Clearance	12 hours/week	12 weeks	3	TBD
2	Auto Licence Number Plate Regulated Entry	12 hours/week	12 weeks	3	TBD
3	Machine Breakdown Image Predictor Classifier	12 hours/week	12 weeks	3	TBD



vaibhav Godbole <godbole@fragnel.edu.in>

---

## Fwd: Invite for Partnership for another RAENG project

2 messages

---

surve CRCE <surve@fragnel.edu.in>  
To: Vaibhav Godbole <godbole@frcrce.ac.in>

Mon, May 20, 2019 at 2:32 PM

Thanks and Regards,

Sunil Surve, Ph.D.  
Professor & Head,  
Department of Computer Engineering,  
Fr. Conceicao Rodrigues College of Engineering, Mumbai.

Phone: +91-022-67114113  
Mobile: +91-9167635546

----- Forwarded message -----

From: **surve CRCE** <surve@fragnel.edu.in>  
Date: Wed, Jan 24, 2018 at 3:57 PM  
Subject: Re: Invite for Partnership for another RAENG project  
To: Deepak Garg <deepakgarg108@gmail.com>

Dear Sir,  
Please find attached letter and resume.

Thanks and Regards,

Sunil Surve, Ph.D.  
Professor & Head,  
Department of Computer Engineering,  
Fr. Conceicao Rodrigues College of Engineering, Mumbai.

Phone: +91-022-67114113  
Mobile: +91-9167635546

On Mon, Jan 22, 2018 at 8:50 PM, Deepak Garg <deepakgarg108@gmail.com> wrote:

Dear Surve Ji

Good day!

We are writing a proposal to Royal Academy of Engineering with the Title "Making "Deep Learning and AI skills mainstream in India to fulfill trilateral needs of entrepreneurship, Industry-academia partnership and application-inspired Engineering Research"

We will like to work together with you. I will need a signed letter of support from your side on institution Letter Head. Draft Letter is attached where you can do minor modifications as required. There is some information to be filled about the institution in the last part of the letter. Kindly keep the Letter on one page only.

We will also need 2-4 Page CV of the Lead Person, who will deal with this project.

Look forward to the Signed Letter of Support by Wednesday Evening (24/01/2018).



--

Thanks and regards  
Prof. Deepak Garg, Professor and Head  
CSE, Bennett University, Greater Noida, U.P.  
ABET PEV, SM ACM, SM IEEE  
[www.gdeepak.com](http://www.gdeepak.com)

---

**2 attachments**



**SKS\_Resume1.doc**

125K



**Garg.pdf**

2176K

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**surve CRCE** <surve@fragnel.edu.in>  
To: Vaibhav Godbole <godbole@frcrce.ac.in>

Mon, May 20, 2019 at 2:33 PM

[Quoted text hidden]



**Letter of Support.docx**

14K



SOCIETY OF ST. FRANCIS XAVIER, PILAR'S

## FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING

(Approved by AICTE & Affiliated to University of Mumbai)

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai - 400 050.

Phone : (022) 6711 4000, 6711 4101, 6711 4104 • Fax : 6711 4100

Website : [www.frcoe.ac.in](http://www.frcoe.ac.in) • Email : [crce@fragnel.edu.in](mailto:crce@fragnel.edu.in)

Application Title : Making "Deep Learning and AI skills" mainstream in India to fulfil trilateral needs of entrepreneurship, Industry-academia partnership and application-inspired Engineering Research

We confirm our Support, partnership and collaboration for the Application made by Prof. Deepak Garg of Bennett University.

The objectives of the project are of great relevance to us because it is unique in its mission and plans. Deep Learning, Machine Learning and Artificial Intelligence are increasingly becoming the must-have skills for faculty, students and researchers in different engineering domains. Our institution is aspiring to inculcate this technology for the benefit of our stakeholders and the country.

We are pleased and excited to work with Prof. Garg for successfully executing this project. We understand that Bennett University has a great supercomputing infrastructure and accomplished faculty, which will be of high value for this engagement.

Our faculty will get trained on futuristic technologies which in turn will help us to train our students. After that we will be able to start a research group who will follow up these activities with student projects, publications, curriculum enhancement. As there are Industry partners also in the project, so it will help us in connecting with the industry and start-ups to get ourselves involved in some real projects.

We are happy to know that we have been chosen as a lead institution in our zone.

We will support the project in terms of manpower, local support and infrastructure. We will nominate five of our good faculty to get trained, set up a research group. World of opportunities will be open after this and group will flourish based on the further engagements and opportunities.

We will support faculty exchange, student interns or other similar offerings required for the project. Our facilities can be used to hold workshops for Tier 2 and Tier 3 Institutions to spread the learning to remote institutions of the country.

### Institutional Information

# Years institution has been in existence: 34 years

Engineering courses offered:

Undergraduate Courses:

1. Production Engineering,
2. Electronics Engineering,
3. Computer Engineering and
4. Information Technology

..2/-



SOCIETY OF ST. FRANCIS XAVIER, PILARS

## FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING

(Approved by AICTE & Affiliated to University of Mumbai)

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai - 400 050.

Phone : (022) 6711 4090, 6711 4101, 6711 4104 • Fax : 6711 4103

Website : [www.frcee.ac.in](http://www.frcee.ac.in) • Email : [crce@fragnet.edu.in](mailto:crce@fragnet.edu.in)

:2:

### Post-Graduate Courses:

1. Mechanical Engineering (CAD-CAM with Robotics) and
2. Electronics Engineering

# students and staff(faculty): 1150 students and 71 Faculty members

# of research groups: 03

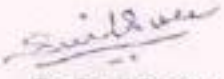
Indicators of track record (rankings, awards etc):

- NIRF ranking (150-200 group)
- NBA Provisionally Accredited three programmes (Computer Engineering, Electronics Engineering and Production Engineering) out of four. Period of accreditation 2017-18 to 2019-20.
- Most sought-after college for admission.

Link to website for engineering faculty: [www.fragnet.edu.in](http://www.fragnet.edu.in)

Two-Three lines about the institution: College was established in 1984. The college is affiliated to University of Mumbai and has acquired a good reputation, among corporate and peer academic institutions, for its academic standards. The college offers under-graduate programmes in Production Engineering, Electronics Engineering, Computer Engineering and Information Technology, post-graduate programmes in Mechanical Engineering (CAD-CAM with Robotics) and Electronics Engineering and doctoral programmes in Electronics Engineering and Mechanical Engineering.

  
Dr. Sija Umikrishnan  
Principal

  
Dr. Sunil Surve  
Professor


**Authorization and Release**

I, individually and on behalf of the Company specified below (if any), hereby authorize Amazon Web Services, Inc. and its affiliates, and their respective agents, employees, contractors, resellers, sublicensees and assigns (collectively, "AWS") to reproduce, publish, distribute and/or translate, for advertising, merchandising and publicity purposes, all or any part of the following items ("Item(s)"): (a) my testimonial regarding my use of AWS services, provided by me to AWS; (b) my case study regarding my use of AWS services, provided by me to AWS; (c) my video testimonial, provided by me to AWS or as recorded by AWS; and (d) my name and Company logo provided to AWS, to identify me and Company as a customer of AWS on websites operated by AWS, including the website at [aws.amazon.com](http://aws.amazon.com), and any subpages of the AWS sites, and in customer lists, commercial presentations, press releases, flyers, brochures, newsletters and other marketing collateral, in any language. AWS will get my approval (which approval may be via email) on the final form of any testimonial, case study or video testimonial.

AWS will not make changes or alterations to the Item(s) in any way that substantially changes the content or meaning of the Item(s). I understand that my name and the name of the Company I am associated with, if any, and any descriptive or written material and all rights of personality or publicity may be used and published in connection with the Item(s). I also understand that AWS may use the Item(s) with or without identifying my name.

I represent and warrant that the Item(s): (i) are true and accurate to the best of my knowledge; (ii) have not been copied in whole or in part from any other work; and (iii) do not violate or infringe any copyright, trademark, or other proprietary rights of any person or entity. I acknowledge that I have received nothing of pecuniary value in exchange for making any of the above referenced items, including any testimonial and/or case study, and that neither I nor any member of my immediate family are employed by AWS.

If at any time I would like AWS to discontinue future use of the items, upon email notice to AWS at [case-study@amazon.com](mailto:case-study@amazon.com) (or such other email address as AWS directs), AWS will promptly discontinue future use, provided that AWS will not be required to remove the Item(s) from any pre-printed materials.

Company (if any):	Fr. Conceicao Rodrigues College of Engineering
Signature:	
Full Name (please print):	Dr. Srija Unnikrishnan
Address:	Fr. Agnel Ashram, Bandstand, Bandra (West), Mumbai, 400050
Telephone number:	+91 - 22 - 6711 6030
Date:	August 13, 2018







राज्य MAHARASHTRA

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RV 852177



पंजीत सुराज कलकल, मुंबई  
प.स. वि.क. ८०००००९  
30 JUN 2017  
नरम अधिष्ठाता



TATA CONSULTANCY SERVICES

Memorandum of Understanding  
Between

Tata Consultancy Services Ltd. and Fr. Conceicao Rodrigues College of Engineering

This Memorandum of Understanding (MoU) is entered into this 7<sup>th</sup> day of May 2018 by and between Tata Consultancy Services Limited, a company incorporated under the Companies Act, 1956 having its Corporate office at TCS House, Raveline Street, 21 D.S. Marg, Fort, Mumbai 400 001 (hereinafter referred to as "TCS"), on the One Part.

And

Fr. Conceicao Rodrigues College of Engineering, Fr. Agnel's Ashram, Bandstand, Bandra(W), Mumbai - 400050 was established in 1983 (hereinafter referred to as "the AIP Collaborating Institute").

Sf 12

### Recitals

- a. TCS is in the business of Software development and Consultancy Services and other allied businesses for its Clients world wide.
- b. Fr. Conceicao Rodrigues College of Engineering, Fr. Agnel's Ashram, Bandstand, Bandra(W), Mumbai, is institute with the vision "Molding Engineers who can build the nation" with sole purpose of affordable technical education to all.
- c. The purpose of this MoU is with reference to exploring the areas of cooperation, benefiting both the AIP Collaborating Institute and TCS.
- d. Following the tradition of India's most admired corporate group TATA, TCS has been involved in strengthening the Academic Community around the world through TCS - Academic Interface Programme (AIP). AIP has been involved in various programmes to bridge the gap between campus and corporate and thereby enhancing the employability of emerging workforce. Some of these activities are: Workshop for students, Faculty Development Programs for teachers, Student Awards to encourage healthy competition at colleges, Internship Training opportunity for students.
- e. And Whereas Fr. Conceicao Rodrigues College of Engineering has evinced keen interest in the said TCS Academic Interface Programme and offered to be a part of it as a collaborator.

NOW THIS MoU WITNESSETH as follows

### Areas of cooperation

1. TCS agrees to offer a package of TCS Academic Interface Programme, containing the following, to the AIP Collaborating Institute. TCS shall support the student and teacher communities through workshops, Faculty Development Programmes and student internships

Item #	Item Description	Target per year
1.	Workshops for students	4
2.	Faculty Development Programmes	2
3.	Best Student Award	1
4.	Best Student Project Awards (maximum of 4 students in the team)	1
5.	Internship	For 2% of the students offered placement in TCS

2. The AIP Collaborating Institute shall explore the possibilities of supporting TCS in its learning, hiring and research requirements based on mutual convenience



Handwritten signatures and initials.





3. **Confidentiality:** Each party shall maintain complete confidentiality of any information of the other, disclosed during the term of this MoU ("Confidential Information") either directly or indirectly in any form whatsoever including, but not limited to, in writing, in machine readable or other tangible form, orally or visually (subsequently reduced to writing). Both parties undertake to (i) hold all such Confidential Information in strict confidence, (ii) not to disclose such Confidential Information either in whole or in part to any person other than those of its officers, employees and agents who need to know the Confidential Information for the purpose authorized hereunder provided that each such officer, employee or agent has agreed in writing to maintain the confidentiality of the Confidential Information in accordance with the terms hereof or (iii) not to use such Confidential Information for any purpose whatsoever save as may be strictly necessary for the performance of this MoU. This clause pertaining to confidentiality shall survive the term of this MoU and remain in full force and effect notwithstanding any termination of this MoU.
4. **Intellectual Property Rights:** IPZ titles or ownership of any products, proprietary information or technology tools, processes, methods, and methodology including any TCS proprietary products or components thereof used hereunder or development of any deliverables and all new ideas, inventions, innovations, or developments conceived, developed, contributed, distributed or made by TCS hereunder, and all customisations, enhancements and modifications thereof, will not be transferred from TCS to the AIP Collaborating Inst. use or account of use of the same as part of any work under this MoU and shall always remain with TCS.
5. In no event shall either party be liable for any indirect, incidental, special, consequential damages, including, but not limited to, loss of profits, revenue, data or use, incurred by the other party in connection with, arising out of or under this MoU, save for any such loss suffered resulting from any wilful and grossly negligent act or omission of either of the parties.
6. Neither this MoU, nor any activities described herein, shall be construed as creating a partnership, joint venture, agency or other such relationship. Both parties agree that this MoU represents a nonexclusive relationship between the parties and nothing contained herein shall preclude either party from participating, initiating similar relationship with third parties.
7. Neither party shall issue any press release, public announcement or other such disclosure concerning this MoU without the other party's prior written consent as to such release or announcement.
8. This MoU may not be amended without the prior written consent of both the parties.
9. This MoU will be effective for three years from Apr, 2018 - 31/03/21. This MoU can be renewed based on mutual convenience.
10. **Governing Law:** This MoU shall be governed by the laws of India and the Courts in Mumbai shall have exclusive jurisdiction.
11. **Termination:** Either party can cancel or terminate this MoU unilaterally (and without reasons) by giving an advance written notice of one month to the other.



*[Handwritten signature]*



12. **Notices:** All notices, requests, demands and other communications under this MoU or in connection herewith shall be given to or made upon the respective parties as follows:

To TCS : Tata Consultancy Services Limited  
TCS House,  
Raveline Street, 21 D.S. Marg, Fort,  
Mumbai - 400 001.

To the AIP Collaborating Institute:  
Fr. Conceicao Rodrigues College of Engineering,  
Fr. Agnel's Ashram, Bandstand, Bandra(W),  
Mumbai - 400050

or to such other person or addresses as any of the Parties shall have notified to the others

All notices, requests, demands and other communications given or made in accordance with the provisions of this MoU shall be in writing by letter, fax or telegram

13. **Tata Code:**

The business activities of TCS are self regulated by the "Tata Code of Conduct". The AIP Collaborating Institute undertakes that it will endeavor to promptly report any violation or potential violation of the Code by any person to the **Local Ethics Counselor** or the **Principal Ethics Counselor** or the **CEO** of TCS. TCS, in turn, undertakes that it will maintain confidentiality of all communication received.

14. **FORCE MAJEURE:**

If either of the two parties is prevented, restricted, delayed or interfered by reason of:

- a) Fire, explosion, cyclone, floods, droughts, earthquakes, epidemics;
- b) War, revolution, acts of public enemies, blockage or embargo, riots and civil commotion;
- c) Any law, order, proclamation, ordinance or requirements of any Government, or authority or representative of any such Government, including restrictive trade practices or regulations;
- d) Strikes, shutdowns or labour disputes which are not instigated for the purpose of avoiding obligations herein; Or
- e) Any other circumstances beyond the reasonable control of the party affected; then not withstanding anything here before contained, the party affected shall be excused from its performance to the extent such performance relates to prevention, restriction, delay or interference and provided the party so affected used its best efforts to remove such cause of non-performances, and when removed the party shall continue performance with the utmost dispatch.

Each of the parties agrees to give written notice to the other party upon becoming aware of an Event of Force Majeure, and mentioning details of the circumstances giving rise to the Event of Force Majeure.



*[Handwritten signature]*



15. **Indemnity:** Each of the parties shall defend, indemnify and hold the other party harmless from and against any claim, liability, loss, costs or expenses (including reasonable Attorney's fees) arising out of or resulting from the material breach of the provisions herein.

IN WITNESS WHEREOF THE parties have set their hands hereto on the day and year first hereinabove written under their respective seal of office.

*Lata*

Authorized Signatory

Tata Consultancy Services Ltd.

*Sx*

Dr. Srija Unnikrishnan,  
Principal

Fr. C.R. College of Engineering

Witnesses:

1. *Lorraine*

2. *Ratan Babbar*





**Christiani  
Sharpline**

**MEMORANDUM OF UNDERSTANDING**

Between

**DEPARTMENT OF PRODUCTION ENGINEERING  
FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING, MUMBAI**

And

**CHRISTIANI SHARPLINE TECHNICAL TRAINING PRIVATE LIMITED, NAVI MUMBAI**

This Memorandum of Understanding is entered into on 19.08.2016 between, Department Of Production Engineering, Fr. Conceicao Rodrigues College of Engineering, Mumbai and Christiani Sharpline Technical Training Private Limited, Navi Mumbai

**1. PREAMBLE**

Collaborative efforts in engineering education have become the key to success. The TEQIP process encourages institutions to establish MCKs with neighboring institutions and industries as well as collaborative consultancy projects with specific time-frames and well defined outputs. The collaboration could be in the areas of joint projects of students and faculty, joint publications, joint sponsored projects from funding agencies, joint faculty and staff development programmes, joint consultancy projects with a sound revenue sharing model etc. The institutions are required to establish collaboration through MOU. The two institutions signing this MOU have agreed to work on the philosophy mentioned in this preamble.

Department Of Production Engineering, Fr. Conceicao Rodrigues College Of Engineering, Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai - 400 050 (herein referred to as **DPPE - Fr. CREC**) is a reputed technical department having the vision of becoming a Centre Of Excellence, which has learned faculty, high quality laboratories and large students community, who can complement the educational industry.

And

Christiani Sharpline Technical Training Private Limited (**CS TT**), a company duly incorporated under the provisions of the Companies Act, 1956 and having its registered office at Plot No. 19, TTC Industrial Area, Vashi Nayar, Digha, Navi Mumbai - 400 709, (herein referred to as **CS TT**) is engaged in the business of

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TEQIP REPORT CARD FOR THE  
YEAR 2015-2016  
RANKED 100th  
137281  
0000  
16-11-16  
16-11-16  
16-11-16

*Handwritten signature*



*Handwritten signature*







**Christian  
Sharpline**

provide, the sale of up-grade solutions and training packages to technical institutions and training sector of industries as well as manufacturing units.

Jointly agree to exchange their expertise in the field of Technical Vocational Education and Skill Development for mutual benefit and growth in the terms mentioned hereunder.

## 2. PURPOSE

The aim of this MoU is primarily to establish a written document under which both the Institute Department Of Productive Engineering, Fr. Conceicao Rodrigues College Of Engineering Christian Sharpline may enter into a written agreement to perform collaborative programmes in the areas of mutual interest.

## 3. AREA OF COLLABORATION

Areas in which DPE – Fr. CRCE and CSTT may collaborate are as follows:

1. Work jointly on research projects to be submitted to various funding agencies, consultancy assignments, faculty and staff development programmes, allow the credit transfer to P2/Ph.D. students working in these institutes etc.
2. Attend conferences organized by the two institutions.
3. Start Collaborative Research Programme of mutual interest.
4. Industrial visit at Christian Sharpline.
5. Developing Centre of Excellence.
6. Expert Lectures from Christian Sharpline.
7. Identify corporate training areas.
8. Internship training.
9. Provide training on software related to Mechanical Engineering.

Any other activity not covered by this MoU shall be decided on a case to case basis by the two institutions – DPE – Fr. CRCE and CSTT.

## 4. AGREEMENT OF COLLABORATIVE PROGRAMMES

Each joint collaboration undertaken by the institutes shall describe in detail the following:

- The nature, scope and the time of collaborative schedule.
- The form as per clause 3.5 above.
- Any other provision as deemed to be necessary and agreed by both.

To prepare and finalize a concrete action plan and schedule of collaboration or priority areas as agreed upon by both.





**Christiani  
Sharpline**

**5. NODAL AUTHORITY**

The Nodal Officer from DPE – Fr. CRCE, shall be the Principal, Fr. CRCE or his nominee and the Nodal Officer from CSTT shall be the General Manager – CSTT or his nominee for all decision making and concurrence.

**6. IMPLEMENTATION AND ACTION PLAN**

CSTT and DPE – Fr. CRCE shall endeavor to finalize the details of implementation and action plan of collaborative efforts to execute the parts of this MOU from the academic year 2016-17.

This MOU shall be effective from the date of signing the same and shall remain in effect for the subsequent two years and may be renewed or discontinued thereafter by mutual consent.

In witness whereof, the Two Institutions hereto have executed this agreement on the date and the year first herein above written.

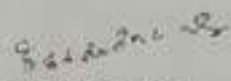
  
Dr. Srija Uthirakrishnan  
Principal  
Fr. Conceicao Rodrigues College of Engineering

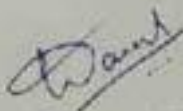


  
Mr. Mohan S. Iyer  
General Manager  
Christiani Sharpline, New Mumbai



Witness:

  
Prof. D.S.S. Sudhakar  
HOD – Production Engineering Dept

  
Mr. Chandrashekhar V  
AGM – Training



Fr. Conceicao Rodrigues College of Engineering, Mumbai.

MEMORANDUM OF UNDERSTANDING

D-Link India Ltd.

And

Fr. Conceicao Rodrigues College of Engineering, Mumbai.

MEMORANDUM OF UNDERSTANDING



For V-LINK COMPUTERS

*W. Chavan*

Proprietor

This Memorandum of Understanding is signed by and between D-Link (India) Limited, a Company, a Public Limited Company (incorporated under the Companies Act 1955 and duly represented by its Chief Executive Officer, Mr. Tushar Sighat, and having its principal office at Kalpataru Square, 2<sup>nd</sup> Floor, D-11 No. 24, Khandivda Lane, Off Andheri-Kurla Road, Mumbai - 400072, India (hereinafter referred to as "D-Link")

#### And

Dr. Convent Rodrigues College of Engineering, Vashishti, Jandri West, Mumbai Represented by Dr. Sushil Surve, HOD - Comp Engg & Authorized Signatory, (hereinafter referred to as "Educational Institution") as follows (hereinafter referred to collectively as "Party" and jointly as the "Parties"):

#### 1. The subject of the agreement:

D-Link, a public limited company pioneered in the field of Networking Technology in the country and engaged in the business of Trading of IT Networking products, D-Link and Educational Institution see a synergy in their objectives and agree to have collaboration in imparting Education programme in IT networking course. In order to achieve this, Educational Institution agrees to set up certification course in Networking Technology by utilizing D-Link's services, expertise and networking infrastructure.

D-Link agrees to provide Educational Institution (E.I) to establish training centre in IT Networking and to provide Technical specialists of D-Link. The educational programme is on the basis non-profit and commercial educational activities. D-Link will issue certificates to the successful candidates after completion of course.

#### 2. Duties and responsibilities of the Parties.

##### 2.1. Educational Institution.

2.1.1. To start up the D-Link authorized training centre, Educational Institution is required to have:

- (i) Availability of the annual work plan, curriculum and teaching materials recommended by D-Link;
- (ii) Availability of teachers/ Trainers/ Technical persons certified from D-Link;
- (iii) Availability of equipment recommended for the training of certified specialist.

2.1.2. Educational Institution shall not copy and change the any literature/ document provided to them by D-Link; however, its practical need and student requirement can be considered as valuable suggestion to revise the literature and documents provided for the course.



For V-LINK COMPUTERS

Wchare  
Proprietor

2.1.3. Teachers of Educational Institution participating in the D-Link educational programs are required every two years to renew their certificates in the region representative office or any authorized training center. Where the certification exams are held in the academic centers of D-Link, the examination committee shall include representatives of D-Link.

2.1.4. Educational Institution shall provide proper infrastructure for training lab space and learning space. It shall provide a Class Room with minimum seating capacity of min. 20 students, equipped with Projector for instruction to meet 24" Dual/D Rack/6" Rack with Power supply Cable, AC, connection of PC/Laptop.

2.1.5. Educational Institution shall have a training schedule prepared along with fixed exam timetable over an every time break for each group of trainee.

2.1.6. Educational Institution must provide hardware, free performance, engineers or Train the Trainer (TTT) program, preferably of training background in IT.

2.1.7. Educational Institution shall provide D-Link with the list of computer parts used.

## 2.2 D-Link

2.2.1. D-Link shall provide assistance in training teachers as required by Educational Institutions as and when required.

2.2.2. D-Link shall carry out periodic inspection of the training centre and quality control activities.

2.2.3. D-Link specialist shall provide accreditation to trainers in training centres as the technological features of the equipment and its configuration.

2.2.4. Subject to all the above conditions, D-Link shall issue a certificate recognizing Educational Institutions as Authorized "D-Link Academy Partners" having an authorized training centre. D-Link reserves the right to issue a "expired certificate" if D-Link. The period of validity of the certificate shall be for two (2) years.

2.2.5. D-Link shall provide the lab equipment with Special Education document with limited life time warranty; however, the equipment will be used as per its training and practicing purposes. Notwithstanding the foregoing, D-Link has the right to demonstrate and show the equipment whenever requested by its customers at Educational Institution premises, provided that prior scheduling for such demonstration is arranged between D-Link Inc. Educational Institution, and a written notice sent by D-Link.

2.2.6. D-Link shall review the lab equipment and training material content periodically. If any changes are needed as per technology update and based on market feedback, D-Link shall notify the Educational Institution and changes upon approval.

2.2.7. The lab equipment, set up charges and course material charges shall be paid to D-Link and their Academic Partner. The examinations and training course conducted



For V-LINK COMPUTERS

*Wahar*

Proprietor

by Educational Institution and charged at its own discretion. Charge per student per exam to be paid along with student's admission.

2.2.3. The GST and other applicable taxes on reporting the training and conduct courses shall be borne by the respective parties as per the applicable tax laws.

### 3. Terms and conditions

3.1 None of the Parties during the term of this Agreement shall, without the prior consent of the other Party, disclose to third parties any confidential information, as well as information regarding the business of the other Party, which became known due to the performance of this Agreement, or use the information for purposes not agreed upon in writing by the other Party.

3.2 The Parties by mutual agreement may make amendments and/or variations to this Agreement. The changes that are made in writing to this Agreement and duly signed by both the Parties constitute an integral part of this Agreement.

3.3 Terms of this Agreement, either directly or indirectly, shall not give rights to the Parties of any other obligations that are not explicitly specified in this Agreement.

3.4 Any training document including training material, brochures, documents and other D-Link Academy related documents cannot be duplicated/scanned without prior approval.

3.5 "The D-Link Academy", D-Link logo and all D-Link trademarks are registered trademark and D-Link is officially over these titles.

3.6 This agreement is effective for One (1) year from the date of the last economic signature by the Parties hereto as shown below and be automatically extended for a further year if neither Party makes a written declaration of its intention to terminate this Agreement (no later than thirty (30) calendar days before the stipulated date of termination). Notwithstanding the foregoing, D-Link may terminate this Agreement with sixty (60) day prior notice.

3.7 This Agreement is made in two copies and one for each Party. Each copy of this Agreement shall have equal legal force.

### 4. Commercial

For commissioning D-Link Academy training programs, Initial cost of lab equipment and setup is involved. The Educational Institution is going to bear the initial training investment supplied by Academic Partner.



For V-LINK COMPUTERS

*Wichan*

Proprietor

4.1. Course Fees & Certification/Module Charges to Students:

D-Link recommends following fee structure for the training program:

Sr. No.	Fees description	Fees (Rs/USD)	Remarks
1	Course Fee/Module fee	Rs.500/-	This fee for the complete course collected by the institution and 70% will be given to Centers (F. Course fees (Admission) & 30% to D-Link (India) Ltd.)  Because D-Link does not want this course for less than 500 Students.
2	Student Learning Kit/Voucher	Rs.1250	Payment to D-Link (Overseas)
3	Exam Fees/Module	Rs.2500	One-time course fee registered and to be appeared on D-Link expert's portal and payment to D-Link (India) Ltd.

\*Admission Fee Payment: + 10% cost of F. Course fee-Rodriguez Group of Institutions, Marikudi + GST + Additional Registration For Certification/Module has to be shared to D-Link along with Student's registration Fees.

\*Course Feeing is mentioned on Student's registration Form

4.1.1. Educational institution has right to increase or decrease the course fees.

4.1.2. Educational institution shall pay the Student Learning Kit/Voucher to D-Link authorized agent (Institute), it is advisable to have student kit with every participant of the course, Exam Voucher is part of Student Kit.



For V- LINK COMPUTERS

*W. Chohan*  
Proprietor



4.2.3. D-Link recommends minimum 76 students in a batch.

4.2.4. Educational Institution shall impart 28 hours of training to the student based on availability of time without affecting their regular curriculum or shall be included in Educational Institution's semester elective.

5.1. The functioning of object of this MoU has to be jointly at the end of one year for introducing any changes in its operations.

5.2. Each party shall respect the other's intellectual property (IP) and shall not use any trade name, trade mark, symbol or designation belonging to the other, without prior approval. No Party shall acquire any right in the other Party Intellectual Property pertaining to any information disclosed by the Party pursuant to this MoU and any Intellectual Property so disclosed shall be owned, controlled and remain vested in the party disclosing such Intellectual Property. No party shall hold out as an agent or representative of the other or create any liability for the other. The parties shall indemnify the other for breach of this clause.

5.3. D-Link shall not be held responsible for any eventual inability to provide facilities due to force-majeure reasons or due to circumstances beyond the control of D-Link.

5.4. Where the above articles of understanding are subject, or for special cases of deviation from these articles, the mutually agreed upon decision between D-Link and Educational Institution will be final. However, in case of any dispute relating to or arising out of this MoU, shall be resolved amicably by mutual consultations. If such resolution is not possible, then, the unresolved dispute or difference for more than 2 months shall be referred to the arbitration of sole Arbitrator to be mutually appointed by D-Link and Fr. Conceicao Rodrigues College of Engineering, Mumbai. The Arbitration Act of 1940 (10 of 1940) and Rules framed thereunder, as amended from time to time, shall be applicable to such arbitration proceedings under this clause. The venue of all the arbitration proceedings shall be Mumbai.

6. Attachments to the MoU:

1. DCS monitoring/BCS-Wireless DCS-Surveillance.

In witness whereof, the Parties hereto have caused this Agreement to be signed by their duly authorized representatives as of the date and year set forth as below:

D-Link India Limited Ltd  
(Signature)

(Mr. Tushar Sighar)

(Chief Executive Officer)

(Date: \_\_\_\_\_)

Fr. Conceicao Rodrigues College of Engineering  
(Signature)

(Dr. Samil Narva)

(HOD-Computer Engg)

(Date: \_\_\_\_\_)

Witness and Third Party to MOU:

*Sudhakar Singh*  
Cdt D-Link (Head of)  
29/02/2017.



For V-LINK COMPUTERS

*Wahare*  
Proprietor



MEMORANDUM OF UNDERSTANDING

BETWEEN

FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING

Fr. Agnel Ashram, Bandra (West), Mumbai - 400 050

(Affiliated to the University of Mumbai)

AND

SENERGY CONSULTANTS PVT LTD. (M.V.B.A.)

D3, Aashrafi, H.S. Devshi Road, Govardi (East), Mumbai - 400 065, Maharashtra, INDIA

WHEREAS,

Fr. Conceicao Rodrigues College of Engineering (CRCE) was established in 1984 as part of Fr. Agnel Technical Complex at Bandra, Mumbai by the Society of St. Xavier. It is named after its founder i.e. Rev. Fr. Conceicao Rodrigues. The college is affiliated to University of Mumbai. The college has acquired a good reputation for its academic standards.

The major characteristics of college are:

Well experienced, dedicated staff. Most of our faculty members have rich experience in Industry / R & D establishments. Well Equipped Laboratories. Computing facilities with computer wide network and Management with a commitment.

WHEREAS,

SENERGY was founded with this objective in early 1990 and has grown up with the same. As the same emphasizes, it's the synergy between SENERGY and the Client that alone can facilitate optimum utilization of energy. Senergy believes that ultimate aim of the study is actual realization of the savings.

SENERGY have over 450 satisfied Clients with many repeat orders from their Sister / Associate Companies. SENERGY is an empanelled Consultant with Maharashtra Energy Development Agency (MEDA) & Gujarat Energy Development Agency (GEDA).

WHEREAS, both CRCE and SEENERGY, now

- Recognizing the importance of industry institute interaction in the areas Energy Conservation and Efficiency, as well as imparting industrial exposure to the engineering faculties and for students.
- Appreciating the need for creation of large reservoir of highly qualified manpower in all fields related to Energy Audit and Management.
- Desiring to club their efforts by pooling their expertise and resources.

NOW, THEREFORE, in consideration of the mutual promises made herein and of good and valuable consideration, the receipt and sufficiency of which by CRCE and SEENERGY hereby acknowledge, CRCE and SEENERGY hereby agree to sign a memorandum of understanding (MOU).



Signature of CRCE representative



Signature of Senergy representative

Vertical stamp: THE ABOVE COOPERATIVE SOCIETY LTD. ...

Stamp: INDIA, 40802, 16385, R0000100H-P85503, AUG 25 2015

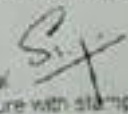
We agree upon the following conditions.

1. The projects will be jointly carried out by CRCE and SCPL.
2. All appointments, management of manpower and travel arrangements to the staff of CRCE may be carried out by SCPL in joint discussion subject to availability of CRCE staff.
3. Attendance and outside duty record of appointed CRCE staff is to be monitored by CRCE.
4. Progress of the project is evaluated and documented by CRCE.
5. Publication of papers and presentations is based on the knowledge generated out of collaborative work will be done by CRCE and SCPL in mutual consultation, if required.
6. CRCE and SCPL hereby agree on their behalf and on behalf of those upon whom they can exercise control to keep all the information, technological and other relevant information obtained from collaborative work and generated during the research project in strict confidence and the same shall not be divulged to any third party without prior approval of each other.
7. Both parties agree that the terms and conditions of MOU can be reviewed for every two years.
8. The honorarium is paid by SCPL to CRCE as consultancy work.

WITNESS WHEREOF the parties have caused their authorized representatives to sign this MOU on their behalf on the day, month and year mentioned here above.

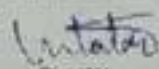
Parties

For and on behalf of CRCE

  
Principal  
(Signature with stamp)



For and on behalf of SCPL

  
Director  
(Signature with stamp)



**AGREEMENT OF COOPERATION  
BETWEEN  
Fr. Conceicao Rodrigues College of Engineering  
AND  
The University of Texas at El Paso**

The University of Texas at El Paso, addressed at 100 W. University Ave., El Paso, Texas, United States of America (hereinafter referred to as "UTEP") and the Fr. Conceicao Rodrigues College of Engineering, located at Fr. Agre, Ashram, Banerband, Bandra (w), Mumbai, Maharashtra, India (hereinafter referred to as "Fr.CRCE") enter into an Agreement of Cooperation to establish a program of exchange and collaboration in areas of interest and benefit to both institutions.

**I.**

The purposes of the cooperation between UTEP and Fr.CRCE are as follows:

- to promote interest in the teaching and research activities of the respective institutions, and
- to deepen the understanding of the economic, cultural, and social issues environment of the respective institutions.

**II.**

To achieve these goals, UTEP and Fr.CRCE will, insofar as the means of each allow:

- promote institutional exchanges by inviting faculty and staff of the partner institutions to participate in a variety of teaching and/or research activities and professional development;
- receive undergraduate and graduate students of the former institution for periods of study and/or research;
- organize symposia, conferences, short courses and meetings on research issues;
- carry out joint research and continuing education programs; and
- exchange information pertaining to developments in teaching, student development and research at each institution.

**III.**

Each institution shall designate a coordinator to oversee and facilitate the implementation of this agreement. The coordinators, working with other appropriate administrators at the respective universities, shall have the following responsibilities:

- to promote academic collaboration at both faculty, graduate and undergraduate student levels for research and study;
- to act as principal contacts for individual and group activities and to plan and coordinate all activities with their institutions as well as with the partner institution;
- to distribute to each institution information about the faculty, facilities, research, publications, library materials and educational resources of the other institution; and
- to meet periodically to review and evaluate past activities and to work out new ideas for future cooperative agreements.

**IV.**

This general Agreement of Cooperation shall be identified as the parent document of any program agreement executed between the parties. Further agreements concerning any program shall provide details concerning the specific commitments made by each party and shall not become effective until they have been reduced to writing and executed by the duly authorized representatives

of the parties. The scope of the activities under this agreement shall be determined by the funds regularly available to both institutions for the types of collaboration undertaken and by financial assistance as may be obtained by either institution from external sources.

V.

Except as may be stipulated in any specific program agreement, each institution shall be responsible for expenses incurred by its employees under this agreement.

Both parties understand that any financial arrangements will have to be negotiated and mutually agreed upon in writing prior to any endeavor under this agreement, and will depend on the availability of funds.


VI.

Upon approval by each institution, this agreement shall remain in effect for a period of ten (10) years unless terminated earlier by either institution. Such termination by one institution shall be effected by giving the other institution at least ninety (90) days advance written notice of its intention to terminate. If such notice is given, this agreement shall terminate: (a) at the end of such ninety (90) days; or (b) when all students involved in a course of study under the agreement at the time such notice is given have completed their respective courses of study under the agreement, whichever event occurs last. Termination shall be without penalty. If this agreement is terminated, neither UTSP nor FRCCE shall be liable to the other for any monetary or other losses which may result.

EXECUTED by The University of Texas at El Paso and the Fr. Conceicao Rodrigues College of Engineering, in duplicate copies, each of which shall be deemed an original.

THE UNIVERSITY OF TEXAS AT EL PASO

Fr. CONCEICAO RODRIGUES  
COLLEGE OF ENGINEERING

By: 

Diana Natalicio

President

Date: 4/26/16

By: 

Srujan Mishra

President

Date: 21<sup>st</sup> March 2016





# United Modeling & Simulation Pvt. Ltd.

## Memorandum of Understanding (MoU)

This Memorandum of Understanding is entered into on the 15th day of December 2015  
Between:

United Modeling & Simulation Pvt Ltd (here after called "UMS"), a company formed under the laws of India and having its registered office at #304, B-Wing, Kanakia Zillion, L.B.S. Marg, Kurla, Mumbai – 400 070, India

And

Fr. Conceicao Rodrigues College of Engineering, Bandstand, Bandra (W), Mumbai, Maharashtra 400050 (here after called "Fr CRCE"), affiliated to Mumbai University.

Whereas UMS is a leading provider of Engineering, Manufacturing and Software Solutions to global customers leveraging their world wide experience.

Whereas UMS has the capability to serve top global companies from Aerospace & Aviation, Automotive & Automobile, Pharmaceuticals, Chemicals & Petro Chemicals, Oil & Gas, Energy Power & Utilities, Consumer Products, Defense & Security, Engineering, Construction, and Operation Maintenance, Medical Simulation & Healthcare, Life Sciences, High Technology, Higher Education & Research, Industrial Machinery & Components, Banking, Insurance, Professional Services, Retail etc.

Fr. CRCE is an institute of excellence in engineering education, moulding engineers with state-of-the-art technologies, innovative skills and human values matching with the growing expectations of the corporates and the society and thus play an effective role in nation building.

Whereas UMS and Fr. CRCE are desirous of exploring opportunities for collaborating with each other on the terms set out in this MoU.

1. UMS desires to seek assistance/guidance of Fr. CRCE for providing consultancy and design to industry specific problems to customers in various industry segments across India and Abroad, on mutually agreeable basis.
2. Sponsoring student projects of UG/PG courses in Mechanical, Production, Electronics, Computer science and Information technology.
3. Sponsoring eligible employees of UMS for doing M.E./Ph.D. degree in Fr CRCE. The eligibility criteria for selection will be as per norms of Mumbai University.
4. Sponsoring R&D projects, which may be carried out wholly at FR CRCE or at premises of UMS or partly at FR CRCE and partly at UMS.
5. Training of UMS personnel through Continuing Education Programmes conducted by Fr CRCE in areas of interest to UMS.
6. Any other appropriate mode of interaction agreed upon between Fr CRCE and UMS.
7. Each of the above modes of interaction will be initiated by entering into a separate agreement between the two parties.

The proposals in which both parties agree for joint collaboration with mutual consent, the parties shall enter into a detailed agreement incorporating therein the detailed scope of work and services to be performed by the parties, their obligations, liabilities, costs, profit sharing and other terms and conditions, etc.



1/2

**"SIMULATION IS OUR ONLY BUSINESS"**



# United Modeling & Simulation Pvt. Ltd.

UMS and Fr. CRCE agree to use good faith and efforts to enter into a formal agreement to give effect to the intentions of the parties described herein.

10. Until the execution of such formal agreement, UMS and Fr. CRCE will collaborate on mutually agreed terms mentioned in this MoU.
11. This MoU shall terminate on execution of formal agreement between both parties or on mutual agreement to exit this MoU or period of 24 calendar months from the date of the MoU. This MoU may be amended or terminated at any time by mutual written agreement of the parties at any time. Either party shall have the right to unilaterally terminate this MoU upon 60 days prior written notice to the other party. However, no such early termination of this MoU, whether mutual or unilateral, shall affect the obligations of the participants under any agreement, Confidentiality clause or any other agreement entered into pursuant to this MoU, which obligations shall survive any such termination.
12. Rights regarding publications, patents, royalty, ownership of software/code/product developed etc. under the scope of this MoU, shall be decided by the two parties by mutual consent.
13. During the tenure of the MoU both UMS and Fr. CRCE will maintain strict confidentiality and prevent disclosure of all the information and data exchanged under the scope of this MoU for any purpose other than as accordance with this MoU.
14. This MoU is intended to serve as a mere confirmation of the Parties' current intention to enter into a binding agreement. Nothing in this MoU shall create upon any Party or its officers, directors, employees or consultants any legal or other enforceable obligation including, but not limited to, any obligation to enter into the definitive agreement or any other agreement. Unless otherwise agreed in writing by all Parties, no Party shall be liable to the others for any losses, damages, costs, expenses or any other disbursements (collectively, "Losses") suffered as a result of the failure of any Party to enter into a definitive agreement, whether or not the Party or Parties that suffered such Losses believed in or relied upon the likelihood of a definitive agreement to be made.

For  
United Modeling & Simulation Pvt Ltd

Signature:

Name: Mr. Amir Khan

Title: Executive Director

Place: Mumbai  
Date: 4<sup>th</sup> Jan 2016



For  
Fr. Convent ~~Katrigatta~~ College of  
Engineering

Signature:

Name: Dr. Seja Umikrishnan

Title: Principal

Place: Mumbai  
Date: 4<sup>th</sup> Jan 2016







FR. CONCEICAO RODRIGUES COLLEGE OF  
ENGINEERING (FR. CRCE)  
Fr. Agnel Technical Complex, Bandstand, Bandra (W),  
Mumbai - 400050 (MAHARASHTRA)



LALBHAI DALPATBHAI COLLEGE OF  
ENGINEERING (LDCOE)  
Opp. Gujarat University Campus, Navrangpura,  
Ahmedabad - 380015 (GUJARAT)

### MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding (MoU) is made on this day, the 2<sup>nd</sup> of November 2015 between :-

Fr. Conceicao Rodrigues College of Engineering, having its registered office located at the Fr. Agnel Technical Complex, Bandstand, Bandra (W), Mumbai - 400050 (hereinafter referred to as "Fr. CRCE" which expression shall include its representatives, successors and assignees) of one part

AND

Lalibhai Dalpatbhai College of Engineering, having its registered office located at No. 120, Circular Road, Opposite Gujarat University, Navrangpura, Ahmedabad - 380015 (hereinafter referred to as "LDCOE" which expression shall include its representatives, successors and assignees) of other part.

Fr. CRCE and LDCOE are jointly referred to as 'Parties' in this MoU.

Whereas Fr. CRCE and LDCOE have expressed mutual interest in setting up a strategic partnership towards academic excellence & tie-up through faculty & students exchange, sharing of resources, collaboration for joint research activities.

In consideration of the mutual obligations herein contained, the parties agree as follows:-

#### **OBJECTIVE AND SCOPE OF WORK**

##### **LDCOE RESPONSIBILITIES**

1. Facilitate use of Siemens Centre of Excellence (CoE) training facility for post-graduate students of Fr. CRCE.  
*as per the mutual consent.*
2. Provide internships to students from Fr. CRCE wherever applicable especially in Siemens CoE at a nominal cost for training and the accommodation.
3. Provide knowledge sharing on latest technologies with students & faculty of Fr. CRCE.
4. Collaborate for joint research proposals, activities & initiatives with students & faculty of Fr. CRCE.

##### **Fr. CRCE RESPONSIBILITIES**

1. Assign one faculty member as point of contact to act as liaison with LDCOE for co-ordination of responsibilities.
2. Exchange of faculty as resource persons with expertise in Embedded Systems, Robotics, Biomedical Engineering & Industrial Automation for guest lectures, expert talks & other academic collaborations.
3. Nominate expert staff members for knowledge sharing in areas of VLSI, Microelectronics & other domains as mentioned in the above point no. 2.

Email :- [crce@frce.ac.in](mailto:crce@frce.ac.in)

Website :- [www.frce.ac.in](http://www.frce.ac.in)

4. Provide knowledge sharing & academic guidance to M.Tech. & Ph.D. students of LDCOE in Biomedical Engineering, VLSI, Embedded Systems & Robotics for their research work.
5. Collaborate with staff & students of LDCOE for joint research proposals, activities & other academic initiatives.

#### ADDITIONAL POINTS

- Faculties and/or students from colleges other than Fr. CRCE might incur a cost if they choose to attend any workshop conducted at LDCOE.
- FCRCE cannot use the name / logo of L. D. College of Engineering (LDCOE) & Siemens Centre of Excellence (CoE) on their website or on any event publicity unless permission is granted by respective companies.

#### VALIDITY

This MoU is valid for three years from the date of signing of this MoU. Thereafter the MoU may be renewed for such term and on conditions as may be agreed between the parties.

#### NO ASSIGNMENT

Neither party without the written consent of the other may assign either the benefit or the burden of this MoU to anybody or any third party.

#### TERMINATION

Either party may terminate the MoU for cogent, operational and logical reasons, by giving to the other party 30 days notice in writing.

#### NOTICES

Notices would be deemed to have been given provided they are sent in writing by registered mail and a copy of the same is faxed to either of the parties by the other party to the following addresses.

Principal  
Lalibhai Dalpatbhai College of Engineering  
No. 120, Circular Road, Opp. Gujarat University  
Navrangpura, Ahmedabad - 380015.  
Phone - 079 2630 6752  
Email - ldce\_cilip@yahoo.com

Principal  
Fr. Conceicao Rodrigues College of Engg.  
Fr Agnel Ashram, Bandstand, Bandra (W),  
Mumbai - 400050.  
Phone - 022 - 67114000  
Email - croe@frcroe.ac.in

#### ENTIRE AGREEMENT

This document represents the entire agreement between the Parties regarding the subject matter of this MoU and can only be amended or modified by an agreement in writing signed by the Parties hereto.

#### LEGAL EFFECT

This document is **not intended** to impose any legal obligation whatsoever on either party (whether based in contract under statutory law). The parties **do not intend to be bound by any agreement until both agree to**

Email -> [croe@frcroe.ac.in](mailto:croe@frcroe.ac.in)


Website -> [www.frcroe.ac.in](http://www.frcroe.ac.in)

and sign a definitive written contract. Neither party can rely on any promises inconsistent with this paragraph. This paragraph supersedes all other conflicting language.

### SIGNATURES

This MOU will come into effect on the day date of signature of the representative of both parties as given:-

For Fr. CRCE

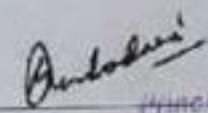
Signature: 

Name: Dr. (Mrs.) Srijalini

Title: Principal, Fr. CRCE

Date: 2<sup>nd</sup> November 2015

For LDCOE

Signature: 

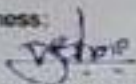
Name: Dr. G. P. Vaidya  
Principal, LDCOE  
L.D. College of Engineering  
Anandnagar - 15.

Title: Principal, LDCOE

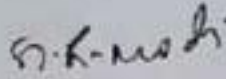
Date: 2<sup>nd</sup> November 2015



Witness:



Dr. Deepak V. Bhoir



Mr. Sunil Modi



Email :- [crce@frce.ac.in](mailto:crce@frce.ac.in)

Website :- [www.frce.ac.in](http://www.frce.ac.in)

## MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding (MOU) is made on this day, the 5<sup>th</sup> of January, 2015 between:

Fr. Conceicao Rodrigues College of Engineering, having its office located at Fr Agnel Ashram, Bandstand, Bandra(W), Mumbai, Maharashtra (hereinafter referred to as 'Fr. CRCE' which expression shall include its representatives, successors and assignees) of one part

AND

Eduvance, the educational arm of Vanmat Technologies Pvt. Ltd. having its registered office located at 202 Mary Anne Heights, Santacruz (East), Mumbai 400055, (hereinafter referred to as "Eduvance" which expression shall include its representatives, successors and assignees) of other part.

Fr.CRCE and Eduvance are jointly referred to as 'Parties' in this MOU.

WHEREAS: Fr. CRCE and EDUVANCE have expressed mutual interest in setting up a "Center of Excellence in Remote Learning Technologies (COERLT)"

In consideration of the mutual obligations herein contained, the parties agree as follows:

### OBJECTIVE AND SCOPE OF WORK

#### EDUVANCE RESPONSIBILITIES

1. Donate the necessary hardware equipment to Fr.CRCE for the setup of the COERLT (As per annexure 1)
2. Setup the COERLT in collaboration with hardware donated by ARM University Program
3. Donate the necessary software to Fr.CRCE for successful functioning of the COERLT (As per annexure 1)
4. Conduct one faculty development workshop per year at no cost for faculty of Fr.CRCE.
5. Conduct two student training workshops per year at no cost for the students of Fr.CRCE (as per annexure 2)
6. Provide internships to students from Fr.CRCE where applicable.
7. Provide knowledge sharing on latest technologies with students and faculty of Fr.CRCE for research activities.
8. If the infrastructure of the COERLT is used for any commercial purpose by Eduvance, then Eduvance will share 25% of the revenue generated from the activities pertaining to the COERLT with Fr.CRCE.



8. If the infrastructure of the COERLT is used for any commercial purpose by Edvance, then Edvance will share 25% of the revenue generated from the activities pertaining to the COERLT with Fr. CRCE.

### FR. CRCE RESPONSIBILITIES

1. Assign one faculty member as a point of contact to act as a liaison with Edvance for coordination of Edvance's responsibilities.
2. Provide space for the use of the donated equipment with necessary power supply and furniture arrangements in discussion with Edvance.
3. Fr. CRCE would provide (on a best effort basis) a dedicated internet connection of 5Mbps to the COERLT during the working hours of 9am to 5pm daily.
4. Fr. CRCE would provide a dedicated internet connection of 35Mbps during the working hours of 5pm to 8am daily.
5. Fr. CRCE will allow Edvance to use the COERLT for Edvance's own purposes of research and internal employee trainings.
6. Fr. CRCE would accommodate the skill development program that Edvance will be conducting in its semester schedule.
7. Fr. CRCE will motivate students and faculty to adopt the COERLT activities.

### VALIDITY

8. This MOU is valid for three years from the date of signing of this MOU. Thereafter the MOU may be renewed for such terms and on conditions as may be agreed between the Parties. The MOU can be modified at the end of every year with mutual consent of both the parties.

### NO ASSIGNMENT

9. Neither party without the written consent of the other may assign either the benefit or the burden of this MOU to anybody.

### TERMINATION

10. Either party may terminate the MOU for cogent and logical reasons, by giving to the other party 50 days' notice in writing.
11. On termination of MOU, the hardware that is donated to Fr. CRCE will remain at Fr. CRCE as its property.

## NOTICES

12. Notices would be deemed to have been given provided they are sent in writing by registered mail and a copy of the same is faxed to either of the parties by the other party to the following addresses:

**CEO**  
**Edvance**  
Vinnat Technologies Pvt. Ltd.  
A-202 Mary Anne Heights,  
3<sup>rd</sup> Golbar Road,  
Santacruz (East), Mumbai 400055  
Ph.No.: 491-9820749235

**Principal**  
**Fr.CRCE**  
F- Agnel Ashram,  
Sandband, Bandra (W), Mumbai  
Mumbai, Maharashtra  
Phone:

## ENTIRE AGREEMENT

13. This document represents the entire agreement between the Parties regarding the subject matter of this MOU and can only be amended or modified by an agreement in writing signed by the Parties hereto.

## SIGNATURES

14. This MOU will come into effect on the day date of signature of the representative of both parties as given:

For Fr.CRCE:

Signature: \_\_\_\_\_

Name: Dr. Srija Urzishrikan

Title: Principal

Date: 05/01/2016



For Edvance

Signature: \_\_\_\_\_

Name: Dr. Jonathan Joshi

Title: C.E.O. Edvance

Date: 05/01/2016





## ANNEXURE 1

Annexure 1 - Lab setup infrastructure by FRCRCE

Item	Quantity	Source	Cost to Fr.CRCE*
Lab Space	1	Fr.CRCE	Existing lab space will suffice.
Remote FPGA and Modules	5	Edkits Electronics	No cost Donation by Edvance (Industry Cost - 5 Lakhs)
Remote ARM FRDM Modules	5	Edkits Electronics	No cost Donation by Edvance (Industry Cost - 4 Lakhs)
Server	1	Computer Shop	No cost Donation by Edvance (Approx INR 38,000)
Software for Remote FPGA Modules	10	Edvance	No Cost (Donation from Edvance) (Actual cost - Rs. 60,000 per module - Total 6,00,000)
Cloud Based Equipment Reservation System	1	Edvance	No cost Donation by Edvance (Approx INR 5,00,000)
		<b>Total Donation Cost</b>	<b>INR 20,38,000</b>

Contact Us: [contact@edvance.in](mailto:contact@edvance.in)

Website: [www.edvance.in](http://www.edvance.in)

## Annexure 2 - Skill Development Activities by Eduvance at Fr.CRCE

Eduvance will conduct one certificate training program per year for all (72 students) of 3<sup>rd</sup> and final year ETRX students at **no cost for a period of 3 years** from the date of lab setup.

Each training program will be of 3 days/24 hour duration on any of the following as decided by Fr.CRCE

- ARM Mbed
- PSoC
- FPGA Design
- VLSI Design
- Actual cost per student per training – Approx. Rs. 5000

Eduvance will conduct one certificate training program per year for all faculty members of the ETRX department at **no cost for a period of 3 years** from the date of lab setup.

Eduvance will provide two students per year with an internship at its facilities for a **period of 3 years** from the date of lab setup.

Eduvance will guide and mentor one mini project and one final year project from Fr.CRCE for a **period of 3 years** from the date of lab setup.

## MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding (the "MOU") is entered into on 16th day of March 2022 (the "Effective Date"), by and between:

**Sorting Hat Technologies Private Limited**, a private company incorporated under the provisions of the Companies Act, 2013 bearing CIN U72200KA2015PTC082063 and having its registered office at Maruti Infotech Centre, 3rd Floor, A-Block, Domlur, Koramangala Inner Ring Road, Bangalore- 560 071, Karnataka, India (hereinafter referred to as "CodeChef", which expression shall, unless repugnant to the meaning or context thereof, be deemed to include its legal representatives and permitted assigns) of the **FIRST PART**;

**AND**

**Fr. Conceicao Rodrigues College of Engineering**, with its campus at Fr agnel , Bandstand bandra west , (hereinafter referred to as "College", which expression shall, unless repugnant to the meaning or context thereof, be deemed to include its legal representatives and permitted assigns) of the **SECOND PART**;

The CodeChef and the College shall thereafter, as the context may require, individually be referred to as a "Party" and collectively be referred to as the "Parties".

### **WHEREAS:**

- i. The College is engaged in education to students across various domains.
- ii. The Parties wish to enter into a collaboration wherein CodeChef shall provide one-year free access to its platform, to the students and faculty of the College.
- iii. The College has represented and warranted to CodeChef that it has relevant authority, permit and licenses to fulfill its obligations under this MoU and based on the said representation and warranties, CodeChef has agreed to enter into this MoU with the College on a non-exclusive basis and the Parties have agreed to fulfill their obligations under this MoU.



**NOW THEREFORE**, in consideration of the mutual promises and covenants contained herein, the Parties agree as follows

1. The College shall enroll approximately 50 students with CodeChef.
  - a. The College shall share the student details in a timely basis and in one-go by sending CodeChef a spreadsheet containing student's account creation details such as - Name, Roll number (optional), email ID, College name (preferred way of referring the College), and preferred pattern for creating their usernames on CodeChef.
  - b. For those students whose accounts are already on CodeChef, the College shall share their existing CodeChef usernames as well in the spreadsheet.

- c. By using the information in the spreadsheet, CodeChef shall create bulk account/profiles of students and share the same with the College.
2. CodeChef shall conduct an Orientation session for faculty and students of the College on a time mutually decided by both the parties.
3. The College shall review the program curriculum shared by CodeChef and map it to its existing semester/curriculum.
  - a. The program curriculum is given as Annexure 2 to this MOU.
  - b. In case of changes, CodeChef and College shall discuss and finalize the same before commencement of the program.
  - c. CodeChef shall organize meeting(s) with the faculty of the College to understand the curriculum in depth, and select problems per topic.
4. Periodic practice sessions & Assessment-based tests (for grading) shall be created by CodeChef for the students and shared regularly with the College. The program structure is given as Annexure 1 to this MOU.
5. Monthly report shall be sent to the College about the students' overall performance on CodeChef.
6. CodeChef has no liability whatsoever other than that of providing access to the platform for one year and creating practice & assessment-based tests.
7. College and CodeChef agree that the information shared during the term of this MoU is confidential in nature and shall not disclose it with any third-party without prior written consent.
8. College hereby agrees to indemnify and save harmless CodeChef including, where applicable, its affiliates, directors, officers, employees and agents (each such party being an "Indemnified Party") harmless from and against and agree to be liable for any and all losses, claims, actions, suits, proceedings, damages, liabilities or expenses of whatever nature or kind, incurred by the Indemnified Party that arises out of:
  - a) breach of any of its obligations, covenants or representations and warranties under this Agreement; or
  - b) Violation of any applicable laws; or
  - c) Infringement of any third-party intellectual property rights;
9. This MoU shall be valid for a period of one year from Effective Date.
10. This MoU may be terminated at any time by either Party upon fifteen (15) days written notice to the other party.
11. This MoU shall be governed by the laws of India. The courts of India shall have exclusive jurisdiction.

12. In the event that the Parties desire to change, add, or otherwise modify any terms, they shall do so in writing to be signed by both parties.

The Parties agree to the terms and conditions set forth above as demonstrated by their signatures as follows:

Signature		
Name	Tony Mathew	Dr. Stija Unnikrishnan
Title	Authorized Signatory	Principal
	For, CodeChef	For, College

Annexure 1

Program Structure (mapped to the College semester)

Week Count	Tasks
------------	-------





cryptoTV™



## ACADEMIC PARTNERSHIP With

**Fr. Conceicao Rodrigues College of Engineering**



CryptoWire ([www.cryptowire.in](http://www.cryptowire.in)), is a Global App offering a full suite of News, Knowledge, and Information on Metaverse, Blockchain and Digital Assets, including a Data Platform for real-time price and insights. CryptoWire is a SBU of TickerPlant ([www.tickermarket.com](http://www.tickermarket.com)), which is a subsidiary of 63 moons technologies ([www.63moons.com](http://www.63moons.com)) that had global operations in financial technology solutions; multi asset class exchanges and clearing corporations; collateral and risk management; real time price dissemination; mobile payment solutions; and knowledge management. Crypto University provides research backed knowledge and imparts practice-oriented skills in the realm of Blockchain and Digital Assets to a wide spectrum of stakeholders.

Crypto University extends the reach and access of its cutting-edge domain expertise to research and academic institutions with an objective of Capacity Building through Faculty Development, Curriculum Design and Delivery, Special Reviews and Studies, Special Skills Development Programs, amongst other initiatives.

As a part of its Industry-Academia Cooperation, it enables the academia to get insights into the fast growing Metaverse, Blockchain and Digital Assets Landscape, thereby enhance the Career Opportunities for the aspiring young professionals by imparting real-time, hands-on, practice-oriented, and industry-driven skills and knowledge.



An SBU of **TICKER**® — a subsidiary of

**63  
moons**



Through this broad understanding, we agree to cooperate and collaborate in the realm of Web 3.0, Metaverse, Blockchain and Digital Assets, whereby Crypto University, through the scope of association as enumerated below, shall

- Extend cooperation for research, data sharing, and paper publishing
- Depute domain experts for offering courses, workshops, special sessions, and electives for continuous learning and exposure amongst the students
- Joint research and development of Metaverse, Blockchain and Digital Assets related curriculum
- Establish Metaverse & Blockchain Lab at the partner institute for nurturing new-age Blockchain enabled startups and skills enhancement
- Conduct hackathons and competitions and offer rewards by way of recognition, prize money, pre-placement offers, featuring on Crypto TV, and coverage in CryptoWire news letter
- Visit to CryptoWire data center
- Provide internships and live projects to students
- Recruit students and assist the partner Institute in placements
- Incubate promising Blockchain enabled startups and extend ecosystem support
- Support and sponsor student events / cultural festivals at the partner institute

Specific activities and prioritizing the scope of association will be developed in the manner and scope as mutually agreed upon from time to time. This understanding comes into effect from the date of signing.



Signed on behalf of  
Crypto University

Name: Ajoy Pathak  
Designation: Head - Crypto University

Date: --08-08-2022  
Place: Mumbai



Signed on behalf of

Name: *Dr. Surenika Rathod*  
Designation: *Principal*

Date: *8/8/2022*  
Place: *Mumbai*



FT Tower, CTS No. 256 & 257, Suren Road, Chakala, Andheri (E), Mumbai - 400093 | P: +91 22 66866010 | M: +91 8657955064 | www.cryptowire.in



An SBU of **TICKER** — a subsidiary of



# EC-COUNCIL | ACADEMIA

## PARTNER

EC-Council recognizes this institution as an authorized EC-Council Academia Partner. The EC-Council Academia Partner network is the premier partnership for delivering high-quality, authorized EC-Council Cybersecurity related academic courses.

### Fr. Conceicao Rodrigues College of Engineering

Accredited Institution

**August 20, 2021**

**August 20, 2024**

**EACD43718**

Date of Issue

Expiry Date

Region

Partner ID



*Wesley Alvarez*

Director of Academics





Linux Professional Institute  
 41 John Street  
 Upper Suite 1  
 Port Hope ON L1A 2Z3  
 Canada

Our mission is to promote the  
 use of open source by  
 supporting the people who  
 work with it.

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# Completion History 2021 0803 Silver AAP - IND Conceicao Rodrigues College of Engineering.pdf

Printed on 2021-08-05 - 16:26:32 UTC

## Document Details

Created by: Linux Professional Institute, Jose Jolly Villaviza

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Signers: 3

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Signature:

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 327b

## Signing Events

Action	By	Date (UTC)	Email Validation
Creation	Linux Professional Institute, Jose Jolly Villaviza jvillaviza@lpi.org	08/03/2021 01:16:04	
Signature	Linux Professional Institute, Jose Jolly Villaviza jvillaviza@lpi.org	08/03/2021 01:23:25	<input checked="" type="checkbox"/> No email Validation
Signature	Fr. Conceicao Rodrigues College of Engineering, Srija Unnikrishnan srija@fragnel.edu.in	08/03/2021 13:51:17	srija@fragnel.edu.in
Signature	Linux Professional Institute, Peregrino Rafael rperegrino@lpi.org	08/05/2021 16:23:59	rperegrino@lpi.org

✓ The document's integrity is valid.

The final document and this completion history have been sent by email on 08/05/2021 to: jvillaviza@lpi.org, info@microdevice.in, elima@lpi.org, rperegrino@lpi.org, srija@fragnel.edu.in.

## Access Logs

Viewed/downloaded by	Date (UTC)	State
Linux Professional Institute, Jose Jolly Villaviza jvillaviza@lpi.org	08/03/2021 01:16:04	Signatures in Progress

info@lpi.org  
 http://lpi.org  
 157: 876037722





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Viewed/downloaded by	Date (UTC)	Status
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	08/05/2021 14:30:23	Signatures in Progress
Linux Professional Institute, Peregrino Rafael@peregrino@lpi.org	08/05/2021 16:22:06	Signatures in Progress
Linux Professional Institute, Peregrino Rafael@peregrino@lpi.org	08/05/2021 16:24:01	Fully Signed



## ACADEMIC TRAINING PARTNER AGREEMENT

This partnership agreement (the "Agreement") is made between

Linux Professional Institute Inc  
41 John Street  
Upper Suite 1  
Port Hope, ON Canada L1A 2Z3  
(hereinafter referred to as "LPI")

- and -

Fr. Conceicao Rodrigues College of Engineering  
Fr. Agnel Ashram, Bandstand, Bandra,  
Mumbai - 400050, India

(hereinafter referred to as "PARTNER")

collectively referred to as the "Parties".

### RECITALS

1. LPI is a producer of professional Open Source certifications, sponsorships and partner programs and now desires to appoint the PARTNER for the promotion of the LPI Academic Training Partner program (the "PROGRAM") subject to the exclusions set forth in Section 16.
2. PARTNER wishes to become a partner of LPI and participate in the PROGRAM.
3. LPI is a vendor-independent organization and does NOT mandate a particular method of test preparation.
4. LPI encourages publishers, employers, schools and training centers to work together within their local community to promote choice, flexibility and innovation.
5. In countries where there is no organization approved by LPI to run a test preparation training program, the PROGRAM may be run by LPI.
6. In consideration of the mutual promises set forth in this Agreement, it is agreed by and between LPI and PARTNER:

LPI initials

PARTNER initials



### 1. DURATION

The term of this Agreement shall be one (1) contract year, beginning on the date this contract is signed ("EFFECTIVE DATE"), unless terminated earlier under Section 17 TERMINATION AND MODIFICATIONS. When allowable by law and desired by PARTNER, on the annual anniversary of this contract, the term will automatically renew for another contract year unless written notice is received by either party 30 days prior to the renewal date indicating that the contract will not be extended by an additional year. When not allowable by law or not desired by PARTNER, this agreement must be reconfirmed annually.

- This agreement will auto-renew.  
 The agreement must be reconfirmed annually.

### 2. PARTNERSHIP LEVEL

PARTNER agrees that, as obligations for the various levels of the PROGRAM are met, their level in the PROGRAM will fluctuate and be reassessed by LPI on an annual basis.

The initial level of partnership in the PROGRAM for PARTNER will be (check one):

- LPI Approved Academic Partner                       LPI Gold Approved Academic Partner  
 LPI Silver Approved Academic Partner               LPI Platinum Approved Academic Partner

### 3. PROGRAM COSTS

The PARTNER agrees to purchase exam vouchers each year. The PARTNER will benefit from a discount on the list price of the exams and will receive recognition and additional benefits as are outlined, per SCHEDULE A. The portions of this agreement incurring costs to LPI, including but not limited to annual plaques, trainer program participation and public listings, may be withheld pending an initial or annual voucher purchase by PARTNER.

Specifically, PARTNER agrees to purchase 5 (five) exam vouchers or equivalent, in advance, per year. The PARTNER will benefit from a 10% discount on the list price of any exam vouchers. In geographic regions where LPI reduces exam fees substantially in order to aid in economic and education development efforts, no or minimal exam voucher discounts may be available to PARTNER.

[Signature]  
LPI initials

[Signature]  
PARTNER initials





This discount is not to be offered to the student except as part of a larger product or service offering as it is meant to offset PARTNER costs related to testing events.

Vouchers and vouchers purchased with coupons supplied to PARTNER as part of other programs, such as grants, trainer vouchers, or retake, employability and scholarship programs, do not apply to this PROGRAM agreement.

### 3.1 COUPONS

When possible, discounted coupons, up to the PARTNER discount amount, may also be used and provided to students, trainers, and other partners.

Each redeemed coupon will count towards the aforementioned voucher commitment. Coupons may not be distributed to the general public and are for participants and partners of PARTNER's programs.

Where permitted by law, LPI will pay to the PARTNER a commission of the difference between partners discounted and the final exam price. Payment will take the form of an account credit, to be calculated quarterly. If PARTNER doesn't have an account, the commission will be disbursed directly to PARTNER.


## 4. PARTNER OBLIGATIONS AND DELIVERABLES

1. **Course Materials:** The PARTNER shall provide information to LPI on the PARTNER's choice of course materials.
2. **Instructor Evaluations:** The PARTNER shall provide LPI the necessary administrative access to the PARTNER's course and instructor evaluations for the sake of quality assurance. These documents will conform to the policies of the institution on privacy regulations and administrative protocol.
3. The PARTNER must ensure students understand the LPI examination process and availability.

## 5. TERRITORY

PARTNER is authorized to perform the duties of the PROGRAM only in geographies assigned to them by LPI.

  
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LPI initials

  
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PARTNER initials



The territory for the PARTNER is:

INDIA

## 6. USE OF TRAINING MATERIALS AND INSTRUCTORS

Gold and Platinum PARTNERS will participate in the LPI Trainer Program and use an LPI Approved or Certified Trainer as defined in SCHEDULE B to deliver training or produce learning materials regardless of modality (i.e. e-learning, website, classroom, blended).

Participation in this program is optional for other partnership levels.


## 7. JUDICIAL DISCLOSURE


If any confidential PARTNER data is to be disclosed due to legal or judicial requirements or due to the request of a supervisory body, the disclosing Party shall promptly report, in writing, to the other Party regarding the fulfillment of such disclosure in order that each Party may, if it is in its best interest, take the necessary measures to restrict or prevent the disclosure of information or sensitive data when permitted by law.

## 8. LOGO AND TRADEMARK USAGE

LPI retains the right to approve the presentation of LPI logos and trademarks in the PARTNER's marketing materials and website. The PARTNER agrees to adhere to LPI Brand and Logo usage guidelines and to provide advance notification to [marketing@lpi.org](mailto:marketing@lpi.org) of marketing materials being developed for the program. The PARTNER agrees to work with LPI marketing in making any changes requested to bring material in compliance with these guidelines.

1. Subject to the provisions of this Agreement, LPI grants to PARTNER a non-exclusive, non-transferable license to use the PROGRAM logos (the "Trademarks") solely in connection with the PROGRAM in the assigned TERRITORY only. The PARTNER does not have any right to sublicense the Trademarks and shall not seek registration of the Trademarks in the PARTNER's name.
2. Upon termination or expiration of this Agreement, the PARTNER will immediately cease all use of the Trademarks and will not directly or indirectly at any time or in any manner

  
LPI initials

  
PARTNER initials



make further use of or reference to the Trademarks in the conduct of its business or otherwise.

3. This Agreement does not grant a license to any technology, trademarks, logos or intellectual property belonging to LPI to the partner other than as described in this Agreement.

## 9. CHANGE OF PROGRAM REQUIREMENTS

The parties agree that LPI may change details of the PROGRAM at any time upon 30 days written notice to the PARTNER's designated contact and posting to the LPI website. The PARTNER shall comply with the PROGRAM guidelines including all portions therefore that are electronically posted at [www.lpi.org](http://www.lpi.org).

## 10. PARTICIPATION IN OTHER LPI PROGRAMS

This agreement does not prevent PARTNER from fully participating in other LPI programs. When combined with other programs, discounts related to the PROGRAM will not stack.

LPI initials

PARTNER initials





### 11. NO FRANCHISE CREATED

The parties acknowledge and agree that execution of this Agreement and participation in the PROGRAM does not create a franchise, joint venture, financial partnership, or similar business relationship between LPI and the PARTNER or any other third party.

### 12. ADDITIONAL SUPPORT

The parties agree that LPI shall not be obligated to provide any support for or to the PARTNER other than as specified in this Agreement and SCHEDULE A. LPI shall not be obligated to provide support for or to the LPI Approved or Certified Trainer other than as specified in the AGREEMENT and SCHEDULE B.

If PARTNER is joining the PROGRAM through the assistance of a channel or community partner, PARTNER further agrees that this support will be provided by the channel or community partner or its regional representatives when appropriate.

If applicable, PARTNER's initial channel or community partner is:

Microdevice Technologies


### 13. ENTIRE AGREEMENT

This Agreement, including the Schedules and Exhibits attached hereto, constitute the entire agreement and supersedes all prior agreements of the parties with respect to the transactions set forth herein and, except as otherwise expressly provided herein, is not intended to confer upon any other person any rights or remedies hereunder.

### 14. INDEMNIFICATION

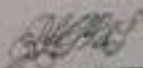
1. LPI shall indemnify and hold harmless the PARTNER and its officers, directors, employees and agents against and in respect of any and all claims, suits, actions, proceedings and investigations instituted by third parties, as well as any judgements, damages, settlements, liabilities, and legal and other expenses (including reasonable legal fees and expenses of attorneys) as and when incurred, arising out of or based upon (a) any misrepresentation or breach of the representations and warranties of LPI


  
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LPI initials

  
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PARTNER initials



- set forth in this Agreement, and (b) any non-compliance by LPI with any covenants or agreements of LPI contained in or made pursuant to this Agreement.
2. PARTNER shall indemnify and hold harmless LPI, its affiliates, and their respective officers, directors, employees and agents, against and in respect of any and all claims, suits, actions, proceedings and investigations instituted by third parties, as well as any judgements, damages, settlements, liabilities, and legal and other expenses (including reasonable legal fees and expenses of attorneys) as and when incurred, arising out of or based upon (a) any misrepresentation or breach of the representations and warranties of the PARTNER set forth in this Agreement, and (b) any non-compliance by the PARTNER with any covenants or agreements of PARTNER contained in or made pursuant to this Agreement.
  3. Upon the assertion of any claim or the commencement of any suit or proceeding against an indemnified party by any third party that may give rise to liability of an indemnifying party hereunder, the indemnified party shall promptly notify the indemnifying party of the existence of such claim and shall give the indemnifying party reasonable opportunity to defend and/or settle the claim at its own expense and with counsel of its own selection. The indemnified party shall cooperate with the indemnifying party and shall at all times have the right to fully participate in, but not control, such defence with its own counsel and at its own expense. The indemnified party shall not make any settlement of any claims which might give rise to liability of the indemnifying party hereunder without the prior written consent of the indemnifying party.
  4. Both PARTNER and LPI will not be liable to the other party, its affiliates, employees, trustees, successors or assigns, or any third party with respect to any claim arising from the other party's activities above an amount that shall not exceed, under any circumstances, the aggregate amount of the total costs paid by PARTNER based on this agreement.
  5. This Agreement shall be governed by and construed in accordance with the laws of CANADA. In the case of a dispute which cannot be resolved, the matter will be resolved under mediation or arbitration guided by the International Centre For Dispute Resolution ("ICDR") or its local equivalent. If mediation or arbitration is initiated by PARTNER, dispute resolution will be carried out in Canada. If mediation or arbitration is initiated by LPI, dispute resolution will be carried out in PHILIPPINES. The Parties submit themselves to the exclusive jurisdiction of the courts of the country in which mediation or arbitration is undertaken.

  
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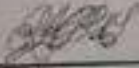



## 15. COUNTERPARTS

This Agreement may be agreed to and executed in more than one counterpart, each of which together shall form one and the same instrument. The parties agree that execution may be achieved in any format convenient to the parties.

## 16. GENERAL CONTRACT PROVISIONS

1. Subject to the provisions of SECTION 16 hereof, no change or modification of this Agreement shall be valid unless it be in writing and signed by each party.
2. The headings used in this Agreement are for convenience only and are not to be considered a part of this Agreement and do not in any way limit or amplify the terms and provisions of this Agreement.
3. It is intended that all provisions of this Agreement shall be fully binding and effective between the parties, but in the event that any particular provision or provisions or a part of one is found to be void or unenforceable for any reason, then the particular provision or provisions or part of the provision shall be deemed severed from the remainder of this Agreement and all other provisions shall remain in full force.
4. This Agreement shall ensure to the benefit of and be binding on the respective heirs, executors, administrators and permitted assigns of each of the parties.
5. Both parties agree to the use of electronic communication and e-signatures for contract execution. Either party will have the option to execute the agreement through original signature.
6. This Agreement is not assignable by the PARTNER without the prior written consent of LPI. Any attempt to assign any of the rights, duties or obligations of this Agreement without written consent is void.
7. The failure on the part of either party to exercise or enforce any right conferred upon it under this Agreement shall not be deemed to be a waiver of any such right or operate to bar the exercise or enforcement thereof at any time or times thereafter.
8. All provisions and details of this Agreement may be considered public information by the PARTNER and disclosed, at will, to whomever or whatever the PARTNER chooses.
9. Upon default by one of the Parties under any terms of this Agreement, and at any time after the default, the aggrieved Party shall have all rights and remedies provided by law and by this Agreement. No single or partial exercise of a right or remedy shall preclude any other or further exercise of them or the exercise of any other right or remedy. Furthermore, the aggrieved Party may remedy any default by the Party in default of this Agreement in any reasonable manner without waiving the default remedied and without

  
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LPI initials

  
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PARTNER initials





waiving any other prior or subsequent default by the Party in violation of this Agreement. All rights and remedies of the aggrieved Party granted or recognized in this Agreement are cumulative and may be exercised at any time and from time to time independently or in combination.

10. If there is any conflict between the terms and conditions of this Agreement and the PROGRAM guidelines, the terms and conditions of the PROGRAM guidelines shall prevail.

17. TERMINATION AND MODIFICATIONS

Either party has the right to terminate this agreement with 30 days written notice to the other party.

All notices required or permitted to be given hereunder shall be in writing and either hand-delivered, telecopied, mailed by certified first class mail, postage prepaid, or sent via electronic mail to the other party or parties hereto at the address(es) on page 1. A notice shall be deemed given when delivered personally, when the telecopied notice is transmitted by the sender, three business days after mailing by certified first class mail, or on the delivery date if delivered by electronic mail.

In Agreement

LPI and PARTNER, correctly represented by the undersigned, hereby confirm their agreement and acceptance of this Agreement and pledge their full support and cooperation to the contents described herein.

Signatures

LPI

PARTNER

2021, August 03rd

Rafael Peregrino da Silva

Date

Account Executive  
Linux Professional Institute

3rd August 2021

Dr. Srija Unnikrishnan  
Principal

Date

Fr. Conceicao Rodrigues  
College of Engineering

LPI initials

PARTNER initials

**Schedule "A"**  
**ACADEMIC PARTNER PROGRAM BENEFITS**

During the partnership period, PARTNER will receive:

1. Enrolment in the LPI Trainer program for their instructors and learning materials developers
2. Use of LPI logo, LPI certification marks and starter kit to promote training partner courses
3. Sales and customer service support to include:
  - a. Assistance from LPI in identifying sources for training material options in PARTNER geography
  - b. Assistance with locating quality instructors that hold an LPI Trainer program designation
  - c. Expediting training partner feedback to courseware vendors
4. Use of LPI Approved Academic Partner logo
5. Commercial use of licensed LPI Learning Materials ([learning.lpi.org](http://learning.lpi.org))

Additionally, all Silver, Gold and Platinum PARTNERS will receive:

1. Promotion on LPI website and inclusion in online training center locator ([www.lpi.org/partner](http://www.lpi.org/partner)) with 100 word description and organization's logo
2. Eligibility for LPI Test Centre Status (send your inquiry on our separate test centre requirements to [training@lpi.org](mailto:training@lpi.org))
3. Discount on the retail price of LPI exams
4. Ability to co-brand licensed LPI Learning Materials ([learning.lpi.org](http://learning.lpi.org))

LPI Silver Approved Academic Partners will also receive:

1. Two (2) annual Professional Development exam vouchers to support ongoing certification of instructors and learning materials developers if PARTNER participates in the LPI Trainer program
2. Use of LPI Silver Approved Academic Partner logo

LPI Gold Approved Academic Partners will also receive:

1. Two (2) annual Professional Development exam vouchers to support ongoing certification of instructors and learning materials developers
2. Use of LPI Gold Approved Academic Partner logo
3. Annual Training Partner Spotlight on the LPI blog or social media channels

  
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PARTNER initials



4. Promotional Kit (may vary depending on location and availability)
5. Opportunity for cooperative promotions at LPI Events

LPI Platinum Approved Academic Partners will also receive:

1. Four (4) annual Professional Development exam vouchers to support ongoing certification of instructors and learning materials developers
2. Use of LPI Platinum Approved Academic Partner logo
3. Annual Training Partner Spotlight on the LPI blog or social media channels
4. Premium Promotional Kit (may vary depending on location and availability)
5. Opportunity for cooperative promotions at LPI Events

LPI initials

PARTNER initials






**Schedule "B"**  
**LPI TRAINER PROGRAM REQUIREMENTS**

1. PARTNERS which are participating in the LPI Trainer program must have a minimum of one LPI Approved or Certified Trainer available to students. New PARTNERS have their first year under this agreement to gain such credentials for their staff or contractors.
2. LPI Approved and Certified Trainers must be certified for the level and speciality of exam they teach. PARTNERS are to have instructors and/or learning materials developers who are certified in the level they teach.
3. LPI Approved and Certified Trainers must have a thorough understanding of the LPI certification program and procedures necessary to take LPI exams.
4. Any other requirements for individuals under the LPI Trainer program will be communicated to them directly and separately from this agreement.

  
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LPI initials

  
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PARTNER initials

# Memorandum of Understanding

Date: March 4, 2021

Hack InOut Tech LLP ("Devfolio") and organizers of Crescendo Hackathon ("Hackathon Organiser") from Fr. Conceicao Rodrigues College of Engineering are agreeing to partner for the hackathon, taking place online from March 20, 2021 to March 21, 2021, on the following terms:

## Duration

This Agreement shall be effective from March 4, 2021, till a month after the final date of the hackathon, i.e., April 21, 2021.

## Guiding principles:

The Hackathon Organiser shall attempt to ensure that,

1. There should be no fee to participate in the Hackathon,
2. The Hackathon shall operate on an open-track basis, and no problem statements or prompts shall be enforced.

## Hackathon organizer shall:

- a. Provide online and offline (if any) branding and benefits for Devfolio according to the Platinum sponsor tier;
- b. Provide online and offline (if any) branding and benefits for Devfolio Partners according to the Gold sponsor tier, as given to others on the same tier;
- c. Use Devfolio's and Devfolio Season Partners' logos and other material only as per the Content and Branding Guidelines provided by Devfolio;
- d. As far as feasible, and if requested by Devfolio, provide Devfolio and Devfolio Season Partners with a workshop (around 30-45 mins each) and API Demo slots (10-15 mins);
- e. Not simultaneously use any other Hackathon platform for applications, submissions, data collection, etc., to maintain the high ease of use and highest standards of hacker experience.

## Devfolio shall:

- Provide the Hackathon SaaS platform to the Hackathon Organiser, free of cost;
- List the organizer's Hackathon on Devfolio Explore free of cost;
- Onboard Devfolio Season Partners (currently Matic, Tezos, and Portis) as partners for the concerned Hackathon, and provide a final list of onboarded partners two (2) weeks before the commencement of the Hackathon;
- Distribute, or pass on for distribution, API Prizes, at the discretion of Partner

Companies, as per the Guidelines provided;

- Provide Devfolio and Devfolio Season Partners' t-shirts and stickers, and individually ship them to all eligible participants (as discussed) free of any cost;
- Provided that these details were asked in the application process, Devfolio shall permit the Hackathon organizer to export the *Name, Email, Gender, T-Shirt Size, College Name, Team Name of* confirmed participants (as per the Devfolio Privacy Policy), i.e.,
  - In case of hackathons with an application review process, hackers whoRSVP, or
  - In case of hackathons without an application review process, hackers who submit projects.

## Termination

Either party can terminate this Agreement in case of any breach of the Devfolio Code of Conduct, Devfolio Terms, or any of these obligations.

## Signing

Denver Dsouza

Denver  
Dsouza, Community  
Manager, Devfolio (Hack  
InOut Tech LLP),  
Bangalore March 4, 2021

Ayaan

Ayaan Shaikh, Marketing  
head, Fr. Conceicao  
Rodrigues College of  
Engineering, Mumbai  
March 4 2021

Prof. D. V. Bhoir

Prof. D. V. Bhoir, Dean of  
Student Affairs, Fr.  
Conceicao Rodrigues  
College of Engineering,  
Mumbai, March 7, 2021

Dr. S. S. Unnikrishnan

Dr. S. S. Unnikrishnan,  
Principal, Fr.  
Conceicao Rodrigues  
College of Engineering  
March 7, 2021





## MEMORANDUM OF UNDERSTANDING (MOU)

BETWEEN

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE, MUMBAI

AND

FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING, BANDRA, MUMBAI

This MOU is entered into on the 02<sup>nd</sup> day of February 2017 by and between Veermata Jijabai Technological Institute (hereinafter called VITI) located at Malunga, Mumbai and Fr. Conceicao Rodrigues College of Engineering, Bandra, Mumbai (hereinafter called FR.CRCE), an engineering college located at Bandra (West), Mumbai.

The aforesaid institutions are hereinafter referred to individually as institute and collectively as institutes.

### 1. Preamble

ACITE has announced number of initiatives under its Quality Improvement Scheme for the year 2016-17. Share and Mentor Institutions (Mardershan) is one of such schemes. The scheme envisages that a Hub 'n Spoke system is to be established by an Institute of repute as a Mentor within an existing facility to serve as the hub to guide and disperse knowledge to ten technical institutions to encourage best practices. The secondary branches, the spokes, are additional services provided to faculty for self-improvement. Eventually, the Hub 'n Spoke system will allow for inter-hamlet information sharing, such as technical education, research and sharing of resources to the entire system. VITI, a premier Institute in the State of Maharashtra has been selected by the ACITE to serve as a Mentor Institute in the region.

### 2. Objectives of the MOU

The aim of this MoU is to stimulate and facilitate the development of collaborative and mutually beneficial programs which serve for technical upliftment of both campuses.

The objectives of the MOU are:

- To promote and enhance academic interaction between VITI & FR.CRCE
- To share and implement best practices for enhancing quality of teaching learning processes
- To conduct faculty development programs for the benefit of teachers of member and other Institutes
- To conduct training programs for the benefit of non-teaching staff of member and other Institutes
- To provide internship opportunity to students of mentee Institutes at VITI
- To provide help in developing laboratories, reference material, laboratory analysis etc.

### 2. Duration

This MOU shall remain effective from the date of execution until the end of the term of three (3) years. However, same also may be amended, terminated or extended by agreement.



S.P.  
PRINCIPAL

*[Signature]*

Director

Veermata Jijabai Technological Institute

MUMBAI - 400 016



### 3. Terms and Conditions

- Cost of development of any infrastructure at VITI shall be borne by VITI through the funds available under the scheme from AICTE and its own funds.
- The activities under this program shall be conducted either at VITI or at FR.CRCE, preferably one at each Institute every year.
- The host Institute will bear all expenses towards hospitality and conduct of activity. Travel expenditure for the participating member shall be borne by the parent organization.
- Each Institute agrees to depute at least one and maximum two members for each of the faculty development / training programs planned by VITI, except when the program has no relevance to Institute concerned.
- Any dispute pertaining to this MoU shall be referred to Director, VITI and his/her decision will be binding on both the Institutes.

### 4. 'Margadarshan' Coordinator

Both the Institutes agree to designate a faculty member at least of the level of Associate Professor who will be responsible to plan, co-ordinate and implement activities undertaken under this MoU.

On behalf, of

Veermaajijaba Technological Institute,  
Matunga, Mumbai



Witnesses

*[Signature]*  
Dr. V. M. Phalke

On behalf, of

*[Signature]*  
Director  
Veermaajijaba Technological Institute  
College of Engineering  
Bandra (W), Mumbai



Witnesses

*[Signature]*  
PRINCIPAL  
Dr. Srija Unnikrishnan  
Principal, Fr. Conceicao Rodrigues College of  
Engineering,  
Bandra (W), Mumbai

*[Signature]*  
Dr. Bhyshan T. Pahl  
Professor, Fr. Conceicao Rodrigues  
College of Engineering, Bandra



United Way Mumbai

CSR Partnerships | Payroll Giving | Employee Volunteering | Event Partnerships

Governing Board

Chairman

Homi R Khusrookhan  
Sr. Advisor, Private Equity,  
Tala Capital Ltd.

Vice Chairman

Rohit Adya  
Managing Director &  
Founder, M's RA Growth  
Consulting

Treasurer

Devendra Bharna  
EVP, The Oberoi Group

Members

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President & Chair,  
Indian School of Design &  
Innovation, ISDI-WPP  
School of Communication  
And ISME

Karuna Bhatia

Head of Sustainability  
India & SA,  
Standard Chartered Bank

Mihir Doshi

MD & Country CEO,  
Credit Suisse Securities,  
India

Pradeep Poddar

Former MD & CEO,  
Mount Everest Mineral  
Water Ltd.

Radhika Kaji

Entrepreneur & Philanthropist

S. K. Mitra

Chairman,  
QSK Advisory Pvt. Ltd.

Sunit Mehra

Managing Partner,  
Hunt Partners

Sunil Mehta

Chairman & MD, SPM Capital  
Advisors Pvt. Ltd.

Advisors

Zia Mody  
Partner, AZB & Partners

Vivek Kudva

MD, Franklin Templeton Grp.

Letter of Intent

24<sup>th</sup> July, 2019

To,

Prof. Dr. Shrija Unnikrishnan,

Principal,

Fr. CRCE College of Engineering,

Fr. Agnel Ashram, Bandstand,

Bandra, Mumbai: - 400050

Subject: - Letter of Intent for partnership with Fr. CRCE College for volunteering in Mission Blue Project of United Way Mumbai.

Dear Madam,

United Way Mumbai is a registered non-profit organization working on a wide range of issues including health, education, livelihood, environment, public safety and social inclusion. Over the past 16 years of our presence, United Way Mumbai has closely engaged over 500 NGOs and over 300 corporates in implementing high impact community initiatives across India. United Way of Mumbai as part of its Community Impact Initiatives endeavors to address environmental issues in Mumbai.

Under Mission Blue project with the support from our donors we have symbolically adopted Chimbai Beach, Bandra. As part of this project, United Way Mumbai would bring together the necessary stakeholders who can create a significant impact on the state of cleanliness at the beach. This include the MCGM, local residents groups and housing societies, colleges in the vicinity and their students, stall owners and vendors at the beach and corporate employee volunteers.

We are happy to collaborate with Fr. CRCE College of Engineering as our institutional partner to participate in Mission Blue project activities.



Mumbai, 309, Nirman Kendra, Famous Studio Lane, Dr. E. Moses Road, Mahalaxmi Estate,  
Mumbai 400011, India +91 22 24937676  
contact@unitedwaymumbai.org www.unitedwaymumbai.org





Volunteering opportunity for the student of your institution:

- 1) Participation in the monthly clean-up drive
- 2) Participation in conceptualizing and executing awareness activities
- 3) Participation in Greenesha 2019 campaign, & eco friendly celebration of Ganesha
- 4) Participation in any other activity planned under the project

United Way Mumbai will be responsible for the following things:

- 1) Arrangements of refreshment to students as when applicable
- 2) Provision of participation certificates to students as when applicable

We will be happy to have representation of professors from Fr. CRCE College of Engineering in our clean beach task force meeting. The members of the task force are expected to add valuable inputs for successful implementation of project activities and help in regular monitoring of the activities.

Period of Partnership: August 2019 to February 2020

Thanking you and looking forward to a successful association.

Best Regards,

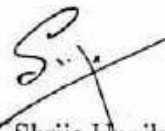


Ajay Govale,  
Director – Community Impact,  
United Way Mumbai



I hereby confirm my agreement with all the terms of appointment as mentioned hereinabove.

Yours Sincerely,



Prof. Dr. Shrija Unnikrishnan,  
Principal,  
Fr. CRCE College of Engineering





## Memorandum of Understanding

### **Preamble:**

A collaborative effort in engineering education has become key to success. Rapidly changing technology, disruptions, necessitates that institutes need to help each other, share the resources for mutual benefits and grow together. Collaboration among institutes for the holistic development of students is the key to successful implementation of NEP-2020.

This MOU is between **Bhartiya Vidya Bhavan's Sardar Patel Institute of Technology** (Hereafter referred as SPIT), Andheri (West) Mumbai and **Fr. Conceicao Rodrigues College of Engineering** (Hereafter referred as CRCE), Bandra (West) Mumbai for the purpose of enhancing the quality of the technical education imparted by both the Institutes. Following points are agreed understanding:

### **Terms & Conditions:**

#### **1. Nature of Relationship**

1.1 This MOU is for collaboration between both parties, for mutual benefit, for the purposes listed below, but not limited to points thereof, to enhance the quality of the educational experience for stakeholders of the institutions.

I. Mutually agree to identify various areas of academic or research interest and depute **students, staff or faculty on exchange** as per the requirements for conducting courses or research in various semesters.

II. CRCE and SPIT may take the help of each other in the revision of curriculum, co-teaching for some important courses, teaching learning processes, external quality audits, assessment & evaluation process and to find out the commonalities to facilitate the exchange of students and faculty.

III. Both institutions help each other to **organize/conduct courses/training modules** enabling students' mobility across both Higher Education Institutes (HEI) for seamless integration of skills and experiences. Minor Degree or Honors Degree courses have to be held in the respective institute only.



*Handwritten signature and date: 2/7/20*







IV. CRCE and SPIT will jointly organize co-curricular and extra-curricular activities, technical competitions, hackathons, conferences, workshops, seminars, Quiz's etc. The faculty and students shall be encouraged to participate in such activities so as to interact with each other for their academic and professional growth. Such programs will be conducted by both the institutions on regular basis during winter/summer vacations or any other mutually agreed time frame and will be informed to each other in advance.

V. CRCE and SPIT mutually agree to help each other to establish and develop laboratories, centers of excellence, research centre's, etc., as and when required.

VI. Faculty of CRCE and SPIT depending on their qualifications and experience, can act as supervisor to the students pursuing their PG and PhD programmes at CRCE or at SPIT; as the case may be.

VII. Areas for staff development shall be identified for training of faculty/staff of both the institutes for their academic growth.

VIII. Undertake collaborative R&D work/R&D Projects:

- a. **Self-Generated:** Using Infrastructure /Laboratory facilities at CRCE/SPIT, faculty from respective fields to jointly undertake research programme either at CRCE or at SPIT. For Technology/Patents so evolved joint rights of ownership will be mooted.
- b. **Industry-Sponsored:** R&D/Consultancy from industry to be jointly undertaken by faculty from CRCE/SPIT
- c. Areas for R & D projects, design and consultancy shall be identified, and **joint proposals** may be submitted to various funding agencies like MHRD, DST, and AICTE etc.
- d. Both the institutions will try to establish all possible research collaborations, including research internships and co-supervision of **UG projects** for mutual benefits in academic and research activities.
- e. **Publications** arising out of collaborative work to be **jointly published**.

2



*Handwritten signature*  
7/7/20







IX. Sharing of journals and other information exchange through elibrary.

X. Develop hardware and software environments that promote technology implementation.

XI. Develop academic products to enrich the laboratory infrastructure

XII. Encourage students towards entrepreneurship, incubation and innovation. Both the institutes will help each other in activities related to Placement, Technology Business Incubation, and industrial collaborations.

XIII. Any other academic or research activity undertaken for mutual benefits or benefiting the society.

XIV. The terms and conditions for each collaborative work/project will be worked out before the commencement of the same by mutual agreement.

1.2 This MOU shall be valid for 3 years from the date of signing the MoU and each party shall be at full liberty to terminate the collaboration, with a notice period of one month.

1.3 Both parties shall take all reasonable steps to ensure the successful completion of the collaboration and co-operate with each other in duly carrying out the obligation agreed upon.

## 2. Mutual Obligation

2.1 This collaboration shall not be exclusive to both parties and shall not disallowed each party from having similar collaboration with others. Except as expressly stated in this MOU, there shall be no obligation on any party to compensate the other in any manner or to make any claim.

2.2 Each party shall meet the expenses between them as mutually agreed.

3



*Handwritten signature and date: 7/7/20*





2.3 Each party shall respect the other's intellectual property (IP) and shall not use any trade name, trademark, symbol or designation belonging to the other, without prior written approval. No party shall hold out as an agent or representative of the other or create any liability for the other. The parties shall indemnify the other for breach of this clause.

2.4 Both parties shall maintain confidentiality about any information, course material, plans, discussions, strategies or any material, which shall be deemed to be confidential and marked accordingly. Any information, course material or the like in the public domain shall not be part of this commitment

2.5 No amendment or modification of this MoU shall be valid unless the same is made in writing by both the parties or their authorized representatives and specifically stating the same to an amendment of this agreement. The modification/changes shall be effective from the date on which they are made/executed unless otherwise agreed to.

### 3 Limitation and Warranties

3.1.1 Each party shall ensure that the other is not put to any liability for any act of the respective party.

3.1.2 Each party represents that they have the full power and authority to enter into this MOU in general.

### 4 Arbitration

In the events of any dispute or difference between the parties hereto, such disputes or differences shall be resolved amicably by mutual discussion between the Principals of the two institutes.



*Handwritten signature and date: 7/7/2020*

4





**5. General**

4.1.1 Both parties will designate a representative from its side who will be the primary point of contact on behalf of that party.

4.1.2 Both parties shall not use the name of the other in any advertisement or make any public announcement without the prior written approval of the other.

In written whereof both parties put their hard seal on the day, month and year herein mentioned.

Date: 07/07/2022

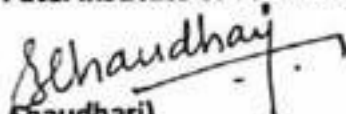
Date: 07/07/2022


Place: Mumbai

Place: Mumbai

For Sardar Patel Institute of Technology

For Fr. Conceicao Rodrigues College of Engineering

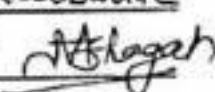
  
(Prof. B. N. Chaudhari)

  
(Prof. Surendra Rathod)



Principal

Principal

Witness:

- Dhananjay Kalbande
- N. A. BHAGAT 

Witness:

- Garima Tripathi 
- Dr. Sujata P. Deshmukh 







SOCIETY OF ST. FRANCIS XAVIER, PILARS  
**FR. CONCEICAO RODRIGUES COLLEGE OF ENGINEERING**

(Approved by AICTE & Affiliated to University of Mumbai)

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai - 400 050.

Phone : (022) 6711-4088, 6711-4101, 6711-4104

Website : www.frcce.ac.in • Email : crce@fragnel.edu.in

Ref. No: CRCE/2022/282

Date: 11/08/2022

To,  
The Director  
IIRS, ISRO, Dehradun

Sub: Willingness for participating in IIRS Outreach Programmes-reg.

Respected Sir,

Fr. Conceicao Rodrigues College of Engineering (Fr. CRCE) is one of the premier engineering college established in 1984 by the Society of St. Francis Xavier Pilar, a Public Charitable Trust. The College is situated at Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai 400 050. The college is affiliated to University of Mumbai and approved by AICTE. The College conducts Engineering Degree programs at Under graduate level, Post Graduate level and Ph.D. As on today, the Institute offers four Undergraduate Programmes, two Post-graduate Programmes and two Ph.D Programmes with a total strength of over 1200 students.

We would like to have collaboration with the Indian Institute of Remote Sensing (IIRS) outreach Programme to encourage our students and faculty to actively participate on these programs. WE believe that this collaboration will enhance student learning outcomes. This letter shows our willingness for participating in IIRS Outreach Programmes-registration.

Please find the contact details of the focal person/ coordinator from our organisation:

Name: Mrs. Sangeeta Parshionkar  
Designation: Assistant Professor  
Department: Computer Engineering  
Postal Address: Fr. CRCE, Agnel Ashram, Bandra (W)  
Email: sangeeta@frcce.ac.in  
Mobile Number: 9869400891

(Signature of Authority)



# Syllabus Honors and Minor Degree



# University of Mumbai



AAMS\_UGS /ICC/2022-23/140

**CIRCULAR:-**

**Sub :- Honours/Minor Degree Programs in Engineering**

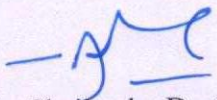
**Ref :- RB/MU-2022/CR-263/Edn-2/1280, dated 31<sup>st</sup> October, 2022.**

All the Principals of the Affiliated Colleges, the Head of the University Department and Directors of the recognized Institutions in Faculty of Science & Technology are hereby informed that the recommendations made by the **Various Board of Studies in Engineering Branches** and subsequently passed in the faculty of Science & Technology and then by the Board of Deans at its online meeting held on **5<sup>th</sup> July, 2022 vide** item No. **6.59(N)** have been accepted by the Academic Council at its meeting held on **11<sup>th</sup> July, 2022, vide** item No. **6.59 (N)** and subsequently approved by the Management Council at its meeting held on **28<sup>th</sup> July, 2022 vide** item No. **8** and that in accordance therewith, in exercise of the powers conferred upon the Management Council under Section 74(4) of the Maharashtra Public Universities Act, 2016 (Mah. Act No. VI of 2017) the Ordinance **6829 & 6830** Regulations **9617 to 9620** and the syllabus of **Honours / Minor Degree Programs in Engineering :-**

- 1 Infrastructure Engineering
- 2 Smart Cities
- 3 Waterways Transport Engineering
- 4 Professional Practices in Structural Engineering
- 5 Green Technology and Sustainability Engineering
- 6 Infrastructure Policies & Regulations
- 7 Artificial Intelligence and Machine Learning
- 8 Block chain
- 9 Cyber Security
- 10 Augmented Reality and Virtual Reality
- 11 Data Science
- 12 Internet of Things (IOT)
- 13 Waste Technology
- 14 Electric Vehicles
- 15 Microgrid Technology
- 16 Robotics
- 17 3D Printing
- 18 Industrial Automation

has been introduced and the same have been brought into force with effect from the academic year **2022-23**, accordingly. (The same is available on the University's website [www.mu.ac.in](http://www.mu.ac.in)).

MUMBAI – 400 032  
2<sup>nd</sup> November, 2022

  
(Dr. Shailendra Deolankar)  
I/c. REGISTRAR



: 2 :

To,

The Principals of the Affiliated Colleges, the Head of the University Department and Directors of the recognized Institutions in Faculty of Science & Technology.

A.C/6.59(N)/11/7/2022

M.C/8/28/7/2022

Copy forwarded with Compliments for information to:-

- 1) The Chairman, Board of Deans
- 2) The Dean, Faculty of Science & Technology,
- 3) The Chairman, various Board of Studies in Engineering Branches,
- 4) The Director, Board of Examinations and Evaluation,
- 5) The Director, Board of Students Development,
- 6) The Director, Department of Information & Communication Technology,
- 7) The Co-ordinator, MKCL.

**Copy to :-**

- 1. The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
- 2. The Deputy Registrar, College Affiliations & Development Department (CAD),**
- 3. The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
- 4. The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
- 5. The Deputy Registrar, Executive Authorities Section (EA),**
- 6. The Deputy Registrar, PRO, Fort, (Publication Section),**
- 7. The Deputy Registrar, (Special Cell),**
- 8. The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,**
- 9. The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

**They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.**

- 1. P.A to Hon'ble Vice-Chancellor,**
- 2. P.A Pro-Vice-Chancellor,**
- 3. P.A to Registrar,**
- 4. All Deans of all Faculties,**
- 5. P.A to Finance & Account Officers, (F.& A.O),**
- 6. P.A to Director, Board of Examinations and Evaluation,**
- 7. P.A to Director, Innovation, Incubation and Linkages,**
- 8. P.A to Director, Board of Lifelong Learning and Extension (BLLE),**
- 9. The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
- 10. The Director of Board of Student Development,**
- 11. The Director, Department of Students Welfare (DSD),**
- 12. All Deputy Registrar, Examination House,**
- 13. The Deputy Registrars, Finance & Accounts Section,**
- 14. The Assistant Registrar, Administrative sub-Campus Thane,**
- 15. The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
- 16. The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
- 17. The Assistant Registrar, Constituent Colleges Unit,**
- 18. BUCTU,**
- 19. The Receptionist,**
- 20. The Telephone Operator,**
- 21. The Secretary MUASA**

**for information.**

# University of Mumbai



**Syllabus for  
Honours/Minor Degree Programs  
in Engineering**

**(Introduced from the academic year 2022-23)**



# University of Mumbai



<p>O: <u>6829</u> Title of Course</p>	<p>Honours/Minor Degree Programs in Engineering</p> <ol style="list-style-type: none"> <li>1. Infrastructure Engineering</li> <li>2. Smart Cities</li> <li>3. Waterways Transport Engineering</li> <li>4. Professional Practices in Structural Engineering</li> <li>5. Green Technology and Sustainability Engineering</li> <li>6. Infrastructure Policies &amp; Regulations</li> <li>7. Artificial Intelligence and Machine Learning</li> <li>8. Blockchain</li> <li>9. Cyber Security</li> <li>10. Augmented Reality and Virtual Reality</li> <li>11. Data Science</li> <li>12. Internet of Things (IoT)</li> <li>13. Waste Technology</li> <li>14. Electric Vehicles</li> <li>15. Microgrid Technologies</li> <li>16. Robotics</li> <li>17. 3D Printing</li> <li>18. Industrial Automation</li> </ol>
<p>O: <u>6830</u> Eligibility</p>	<ol style="list-style-type: none"> <li>1. Third year undergraduate engineering student from semester V satisfying following eligibility criteria can opt for Honours and Minor Degree Programs in Engineering.             <ol style="list-style-type: none"> <li>A. Students with no backlog in semester I, II, and III</li> <li>B. The CGPI (based on semester I, II, and III) of the students must be 6.75 and above</li> <li>C. For direct second year (DSE) admitted students - No backlog in semester III and CGPI must be 6.75 and above</li> </ol> </li> <li>2. It is optional for students to take Honours /Minor degree programs in Engineering.</li> </ol>
<p>R: <u>9617</u> Duration of Course</p>	<p>In TE and BE</p>
<p>R: <u>9618</u> Intake Capacity</p>	<p>Without intake as per choice of students</p>
<p>R: <u>9619</u> Scheme of Examination</p>	<p>Part of Rev 2019 'C'</p>
<p>R: <u>9620</u> Standards of Passing</p>	<p>40%</p>
<p>No. of years/Semesters:</p>	<p>Semesters – 4</p>
<p>Level:</p>	<p>U. G</p>
<p>Pattern:</p>	<p>Semester</p>
<p>Status:</p>	<p>New</p>
<p>To be implemented from Academic Year :</p>	<p>From Academic Year: 2022-23</p>

Dr. Suresh K. Ukarande  
Chairman  
Board of Studies in  
Civil Engineering

Dr. Suresh K. Ukarande  
Associate Dean,  
Faculty of Science and Technology,  
University of Mumbai

Dr. Anuradha Majumdar  
Dean  
Faculty of Science and Technology,  
University of Mumbai

# Manual for Honours and Minor Degree Programs in Engineering

## 1. Introduction:

As per the AICTE's Approval Process Handbook-2020-21: Chapter VII- clause 7.3.2 (Page 99-101), all branches of Engineering and Technology shall offer Elective Courses in the EMERGING AREAS viz., Artificial Intelligence (AI), Internet of Things (IoT), Blockchain, Robotics, Quantum Computing, Data Sciences, Cyber Security, 3D Printing and Design, Augmented Reality/ Virtual Reality (AR/VR), as specified in Annexure 1 of the Approval Process Handbook.

- a) Under Graduate Degree Courses in EMERGING AREAS shall be allowed as specialization from the same Department. The minimum additional Credits for such Courses shall be in the range of 18-20 and the same shall be mentioned in the degree, as specialization in that particular area. For example, doing extra credits for Robotics in Mechanical Engineering shall earn B.E./ B.Tech. (Honours.) Mechanical Engineering with specialization in Robotics
- b) Minor specialization in EMERGING AREAS in Under Graduate Degree Courses may be allowed where a student of another Department shall take the minimum additional Credits in the range of 18-20 and get a degree with minor from another Department.

It is also made very clear by AICTE that areas in which Minor Degree/Honours may be offered are numerous. It is up to the Universities with the help of their Academic Board/Council to decide whether Minor Degree/Honours. is to be offered or not in any particular area, which is not mentioned above. AICTE approval is not required for offering Minor Degree/Honours. in any such area, however the criteria that "Minor Degree or Honours. will cumulatively require additional 18 to 20 credits in the specified area in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits)"

## 2. Proposed Honours and Minor Degree:

Honours and Minor degree program is introduced in order to facilitate the students to choose additionally the specialized courses in the emerging areas of their choice and build their competence in such domains. Based on AICTE guidelines, the Faculty of Science and Technology has proposed to offer following Honours/ Minor degree program corresponding to each engineering program:

**Table 1: Honours / Minor Degree Programs**

Sr. No	Honours/Minor degree programs
1	Infrastructure Engineering
2	Smart Cities
3	Waterways Transport Engineering
4	Professional Practices in Structural Engineering
5	Green Technology and Sustainability Engineering
6	Infrastructure Policies & Regulations
7	Artificial Intelligence and Machine Learning

8	Blockchain
9	Cyber Security
10	Augmented Reality and Virtual Reality
11	Data Science
12	Internet of Things (IoT)
13	Waste Technology
14	Electric Vehicles
15	Microgrid Technologies
16	Robotics
17	3D Printing
18	Industrial Automation

The Honours and Minor degree programs selection for each of the engineering programs offered in University of Mumbai is as given in next section.

### 3. Mapping with Engineering/Technology Programs in University of Mumbai

Honour's/Minors degree program is being introduced by the Faculty of Science and Technology of University of Mumbai in order to facilitate the students to choose additionally the specialized courses in the emerging areas of their choice and build their competence in such domains. As per AICTE guidelines, Honours/Minors degree program to be chosen by eligible students (based on certain criteria given in manual) studying in third year of various Engineering program's are elaborated in **Table 2** to bring clarity to all stakeholders including students, faculty members and institutions. **Each eligible student can opt for maximum one Honour's or one Minor Programs at any time.**



**Table 2: Honours and Minor Degree Program Mapping with Engineering Programs**

	Honours / Minor Degree Programs	Programs who can offer this as the Honours Degree Program	Programs who can offer this as the Minor Degree program
Row	Column A	Column B	Column C
1	Infrastructure Engineering	Civil Engineering	<ol style="list-style-type: none"> <li>1. Mechanical Engineering</li> <li>2. Production Engineering</li> <li>3. Automobile Engineering</li> <li>4. Mechatronics Engineering</li> <li>5. Printing and Packaging Technology</li> <li>6. Electrical Engineering</li> <li>7. Chemical Engineering</li> <li>8. Electronics and Telecomm. Engineering</li> <li>9. Electronics Engineering</li> <li>10. Computer Engineering</li> <li>11. Information Technology</li> <li>12. Instrumentation Engineering</li> <li>13. Electronics and Computer Science</li> <li>14. Artificial Intelligence &amp; Data Science</li> <li>15. Cyber Security</li> <li>16. Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>17. Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>18. Computer Science and Engineering (Data Science)</li> <li>19. Artificial Intelligence &amp; Machine Learning</li> <li>20. Data Engineering</li> <li>21. Internet of Things</li> <li>22. Computer Science and Design</li> </ol>

2	Smart Cities	Civil Engineering	<ol style="list-style-type: none"> <li>1. Civil and Infrastructure Engineering</li> <li>2. Mechanical Engineering</li> <li>3. Production Engineering</li> <li>4. Automobile Engineering</li> <li>5. Mechatronics Engineering</li> <li>6. Printing and Packaging Technology</li> <li>7. Electrical Engineering</li> <li>8. Chemical Engineering</li> <li>9. Electronics and Telecomm. Engineering</li> <li>10. Electronics Engineering</li> <li>11. Computer Engineering</li> <li>12. Information Technology</li> <li>13. Instrumentation Engineering</li> <li>14. Electronics and Computer Science</li> <li>15. Artificial Intelligence &amp; Data Science</li> <li>16. Cyber Security</li> <li>17. Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>18. Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>19. Computer Science and Engineering (Data Science)</li> <li>20. Artificial Intelligence &amp; Machine Learning</li> <li>21. Data Engineering</li> <li>22. Internet of Things</li> <li>23. Computer Science and Design</li> </ol>
3	Waterways Transport Engineering	Civil Engineering	<ol style="list-style-type: none"> <li>1. Civil and Infrastructure Engineering</li> <li>2. Mechanical Engineering</li> <li>3. Production Engineering</li> <li>4. Automobile Engineering</li> <li>5. Mechatronics Engineering</li> <li>6. Printing and Packaging Technology</li> <li>7. Electrical Engineering</li> <li>8. Chemical Engineering</li> <li>9. Electronics and Telecomm. Engineering</li> <li>10. Electronics Engineering</li> <li>11. Computer Engineering</li> <li>12. Information Technology</li> <li>13. Instrumentation Engineering</li> <li>14. Electronics and Computer Science</li> <li>15. Artificial Intelligence &amp; Data Science</li> <li>16. Cyber Security</li> <li>17. Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>18. Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>19. Computer Science and Engineering (Data Science)</li> <li>20. Artificial Intelligence &amp; Machine Learning</li> <li>21. Data Engineering</li> </ol>

			<ul style="list-style-type: none"> <li>22. Internet of Things</li> <li>23. Computer Science and Design</li> </ul>
<b>4</b>	<b>Professional Practices in Structural Engineering</b>	<b>Civil Engineering</b>	<ul style="list-style-type: none"> <li>1. Civil and Infrastructure Engineering</li> <li>2. Mechanical Engineering</li> <li>3. Production Engineering</li> <li>4. Automobile Engineering</li> <li>5. Mechatronics Engineering</li> <li>6. Printing and Packaging Technology</li> <li>7. Electrical Engineering</li> <li>8. Chemical Engineering</li> <li>9. Electronics and Telecomm. Engineering</li> <li>10. Electronics Engineering</li> <li>11. Computer Engineering</li> <li>12. Information Technology</li> <li>13. Instrumentation Engineering</li> <li>14. Electronics and Computer Science</li> <li>15. Artificial Intelligence &amp; Data Science</li> <li>16. Cyber Security</li> <li>17. Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>18. Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>19. Computer Science and Engineering (Data Science)</li> <li>20. Artificial Intelligence &amp; Machine Learning</li> <li>21. Data Engineering</li> <li>22. Internet of Things</li> <li>23. Computer Science and Design</li> </ul>
<b>5</b>	<b>Green Technology and Sustainability Engineering</b>	<ul style="list-style-type: none"> <li>1 <b>Civil Engineering</b></li> <li>2 <b>Chemical Engineering</b></li> <li>3 <b>Printing and Packaging Technology</b></li> </ul>	<ul style="list-style-type: none"> <li>1. Civil and Infrastructure Engineering</li> <li>2. Mechanical Engineering</li> <li>3. Production Engineering</li> <li>4. Automobile Engineering</li> <li>5. Mechatronics Engineering</li> <li>6. Electrical Engineering</li> <li>7. Electronics and Telecomm. Engineering</li> <li>8. Electronics Engineering</li> <li>9. Computer Engineering</li> <li>10. Information Technology</li> <li>11. Instrumentation Engineering</li> <li>12. Electronics and Computer Science</li> <li>13. Artificial Intelligence &amp; Data Science</li> <li>14. Cyber Security</li> <li>15. Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>16. Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>17. Computer Science and Engineering (Data Science)</li> <li>18. Artificial Intelligence &amp; Machine Learning</li> <li>19. Data Engineering</li> </ul>

			<ul style="list-style-type: none"> <li>20. Internet of Things</li> <li>21. Computer Science and Design</li> </ul>
<b>6</b>	<b>Infrastructure Policies &amp; Regulations</b>	<b>Civil and Infrastructure Engineering</b>	<ul style="list-style-type: none"> <li>1. Civil Engineering</li> <li>2. Mechanical Engineering</li> <li>3. Production Engineering</li> <li>4. Automobile Engineering</li> <li>5. Mechatronics Engineering</li> <li>6. Printing and Packaging Technology</li> <li>7. Electrical Engineering</li> <li>8. Chemical Engineering</li> <li>9. Electronics and Telecomm. Engineering</li> <li>10. Electronics Engineering</li> <li>11. Computer Engineering</li> <li>12. Information Technology</li> <li>13. Instrumentation Engineering</li> <li>14. Electronics and Computer Science</li> <li>15. Artificial Intelligence &amp; Data Science</li> <li>16. Cyber Security</li> <li>17. Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>18. Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>19. Computer Science and Engineering (Data Science)</li> <li>20. Artificial Intelligence &amp; Machine Learning</li> <li>21. Data Engineering</li> <li>22. Internet of Things</li> <li>23. Computer Science and Design</li> </ul>
<b>7</b>	<b>Artificial Intelligence and Machine Learning</b>	<ul style="list-style-type: none"> <li>1 Computer Engineering</li> <li>2 Electronics and Telecomm. Engineering</li> <li>3 Electronics Engineering</li> <li>4 Information Technology</li> <li>5 Electronics and Computer Science</li> <li>6 Mechatronics Engineering</li> <li>7 Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>8 Cyber Security</li> <li>9 Computer Science and Engineering (Data Science)</li> <li>10 Internet of Things</li> <li>11 Data Engineering</li> <li>12 Computer Science and Design</li> </ul>	<ul style="list-style-type: none"> <li>1. Civil Engineering</li> <li>2. Civil and Infrastructure Engineering</li> <li>3. Mechanical Engineering</li> <li>4. Production Engineering</li> <li>5. Automobile Engineering</li> <li>6. Printing and Packaging Technology</li> <li>7. Electrical Engineering</li> <li>8. Chemical Engineering</li> <li>9. Instrumentation Engineering</li> <li>10. Biomedical Engineering</li> </ul>

8	Blockchain	<ol style="list-style-type: none"> <li>1 Computer Engineering</li> <li>2 Electronics and Telecomm. Engineering</li> <li>3 Electronics Engineering</li> <li>4 Information Technology</li> <li>5 Electronics and Computer Science</li> <li>6 Artificial Intelligence &amp; Data Science</li> <li>7 Cyber Security</li> <li>8 Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>9 Computer Science and Engineering (Data Science)</li> <li>10 Internet of Things</li> <li>11 Data Engineering</li> <li>12 Computer Science and Design</li> <li>13 Artificial Intelligence &amp; Machine Learning</li> </ol>	<ol style="list-style-type: none"> <li>1. Civil Engineering</li> <li>2. Civil and Infrastructure Engineering</li> <li>3. Mechanical Engineering</li> <li>4. Production Engineering</li> <li>5. Automobile Engineering</li> <li>6. Mechatronics Engineering</li> <li>7. Printing and Packaging Technology</li> <li>8. Electrical Engineering</li> <li>9. Chemical Engineering</li> <li>10. Instrumentation Engineering</li> <li>11. Biomedical Engineering</li> </ol>
9	Cyber Security	<ol style="list-style-type: none"> <li>1 Computer Engineering</li> <li>2 Electronics and Telecomm. Engineering</li> <li>3 Electronics Engineering</li> <li>4 Information Technology</li> <li>5 Electronics and Computer Science</li> <li>6 Artificial Intelligence &amp; Data Science</li> <li>7 Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>8 Computer Science and Engineering (Data Science)</li> <li>9 Internet of Things</li> <li>10 Artificial Intelligence &amp; Machine Learning</li> <li>11 Data Engineering</li> <li>12 Computer Science and Design</li> </ol>	<ol style="list-style-type: none"> <li>1. Civil Engineering</li> <li>2. Civil and Infrastructure Engineering</li> <li>3. Mechanical Engineering</li> <li>4. Production Engineering</li> <li>5. Automobile Engineering</li> <li>6. Mechatronics Engineering</li> <li>7. Printing and Packaging Technology</li> <li>8. Electrical Engineering</li> <li>9. Chemical Engineering</li> <li>10. Instrumentation Engineering</li> <li>11. Biomedical Engineering</li> </ol>
10	Augmented Reality and Virtual Reality	<ol style="list-style-type: none"> <li>1 Computer Engineering</li> <li>2 Electronics and Telecomm. Engineering</li> <li>3 Electronics Engineering</li> <li>4 Information Technology</li> <li>5 Electronics and Computer Science</li> <li>6 Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>7 Artificial Intelligence &amp; Data Science</li> <li>8 Cyber Security</li> <li>9 Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>10 Computer Science and Engineering (Data Science)</li> <li>11 Internet of Things</li> </ol>	<ol style="list-style-type: none"> <li>1. Civil Engineering</li> <li>2. Civil and Infrastructure Engineering</li> <li>3. Mechanical Engineering</li> <li>4. Production Engineering</li> <li>5. Automobile Engineering</li> <li>6. Mechatronics Engineering</li> <li>7. Printing and Packaging Technology</li> <li>8. Electrical Engineering</li> <li>9. Chemical Engineering</li> <li>10. Instrumentation Engineering</li> <li>11. Biomedical Engineering</li> </ol>

		<b>12 Artificial Intelligence &amp; Machine Learning</b> <b>13 Data Engineering</b> <b>14 Computer Science and Design</b>	
<b>11</b>	<b>Data Science</b>	<b>1 Computer Engineering</b> <b>2 Electronics and Telecomm. Engineering</b> <b>3 Electronics Engineering</b> <b>4 Information Technology</b> <b>5 Electronics and Computer Science</b> <b>6 Mechanical Engineering</b> <b>7 Production Engineering</b> <b>8 Automobile Engineering</b> <b>9 Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</b> <b>10 Cyber Security</b> <b>11 Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</b> <b>12 Internet of Things</b> <b>13 Artificial Intelligence &amp; Machine Learning</b> <b>14 Electrical Engineering</b> <b>15 Computer Science and Design</b>	1. Civil Engineering 2. Civil and Infrastructure Engineering 3. Mechatronics Engineering 4. Printing and Packaging Technology 5. Chemical Engineering 6. Instrumentation Engineering 7. Biomedical Engineering
<b>12</b>	<b>Internet of Things (IoT)</b>	<b>1. Computer Engineering</b> <b>2. Electronics and Telecomm. Engineering</b> <b>3 Electronics Engineering</b> <b>4 Information Technology</b> <b>5 Electronics and Computer Science</b> <b>6 Electrical Engineering</b> <b>7 Mechanical Engineering</b> <b>8 Production Engineering</b> <b>9 Automobile Engineering</b> <b>10 Mechatronics Engineering</b> <b>11 Artificial Intelligence &amp; Data Science</b> <b>12 Cyber Security</b> <b>13 Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</b> <b>14 Computer Science and Engineering (Data Science)</b> <b>15 Artificial Intelligence &amp; Machine Learning</b> <b>16 Data Engineering</b> <b>17 Computer Science and Design</b>	1. Civil Engineering 2. Civil and Infrastructure Engineering 3. Printing and Packaging Technology 4. Chemical Engineering 5. Instrumentation Engineering 6. Biomedical Engineering



13	Waste Technology	Chemical Engineering	<ol style="list-style-type: none"> <li>1. Civil Engineering</li> <li>2. Civil and Infrastructure Engineering</li> <li>3. Mechanical Engineering</li> <li>4. Production Engineering</li> <li>5. Automobile Engineering</li> <li>6. Mechatronics Engineering</li> <li>7. Printing and Packaging Technology</li> <li>8. Electrical Engineering</li> <li>9. Electronics and Telecomm. Engineering</li> <li>10. Electronics Engineering</li> <li>11. Computer Engineering</li> <li>12. Information Technology</li> <li>13. Instrumentation Engineering</li> <li>14. Electronics and Computer Science</li> <li>15. Artificial Intelligence &amp; Data Science</li> <li>16. Cyber Security</li> <li>17. Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>18. Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>19. Computer Science and Engineering (Data Science)</li> <li>20. Artificial Intelligence &amp; Machine Learning</li> <li>21. Data Engineering</li> <li>22. Internet of Things</li> <li>23. Computer Science and Design</li> </ol>
14	Electric Vehicles	<ol style="list-style-type: none"> <li>1 Electrical Engineering</li> <li>2 Mechanical Engineering</li> <li>3 Production Engineering</li> <li>4 Automobile Engineering</li> </ol>	<ol style="list-style-type: none"> <li>1. Civil Engineering</li> <li>2. Civil and Infrastructure Engineering</li> <li>3. Mechatronics Engineering</li> <li>4. Printing and Packaging Technology</li> <li>5. Chemical Engineering</li> <li>6. Electronics and Telecomm. Engineering</li> <li>7. Electronics Engineering</li> <li>8. Computer Engineering</li> <li>9. Information Technology</li> <li>10. Instrumentation Engineering</li> <li>11. Electronics and Computer Science</li> <li>12. Artificial Intelligence &amp; Data Science</li> <li>13. Cyber Security</li> <li>14. Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>15. Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>16. Computer Science and Engineering (Data Science)</li> <li>17. Artificial Intelligence &amp; Machine Learning</li> <li>18. Data Engineering</li> <li>19. Internet of Things</li> <li>20. Computer Science and Design</li> </ol>

15	<b>Microgrid Technologies</b>	<b>Electrical Engineering</b>	<ol style="list-style-type: none"> <li>1. Civil Engineering</li> <li>2. Civil and Infrastructure Engineering</li> <li>3. Mechanical Engineering</li> <li>4. Production Engineering</li> <li>5. Automobile Engineering</li> <li>6. Mechatronics Engineering</li> <li>7. Printing and Packaging Technology</li> <li>8. Chemical Engineering</li> <li>9. Electronics and Telecomm. Engineering</li> <li>10. Electronics Engineering</li> <li>11. Computer Engineering</li> <li>12. Information Technology</li> <li>13. Instrumentation Engineering</li> <li>14. Electronics and Computer Science</li> <li>15. Artificial Intelligence &amp; Data Science</li> <li>16. Cyber Security</li> <li>17. Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>18. Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>19. Computer Science and Engineering (Data Science)</li> <li>20. Artificial Intelligence &amp; Machine Learning</li> <li>21. Data Engineering</li> <li>22. Internet of Things</li> <li>23. Computer Science and Design</li> </ol>
16	<b>Robotics</b>	<ol style="list-style-type: none"> <li>1. <b>Mechanical Engineering</b></li> <li>2. <b>Production Engineering</b></li> <li>3. <b>Automobile Engineering</b></li> <li>4. <b>Printing and Packaging Technology</b></li> <li>5. <b>Mechatronics Engineering</b></li> <li>6. <b>Electrical Engineering</b></li> </ol>	<ol style="list-style-type: none"> <li>1. Civil Engineering</li> <li>2. Civil and Infrastructure Engineering</li> <li>3. Chemical Engineering</li> <li>4. Electronics and Telecomm. Engineering</li> <li>5. Electronics Engineering</li> <li>6. Computer Engineering</li> <li>7. Information Technology</li> <li>8. Instrumentation Engineering</li> <li>9. Electronics and Computer Science</li> <li>10. Artificial Intelligence &amp; Data Science</li> <li>11. Cyber Security</li> <li>12. Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>13. Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>14. Computer Science and Engineering (Data Science)</li> <li>15. Artificial Intelligence &amp; Machine Learning</li> <li>16. Data Engineering</li> <li>17. Internet of Things</li> <li>18. Computer Science and Design</li> <li>19. Biomedical Engineering</li> </ol>

17	3D Printing	<ol style="list-style-type: none"> <li>1. Mechanical Engineering</li> <li>2. Production Engineering</li> <li>3. Automobile Engineering</li> <li>4. Printing and Packaging Technology</li> </ol>	<ol style="list-style-type: none"> <li>1. Civil Engineering</li> <li>2. Civil and Infrastructure Engineering</li> <li>3. Mechatronics Engineering</li> <li>4. Electrical Engineering</li> <li>5. Chemical Engineering</li> <li>6. Electronics and Telecomm. Engineering</li> <li>7. Electronics Engineering</li> <li>8. Computer Engineering</li> <li>9. Information Technology</li> <li>10. Instrumentation Engineering</li> <li>11. Electronics and Computer Science</li> <li>12. Artificial Intelligence &amp; Data Science</li> <li>13. Cyber Security</li> <li>14. Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>15. Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>16. Computer Science and Engineering (Data Science)</li> <li>17. Artificial Intelligence &amp; Machine Learning</li> <li>18. Data Engineering</li> <li>19. Internet of Things</li> <li>20. Computer Science and Design</li> </ol>
18	Industrial Automation	Instrumentation Engineering	<ol style="list-style-type: none"> <li>1. Civil Engineering</li> <li>2. Civil and Infrastructure Engineering</li> <li>3. Mechanical Engineering</li> <li>4. Production Engineering</li> <li>5. Automobile Engineering</li> <li>6. Mechatronics Engineering</li> <li>7. Printing and Packaging Technology</li> <li>8. Electrical Engineering</li> <li>9. Chemical Engineering</li> <li>10. Electronics and Telecomm. Engineering</li> <li>11. Electronics Engineering</li> <li>12. Computer Engineering</li> <li>13. Information Technology</li> <li>14. Electronics and Computer Science</li> <li>15. Artificial Intelligence &amp; Data Science</li> <li>16. Cyber Security</li> <li>17. Computer Science and Engineering (Artificial Intelligence &amp; Machine Learning)</li> <li>18. Computer Science and Engineering (Internet of Things &amp; Cyber Security including Blockchain)</li> <li>19. Computer Science and Engineering (Data Science)</li> <li>20. Artificial Intelligence &amp; Machine Learning</li> <li>21. Data Engineering</li> <li>22. Internet of Things</li> <li>23. Computer Science and Design</li> </ol>

#### 4. Honours and Minor Degree Eligibility Criteria for Students:

In view of the above-mentioned guidelines issued by AICTE in APH 2020-21 for offering Honours and Minor degree in the various engineering programs, the following recommendations are proposed on the eligibility criteria for students opting for same;

- i) **Eligibility criteria for opting the Honours/ Minor Degree program:**
  - a. **Students with no backlog in semester I, II, and III**
  - b. **The CGPI (based on semester I, II, and III) of the students must be 6.75 and above**
  - c. **For direct second year (DSE) admitted students - No backlog in semester III and CGPI must be 6.75 and above**
- ii) **Each eligible student can opt for maximum one Honour's or one Minor Programs at any time.**
- iii) **However, it is optional for students to take Honours/Minor degree program.**
- iv) **The Honours/ Minor degree program can be opted only during regular engineering studies**
- v) **The student shall complete the Honours/ Minor degree program in stipulated four semesters only.**

#### 5. Eligibility criteria for Department/Institute to offer Honours/Minor degree:

As the intention of offering the Honours degree program is to facilitate the advanced learners to build their competence in emerging areas with additional in-depth course work, it becomes very essential to ensure availability of such expert faculties and infrastructure with the departments and institutes. **The proposed modality of approval is self-assessment and declaration basis.** Institute can assess on following points before offering Honours/Minor degrees,

1. The Honours Degree program out of 18 programs listed in Table-1 can only be offered by an institute having the regular degree program running as specified in Table 2 column B.
2. Availability of Faculty expertise in domains of Honours/Minor degree programs
  - a. Regular faculty on institute role who has completed PhD/Masters in same domain.  
OR
  - b. Regular faculty on institute role who is doing research either sponsored by government agencies or industries or trusts.  
OR
  - c. Regular faculty on institute role who has successfully completed certificate course in same domain and able to deliver the expectations of specialisation in emerging areas.
3. Availability of laboratory infrastructure/facilities in domains of Honours /Minor degree
  - a. Established centre of excellence in same domain.  
OR
  - b. Built research facilities to facilitate research in emerging areas  
OR
  - c. Minimum facility is already developed to conduct hands on experience in chosen domains of Honours and Minor degrees.

## **6. Procedure of Starting Honours/Minor Programs:**

Departments offering Honours/Minor Programs shall be assessed by Institute as per eligibility criteria mentioned in manual. Once found to be eligible fill the template of self assessment and send to Deputy Registrar Affiliation and Development Section, Fort Campus of University of Mumbai for information and simultaneously copy to Director Board of Examination and Evaluation, Examination House, Mahatma Phule Bhavan, Kalina campus of University of Mumbai. Affiliation section shall handover copy of same to LIC committee to verify correctness of self declaration, as and when appointed to visit for continuation of affiliation. Template to be used for self assessment and decleration form is given in **Table 3**.

**Table 3. Self-assessment and Declaration form for starting Honours/Minor Programs under University of Mumbai**

<b>Name of Institute:</b>		
<b>Honours / Minor Program:</b>		
<b>Do you have regular program to offer Honours Program?</b>		<b>Yes/No</b>
<b>If Yes,</b>		
Availability of <b>Regular Engineering Programs</b> (as specified in Table 2 column B of Honours and Minor Degree Program Manual Part-1)		<b>Following regular programs exists in Institute to offer Honours Program mentioned above,</b> 1. 2.
<b>Do you have availability of Faculty expertise as per criteria mentioned in manual to offer Honours Program?</b>		<b>Yes/No</b>
<b>If Yes, (Strike through whichever is not applicable)</b>		
<b>1.</b>	<b>Regular faculty</b> on institute role who is doing research either sponsored by government agencies or industries or trusts.	<b>Yes</b> <b>No</b>
<b>2.</b>	<b>Regular faculty</b> on institute role who had completed either Phd or Masters in same domain of Honours Program.	<b>Yes</b> <b>No</b>
<b>3.</b>	<b>Regular faculty on institute role who has successfully completed certificate course</b> in same domain of Honours Program	<b>Yes</b> <b>No</b>
<b>Do you have availability of laboratory facilities as per criteria mentioned in manual to offer Honours Program?</b>		<b>Yes/No</b>
<b>If Yes, (Strike through whichever is not applicable)</b>		
<b>1.</b>	<b>Availability of Established Centre of Excellence (CoE)</b> in same domain of Honours Program	<b>Yes</b> <b>No</b>
<b>2.</b>	<b>Availability of Research Facilities built to</b> facilitate research in same domain of Honours Program.	<b>Yes</b> <b>No</b>
<b>3.</b>	<b>Availability of Minimum facility</b> to conduct hands on experience in same domain of Honours Program	<b>Yes</b> <b>No</b>
<p><b>This is to certify that Departments offering honours programs is assessed and found that at least one of the eligibility norms in each of the three eligibility criteria has been found fulfilling. Hence forwarded application for starting Honours program in “.....” to University of Mumbai.</b></p>		
<p><b>Head of Institute sign and seal</b> (Enclosure: Supporting documents of fulfilling criteria’s)</p>		



## 7. Examination Process and Result Declaration

In current scenario First Year and Final Year of engineering examinations, assessments and result declaration are entirely done by University, while as in Second and Third Year question papers are delivered by University, assessment and results preparation and declaration after approval from university is done by Institute on behalf of University following all ordinances and regulations of university. Honours/Minor degrees courses will be offered in Third and Final Year of engineering as specialisation in emerging areas.

By keeping in mind availability of expertise of faculty with particular Institute only, proposed following modalities of Examination and Evaluation,

### Internal Assessment Examination:

1. Two Internal Assessment (IA) tests shall be carried out at institute level for each subject of Honours / Minor programs as per the directives given in the scheme and the syllabus.

### End Semester Examination:

1. Question papers of End Semester Examination for each subject shall be prepared by the paper setter panel appointed by University of Mumbai.
2. End Semester Examination answer-books evaluation (for sem. V, sem. VI, sem. VII and sem. VIII) of subjects offered at each Honours / Minor programs shall be carried out by respective institute at institute level by the examiners appointed by Principal from the panel provided by University.
3. Moderation-moderation of the answer books shall be carried out as per the existing rules applicable as per ordinance **O.5046-A** to the regular examination by the moderator appointed by Principal from the panel provided by the university.
4. Revaluation- Revaluation of the answer books shall be carried out as per the existing rules applicable to the regular examination by the examiners appointed by Principal
5. Each institute shall process the result applying ordinance **O.5042-A** and prepare the gazette copy of the results for respective semester for each Honours / Minor programs offered. Institutes shall submit results for moderation and approval to University similar to process of semester II to VI. Institute shall maintain the record of each student for each of the Honours / Minor programs offered till the completion of the Sem VIII end sem. examination.
6. University shall create portal for getting all marks and status of students results of Honours/Minor Programs. University shall issue common grade sheet of Honours/Minors Programs after the successful completion of all semesters including 8<sup>th</sup> semester (final semester of their regular program).
7. If the students completes the Honours / Minor program but fails in Sem VII / VIII, he/ she will not get any degree at that point of time, but both after passing regular degree program and Honours/ Minor program. However, the Honours/ Minor program should be completed in four semesters only.
8. The following **ordinances** are not applicable to Honours/Minors programs as these are applicable for entire examination and overall results of semesters.
  - i. **O.5043-A**
  - ii. **O.5044-A**
  - iii. **O.5045-A**
  - iv. **O.229**

## 8. Award of Degree Certificates:

University shall make provision of two types of degrees, one without and with honours/ Minors program;

1. Degree certificate without honours/minors programs shall be one, which is currently issued.
2. The students successfully completing the Honours / Minor program Degree shall be awarded with the degree designated as: "B. E. in .....(regular) Engineering with Honours/Minor in ..... (specialization)"

Example 1: Students s successfully completing BE in Mechanical Engineering with specialization (Honours) in 3D Printing shall get a degree as "B.E. in Mechanical Engineering with Honours in 3D Printing"

Example 2: Students successfully completing BE in Electrical Engineering with specialization (Minor) in 3D Printing shall get a degree as "B.E. in Electrical Engineering with Minor in 3D Printing"

## 9. Honours and Minor Degree Program Scheme and Structure:

Honours and Minor degree program be offered from academic year 2022-23 onwards along with Rev 2019 'C' scheme syllabus.

Honours and Minor credit courses will be offered from Semester V onwards to Semester VIII, scheme structure of syllabus is given in **Table 3**

Table 3. Template for Honours/ Minor degree program syllabus scheme

University of Mumbai Honours in ----- (With effect from 2022-23)										
Year & Sem	Course Code and Course Title	Teaching Scheme			Examination Scheme and Marks					Credit Scheme
		Hours / Week			Internal Assessment	End Sem. Exam	Term Work	Oral	Total	Credits
TE Sem. V	HXXC501: Subject 1	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>--</b>	<b>100</b>		<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										
TE Sem. VI	HXXC601: Subject 2	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>		<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										
BE Sem. VII	HXXC701: Subject 3	04	--	--	20	80	--	--	100	04
	HXXSBL701: Lab-1	--	--	04	--	--	50	50	100	02
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>04</b>	<b>100</b>		<b>50</b>	<b>50</b>	<b>200</b>	<b>06</b>
<b>Total Credits = 06</b>										
BE Sem.VIII	HXXC801: Subject 4	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>		<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V,VI, VII &amp;VIII = 04+04+06+04 = 18</b>										
Reference: <a href="https://www.aicte-india.org/sites/default/files/APH%202020_21.pdf">https://www.aicte-india.org/sites/default/files/APH%202020_21.pdf</a> (page 99-101)										

Dr. Suresh K. Ukarande  
Associate Dean,  
Faculty of Science and Technology,  
University of Mumbai



# University of Mumbai



## Syllabus

**Honours/Minor Degree Programs  
(with effect from 2022-2023)**

**Faculty of Science and Technology**

**UNIVERSITY OF MUMBAI**  
**Honours/Minor Degree Programs**  
**(with effect from 2022-2023)**

<b>Sr. No</b>	<b>Honours/Minor degree programs</b>	<b>Page No.</b>
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**Note: Course code format used in the document**

- Course Code: HXXC-Z01: (example- HEVC-501)  
H stands for Honours/ Minor course  
XX : Abbreviation of Program code: eg. For Electric Vehicles- it is 'EV'  
C- Theory Course  
Z for semester. For sem 5 -> 501
- Skill Based Lab Code: HXXSBL-Z01: (example- HEVSBL-701)  
H stands for Honours/ Minor course  
XX : Abbreviation of Program code: eg. For Electric Vehicles- it is 'EV'  
SBL- Theory Course  
Z for semester. For sem 7 -> 701



# University of Mumbai



## Syllabus

Honours/Minor Degree Program

in

Infrastructure Engineering

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Infrastructure Engineering**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HIEC501: Transportation Infrastructure	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>--</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
TE Sem VI	HIEC601: Energy and IT Infrastructure	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
BE Sem. VII	HIEC701: Geographic Information System	04	--	--	20	80	--	--	100	04
	HIESBL701:Lab1 Geographic Information System	--	--	04	--	--	50	50	100	02
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>04</b>	<b>100</b>	<b>--</b>	<b>50</b>	<b>200</b>	<b>06</b>	
<b>Total Credits = 06</b>										
BE Sem. VIII	HIEC801: Infrastructural Planning and Management	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V,VI, VII &amp;VIII = 04+04+06+04=18</b>										

Infrastructure Engineering: Semester-V		
Subject Code	Subject Name	Credits
HIEC501	Transport Infrastructure	4

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	3 hrs.	-	-	-	100

### Rationale

Urban sprawl worldwide is causing tremendous pressure on transport infrastructure. Transportation infrastructure is one of the most important factors for a country's progress. The complex network of connections between coastal ports, inland ports, rails and air routes is the 'lifeline' of a nation and it forms a foundation of economic development. Transportation is an important sector of the economy in its own right and that has been proven by so many instances how transport infrastructure has added speed and efficiency to a country's progress. India has a large and diverse transport sector with its own share of challenges and students will be conversant with transport infrastructure, diverse Transportation needs and equipments after completion of this course.

### Objectives

1. To understand the fundamentals of infrastructure and different modes of transportation globally and current state of affairs in India
2. To illustrate the types of modern highways, bridges and tunnels required for the transport infrastructure.
3. To identify the Mass Transit systems, for end to end transport and the structural systems required for the same.
4. To design airport infrastructure mechanism
5. To classify water way infrastructure
6. To study all the important tools and equipments required for the efficient functioning of Transportation infrastructure.

Module	Contents	Hours
1	<b>Introduction to Infrastructure:</b> Definition of infrastructure, Need of infrastructure, different forms of infrastructure, physical and social infrastructure, role of infrastructure in the development of a nation, Transportation scenario globally and in India; Overview of various transport systems in India-rail, road, air, waterways. Major organizations and players in the field of transport infrastructure	07
2	<b>Modern Highways:</b> Roads, Planning concepts, Uninterrupted traffic systems, Signal free intersections, Freeway, Expressway, Service roads, bye pass, Turnpike.	10

	<p><b>Bridges and Tunnels:</b> Classification based on Structural Materials like Steel, RCC, Pre-stressed concrete or Composite. Bridge types based on structural behaviour such as Beam bridge, Truss Bridge, Arch Bridge, Suspension &amp; Cable stayed cantilever and special purpose bridges.</p> <p>Tunneling Methods: Types and purpose of tunnels; factors affecting choice of excavation technique; Methods – soft ground tunneling, hard rock tunneling, shallow tunneling, deep tunneling; Supports in Tunnels: Different types of supports in tunneling and their applicability.</p>	
3	<p><b>Mass Transit system:</b> trains, ferries, buses, trams, Rapid mass transit systems such as subways and surface light rail systems, Cable cars, Various types of guided transport, tube, U-Bahn, metropolitan or underground, Metro rails, Structural components and their selection criteria.</p>	07
4	<p><b>Airport Planning:</b> Airport Master Plan, Airport Site Feature, Economic and Financial feasibility, Zoning around airports, design considerations for Apron, Runway, Taxiway, Hangar.</p> <p><b>Air traffic control:</b> radar, satellite navigation, One way, Two-way radio communication. ATC assistance during Departure, En-Route, Descent, Approach and Landing.</p>	08
5	<p><b>Waterways transportation:</b> History of water transportation, policies related to water transportation in India. Status of river, canals and ocean transportation in India. Modes of water transport - pontoons, amphibians, hovercrafts, boats, ships, water taxi. Advantages and disadvantages of water transportation.</p> <p><b>Ports harbours and docks:</b> Historical development of Port, Docks and Harbour. Port building facilities, Classification of harbours, Requirement of Harbour, Jetty, Harbour components, characteristics of good harbour and principles of harbour planning</p>	09
6	<p><b>Modern surveying tools</b> - Drones, satellite survey, GIS software, GPS system, Total station, Electronic Distance Measurement (EDM) Instruments</p> <p><b>Modern Equipment-</b> Dumper trucks, dozers, vibratory rollers, graders, tunneling equipments, lifting equipments (Cranes), sand washing equipments, earth movers, different excavators, wheel tractor scraper, trenchers, loaders, pile boring and pile driving machine, concrete mixers. concrete batching/mixing plant, concrete pumps, slip forms, concrete vibrator, hot mix plant</p>	11

### Contribution to Outcomes

After completion of the course work, students will be able to,

1. Understand the fundamentals of infrastructure and different modes of transportation
2. Illustrate the types of modern highways, bridges and tunnels along with tunnelling methods required for the transport infrastructure.
3. Identify the mass transit system in transport infrastructure
4. Design different components of airport infrastructure along with its economical and financial feasibility
5. Classify different modes of water transportation and evaluate the principles of harbour planning
6. Study different modern surveying tools and modern equipment required for transport infrastructure

### Theory Examination:-

1. The question paper will comprise **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** that will have short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining **five** questions will be based on all the modules. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
5. The students will have to attempt any **three** questions out of remaining five questions.
6. A total of **four** questions need to be attempted.

### Text Books:-

1. A Sustainable Vision for Urban India, Jain A K, Publisher: Kalpaz Publications
2. Highway Engineering, C. E. G. Justo and S. K. Khanna, Nem Chand & Bros; 10th Edition 2015 (1 January 2001)
3. Railway Engineering, M. M. Agarwal and Satish Chandra, Oxford University Press.
4. Design of Bridges, N. Krishna raju, Oxford and IBH Publishing
5. Airport Engineering: Planning And Design by Saxena S C , CBS Publication
6. Airport planning and design, S.K. Khanna, S. S Jain, M.G Arora , Nem Chand Brothers; 6th edition (January 1, 1999)
7. Inland Water Transport in India by R.P. Misra published by Prasaranga, University of Mysore in 1972.
8. Docks and Harbour Engineering: Dr. S.P Bindra, Dhanpatrai Publications, India
9. Harbour, Dock and Tunnel Engineering: R. Srinivasan, Charotar Publication, India
10. Remote sensing and Geographical Information System, By A. M. Chandra and S. K. Ghosh, Narosa Publishing House.
11. Advanced Surveying -Total Station, GIS and Remote Sensing by Satheesh Gopi, R. Sathikumar and N. Madhu, Pearson publication
12. Surveying Vol. 2 by S. K. Duggal, McGraw Hill Publication

### Recommended Books:-

1. Introduction to Infrastructure: An Introduction to Civil and Environmental Engineering, Michael R Penn
2. Remote Sensing & GIS,2/E—Bhatta— Oxford University Press
3. Modern Construction Equipment and Methods by Frank Harris
4. Construction Planning, Equipment, and Methods (McGraw-Hill Series In Civil Engineering) by Robert L Peurifoy ), Clifford J. Schexnayder, AviadShapira
5. Driving Horizontal Workings and Tunnel, by Pokorovski, Mir Publishers, 1980.
6. Harbour, Dock and Tunneling Engineering by R. Srinivasan Published by Charotar Publication

Infrastructure Engineering: Semester-VI		
Subject Code	Subject Name	Credits
HIEC601	Energy and IT Infrastructure	4

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	3 hrs.	-	-	-	100

### Rationale

The power infrastructure consists of generation, transmission, and distribution systems that are essential to all other infrastructures and every aspect of the economy. In India, various sources of energy are used to generate power. These include coal, natural gas, hydro, nuclear, and renewable (includes solar, wind, small hydro and biomass). Telecommunications infrastructure is a physical medium through which all Internet traffic flows. This includes telephone wires, cables and mobile technology such as fifth-generation (5G) mobile networks. The IT infrastructure consists of all elements that support the management and usability of data and information. These include the physical hardware and facilities (including data centers), data storage and retrieval, network systems, legacy interfaces, and software to support the business goals of an enterprise.

### Objectives

1. Evaluate energy infrastructure and hydroelectric power plant.
2. Classify the tidal, wind and solar energy and its operation
3. Explain nuclear energy infrastructure, policies and regulations for establishing nuclear power plant and issues related to radioactive waste
4. Design criteria for telecommunication tower
5. Describe the fundamental elements of IT infrastructure
6. Design criteria for development of smart grid networks

Module	Contents	Hours
1	<b>Introduction to energy infrastructure:</b> Types of electrical generation; generation system architecture; power plant planning and design. <b>Hydroelectric infrastructure:</b> Site selection; classification; hydrographs; storage and pondage; essential elements; selection of turbines, environmental impact assessment.	04
2	<b>Tidal energy infrastructure:</b> Fundamentals of tide; wave theory, loading and energy; operating principle - oscillating device; turbine characteristics; devices; moorings and anchors; foundations. <b>Wind energy infrastructure:</b> Offshore and onshore wind; properties of wind; wind resource assessment; wind turbine blades; wind turbines in grid; wind projects.	06



	<b>Solar energy infrastructure:</b> Basics of solar PV, fundamentals of the design of solar energy fields; concentrated solar power plant; solar water heating systems	
3	<b>Nuclear energy infrastructure:</b> Policy and regulations; economics and financing of nuclear power plants; nuclear technology selection and project implementation; fuel supply, radioactive waste and management; issues; environmental impact	10
4	<b>Telecommunication</b> – Definition, use, functions, and components, site surveys- raw land tower site survey and boundary survey, classification of telecommunication towers, Telecommunication signals, Design of towers – configuration, tower erection, transmission lines construction, operation and maintenance of distribution systems.	13
5	<b>IT infrastructure</b> – components of IT infrastructure, Internet and world wide web, design, planning, and implementation of networks and servers, storage management , Backup / Restore Methodology, Remote Access, Control, Administration.	12
6	<b>Smart grid, transmission and distribution:</b> Grid resilience; environmental performance; operational efficiencies; network architecture; transmission systems; wide area monitoring, protection and control, transmission and distribution architecture; micro grids; vulnerability; peak load shifting and grid storage.	07

#### Contribution to Outcomes

After completion of the course work, students will have ability to

1. Explain generation of hydroelectric power and its impact on environment
2. Classify and design infrastructure for non conventional energy sources
3. Describe the policies and regulations for nuclear power plant, infrastructural requirement and its environmental impact assessment
4. Evaluate the components and functions of telecommunication
5. Summarize the fundamental elements of IT infrastructure such as networks and servers, storage and remote access
6. Design and develop smart grid networks for transmission and distribution of the energy

#### Theory Examination:-

1. The question paper will comprise **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** that will have short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining **five** questions will be based on all the modules. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
5. The students will have to attempt any **three** questions out of remaining five questions.
6. A total of **four** questions need to be attempted.

### **Text Books:-**

1. Textbook of Renewable Energy (Wood head Publishing India in Energy) ,by S.C. Bhatia , R.K. Gupta
2. P. Jain, Wind Energy Engineering, McGraw-Hill.
3. Nuclear Power in India by N. Sharma, B. Banerjee, Rupa Publication 2008
4. Environmental Issues for 21<sup>st</sup> Century by S. P. Dasgupta, Mittal Publication.
5. Steve Morris, Up the Tower: The complete Guide to Tower Construction, Champion Radio Products Brian W. Smith, Communication Structures, Thomas Telford publications
6. ICT in Urban services, Compendium of global good practices, National Institute of Urban affairs, [http://pearl.niua.org/sites/default/files/books/GPGL1\\_ICT.pdf](http://pearl.niua.org/sites/default/files/books/GPGL1_ICT.pdf)
7. Fundamentals of telecommunication- [https://www.net.t-labs.tuberlin.de/teaching/computer\\_networking/documents/telecomm\\_fundamentals.pdf](https://www.net.t-labs.tuberlin.de/teaching/computer_networking/documents/telecomm_fundamentals.pdf)

### **Recommended Books:-**

1. Hydroelectric Energy, Renewable Energy and the Environment By Bikash Pandey, Ajoy Karki, ISBN 9781439811672 CRC Press
2. Tidal Energy Systems, 1st Edition, Design, Optimization and Control, Vikas Khare Cheshta Khare Savita Nema Prashant Bareda, Elsevier
3. E book on Energy Law in India by Mohammad Naseem, Saman Naseem, 2017, publisher Wolters Kluwer
4. Graham, S. and Marvin, S. Planning Cybercities Integrating Telecommunications into Urban Planning, The town planning review, 70(1), Liverpool University Press
5. S. Borlase (2013) Smart Grid Infrastructure, Technology, and Solutions, CRC Press. ISBN 9781439829103.
6. L.F. Drbal, P.G. Boston, K.L. Westra, R.B. Erickson (1996) Power Plant Engineering, Kluwer Academic Publishers. ISBN 9781461380474.
7. D. Greaves, G. Iglesias (2018) Wave and Tidal Energy, John Wiley & Sons Ltd. ISBN 9781119014454.
8. S. A. Kalogirou (2009) Solar Energy Engineering Processes and Systems, Elsevier. ISBN 9780123745019.
9. Basic Infrastructure for a Nuclear Power Project (2006) Technical Report, CI#128 IAEA. ISBN 9201085060.
10. Kiessling, F., Nefzger,P., Nolasco,J.F., Kaintzyk,U., (2003), Overhead Power Lines Planning Design Construction, 4th Edition, Springer
11. Ganguli, S.K., Kohli,V., (2016), Power Cable Technology, CRC Press

Infrastructure Engineering: Semester-VII		
Subject Code	Subject Name	Credits
HIEC701	Geographic Information Systems	4

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	3 hrs.	-	-	-	100

### Rationale

**Geographic information system (GIS)** is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface. By relating seemingly unrelated data, GIS can help individuals and organizations better understand spatial patterns and relationships. IS technology is a crucial part of spatial data infrastructure. Many different types of information can be compared and contrasted using GIS. The system can include data about people, such as population, income, or education level. It can include information about the landscape, such as the location of streams, different kinds of vegetation, and different kinds of soil. It can include information about the sites of factories, farms, and schools, or storm drains, roads, and electric power lines. Use of Geographic's Information system in all infrastructures will enhance the social, economic, development of India in all aspects.

### Objectives

1. To understand the fundamentals of GIS, basics tools, and its applications in all branches of Civil and infrastructure Engineering.
2. To Illustrate the various Component of GIS, co-ordinate systems for creations of vector data and raster dataset by using various GIS tools.
3. To understand Basic geodata base system for Creation of various types of maps.
4. To create various thematic maps by using the vector Data set as well as raster data set.
5. To analyze spatial Data for solving real word problems.
6. To apply GIS output data for solving real life problems.

Module	Contents	Hours
1	<b>Introduction to Geographic Information System</b> GIS: History, Development of GIS, Objective of GIS, Advantages of GIS.	03
2	<b>Introduction to Maps:</b> Definition, Scale, Types of Maps, elements of Map, Projection Coordinate Systems: Geographic, rectangular and Polar – Transformation, types and application. <b>GIS:</b> What is GIS, components of GIS, its applications, open source softwares.	09

3	<p><b>DBMS:</b> -Database Management system – function – types – advantages, Introduction to Toposheet. Various open data sources.</p> <p><b>GIS Data Model:</b> Spatial Data Types- , Vector data, Raster data, TIN (Triangulated reregulated network) data model, comparison of Vector &amp; raster data, Non spatial data (attributes) &amp; its types. Preprocessing of spatial data set.</p>	10
4	<p><b>GIS input data:</b></p> <p><b>Vector Data:</b> -Sources for GIS Data Shape files, Vector Data Input – Georeferencing, Map digitization and editing, and Topology – Topological Relationship.</p> <p><b>Raster Data Input</b> – Digital Elevation Mode (DEM)- Introduction to DEM, types of Dem, Uses of Dem &amp; different types of resolution, Introduction to satellite images, image classification, Quality assessment of freely available Digital Elevation Model, Raster File Formats, Vector File Formats – Raster to Vector and Vector to Raster Conversion.</p>	12
5	<p><b>GIS Data Analysis:</b> Introduction to GIS data Analysis – Data selection, reclassification, overlaying analysis, Buffer Analysis, Spatial Analysis (Dem Analysis,) Surface Analysis, Network Analysis, proximity Analysis, Vector &amp; Raster Analysis Methods. Error in GIS and key elements of maps.</p>	12
6	<p><b>GIS Output Design and Presentation</b></p> <p>Introduction - Spatial and non-spatial data presentation - Map layout – Charts, graphs and multimedia output, elements of spatial data quality, Meta data and introduction to web GIS.</p>	06

#### Contribution to Outcomes

After completion of the course work, students will be able to,

1. Explain GIS applications in various fields
2. Illustrate the types of maps, their characteristics and different co-ordinate system, Components of GIS & Familiar with new GIS software.
3. Compare the basics of Data Base Management system for GIS - vector data set, raster data set & Produce an error free GIS database for civil engineering applications.
4. Create & design basic database like creation of shape files, vector data set, raster data set & Produce an error free GIS database for civil engineering applications
5. Analyze GIS Data which includes creating buffers, Clipping Features, raster data analysis, vector Data Analysis and Dissolve Features.
6. Application of spatial data output along with quality assessment for applications in Civil & Infrastructure Engg.

#### Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests** - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### End Semester Examination (80 Marks):

Weight age of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1) Question paper will comprise of total **six questions, each carrying 20 marks.**
- 2) **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**

3) **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3) .

4) The students will have to attempt any **three** questions out of remaining five questions

5) Total Four questions need to be attempted.

**Text Books:-**

1. Remote Sensing and Geographic Information System, By A.M. Chandra and S.K. Ghosh, Narosa Publication House.
2. Remote Sensing: Principles and Applications by B C Panda.
3. Geographic Information System by Jatin Pandey .
4. Remote Sensing and GIS by Basudeb Bhatta, Oxford University.

**Recommended Books:-**

1. Jonathan Campbell and Michael Shin, Essentials of Geographic Information Systems, 2011, Saylor Foundation, ISBN: 9781453321966.
2. Michael N. DeMeres, Fundamentals of Geographic Information Systems, 4th Edition, 2009, Wiley, ISBN: 9780470129067
3. NPTEL GIS web course.

Infrastructure Engineering: Semester-VII		
Subject Code	Subject Name	Credits
HIESBL701	Geographic Information System – Lab	2

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	4	-	-	2	-	2

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	50	-	50	100

### Objectives

1. To acquire basic knowledge of Geographic Information System Lab practices and applying it for solving real life problem in Civil & Infrastructure Engineering.
2. To illustrate basic GIS-terms which are connected to data processing by means of exercises
3. To prepare basic geo data for Spatial and non spatial Analysis.
4. To apply Google earth in Geographic information system for preparation of various shapes files, preparation of vector data set.
5. To analyze basic geodata base by using various tools.
6. To convert GIS output into various thematic maps for solving various real life problems in Civil – infrastructure Engineering.

### List of Experiments

Module	Contents	Hours
1	Getting started with GIS software (QGIS, ArcGIS) & data collection from various free available sources.	4
2	Georeferencing and projection of toposheet, Digitization of map/ Toposheet.	4
3	Creation of thematic maps, Base Map preparation, Data Conversion – Vector to Raster, Raster to Vector.	4
4	Google earth integrations in GIS.	4
5	Vector analysis and Raster analysis, adding attribute data – quarries on attribute data, Map composition.	4
6	Developing Digital Elevation Model, its application & analysis.	4
7	A case study of GIS applications.	4

### Contribution to Outcomes

Learner will be able to...

1. Apply the installation of GIS software's and various tools.
2. Explain various Database structure like vector data, raster data set.
3. Prepare and convert vector data set into raster data set.



4. Interpret Google earth with GIS.
5. Perform various types of Analysis on raster data, vector data.
6. Transform GIS output by preparation of various thematic maps.

GIS Software's: Arc GIS 10.3, QGIS.

### **Assessment**

#### **Term Work Including**

- Laboratory work :            25 Marks
- Case Study/Report/Tutorial:        20 Marks
- Attendance:        05 Marks

#### **End Semester Oral Examination**

Oral examination will be based on the entire syllabus.

### **Text Books:-**

1. Remote Sensing and Geographic Information System, By A.M. Chandra and S.K. Ghosh, Narosa Publication House.
2. Remote Sensing: Principles and Applications by B C Panda.
3. Geographic Information System, by Jatin Pandey .
4. Remote Sensing and GIS by Basudeb Bhatta, Oxford University.

### **Recommended Books:-**

1. Jonathan Campbell and Michael Shin, Essentials of Geographic Information Systems, 2011, Saylor Foundation, ISBN: 9781453321966.
2. Michael N. DeMeres, Fundamentals of Geographic Information Systems, 4th Edition, 2009, Wiley, ISBN: 9780470129067
3. NPTEL GIS web course.

Infrastructure Engineering: Semester-VIII		
Subject Code	Subject Name	Credits
HIEC801	Infrastructural planning and management	4

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	3 hrs.	-	-	-	100

### Rationale

Infrastructure is the resources required for a society and its economy to function. Infrastructure Planning primarily relates to new infrastructure creation but also phasing out of deficient and outdated infrastructure when it is cost-effective.

Economic infrastructure is an internal facility of a country that make business activity possible, Such as communication, transportation and distribution networks, financial institutions and markets, and energy supply systems. Economic infrastructure definitely ensures the mobility of labour and capital within/from the economy. It results in the overall growth of towns and cities. Infrastructures provide for a lot of employment generation and employment opportunities. They also play a crucial role in national defense activities.

### Objectives

1. To understand the infrastructural scenario in India and opportunities and challenges to be faced in road development.
2. To understand the Infrastructure economics, finance and social environmental risk in infrastructure
3. To Realizing the real-world risks and challenges in managing infrastructure.
4. To identify the needs in urban infrastructure development and recycling technologies
5. To Understand the impact of infrastructural projects on environment
6. To analyse success and failure of measure infrastructural projects in India

Module	Contents	Hours
1	<b>Introduction-</b> Infrastructure scenario in India, transportation, power and telecom sectors, urban and rural infrastructure in India, road infrastructure development in India, rural roads development in India-opportunities and challenges	06
2	Infrastructure economics and finance, project structuring and risk allocation in project finance, Public-Private Partnership (PPP) for infrastructure- case studies, risk management in infrastructure projects, term sheet development economic and social e4nvironmental risk in infrastructure,	08
3	Project Governance, public sector governance, strategies for governing against infr6astructure project turbulence, the governance model, data–base management,	10

	actor mapping and social network analysis, fair process and negotiations, design thinking, life cycle and benefit cost analysis	
4	Innovative infrastructure financing, urban infrastructure needs in India and funding options, new and innovative materials for long lasting road infrastructure, green highways –recycling technology, durable road infrastructure –options and recent developments, polycentric governance and incomplete design, successful project delivery strategies.	10
5	Environmental impact assessment: Tools, impact on air ,water, soil & Noise, Role of Biodiversity impact Assessment, Identification ,Prediction &Evaluation of Impacts on Biodiversity, Techniques of Biodiversity impact assessment, E I A Report Preparation	10
6	Case Studies: Case studies for 1)BOT 2)Dams 3)Mass Transit System 4)Government Funded Projects	08

### Contribution to Outcomes

Students will have the ability to

1. Explain Indian Infrastructural framework and future challenges.
2. Analyze the infrastructure projects based on various risks.
3. Develop critical thinking on a variety of novel solutions or fixes which aids in execution infrastructure projects better.
4. Design innovative methods for long lasting infrastructure and understand the successful project delivery strategies.
5. Analyze the effect of infrastructural projects on environment.
6. Apply the design methodologies to the real world case studies

#### Theory Examination:-

1. The question paper will comprise **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** that will have short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining **five** questions will be based on all the modules. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
5. The students will have to attempt any **three** questions out of remaining five questions.
6. A total of **four** questions need to be attempted.

#### Text Books:-

1. Infrastructure Planning and Management (2018) by Prof. Ashwin Mahalingam NPTEL. <https://nptel.ac.in/courses/105/106/105106188/>
2. Projects planning, Analysis Selection, Implementation and Review, Prasanna Chandra Tata McGraw Hill, New Delhi, 2005
3. Vasant Desai, “Project Management”, Himalaya Publishing, 1st Edition, 2010
4. Arbitration”, Jubilee Publications, 2nd Edition., 1996 Engineering Contracts and B. J. Vasavada, “

5. Construction Management & PWD Accounts --- D Lal, S. K. Kataria & Sons, 2012
6. Fundamentals of Engineering Economics—Pravin Kumar, Wiley, India

**Recommended Books:-**

1. Goodman AS, Hastak M (2006). Infrastructure planning handbook: planning, engineering, and economics. New York: ASCE Press.
2. Miller R, Lessard DR (2001). The strategic management of large engineering projects: Shaping institutions, risks, and governance. MIT press.
3. J. Parkin and D. Sharma, Infrastructure planning, Thomas Telford, London, 1999.
4. Construction project scheduling and control ----Mubarak, Wiley India
5. Construction Management: Planning and finance-- Cormican D. Construction press, London, Feb 2002.

# University of Mumbai



## Syllabus

Honours/Minor Degree Program

in

Smart Cities

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Smart Cities**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	<b>HSCC501: Smart City Planning and Development</b>	04	--	--	20	80	--	--	100	04
	Total	<b>04</b>	-	--	<b>100</b>	-	-	<b>100</b>	<b>04</b>	
Total Credits = 04										
TE Sem VI	<b>HSCC601: Smart City-Project Management</b>	04	--	--	20	80	--	--	100	04
	Total	<b>04</b>	-	-	<b>100</b>	-	-	<b>100</b>	<b>04</b>	
Total Credits = 04										
BE Sem VII	<b>HSCC701: Smart Urban Infrastructures</b>	04	--	--	20	80	--	--	100	04
	<b>HSCSBL701: Lab-1: Smart City-Project Management</b>	--	--	02	--	--	50	50	100	02
	Total	<b>04</b>	-	<b>04</b>	<b>100</b>	<b>50</b>	<b>50</b>	<b>200</b>	<b>06</b>	
Total Credits = 06										
BE Sem VIII	<b>HSCC801: Smart Management of Smart Urban Infrastructures</b>	04	-	--	20	80	--	--	100	04
	Total	<b>04</b>	-	-	<b>100</b>	-	-	<b>100</b>	<b>04</b>	
Total Credits = 04										
<b>Total Credits for Semesters V,VI, VII &amp;VIII = 04+04+06+04=18</b>										



Smart Cities: Semester V		
Course Code	Course Name	Credits
HSCC501	Smart City Planning and Development	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	-	-	-	100

### Rationale

Today, more than 54% of the world's total population lives in urban areas. It is projected that urbanization will continue in the coming years, raising the urban population to 6.0 billion people by 2045. The significant increase in urban population will put awesome load on urban infrastructure which results in increasing the demand for energy, mobility, water, and other urban services in cities. So, cities have to become smarter in provision of urban services. Also due to the global awareness about negative environmental impacts of pollution, cities are feeling more pressure to improve their environmental performance, while improving their level of services. Increasing demand for sustainable, inclusive, reliable and efficient urban service puts our urban infrastructures under a huge pressure. But digitalization provides a powerful tool to address these issues and create a paradigm shift in our concept of cities. Due to this novel nature of smart cities, it is important that policymakers, urban managers and other relevant actors be prepared to understand and address the challenges that the transition will bring about. This course will provide the basic principles that to consider for a successful transition into a smart city.

### Objectives

1. Enable students in understanding the concepts, discourses and practices of "Smart Cities" across the Globe.
2. To develop competence in planning projects at the city level to ensure sustainability of environment and human beings.
3. Apply smart technologies across the spectrum of infrastructure and governance.
4. Develop overall city strategy to become contemporary and competitive.
5. Enable students to understand city centric capital formation and finance, risk and feasibility to ensure the economic health of the city.
6. Develop overall smart cities and villages.

Detailed Syllabus		
Module	Course Module / Contents	Hours
1	Introduction to Smart Cities-	09

	1.1	Definition and concept of smart city, Introduction to City planning, Introduction to Development Control Rules, Building Bye Laws	
	1.2	Conventional Vs. Smart city, Understanding Smart City	
	1.3	Various approaches to smart city, Pan city concept	
	1.4	Challenges of Urbanization, Smart City Characteristics	
2	<b>Smart City Standards-</b>		09
	2.1	Smart City Planning and Development, Dimensions of Smart Cities	
	2.2	Government of India initiatives “100 Smart Cities” Policy and Mission	
	2.3	Global experience of smart cities	
	2.4	Smart cities –Global standards	
	2.5	Smart cities-Performance benchmarks	
	2.6	Smart cities-Practice codes	
3	<b>Important sectors of smart city</b>		09
	3.1	Various sectors in smart city, Smart building and home device	
	3.2	Smart water, Smart Transportation, Smart Health, Smart Energy, smart public service	
	3.3	Cyber security, Safety and privacy, Concept of smart community	
	3.4	Concept of Digitalization, brief information about the various tools used for digitalization such as- ICT, IoT, Sensors, Artificial Intelligence	
4	<b>Governance of Smart Cities-E-Governance</b>		09
	4.1	Introduction to smart E-Governance, Smart E-Governance for Citizen services	
	4.2	Smart E-Governance for Industries and Commerce	
	4.3	Smart E-Governance within Government	
	4.4	Envisaging Future Smart E-Governance	
	4.5	Models for smart Governance	
	4.6	Regulatory Guidelines and Standards for E-Governance	
5	<b>Smart Citizen Services</b>		08
	5.1	Smart leadership and strategy; Stakeholder’s engagement	
	5.2	Smart healthcare	
	5.3	Smart education, skill development centers, incubation/ Trade facilitation centers	
	5.4	Safety and security of citizens particularly women, children and the elderly people	
6	<b>Green Building in Smart Cities and Smart Villages-</b>		08
	6.1	Sustainability, smart housing, Green buildings, Rating system of Green Building	
	6.2	Energy efficient buildings, Energy Saving System in buildings	
	6.3	Introduction to Rural Planning and Development, Understanding Concept of Smart Village, Issues of Smart Village	
	6.4	Smart Village Performance Benchmark, Smart Village Policy and Mission, Planning and Management of Smart Village, Financing Smart Village	

## Contribution to Outcome

On completion of this course, the students will be able to:

1. Conceptualize cities as socio-technical systems
2. Evaluate the main impacts of information and communication technologies on urban infrastructures and services.
3. Describe the main steps and considerations of the smart city transition.
4. Compare the main managerial and governance challenges of developing and managing a smart city.
5. Apply such concepts and tools in the case of smart water and smart housing systems.

### **Internal Assessment**

20 Marks

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

### **End Semester Examination**

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

### **Reference Books:**

1. "Smart Cities Unbundled" by, Sameer Sharma, Bloomsbury Publishing India Pvt. Ltd.
2. "Introduction to Smart Cities" by P.P. Anil Kumar, Pearson Publications
3. "Smart Cities & Urban Development in India "by N. Mani, New Century Publications
4. "Smart City" by Arun Firodia, Vishwakarma Publications.
5. "The Smart City Transformations: The Revolution of the 21st Century" by Amitabh Satyam & Igor Calzada, Bloomsbury Publishing India Pvt. Ltd.
6. "Financing Cities in India: Municipal Reforms, Fiscal Accountability and Urban Infrastructure" by, Prasanna K. Mohanty, SAGE publications India pvt. Ltd.
7. "Transforming Our Cities: Facing Up To India's Growing Challenge: Postcards of Change", by Isher Judge Ahluwalia, Harper Collins publications
8. "Urban Systems Design Creating Sustainable Smart Cities in the Internet of Things Era", by Yoshiki Yamagata, Perry P. J. Yang, Elsevier publications
9. "Internet of Things in Smart Technologies for Sustainable Urban Development" by G. R. Kanaga chidambaresan, R. Maheswar V. Manikandan, K. Ramakrishnan by Springer Publications
10. "Smart Cities: Introducing Digital Innovation to Cities" by Oliver Gassmann, Jonas Böhm, Maximilian Palmié, Emerald Publications.

Honours in Smart Cities: Semester VI		
Course Code	Course Name	Credits
HSCC601	Smart City-Project Management	4

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory				Term Work/Practical/Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.		Oral
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	-	-	-	100

### Rationale

Smart City projects involve great technical complexity, and require a wide diversity of skills to control and monitor them. Project Management would be an integral part for smart infrastructure and cities. Like other complex infrastructure projects; smart city projects are subjected to risk and uncertainties leading to huge time and cost overrun. Managers are faced with the problem of putting together and directing large temporary organizations subjected to constrained resources, limited time, and environmental uncertainty. Project management plays an important role in developing the Smart Cities. It has grown in response to the need for a managerial approach that deals with the problems and opportunities of modern society. It provides the technical and managerial competency, communication and decision making necessary to meet the challenges of complex activities. Application of modern project management tools would ensure more collaboration, communication flow and much flawless implementation of Smart City projects. Modern project management concepts of application of Integrated Project Delivery (IPD) and Building Information Modeling (BIM) would reduce the co-ordination problems and ensure much higher probability of successful completion of the projects within stipulated time and cost frame

### Objectives

1. This course is designed to give exposure to project management tools and techniques applicable for planning, controlling and monitoring of Smart Infrastructure and Cities.
2. This course would also enable to develop insight for managing project risks, uncertainties and complexities of smart city projects.
3. To provide overview on sound disaster risk management practices for preparing towards "Safe Cities". To educate and sensitize students, government officers, planners, policy makers, academicians, researchers and others on process of disaster management in smart cities.
4. To educate participants on various tools and methods that can be adopted for hazard identification, vulnerability analysis and disaster risk reduction measures.
5. To stimulate thought process to address hazard risks and vulnerabilities of distinct groups within the city to make more resilient communities.
6. To stimulate process of critically analyzing risks to various urban sectors like Health, Transport, Communication, Housing, Services, Infrastructure etc to come up with strategy to reduce risks Researchers and Academicians.

Detailed Syllabus			
Module	Course Module / Contents		Hours
1	Name of Module 1: <b>Philosophy and Concepts of Project Management in smart cities-</b>		08
	1.1	Philosophy and Concepts of Project Management-Phases	
	1.2	Philosophy and Concepts of Project Management- Stages of Project-	
	1.3	Philosophy and Concepts of Project Management-Approval Status	
	1.4	Philosophy and Concepts of Project Management-Work Break down Structure	
2	Name of Module 2: <b>Project Organization Structure-</b>		08
	2.1	Project Organization Structure- Planning	
	2.2	Project Organization Structure- Scheduling	
	2.3	Project Organization Structure-Controlling	
	2.4	Project Organization Structure-CPM	
	2.5	Project Organization Structure-The PERT Model	
	2.6	Project Management using BIM	
3	Name of Module 3: <b>Project Cost Analysis</b>		09
	3.1	Project Cost Analysis	
	3.2	Updating a Project	
	3.3	Resource Allocation and Leveling	
	3.4	Line of Balance Technique	
4	Name of Module 4: <b>Smart City Project Management with Case Studies -</b>		09
	4.1	Smart Project Planning	
	4.2	Smart Project Scheduling	
	4.3	Smart Project Monitoring	
	4.4	Smart Project Controlling	
	4.5	Project Risk Management	
	4.6	Case Studies on Smart Cities	
5	Name of Module 5: <b>Safety, Security and Disaster Management for Smart Citizen-</b>		09
	5.1	Safety, Security and Disaster Management for Smart Citizen	
	5.2	Disaster Risk Reduction (DRR) Overview	
	5.3	Smart Cities and Disaster Management	
	5.4	DRR Framework for Smart Cities	
6	Name of Module 6: <b>Thematic Analysis and Resilience Strategy for Smart Cities-</b>		09
	6.1	Thematic Analysis, Infrastructure Data/Digital Services	

	6.2	Data Management and Analytics	
	6.3	Resilience Strategy for Smart Cities	
	6.4	Stakeholder Capacity Building, Self-Assessment at project and city level	

On completion of this course, the students will be able to:

1. Explain role of project management in developing the Smart Cities.
2. Evaluate the risk and uncertainties throughout all the phases of Smart City projects.
3. Compare application of modern project management tools for flawless implementation of smart city projects.
4. Evaluate the managerial approach that deals with the problems and opportunities challenges of modern society of developing and managing a smart city.
5. Apply such concepts and tools for smart infrastructure and cities.

#### Internal Assessment

20 Marks

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only four questions need to be solved.

#### Reference Books:

1. "Principles of Sustainable Project Management" by Mohamed Salama, Goodfellow Publishers
2. "Smart Cities Unbundled" by Sameer Sharma, Bloomsbury Publishing India Pvt. Ltd.
3. "Introduction to Smart Cities" by P.P. Anilkumar, Pearson Publications
4. "Smart Cities & Urban Development in India" by N. Mani, New Century Publications
5. "Smart City" by Arun Firodia, Vishwakarma Publications
6. "The Smart City Transformations: The Revolution of the 21st Century" by Amitabh Satyam & Igor Calzada, Bloomsbury Publishing India Pvt. Ltd.
7. "Financing Cities in India: Municipal Reforms, Fiscal Accountability and Urban Infrastructure" by, Prasanna K. Mohanty, SAGE publications India pvt. Ltd.
8. "Transforming Our Cities: Facing Up To India's Growing Challenge: Postcards of Change", by Isher Judge Ahluwalia, Harper Collins publications
9. Smart City Tech Planning Handbook by Wade Sarver
10. <https://www.projectsmart.co.uk/project-management-ebooks.php>



Smart Cities: Semester VII		
Course Code	Course Name	Credits
HSCC701	Smart Urban Infrastructures	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4		-	4		-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.		-		100

### Rationale

The smart city infrastructure is the introductory step for establishing the overall smart city framework and architecture. The scope of these cities is mainly limited to construct a technology park converting the industrial real estate to state-of-the-art information technology using the evolution in the telecom and IP networks including insignificant asset management automation system. Urbanization is not only associated with economic development but over the time it started aspiring people to better quality of life. Cities are seen as solutions for boosting economy, generating employment, creating skills, providing better health services and many more things. However, the state of urban service delivery in India's cities and towns is far poorer than is desirable for India's current income levels. Considering that the Indian economy has been one of the fastest growing economies in the world for some time, and aspirations and standards are raising, the current state of service delivery is simply unacceptable. Moreover, a successful city cannot operate efficiently in isolation from its environment. It must balance social, economic and environmental needs. Smart Cities focus on their most pressing needs and on the greatest opportunities to improve lives. They tap a range of approaches – digital and information technologies, urban planning best practices, public private partnerships, and policy change to make a difference.

### Objectives

1. To study application of Solar Energy for Smart Cities-Conventional vs. Smart City
2. To prepare the qualified resource persons for the upcoming specialization in solid waste management practices after the mission period of SBM i.e., after 2020.
3. To learn from the challenges and limitations faced in e-governance projects in Citizen Services delivery, industries and commerce and intra-government systems for efficiency and transparency.
4. To develop ability to conceptualize, design, implement and manage the new era smart e-governance projects.
5. An understanding of the urban water supply and sanitation systems and linkages with urban forms.
6. Understanding the fundamentals of large project financing-Financial markets for smart city project finance such as syndicated bank loans, capital markets, private equity fund, multilateral institutions, joint ventures, public-private-partnership (PPP)
7. Understanding the projects and their business risks.
8. Understanding the documentation used to structure individual large project financings.

### Detailed Syllabus

Module	Course Module / Contents	Hours
1	<b>Conceptualization of Smart Energy System for Smart city:</b>	08
	1.1 Application of Solar Energy for Smart Cities, Conventional vs. Smart City, Green approach to meet Energy demand, Energy scenarios of conventional cities, Energy Efficient Building	
	1.2 Meeting energy demand through direct and indirect solar resources, Efficiency of indirect solar resources and its utility, Structure of Smart Grid, Indian Perspective, Advantage and limitation	
	1.3 Renewable in Smart grid Structural concept, Specific applications, Perspective in Smart Cities	
	1.4 Application of Solar in mobility, Matching demand and supply of energy in typical Smart city through Green mobility	
2	<b>Smart Water Management in Smart Cities-</b>	10
	2.1 Introduction to water Bye-Laws	
	2.2 Details of Water Supply system, various stages in implementing the system	
	2.3 Planning Stage: Conversion of existing maps to GIS	
	2.4 Assessing earlier population forecast, Demand estimation	
	2.5 Validation of ground elevations	
3	<b>Solid Waste Management in Smart Cities</b>	09
	3.1 Introduction to an effective urban Solid Waste Management (SWM) with 5Rs, MSW Characteristics and Quantities, MSW Rules 2016, Swachh Bharat Mission and Smart Cities Program	
	3.2 Disposal of Municipal Solid Waste: Landfill, Biochemical Processes and Composting, Energy Recovery from Municipal Solid Waste, case study of any Smart Cities in the Country	
	3.3 Construction and Demolition (C&D) Waste Management - Overview, Regulation, Beneficial Reuse of C&D Waste Materials, E-Waste Management Issues & Challenges and Status in India, E-Waste Management Rules 2016 and Management	
	3.4 Critical examinations of SBM endeavor with special emphasis on clean city rankings along with case study on solid waste management	
4	<b>Smart Transportation in Smart Cities-</b>	08
	4.1 Introduction of "Smart Transport"	
	4.2 Application of traffic engineering to smart cities: Level of service, Traffic system management, reduction of conflicts, signal design	
	4.3 Smart pavement materials: plastic pavement, porous pavement, electric generating roads (Piezo electric roads) etc.	
	4.4 Introduction to Urban Transportation system planning: Trip Generation, distribution	
4.5 Modal split and traffic assignment		

	4.6	Highway economics	
5	<b>Smart sanitation and storm water drainage system for Smart city-</b>		09
	5.1	Crisis of Sanitation- India, Key Sanitation policy issues and goals, Benchmarks for Smart Sewerage and Sanitation, steps required to achieve these benchmarks	
	5.2	Need of sewer model, Assessment of sewerage system at Planning and Design stage for transforming into smart sanitation	
	5.3	Sludge Management, Wastewater Reuse and Recycling. Need of Storm water drainage system, Storm water Planning, Challenges in Sustainable Storm water Planning	
	5.4	Trends and issues in storm water system Storm water management to for sustainable water management in Indian smart cities	
6	<b>Smart Funding for Smart Cities-</b>		08
	6.1	Financing Smart Cities Development-Types of sources for sustainable smart city funding: GOI seed capital grant of Rs 500 crore to each smart city, Leveraging this grant for funding from open sources, Business Risk Assessment, Public Private Partnership PPP concept and Modes of Smart City funding-BOOT, BOT, BOO, DBFOT etc.	
	6.2	PPP Request for Qualification (RFQ) and Criteria as per Planning Commission guidelines (Case Study), PPP request for Proposal (RFP) along with Concession agreement terms and conditions as per Planning Commission Guidelines	
	6.3	Debt funding, Consortium of financiers, Guarantees and mortgage, Joint venture, Municipal Bonds, Documentation of debt funding, Equity Funding through Initial Public Offer	
	6.4	Private equity funding and risk factors in IPO, Procedure of IPO funding, Other funding sources like Viability gap funding, Special subsidy for the project, Merger and Acquisition, Long term Lease, Financing etc.	

### Contribution to Outcome

Conceptualize on completion of this course, the students will be able to:

1. Smart Energy System required for Smart city.
2. Explain the effective urban Solid Waste Management practices, MSW rules.
3. Evaluate the importance of best sanitation practices, storm water management and its linkage for the smart city transition.
4. Describe the evolution of e-governance and smart public services to be provided for developing and managing a smart city.
5. Evaluate application of traffic engineering to smart cities

#### Internal Assessment

20 Marks

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.

2. Question 1 will be compulsory and should cover maximum contents of the curriculum.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

**Recommended Books:**

1. "Water, Wastewater, and Stormwater Infrastructure Management", by Neil S. Grigg, CRC Press Taylor and Francis Group
2. "Smart Cities Unbundled" by Sameer Sharma, Bloomsbury Publishing India Pvt. Ltd.
3. "Introduction to Smart Cities" by P.P. Anilkumar, Pearson Publications
4. "Smart Cities & Urban Development in India" by N. Mani, New Century Publications
5. "Smart City" by Arun Firodia, Vishwakarma Publications
6. "Municipal Stormwater Management" by Debo, Thomas, Reese, Andrew, Lewis Publishers
7. "State of the Capital: Creating a Truly Smart City", by K.S. Mehra, Rupa Publications India
8. Security in Smart Cities: Models, Applications, and Challenges", by Aboul Ella Hassanien Mohamed Elhoseny, Syed Hassan Ahmed, Amit Kumar Singh Published by Springer
9. "Transportation and Power Grid in Smart Cities: Communication Networks and Services" by Melike Erol-Kantarci, Hussein T. Mouftah, Mubashir Husain Rehmani , Wiley Publications
10. Cities and Mobility & Transportation: Towards the next generation of Urban Mobility by Pascual Berrone, Joan Enric Ricart Costa, Ana Duch T-Figueras, IESE CITIES IN MOTION: International.

Smart Cities: Semester VII						
Course Code		Course Name				Credits
Lab 1: HSCSBL701		Smart City-Project Management				02
Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	04	-	-	02		02

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
-	-	-	-	-	50	-	50	100

### Rationale

Smart City projects involve great technical complexity. It requires a widespread diversity of skills to control and monitor them. For any smart infrastructure project management would be an integral part. Like other complex infrastructure projects; smart city projects are subjected to risk and uncertainties leading to huge time and cost overrun. Project managers are faced with many problems that are putting together subjected to constrained resources, finance, time, and environmental uncertainty. Therefore, project management plays an important role in the development of the Smart Cities. It provides the technical and managerial competency, communication and decision making necessary to meet the challenges of complex activities. It has grown in response to the need for a managerial approach that deals with the problems and opportunities of modern society. A successful city operates efficiently only when it balances social, economic and environmental needs. Smart Cities focus on their most demanding needs to improve lives. They tap various approaches like digital and information technologies, urban planning best practices, public private partnerships, capacity building, policy change to achieve the success.

### Course Objective:

1. To acquire knowledge on various components of Smart Cities.
2. To study ongoing projects and their business risks
3. To understand documentation, financings, capacity building used to structure individual large project
4. To study urban water supply, sanitation, solid waste management, transportation & application of Solar Energy for Smart Cities

List of Experiments (Conduct three practical out of six practical's mentioned below)		
Module	Detailed Content	Lab Session / Hours.

1	Preparing a report on Project Management- <b>Phases-Stages of project -Work Break down Structure of Smart city in India</b> (Ongoing Smart City Project-Case study).	08
2	Preparing a report of <b>Project Cost Analysis-Resource Allocation and Leveling, Line of Balance Technique</b> (Ongoing Smart City Case Study).	08
3	Preparing a report on <b>Smart Energy System for Smart city</b> (Ongoing Smart City-Case Study).	08
4	Preparing a report on <b>Smart Water Management in Smart Cities</b> (Ongoing Smart City-Case Study).	08
5	Preparing a report on <b>Solid Waste Management in Smart Cities</b> (Ongoing Smart City-Case Study).	08
6	Preparing a report on <b>Smart Transportation in Smart Cities</b> (Ongoing Smart City-Case Study).	08

#### Course Outcomes:

At the end of the course, learner will be able to:

1. Compare various stages of project of smart city.
2. Evaluate the effective urban Solid Waste Management practices, MSW rules.
3. Compare the importance smart water management, best sanitation practices, storm water management and its linkage for the smart city transition.
4. Prepare application of traffic engineering to smart cities

#### Assessment:

- Term Work Including Laboratory Work and neatly written project report of the work done.  
Laboratory Work: 50 Marks
- End Semester Oral Examination: 50 Marks

#### Recommended Books:

1. Manual on Water Supply and Treatment, (latest Ed.): Ministry of Urban Development, New Delhi
2. Manual on Wastewater Treatment 3rd Ed. Pub: CPHEEO, Ministry of Urban Development, Govt. of India, New Delhi,
3. Municipal Solid Waste Management Manual, (Part1,2,3) Ministry of Urban Development, CPHEEO, 2016
4. Refer various websites of municipal corporations of the cities selected under the smart city mission to study success story,
5. Refer following official government websites
  - <http://cpheeo.gov.in>
  - <https://moef.gov.in/en/>



Smart Cities: Semester VIII		
Course Code	Course Name	Credits
HSCC801	Smart Management of Smart Urban Infrastructures	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hours	-	-	-	100

#### Rationale

The introduction of Smart urban technologies into legacy infrastructures has resulted in numerous challenges and opportunities for contemporary cities and will continue to do so. Over the past few years, advances in the Information and Communication Technologies (ICTs) have significantly challenged the traditionally stable landscape of urban infrastructure service provision. This has resulted in increasing interest from both technology vendors and public authorities in the transition of cities towards so-called “Smart Cities”. Although such “Smart technologies” can provide immense opportunities for citizens and service providers alike, the ICTs often act as disruptive innovators of urban infrastructure service provision.

#### Objectives

1. Enable students to develop competence in planning of projects at the city level to ensure sustainability of environment and humans
2. Enable students to apply smart technologies across the spectrum of infrastructure and governance
3. Enable students to develop overall city strategy to become contemporary and competitive
4. Enable students to understand city centric capital formation and finance, risk and feasibility to ensure the economic health of the city

Detailed Syllabus			
Module	Course Module / Contents		Hours
1	<b>Management of Smart Urban Infrastructures</b>		08
	1.1	Issues and Challenges in Construction and Maintenance of Infrastructure, Information Technology and Systems for Successful Infrastructure Management	

	1.2	Innovative Design and Maintenance of Infrastructure Facilities, Infrastructure Modeling and Life Cycle Analysis Techniques	
	1.3	Capacity Building and Improving the Governments Role in Infrastructure Implementation	
	1.4	An Integrated Framework for Successful Infrastructure Planning and Management, Infrastructure Management Systems and Future Directions	
2	<b>Management of Smart water, Wastewater System-</b>		10
	2.1	Overview of Urban Water Supply, Rainwater Harvesting, Dual water supply system, water recycling	
	2.2	Building blocks of 24x7 water supply system,	
	2.3	Performance indicator and Benchmark for water supply services	
	2.4	Smart metering, Leakage management & NRW reduction for achieving 24x7 water supply	
	2.5	Smart monitoring through SCADA system for various components of water and sewerage system	
	2.6	Redressal of complaints on real time basis, Current Practices in Wastewater Recycling	
3	<b>Management of Smart Urban Energy Systems</b>		08
	3.1	Meaning of 'Smart Energy Management	
	3.2	Smart Energy Management – Water, Transport	
	3.3	Smart Energy Management-Waste Management and Public Services etc	
	3.4	Challenges and Implementation Barriers for Smart Energy Management, Way forward for achieving integrated Smart Energy Management	
4	<b>Management of Smart Solid Waste System-</b>		10
	4.1	The environmental impact of waste management and its relationship on the sustainable development and smart city development	
	4.2	Management of Solid Waste using IoT	
	4.3	management issues in source reduction, recycling, material recovery and transformation of waste through composting	
	4.4	Implementation of solid waste management options -collection system, energy recovery and landfill disposal.	
	4.5	Biomedical waste management, Economy and financial aspects of solid waste management.	
	4.6	Case Studies of Smart cities having successful solid waste Management program	
5	<b>Name of Module 5: Management of Smart Urban Transportation Systems</b>		08
	5.1	Introduction of "Smart Transport", Smart Automobile and Sustainable fuels	
	5.2	Smart infrastructure-Intelligent Transport systems (ITS), GIS, RS, GPS, Navigation and Identification Systems	
	5.3	Electronic fee payment technology (E-ticketing), Traffic Safety Management	

	5.4	Human and Environmental Impacts, Safety and Sustainability, Case Study: BRTS or Smart Parking with economics and costing, Mobility Services, Smart Mobility	
6	<b>Case Study Towards Smart Cities: Part I &amp; II</b>		08
	6.1	<b>Towards Smart Cities: Part I: (04 hours)</b> The transition of legacy cities to Smart Cities is not a spontaneous process. To get the transition process right, and to the benefit of citizens, cities have to adopt effective management and governance approaches to successfully deal with numerous complexities of this process. This Module will help to understand the most important factors in the transition phase of legacy cities to smart cities and their managerial implications	
	6.2	<b>Towards Smart Cities: Part II: (04 hours)</b> Management of Smart Cities calls for different approaches from conventional urban management approaches, Role of city government in the network of actors who play an important role in management of clean, safe, healthy living conditions. Modern, efficient infrastructure that enables and promotes high-quality work opportunities and high-quality living, Efficient and sustainable use of resources, The city challenges such as city master plans, long term urban plans, city mobility plans, city strategic plans for renewable energy, water sources, waste management, pricing on water, power, tax assessment and frequent revisions, appropriation of resources, water harvesting and recycling, public participatory approach, citizen participation, citizen audit, capacity building in key disciplines, effective urban governance, adoption of ICT facilities, in due respect to local and regional culture, social aspects, safety and security based on economical vibrancy-Smart Cities-Internet of Things (IoT) and Artificial Intelligence (AI).	

#### Contribution to Outcome

On completion of this course, the students will be able to:

1. Explain how to make the best of these smart technologies in your cities' legacy infrastructures.
2. Learn about state-of-the-art strategies for effectively managing the transition from legacy infrastructures to smart urban systems.
3. Evaluate Life Cycle Analysis Techniques and sustainable development of Infrastructure.
4. Describe principles for the management of Smart urban infrastructures as well as the applications of these principles in the various sectors.

#### Internal Assessment

20 Marks

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
  2. Question 1 will be compulsory and should cover maximum contents of the curriculum.
  3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
  4. Only Four questions need to be solved.
- 

**Recommended Books:**

1. Integrated Solid Waste management, George Tchobanoglous, Hilary Theisen and Samuel A Vigil Tata McGraw Hill
2. "Smart Cities Unbundled" by Sameer Sharma, Bloomsbury Publishing India Pvt. Ltd.
3. "Introduction to Smart Cities" by P.P. Anilkumar, Pearson Publications
4. "Smart Cities & Urban Development in India" by N. Mani, New Century Publications
5. "Smart City" by Arun Firodia, Vishwakarma Publications
6. "The Smart City Transformations: The Revolution of the 21st Century" by Amitabh Satyam & Igor Calzada, Bloomsbury Publishing India Pvt. Ltd.
7. "Financing Cities in India: Municipal Reforms, Fiscal Accountability and Urban Infrastructure" by, Prasanna K. Mohanty, SAGE publications India pvt. Ltd.
8. "Transforming Our Cities: Facing Up To India's Growing Challenge: Postcards of Change", by Isher Judge Ahluwalia, Harper Collins publications
9. "Urban Systems Design Creating Sustainable Smart Cities in the Internet of Things Era", by Yoshiki Yamagata, Perry P. J. Yang, Elsevier publications
10. "Internet of Things in Smart Technologies for Sustainable Urban Development" by G. R. Kanaga chidambaresan, R. Maheswar V. Manikandan, K. Ramakrishnan by Springer Publications
11. "Smart Cities: Introducing Digital Innovation to Cities" by Oliver Gassmann, Jonas Bohm, Maximilian Palmie, emerald Publications

# University of Mumbai



## Syllabus

Honours/Minor Degree Program

In

Waterways Transportation Engineering

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Waterways Transportation Engineering**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HWTC501: Waterways and Ports	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>--</b>	<b>100</b>		<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										

TE Sem. VI	HWTC601: Design of Ports and Harbour structures	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>		<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										

BE Sem. VII	HWTC701: Port and Harbour Operations and Services	04	--	--	20	80	--	--	100	04
	HWTSBL701: Lab-1	--	--	04	--	--	50	50	100	02
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>04</b>	<b>100</b>		<b>50</b>	<b>50</b>	<b>200</b>	<b>06</b>
<b>Total Credits = 06</b>										

BE Sem. VIII	HWTC801: Construction and Management of Port and Harbour	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>		<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										



### Waterways Transportation Engineering : Semester V

Course Code	Course Name	Credits
HWTC501	Waterways and Ports	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory				Term Work/Practical/Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.		Oral
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	-	-	-	100

#### Rationale

Waterways are critically important to the transportation of people and goods throughout the world. The complex network of connections between coastal ports, inland ports, rail, air, and truck routes forms a foundation of material economic wealth worldwide. This subject introduces the basic elements related to waterway engineering.

#### Objectives

- To understand the historical development of waterways at a national and global level and also the significance of ports and harbours as a mode of transport.
- To understand the present status and different surveys required for the planning of Ports and Harbours.
- To understand the policies related to water transportation in India.
- To understand the natural phenomenon affecting waterways and its elements.
- To understand the coastal protection works and coastal Regulations to be adopted
- To study and understand all the important facilities required at the port for the efficient planning of port.

#### Detailed Syllabus

Module	Contents	Hours
1	<b>General:</b> Comparison of different modes of transportation. Types, Characteristics, advantages and disadvantages of water transportation. History of water transportation at world level and at national level. Case studies of countries with excellent water transportation facilities.	04
2	<b>Historical development and Harbour planning:</b> Development and policies related to water transportation in India. Status of river, canal and ocean transportation in India. Classification of harbours, Requirement of Harbour. Harbour components, ship characteristics,	12

	characteristics of good harbour and principles of harbour planning, size of harbour, site selection criteria and layout of harbours. Surveys to be carried out for harbour planning Marine surveys, Topographic survey of marine area. Hydro graphic surveys, Tide Surveys.	
3	<b>Port development and planning:</b> Port building facilities. Differences between Port, Docks and Harbour. Requirement of a good port, Port development in India, Major ports in India. Maritime policies, Port authorities, bodies and associations. Port modernization and new port development (Sagarmala project). Connectivity enhancement Port-linked industrialization and Coastal community development and development of river information services. Environment Impact Statement (EIS). Approvals and mitigation .Case studies of various available Ports in India and abroad.	10
4	<b>Natural Phenomena:</b> Wind, waves, tide formation and currents phenomena, their generation characteristics and effects on marine structures. Wind strength, water waves, origin of water waves, effect of wind duration, and bottom friction and water depth on water waves. Wave form and generation. Velocity, height and length of waves. Diffraction, breaking and reflection of waves, wave action on vertical walls, piles. Beach protection, littoral drift, silting, erosion and littoral drift.	12
5	<b>Coastal Structures:</b> Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage Types, Objective, principal function and suitability.	06
6	<b>Harbour Terminal facilities and Navigational Aids:</b> Port building facilities, Transit sheds, Warehouses, Cargo handling facility, Services for shipping terminals, Inland port facilities planning, purpose and general description. Necessity of navigation aids and their types, Requirement of signals, Fixed and floating navigation aid.	08

### Contribution to Outcomes

After completion of the course work, the students are expected to

1. Develop a strong fundamentals related to waterways transportation Engineering.
2. Understand the present status and different surveys required for the planning of Ports and Harbours.
3. The students shall be in a commanding position to plan and execute hydrographic surveys required at various stages of planning, construction and execution of Port and harbours. Also understand the policies related to water transportation in India.
4. The student will also be able to understand the role and effect of natural phenomenon such as wind and waves on the waterways.
5. Understand the coastal protection works and coastal Regulations to be adopted.
6. The student is expected to get full knowledge related to all the modern techniques and various important methods for effective management of port facilities.

### Internal Assessment (20 Marks)

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

### **End Semester Examination (80 Marks)**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of **total six questions, each carrying 20 marks.**
- 2 Question 1 will be compulsory and should cover **maximum contents of the curriculum.**
- 3 **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 **Only Four questions need to be solved.**

### **Recommended Books:-**

1. Docks and Harbour Engineering: *Dr. S.P Bindra*, Dhanpatrai Publications, India
2. Docks and Harbour Engineering: *Hasmukh P. Oza, Gautam H. Oza*, Charotar Publication, India
3. Harbour, Dock and Tunnel Engineering: *R. Srinivasan*, Charotar Publication, India
4. Alonzo Def. Quinn, Design and Construction of Ports and Marine Structure, McGraw – Hill Book Company, New York.
5. PeraBrunn, “Port Engineering”, 1 st Edition, Gulf Publishing Company, 2000.
6. Leslie A.Bryan, “Principles of Water Transportation”, University of Chicago Press

Waterways Transportation Engineering : Semester VI		
Course Code	Course Name	Credits
HWTC601	Design of Ports and Harbour structures	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	-	-	-	100

#### Rationale

In the subject of Transportation Engineering, study of Harbour, Dock and Port Engineering is essential. This course is designed to give the basic understanding of ports and harbour structures. The course will also cover wide areas such as vessel types, types of harbours, design of entrance channel, turning circle, breakwaters, berthing structures etc. A key feature of this course is to introduce the international practice and technologies in fields of coastal, ports and harbour including the codal requirements for designing the various components of port and harbour structures.

#### Objectives

1. To make the students understand the basic principles of design of port and harbour structures.
2. To cover the design aspects of areas such as vessel types, types of harbours, design of entrance channel, turning circle, breakwaters, berthing structures etc.
3. To understand the importance of load consideration and will enable the students to calculate the different loads in designing the various components.
4. To introduce the international practices and construction technologies in order to design the foundation and fenders of ports and harbour.
5. To appreciate the design principles and codal requirements for designing a breakwater with the help of model studies.
6. To enable the students in understanding the concept, types and differences of docks and locks in order to navigate safely.

Detailed Syllabus		
Module	Content	Hours
1	<b>Introduction:</b> Ports and harbours – an infrastructure layer between two transport media. Introduction to navigation channel, entrance channel and turning circle.	08

	<b>Design issues:</b> Sea port layout with regards to - wave action- siltation - navigability, berthing facilities.-Vessel type and size	
2	<b>Wind rose and wave rose</b> as per IS 4651, Operational and design wave as per return period, seismic, sidescan and bathymetry charts	08
3	<b>Load consideration and calculations:</b> Environmental Loads: Wind, Currents, Waves. Mooring Loads: Mooring Lines Arrangement, Mooring Line Materials, Mooring Forces. Loads From Cargo Handling and Hauling Equipment and Uniform Distributed Loads. Design Load Assumptions, Uniform Distributed Cargo Loads and Miscellaneous Live Loads, Rubber Tire and Crawler Track Mounted Equipment, Rail-Mounted Cargo, Fixed-Base Equipment, Ship Impact.	12
4	<b>Foundation Design:</b> Vertical Loads on Piles or Piers Due to Changes in Water Level Ice Load of Thermal Origin, Other Ice-Induced Loads design methodology for pier , girder, slab, foundations and fenders - codes and standards	10
5	<b>Design of breakwater</b> and physical model studies on stability. Introduction to effect of breakwater on shoreline, dredging and disposal	06
6	<b>Docks and Locks:</b> Tidal basin, wet docks-purpose, design consideration, operation of lock gates and passage, repair docks - graving docks, floating docks	08
	<b>Total</b>	<b>52</b>

### Contribution to Outcomes

After successful completion of the course the students shall be able to

1. Understand the different terminologies and components of port and harbour and will enable the students to understand the design issues.
2. Embrace the concept and principle behind load consideration and will enable the students to determine the different loads as well.
3. Design the foundation of different structures of ports and harbour and explore the codal requirements while designing.
4. Understand the concept of breakwater and will enable the students to design a breakwater.
5. Discuss the various international practices and modern construction technologies introduced in ports and harbour in order to design the foundation and fenders.
6. Understand the purpose of docks and locks with the major differences between them.

#### **Internal Assessment (20 Marks)**

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### **End Semester Examination (80 Marks)**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of **total six questions, each carrying 20 marks.**

- 2 Question 1 will be compulsory and should cover **maximum contents of the curriculum.**
- 3 **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 **Only Four questions need to be solved.**

**References:**

1. Port Design - Guidelines and recommendations by C. A. Thoresen, Tapir Publications.
2. Design of Marine Facilities for the Berthing, Mooring and Repair of Vessels by J. W. Gaythwaite, Van Nostrand.
3. Handbook of Offshore Engineering by S.K. Chakrabarti, Elseviers, 2005.
4. Agerschou, H., Lundgren, H., Sorensen, T., Ernst, T., Korsgaard, J., Schmidt, L.R. and Chi, W.K., (1983). "Planning and Design of Ports and Marine Terminals", A Wiley-Interscience Publication.
5. Per brun (1983). "Port Engineering" Gulf Publishing Co.
6. Docks and Harbour Engineering: Bindra, S. P.; Dhanpat Rai and Sons, New Delhi.
7. Harbour, Dock and Tunnel Engineering: Shrinivas, R.; Charotar Publishing House, Anand
8. Design and Construction of Ports and Marine Structures: Quinn, A. D., Tata Mc-Graw Hill India Publishing House

**Additional Reading**

IS-4651 Indian standard Code of practice for planning and design of ports and harbour, Bureau of Indian Standards, New Delhi.



Waterways Transportation Engineering : Semester VII		
Course Code	Course Name	Credits
HWTC701	Port and Harbour Operations and Services	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory				Term Work/Practical/Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.		Oral
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	-	-	-	100

### Rationale

Today 80% of the world's cargo is being transported by waterways. The boom in e-commerce has led to the thinning of borders between countries and goods being exchanged seamlessly. Thus, ports have become the bedrock of today's global economy and India is no exception. Thus it's imperative for students to understand how seaport operates and apply the best practices along with the latest industrial developments. This course is designed in line with the contemporary developments. The syllabus covers global port management practices at the regulatory, commercial, technological, operational and financial levels. The shipping industry has myriad complexities and the syllabus provides students wide-ranging and up-to-date understanding required to thrive in today's highly competitive and evolving environment.

### Objectives

1. To study History of Ports, its evolution, Governance and Ownership structure.
2. To Understand different types of logistic integration, Port operations and services.
3. To study planning of vessel movements and improvement of Port capacity.
4. To study the different types of International agreements which are the tools for growth in Indian ports.
5. To study and analyze traffic forecasting in order to plan the port operations effectively.
6. To study port authorities and regulatory framework

### Detailed Syllabus

Module	Course Module / Contents		Hours
1	<b>Introduction</b>		08
	1.1	The History of Ports: Ports history, Planning, and Development.	
	1.2	Port Ownership, Structure, and Organization. Port Governance and Structural Type.	
	1.3	Port Workforce: Productivity, Growth, and Empowerment Strategies. Measuring Productivity, Throughput, and Growth.	
	<b>Connecting Hub port Gateways to the Inland Infrastructure</b>		

2	2.1	Logistics Integration of Port Activities: The Five Stages of Integration for the Maritime Industry.	08
	2.2	Strategic Location and Market Accessibility for Existing and Emerging Seaports.	
	2.3	Ports' Success Factors. Supply Chain Opportunities, Competition, and Conflict Prevention	
3	Port Operations		14
	3.1	Terminal Operators; Property Leasing Opportunities. Port Management Services and Operations. The Harbourmaster's Department and Functions, Terminal Manager, Vessels' Planning.	
	3.2	The Four Stages of Port Management and Operations: Leasing Opportunities, Marine Terminal Operator (MTO) Agreements and Leasing Opportunities and MTO case studies	
	3.3	Charter Party Types, Charter Party Clauses and Areas of Dispute, The Port and Charter Party Terms	
	3.4	The Components of Shipbuilding, Intellectual Property Rights, The History of Shipbuilding, Reasons for Shipyards Losing Market Share, Contemporary Shipbuilding Trends, Shipbuilding and Oil Market Analysis, Global Market Analysis.	
	3.5	Liner Services, Tramp Trade, and Offshore Support Agents. Agency Selection and Practices, Port Agency Responsibilities. General Agency Duties, for Tramp, Liner, and Logistics Services.	
4	International Trade and Port capacity		06
	4.1	The General Agreement on Tariffs and Trade. The World Trade Organization. Ports' Growth and the Global Trade Agreements Matrix.	
	4.2	Traffic Forecasting, Ports and the Principles of Derived Demand, Shipping, Ports, and the Ripple Effect. Optimum Size and Economies of Scale	
	4.3	Port Capacity Utilization, Capacity Management, Capacity Planning and Ports' Technology and Innovation.	
5	Strategic Planning		08
	5.1	Strategic Planning, Development, and Management: Corporate Objectives and factors considered in planning, developing and management	
	5.2	Port Pricing Strategies: Tariff Changing and Competitiveness. Port Pricing. Pricing Systems and Price-Setting Considerations.	
	5.3	KPIs: Measuring Financial and Operational Performance.	
	5.4	Port Equipment and Berth Facilities: Operations and Maintenance, Port Cargo Handling Equipment (CHE). Performance Management and the Human Factor	
6	Port Regulations and Future of Ports		08
	6.1	ISM: International Safety Management ISPS: International Ship and Port Facility Security Code OHSAS and OSHA: Occupational Safety and Health Administration VGP: Vessel General Permit by the US Environmental Protection Agency	
	6.2	ISO 14001: Environmental Management System HAZMAT: Hazardous Materials; HAZWOPER: Hazardous Waste Operations and Emergency Response BWM: Ballast Water Management	
	6.3	Incident Investigation and Root Cause Analysis; Inspections, Surveys, and Audits; Global and National Regulatory Compliance for Ships	

6.4	Port Development Strategy: Elements of Long-Term Strategic Planning, Strategic Port Planning and Tactical Port Planning, Port Planning and the Factors of Production
6.5	Forecasting the Market: Port Management and Forecasting Areas. The Risk Element in Forecasting, Forecasting Methods and Tools

### Contribution to Outcome

On completion of this course, the students will be able to:

1. Port operations and planning
2. Port capacity Planning and Forecasting
3. Understand the Key Performance Indicators (KPIs) for strategic planning and management in port operations
4. Understand the different types of International agreements which are the tools for growth in Indian ports
5. Understand the regulatory framework involved in running a port.
6. Understand the traffic forecasting in order to plan the port operations effectively

#### Internal Assessment

20 Marks

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total six questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

#### Recommended Books:

- 1 Maria G. Burns , "Port Management and Operations "1st Edition,2015
- 2 Muir Wood, A.M., and Fleming. C.A., "Coastal Hydraulics Sea and Inland Port Structures", 1st Edition, Hallstead Press, 2002.
- 3 Ozha&Ozha, "Dock and Harbour Engineering", 1 st Edition, Charotar Books, Anand., 1990

#### Reference Books:

- 1 S. Seetharaman, "Construction Engineering and Management", 4 thEdition ,Umesh publications, New Delhi, 1999.
- 2 Richard L. Silister, "Coastal Engineering Volume I & II, Elsevier Publishers, 2000.
- 3 PeraBrunn, "Port Engineering", 1 st Edition, Gulf Publishing Company

### Waterways Transportation Engineering : Semester VII

Course Code	Course Name	Credits
Lab 1: HWTSBL701	Port and Harbour Operations and Services	02

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	04 Per Week	-	-	02		02

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
-	-	-	-	-	50	-	50	100

#### Rationale

This subject is designed to give the basic understanding of ports and harbour structures. The course will also cover wide areas such as design of entrance channel, turning circle, breakwaters, berthing structures etc. Thus it's imperative for students to understand how seaport planned, designed, operates and apply the best practices along with the latest industrial developments. The course equips students with necessary field exposure and makes them aware of complex administration and structural reforms and acquaints them with necessary precautions and precision of this profession.

#### Course Objectives

- To study and understand all the important facilities required at the port for the efficient planning.
- To make the students to understand design and analysis of port and harbour structures using conventional approach as well as software.
- To understand the importance of load consideration and will enable the students to calculate the different loads in designing the various components.
- To study and analyse traffic forecasting in order to plan the port operations effectively
- To understand organizational behavior and management techniques for management of port.
- To study human resource management skills required at port.

#### List of Experiments( Any Six)

Exp.No.	Detailed Content	Lab Session / Hr.
1	The visit of any harbour and port to understand the various structures, its construction and operations-Report	02
2	Effect of earth quake and Tsunami on port structures - Case studies	02
3	IT System and Port Planning	02

4	Design of Jetties using STAAD Pro and Midas	02
5	Design of Jetties using Sacs	02
6	Design of breakwater using STAAD Pro and Midas	02
7	Design of breakwater using Sacs	02
8	Planning and Designing of Storage, warehouse using STAAD Pro or any other designing software's.	02
9	Planning of placing the components of Port and estimating its capacity.	02
10	Current Issues in Port Management: Report on Case Study	02
11	Marine Structure, Navigation Aids	02
12	Docks and Repair Facilities, Port Facilities	02
13	Dredging, Coastal Protection	02

### Contribution to Outcomes

- Develop a strong fundamental related to waterways transportation Engineering. Understand the different terminologies and components of port and harbour and will enable the students to understand the design issues.
- Understand the concept and principle behind load consideration and will enable the students to determine the different loads as well.
- Understand the concept of design the foundation and breakwater of different structures of ports and harbour and explore the codal and software requirements while designing.
- Understand the Port operations, planning and process of Dredging
- Understand skill required for effective organizational behavior, project management and port management skills.

#### Term work

Shall consist of Assignment, design report, case study and Site visit report related to this course. Distribution of marks for Term Work shall be as follows:

Assignment : 15 marks

Case study and design report: 15 marks

Site visit : 15 marks

Attendance: 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to: 75%-80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks.

#### End Semester Oral Examination

The oral examination shall be based upon the entire theory and laboratory syllabus.

#### Reference Books:

1. Docks and Harbour Engineering: Dr. S.P Bindra, Dhanpatrai Publications, India
2. Docks and Harbour Engineering: Hasmukh P. Oza, Gautam H. Oza, Charotar Publication, India.

3. Port Design - Guidelines and recommendations by C. A. Thoresen, Tapir Publications.
4. Design of Marine Facilities for the Berthing, Mooring and Repair of Vessels by J. W. Gaythwaite, Van Nostrand.
5. Handbook of Offshore Engineering by S.K. Chakrabarti, Elseviers, 2005.
6. Maria G. Burns, "Port Management and Operations "1st Edition,2015
7. Detnorskeveritas, Rules for the Design, Construction and Inspection of Fixed Offshore Structures
8. R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 1995, Charotar Pub.House, Anand
9. SCI/SCOPUS Indexed Refereed International Journals (For Case Studies) 2 Relevant Indian Standard Specifications Codes, BIS Publications, New Delhi. 3 Departmental Laboratory Manual
10. Standard Geotechnical Engineering Handbook
11. NPTEL Video lectures on Practical.



Waterways Transportation Engineering : Semester VIII		
Course Code	Course Name	Credits
HWTC801	Construction and Management of Port and Harbour	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
04	--	--	04	--	--	04

Theory				Term Work/Practical/Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.		Oral
Test-I	Test-II	Average						
20	20	20	80	3 Hrs.	--	--	--	100

### Rationale

This is a course which deals with various construction equipment and processes of various structures involved in the port and shipping business as well as teaching capable administration strategies for the same. The course equips students with necessary field exposure and makes them aware of complex administration and structural reforms and acquaints them with necessary precautions and precision of this profession.

### Objectives

1. To study the various construction equipment and process of Port and harbor structures.
2. To study the construction and maintenances of Fishing Harbor.
3. To understand the process of Dredging
4. To understand organizational behavior and management techniques for management of port.
5. To study human resource management skills required at port.
6. To understand health, safety, security and environment concerns related to port activities.

Detailed Syllabus		
Module	Course Module / Contents	Hours
1	Marine and offshore construction equipment: Basic motions of Barges, crane barges, Offshore derrick barges, semisubmersible barges, Jack-up construction barges, launch barges, pipe laying barges, floating concrete plant. Pile driving equipment.	10
2.	<b>Fishing Harbour Construction</b>	12

	Fishing Harbour and Fish landing centres – Types, Various components of fishing Harbour and landing centre. Land side and water side facilities and structures of fishing Harbour. Small and medium fishing Harbour, Deep sea fishing Harbour, Environmental auditing for fishing Harbour. Dredging and breakwater construction. Layout and construction of Jetties, quays and slipways. Use of different construction materials for shore based and seaside structures. Fishing Harbour maintenance and waste disposal, Water treatment plant in fishing Harbour. Status of fishing Harbours in India.	
3	<b>Dredging</b> General ,Classification of dredging works, Types of dredgers, Uses of dredged material ,Execution of dredging work	06
4	<b>Introduction to Port management:</b> Organizational behavior: Definition, diversity in workplace, Ethics and ethical behavior in organizations. Project Management: Principles of management, Project definition, Project manager skills, Stages of project, Scheduling, Contract Strategy, selection and appointment of contractors, project implementation and execution, closure of project. Port and terminal operations, types of ports and terminals, terminal ownership, port and cargo movements, competition and other challenges facing the industry	08
5	<b>Port Labour, People Management and Port master planning:</b> Historic and current port labour environment, effective management of staff on ports, Labour reforms and social issues, employment framework and employee relations.  Introduction to post master planning, land parcelisation, development phasing strategy, developing 30 year masterplan. Terminal Ownership: Impact of port ownership, Privatization benefits and concerns, BOT, BOOT and BOO, Concession agreement, Tariff setting, role of port regulators.	08
6	<b>Health, Safety, Security and the Environment (HSSE) in Ports:</b> Importance of HSSE culture, HSSE concepts, HSS on Ports, safety and security indicators, regulations related to HSSE. Risk awareness and risk management, system approach to port safety and security. Environment management: Introduction, Environment impact, Environment regulations and governance.	08

### Contribution to Outcome

On completion of this course, the students will be able to:

- 1 Understand the various methods and equipment for the construction of Port and harbor structures
- 2 Understand the construction and maintenances of Fishing Harbor.
- 3 Understand the process of Dredging.

- 4 Understand skill required for effective organizational behavior, project management and port management skills.
- 5 Carry out human resource management in accordance to labour laws and to develop master plan for port.
- 6 Understand the importance of health, safety, security and environment concerns at port and to suggest measure.

#### **Internal Assessment**

20 Marks

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### **End Semester Examination**

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total six questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

#### **Recommended Books:**

- 1 S. Seetharaman, "Construction Engineering and Management", 4th Edition , Umesh publications, New Delhi, 1999.
- 2 Detnorskeveritas, Rules for the Design, Construction and Inspection of Fixed Offshore Structures.
- 3 R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 1995, Charotar Pub.House, Anand
- 4 Alonzo Def. Quinn, Design and Construction of Ports and Marine Structure, McGraw – Hill **Book Company, New York**
- 5 Construction project management by KK Chitkara, Tata McGraw Hill (2010)

# University of Mumbai



## Syllabus

Honours/Minor Degree Program

In

Professional Practices in Structural Engineering

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Professional Practices in Structural Engineering**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HPSC501: Concrete Consultant Practices	04	--	--	20	80	--	--	100	04
	Total	04	-	--	100	-	-	100	04	
<b>Total Credits = 04</b>										
TE Sem VI	HPSC601: Formwork Design Practices	04	--	--	20	80	--	--	100	04
	Total	04	-	-	100	-	-	100	04	
<b>Total Credits = 04</b>										
BE Sem VII	HPSC701: Structural Consultant practices – I	04	--	--	20	80	--	--	100	04
	HPSSBL701: Structural Consultant Practices (SBL)			04	--		50	50	100	02
	Total	04		04	100		50	50	200	06
<b>Total Credits = 04+02=06</b>										
BE Sem VIII	HPSC801: Structural Consultant practices – II	04	-	--	20	80	--	--	100	04
	Total	04	--		100	--	--	100	04	
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V,VI, VII &amp; VIII = 04+04+06+04=18</b>										

### Professional Practices in Structural Engineering: Semester V

Course Code	Course Name	Credits
HPSC501	Concrete Consultant Practices	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
04	--	--	04	--	--	04

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	3 Hrs.	--	--	--	100

#### Rationale

Basic concept of concrete technology is essential for civil engineering students to execute the civil engineering projects as per the standard laid down time to time. The concrete technology is the backbone of infrastructure of civil engineering field. The students must know various concreting operations and testing operations during and after construction. It is expected to know the properties of materials, especially concrete and to maintain quality in construction projects. The civil engineering students ought to know the selection of materials, its mix proportioning, mixing, placing, compacting, curing and finishing.

#### Objectives

- 1 To study the properties of fresh and hardened concrete.
- 2 To study the properties such as workability and durability.
- 3 To acquaint the practical knowledge by experimental processes of various materials required for concrete.
- 4 To understand the Mix design by different methods.
- 5 To understand ordering and handling of RMC.

#### Detailed Syllabus

Module	Course Module / Contents		Hours
1	<b>Introduction to concrete making materials</b>		09
	1.1	<b>Cement</b> Physical properties of cement as per IS Codes, types of cements and their uses.	
	1.2	<b>Aggregates</b> Properties of coarse and fine aggregates and their influence on properties of concrete, properties of crushed aggregates.	
2	<b>Special cementitious materials</b>		07



	2.1	GGBS: properties, advantages and disadvantages, uses	
	2.2	Silica fume: properties, advantages and disadvantages, uses	
	2.3	<b>Admixture</b> Plasticizers, Super-plasticizers, Retarders, Accelerators, Mineral admixtures and other admixtures, test on admixtures, chemistry and compatibility with concrete.	
3	<b>Concrete and its properties</b>		13
	3.1	Grades of concrete, Manufacturing of concrete, importance of w/c ratio.	
	3.2	<b>Properties of fresh concrete-</b> workability and factors affecting it, consistency, cohesiveness, bleeding, segregation.	
	3.3	<b>Properties of hardened concrete-</b> Compressive, Tensile and Flexural strength, Modulus of Elasticity, Shrinkage and Creep.	
	3.4	<b>Durability-</b> Factors affecting durability, Relation between durability and permeability	
4	<b>Concrete Mix Design</b>		10
	4.1	Design of concrete mixes by IS code method	
	4.2	Design of concrete mixes by ACI method	
	4.3	Design of concrete mixes by Road Note 4 method	
	4.4	Design of high strength concrete mixes, design of light weight aggregate concrete mixes, design of fly-ash cement concrete mixes, design of high-density concrete mixes.	
5	<b>Testing of Concrete</b>		07
	5.1	<b>Non-Destructive testing of concrete</b> Rebound Hammer test, ultrasonic pulse velocity test, load test, carbonation test, 1/2 cell potentiometer test, core test and relevant provisions of I.S. codes.	
	5.2	<b>Durability</b> Permeability test, Rapid chloride penetration test.	
6	<b>Ready mix concrete</b>		06
	6.1	Advantages of RMC, components of RMC plant, distribution and transport, handling and placing, mix design of RMC.	
	6.2	Distribution and transport, handling and placing, mix design of RMC.	
	6.3	Handling Quality Complaints	

### Contribution to Outcome

On completion of this course, the students will be able to:

- 1 Identify the properties of ingredients of concrete.
- 2 Know the properties of wet concrete, hardened concrete.
- 3 Understand the Mix design by different methods for different grades of concrete.
- 4 Perform various test on concrete.
- 5 Understand the concept of durability and cracking in concrete.

Internal Assessment

20 Marks

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total six questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

**Recommended Books:**

- 1 Concrete Technology: A. R. Shanthakumar, Oxford University Press.
- 2 Concrete mix proportioning-guidelines (IS 10262:2009).
- 3 Method making, curing and determining compressive strength of accelerated-cured concrete test specimens as per IS: 9013-2004.
- 4 Tentative Guidelines for cement concrete mix design for pavements (IRC: 44-1976): Indian Road Congress, New Delhi.
- 5 Properties of concrete: Neville, Isaac Pitman, London.

**Reference Books:**

- 1 Concrete Technology Theory and Practice: Shetty M.S., S. Chand.
- 2 Relevant I.S. codes: Bureau of Indian standard.
- 3 Concrete Technology: D.F. Orchard, Wiley, 1962.
- 4 Chemistry of Cement and Concrete: F.M. Lue, Edward Arnold, 3rd Edition, 1970.
- 5 Concrete Technology: Neville A.M. & Brooks. J. J., ELBS-Longman.
- 6 Concrete Technology: Gambhir M.L., Tata McGraw Hill, New Delhi.

**Professional Practices in Structural Engineering: Semester VI**

Course Code	Course Name	Credits
HPSC601	Formwork Design Practices	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
04	--	--	04	--	--	04

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Practi.	Oral	
Test-I	Test-II	Average						
20	20	20	80	3 Hrs.	--	--	--	100

**Rationale**

Course focuses on importance of Formwork design in RCC construction apart from concreting and bar bending work. It deals with the changing scenario towards formwork designing as a career option in Construction Industry. The course helps the students to know the market outlook as well as the requirements of formwork design by knowing all the technical as well as field considerations while designing formwork for various components of building. It gives the exposure to students regarding cost benefits and time saving along with advanced technologies and new formwork material in construction industry.

**Objectives**

- 1 To know the different types of formwork and importance of formwork in RCC Construction
- 2 To study the market outlook and requirements of system formwork in construction industry.
- 3 To design a formwork for walls, columns, beams and slabs considering all the live loads, concrete pressures, wind loads, concreting methods and do the necessary checks.
- 4 To understand the formwork selection criteria for various tunnel construction methods, bridge construction methods and high-rise construction.
- 5 To plan and estimate the material and man power required for Formwork.
- 6 To know the various advancements in formwork design in construction market.

**Detailed Syllabus**

Module	Course Module / Contents	Hours
1	<b>Introduction to Formwork</b>	08
	1.1 Various Activities and Equipment involved in concrete construction- Concrete, Reinforcement, Batching Plant, Boom Placer, Concrete Pumps, Buckets, Crane, Formwork (Shuttering/Centering), Scaffolding, etc.	

	1.2	Introduction of Formwork, Types of Formwork, Importance of Formwork in RCC Structure	
	1.3	Conventional Formwork and Scaffolding- Advantages and Disadvantages in view of ongoing approach and site requirements	
	1.4	System Formwork and Scaffolding, Time-Cost Distribution in RCC Construction with respect to Formwork, Reinforcement and Concreting.	
2	<b>System Formwork</b>		09
	2.1	Importance of System Formwork- Construction Market Outlook, Market Growth Drivers (Increasing Urbanization, Housing Shortage, Economic Development),	
	2.2	Factors driving demand for System Formwork and Scaffolding, Key Challenges at construction sites, Requirements and Solutions against Challenges- Design and Planning, Equipment usage time, etc.	
	2.3	Design and Planning- Project Planning Sequence- Current and Correct Practice, Any TWO Case Studies.	
	2.4	Equipment usage time- Crane Availability, Boom Placer, labour, etc.	
	2.5	Parameters considered in High Rise Buildings- Comparison between System Formwork and Conventional Formwork	
3	<b>Formwork Design- Walls, Columns &amp; Slabs</b>		14
	3.1	Introduction to Formwork Design- Factors related to Concreting, Concrete Placing method influence pressure of Concrete - Crane Bucket Concreting, Boom Placer Concreting	
	3.2	Loads on formwork and lateral pressure of concrete, Calculation of design pressure based on type of concrete, method of concreting, grade of concrete, type of structure and rate of concreting	
	3.3	Concrete Pressure Calculation- Column and Wall Formwork	
	3.4	Design of formwork for slab (less than 4 m height)- Design Loads for slabs and beams formwork	
	3.5	Design of formwork Material for walls & Columns (Vertical application) - Sheathing Member (Plywood), Secondary Member, Primary Member, Tie System; Check against various forces and bending.	
	3.6	Design of Slab Formwork Material- Primary, Secondary and Prop Members; Checks against failures.	
	3.7	Planning & Estimation of Formwork for Residential & Commercial Buildings, Column Formwork Sets, Cycle time- Slabs and Beams	
4	<b>Formwork for High Rise Constructions, Tunnels and Bridges</b>		12
	4.1	Design Concept for Climbing system- Define, Types, CB 240 and SCS 250 system, Anchoring System	
	4.2	Study of IS: 875(Part3): Wind Loads on Buildings and Structures, Wind Force for Formwork design- High Rise Construction and Slab height more than 4 m	
	4.3	Design of Formwork system for any typical floor plan with self-climbing system for walls, columns, beams and slabs	
	4.4	Overview of Tunnel Construction Methods & Formwork selection	
	4.5	Overview Bridge Construction Methods & Formwork Selection	
	4.6	Overview of High-Rise Construction & Formwork Selection	

5	<b>Economics and Maintenance of Formwork</b>		05
	5.1	Factors affecting supply and demand of Formwork	
	5.2	Manpower Management required for formwork	
	5.3	Maintenance of Formwork & its Stacking.	
6	<b>Advancement &amp; Scope of Formwork Design</b>		04
	6.1	Advance formwork technology Available in the market	
	6.2	Advanced Material used as a Formwork	
	6.3	Formwork field as career option	

### Contribution to Outcome

On completion of this course, the students will be able to:

- 1 Understand the different types of formwork and its importance in various RCC construction activities.
- 2 Understand various aspects of system formwork over conventional formwork. Also, understand the market outlook and various parameters need to be considered in design of formwork
- 3 Design a formwork for walls, columns, beams and slabs considering all the live loads, concrete pressures, wind loads in a view of different concreting methods and do the necessary checks
- 4 Understand the formwork selection criteria for various tunnel construction methods, bridge construction methods and high-rise construction.
- 5 Plan and estimate the material and man power required for Formwork.
- 6 Know the advance formwork technologies and advanced material available in the market.

Internal Assessment

20 Marks

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total six questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

Recommended Books:

- 1 Formwork for concrete structures: Robert L. Peurifoy and Garold D. Oberlender, The McGraw hill publishing company.
- 2 Concrete Formwork Systems: Awad S. Hanna, Marcel Dekker.

- 3 Design and Construction of Formwork for Concrete Structures: Albert Edward Wynn, Cement and Concrete Assn.
- 4 Concrete Formwork: Leonard Koel, Amer Technical Pub.

Reference Books:

- 1 IS: 875(Part3): Wind Loads on Buildings and Structures
- 2 Formwork for concrete structures: Dr. Kumar Neeraj Jha, The McGraw Hill Education India
- 3 Modern Practices in Formwork for Civil Engineering Construction Work: Dr. Janardan Jha, Prof. S. K. Sinha.



Professional Practices in Structural Engineering: Semester VII		
Course Code	Course Name	Credits
HPSC701	Structural Consultant Practice-1	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
04	--	--	04	--	--	04

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	3 Hrs.	--	--	--	100

### Rationale

Course is equipped with the basic knowledge about structural designs and various other consultants and vendors related with the structural consultant which combines together to carry out the design of any structural project. This will make students to understand the hierarchy of the work which has to carry out the structural consultant and structural engineer with other agencies and consultants and also it will highlight the brief information regarding structural quantity estimation and tenders.

### Objectives

- 1 To understand types of various structures, importance of structural consultant and role of structural engineer
- 2 To understand the scope, responsibilities and activities of structural engineer
- 3 To study the schematic designs, documentation and certification in structural design.
- 4 To understand the roles of client, architect, another consultant with structural consultant.
- 5 To understand relation of structural consultant with different agencies and vendors.
- 6 To study structural quantity estimation and tender preparation and also documentation.

Detailed Syllabus			
Module	Course Module / Contents		Hours
1	Introduction		09
	1.1	Types of Structures, functionality, various forms of structures, usage driven requirements, notable structures in the world, country, state, city.	
	1.2	Information on team of consultants required for the comprehensive design of structures. Responsibilities of various consultants' team members – legal, professional, ethical and moral	

	1.3	Place of a structural engineer in the matrix of the overall project, Set up of a structural designer's office, Various personnel working in a structural designer's office	
2	Role of Structural Consultant		07
	2.1	Scope of a structural consultant, Tasks and deliverables for a structural consultant	
	2.2	Activities that a structural engineer has to carry out	
	2.3	Legal responsibilities of a structural engineer	
3			09
	3.1	Introduction to: Concept, Schematic, Tender, Design Development, Detail Design of various structural designs	
	3.2	Construction Stage Documentation, Construction Administration, Completion Stage Documentation, Certification	
	3.3	Bye laws pertaining to structural engineers in MCGM rule book, HRC, liaison, NBC, DCR etc.	
	3.4	Licensing requirements for a structural engineer	
4	Teaming up with other consultants, contractors and vendors – Nature of communication transactions – Part 1		11
	4.1	Client – Brief and scope defined by Client's representative Architects – Design and Liaison, Surveyor, Geotechnical Engineer, Wind Engineer	
	4.2	Façade Engineer, Interior Architect, Landscape architect, Steel Fabrication contractor's detailers	
	4.3	Water proofing Consultant/vendor, Fire proofing Consultant/Vendor, Concrete technologists, concrete manufacturers	
5	Teaming up with other consultants, contractors and vendors – Nature of communication transactions – Part 2		08
	5.1	Agencies: Material Testing Agency, Rebaring Agency, Anchoring Agency, Post Tensioning Agency, Ground Anchoring Agency, Piling Agency.	
	5.2	Vendors: Steel suppliers/manufacturers, Alternate material suppliers/manufacturers/ vendors, Bearings/isolators suppliers/manufacturers / vendors, Electrical Engineers, Mechanical Engineers	
	5.3	Other vendor and agencies: Plumbing/Drainage Engineers, Traffic Consultants / Parking system vendor / parking requirements, Vertical Transportation Consultants, Pre-Engineered Building Agencies Contractors in general	
6	Structural Quantity Estimation and Tender		08
	6.1	Structural Quantity Estimation: Structural Specifications, Structural Bill of Quantities, General material consumption ratios, Actual sample workout problem.	
	6.2	Tender Stage: Preparation of Tender Drawings, Bill of Quantities, Specifications, Special Notes, Consultant's estimate, Disclaimers	
	6.3	Construction Documentation and Construction Administration Delivery of drawings and other documents to site for execution.	
Contribution to Outcome			

On completion of this course, the students will be able to:

- 1 Understand types of various structures, importance of structural consultant and role of structural engineer.
- 2 Understand the various scope, responsibilities and activities of structural engineer has in structural consultant.
- 3 Study and understand the schematic designs, documentation and certification in structural design
- 4 Understand the roles and nature of client, architect, other consultant with structural consultant and also safety measures at site.
- 5 Understand the nature of communication transactions of structural consultant with different agencies and vendors.
- 6 Study the structural quantity estimation and tender preparation and also documentation works required to the structural consultant.

#### Internal Assessment

20 Marks

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total six questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

#### Recommended Books:

1. Fundamentals of Reinforced Concrete: Sinha& Roy, S. Chand and Co. Ltd.
2. Estimating, Costing, Specifications and Valuation: Chakraborty, M., Kolkata.
3. Relevant Indian Standard Specifications, BIS Publications
4. Professional Construction Management: Barrie D.S. & Paulson B C, McGraw Hill
5. The cost management toolbox; A Managers guide to controlling costs and boosting profits- Oliver, Lianabel (Tata McGraw Hill).

Professional Practices in Structural Engineering: Semester VII		
Course Code	Course Name	Credits
HPSSBL701	Structural Consultant Practice-Lab	02

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
--	04	-	--	02	--	02

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
--	--	--	--	--	50	--	50	100

### Course Objectives

- 1 To understand types of various structures, importance of structural consultant and role of structural engineer
- 2 To understand the scope, responsibilities and activities of structural engineer
- 3 To study the schematic designs, documentation and certification in structural design.
- 4 To understand the roles of client, architect, another consultant with structural consultant.
- 5 To understand relation of structural consultant with different agencies and vendors.
- 6 To study structural quantity estimation and tender preparation and also documentation.

### Contribution to Outcome

On completion of this course, the students will be able to:

1. Understand types of various structures, importance of structural consultant and role of structural engineer.
2. Understand the various scope, responsibilities and activities of structural engineer has in structural consultant.
3. Study and understand the schematic designs, documentation and certification in structural design
4. Understand the roles and nature of client, architect, and other consultant with structural consultant and also safety measures at site.
5. Understand the nature of communication transactions of structural consultant with different agencies and vendors.
6. Study the structural quantity estimation and tender preparation and also documentation works required to the structural consultant.

List of Tutorials and Assignments		
Week (Activity)	Detailed Content	Lab Session / Hr.
1	Study of different types of structures based on its utility, roles and responsibilities of various consultants.	02/04
2	Study of Legal responsibilities, scope and activities for structural consultant	02/04
3	Preparation of tender, documentations and detailed design of various structural components of any one structure	02/04
4	Design of single bay double storey building structure using softwares like ETAB/STAAD and SAFE	03/06
5	Application of different IS codes for the selection of parameters (like loading, design, materials, etc) for different types of structural systems	02/04
6	Structural quantity estimation which includes bill of quantities, general material consumption ratios, consultant's estimate	02/04

Assessment:

- **End Semester Oral Examination**

Oral examination will be based on entire syllabus

**Reference Books:**

1. Design of Reinforced Concrete Structures: Dayaratnam, P; Oxford and IBH.
2. Illustrated Reinforced Concrete Design: Dr. V. L. Shah and Dr. S. R. Karve, Structure Publications, Pune
3. Relevant IS codes, BIS Publication, New Delhi
4. Project Preparation, Appraisal, Budgeting, and Implementation: Prasanna Chandra (Tata McGraw Hill).
5. Construction Engineering and Management: S. Seetharaman, Umesh Publications, Delhi.

Professional Practices in Structural Engineering: Semester VIII		
Course Code	Course Name	Credits
HPSC801	Structural Consultant Practice-II	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
04	--	--	04	--	--	04

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	3 Hrs.	--	--	--	100

### Rationale

This course is capable of different parameters with the designs and drawing of various structures and the roles of different structural consultant. The course will give ideas regarding the software applications in the structural engineering works which ease the design and drawing stage difficulties. It also provides students the brief knowledge about different tests required from various agencies, consultants and venders.

### Objectives

- 1 To understand different structures, material required for construction and various interpretations
- 2 To study the various IS codes, loadings and framing structure systems.
- 3 To understand and prepare the cost comparison report and hand calculation techniques.
- 4 To study and run different software used in structural consultant.
- 5 To understand reinforcement details, drawings and various design audit
- 6 To conduct different tests and to form stagewise and final certifications for the designs.

Detailed Syllabus			
Module	Course Module / Contents		Hours
1	Introduction		09
	1.1	Concept and Schematic Stages Definition of a given structure – identifying the structural system	
	1.2	Material of construction – Appropriate selection based on functional requirement, space constraints, aesthetics, special demands from client/architect/function	
	1.3	Data and drawing reading and its interpretation as received from all collaborating agencies	
2	Introduction to IS codes		07



	2.1	Introduction to IS 456, IS 800, IS 1786, Loading parameters – as per architectural drawings and usage requirements	
	2.2	Introduction to IS 875, IS 875-Part 3, IS 1893	
	2.3	Various types of framing, structural systems – gravity and lateral, codal interpretations, parameter selection – comparative studies	
3	Cost Comparison and Report		12
	3.1	Comparative costing of components: Flooring, Column grids, Types of columns, Lateral Systems, Foundation systems and Soil retention structures – retaining walls, shoring systems etc	
	3.2	Formation of Design Basis Report, Preliminary Analysis Tools – Introduction	
	3.3	Preparation of Concept and Schematic Drawings. Contents of these drawings.	
	3.4	Hand Calculation techniques, Softwares available, tips for usage of software Introduction to Etabs/ Staad	
4	Softwares to carry out structural designs		10
	4.1	Hands on ETABS / STAAD / SAFE modelling for sample simple structures for understanding of the working of the software only, its various facilities, capacity and limitations. Meaning of various parameter definitions	
	4.2	Design Development / Working Stage, Incorporation of other consultants' requirements, Preparation of DD stage drawings	
	4.3	Running final ETABS model, Running final SAFE mode	
5	Reinforcement details		06
	5.1	Reinforcement calculations, Feeding data to structural draughtsman Preparation of GFC / working reinforcement drawings – contents	
	5.2	Notes on reinforcement drawings, Typical details, Standard formats of reinforcement drawings	
	5.3	Special requirements of detailing – Introduction to SP34 and IS 13920 Drawing and design audit	
6	Tests and Certifications		08
	6.1	List of submittals expected from contractors/vendors/agencies for structural engineer's approval	
	6.2	Site visit records / reports / approvals / comments / suggestions, Changes in design / drawings / details as per site situations, Monitoring safety / stability on the site during construction, Retrofitting / repairs / modifications etc. if necessary	
	6.3	Stage wise Certification, Monitoring quantities as construction progresses as in built drawings, Final certification	

### Contribution to Outcome

On completion of this course, the students will be able to:

- 1 Explain different concepts and schematic stages of structures, material required for construction and various interpretations.
- 2 Demonstrate use of the various IS codes, loadings parameters and different framing structure systems.

- 3 Prepare the cost comparison report and hand calculation techniques.
- 4 Prepare and run sample models in different software such as ETABS, STAAD, SAFE used in structural consultant.
- 5 Explain reinforcement details from samples, preparation of drawings and various design audit.
- 6 Conduct different tests according to list wise submittals and to form stage wise and final certifications for the designs.

#### Internal Assessment

20 Marks

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### End Semester Examination

80 Marks

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total six questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

#### Recommended Books:

1. Design of Reinforced Concrete Structures: *Dayaratnam, P*; Oxford and IBH.
2. Illustrated Reinforced Concrete Design: *Dr. V. L. Shah and Dr. S. R. Karve*, Structure Publications, Pune
3. Relevant IS codes, BIS Publication, New Delhi
4. Project Preparation, Appraisal, Budgeting, and Implementation: *Prasanna Chandra* (Tata McGraw Hill).
5. Construction Engineering and Management: *S. Seetharaman*, Umesh Publications, Delhi.

# University of Mumbai



## Syllabus

**Honours/Minor Degree Program**

**In**

**Green Technology and Sustainable Engineering**

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Green Technology and Sustainable Engineering**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HGSC501: Green Technologies and Practices	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>--</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
TE Sem. VI	HGSC601: Green Building and Infrastructure Engineering	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
BE Sem. VII	HGSC701: Fundamentals of Sustainable Engineering	04	--	--	20	80	--	--	100	04
	HGSSBL701: Lab-1 Green Building and Infrastructure Engineering	--	--	04	--	--	50	50	100	02
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>04</b>	<b>100</b>	<b>50</b>	<b>50</b>	<b>200</b>	<b>06</b>	
<b>Total Credits = 06</b>										
BE Sem. VIII	HGSC801: Sustainable Built Environment Engineering	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V,VI, VII &amp;VIII = 04+04+06+04 = 18</b>										

Green Technology and Sustainable Engineering: Semester V		
Course Code	Course Name	Credits
HGSC501	Green Technologies and Practices	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hours	-	-	-	100

### Rationale

Technology is application of knowledge to practical requirements. Green technologies encompass various aspects of technology which help us reduce the human impact on the environment and create ways of sustainable development. Social equitability, economic feasibility and sustainability are the key parameters for green technology. Today, the environment is racing towards the tipping point at which we would have done permanent irreversible damages to the planet earth. Our current actions are pulling the world towards an ecological landslide which if happens would make destruction simply inevitable. Green technologies are an approach towards saving earth and are necessary. Green technologies are our way out of destruction.

### Objectives

1. To acquire knowledge on the concept of green technologies
2. To understand the principles of Green Chemistry in the Energy efficient technologies.
3. To analyze the methods of reducing CO<sub>2</sub> levels in atmosphere for Cleaner Production Project Development and Implementation
4. To evaluate the methods of Pollution Prevention and Cleaner Production Awareness Plan.
5. To analyze the application of Energy Efficacy.
6. To apply the knowledge of Green Fuels during implementation.

Detailed Syllabus			
Module	Course Module / Contents		Hours
1	<b>Introduction to Green Technology</b>		07
	1.1	Definition- Importance – Historical evolution – advantages and disadvantages of green technologies.	
	1.2	Factors affecting green technologies.	
	1.3	Role of Industry, Government and Institutions-Industrial Ecology.	
	1.4	Role of industrial ecology in green technology.	
2	<b>Green Chemistry</b>		08

	2.1	Principles of Green Chemistry, Green chemistry metrics-atom economy.	
	2.2	E factor, reaction mass efficiency.	
	2.3	Waste: Sources of waste, different types of waste.	
	2.4	Chemical, physical and biochemical methods of waste minimization.	
	2.5	Clean development mechanism: reuse, recovery & recycle.	
	2.6	Raw material substitution: Wealth from waste, case studies.	
3	<b>Cleaner Production Project Development and Implementation</b>		09
	3.1	Overview of CP Assessment Steps and Skills, Process Flow Diagram.	
	3.2	Material Balance, CP Option Generation: Technical and Environmental Feasibility analysis.	
	3.3	Economic valuation of alternatives: Total Cost Analysis – CP Financing.	
	3.4	Preparing a Program Plan: Measuring Progress-ISO 14000.	
4	<b>Pollution Prevention and Cleaner Production Awareness Plan</b>		10
	4.1	Waste audit: Environmental Statement.	
	4.2	Carbon credit, Carbon trading, Carbon footprint.	
	4.3	Carbon sequestration.	
	4.4	Life Cycle Assessment- Elements of LCA.	
	4.5	Life Cycle Costing.	
	4.6	Eco Labeling.	
5	<b>Energy Efficacy</b>		08
	5.1	Availability and need of conventional energy resources: major environmental problems related to the conventional energy resources.	
	5.2	Future possibilities of energy need and availability.	
	5.3	Non-conventional energy sources: Solar Energy-solar energy conversion technologies and devices.	
	5.4	Solar Energy: principles, working and application.	
6	<b>Green Fuels</b>		10
	6.1	Definition-benefits and challenges: comparison of green fuels with conventional fossil fuels with reference to environmental, economical and social impacts- public policies and market driven initiatives.	
	6.2	Biomass energy: Concept of biomass energy utilization, types of biomass energy, conversion processes.	
	6.3	Wind Energy, energy conversion technologies, their principles, equipment and suitability in Indian context.	
	6.4	Tidal and geothermal energy.	

### Contribution to Outcome

On completion of this course, the students will be able to:



- 
1. Enlist different concepts of green technologies in a project.
  2. Describe the principles of Green Chemistry in the Energy efficient technologies.
  3. Select the best method for the carbon credits of various activities for Cleaner Production Project Development and Implementation.
  4. Evaluate the importance of life cycle assessment for Pollution Prevention and Cleaner Production Awareness Plan.
  5. To apply the problems related to Pollution Prevention and Cleaner Production Awareness Plan.
  6. To choose the green fuels based on their benefits for sustainable development.

#### **Internal Assessment**

**20 Marks**

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### **End Semester Examination**

**80 Marks**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

#### **Recommended Books:**

1. 'Pollution Prevention: Fundamentals and Practice' by Paul L Bishop (2000), McGraw Hill International.
2. 'Pollution Prevention and Abatement Handbook –Towards Cleaner Production' by World Bank Group (1998), World Bank and UNEP, Washington D.C.
3. 'Cleaner Production Audit' by Prasad Modak, C. Visvanathan and Mandar Parasnis (1995), Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok
4. 'Handbook of Organic Waste Conversion' by Bewik M.W.M.
5. 'Solar Energy' by Sukhatme S.P.

#### **Reference Books:**

1. 'Energy, The Solar Hydrogen Alternative' by Bokris J.O.
2. 'Non-conventional Energy Sources' by Rai G.D.
3. 'Waste Energy Utilization Technology' by Kiang Y. H.
4. Wind, Tidal, Geothermal, Biomass and Non-conventional energy Green fuel by G.D.Rai.

### Green Technology and Sustainable Engineering : Semester VI

Course Code	Course Name	Credits
HGSC601	Green Building and Infrastructure Engineering	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hours	-	-	-	100

### Rationale

This course incorporating sustainable design/thinking as a new civil engineering course and experiences from the pilot offering. Important areas are outlined to aid all engineers in understanding sustainability in context with traditional engineering principles. Green-building rating systems are used to introduce the concepts of sustainability in buildings and infrastructure, highlighted by presentations from green-building professionals. By providing a better understanding of sustainability through education, civil engineers can provide proactive solutions to a growing global infrastructure.

### Objectives

1. To acquire knowledge on various aspects of green building concepts.
2. To acquire knowledge on Indian Green Building Council.
3. To understand to green building design.
4. To apply knowledge on material conservation handling of non-process waste.
5. To analyze green building assessment systems national as well international.
6. To evaluate various terminologies Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management.

### Detailed Syllabus

Module	Course Module / Contents		Hours
1	<b>Green Building Concepts</b>		07
	1.1	What is Green Building, Why to go for Green Building, Benefits of Green Buildings-	
	1.2	Green Building Materials and Equipment in India, What are key Requisites for Constructing a Green Building?	

	1.3	Principles of green building – Selection of site and Orientation of the building – usage of low energy materials – effective cooling and heating systems-	
	1.4	Effective electrical systems – effective water conservation systems-	
2	<b>Green Building Practices in India</b>		09
	2.1	Practices Indian Green Building Council, Green Building Moment in India, Benefits Experienced in Green Buildings-	
	2.2	Launch of Green Building Rating Systems, Residential Sector, Market Transformation-	
	2.3	Green Building Opportunities And Benefits: Opportunities of Green Building-	
	2.4	Green Building Features, Material and Resources, Water Efficiency	
	2.5	Optimum Energy Efficiency-	
	2.6	Typical Energy Saving Approach in Buildings-	
3	<b>Introduction to Green Building Design</b>		09
	3.1	Green Building Design Introduction, Reduction in Energy Demand-	
	3.2	Onsite Sources and Sinks, Maximize System Efficiency-	
	3.3	Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources.	
	3.4	Eco-friendly captive power generation for factory, Building requirement-	
4	<b>Material Conservation and Occupational Health</b>		09
	4.1	Material Conservation Handling of non -process waste, waste reduction during construction-	
	4.2	Materials with recycled content, local materials, material reuse, certified wood, Rapidly renewable building materials and furniture-	
	4.3	Indoor Environment Quality And Occupational Health: Air conditioning, Indoor air quality, Sick building syndrome, Tobacco smoke control-	
	4.4	Minimum fresh air requirements avoid use of asbestos in the building-	
	4.5	Improved fresh air ventilation, Measure of IAQ-	
	4.6	Reasons for poor IAQ, Measures to achieve Acceptable IAQ levels-	
5	<b>Green building Rating Systems</b>		09
	5.1	Green building assessments system studying e.g. LEED US (Leadership in Energy and Environmental Design)-	
	5.2	Living Building Challenge, Green Globes (Green Building Initiative) (US), Green Globes (ECD-Canada; LEED-Canada, Built Green CANADA	
	5.3	BREEAM (Building Research Establishment Environmental Assessment Method) (UK)-	
	5.4	LEED India (Indian GBC); IGBC Green modules; TERI-GRIHA (Green Rating for Integrated Habitat Assessment) (India) Rating modules-	
6	<b>Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management</b>		09
	6.1	Introduction to the Concept: “Life Cycle assessment of materials”-	

6.2	EIA: Introduction to EIA. Process of EIA and its application through a case study, EIA as a strategic tool for sustainable development-Social Impact Assessment of Infrastructure projects-
6.3	Embodied energy of various construction materials-Energy Management with respect to buildings-
6.4	Clean Development Mechanism, Kyoto Protocol, Energy Conservation Building Code-

### Contribution to Outcome

On completion of this course, the students will be able to:

1. Explain the concepts of green building.
2. Learn practices Indian Green Building Council and GRIHA.
3. Use the green building design in the projects.
4. Learn material conservation handling of non -process waste.
5. Learn green building assessment systems national as well international.
6. Study various terminologies Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management.

#### Internal Assessment

**20 Marks**

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### End Semester Examination

**80 Marks**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum.
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

#### Recommended Books:

1. Manual of Tropical housing and climate by Koenisberger
2. Climate responsive architecture by Arvind Krishnan
3. Manual of solar passive architecture - by Nayak J.K. R. Hazra J. Prajapati.
4. Energy Efficient Buildings in India by Milli Mujumdar
5. Solar Energy in Architecture and Urban Planning by Herzog Thomas
6. Sustainable Building Design Manual-Volume I and II –TERI Publication
7. Green building codes and standards
8. International Green Construction Code
9. Complete Guide to Green Buildings by Trish riley
10. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009

#### Reference Books:

1. Green Building Hand Book by Tom woolley and Sam kimings, 2009.
2. Green Building Materials by Ross Spiegel and Dru Meadows
3. Publications from - CBRI, SERC, BMTPC
4. Shahane, V. S, "Planning and Designing Building", Poona, Allies Book Stall, 2004.
5. Michael Bauer, Peter Mösle and Michael Schwarz "Green Building – Guidebook for Sustainable Architecture" Springer, 2010.
6. Tom Woolley, Sam Kimmins, Paul Harrison and Rob Harrison "Green Building Handbook" Volume I, Spon Press, 2001.

### Green Technology and Sustainable Engineering : Semester VII

Course Code	Course Name	Credits
HGSC701	Fundamentals of Sustainable Engineering	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hours	-	-	-	100

#### Rationale

This course contains content that address sustainability issues and innovations of relevance to the discipline area. Sustainability content (principles and theory) is well integrated into the course. The course outline specifically addresses the sustainability content.

#### Objectives

1. To acquire knowledge and awareness among students on issues in areas of sustainability.
2. To understand the role of engineering Environmental Pollution and Environmental legislations in India.
3. To understand the International Environmental Management Standards.
4. To apply a clear understanding of the role and impact of various aspects of engineering and engineering decisions on environmental, societal, and economic problems.
5. To analyze the Sustainable Engineering.
6. To evaluate the Sustainable Assessment Systems.

#### Detailed Syllabus

Module	Course Module / Contents	Hours
1	<b>Introduction to Sustainability</b>	08
	1.1 Sustainability-Introduction, Historical Evolution-Goals of Sustainable Development-Principles of Sustainability-Sustainability-need and concept, challenges.	
	1.2 Social, Environmental and Economic sustainability concepts	
	1.3 Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development.	
	1.4 Multilateral environmental agreements and Protocols-Clean Development Mechanism (CDM)	
2	<b>Environmental Pollution and Environmental legislations in India</b>	09



	2.1	Regional and Local Environmental Issues-Air Pollution, Sources- Effects-Preventative Measures of Air Pollution; Water pollution- Land Pollution	
	2.2	Sustainable wastewater treatment, Solid waste - sources, impacts of solid waste, Zero waste concepts, 3 R concept-	
	2.3	Environmental legislations in India-Water Act, Air (Pollution & Prevention) Act	
	2.4	Environmental Protection Act and Climate Change Act	
	2.5	Forest Act, Animal Protection Act, Factory Act, Labour Act	
	2.6	SEZ Notifications, CRZ Notifications etc	
3	<b>International Environmental Management Standards</b>		09
	3.1	International Environment Acts and Protocols, Global, Regional and Local environmental issues, Natural resources and their pollution, Carbon credits, Carbon Trading, Carbon Foot Print	
	3.2	ISO 14000, ISO 14001, Life Cycle Analysis, Environmental Impact Assessment studies, Sustainable habitat	
	3.3	Global environmental issues-Resource degradation, Climate change, Global warming, Ozone layer depletion	
	3.4	Sustainable materials-Conventional and renewable material sources, sustainable development, Sustainable urbanization, Industrial Ecology	
4	<b>Basic concepts of sustainable habitat and Energy sources</b>		09
	4.1	Basic concepts of sustainable habitat, Sustainable materials for building construction	
	4.2	Material selection for sustainable design	
	4.3	Conventional and non-conventional energy sources-Solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy-Methods for increasing energy efficiency of buildings	
	4.4	Embodied energy of various construction materials-Energy Management with respect to buildings	
	4.5	Clean Development Mechanism	
	4.6	Kyoto Protocol, and Energy Conservation Building Code	
5	<b>Sustainable Engineering-</b>		08
	5.1	Sustainable Urbanization- Sustainable cities-	
	5.2	Sustainable transport-Industrialization and poverty reduction-Social and technological change-	
	5.3	Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis	
6	<b>Sustainable Assessment Systems</b>		09
	6.1	Studying few Green/Sustainable building assessments systems e.g. Living Building Challenge, Green Globes (Green Building Initiative) (US)	
	6.2	LEED India and GRIHA Sustainability Assessment Techniques-	
	6.3	Green Globes (ECD–Canada, International Initiative for a Sustainable Built Environment: iiSBTool	

6.4	SBModel 15	
<b>Contribution to Outcome</b>		

On completion of this course, the students will be able to:

1. To explain issues in areas of sustainability.
2. To summarize the role of engineering Environmental Pollution and Environmental legislations in India.
3. To interpret the International Environmental Management Standards.
4. To relate a clear understanding of the role and impact of various aspects of engineering and engineering decisions on environmental, societal, and economic problems.
5. To connect the Sustainable Engineering
6. To develop the Sustainable Assessment Systems.

#### **Internal Assessment**

**20 Marks**

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### **End Semester Examination**

**80 Marks**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total six questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

#### **Recommended Books:**

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
4. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Lang.
5. Prohit, S. S., Green Technology - An approach for sustainable environment, Agrobios publication uage Book Society (ELBS).

#### **Reference Books:**

1. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
2. ECBC Code 2016, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
3. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.

**Green Technology and Sustainable Engineering : Semester-VII**

Course Code	Course Name	Credits
Lab 1: HGSSBL601	Green Building and Infrastructure Engineering	02

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	04 Per Week	-	-	02		02

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
-	-	-	-	-	50	-	50	100

**Course Objective:**

1. To acquire knowledge on various aspects of green building concepts.
2. To acquire knowledge on Indian Green Building Council.
3. To understand green building design.
4. To analyze green building assessment systems national as well international.
5. To apply knowledge on material conservation handling of non-process waste.
6. To evaluate various terminologies of Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management

**List of Experiments (Conduct six practicals out of nine mentioned below)**

Module	Detailed Content	Lab Session / Hr.
1	To study sustainable planning aspects for urban housing (Literature based).	04
2	To study the benefits given by Municipal Corporations to Green Buildings (Literature based).	04
3	To prepare detailed plan for a hypothetical site indicating utility of solar path, wind direction, rainfall intensity etc., to make it sustainable (Literature based)	04
4	To prepare a report on energy efficient buildings in India (Case Study based).	04
5	To compare the benefits under different green building rating systems (Literature based)	04
6	To study: Innovative Materials Developed by CBRI, SERC (Literature based).	04
7	To study, analyze present scenario of organic waste collection and management of any of the premise; preferably hotels (Case Study based)	04
8	To prepare a report on carbon credit, carbon Trading and Carbon footprint (Literature based).	04
9	To study: Environmental Audit of any existing building and prepare a report (Case Study based).	04

**Course Outcomes**

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At the end of the course, learner will be able to:

1. Understand the concepts of green building.
2. Learn practices of Indian Green Building Council and GRIHA
3. Design a sustainable green building
4. Assessed green building systems nationally as well internationally.
5. Learn material conservation handling of non-process waste.
6. Study various terminologies of Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management.

**Assessment:**

**Term work:**

Shall consist of Assignment, design report, case study and Site visit report related to this course. Distribution of marks for Term Work shall be as follows:

Assignment: 15 marks

Case study/Literature report: 15 marks

Site visit: 15 marks

Attendance: 05 marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to: 75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks.

**End Semester Oral Examination:**

Oral examination shall be based upon the entire theory, site visit and laboratory syllabus.

**Recommended Books:**

1. 'Handbook of Organic Waste Conversion' by Bewik M.W.M.
2. Green Building Hand Book by Tom woolley and Sam kimings, 2009.
3. Energy Efficient Buildings in India by Milli Mujumdar
4. Allen, D. T. and Shonnard, D. R., 'Sustainability Engineering: Concepts, Design and Case Studies', Prentice Hall.
5. 'Solar Energy' by Sukhatme S.P.
6. 'Waste Energy Utilization Technology' by Kiang Y. H.

**Reference Books:**

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air-conditioning Engineers, 2009.
2. Manual of Tropical housing and climate by Koenisberger
3. Climate responsive architecture by Arvind Krishnan
4. Manual of solar passive architecture - by Nayak J.K. R. Hazra J. Prajapati.
5. Green Building Materials by Ross Spiegel and Dru Meadows Publications from - CBRI, SERC, BMTPC
6. Solar Energy in Architecture and Urban Planning by Herzog Thomas
7. Sustainable Building Design Manual-Volume I and II –TERI Publication
8. Green building codes and standards
9. International Green Construction Code
10. Complete Guide to Green Buildings by Trish riley
11. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009
12. Shahane, V. S, "Planning and Designing Building", Poona, Allies Book Stall, 2004.
13. Michael Bauer, Peter Möslle and Michael Schwarz "Green Building – Guidebook for Sustainable Architecture" Springer, 2010.
14. Tom Woolley, Sam Kimmins, P. Harrison and R. Harrison "Green Building Handbook" Volume-I, Spon Press, 2001.

**Green Technology and Sustainable Engineering : Semester VIII**

Course Code	Course Name	Credits
HGSC801	Sustainable Built Environment Engineering	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory				Term Work/Practical/Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.		Oral
Test-I	Test-II	Average						
20	20	20	80	03 Hours	-	-	-	100

**Rationale**

Education for sustainability is an important part of the journey to live and work in a sustainable manner. Curricula changes to incorporate sustainability education in the built environment disciplines is not a new phenomenon. Often, curricula changes are made from the perspective of the discipline and the individual learning the course.

**Objectives**

1. To Understand Sustainable Development
2. To apply knowledge for Understanding Ecosystems
3. To evaluate Environmental Sustainability.
4. To create Socio-economic Sustainability.
5. To create Urban Planning and Environment.
6. To analyze the Built in Environment.

**Detailed Syllabus**

Module	Course Module / Contents	Hours	
1	<b>Sustainable Development</b>	08	
	1.1		Definitions and principles of Sustainable Development - History and emergence of the concept of Sustainable Development.
	1.2		Environment and Development linkages- Globalization and environment.
	1.3		Millennium Development Goals- Status (global and Indian)-
	1.4		Impacts on approach to development policy and practice in India, future directions.
2	<b>Understanding Ecosystems</b>	09	
	2.1		Understanding Ecosystems-biodiversity hotspots, Understanding Critical Perspectives on Environment and Development-Environmental Policy and Law, Landscape Ecology and human development.
	2.2		Introduction to Policy, Institutions and Governance-Urbanization-Conservation of natural resources and livelihood security.

	2.3	Environment- Evaluation and Impact Assessment Frameworks-Knowledge of ecosystem dynamics, ecosystem-livelihood linkages, Environmental vulnerabilities and adaptations.	
	2.4	Resilience towards climate change and disasters-Environment-development-poverty linkages, issues of access and justice.	
	2.5	Understanding of field techniques and skills to assess ecological processes-Skills to engage with local communities, undertake impact assessments.	
	2.6	Experiential learning of conservation and development issues.	
3	<b>Environmental Sustainability</b>		09
	3.1	Land, Water and Food production	
	3.2	Moving towards sustainability: Energy powering	
	3.3	Sustainable Development - Financing the environment	
	3.4	Sustainable Development- Development of Environmental Protection Mechanism	
4	<b>Socio-economic Sustainability</b>		09
	4.1	Empowerment of Women, Children, Youth, Indigenous People	
	4.2	Non-Governmental Organizations, Local Authorities, Business and Industry	
	4.3	Sustainability Performance indicators and Assessment mechanism	
	4.4	Hurdles to sustainability- Constraints and barriers for sustainable development	
	4.5	Operational guidelines-Interconnected prerequisites for sustainable development	
	4.6	Science and Technology for sustainable development	
5	<b>Urban Planning and Environment</b>		08
	5.1	Environment and Resources	
	5.2	Sustainability Assessment- Future Scenarios	
	5.3	Form of Urban Region- Managing the change	
	5.4	Integrated Planning-Sustainable Development	
6	<b>The Built in Environment</b>		09
	6.1	Urban Form	
	6.2	Land Use-Compact Development	
	6.3	Principles of street design-complete streets	
	6.4	Transport Integrated Urban land use Planning- Guidelines for Environmentally sound Transportation	

### Contribution to Outcome

On completion of this course, the students will be able to:

1. Describe the concept and socio-economic policies of Sustainable Development.
2. Identify the strategies for implementing eco development programs.
3. Identify different approaches for resource conservation and management.



4. Suggest action plans for implementation of sustainable development.
5. Explain Urban Planning and Environment.
6. Explain the built in environment.

#### **Internal Assessment**

**20 Marks**

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### **End Semester Examination**

**80 Marks**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- 1 Question paper will comprise of total six questions, each carrying 20 marks.
- 2 Question 1 will be compulsory and should cover maximum contents of the curriculum.
- 3 Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
- 4 Only Four questions need to be solved.

#### **Recommended Books:**

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
3. ECBC Code 2016, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
4. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
5. Prohit, S. S., Green Technology - An approach for sustainable environment, Agrobios publication uage Book Society (ELBS).
6. Ganesha Somayaji and Sakarama Somayaji, "Environmental Concerns and Sustainable development: Some perspectives from India", Editors: publisher TERI Press, ISBN 8179932249.
7. Kirkby, J, O'Keefe P. and Timberlake, "Sustainable development" Earth Scan Publication, London, 1996.

#### **Reference Books:**

1. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
2. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
3. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Lang
4. Gilg A W and Yarwood R, "Rural Change and Sustainability - Agriculture, the Environment and Communities", CABI Edited by S J Essex, September2005.
5. James H. Weaver, Michael T. Rock, Kenneth Kustere, "Achieving Broad-Based Sustainable Development: Governance, Environment, and Growth with Equity", Kumarian Press, West Hartford, CT. Publication Year, 1997.
6. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher: Belhaven Press, ISBN: 1852930039.
7. Munier N, "Introduction to Sustainability", Springer2005.

# University of Mumbai



## Syllabus

**Honours/Minor Degree Program**

**In**

**Infrastructure Policies & Regulations**

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Infrastructure Policies & Regulations**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract.	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HIPC501: Environmental Policies & Regulations	04	--	--	20	80	-	--	100	04
	<b>Total</b>	<b>04</b>	-	--	<b>100</b>	-	-	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
TE Sem. VI	HIPC601: Land Policies & Regulations	04	--	--	20	80	-	--	100	04
	<b>Total</b>	<b>04</b>	-	-	<b>100</b>	-	-	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
BE Sem. VII	HIPC701: Infrastructure Finance & Business Policies	04	--	--	20	80	--	--	100	04
	HIPSBL 701: Lab-1 Infrastructure Finance & Business Policies	--	--	04	--	--	50	50	100	02
	<b>Total</b>	<b>04</b>	-	<b>04</b>	<b>100</b>	<b>50</b>	<b>50</b>	<b>200</b>	<b>06</b>	
<b>Total Credits = 06</b>										
BE Sem. VIII	HIPC801: Arbitration & Conciliation	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	-	-	<b>100</b>	-	-	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V, VI, VII &amp; VIII = 04+04+06+04 = 18</b>										

### Infrastructure Policies & Regulations : Semester-V

Course Code	Course Name	Credits
HIPC 501	Environmental Policies & Regulations	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	3 hrs.	-	-	-	100

#### Rationale

Environmental law describes a network of regulations and customary laws that address the effects of human activity on the natural environment. These laws are also referred to as environmental and natural resource laws and centre on the idea of environmental pollution. Environmental law is necessary to combat issues related to the environment and conservation of natural resources. Environmental law addresses a wide variety of different areas like reducing air pollution and maintaining air quality, Water Quality, Waste management, Sustainability of resources. This course covers the laws related to sustainable development and protections of environment under general laws. It also emphasizes the laws regarding hazardous and solid waste management, water, air and noise pollution and its prevention. It explores the compliance and enforcement of international environmental law.

#### Objectives

1. To understand and explain the significance of sustainable development and laws regarding protection of environment.
2. To study the laws related to environment (protection) act, 1986.
3. To emphasize the salient features of water act and describe the laws related to water pollution.
4. To study the salient features of air pollution act and understand the laws related to air and noise pollution.
5. To study the laws regarding hazardous and solid waste management.
6. To understand the International Environment Laws and policies.

#### Detailed Syllabus

Module	Course Modules / Contents	Hours
1	<b>Sustainable Development and Protection of environment under General Laws</b> Introduction, Sustainable development, Precautionary principle, the polluter pays principle, the public trust doctrine, eco-development, sustainable development and the Indian judiciary, Environment protection under the law of Torts, Environment protection under the Indian Penal Code:1860, Environment protection under the criminal procedure code:1973, Constitutional provisions and environment protection in India.	10
2	<b>The Environment (Protection) Act, 1986</b>	8

	Introduction, Aims and objectives, Scope and commencement of the act, Salient features of the act, definitions, general powers of the central government, prevention, control and abatement of environmental pollution, offences and penalties, miscellaneous provisions.	
<b>3</b>	<b>Water Pollution</b>	<b>9</b>
	Introduction, aims and objectives, Salient features of the water pollution act, constitution of central and state boards and their powers and functions, appeals and revisions, offences and penalties, prevention and control of water pollution, miscellaneous provisions.	
<b>4</b>	<b>Air pollution and Noise Pollution</b>	<b>10</b>
	Introduction, Aims and objectives, Salient features of the air pollution act, constitution of central and state boards and their powers and functions, appeals and revisions, offences and penalties, miscellaneous provisions, Noise Pollution regulation and control rule 2000, legislative and non-legislative measures, control of noise pollution.	
<b>5</b>	<b>Hazardous and Solid Waste Management</b>	<b>8</b>
	Introduction, ozone depleting substances (Regulation and control rule 2000), Hazardous and other waste (Management and transboundary movement) Rules 2016, Construction and demolition waste management Rule 2016, Solid waste management Rule 2016, Wetland (Conservation and management) Rule 2017.	
<b>6</b>	<b>International Environment Law</b>	<b>7</b>
	An introduction to international law, Sources and basic principles of international law, development of international laws, nature and scope, establishment of environment institutions like UNEP, World charter for nature 1982, Relationship between international laws and domestic laws: Compliance and enforcement.	
	<b>Total</b>	<b>52</b>

### Contribution to Outcome

On completion of this course, the students will be able to:

1. Illustrate the significance of sustainable development and protection of environment under general laws.
2. Explain and implement the laws related to environment (protection) act, 1986.
3. Summarize the salient features of water act and identify the laws related to water pollution.
4. Understand the salient features of air pollution act and classify the laws related to air and noise pollution.
5. Analyze and appraise the laws regarding hazardous and solid waste management.
6. Explore and justify the importance of International Environment Laws and policies.

#### Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lectures hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**

2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

**Recommended Books:**

1. Divan S. and Rosencranz A. (2005) Environmental Law and Policy, 2<sup>nd</sup> ed., New Delhi.
2. Leelakrishnan P. (2008) Environmental Law in India, 3<sup>rd</sup> ed., Lexis Nexis, India.
3. Shastri S. C. (2012) Environmental Law, Eastern Book Company, 4<sup>th</sup> ed., Lucknow.
4. Gurdip Singh (2016) Environmental Law in India, 2<sup>nd</sup> ed.
5. Dr. Paramjit Jaswal, Dr. Nishtha Jaswal and Vibhuti Jaswal (2021) Environmental Law, Allahabad Law Agency, 5<sup>th</sup> ed., Allahabad.

**Reference Books:**

1. Alaxander kiss and Diana Shelton (2007) Guide to International Environmental Laws, Martinus Nijhoff Publisher, USA.
2. Philippe Sands and Jacqueline Peel, Principles of International Environmental Law (4th ed., 2018).
3. Shibani Ghosh ed., Indian Environmental Law: Key Concepts and Principles (2019).
4. Geetanjoy Sahu, Environmental Jurisprudence and the Supreme Court: Litigation, Interpretation, Implementation (2014).
5. Stuart Bell & Donald Mc Gillivray, Environmental Law (7th ed., 2008).

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Infrastructure Policies & Regulations : Semester-VI		
Course Code	Course Name	Credits
HIPC 601	Land Policies & Regulations	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
04	-	-	04	-	-	04

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	3 hrs.	--	-	-	100

#### Rationale

Land law is important in relation with the Infrastructure Engineering students. This will familiarize the students with the acts and codes that are applicable as per actual conditions in the field. The course deals with the overall knowledge of the central and state acts and rules. Land law is the form of law that deals with the rights to use, alienate, or exclude others from land. In many jurisdictions, these kinds of property are referred to as real estate or real property, as distinct from personal property. Land use agreements, including renting, are an important intersection of property and contract law. Civil and Infrastructural Engineers need to have a working knowledge of the land laws that affect their work and that will enable them to comply with local, state & national regulations; understand the boundaries of their personal and professional liability; negotiate contracts; protect their intellectual property; develop a relationship with a law firm that understands the engineering business.

#### Objectives

1. To understand and explain the registration act and coastal regulations zones.
2. To provide knowledge of the urban land act & the land acquisition act.
3. To understand Maharashtra stamp act & the development control regulations.
4. To understand the MHADA and MahaRERA act.
5. To study Maharashtra Regional Town Planning Act.
6. To study the Maharashtra Land Revenue Code.

#### Detailed Syllabus

Module	Course Module / Contents	Periods
<b>A</b>	<b>CENTRAL LEGISLATION</b>	
<b>1</b>	<b>The Registration Act, 1908 &amp; The Environment (Protection) Act, 1986 – Coastal Regulation Zones (CRZ)</b>	<b>08</b>
1.1	The Registration Act, 1908: Introduction, definitions, documents, time limit for registration and effects of non-registrations of documents.	
1.2	The Environment (Protection) Act, 1986 – Coastal Regulation Zones (CRZ): Areas covered, prohibited and regulated activities and classification of CRZ.	
<b>2</b>	<b>The Urban Land (Ceiling and Regulation) Act, 1976 &amp; The Land Acquisition Act, 1894</b>	<b>09</b>
2.1	The Urban Land (Ceiling and Regulation) Act, 1976: Introduction and repeal, definitions, ceiling limits on vacant lands and power to exempt and retention of excess vacant land	

	2.2	The Land Acquisition Act, 1894: General, introduction and definitions, acquisition of land, reference to the court, miscellaneous provisions and case law. Land Records documents i.e. 7x12 abstract, 8A, Ferfar, property card, Gut book. CTS Plan	
<b>B</b>	<b>STATE LEGISLATION</b>		
<b>3</b>	<b>Maharashtra Stamp Act, 1958 &amp; The Development Control Regulations (DCR), 1991</b>		<b>07</b>
	3.1	Maharashtra Stamp Act, 1958: Constitutional provisions, objects & summary of the act, payment of stamp duty, adjudication of stamp duty, impounding of instruments, admissibility of instrument and prosecution for stamp law offences.	
	3.2	The Development Control Regulations (DCR), 1991: Floor Space Index (FSI), transfer of development rights (TDR), heritage buildings and precincts.	
<b>4</b>	<b>The Maharashtra Housing &amp; Area Development Act (MHADA), 1976 &amp; Maharashtra's Real Estate (Regulation and Development) Act, 2016 (MahaRERA)</b>		<b>14</b>
	4.1	The Maharashtra Housing & Area Development Act (MHADA), 1976: Definitions, powers & duties of the Mumbai repairs and reconstruction board, levy and collection of cess, structural repairs, acquisition of cessed properties for cooperative societies.	
	4.2	Maharashtra's Real Estate (Regulation and Development) Act, 2016 (MahaRERA): Introduction, regulatory framework, registration of real estate project and registration of real estate agents, functions and duties of promoter, rights and duties of allottees, the real estate regulatory authority, central advisory council, offences, penalties and adjudication, FAQ's.	
<b>5</b>	<b>Maharashtra Regional Town Planning (MRTP) Act, 1966</b>		<b>04</b>
	5.1	Introductory & definitions, control of development, unauthorized development and acquisition of land.	
<b>6</b>	<b>Maharashtra Land Revenue Code, 1966</b>		<b>10</b>
	6.1	Introduction, use of land, removal & regularisation of encroachments, grant of sanad, record of rights, rights in unoccupied land, appeals, revision and review	
	6.2	Special provisions for land revenue in Bombay city: general, assessment and collection of land revenue, Bombay city survey & boundary marks, government lands and foreshore, transfer of lands.	
<b>Total</b>			<b>52</b>

#### Contribution to Outcome

After the completion of the course the student should be able to:

1. Understand the functionality of the registration act and coastal regulations zones as per central regulations of India.
2. Analyse and integrate functionality of the urban land act & the land acquisition act in India.
3. Explain Maharashtra Stamp Act & the development control regulations.
4. Understand the MHADA and MahaRERA act.
5. Understand Maharashtra Regional Town Planning Act.
6. Familiarise with the Maharashtra Land Revenue Code.

#### **Internal Assessment (20 Marks):**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination (80 Marks):**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

**Recommended & Reference Books:**

1. MahaRERA Act, The Real Estate (Regulation and Development) Act, 2016 and Rule 2017 - Y. M. Agarwala, Adv. A. B. Shah; Aarti & Company's Publications
2. Land Law – Prof. H.D. Pithawalla; C. Jamndas & Co.
3. Maharashtra Land Laws by D N Mathur, Central Law Publications
4. Land Laws in Maharashtra by Sunil Dighe, Snow White Pub. P Ltd
5. Land Laws by Abhay Shah; Aarti & Company's Publications
6. Land Law (Law and Real Estate Laws) by Krishan Keshav; Singhal's Publications
7. Land Laws (Including Land Acquisition and Rent Laws) by Kanwal D.P. Singh; Satyam Law International

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### Infrastructure Policies & Regulations : Semester-VII

Course Code	Course Name	Credits
HIPC 701	Infrastructure Finance & Business Policies	04

Contact Hours			Credits Assigned					
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total		
04	-	-	04	-	-	04		
Theory			Term Work/Practical/Oral			Total		
Internal Assessment			Duration of End Sem Exam	TW	PR		OR	
Test-I	Test-II	Average						
20	20	20	80	3 hrs.	--	-	-	100

### Rationale

Looking at India's exponential growth with the infrastructure space teeming with activity and the government as well as the private sector heavily investing in the creation of better infrastructure both in terms of its business and with an eye on its longevity, this course will prove to be a holy grail for students considering the aspects of business law. The course will provide an overview of the underlying legal framework for doing business in India including Constitutional Acts, Companies Act and other relevant statutes. The course will familiarize students with the sector specific legislation, the constitutional, general legal context, regulatory law, where it exists. The course intends to enable each student to have knowledge of fundamental tools of legal research and application of the same in development of the infrastructure sector.

### Objectives

1. To highlight the business environment, forms of business, scale of business and emerging trends in business.
2. To describe about the general legal environment and framework in India.
3. To provide an overview of Indian Constitutional Acts, Companies Act and other relevant statutes.
4. To define & interpret the financing of infrastructure and growth of PPP (Public Private Partnership) in various sectors of Infrastructural development.
5. To understand preconstruction and post construction processes involved in infrastructural projects/contracts.
6. To examine the details of Project Financing in Infrastructure Contracts.

### Detailed Syllabus

Module	Course Modules / Contents	Hours
1	<b>Business Environment</b>	8
	Types of Business Environment, Forms of Business Organization, Concept and Features in relation to following business models- Sole Proprietorship; Partnership, Company; Statutory Bodies and Corporations; HUF and Family Business. Scales of Business, Micro, Small and Medium Enterprises; Large Scale Enterprises and Public Enterprises; MNC's Emerging Trends in Business, Concepts, Advantages and Limitations-Franchising, Aggregators, Business Process Outsourcing (BPO)& Knowledge Process Outsourcing (KPO); E-Commerce, Digital Economy.	
2	<b>Legal Environment of Business in India</b>	10
	Introduction to Bills, Laws/Acts, Rules, Regulations, and associated legal reasoning and procedures, Introduction to Constitution and Constitutional Law. Stakeholders including legal	

	system covering judicial, quasi-judicial authorities & Constitutional Authorities etc. and other Advisory Boards/entities. Outline the intent of Business Allocation of Rules of Government (e.g. Departments in States and Ministries at the Centre)	
<b>3</b>	<b>Acts, Statutes and Regulation</b>	<b>10</b>
	Introduction to various Acts and their key provisions, such as Indian Companies Act- 2013, Negotiable Instruments Act, Industrial Dispute Act, Minimum Wages Act, Special Relief Act, Transfer of property act, Right to fair compensation & transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, Income Tax Act.	
<b>4</b>	<b>Infrastructure Contracts</b>	<b>8</b>
	Introduction and Features of Infrastructure contracts, Introduction to PPP in India, PPP Models in India, Contracts in PPP model  Principles of contract-essential conditions, Void & voidable contract, capacity & consideration, types & terms of contracts (in accordance with Indian Contract Act 1872); Performance and discharge of contract; breaches of contracts and remedies; introduction to special contracts such as contract of indemnity, guarantee, leasing agreement.	
<b>5</b>	<b>Infrastructure Project Contracts</b>	<b>8</b>
	Parties in Infrastructure Contracts, Bidding Process, Negotiation of Infrastructure Project Management Contracts, Allotment of Contracts, Drafting EPC & Concession Agreements, Project Appraisal, Compliances and Due Diligence.	
<b>6</b>	<b>Project Financing in Infrastructure Contracts</b>	<b>8</b>
	Introduction to project financing, Equity and corporate debt financing, Stages in Project Financing, Regulatory Framework and Authorities, Borrowing from International financial institutions, FDI in Infrastructure developments, Documentation in Project Financing, Restructuring in project finance transactions, Case Studies on Infrastructure Project Management	
<b>Total</b>		<b>52</b>
<b>Contribution to Outcome</b>		

On completion of this course, the students will be able to:

1. Explain the concepts related to Business environment
2. Elaborate the general legal environment and framework in India
3. Understand the acts, statutes and their regulation involved in infrastructure projects
4. Apply models of infrastructure development on respective projects in PPP
5. Understand preconstruction and post construction processes involved in infrastructural projects/contracts.
6. Define and interpret the financing of Infrastructure Contracts.

**Internal Assessment (20 Marks):**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination (80 Marks):**

Weightage of each module in end semester examination will be proportional to number of respective lectures hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

**Recommended Books:**

1. Satyanarayana, G. (2017). Infrastructure Development & the Role of Public-PrivatePartnership. 1st ed. New Delhi, India: New Century Publications.
2. Piyush Joshi(2003), Law Relating to Infrastructure Projects, New Delhi: Butterworths.
3. N.D. Kapoor &DinkarPagare Business Laws and Management; Sultan Chand & Sons.
4. P. P. S. Gogna A Textbook of Business Law; Sultan Chand & Company, New Delhi.
5. Poonam Gandhi Business Studies; Dhanpat Rai & Company Private Limited, Delhi.
6. Willie Tan, (2007). Principles of Project and Infrastructure Finance, 1 edition. Routledge;
7. Hoffman, Scott L., (2007). The Law and Business of International Project Finance, 3rd Edition, London: Cambridge University Press.
8. Vinter, Graham (2013) Project Finance, 4th Edition, London: Sweet and Maxwell.
9. Gajendra Haldea, (2011). Infrastructure at Crossroads: The Challenges of Governance, Oxford University Press; 1st ed edition
10. Dewar, John (2015) International Project Finance: Law and Practice, 2nd Edition, Oxford University Press
11. Mulla, D.F., The Indian Contract Act, 13th Ed., LexisNexis/Butterworths
12. Tripathi, S.C., Modern Company Law, 5th Ed., Central Law Publications
13. I.P Massey (2008), Administrative Law, Lucknow: Eastern Book Company.
14. D D Basu (2009), The Constitutional Law of India, New Delhi: Lexis Nexis Butterworths.

**Reference Books:**

1. Sen & Mitra Commercial Law; The World Press Pvt. Ltd., Calcutta.
2. Ian Wirthington & Chris Britton The Business Environment; Pearson Education Ltd., England.
3. Raymond W.Y. Kao Entrepreneurship and Enterprises Development

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Infrastructure Policies & Regulations : Semester-VII		
Course Code	Course Name	Credits
HIPSBL 701	Infrastructure Finance & Business Policies (Lab)	02

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	04	-	-	02	-	02

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
-	-	-	-	-	50	-	50	100

### Objectives

1. To study the business environment and emerging trends in business.
2. To learn the general legal environment followed for infrastructure projects in India.
3. To provide detail overview of land acquisition, rehabilitation and redevelopment of infrastructure.
4. To explain emerging sectoral growth of PPP (Public Private Partnership) in various sectors of infrastructural development.
5. To develop contracts and agreements with various stakeholders related to infrastructure projects.
6. Examine the intricacies of Project Financing in Infrastructure Contracts.

Module	Detailed Contents (Any Six)	Lab Sessions/Hr
1	To prepare a case study report of Knowledge Process Outsourcing (KPO) related to infrastructure-based company.	4
2	To prepare a case study report of Business Process Outsourcing (BPO) related to infrastructure-based company.	4
3	To prepare a case study report based on legal environment of business in India.	4
4	To prepare a case study report based on land acquisition and rehabilitation (eg. Sardar Sarovar).	4
5	To prepare a case study report of PPP in one of the sectors of Infrastructural development.	4
6	Prepare a sample draft of EPC contracts enlisting all the necessary elements for infrastructure project.	4
7	To prepare a case study report of business model applying key parameters in project financing.	4
8	To prepare a case study report highlighting the important features of slum rehabilitation (eg. SRA project).	4
9	To prepare a case study report based on mega redevelopment projects in India (eg. BDD chawl).	4

### Lab Outcomes

Learner will be able to...

1. Explain the business environment and emerging trends in business.
2. Elaborate the general legal environment followed for infrastructure projects in India.
3. Apply intricacies of land acquisition, rehabilitation and redevelopment of infrastructure.
4. Apply emerging techniques related to PPP (Public Private Partnership) in various sectors of infrastructural development.
5. Build contracts and agreements with various stakeholders related to Infrastructure projects.
6. Define the intricacies of project financing in infrastructure contracts.

**End Semester Oral Examinations:**

Oral exam will be based on laboratory work performed (case study report).

**Recommended Books:**

1. Satyanarayana, G. (2017). Infrastructure Development & the Role of Public-Private Partnership. 1st ed. New Delhi, India: New Century Publications.
2. Piyush Joshi(2003), Law Relating to Infrastructure Projects, New Delhi: Butterworths.
3. N. D. Kapoor & Dinkar Pagare Business Laws and Management; Sultan Chand & Sons.
4. P. P. S. Gogna A Textbook of Business Law; Sultan Chand & Company, New Delhi.
5. Poonam Gandhi Business Studies; Dhanpat Rai & Company Private Limited, Delhi.
6. Willie Tan, (2007). Principles of Project and Infrastructure Finance, 1 edition. Routledge;
7. Hoffman, Scott L., (2007). The Law and Business of International Project Finance, 3rd Edition, London: Cambridge University Press.
8. Vinter, Graham (2013) Project Finance, 4th Edition, London: Sweet and Maxwell.
9. Gajendra Haldea, (2011). Infrastructure at Crossroads: The Challenges of Governance, Oxford University Press; 1st ed edition
10. Dewar, John (2015) International Project Finance: Law and Practice, 2nd Edition, Oxford University Press
11. Mulla, D. F., The Indian Contract Act, 13th Ed., LexisNexis/Butterworths
12. Tripathi, S.C., Modern Company Law, 5th Ed., Central Law Publications
13. I. P. Massey (2008), Administrative Law, Lucknow: Eastern Book Company.
14. D. D. Basu (2009), The Constitutional Law of India, New Delhi: Lexis Nexis Butterworths

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Infrastructure Policies & Regulations : Semester-VIII		
Course Code	Course Name	Credits
HIPC801	Arbitration & Conciliation	

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

Theory				Term Work/Practical/Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR		OR
Test-I	Test-II	Average						
20	20	20	80	03	--	-	-	100

### Rationale

The Arbitration and Conciliation concept has been modelled on lines of the UNCITRAL (United Nations Commission on International Trade Law) framework of laws with the idea to modernize Indian arbitration law and bring it in line with the best global practices and also make India a global hub for arbitration. Arbitration and conciliation play significant role in construction industry due to disputes arising on large scale construction projects. Alternative Dispute Resolution (ADR) mechanism provides scientifically developed techniques to Indian judiciary. ADR provides various modes of settlement including arbitration, conciliation, mediation, negotiation, etc. This course deals with introduction to arbitration and conciliation, their requisites, rules, proceedings, roles of individuals, etc.

### Objectives

1. To understand the importance of arbitration in resolving disputes in construction infrastructure industry.
2. To study the constitution of arbitral tribunal in the process of arbitration.
3. To study the procedures and conduct of arbitral proceedings.
4. To understand the making of arbitral award & termination of proceedings.
5. To study the significance and concepts of conciliation.
6. To study of the alternative means of settlement of disputes with negotiations.

### Detailed Syllabus

Module	Course Modules / Contents	Hours
1	<b>Arbitration</b>	09
	Arbitration and its significance in construction industry, Role of arbitrator, The Construction Industry Arbitration Commission (CIAC), Arbitration agreement- Form, constitution, Guarantor to agreement, Interim measures by court, Arbitral award, Arbitral tribunal, International commercial arbitration, legal representative, Scope of arbitration, Arbitral disputes, the arbitration & conciliation act 1996- Consolidating & amendment act, provisions, preamble & its purpose.	
2	<b>Composition of Arbitral Tribunal</b>	09

	Arbitrator, No. of arbitrator, Agreement providing two arbitrators, Appointment of arbitrator, Appointment of international commercial arbitrator, appointment of sole arbitrator, objection to nationality of arbitrator, Selection of arbitrator, appointment of arbitrator by court, Removal of arbitrator, Grounds for challenge, challenge procedure, Termination and substitution of mandate of arbitrator, insolvency notice.	
3	<b>Conduct of Arbitral Proceedings</b>	06
	Equal treatment of parties, Determination of rules of procedure- English law, Indian law, Place of arbitration, Commencement of arbitral proceedings, Statement of claim and defense, Expert appointment by arbitral tribunal,	
4	<b>Making of Arbitral Award &amp; Termination of Proceedings</b>	06
	Rules applicable to substance of disputes, decision making by panel of arbitrators, Settlement, Form and contents of arbitral award, Termination of proceedings, Correction and interpretation of award, Additional award	
5	<b>Conciliation</b>	13
	Application and scope, commencement of proceedings, Appointment of conciliation, Role of conciliator, sole conciliator, Communication between conciliator and parties, Settlement agreement- Concept, status and effect, Confidentiality, Termination of proceedings, costs, Deposits, Role of conciliator in other proceedings, Difference between conciliation and mediation.  ICC Rules of Conciliation and arbitration, Rules of arbitration of the Indian council of arbitration.	
6	<b>Alternative Means of Settlement of Disputes (ADR)</b>	09
	Introduction, Methods, merits, demerits, Indian statutes, Difference between mediation and arbitration, Mediator and its necessity, Rules and Limitation of mediation, mediator's settlement.  Negotiation- Necessity, state of negotiation, power sources, , styles, kinds of approaches, qualities of negotiation power, Obstructions to negotiation, Trade unions and negotiation.	
	<b>Total</b>	<b>52</b>

### Contribution to Outcome

On completion of this course, the students will be able to:

1. Appraise the significance and concepts of arbitration in resolving disputes in construction infrastructure industry.
2. Explain the intricacies of constitution of arbitral tribunal in the process of arbitration.
3. Value the importance of the procedures and conduct of arbitral proceedings.
4. Comply the making of arbitral award & termination of proceedings.
5. Compare and study the significance and concepts of conciliation and mediation.
6. Apply the process of alternative means of settlement of disputes with negotiations.

#### Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination (80 Marks):**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

**Recommended Books:**

1. Dr. S C Tripathi (2012), The Arbitration and Conciliation Act, 1996, 6<sup>th</sup> Edn. Central Law Publication.
2. Dr. Rega Surya Rao. (2021), Lectures on Arbitration, Conciliation and ADR Systems, Andhra Law House.
3. Dr. Harman Shergil Sullar (2021), Alternative Dispute Resolution - Including Arbitration Conciliation Act, 1996 Amended Amendment Act, 4<sup>th</sup> Edn., Shreeram Law House Publication.
4. H C Johari Edition, A Guide to Arbitration and Conciliation Act, 1996 (2022), Kamal Law House.
5. Rahul Ranjan (2020), Alternative Dispute Resolution Arbitration, Conciliation, Negotiation and Mediation, 2022 Edn., Proflic Publication.
6. Madhusudan Saharay, Textbook on Arbitration & Conciliation with Alternative Dispute Resolution, 4<sup>th</sup> Edn., Universal Law Publishing.
7. Dr. Anupam Kurlwal (2017), An Introduction to Alternative Dispute Resolution, 3<sup>rd</sup> Edn., Central Law Publications.

**Reference Books:**

1. P. C. Markanda, Naresh Markanda & Rajesh Markanda (2020), Law Relating to Arbitration and Conciliation, 10<sup>th</sup> Edn., LexisNexis.
2. Abraham P. Ordovery & Andrea Doneff (2002), Alternatives to Litigation: Mediation, Arbitration, and the Art of Dispute Resolution, 2<sup>nd</sup> Edn., LexisNexis / National Institute for Trial Advocacy Publication.
3. Elkouri & Elkouri (2003), How Arbitration Works, Bna Books Publications, Edison, New Jersey, USA.

# University of Mumbai



**Syllabus for**  
**Honours/Minor Degree Program**  
**In**  
**Blockchain**

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)



**University of Mumbai**  
**Blockchain**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HBCC501: Bit coin and Crypto currency	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>--</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
TE Sem. VI	HBCC601: Blockchain Platform	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
BE Sem. VII	HBCC701: Block chain Development	04	--	--	20	80	--	--	100	04
	HBCSBL701: Private Blockchain Setup Lab(SBL)	--	--	04	--	--	50	50	100	02
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>04</b>	<b>100</b>	<b>50</b>	<b>50</b>	<b>200</b>	<b>06</b>	
<b>Total Credits = 06</b>										
BE Sem. VIII	HBCC801: DeFi (Decentralized Finance)	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V,VI, VII &amp;VIII = 04+04+06+04=18</b>										

Blockchain: Sem V								
Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HBCC501	Bit coin and Crypto currency	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg.					
HBCC501	Bit coin and Crypto currency	20	20	20	80	--	--	--	100

#### Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To get acquainted with the concept of Block and Blockchain.
2	To learn the concepts of consensus and mining in Blockchain.
3	To get familiar with the bitcoin currency and its history.
4	To understand and apply the concepts of keys, wallets and transactions in the Bitcoin Network.
5	To acquire the knowledge of Bitcoin network, nodes and their roles.
6	To analyze the applications& case studies of Blockchain.

#### Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Describe the basic concept of Block chain.	L1,L2
2	Associate knowledge of consensus and mining in Block chain.	L1,L2
3	Summarize the bit coin crypto currency at an abstract level.	L1,L2
4	Apply the concepts of keys, wallets and transactions in the Bit coin network.	L3
5	Interpret the knowledge of Bit coin network, nodes and their roles.	L1,L2
6	Illustrate the applications of Block chain and analyze case studies.	L3

#### Detailed Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	<b>Introduction to Cryptography:</b> Hash functions, Public key cryptography, Digital Signature (ECDSA).	2	--
I	<b>Introduction to Block chain</b>	Structure of a Block, Block Header, Block Identifiers: Block Header Hash and Block Height, The Genesis Block, Linking Blocks in the Block chain, Merkle Trees and Simplified Payment Verification (SPV). <b>Self-learning Topics:</b> Block chain Demo.	6	CO1

II	<b>Consensus and Mining</b>	Decentralized Consensus, Byzantine General's Problem, Independent Verification of Transactions, Mining Nodes, Aggregating Transactions into Blocks, Constructing the Block header, Mining the Block, Successfully Mining the Block, Validating a New Block, Assembling and Selecting Chains of Blocks, Block chain Forks <b>Self-learning Topics:</b> Study different consensus algorithms	<b>12</b>	CO2
III	<b>Introduction to Bit coin</b>	What is Bit coin and the history of Bit coin, Getting the first bit coin, finding the current price of bit coin and sending and receiving bit coin, Bit coin Transactions. <b>Self-learning Topics:</b> Study the website <a href="https://coinmarketcap.com/">coinmarketcap.com/</a>	<b>4</b>	CO3
IV	<b>Concepts of Bit coin</b>	<b>Keys and addresses, Wallets and Transactions:</b> Public Key Cryptography and Crypto currency, Private and Public Keys, Bit coin Addresses, Base58 and Base58Check Encoding, Nondeterministic (Random) Wallets, Deterministic (Seeded) Wallets, HD Wallets (BIP-32/BIP-44), Wallet Best Practices, Using a Bit coin Wallets, Transaction Outputs and Inputs, Transaction Fees, Transaction Scripts and Script Language, Turing Incompleteness, Stateless Verification, Script Construction (Lock + Unlock), Pay-to-Public-Key-Hash (P2PKH), Bitcoin Addresses, Balances, and Other Abstractions <b>Self-learning Topics:</b> Visit and use <a href="https://bitcoin.org/en/">https://bitcoin.org/en/</a>	<b>13</b>	CO4
V	<b>Bit coin Networks</b>	Peer-to-Peer Network Architecture, Node Types and Roles, Incentive based Engineering The Extended Bitcoin Network, Bitcoin Relay Networks, Network Discovery, Full Nodes, Exchanging "Inventory", Simplified Payment Verification (SPV) Nodes, Bloom Filters, SPV Nodes and Privacy, Encrypted and Authenticated Connections, Transaction Pools <b>Self-learning Topics:</b> Study technical papers based on bitcoin security	<b>7</b>	CO5
VI	<b>Blockchain Applications &amp; case studies</b>	Domain-Specific Applications: FinTech, Internet of Things, Industrial and Manufacturing, Energy, Supply chain & Logistics, Records & Identities, Healthcare Case studies related to cryptocurrencies Concept of Altcoin <b>Self-learning Topics:</b> Read Technical papers on blockchain applications	<b>8</b>	CO6

#### Text Books:

1. "Mastering Bitcoin, PROGRAMMING THE OPEN BLOCKCHAIN", 2nd Edition by Andreas M. Antonopoulos, June 2017, O'Reilly Media, Inc. ISBN: 9781491954386.
2. "Blockchain Applications: A Hands-On Approach", by ArshdeepBahga, Vijay Madiseti, Paperback – 31 January 2017.
3. "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", July 19, 2016, by Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University Press.

#### Reference Books:

1. "Mastering Blockchain", by Imran Bashir, Third Edition, Packt Publishing
2. "Mastering Ethereum: Building Smart Contracts and Dapps Paperback" by Andreas Antonopoulos, Gavin Wood, Publisher(s): O'Reilly Media

3. "Blockchain revolution: how the technology behind bitcoin is changing money, business and the world \$ don tapscott and alex tapscot, portfolio penguin, 856157449

**Online References:**

Sr. No.	Website Name
1	<a href="https://andersbrownworth.com/blockchain/">https://andersbrownworth.com/blockchain/</a>
2	<a href="https://andersbrownworth.com/blockchain/public-private-keys/">https://andersbrownworth.com/blockchain/public-private-keys/</a>
3	<a href="https://www.coursera.org/learn/cryptocurrency">https://www.coursera.org/learn/cryptocurrency</a>
4	<a href="https://coinmarketcap.com/">https://coinmarketcap.com/</a>

**Assessment:**

**Internal Assessment (IA) for 20 marks:**

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1 will be compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions will be mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

**Blockchain: Sem VI**

Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HBCC601	Block chain Platform	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg					
HBCC601	Block chain Platform	20	20	20	80	--	--	--	100

**Course Objectives:**

Sr. No.	Course Objectives
The course aims:	
1	Understand the blockchain platform and its terminologies.
2	Understand smart contracts, wallets, and consensus protocols.
3	Design and develop decentralized applications using Ethereum, and Hyperledger.
4	Creating blockchain networks using Hyperledger Fabric deployment.
5	Understand the considerations for creating blockchain applications.
6	Analyze various Blockchain Platforms.

**Course Outcomes:**

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Explain the Blockchain platform and its types.	L1,L2
2	Create Public Blockchain using Ethereum.	L3,L4,L5, L6
3	Develop Smart Contracts using REMIX IDE.	L3,L4,L5
4	Apply the concept of private blockchain using Hyperledger.	L3
5	Analyze different types of blockchain platforms.	L3,L4
6	Deploy Enterprise Applications on Blockchain.	L3,L4,L5

**DETAILED SYLLABUS:**

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Introduction to Block chain and Bit coin,	2	--
1	Introduction to Block chain Platforms	Why Blockchain Platform: Platform types, Public, Private, technology requirements for implementation.  Introduction to Ethereum, Hyperledger and Smart Contracts. Case study of blockchain Application.  <b>Self-learning Topics:</b> Study different applications of block chain.	6	CO1

II	<b>Public Blockchain</b>	Introduction, Characteristics of Public Blockchain, Advantages. Examples of Public Blockchain-Bitcoin: Terminologies and Transaction, Ethereum: Smart contract, Comparison of Bitcoin and Ethereum, Other public Blockchain platforms. <b>Self-learning Topics:</b> Study any one case study on public block chain.	<b>8</b>	CO2, CO3
III	<b>Ethereum Blockchain</b>	Introduction, Ethereum and Its Components: Mining, Gas, Ethereum, Ether, Ethereum Virtual Machine, Transaction, Accounts. Architecture of ethereum, Smart Contract: Remix IDE, Developing smart contract for ethereum blockchain, e-voting applications using smart contract, Dapp Architecture. Types of test-networks used in ethereum, Transferring Ethers Using MetaMask, Mist Wallet, Ethereum Frameworks, Case study of Ganache for ethereum blockchain. Deploying e-voting applications on Ganache framework. Ethereum 2., Concept of Beacon chain, POS (Proof of Stake), Sharding of Chain.  <b>Self-learning Topics:</b> Study case study on any ethereum blockchain.	<b>12</b>	CO2, CO3, CO6
IV	<b>Private Blockchain</b>	Introduction, Key Characteristics, Need of Private Blockchain. Consensus Algorithm for private Blockchain (Ex. RAFT and PAXOS), Smart Contract in Private Blockchain, Case Study of E-commerce Website, Design Limitations.  <b>Self-learning Topics:</b> Case study on private block chain.	<b>8</b>	CO4
V	<b>Hyperledger Blockchain</b>	Introduction to Hyperledger, tools and frameworks, Hyperledger Fabric, Comparison between Hyperledger Fabric & Other Technologies, Distributed Ledgers. Hyperledger Fabric Architecture, Components of Hyperledger Fabric: MSP, Chain Codes etc., Transaction Flow, Advantages of Hyperledger Fabric Blockchain, working of Hyperledger Fabric, Creating Hyperledger network, Case Study of Supply chain management using Hyperledger  <b>Self-learning Topics:</b> Case study on Hyperledger blockchain.	<b>12</b>	CO5, CO6
VI	<b>Other Blockchain platforms</b>	Corda, Ripple, Quorum and other emerging blockchain platforms, Case Study on any of the blockchain platforms. Developing Blockchain application on Cloud(AWS/Azure) <b>Self-learning Topics:</b> Compare different blockchain platforms.	<b>4</b>	CO5

**Text Book:**

- 1) Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhillash K. A and MeenaKarthikeyen, Universities press.
- 2) Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'reilly.

**Reference Books:**

- 1) Blockchain for Beginners, Yathish R and Tejaswini N, SPD
- 2) Blockchain Basics, A non Technical Introduction in 25 Steps, Daniel Drescher, Apress.

- 3) Blockchain with Hyperledger Fabric, LucDesrosiers, Nitin Gaur, Salman A. Baset, Venkatraman Ramakrishna, Packt Publishing

**E Books:**

- 1) Blockchain By Example, BellajBadr, Richard Horrocks, Xun (Brian) Wu, November 2018, Implement decentralized blockchain applications to build scalable Dapps.  
2) Blockchain for Business, <https://www.ibm.com/downloads/cas/3EGWKGX7>.

**Online References:**

Sr. No.	Website Name
1.	<a href="https://www.hyperledger.org/use/fabric">https://www.hyperledger.org/use/fabric</a>

**Assessment:**

**Internal Assessment (IA) for 20 marks:**

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered



### Blockchain: Sem VII

Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HBCC701	Blockchain Development	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg					
HBCC701	Block chain Development	20	20	20	80	--	--	--	100

#### Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand Ethereum Ecosystem.
2	To understand aspects of different programming languages.
3	To explain how to use the solidity programming language to develop a smart contract for blockchain.
4	To demonstrate deployment of smart contracts using frameworks.
5	To understand principles of Hyperledger fabric.
6	To understand challenges to apply blockchain in emerging areas.

#### Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	To use Ethereum Components.	L1,L2
2	To analyse different blockchain programming languages.	L3
3	To implement smart contract in Ethereum using solidity.	L4,L5
4	To analyse different development frameworks.	L4
5	To implement private blockchain network with Hyperledger fabric.	L4,L5
6	To illustrate blockchain integration with emerging technologies and security issues.	L1,L2

#### DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Blockchain cryptocurrency, Blockchain platform	2	--
I	Ethereum Ecosystem	Ethereum components: miner and mining node, Ethereum virtual machine, Ether, Gas, Transactions, accounts, swarm and whisper, Ethash, end to end transaction in Ethereum, architecture of Ethereum  <b>Self-learning Topics:</b> Emerging blockchain platforms	4	CO1
II	Blockchain Programming	Types of Blockchain Programming, Solidity, GoLang, Vyper, Java, Simplicity, Rholang, Game Theory and Cryptonomics,	8	CO2

		Comparative study of different blockchain programming languages  Decentralized file system-IPFS.  <b>Self-learning Topics:</b> Emerging blockchain programming languages		
III	<b>Smart Contract</b>	Solidity programming, Smart Contract programming using solidity, mapper function, ERC20 and ERC721 Tokens, comparison between ERC20 & ERC721, ICO, STOMetamask (Ethereum Wallet), setting up development environment, use cases of smart contract, smart Contracts: Opportunities, Risks  <b>Self-learning Topics:</b> Cryptocurrencies and their security issues, Consensus mechanisms, Digital Signatures	<b>10</b>	CO3
IV	<b>Blockchain Deployment</b>	Ethereum client, Ethereum Network, Introduction to Go Ethereum (Geth), Geth Installation and Geth CLI, Setting up a Private Ethereum Blockchain. Introduction to Truffle, Smart Contract deployment on a Private Blockchain. Introduction to Ganache  Introduction to Dapp, Dapp architecture, Daaps Scalability, testing  Connecting to the Blockchain and Smart Contract, Web3js, Deployment  <b>Self-learning Topics:</b> Smart Contract deployment using Ganache.	<b>10</b>	CO4
V	<b>Hyperledger Application Development</b>	Installing Hyperledger Fabric, Hyperledger Fabric Network, Building Your First Network, Hyperledger Fabric Demo, Hyperledger Fabric Network Configuration, Certificate Authorities, Chaincode Development and Invocation, Deployment and testing of chaincode on development network, Hyperledger Fabric Transactions  <b>Self-learning Topics:</b> Hyperledger sawtooth,Hyperledger caliper	<b>12</b>	CO5
VI	<b>Blockchain integration and Research challenges</b>	Integrating Blockchain with cloud, IoT, AI, ERP, End to end blockchain integration, Risks and Limitations of Blockchain: Privacy & Security. Criminal Use of Payment Blockchains, The “Dark” Side of Blockchain  Research challenges in blockchain, <b>Self-learning Topics:</b> Use Cases: Blockchain for Health Insurance, Blockchain in Supply chain management, Blockchain & PropTech, Blockchain in Banking	<b>6</b>	CO6

**Text Books:**

1. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'reilly.
2. Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhillash K. A and Meena Karthikeyen, Universities press

**References:**

1. Blockchain enabled Applications, Vikram Dhillon, DevidMetcalf, Max Hooper, Apress
2. Building Blockchain Projects, Narayan Prusty, Packt

**Online References:**

Sr. No.	Website Name
1.	<a href="https://ethereum.org/en/">https://ethereum.org/en/</a>
2.	<a href="https://hyperledger-fabric.readthedocs.io/en/release-2.2/whatis.html">https://hyperledger-fabric.readthedocs.io/en/release-2.2/whatis.html</a>
3.	<a href="https://www.blockchain.com/">https://www.blockchain.com/</a>
4.	<a href="https://docs.soliditylang.org/en/v0.7.4/">https://docs.soliditylang.org/en/v0.7.4/</a>

**Assessment:**

**Internal Assessment (IA) for 20 marks:**

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1 will be compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Blockchain: Sem VII								
		Teaching Scheme (Contact Hours)			Credits Assigned			
Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HBCSBL701	Private Blockchain Setup Lab(SBL)	--	4	--	--	02	--	02

Course Code	Course Title	Examination Scheme							
		Theory Marks					Term Work	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg.					
HBCSBL601	Private Blockchain Setup Lab(SBL)	--	--	--	--	50	50	100	

#### Lab Objectives:

Sr. No.	Lab Objectives
The Lab aims:	
1	To build and test Private Ethereum Blockchain.
2	To learn the concept of the genesis block and Account in the Blockchain.
3	To get familiar with the mining blocks to create a ether.
4	To understand and apply the concepts of keys, wallets.
5	To acquire the knowledge of gateway and desktop application.
6	To analyze the applications & case studies of Blockchain.

#### Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of lab, learner/student will be able to:		
1	To understand how blockchain systems (mainly Ethereum) work.	L1,L2
2	To create the genesis block using Puppeth, a CLI tool and account using Smart Contract.	L6
3	To create mining blocks, check the account and PoW.	L6
4	To use cryptocurrency exchanges and wallets safely.	L1,L2,L3
5	To create Gateway to Blockchain Apps.	L6
6	To use Blockchain on Mobile App and on Cloud.	L1,L2,L3

**Prerequisite:** Expertise in Programming, Basic knowledge of Computer Security, Networking.

#### Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With Following Configuration 1. PC i3/i5/i7 Processor or above. 2. 4 GB RAM 3. 500 GB Harddisk 4. Network interface card	1. NodeJs 2. Ethereum 3. Geth 4. Solidity	1. Internet Connection.

## DETAILED SYLLABUS:

Note: All practical are to be conducted on Linux platform its Compulsory for this entire practical

Sr. No	Module .	Description	Hours	LO Mapping
1	Build and Test	Install Ethereum network to create a private Ethereum Blockchain  Self- learning topic : Hyperledger	4	LO1
2	Build and Test	Installation of geth	5	LO1
3	Create the Genesis block	Create the genesis block using Puppeth, a CLI tool	5	LO2
4	Create Account in the blockchain	Smart contract	6	LO2
5	Mining Blocks to create Ether	Mine blocks, check account balance, PoWvsPoA	6	LO3
6	Gateway to Blockchain Apps	Metamask	5	LO4
7	Web and Desktop Application	Solidity programming on remix	6	LO4
8	Application Development	Crypto Exchange and Wallet	4	LO5
9	Application Development	Blockchain Mobile App or Web Application using Dapp	6	LO6
10	Application Development	Hosting of a private blockchain on cloud(AWS/Azure)	5	LO6

### Text Books:

1. Mastering Ethereum: Building Smart Contracts and Dapps, Andreas Antonopoulos, Gavin Wood, O'Reilly Publication
2. Mastering Blockchain, Second Edition: Distributed ledger technology, decentralization, and smart contracts explained, 2nd Edition, Imran Bashir
3. Solidity Programming Essentials: A beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, RiteshModi, Packt publication
4. Mastering Blockchain, Imran Bashir, Second Edition, Packt Publication.

### References Books:

1. Mastering Bitcoin, PROGRAMMING THE OPEN BLOCKCHAIN, 2nd Edition by Andreas M. Antonopoulos, June 2017, Publisher(s): O'Reilly Media, Inc. ISBN: 9781491954386.
2. Blockchain Applications: A Hands-On Approach, by ArshdeepBahga, Vijay Madiseti, Paperback – 31 January 2017.
3. Mastering Blockchain, Imran Bashir, Packt Publication.

### Online References:

Sr. No.	Website Name
1.	<a href="https://geth.ethereum.org/downloads/">https://geth.ethereum.org/downloads/</a>

2.	<a href="https://medium.com/@agrawalmanas09/how-to-setup-private-ethereum-blockchain-on-windows-10-machine-ab497e03d6b8">https://medium.com/@agrawalmanas09/how-to-setup-private-ethereum-blockchain-on-windows-10-machine-ab497e03d6b8</a>
3.	<a href="https://geth.ethereum.org/docs/dapp/">https://geth.ethereum.org/docs/dapp/</a>
4.	<a href="https://www.edureka.co/blog/ethereum-private-network-tutorial">https://www.edureka.co/blog/ethereum-private-network-tutorial</a>
5.	<a href="https://docs.soliditylang.org/en/develop/index.html">https://docs.soliditylang.org/en/develop/index.html</a>
6.	<a href="https://metamask.io">https://metamask.io</a>
7.	<a href="https://medium.com/publicaio/a-complete-guide-to-using-metamask-updated-version-cd0d6f8c338f">https://medium.com/publicaio/a-complete-guide-to-using-metamask-updated-version-cd0d6f8c338f</a>
8.	<a href="https://docs.aws.amazon.com/blockchain-templates/latest/developerguide/blockchain-templates-create-stack.html">https://docs.aws.amazon.com/blockchain-templates/latest/developerguide/blockchain-templates-create-stack.html</a>

**Term Work:**

The Term work shall consist of at least 10 to 12 practical based on the above syllabus. The term work Journal must include at least 2 assignments. The assignments should be based on real world applications which cover concepts from all above syllabus.

**Term Work Marks:** 50 Marks (Total marks) = 40 Marks (Experiment) + 5 Marks (Assignments/tutorial/write up) + 5 Marks (Attendance)

**Oral Exam:** An Oral exam will be held based on the above syllabus.

**Blockchain: Sem VIII**

Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HBCC801	DeFi (Decentralized Finance)	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam					
		Test1	Test 2	Avg						
HBCC801	DeFi (Decentralized Finance)	20	20	20	80	--	--	--	100	

**Course Objectives:**

Sr. No.	Course Objectives
The course aims:	
1	The basic concepts of Centralized and Decentralized Finance and compare them.
2	The DeFi System and its key categories.
3	The DeFi components, primitives, incentives, metrics and major business models where they are used.
4	The DeFi Architecture and EcoSystem.
5	The DeFi protocols.
6	The real time use cases of DeFi.

**Course Outcomes:**

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Explain the basic concepts of Centralized and Decentralized Finance and compare them.	L1, L2
2	Describe the the DeFi System and its key categories.	L1
3	Discuss the DeFi components, primitives, incentives, metrics and major business models where they are used.	L1, L2
4	Explain the DeFi Architecture and EcoSystem.	L1, L2
5	Illustrate the DeFi protocols.	L1
6	Discuss the real time use cases of DeFi.	L1,L2

**DETAILED SYLLABUS:**

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	<b>Prerequisite</b>	Blockchain & Cryptocurrency, Blockchain Platform, Blockchain Development	02	-
I	<b>Introduction:</b>	Difference between Centralized and Decentralized Finance, Traditional Financial Institution- Banks: 1. Payment and	06	CO1



	<b>Centralized and decentralized finance</b>	Clearance systems, 2. Accessibility, 3. Centralization and Transparency, Decentralized Finance Vs Traditional Finance <b>Self-learning Topics:</b> The Potential Impact of Decentralized Finance		
II	<b>What is decentralized finance (defi)?</b>	The DeFi Ecosystem, Problems that DeFi Solves How Decentralized is DeFi? Defi key Categories:-Stablecoins, Stable coin and pegging, Lending and Borrowing, Exchanges, Derivations, Fund Management, Lottery, Payments, Insurance <b>Self-learning Topics:</b> How Decentralized Finance Could Make Investing More Accessible.	<b>06</b>	CO2
III	<b>DeFi Primitives and Business Models</b>	3.1 DeFi Components: Blockchain Cryptocurrency The Smart Contract Platform Oracles Stablecoins Decentralized Applications  3.2 DeFi Primitives: Transactions Fungible Token: Equity Tokens, Utility Tokens and Governance TokensNFT: NFT Standard, Multi-token standard Custody Supply Adjustment: Burn-Reduce Supply, Mint-Increase Supply, Bonding Curve-Pricing Supply  Incentives: Staking Rewards, Slashing, Direct Rewards and Keepers, Fees  Swap: Order Book Matching, Automated Market Makers  Collateralized Loans Flash Loans (Uncollateralized Loans)  3.3 DeFi Key Metrics: Total Value Locked, Daily Active Users,Market Cap  3.4 DeFi Major Business Models: Decentralized Currencies, Decentralized Payment Services, Decentralized fundraising, Decentralized Contracting  <b>Self-learning Topics:</b> Study any real time Business model.	<b>10</b>	CO3
IV	<b>DeFi Architecture and EcoSystem</b>	4.1DeFi Architecture: Consumer Layer: Blockchains, Cross-Blockchain networks, Oracles, Digital Asset Layer: Cryptocurrencies, Infrastructure Layer: Wallets and Asset Management, DEXes and Liquidity, Lending and Borrowing, Prediction Markets, Synthetic Assets, Insurance  4.2 DeFi EcoSystem and Protocols: On-chain Asset Exchange, Loanable Fund Markets on-chain assets, Stablecoins, Portfolio Management, Derivatives, Privacy-preserving mixers  4.3 DeFi Risk and Challenges: Technical Risks, Usability Risks, Centralization Risks, Liquidity Risks, Regulation Risk	<b>10</b>	CO4

		<b>Self-learning Topics:</b> Study of the Problems which are holding DeFi adoption back		
V	<b>DeFi Deep Dive</b>	<p>5.1. Maker DAO: Maker Protocol: Dai Stablecoins, Maker Vaults, Maker Protocol Auctions  Maker Actors: Keepers, Price Oracles, Emergency Oracles, DAO Teams, Dai Savings Rate  Dai Use case Benefits and Examples</p> <p>5.2. UniSwap: UniSwap Protocol Overview: How UniSwap Works, EcoSystem Participants, Smart Contracts  UniSwap Core Concepts: Swaps, Pools, Flash Swaps, Oracles</p> <p>5.3. Compound: Compound Protocol: Supplying Assets, Borrowing Assets, Interest Rate Model  Compound Implementation and Architecture: cToken Contracts, Interest Rate Mechanics, Borrowing, Liquidation, Price Feeds, Comptroller, Governance</p> <p>5.4. wBTC: Need for wBTC: Tokenization and common Issues  wBTC Implementation and Technology: Users, Custodian Wallet Setup, Minting, Burning  wBTC Governance, wBTC vs Atomic Swaps, Fees, Legal Binding, Trust Model and Transparency</p> <p><b>Self-learning Topics:</b>  MakerDAO Governance, UniSwap Governance Protocol Math, Compound Protocol Math</p>	<b>10</b>	CO5
VI	<b>Use Cases</b>	<p>6.1 Decentralized Exchanges  6.2 Decentralized Stablecoins  6.3 Decentralized Money Markets  6.4 Decentralized Synthetix  6.5 Decentralized Insurance  6.6 Decentralized Autonomous Organization (DAO),</p> <p><b>Self-learning Topics:</b>  Stock Exchange Operations, Derivatives, Tether, Ampleforth, How to get stablecoins, Synthetix Network, Token, The Ongoing Impact of The DAO's Rise and Fall, DAO Projects</p>	<b>08</b>	CO6

**Text Books:**

1. How to DeFi, Darren Lau, Daryl Lau, Teh Sze Jin, Kristian Kho, Erina Azmi, TM Lee, Bobby Ong-1st Edition, March 2020
2. DeFi and the Future of Finance-Campbell R. Harvey
3. DeFi Adoption 2020 A Definitive Guide to Entering the Industry

**Reference Books/White Papers:**

1. Blockchain disruption and decentralized finance: The rise of decentralized business models-Yan Chen, Cristiano Bellavitis
2. SoK: Decentralized Finance (DeFi)-Sam M. Werner, Daniel Perez, Lewis Gudgeon, Arian Klages-Mundt, Dominik Harz\*‡, William J. Knottenbelt, Imperial College London, † Cornell University, Interlay
4. Decentralized Finance (DeFi) –A new Fintech Revolution?
5. <https://makerdao.com/da/whitepaper/>
6. <https://uniswap.org/>
7. <https://compound.finance/documents/Compound.Whitepaper.pdf>
8. <https://wbtc.network/assets/wrapped-tokens-whitepaper.pdf>

9. <https://defiprime.com/exchanges>
10. <https://defirate.com/stablecoins/>
11. <https://academy.ivanontech.com/blog/decentralized-money-markets-and-makerdao>
12. <https://www.gemini.com/cryptopedia/nexus-mutual-blockchain-insurance-nxm-crypto>
13. <https://consensys.net/blockchain-use-cases/decentralized-finance/>
14. [https://tokenlon.zendesk.com/hc/en-us/articles/360041114431-DeFi-Explained-Synthetic-Assets,](https://tokenlon.zendesk.com/hc/en-us/articles/360041114431-DeFi-Explained-Synthetic-Assets)  
<https://www.blockchain-council.org/synthetic/synthetic-snx-the-biggest-ecosystem-in-decentralized-finance/>

**Online References:**

Sr. No.	Website Name
1.	<a href="https://www.udemy.com/">https://www.udemy.com/</a>
2.	<a href="https://www.coursera.org/">https://www.coursera.org/</a>

**Assessment:**

**Internal Assessment (IA) for 20 marks:**

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1 will be compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions will be mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

# University of Mumbai



## Syllabus

**Honours/ Minor Degree Program**

**in**

**Cyber Security**

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Cyber Security**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral/Pract	Total	Credits
TE Sem V	HCSC501: Ethical Hacking	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>--</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
TE Sem. VI	HCSC601: Digital Forensic	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
BE Sem. VII	HCSC701: Security Information Management	04	--	--	20	80	--	--	100	04
	HCSSBL601: Vulnerability Assessment Penetration Testing (VAPT) Lab (SBL)	--	--	04	--	--	50	50	100	02
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>04</b>	<b>100</b>	<b>50</b>	<b>50</b>	<b>200</b>	<b>06</b>	
<b>Total Credits = 06</b>										
BE Sem. VIII	HCSC801: Application Security	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V,VI, VII &amp;VIII = 04+04+06+04=18</b>										

Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
HCSC501	Ethical Hacking	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam					
		Test 1	Test 2	Avg. of 2 Tests						
HCSC501	Ethical Hacking	20	20	20	80	--	--	--	100	

### Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To describe Ethical hacking and fundamentals of computer Network.
2	To understand about Network security threats, vulnerabilities assessment and social engineering.
3	To discuss cryptography and its applications.
4	To implement the methodologies and techniques of Sniffing techniques, tools, and ethical issues.
5	To implement the methodologies and techniques of hardware security.
6	To demonstrate systems using various case studies.

### Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Articulate the fundamentals of Computer Networks, IP Routing and core concepts of ethical hacking in real world scenarios.	L1,L2
2	Apply the knowledge of information gathering to prevent penetration testing and social engineering attacks.	L3
3	Demonstrate the core concepts of Cryptography, Cryptographic checksums and evaluate the various biometric authentication mechanisms.	L1,L2
4	Apply the knowledge of network reconnaissance to prevent Network and web application-based attacks.	L3
5	Apply the concepts of hardware elements and endpoint security to provide security to physical devices.	L3
6	Simulate various attack scenarios and evaluate the results.	L4,L5

### DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	<b>Prerequisite</b>	Computer Networks, Databases, system security	<b>2</b>	-
I	<b>Introduction to Ethical Hacking</b>	Fundamentals of Computer Networks/IP protocol stack, IP addressing and routing, Routing protocol, Protocol vulnerabilities, Steps of ethical hacking, Demonstration of Routing Protocols using Cisco Packet Tracer  <b>Self-learning Topics:</b> TCP/IP model, OSI model	<b>10</b>	CO1
II	<b>Introduction to Cryptography</b>	Private-key encryption, public key-encryption, key Exchange Protocols, Cryptographic Hash Functions & applications, steganography, biometric authentication, lightweight cryptographic algorithms. Demonstration of various cryptographic tools and hashing algorithms  <b>Self-learning Topics:</b> Quantum cryptography, Elliptic curve cryptography	<b>08</b>	CO3
III	<b>Introduction to network security</b>	Information gathering, reconnaissance, scanning, vulnerability assessment, Open VAS, Nessus, System hacking: Password cracking, penetration testing, Social engineering attacks, Malware threats, hacking wireless networks (WEP, WPA, WPA-2), Proxy network, VPN security, Study of various tools for Network Security such as Wireshark, John the Ripper, Metasploit, etc.  <b>Self-learning Topics:</b> Ransomware(Wannacry), Botnets, Rootkits, Mobile device security	<b>12</b>	CO2
IV	<b>Introduction to web security and Attacks</b>	OWASP, Web Security Considerations, User Authentication, Cookies, SSL, HTTPS, Privacy on Web, Account Harvesting, Web Bugs, Sniffing, ARP poisoning, Denial of service attacks, Hacking Web Applications, Clickjacking, Cross-Site scripting and Request Forgery, Session Hijacking and Management, Phishing and Pharming Techniques, SSO, Vulnerability assessments, SQL injection, Web Service Security, OAuth 2.0, Demonstration of hacking tools on Kali Linux such as SQLMap, HTTrack, hping, burp suite, Wireshark etc. <b>Self-learning Topics:</b> Format string attacks	<b>10</b>	CO4
V	<b>Elements of Hardware Security</b>	Side channel attacks, physical unclonable functions, Firewalls, Backdoors and trapdoors,	<b>6</b>	CO5



		Demonstration of Side Channel Attacks on RSA, IDS and Honeypots. <b>Self-learning Topics:</b> IoT security		
VI	<b>Case Studies</b>	Various attacks scenarios and their remedies. Demonstration of attacks using DVWA. <b>Self-learning Topics:</b> Session hijacking and man-in-middle attacks	<b>4</b>	CO6

**Text Books:**

1. Computer Security Principles and Practice --William Stallings, Seventh Edition, Pearson Education, 2017
2. Security in Computing -- Charles P. Pfleeger, Fifth Edition, Pearson Education, 2015
3. Network Security and Cryptography -- Bernard Menezes, Cengage Learning, 2014
4. Network Security Bible -- Eric Cole, Second Edition, Wiley, 2011
5. Mark Stamp's Information Security: Principles and Practice --Deven Shah, Wiley, 2009

**References:**

1. UNIX Network Programming –Richard Steven, Addison Wesley, 2003
2. Cryptography and Network Security -- Atul Kahate, 3rd edition, Tata Mc Graw Hill, 2013
3. TCP/IP Protocol Suite -- B. A. Forouzan, 4th Edition, Tata Mc Graw Hill, 2017
4. Applied Cryptography, Protocols Algorithms and Source Code in C -- Bruce Schneier, 2nd Edition / 20th Anniversary Edition, Wiley, 2015

**Online Resources:**

Sr. No.	Website Name
1.	<a href="https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project">https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project</a>
2.	<a href="https://dvwa.co.uk/">https://dvwa.co.uk/</a>
3.	<a href="http://testphp.vulnweb.com/">http://testphp.vulnweb.com/</a>

**Assessment:**

**Internal Assessment (IA) for 20 marks:**

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
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- A total of **four questions** need to be answered

Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
HCSC601	Digital Forensic	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
HCSC601	Digital Forensic	20	20	20	80	--	--	--	100

#### Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand the various computer and cyber-crimes in the digital world.
2	To understand a significance of digital forensics life cycle, underlying forensics principles and investigation process.
3	To understand the importance of File system management with respect to computer forensics.
4	To be able to identify the live data in case of any incident handling and application of appropriate tools and practices for the same.
5	To Develop the skills in application of various tools and investigation report writing with suitable evidences.
6	To be able to identify the network and mobile related threats and recommendation of suitable forensics procedures for the same.

#### Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify and define the class for various computer and cyber-crimes in the digital world.	L1,L2
2	Understand the need of digital forensic and the role of digital evidence.	L1,L2
3	Understand and analyze the role of File systems in computer forensics.	L1,L2,L3
4	Demonstrate the incident response methodology with the best practices for incidence response with the application of forensics tools.	L3
5	Generate/Write the report on application of appropriate computer forensic tools for investigation of any computer security incident .	L5
6	Identify and investigate threats in network and mobile.	L4

#### DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	<p><b>Computer Hardware:</b> Motherboard, CPU, Memory: RAM, Hard Disk Drive (HDD), Solid State Drive (SSD), Optical drive</p> <p><b>Computer Networks:</b> Introduction CN Terminology: Router, Gateway, OSI and TCP/IP Layers</p> <p><b>Operating Systems:</b> Role of OS in file management, Memory management utilities, Fundamentals of file systems used in Windows and Linux.</p>	2	--
I	Introduction to Cybercrime and Computer-crime	<p><b>1.1 Definition and classification of cybercrimes:</b> Definition, Hacking, DoS Attacks, Trojan Attacks, Credit Card Frauds, Cyber Terrorism, Cyber Stalking.</p> <p><b>1.2 Definition and classification of computer crimes:</b> Computer Viruses, Computer Worms.</p> <p><b>1.3 Prevention of Cybercrime:</b> Steps that can be followed to prevent cybercrime, Hackers, Crackers, Phreakers.</p> <p><b>Self-learning Topics:</b> Steps performed by Hacker</p>	4	CO1
II	Introduction to Digital Forensics and Digital Evidences	<p><b>2.1 Introduction to Digital Forensics:</b> Introduction to Digital Forensics and lifecycle, Principles of Digital Forensic.</p> <p><b>2.2 Introduction to Digital Evidences:</b> Challenging Aspects of Digital Evidence, Scientific Evidence, Presenting Digital Evidence.</p> <p><b>2.3 Digital Investigation Process Models:</b> Physical Model, Staircase Model, Evidence Flow Model.</p> <p><b>Self-learning Topics:</b> Digital Investigation Process Models comparison and its application, Rules of Digital Evidence.</p>	5	CO2
III	Computer Forensics	<p><b>3.1 OS File Systems Review:</b> Windows Systems- FAT32 and NTFS, UNIX File Systems, MAC File Systems</p> <p><b>3.2 Windows OS Artifacts:</b> Registry, Event Logs</p>	7	CO3

		<p><b>3.3 Memory Forensics :</b> RAM Forensic Analysis, Creating a RAM Memory Image, Volatility framework, Extracting Information</p> <p><b>3.4 Computer Forensic Tools:</b> Need of Computer Forensic Tools, Types of Computer Forensic Tools, Tasks performed by Computer Forensic Tools</p> <p><b>Self-learning Topics:</b> Study of ‘The Sleuth Kit’ Autopsy tool for Digital Forensics</p>		
IV	<b>Incident Response Management, Live Data Collection and Forensic Duplication</b>	<p><b>4.1 Incidence Response Methodology:</b> Goals of Incident Response, Finding and Hiring IR Talent</p> <p><b>4.2 IR Process:</b> Initial Response, Investigation, Remediation, Tracking of Significant Investigative Information.</p> <p><b>4.3 Live Data Collection:</b> Live Data Collection on Microsoft Windows,</p> <p><b>4.4 Forensic Duplication:</b> Forensic Duplicates as Admissible Evidence, Forensic Duplication Tools: Creating a Forensic evidence, Duplicate/Qualified Forensic Duplicate of a Hard Drive.</p> <p><b>Self-learning Topics:</b> Live Data Collection on Unix-Based Systems</p>	<b>10</b>	CO4
V	<b>Forensic Tools and Report Writing</b>	<p><b>5.1 Forensic Image Acquisition in Linux :</b> Acquire an Image with dd Tools, Acquire an Image with Forensic Formats, Preserve Digital Evidence with Cryptography, Image Acquisition over a Network, Acquire Removable Media</p> <p><b>5.2 Forensic Investigation Report Writing:</b> Reporting Standards, Report Style and Formatting, Report Content and Organization.</p> <p><b>Self-learning Topics:</b> Case study on Report Writing</p>	<b>10</b>	CO5
VI	<b>Network Forensics and Mobile Forensics</b>	<p><b>6.1 Network Forensics:</b> Sources of Network-Based Evidence, Principles of Internetworking, Internet Protocol Suite, Evidence Acquisition, Analyzing Network Traffic: Packet Flow and Statistical Flow, Network Intrusion Detection and Analysis, Investigation of Routers, Investigation of Firewalls</p> <p><b>6.2 Mobile Forensics:</b> Mobile Phone Challenges, Mobile phone evidence extraction</p>	<b>14</b>	CO6

		process, Android OS Architecture, Android File Systems basics, Types of Investigation, Procedure for Handling an Android Device, Imaging Android USB Mass Storage Devices.  <b>Self-learning Topic:</b> Elcomsoft iOS Forensic Toolkit, Remo Recover tool for Android Data recovery		
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### Text Books:

1. Digital Forensics by Dr. Dhananjay R. Kalbande Dr. Nilakshi Jain, Wiley Publications, First Edition, 2019.
2. Digital Evidence and Computer Crime by Eoghan Casey, Elsevier Academic Press, Third Edition, 2011.
3. Incident Response & Computer Forensics by Jason T. Luttgens, Matthew Pepe and Kevin Mandia, McGraw-Hill Education, Third Edition (2014).
4. Network Forensics : Tracking Hackers through Cyberspace by Sherri Davidoff and Jonathan Ham, Pearson Edu,2012
5. Practical Mobile Forensic by Satish Bommisetty, Rohit Tamma, Heather Mahalik, PACKT publication, Open source publication, 2014 ISBN 978-1-78328-831-1
6. The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory by Michael Hale Ligh (Author), Andrew Case (Author), Jamie Levy (Author), AAaron Walters (Author), Publisher : Wiley; 1st edition (3 October 2014),

### References:

1. Scene of the Cybercrime: Computer Forensics by Debra Littlejohn Shinder, Syngress Publication, First Edition, 2002.
2. Digital Forensics with Open Source Tools by Cory Altheide and Harlan Carvey, Syngress Publication, First Edition, 2011.
3. Practical Forensic Imaging Securing Digital Evidence with Linux Tools by Bruce Nikkel, NoStarch Press, San Francisco,(2016)
4. Android Forensics : Investigation, Analysis, and Mobile Security for Google Android by Andrew Hogg, Elsevier Publication,2011

### Online References:

Sr. No.	Website Name
1.	<a href="https://www.pearsonitcertification.com/articles/article.aspx?p=462199&amp;seqNum=2">https://www.pearsonitcertification.com/articles/article.aspx?p=462199&amp;seqNum=2</a>
2.	<a href="https://flylib.com/books/en/3.394.1.51/1/">https://flylib.com/books/en/3.394.1.51/1/</a>
3.	<a href="https://www.sleuthkit.org/autopsy/">https://www.sleuthkit.org/autopsy/</a>
4.	<a href="http://md5deep.sourceforge.net/md5deep.html">http://md5deep.sourceforge.net/md5deep.html</a>
5.	<a href="https://tools.kali.org/">https://tools.kali.org/</a>
6.	<a href="https://kalilinuxtutorials.com/">https://kalilinuxtutorials.com/</a>
7.	<a href="https://accessdata.com/product-download/ftk-imager-version-4-3-0">https://accessdata.com/product-download/ftk-imager-version-4-3-0</a>
8.	<a href="https://www.amazon.in/Art-Memory-Forensics-Detecting-Malware/dp/1118825098">https://www.amazon.in/Art-Memory-Forensics-Detecting-Malware/dp/1118825098</a>

## Research Papers: Mobile Forensics/Guidelines on Cell Phone Forensics

1. Computer Forensics Resource Center: NIST Draft Special Publication 800-101 :  
<https://csrc.nist.gov/publications/detail/sp/800-101/rev-1/final>
2. <https://cyberforensicator.com/category/white-papers>
3. <https://www.magnetforensics.com/resources/ios-11-parsing-whitepaper/>
4. Samarjeet Yadav , Satya Prakash , Neelam Dayal and Vrijendra Singh, "Forensics Analysis WhatsApp in Android Mobile Phone", Electronic copy available at: <https://ssrn.com/abstract=3576379>

### Assessment:

#### Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

#### ➤ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
HCSC701	Security Information Management	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
HCSC701	Security Information Management	20	20	20	80	--	--	--	100

#### Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	The course is aimed to focus on cybercrime and need to protect information.
2	Understand the types of attacks and how to tackle the amount of risk involved.
3	Discuss the role of industry standards and legal requirements with respect to compliance.
4	Distinguish between different types of access control models, techniques and policy.
5	Awareness about Business Continuity and Disaster Recovery.
6	Awareness about Incident Management and its life cycle.

#### Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Understand the scope of policies and measures of information security to people.	L1,L2
2	Interpret various standards available for Information security.	L1,L2
3	Apply risk assessment methodology.	L3
4	Apply the role of access control to Identity management.	L3
5	Understand the concept of incident management, disaster recovery and business continuity.	L1,L2
6	Identify common issues in web application and server security.	L3

#### DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Vulnerability Assessment for Operating Systems, Network (Wired and Wireless). Tools for conducting Reconnaissance.	2	--



I	<b>Basics of Information Security</b>	<p>1.1 What is Information Security &amp; Why do you need it? –</p> <p>1.2 Basics Principles of Confidentiality, Integrity</p> <p>1.3 Availability Concepts, Policies, procedures, Guidelines, Standards</p> <p>1.4 Administrative Measures and Technical Measures, People, Process, Technology, IT ACT 2000, IT ACT 2008</p> <p><b>Self-learning Topics:</b> Impact of IT on organizations, Importance of IS to Society</p>	6	CO1, CO2
II	<b>Current Trends in Information Security</b>	<p>2.1 Cloud Computing: benefits and Issues related to information Security.</p> <p>2.2 Standards available for InfoSec: Cobit, Cadbury, ISO 27001, OWASP, OSSTMM.</p> <p>2.3 An Overview, Certifiable Standards: How, What, When, Who.</p> <p><b>Self-learning Topics:</b> Cloud Threats, Impact of cloud computing on users, examples of cloud service providers: Amazon, Google, Microsoft, Salesforce etc.</p>	8	CO2
III	<b>Threat &amp; Risk Management</b>	<p>3.1 Threat Modelling: Threat, Threat-Source, Vulnerability, Attacks.</p> <p>3.2 Risk Assessment Frameworks: ISO 31010, NIST-SP-800-30, OCTAVE</p> <p>3.3 Risk Assessment and Analysis: Risk Team Formation, Information and Asset Value, Identifying Threat and Vulnerability, Risk Assessment Methodologies</p> <p>3.4 Quantification of Risk, Identification of Monitoring mechanism, Calculating Total Risk and Residual Risk.</p> <p><b>Self-learning Topics:</b> Risk management trends today and tomorrow.</p>	8	CO3
IV	<b>Identity and Access Management</b>	<p>4.1 Concepts of Identification, Authentication, Authorization and Accountability.</p> <p>4.2 Access Control Models: Discretionary, Mandatory, Role based and Rule-based.</p> <p>4.3 Access Control Techniques: Constrained User, Access control Matrix, Content-dependent, Context – dependent</p> <p>4.4 Access Control Methods: Administrative, Physical, Technical, Layering of Access control</p> <p>4.5 Access Control Monitoring: IDS and IPS and anomaly detection.</p> <p>4.6 Accountability: Event-Monitoring and log reviews. Log Protection</p> <p>4.7 Threats to Access Control: Various Attacks on the Authentication systems.</p> <p><b>Self-learning Topics:</b> challenges and solutions in identity and access management</p>	10	CO4

V	<b>Operational Security</b>	<p><b>5.1</b> Concept of Availability, High Availability, Redundancy and Backup.</p> <p><b>5.2</b> Calculating Availability, Mean Time Between Failure (MTBF), Mean Time to Repair (MTTR)</p> <p><b>5.3</b> Incident Management: Detection, Response, Mitigation, Reporting, Recovery and Remediation</p> <p><b>5.4</b> Disaster Recovery: Metric for Disaster Recovery, Recovery Time Objective (RTO), Recovery Point Objective (RPO), Work Recovery Time (WRT), Maximum Tolerable Downtime (MTD), Business Process Recovery, Facility Recovery (Hot site, Warm site, Cold site, Redundant site), Backup &amp; Restoration</p> <p><b>Self-learning Topics:</b> Challenges and Opportunities of Having an IT Disaster Recovery Plan</p>	<b>10</b>	CO5
VI	<b>Web Application, Windows, and Linux security</b>	<p><b>6.1</b> Types of Audits in Windows Environment</p> <p><b>6.2</b> Server Security, Active Directory (Group Policy), Anti-Virus, Mails, Malware</p> <p><b>6.3</b> Endpoint protection, Shadow Passwords, SUDO users, etc.</p> <p><b>6.4</b> Web Application Security: OWASP, Common Issues in Web Apps, what is XSS, SQL injection, CSRF, Password Vulnerabilities, SSL, CAPTCHA, Session Hijacking, Local and Remote File Inclusion, Audit Trails, Web Server Issues, etc.</p> <p><b>Self-learning Topics:</b>, Network firewall protection, Choosing the Right Web Vulnerability Scanner</p>	<b>8</b>	CO6

### Textbooks:

1. Shon Harris, Fernando Maymi, CISSP All-in-One Exam Guide, McGraw Hill Education, 7<sup>th</sup> Edition, 2016.
2. Andrei Miroshnikov, Introduction to Information Security - I, Wiley, 2018
3. Ron Lepofsky, The Manager's Guide to Web Application Security, Apress; 1st ed. edition, 2014

### References:

1. Rich-Schiesser, IT Systems Management: Designing, Implementing and Managing World - Class Infrastructures, Prentice Hall; 2 edition, January 2010.
2. NPTEL Course: - Introduction to Information Security – I (URL: <https://nptel.ac.in/noc/courses/noc15/SEM1/noc15-cs03/>)
3. Dr. David Lanter – ISACA COBIT – 2019 Framework - Introduction and Methodology
4. Pete Herzog, OSSTMM 3, ISECOM
5. NIST Special Publication 800-30, Guide for Conducting Risk Assessments, September 2012

### Online References:

Sr. No.	Website Name
1.	<a href="https://www.ultimatewindowssecurity.com/securitylog/book/Default.aspx">https://www.ultimatewindowssecurity.com/securitylog/book/Default.aspx</a>
2.	<a href="http://www.ala.org/acrl/resources/policies/chapter14">http://www.ala.org/acrl/resources/policies/chapter14</a>
3.	<a href="https://advisera.com/27001academy/what-is-iso-27001/">https://advisera.com/27001academy/what-is-iso-27001/</a>

4.	<a href="https://nvlpubs.nist.gov/nistpubs/legacy/sp/nistspecialpublication800-30r1.pdf">https://nvlpubs.nist.gov/nistpubs/legacy/sp/nistspecialpublication800-30r1.pdf</a>
5.	<a href="http://www.diva-portal.org/smash/get/diva2:1117263/FULLTEXT01.pdf">http://www.diva-portal.org/smash/get/diva2:1117263/FULLTEXT01.pdf</a>

### Assessment:

#### Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

#### ➤ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

		Teaching Scheme (Contact Hours)			Credits Assigned			
Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HCSSBL601	Vulnerability Assessment Penetration Testing (VAPT) Lab (SBL)	--	4	--	--	2	--	02

Course Code	Course Title	Examination Scheme							
		Theory Marks					Term Work	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
HCSSBL601	Vulnerability Assessment Penetration Testing (VAPT) Lab (SBL)	--	--	--	--	50	50	100	

### Lab Objectives:

Sr. No.	Lab Objectives
The Lab aims:	
1	To identify security vulnerabilities and weaknesses in the target applications.
2	To discover potential vulnerabilities which are present in the system in network using vulnerability assessment tools.
3	To identify threats by exploiting them using penetration test attempt by utilizing the vulnerabilities in a system
4	To recognize how security controls can be improved to prevent hackers gaining access controls to database.
5	To test and exploit systems using various tools and understands the impact in system logs.
6	To write a report with a full understanding of current security posture and what work is necessary to both fix the potential threat and to mitigate the same source of vulnerabilities in the future

### Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of lab, learner/student will be able to:		
1	Understand the structure where vulnerability assessment is to be performed.	L1,L2
2	Apply assessment tools to identify vulnerabilities present in the system in network.	L3

3	Evaluate attacks by executing penetration tests on the system or network.	L4
4	Analyse a secure environment by improving security controls and applying prevention mechanisms for unauthorised access to database.	L5
5	Create security by testing and exploit systems using various tools and remove the impact of hacking in system.	L6
6	Formation of documents as per applying the steps of vulnerabilities of assessment and penetration testing.	L3, L4, L5

**Prerequisite:** Computer Networks, Basic of Network Security.

**Hardware & Software Requirements:**

Hardware Requirements	Software Requirements	Other Requirements
PC With Following Configuration 1. Intel PIV Processor 2. 4 GB RAM 3. 500 GB Harddisk 4. Network interface card	1. Windows or Linux Desktop OS 2. Security Software and tools	1. Internet Connection.

**DETAILED SYLLABUS:**

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	<b>Prerequisite</b>	Computer Network, Basics of Network Security, Ethical Hacking, Digital Forensics	2	
I	<b>Human Security (Social Engineering) Assessment</b>	<b>Visibility Audit:</b> Collecting information through social media and internet. Collecting contact details (like phone number, email ID, What's App ID, etc) <b>Active Detection Verification:</b> Test if the phone number, email id etc are real by test message. Test whether the information is filtered at point of reception. Test if operator / another person assistance can be obtained. <b>Device Information:</b> IP Address, Port details, Accessibility, Permissions, Role in business <b>Trust Verification:</b> Test whether the information can be planted in form of note / email / Message (Phishing) <b>Test Subjects:</b> College Staff, Reception, PA to Director / Principal. To conduct information gathering to conduct social engineering audit on various sections in your college. <b>Self-Learning Topics:</b> Networking Commands	8	LO1
II	<b>Network &amp; Wireless Security Assessment</b>	<b>Network Discovery:</b> Using various tools to discover the various connected devices, to get device name, IP Address, relation of the device in network, Detection of	8	LO2

		<p>Active port, OS Fingerprinting, Network port and active service discovery</p> <p><b>Tools:</b> IP Scanner, Nmap etc</p> <p><b>Network Packet Sniffing:</b> Packet Sniffing to detect the traffic pattern, Packet capturing to detect protocol specific traffic pattern, Packet capturing to reassemble packet to reveal unencrypted password</p> <p><b>Tools:</b> Wireshark</p> <p><b>Self-Learning Topics:</b> Learning the CVE database for vulnerabilities detected.</p>		
III	<b>Setting up Pentester lab</b>	<p>Including an attacker machine preferably Kali and in the same subnet victim machines either DVWA/SEEDlabs/ multiple VULNHUB machines as and when required. Understanding Categories of pentest and legalities/ ethics.</p> <p>Installed Kali machine on VM environment with some VULNHUB machines and we can find out vulnerability of Level 1-VULNHUB machine like deleted system files, permissions of files.</p> <p><b>Self learning Topics:</b> Vulnerability exploitation for acquire root access of the Kioptrx machine</p>	9	LO3
IV	Database and Access Control Security Assessment	<p><b>Database Password Audit:</b> Tool based audit has to be performed for strength of password and hashes.</p> <p><b>Tools:</b> DBPw Audit</p> <p><b>Blind SQL Injection:</b> Test the security of the Database for SQL Injection</p> <p><b>Tools:</b> BSQL Hacker</p> <p><b>Password Audit:</b> Perform the password audit on the Linux / Windows based system</p> <p><b>Tools:</b> Cain &amp; Able, John the ripper, LCP Password Auditing tools for Windows.</p> <p><b>Active Directory and Privileges Audit:</b> Conduct a review of the Active Directory and the Group Policy to assess the level of access privileges allocated.</p> <p><b>Tools:</b> SolarWinds</p> <p><b>Self-Learning Topics:</b> Federated Database security challenges and solutions.</p>	9	LO4
V	Log Analysis	<p>Conduct a log analysis on Server Event Log / Firewall Logs / Server Security Log to review and obtain insights</p> <p>Tools: graylog, Open Audit Module.</p> <p><b>Self-Learning Topics:</b> Python and R-Programming scripts</p>	6	LO5
VI	Compliance and Observation Reporting	<p><b>License Inventory Compliance:</b></p> <p>Identify the number of licenses and its deployment in your organization.</p> <p>Tools: Belarc Advisor, Open Audit Report Writing: NESSUS tool</p> <p>Report should contain:</p>	10	LO6

		<p>a. Vulnerability discovered</p> <p>b. The date of discovery</p> <p>c. Common Vulnerabilities and Exposure (CVE) database reference and score; those vulnerabilities found with a medium or high CVE score should be addressed immediately</p> <p>d. A list of systems and devices found vulnerable</p> <p>e. Detailed steps to correct the vulnerability, which can include patching and/or reconfiguration of operating systems or applications</p> <p>f. Mitigation steps (like putting automatic OS updates in place) to keep the same type of issue from happening again</p> <p><b>Purpose of Reporting:</b> Reporting provides an organization with a full understanding of their current security posture and what work is necessary to both fix the potential threat and to mitigate the same source of vulnerabilities in the future.</p> <p><b>Self-Learning Topics:</b> Study of OpenVAS, Nikto, etc.</p>		
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### Text & Reference Books and Links:

1. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws Paperback – Illustrated, 7 October 2011 by Dafydd Stuttard
2. Hacking: The Art of Exploitation, 2nd Edition 2nd Edition by Jon Erickson
3. Important links of Vulnhub: Vulnhub Kioptrix  
Download Link: <https://www.vulnhub.com/entry/basic-pentesting-1,216/>  
<https://www.vulnhub.com/entry/kioptrix-level-1-1,22/>  
Installation Video: <https://youtu.be/JupQRHtfZmw>  
Walkthrough/solutions Video: <https://youtu.be/Qn2cKYZ6kBI>
4. OWASP Broken Web Application Projects  
<https://sourceforge.net/projects/owaspbwa/>
5. Mastering Modern Web Penetration Testing By Prakhar Prasad, October 2016, Packt Publishing.
6. Kali Linux Revealed: Mastering the Penetration Testing Distribution – June 5, 2017 by Raphael Hertzog (Author), Jim O'Gorman (Author), Offsec Press Publisher

### Term Work:

The Term work shall consist of at least 10 to 12 practical based on the above syllabus. The term work Journal must include at least 2 assignments. The assignments should be based on real world applications which cover concepts from all above syllabus.

**Term Work Marks:** 50 Marks (Total marks) = 40 Marks (Experiment) + 5 Marks Assignments/tutorial/write up) + 5 Marks (Attendance)

**Oral Exam:** An Oral exam will be held based on the above syllabus.



Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
HCSC801	Application Security	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
HCSC801	Application Security	20	20	20	80	--	--	--	100

**Course Objectives:**

Sr. No.	Course Objectives
The course aims:	
1	The terms and concepts of application Security, Threats, and Attacks
2	The countermeasures for the threats wrt Application security.
3	The Secure Coding Practices
4	The Secure Application Design and Architecture
5	The different Security Scanning and testing techniques
6	The threat modeling approaches

**Course Outcomes:**

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Enumerate the terms of application Security, Threats, and Attacks	L1
2	Describe the countermeasures for the threats with respect to Application security.	L1
3	Discuss the Secure Coding Practices.	L2
4	Explain the Secure Application Design and Architecture.	L2
5	Review the different Security Scanning and testing techniques.	L2
6	Discuss the threat modeling approaches.	L2

**DETAILED SYLLABUS:**

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	<b>Prerequisite</b>	Operating System, DBMS, Computer Network, Web Programming, OOP	02	-

I	<b>Introduction to Application Security, Threats, and Attacks</b>	<p>Introduction to Web Application Reconnaissance, Finding Subdomains, API Analysis, Identifying Weak Points in Application Architecture</p> <p><b>Offense:</b> Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), XML External Entity (XXE) Injection, Injection Attacks, Denial of Service (DoS), Cross-Origin Resource Sharing Vulnerabilities</p> <p><b>Self-learning Topics: Simulate the attacks using open-source tools in virtual environment</b></p>	<b>05</b>	CO1
II	<b>Defence and tools</b>	<p>Securing Modern Web Applications, Secure Application Architecture, Reviewing Code for Security, Vulnerability Discovery, Defending Against XSS Attacks, Defending Against CSRF Attacks, Defending Against XXE, Defending Against Injection attacks, Defending Against DoS, Defending against CORS based attacks</p> <p><b>Self-learning Topics: Implement the countermeasures to the attacks using open-source tools</b></p>	<b>09</b>	CO2
III	<b>Secure Coding Practices</b>	<p>Security Requirements, Encryption, Never Trust System Input, Encoding and Escaping, Third-Party Components, Security Headers: Seatbelts for Web Apps, Securing Your Cookies, Passwords, Storage, and Other Important Decisions, HTTPS Everywhere, Framework Security Features, File Uploads, Errors and Logging, Input Validation and Sanitization, Authorization and Authentication, Parameterized Queries, Least Privilege, Requirements Checklist</p> <p><b>Self-learning Topics: OWASP Secure Coding Practices</b></p>	<b>09</b>	CO3
IV	<b>Secure Application Design and Architecture</b>	<p><b>Secure Software Development Lifecycle</b></p> <p>Averting Disaster Before It Starts, Team Roles for Security, Security in the Software Development Lifecycle,</p> <p><b>Design Flaw vs. Security Bug,</b></p> <p><b>Secure Design Concepts,</b></p> <p><b>Segregation of Production Data,</b></p>	<b>09</b>	CO4

		<b>Application Security Activities</b> <b>Self-learning Topics: Secure Hardware architecture</b>		
V	<b>Security Scanning and testing</b>	Testing Your Code, Testing Your Application, Testing Your Infrastructure, Testing Your Database, Testing Your APIs and Web Services, Testing Your Integrations, Testing Your Network, Dynamic Web Application Profiling  <b>Self-learning Topics: Open-source Application Security Tools, IAST, RASP and WAF, Selenium</b>	<b>09</b>	CO5
VI	<b>Threat Modeling</b>	<b>Objectives and Benefits of Threat Modeling,</b> Defining a Risk Mitigation Strategy, Improving Application Security, Building Security in the Software Development Life Cycle  <b>Existing Threat Modeling Approaches</b> Security, Software, Risk-Based Variants  <b>Threat Modeling Within the SDLC</b> Building Security in SDLC with Threat Modeling, Integrating Threat Modeling Within the Different Types of SDLCs,  <b>Self-learning Topics: The Common Vulnerability Scoring System (CVSS)</b>	<b>09</b>	CO6

**Text Books:**

1. Alice and Bob Learn Application Security, by Tanya Janca Wiley; 1st edition (4 December 2020)
2. Web Application Security, A Beginner's Guide by Bryan Sullivan McGraw-Hill Education; 1st edition (16 January 2012)
3. Web Application Security: Exploitation and Countermeasures for Modern Web Applications by Andrew Hoffman Shroff/O'Reilly; First edition (11 March 2020)
4. The Security Development Lifecycle by Michael Howard Microsoft Press US; 1st edition (31 May 2006)
5. Risk Centric Threat Modeling Process for Attack Simulation And Threat Analysis, Tony Ucedavélez and Marco m. Morana, Wiley
6. Iron-Clad Java: Building Secure Web Applications (Oracle Press) 1st Edition by Jim Manico

**References:**

1. Software Security: Building Security In by Gary McGraw Addison-Wesley Professional; 1st edition (January 23, 2006)
2. A Guide to Securing Modern Web Applications by Michal Zalewski
3. Threat Modeling: A Practical Guide for Development Teams by Izar Tarandach and Matthew J. Coles Dec 8, 2020

## Online References:

Sr. No.	Website Name
1.	<a href="https://owasp.org/www-project-top-ten/">https://owasp.org/www-project-top-ten/</a>
2.	<a href="https://owasp.org/www-pdf-archive/OWASP_SCP_Quick_Reference_Guide_v2.pdf">https://owasp.org/www-pdf-archive/OWASP_SCP_Quick_Reference_Guide_v2.pdf</a>
3.	<a href="https://pentesterlab.com/">https://pentesterlab.com/</a>
4.	<a href="https://app.cybrary.it/browse/course/advanced-penetration-testing">https://app.cybrary.it/browse/course/advanced-penetration-testing</a>
5.	<a href="https://www.udemy.com/">https://www.udemy.com/</a>
6.	<a href="https://www.coursera.org/">https://www.coursera.org/</a>

## Assessment:

### Internal Assessment (IA) for 20 marks:

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#### ➤ Question paper format

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- A total of **four questions** need to be answered

# University of Mumbai



## Syllabus

**Honours/Minor Degree Program**

**In**

**Augmented Reality and Virtual Reality**

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Augmented Reality and Virtual Reality**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral/Pract	Total	Credits
TE Sem V	HARVRC501: Virtual Reality	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	-	--	<b>100</b>	-	-	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
TE Sem. VI	HARVRC601: AR and Mix Reality	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	-	-	<b>100</b>	-	-	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
BE Sem. VII	HARVRC701: ARVR Application-I	04	--	--	20	80	--	--	100	04
	HARVRSBL701: ARVR Lab (SBL)	--	--	04	--	--	50	50	100	02
	<b>Total</b>	<b>04</b>	-	<b>04</b>	<b>100</b>	<b>50</b>	<b>50</b>	<b>200</b>	<b>06</b>	
<b>Total Credits = 06</b>										
BE Sem. VIII	HARVRC801: Game Development with VR	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	-	-	<b>100</b>	-	-	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V,VI, VII &amp;VIII = 04+04+06+04 = 18</b>										

### Augmented Reality and Virtual Reality: Sem V

Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HARVRC501	Virtual Reality	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam					
		Test1	Test 2	Avg.						
HARVRC501	Virtual Reality	20	20	20	80	--	--	--	100	

#### Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand primitives of computer graphics fundamental.
2	To analyze various Hardware devices suitable for VR.
3	To analyze visual physiology and issues related to it.
4	To apply the knowledge of Visual rendering.
5	To evaluate problems faced due to audio scattering in VR.
6	To create different interface in VR environment.

#### Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Solve Computer Graphics Problems.	L1
2	Analyze application of VR hardware and software components.	L1, L2, L3
3	Identify issues related to visual physiology.	L1, L2
4	Integrate various shading and rendering techniques.	L6
5	Solve problems due to Audio distortions.	L5
6	Create User Interface for VR.	L6

**Prerequisite:** Basic C programming

#### DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Functioning of human sensory organs – EYE, Ear, Touch etc.	02	--



		Light and Lenses Basic functioning of camera Matrix multiplication		
I	<b>Geometry of Virtual World</b>	Geometric Modeling, 2D transformations, Homogenous coordinate system, 3D rotation and 6 degree of freedom, Viewport Transformation  <b>Self:</b> Eye Transformation, demo of 2D transformation	<b>10</b>	<b>CO1</b>
II	<b>Introduction to VR</b>	Introduction to VR and definitions and its components., Hardware components: Display devices: LCD, OLED Audio: Speakers, Earphones, Bone conduction Touch: Haptic Device GPU and CPU, Input devices like game controller, data gloves, Joysticks  Tracking Hardware: Industrial measurement Unit-IMU, Gyroscope, accelerometer Software component: Java3D, VRML <b>Self:</b> Feedback mechanisms in VR environment	<b>07</b>	<b>CO2</b>
III	<b>Visual Physiology, perception and tracking</b>	Functioning of Eye with photoreceptors, Resolution for VR, Eye movements and issues with it in VR, Neuroscience of vision, Depth and motion perception, Frame rates and display, Orientation tracking, tilt and yaw drift correction, Tracking with camera  <b>Self:</b> Light House approach	<b>08</b>	<b>CO3</b>
IV	<b>Visual Rendering</b>	Overview, shading models, rendering pipelines, rasterization, pixel shading, Distortion shading, post rendering image wrap  <b>Self:</b> Rendering for VR application	<b>09</b>	<b>CO4</b>
V	<b>Audio</b>	Physics of Audio, Auditory Perception, localization, rendering, Problems due to scattering of audio  <b>Self:</b> Study reaction of audio and other senses for VR environment	<b>10</b>	<b>CO5</b>
VI	<b>Interfaces</b>	Locomotion, Manipulation, system control, social interaction using open-source tool like Gopro VR etc.  <b>Self:</b> Explore tools for UI in VR	<b>06</b>	<b>CO6</b>

**Text Books:**

1. Hearn and Baker, "Computer Graphics- C version", 2<sup>nd</sup> edition, Pearson, 2002.
2. R. K Maurya, "Computer Graphics with Virtual Reality", 3<sup>rd</sup> Edition, Wiley India, 2018.
3. Steven M. LaVelle, "Virtual Reality", Cambridge University press, 2019

4. Grigore Burdea, Philippe Coiffet, "Virtual Reality Technology", 2<sup>nd</sup> Edition, Wiley India, 2003
5. Vince, "Virtual Reality Systems", 1<sup>st</sup> Edition, Pearson Education, 2002

**References:**

1. George Mather, "Foundations of Sensation and Perception", Psychology Press book; 3<sup>rd</sup> Edition, 2016
2. Tony Parisi, "Learning Virtual Reality", 1<sup>st</sup> edition, O'Reilly, 2015
3. Alan Craig and William Sherman, "Understanding virtual reality: Interface, application and design", 2<sup>nd</sup> Edition, Morgan Kaufmann Publisher, 2019
4. Peter Shirley, Michael Ashikhmin, and Steve Marschner, "Fundamentals of Computer Graphics", A K Peters/CRC Press; 4<sup>th</sup> Edition, 2016.

**Online Resources:**

Sr. No.	Website Name
1.	<a href="https://nptel.ac.in/courses/121/106/121106013/#">https://nptel.ac.in/courses/121/106/121106013/#</a>
2.	<a href="http://msl.cs.uiuc.edu/vr/">http://msl.cs.uiuc.edu/vr/</a>
3.	<a href="http://lavalle.pl/vr/">http://lavalle.pl/vr/</a>

**Assessment:**

**Internal Assessment (IA) for 20 marks:**

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

### Augmented Reality and Virtual Reality: Sem VI

Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HARVRC601	AR and Mix Reality	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam					
		Test1	Test 2	Avg. of 2 Tests						
HARVRC601	AR and Mix Reality	20	20	20	80	--	--	--	100	

#### Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand the concepts of Augmented Reality and related technologies.
2	To understand the AR tracking system and use of computer vision in AR/MR.
3	To describe the technology for multimodal user interaction and authoring in AR.
4	To use different AR toolkits and apply them to develop AR applications.
5	To demonstrate AR Applications using Mobile AR Toolkits and SDKs.
6	To understand the use of AR/MR in interdisciplinary immersive applications.

#### Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify and compare different Augmented Reality and Mixed Reality Technologies.	L1, L2
2	Apply concepts of Computer Vision for tracking in AR and MR Systems.	L3
3	Model different interfaces and authoring in AR/MR.	L3
4	Design AR/MR applications using open source platforms and toolkits.	L6
5	Design Mobile based AR Applications.	L6
6	Apply insights of AR/MR in different applications.	L3

**Prerequisite:** Programming Language, Computer Graphics, Virtual Reality

#### DETAILED SYLLABUS:

Module	Title	Description	Hours	CO
0	Pre-requisite	Basics of Computer Graphics, Coordinate Systems, VR Introduction, Tracking in VR	02	--

I	<b>Introduction to Augmented Reality and Mixed Reality</b>	<p>Definition and Scope, A Brief History of Augmented Reality, AR Architecture, Related Fields of AR (like Mixed Reality, Virtual Reality, Immersive Reality, Extended Reality) and Their comparison, General Architecture of Mixed Reality System, Algorithm Steps in Mixed Reality</p> <p><b>Self-Learning Topics:</b> How AR/MR are related to Ubiquitous Computing, Multidimensional Systems.</p>	<b>06</b>	CO1
II	<b>Tracking and Computer Vision for AR and MR</b>	<p>Multimodal Displays; Visual Perception; Spatial Display Model; Visual Displays; Tracking, Calibration and Registration; Coordinate Systems; Characteristics of Tracking Technology; Stationary Tracking Systems; Mobile Sensors; Optical Tracking; Sensor Fusion; Marker Tracking; Multiple Camera Infrared Tracking; Natural Feature Tracking by Detection; Incremental Tracking; Simultaneous Localization and Tracking; Outdoor Tracking</p> <p><b>Self-Learning Topics:</b> Indoor Tracking, Full Body Tracking</p>	<b>07</b>	CO2
III	<b>Interaction, Modeling and Annotation and Authoring</b>	<p>Output Modalities, Input Modalities, Tangible Interfaces, Virtual User Interfaces on Real Surfaces, Multi-view Interfaces, Haptic Interaction, Multimodal Interaction, Specifying Geometry, Specifying Appearance, Semi-automatic Reconstruction, Free-form Modeling, Annotation, Requirement of AR Authoring, Elements of Authoring, Stand-alone Authoring Solutions, Plug-in Approaches, Web Technology</p> <p><b>Self-Learning Topics:</b> Case Study on Object Annotation in Real Time, Avatar Modeling.</p>	<b>08</b>	CO3
IV	<b>Software Architecture in AR and AR Development Toolkits</b>	<p>AR Application Requirements, Software Engineering Requirements, Distributed Object Systems, Data Flow, Scene Graphs; Developer Support: Parameter Configuration, Declarative Scripting, Procedural Scripting, Mixed Language Programming, Runtime Reconfiguration, Choosing an AR Platforms and Toolkits; AR Non-programming Frameworks, AR Programming Frameworks, Programming AR using ARToolkit.</p> <p><b>Self-Learning Topics:</b> Commercial AR Frameworks, AR Related Markup Languages</p>	<b>10</b>	CO4
V	<b>Mobile AR</b>	<p>Types of Mobile Apps, AR Browsers for Smartphones, Point of Interests (POI) in Mobile AR, POI Authoring and Publishing Tools, AR Applications for Android, AR Games for Android, Mobile AR Toolkits and SDKs, Developing Mobile AR Applications, AR Application Development for Android Smartphone</p> <p><b>Self-Learning Topics:</b> AR Applications for iOS, AR Games for iOS, AR Application Development for iOS Smartphone</p>	<b>10</b>	CO5
VI	<b>Applications of AR/MR and Human</b>	<p>Applications of AR/MR in: Edutainment, Medical, Military, Production and Manufacturing, Navigation, Astronomical Observation, E-commerce; What are Human Factors, Physical</p>	<b>07</b>	CO6

	<b>Factors, Legal and Social Considerations</b>	Side Effects, Visual Side Effects, Legal Considerations, Moral and Ethical Considerations.  <b>Self-Learning Topics:</b> Applications of AR/MR in Civil Construction and Architecture, Collaboration, Information Control and Big Data Visualization		
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#### Textbooks:

1. Dieter Schmalsteig and Tobias Hollerer, “Augmented Reality- Principles and Practice”, Pearson Education, Inc. 2016 Edition.
2. Chetankumar G Shetty, “Augmented Reality- Theory, Design and Development”, Mc Graw Hill, 2020 Edition.
3. Alan B. Craig, “Understanding Augmented Reality – Concepts and Applications”, Morgan Kaufmann, Elsevier, 2013 Edition.

#### References:

1. Borko Furht, “Handbook of Augmented Reality”, Springer, 2011 Edition.
2. Erin Pangilinan, Steve Lukas, and Vasanth Mohan, “Creating Augmented and Virtual Realities- Theory and Practice for Next-Generation Spatial Computing”, O’Reilly Media, Inc., 2019 Edition.
3. Jens Grubert, Dr. Raphael Grasset, “Augmented Reality for Android Application Development”, PACKT Publishing, 2013 Edition.

#### Online Resources:

Sr. No.	Website Name
1.	www.nptel.ac.in
2.	www.coursera.org

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Augmented Reality and Virtual Reality: Sem VII								
Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HARVRC701	ARVR Application-I	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg					
HARVRC701	ARVR Application-I	20	20	20	80	--	--	--	100

#### Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To learn the underlying concepts of Virtual Reality, Augmented Reality and related technologies.
2	To analyse the principles of VR design, prototype.
3	To analyse the principles of AR design, prototype.
4	To design Graphical User interface using VR
5	To identify trends in XR, key issues in XR and XR Tools.
6	To analyse privacy, ethical, social concern on AR/VR problem.

#### Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Apply modelling techniques on Augmented Reality applications..	L1, L2, L3
2	Gets an overview of guidelines, methods, tools and pick design problems in Virtual Reality.	L1, L2
3	Gets an overview of guidelines, methods, tools and pick design problems in Augmented Reality.	L1, L2
4	Evaluate designs based on theoretical frameworks and build Graphical User interface using VR, Tools	L3, L4
5	Apply the appropriate XR development Approach on problem	L3
6	Analyse main concerns with respect to designed solutions and discuss the privacy, ethical, social concerns.	L3, L4

**Prerequisite:** Programming Language, Computer Graphics, Virtual Reality

#### DETAILED SYLLABUS:

Module	Title	Description	Hours	CO
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0	<b>Prerequisite</b>	Fundamental Concept and Components of Virtual Reality, Augmented Reality and Mixed Reality Technologies, Authoring in AR	<b>02</b>	--
I	<b>AR/VR Concepts and Technologies</b>	Difference between AR and VR, Rendering for VR/AR, Challenges with AR,AR systems and functionality  <b>Augmented Reality Application Development:</b> Types of Augmented Reality Application (Location Based AR Apps Marker-Based AR Applications), three-dimensional modeling and computer vision, displays & tracking technologies  <b>Self-learning Topic:</b> Case study on Retail shopping using AR	<b>08</b>	CO1
II	<b>VR Design Overview</b>	Principles of VR design, Overview of guidelines, methods, tools & design problem, Physical Prototyping for VR- Physical prototype of potential solution, Digital Prototyping for VR- tool choices, digital prototype of (key aspects of) solution <b>Self-learning Topic:</b> Study of 3D navigation , layout and contents	<b>09</b>	CO2
III	<b>AR Design Overview</b>	Principles of AR design, Overview of guidelines, methods, tools & design problem, Physical Prototyping for AR - Physical prototype of potential solution, Digital Prototyping for AR- tool choices, digital prototype of (key aspects of) solution.  <b>Self-learning Topic:</b> Use of Anchors in AR	<b>09</b>	CO3
IV	<b>3 D interaction with VR</b>	3 D interaction Overview and types, Navigation in VR, Object interaction, Graphical User interface using VR, Challenges in VR interaction, Tools  <b>Self-learning Topic:</b> Case study of Mobile applications using 3D interface	<b>10</b>	CO4
V	<b>XR Application Development</b>	XR overview, XR development Approach, XR design process, Trends in XR, key issues in XR, Tools  <b>Self-learning Topic:</b> Difference between, AR, VR, MR and XR	<b>10</b>	CO5
VI	<b>Privacy and security</b>	Privacy, Ethical, and Social Implications, and the Future of AR/VR  <b>Self-learning Topic:</b> Case study on Privacy and security issues using AR and VR	<b>04</b>	CO6

**Textbooks:**

1. John Vince, " Virtual Reality Systems", Pearson publication
2. Tony Parisi, " Learning Virtual Reality", O'REILLY'
3. Dieter Schmalsteig and Tobias Hollerer, "Augmented Reality- Principles and Practice", Pearson Education, Inc. 2016 Edition.
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- A total of **four questions** need to be answered

Augmented Reality and Virtual Reality: Sem VII								
		Teaching Scheme (Contact Hours)			Credits Assigned			
Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HARVRSBL701	ARVR Lab (SBL)	--	4	--	--	2	--	2

Course Code	Course Title	Examination Scheme						
		Theory Marks				Term Work	Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg.				
HARVRSBL601	ARVR Lab (SBL)	--	--	--	--	50	50	100

#### Lab Objectives:

Sr. No.	Lab Objectives
The lab course aims:	
1	To Understand the definition and significance of the VR,AR and MR.
2	To Design various applications in VR .
3	To Examine various audio tools for audio embedded in scene
4	To Explore AR and MR applications in real world
5	To develop interface for VR and AR applications
6	To Explore the interconnection and integration of the physical world and able to design & develop Mobile applications.

#### Lab Outcomes

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Adapt different tools to implement VR,AR and MR.	L1,L2
2	Demonstrate the working of VR background design.	L1,L2
3	Apply audio tools and developed real world application.	L1,L2,L3
4	Adapt different techniques for Integrating AR and MR concepts in applications.	L5
5	Create interface for selected application	L6
6	Create application and interface for mobile application /desktop version	L6

#### Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With Following Configuration 1. PC i3/i5/i7 Processor or above. 2. 4 GB RAM 3. 500 GB Harddisk 4. Network interface card	1. Unity 2. Python 3.OpenCV 4. Solidity	1. Internet Connection.

**Prerequisite:** VR, AR and MR concepts

## Suggested List of Experiments

ARVR lab will describe the Designing of VR and AR applications using different Tools. It starts with installation of software and then learner learn how to design background of various application. Now a day's audio implementation in VR scenes is also getting lots of attention so this aspect is also covered in the lab experiments. AR and MR are important concepts where learner design the applications for desktop as well as mobile environment.

Sr. No.	Detailed Content	LO Mapping
1	To install Open source software /Unity with its functionality	LO1
2	Select real world application and design background for the same	LO2
3	To add sound in the selected application using Open source software /Unity software	LO3
4	To study interface requirements and apply for the selected application	LO3
5	Creating Your Digital Prototype of your objects/environment – (WebVR/ Sketchup / Blender/Unity/Keynote/Figma)	LO6
6	To implement a depth map with Python and OpenCV and using Unity	LO5
7	Identify multiple surfaces and move objects between them using ARCore	LO3
8	To study Interact with AR objects and detect collisions.	LO2
9	Marker less Object Placement - WebAR	LO4
10	In a group of three to five students develop one real world application in VR/ AR or MR with object details and sound with good user interface	LO6

### Text Books/ References:

1. Hearn and Baker, "Computer Graphics- C version", 2nd edition, Pearson, 2002.
2. R. K Maurya, "Computer Graphics with Virtual Reality", 3rd Edition, Wiley India, 2018.
3. Dieter Schmalsteig and Tobias Hollerer, "Augmented Reality- Principles and Practice", Pearson Education, Inc. 2016 Edition.
4. Chetankumar G Shetty, "Augmented Reality- Theory, Design and Development", Mc Graw Hill, 2020 Edition.
5. Alan B. Craig, "Understanding Augmented Reality – Concepts and Applications", Morgan Kaufmann, Elsevier, 2013 Edition.

### Online Resources:

Sr. No.	Website Name
1.	<a href="https://nptel.ac.in/courses/121/106/121106013/#">https://nptel.ac.in/courses/121/106/121106013/#</a>
2.	<a href="http://msl.cs.uiuc.edu/vr/">http://msl.cs.uiuc.edu/vr/</a>
3.	<a href="http://lavallo.pl/vr">http://lavallo.pl/vr</a>
4.	<a href="http://nptel.ac.in">http://nptel.ac.in</a>
5.	<a href="http://www.coursera.org">www.coursera.org</a>

### Term Work:

The Term work shall consist of at least 10 to 12 practical based on the above syllabus. The term work Journal must include at least 2 assignments. The assignments should be based on real world applications which cover concepts from all above syllabus.

**Term Work Marks:** 50 Marks (Total marks) = 40 Marks (Experiment) + 5 Marks (Assignments/tutorial/write up) + 5 Marks (Attendance)

**Oral Exam:** An Oral exam will be held based on the above syllabus.

### Augmented Reality and Virtual Reality: Sem VIII

Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HARVRC801	Game Development with VR	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam					
		Test1	Test 2	Avg.						
HARVRC801	Game Development with VR	20	20	20	80	--	--	--	100	

#### Course Objectives

Sr. No.	Course Objectives
The course aims:	
1	The different genres of game and explain the Unity UI Basics.
2	The use of navigation and cursor control to create a game environment.
3	How to import assets, interact with them using action objects and manage object states.
4	To build transitions by scripting events ,using physics, particle systems, and other Unity functionality action sequences with UnityGUI design.
5	To build the game project together by handling mecanim ,using dialogue trees, creating and setting up the game environment and menus for the game.
6	The VR development in Unity.

#### Course Outcomes

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify the different genres of game and explain the Unity UI Basics	L1,L2
2	Make use of navigation and cursor control to create a game environment	L3
3	Apply how to import assets ,interact with them using action objects and manage object states	L3
4	Build transitions by scripting events ,using physics, particle systems, and other Unity functionality action sequences with UnityGUI design	L3
5	Build the game project together by handling mecanim ,using dialogue trees,creating and setting up the game environment and menus for the game	L3
6	Explain VR development in Unity	L2

**Prerequisite:** Basics of VR

**DETAILED SYLLABUS:**

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	<b>Prerequisite</b>	VR Basic concepts	<b>02</b>	-
I	<b>Game Development and Unity UI Basics</b>	<p>The Adventure Genre, Fast Forward to Real-Time, What Draws People to This Genre? Designing Your Game: Defining a Style, Compartmentalizing Environments, First-Person or Third? Animation, Basic Human Characteristics Make for Fun? Managing Your Project, Tips for Completing the Game, Real Time vs. Pre-render.AI in Gaming-AI Guidelines, a simple workflow.</p> <p>Unity UI: The Layout, Toolbar, Menus, Creating Simple Objects, Selecting and Focusing, Transforming Objects In 3D, Snaps, Scene Gizmo.Lights,3D Objects, Materials</p> <p>Scripting: What is a script? Components of a Script, Picking an Object in the Game, Conditionals and State, Order of Evaluation</p> <p><b>Self-learning Topics:</b> Understanding the role of AI in gaming</p>	<b>08</b>	CO1
II	<b>Navigation and Cursor Control</b>	<p>Creating Environments, Navigation-Arrow Navigation and Input, Fun with Platforms, Collision Walls, Cursor visibility, Custom cursors, GUI Texture Cursor, Hardware Cursor, UnityGUI Cursor, Object-to-Object Communication, Mouseover Cursor Changes, Object Reaction to Mouseover</p> <p><b>Self-learning Topics:</b> Multimodal Gaming for Navigation Skills in Players Who Are Blind</p>	<b>06</b>	CO2
III	<b>Imported Assets, Objects &amp; Managing states</b>	<p>Imported Assets:3D Art Assets, Setting Up Materials, Shadows.</p> <p>Action Objects: Colliders, Triggering Animation, Adding Sound F/X,</p> <p>Managing States: Identifying the Action Objects, Developing a State Machine, Lookup Table, Scripting in Unity, Picking a script Editor, Fundamentals of scripting in Unity. The Object Lookup Script, Action-Related Messages</p> <p><b>Self-learning Topics:</b> Study the new Asset Import Pipeline: Solid foundation for speeding up asset imports, Effects of scripting on dialogues.</p>	<b>09</b>	CO3
IV	<b>Transitions, Text Management</b>	<p>Processing the Auxiliary Objects, Handling Object Visibility, Ensuring Player Focus,</p> <p>Adding New Assets, Physics, Combining Physics and Keyframe Animation, Particle systems,</p> <p>GUI Skin, Text Visibility, Using Layers, Creating the Inventory Screen, Adding Inventory Icons, Managing the inventory.</p> <p><b>Self-learning Topics:</b> Importance of effective Text management in Gaming</p>	<b>09</b>	CO4

V	<b>Game Deployment</b>	Dialogue Trees, The Scenario, Starting a Conversation, Mecanim and Characters, Game Environment, Setting up the game, Menus and levels  <b>Self-learning Topics:</b> Branching dialogue trees and its effect in Gaming. Study of different UI designs for Menus in Games.	<b>09</b>	CO5
VI	<b>XR development in Unity</b>	Unity platform and services, XR Getting started with AR development in Unity, Getting started with VR development in Unity, XR Plug-in Framework, Configuring your Unity Project for XR, Universal Render Pipeline compatibility in XR, XR API reference, Single Pass Stereo rendering (Double-Wide rendering), VR Audio Spatializers, VR frame timing ,Unity XR SDK, Open-source repositories using Bitbucket, Asset Store Publishing, use of unity as library in other application.  <b>Self-learning Topics:</b> Study any open source tool for VR Development	<b>09</b>	CO6

**Text Books:**

1. Beginning 3D Game Development with Unity 4 All-in-one Multi-platform Game development, 2<sup>nd</sup> Edition, Apress, Sue Backman
2. Game Development with Unity 2nd Edition, Michelle Menard and Bryan Wagstaff
3. Unity Game development Essentials, Will Goldstone, PACKT Publishing
4. Unity Game Development Cookbook-Essentials for every Game, O'reilly, Paris Buttfield-Addison, Jon Manning-Tim Nugent.

**Reference Books:**

1. Introduction to Gam Development, Second Edition, Steve Rabin, CENGAGE Learning
2. Sams Teach Yourself Unity Game Development in 24 Hours-Mike Geig

**Online References:**

Sr. No.	Website Name
1.	<a href="https://docs.unity3d.com/Manual/VROverview.html">https://docs.unity3d.com/Manual/VROverview.html</a>
2.	<a href="https://www.coursera.org/">https://www.coursera.org/</a>
3.	<a href="https://www.udemy.com/">https://www.udemy.com/</a>

**Assessment:**

**Internal Assessment (IA) for 20 marks:**

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

# University of Mumbai



**Syllabus for**

**Honours/Minor Degree Program**

**In**

**Artificial Intelligence and Machine Learning**

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)



**University of Mumbai**  
**Artificial Intelligence and Machine Learning (AI&ML)**  
**(With effect from 2022-23)**

Year & Sem	Course Code & Course Title	Teaching Scheme Hrs / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar / Tutorial	Practical	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HAIMLC501: Mathematics for AI & ML	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>--</b>	<b>100</b>	<b>-</b>	<b>-</b>		<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										
TE Sem VI	HAIMLC601: Game Theory using AI & ML	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>		<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										
BE Sem VII	HAIMLC701: AI&ML in Healthcare	04	--	--	20	80	--	--	100	04
	HAIMLSBL701: AI&ML in Healthcare: Lab	--	--	04	--	--	50	50	100	02
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>04</b>	<b>100</b>	<b>50</b>	<b>50</b>		<b>200</b>	<b>06</b>
<b>Total Credits = 06</b>										
BE Sem VIII	HAIMLC801: Text, Web and Social Media Analytics	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>		<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V,VI, VII &amp;VIII = 04+04+06+04 = 18</b>										

Artificial Intelligence and Machine Learning: Sem V								
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HAIMLC501	Mathematics for AI&ML	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration In Hours	Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test2	Avg.					
HAIMLC501	Mathematics for AI&ML	20	20	20	80	03	--	--	100

<b>Course Prerequisites:</b>	
Applied Mathematics, Discrete mathematics	
<b>Course Objectives:</b>	
1	To build an intuitive understanding of Mathematics and relating it to Artificial Intelligence, Machine Learning and Data Science.
2	To provide a strong foundation for probabilistic and statistical analysis mostly used in varied applications in Engineering.
3	To focus on exploring the data with the help of graphical representation and drawing conclusions.
4	To explore optimization and dimensionality reduction techniques.
<b>Course Outcomes:</b>	
After successful completion of the course, the student will be able to:	
1	Use linear algebra concepts to model, solve, and analyze real-world problems.
2	Apply probability distributions and sampling distributions to various business problems.
3	Select an appropriate graph representation for the given data.
4	Apply exploratory data analysis to some real data sets and provide interpretations via relevant visualization
5	Analyze various optimization techniques.
6	Describe Dimension Reduction Algorithms

Module No.	Topics	Hrs.
1.0	<b>Linear Algebra</b>	05
1.1	Vectors and Matrices, Solving Linear equations, The four Fundamental Subspaces, Eigenvalues and Eigen Vectors, The Singular Value Decomposition (SVD).	
2.0	<b>Probability and Statistics</b>	09
2.1	Introduction, Random Variables and their probability Distribution, Random Sampling, Sample Characteristics and their Distributions, Chi-Square, t-, and F-Distributions: Exact Sampling Distributions, Sampling from a Bivariate Normal Distribution, The Central Limit Theorem.	
3.0	<b>Introduction to Graphs</b>	10

	3.1	Quantitative vs. Qualitative data, Types of Quantitative data: Continuous data, Discrete data, Types of Qualitative data: Categorical data, Binary data, Ordinary data, Plotting data using Bar graph, Pie chart, Histogram, Stem and Leaf plot, Dot plot, Scatter plot, Time-series graph, Exponential graph, Logarithmic graph, Trigonometric graph, Frequency distribution graph.	
<b>4.0</b>		<b>Exploratory Data Analysis</b>	<b>09</b>
	4.1	Need of exploratory data analysis, cleaning and preparing data, Feature engineering, Missing values, understand dataset through various plots and graphs, draw conclusions, deciding appropriate machine learning models.	
<b>5.0</b>		<b>Optimization Techniques</b>	<b>10</b>
	5.1	Types of optimization-Constrained and Unconstrained optimization, Methods of Optimization-Numerical Optimization, Bracketing Methods-Bisection Method, False Position Method, Newton's Method, Steepest Descent Method, Penalty Function Method.	
<b>6.0</b>		<b>Dimension Reduction Algorithms</b>	<b>05</b>
	6.1	Introduction to Dimension Reduction Algorithms, Linear Dimensionality Reduction: Principal component analysis, Factor Analysis, Linear discriminant analysis.	
	6.2	Non-Linear Dimensionality Reduction: Multidimensional Scaling, Isometric Feature Mapping, Minimal polynomial	
		<b>Total</b>	<b>48</b>

#### Text Books:

- 1 Linear Algebra for Everyone,
- 2 Gilbert Strang, Wellesley Cambridge Press.
- 3 An Introduction to Probability and Statistics, Vijay Rohatgi, Wiley Publication
- 4 An introduction to Optimization, Second Edition, Wiley-Edwin Chong, Stainslaw Zak.
- 5 Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press.
- 6 Exploratory Data Analysis, John Tukey, Princeton University and Bell Laboratories.

#### References:

- 1 Introduction to Linear Algebra, Gilbert Strang.
- 2 Advanced Engineering Mathematics, Erwin Kreyszig
- 3 Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar. Foundations of Machine Learning. MIT Press, 2018.
- 4 Shai Shalev-Shwartz and Shai Ben-David. Understanding Machine Learning: From Theory to Algorithms. Cambridge University Press, 2014
- 5 Last updated on Sep 9, 2018.
- 6 Mathematics and Programming for Machine Learning with R, William B. Claster, CRC Press,2020

#### Useful Links:

- 1 <https://math.mit.edu/~gs/linearalgebra/>
- 2 <https://www.coursera.org/learn/probability-theory-statistics>
- 3 <https://nptel.ac.in/courses/111/105/111105090/>
- 4 [https://onlinecourses.nptel.ac.in/noc21\\_ma01/preview](https://onlinecourses.nptel.ac.in/noc21_ma01/preview)
- 5 <https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/>

#### Assessment:

##### Internal Assessment: (20)

- 1 Assessment consists of two class tests of 20 marks each.

- 2 The first-class test is to be conducted when approx. 40% syllabus is completed and second-class test when additional 40% syllabus is completed.
- 3 Duration of each test shall be one hour.

**End Semester Theory Examination: (80)**

- 1 Question paper will comprise of **total 06** questions, each carrying **20 marks**.
- 2 **Question No: 01** will be **compulsory** and based on the entire syllabus wherein 4 to 5 sub-questions will be asked.
- 3 Remaining questions will be mixed in nature and randomly selected from all the modules.
- 4 Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
- 5 **Total 04 questions** need to be solved.

**Artificial Intelligence and Machine Learning: Sem VI**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HAIMLC601	Game Theory using AI & ML	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks			Exam Duration In Hours	Term Work	Practical and Oral	Total	
		Internal Assessment	End Sem. Exam.						
Test1	Test2	Avg.							
HAIMLC601	Game Theory using AI & ML	20	20	20	80	03	--	--	100

**Course Prerequisites:**

Knowledge of probability theory, discrete mathematics, and algorithm design is required.

**Course Objectives:**

- 1 To acquire the knowledge of game theory.
- 2 To understand the basic concept of AI, strength and weakness of problem solving and search
- 3 To study about various heuristic and game search algorithms
- 4 To optimize the different linear methods of regression and classification
- 5 To interpret the different supervised classification methods of support vector machine.
- 6 To acquire the knowledge of different generative models through unsupervised learning

**Course Outcomes:**

After successful completion of the course, the student will be able to:

- 1 Understand basic concept of game theory.
- 2 Evaluate Artificial Intelligence (AI) methods and describe their foundations
- 3 Analyze and illustrate how search algorithms play vital role in problem solving, inference, perception, knowledge representation and learning
- 4 Demonstrate knowledge of reasoning and knowledge representation for solving real world problems
- 5 Recognize the characteristics of machine learning that makes it useful to realworld problems and apply different dimensionality reduction techniques
- 6 Apply the different supervised learning methods of support vector machine and tree based models

Module No.	Topics	Hours.
1.0	<b>Introduction to Game Theory</b>	05
1.1	Introduction, The theory of rational choice, Games with Perfect Information, Nash Equilibrium: Theory, Prisoner's Dilemma, Stag Hunt, Matching pennies, BOS, Multi NE, Cooperative and Competitive Games, Strict and Non Strict NE, Best response functions for NE.	
1.2	Nash Equilibrium: Illustrations, Cournot's model of oligopoly, Bertrand's model of oligopoly, Electoral competition, The War of Attrition, Auctions, Mixed Strategy Equilibrium, Strategic games in which players may randomize, Dominated actions, Extensive Games with Perfect Information	

<b>2.0</b>		<b>Games with Imperfect Information</b>	<b>09</b>
	2.1	Bayesian Games, Introduction, Motivational examples, General definitions, two examples concerning information, Strictly Competitive Games and Maxminimization, Rationalizability	
	2.2	Evolutionary Equilibrium, Monomorphic pure strategy equilibrium, Mixed strategies and polymorphic equilibrium, Repeated games: The Prisoner's Dilemma, Infinitely repeated games, Strategies, General Results,	
<b>3.0</b>		<b>Introduction to AI &amp; Problem Solving</b>	<b>10</b>
	3.1	<b>Definitions</b> – Foundation and History of AI, Evolution of AI - Applications of AI, Classification of AI systems with respect to environment. Artificial Intelligence vs Machine learning,	
	3.2	<b>Heuristic Search Techniques:</b> Generate-and-Test; Hill Climbing; Properties of A* algorithm, Best first Search; Problem Reduction.	
	3.3	<b>Beyond Classical Search:</b> Local search algorithms and optimization problem, local search in continuous spaces, searching with nondeterministic action and partial observation, online search agent and unknown environments	
<b>4.0</b>		<b>Knowledge and Reasoning</b>	<b>09</b>
	4.1	<b>Knowledge and Reasoning:</b> Building a Knowledge Base: Propositional logic, first order Logic, situation calculus. Theorem Proving in First Order Logic, Planning, partial order planning. Uncertain Knowledge and Reasoning, Probabilities,	
	4.2	Bayesian Networks. Probabilistic reasoning over time: time and uncertainty, hidden Markova models, Kalman filter, dynamic bayesian network, keeping track of many objects	
<b>5.0</b>		<b>Introduction to ML</b>	<b>10</b>
	5.1	Introduction to Machine Learning, Examples of Machine Learning Applications, Learning Types, <b>Supervised Learning</b> -Learning a Class from Examples, Vapnik- Chervonenkis (VC) Dimension, Probably Approximately Correct (PAC) Learning, Noise, Learning Multiple Classes, Regression, Model Selection and Generalization, Dimensions of a Supervised Machine Learning Algorithm	
	5.2	Introduction, Linear Regression Models and Least Squares, Subset Selection, Shrinkage Methods, <b>Logistic Regression-</b> Fitting Logistic Regression Models, Quadratic Approximations and Inference, L1 Regularized Logistic Regression, <b>SVM</b> -Introduction to SVM, The Support Vector Classifier, Support Vector Machines and Kernels- Computing the SVM for Classification	
<b>6.0</b>		<b>Unsupervised Learning</b>	<b>05</b>
	6.1	Introduction, Association Rules-Market Basket Analysis, The Apriori Algorithm, Unsupervised as Supervised Learning, Generalized Association Rules, Cluster Analysis Proximity Matrices, <b>Clustering Algorithms</b> -K-mean, Gaussian Mixtures as Soft K-means Clustering, Example: Human Tumor Microarray Data, Vector Quantization, K-medoids, Hierarchical Clustering, Self-Organizing Maps, PCA-Spectral Clustering	
	6.2	<b>Hidden Markov Models</b> -Introduction, Discrete Markov Processes, Hidden Markov Models, Three Basic Problems of HMMs, Evaluation Problem, Finding the State Sequence, Learning Model Parameters, Continuous Observations, The HMM with Input, Model Selection in HMM	
		<b>Total</b>	<b>48</b>

**Text Books:**

- 1 Martin Osborne, An Introduction to Game Theory, Oxford University Press.
- 2 Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall
- 3 Introduction to Machine Learning Edition 2, by Ethem Alpaydin

**References:**

- 1 Thomas Ferguson, Game Theory, World Scientific, 2018.
- 2 Stef Tijs. Introduction to Game Theory, Hindustan Book Agency
- 3 J. Gabriel, Artificial Intelligence: Artificial Intelligence for Humans (Artificial Intelligence, Machine Learning), Create Space Independent Publishing Platform, First edition , 2016
- 4 Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI., 2010 2. S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed. 2011
- 5 Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997

**Assessment:**

**Internal Assessment: (20)**

- 1 Assessment consists of two class tests of 20 marks each.
- 2 The first-class test is to be conducted when approx. 40% syllabus is completed and second-class test when additional 40% syllabus is completed.
- 3 Duration of each test shall be one hour.

**End Semester Theory Examination: (80)**

- 1 Question paper will comprise of **total 06** questions, each carrying **20 marks**.
- 2 **Question No: 01** will be **compulsory** and based on the entire syllabus wherein 4 to 5 sub-questions will be asked.
- 3 Remaining questions will be mixed in nature and randomly selected from all the modules.
- 4 Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
- 5 **Total 04 questions** need to be solved.



**Artificial Intelligence and Machine Learning: Sem VII**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HAIMLC701	AI&ML in Healthcare	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration In Hours	Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam.				
Test1	Test2	Avg.							
HAIMLC701	AI&ML in Healthcare	20	20	20	80	03	--	--	100

**Course Prerequisites:**

Artificial Intelligence, Machine Learning

**Course Objectives:** The course aims

- To understand the need and significance of AI and ML for Healthcare.
- To study advanced AI algorithms for Healthcare.
- To learn Computational Intelligence techniques .
- To understand evaluation metrics and ethics in intelligence for Healthcare systems,
- To learn various NLP algorithms and their application in Healthcare,
- To investigate the current scope, implications of AI and ML for developing futuristic Healthcare Applications.

**Course Outcomes:**

After successful completion of the course, the student will be able to:

- Understand the role of AI and ML for handling Healthcare data.
- Apply Advanced AI algorithms for Healthcare Problems.
- Learn and Apply various Computational Intelligence techniques for Healthcare Application.
- Use evaluation metrics for evaluating healthcare systems.
- Develop NLP applications for healthcare using various NLP Techniques..
- Apply AI and ML algorithms for building Healthcare Applications

Module	Topics	Hours.
<b>1.0</b>	<b>Introduction</b>	<b>04</b>
1.1	Overview of AI and ML,A Multifaceted Discipline, Applications of AI in Healthcare - Prediction, Diagnosis, personalized treatment and behavior modification, drug discovery, followup care etc,	
1.2	Realizing potential of AI and ML in healthcare, Healthcare Data - Use Cases.	
<b>2.0</b>	<b>AI, ML, Deep Learning and Data Mining Methods for Healthcare</b>	<b>10</b>
2.1	Knowledge discovery and Data Mining, ML, Multi classifier Decision Fusion, Ensemble Learning, Meta-Learning and other Abstract Methods.	
2.2	Evolutionary Algorithms, Illustrative Medical Application-Multiagent Infectious Disease Propagation and Outbreak Prediction, Automated Amblyopia Screening System etc.	
2.3	Computational Intelligence Techniques, Deep Learning, Unsupervised learning, dimensionality reduction algorithms.	

<b>3.0</b>		<b>Evaluating learning for Intelligence</b>	<b>06</b>
	3.1	Model development and workflow, evaluation metrics, Parameters and Hyperparameters, Hyperparameter tuning algorithms, multivariate testing, Ethics of Intelligence.	
<b>4.0</b>		<b>Natural Language Processing in Healthcare</b>	<b>08</b>
	4.1	NLP tasks in Medicine, Low-level NLP components, High level NLP components, NLP Methods.	
	4.2	Clinical NLP resources and Tools, NLP Applications in Healthcare. Model Interpretability using Explainable AI for NLP applications.	
<b>5.0</b>		<b>Intelligent personal Health Record</b>	<b>04</b>
	5.1	Introduction, Guided Search for Disease Information, Recommending SCA's. Recommending HHP's , Continuous User Monitoring.	
<b>6.0</b>		<b>Future of Healthcare using AI and ML</b>	<b>07</b>
	6.1	Evidence based medicine, Personalized Medicine, Connected Medicine, Digital Health and Therapeutics, Conversational AI, Virtual and Augmented Reality, Blockchain for verifying supply chain, patient record access, Robot - Assisted Surgery, Smart Hospitals, Case Studies on use of AI and ML for Disease Risk Diagnosis from patient data, Augmented reality applications for Junior doctors.	
	6.2	Blockchain for verifying supply chain, patient record access, Robot - Assisted Surgery, Smart Hospitals, Case Studies on use of AI and ML for Disease Risk Diagnosis from patient data, Augmented reality applications for Junior doctors.	
		<b>Total</b>	<b>48</b>

#### Textbooks:

- 1 Arjun Panesar, "Machine Learning and AI for Healthcare", A Press.
- 2 Arvin Agah, "Medical applications of Artificial Systems ", CRC Press

#### References:

- 1 Erik R. Ranschaert Sergey Morozov Paul R. Algra, "Artificial Intelligence in medical Imaging- Opportunities, Applications and Risks", Springer
- 2 Sergio Consoli Diego Reforgiato Recupero Milan Petković, "Data Science for Healthcare- Methodologies and Applications", Springer
- 3 Dac-Nhuong Le, Chung Van Le, Jolanda G. Tromp, Gia Nhu Nguyen, "Emerging technologies for health and medicine", Wiley.
- 4 Ton J. Cleophas • Aeilko H. Zwinderman, "Machine Learning in Medicine- Complete Overview", Springer

#### Assessment:

##### Internal Assessment: (20)

- 1 Assessment consists of two class tests of 20 marks each.
- 2 The first-class test is to be conducted when approx. 40% syllabus is completed and second-class test when additional 40% syllabus is completed.
- 3 Duration of each test shall be one hour.

##### End Semester Theory Examination: (80)

- 1 Question paper will comprise of **total 06** questions, each carrying **20 marks**.
- 2 **Question No: 01** will be **compulsory** and based on the entire syllabus wherein 4 to 5 sub-questions will be asked.
- 3 Remaining questions will be mixed in nature and randomly selected from all the modules.
- 4 Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
- 5 **Total 04 questions** need to be solved.

### Artificial Intelligence and Machine Learning: Sem VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HAIMLC801	Text, Web and Social Media Analytics	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration In Hours	Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test2	Avg.					
HAIMLC801	Text, Web and Social Media Analytics	20	20	20	80	03	--	--	100

#### Course Prerequisites:

Python, Data Mining

#### Course Objectives: The course aims

- 1 To have a strong foundation on text, web and social media analytics.
- 2 To understand the complexities of extracting the text from different data sources and analysing it.
- 3 To enable students to solve complex real-world problems using sentiment analysis and Recommendation systems.

#### Course Outcomes:

After successful completion of the course, the student will be able to:

- 1 Extract Information from the text and perform data pre-processing
- 2 Apply clustering and classification algorithms on textual data and perform prediction.
- 3 Apply various web mining techniques to perform mining, searching and spamming of web data.
- 4 Provide solutions to the emerging problems with social media using behaviour analytics and Recommendation systems.
- 5 Apply machine learning techniques to perform Sentiment Analysis on data from social media.

Module	Topics	Hours.
<b>1.0</b>	<b>Introduction</b>	<b>06</b>
	1.1 <b>Introduction to Text Mining:</b> Introduction, Algorithms for Text Mining, Future Directions	
	1.2 <b>Information Extraction from Text:</b> Named Entity Recognition, Relation Extraction, Unsupervised Information Extraction	
	1.3 <b>Text Representation:</b> tokenization, stemming, stop words, NER, N-gram modelling	
<b>2.0</b>	Clustering and Classification	10

	2.1	<b>Text Clustering:</b> Feature Selection and Transformation Methods, distance based Clustering Algorithms, Word and Phrase based Clustering, Probabilistic document Clustering	
	2.2	<b>Text Classification:</b> Feature Selection, Decision tree Classifiers, Rule-based Classifiers, Probabilistic based Classifiers, Proximity based Classifiers.	
	2.3	<b>Text Modelling:</b> Bayesian Networks, Hidden Markovian Models, Markov random Fields, Conditional Random Fields	
<b>3.0</b>		<b>Web-Mining:</b>	<b>05</b>
	3.1	<b>Introduction to Web-Mining:</b> Inverted indices and Compression, Latent Semantic Indexing, Web Search,	
	3.2	<b>Meta Search:</b> Using Similarity Scores, Rank Positons	
	3.3	<b>Web Spamming:</b> Content Spamming, Link Spamming, hiding Techniques, and Combating Spam	
<b>4.0</b>		<b>Web Usage Mining:</b>	<b>05</b>
	4.1	Data Collection and Pre-processing, Sources and types of Data, Data Modelling, Session and Visitor Analysis, Cluster Analysis and Visitor segmentation, Association and Correlation Analysis, Analysis of Sequential and Navigational Patterns, Classification and Prediction based on Web User Transactions.	
<b>5.0</b>		<b>Social Media Mining:</b>	<b>05</b>
	5.1	Introduction, Challenges, Types of social Network Graphs	
	5.2	Mining Social Media: Influence and Homophily, Behaviour Analytics, Recommendation in Social Media: Challenges, Classical recommendation Algorithms, Recommendation using Social Context, Evaluating recommendations.	
<b>6.0</b>		<b>Opinion Mining and Sentiment Analysis:</b>	<b>08</b>
	6.1	The problem of opinion mining,	
	6.2	<b>Document Sentiment Classification:</b> Supervised, Unsupervised	
	6.3	<b>Opinion Lexicon Expansion:</b> Dictionary based, Corpus based	
	6.4	<b>Opinion Spam Detection:</b> Supervised Learning, Abnormal Behaviours, Group Spam Detection.	
		<b>Total</b>	<b>48</b>

#### Textbooks:

- 1 Daniel Jurafsky and James H. Martin, "Speech and Language Processing," 3rd edition, 2020
- 2 Charu. C. Aggarwal, Cheng Xiang Zhai, Mining Text Data, Springer Science and Business Media, 2012.
- 3 BingLiu, "Web Data Mining-Exploring Hyperlinks, Contents, and Usage Data", Springer, Second Edition, 2011.

- 4 Reza Zafarani, Mohammad Ali Abbasi and Huan Liu, "Social Media Mining- An Introduction", Cambridge University Press, 2014

**Assessment:**

**Internal Assessment: (20)**

- 1 Assessment consists of two class tests of 20 marks each.
- 2 The first-class test is to be conducted when approx. 40% syllabus is completed and second-class test when additional 40% syllabus is completed.
- 3 Duration of each test shall be one hour.

**End Semester Theory Examination: (80)**

- 1 Question paper will comprise of **total 06** questions, each carrying **20 marks**.
- 2 **Question No: 01** will be **compulsory** and based on the entire syllabus wherein 4 to 5 sub-questions will be asked.
- 3 Remaining questions will be mixed in nature and randomly selected from all the modules.
- 4 Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
- 5 **Total 04 questions** need to be solved.

**Artificial Intelligence and Machine Learning:Sem VII**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HAIMLSBL701	AI&ML in Healthcare: Lab	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks			Exam Duration	Term Work	Oral	Total
		Internal Assessment	End Sem. Exam.					
Test1	Test2	Avg.						
HAIMLSBL701	AI&ML in Healthcare: Lab					50	50	100

**Course Prerequisites:**

Python

**Course Outcomes:**

After successful completion of the course, the student will be able to:

- 1 Students will be able to understand computational models of AI and ML.
- 2 Students will be able to develop healthcare applications using appropriate computational tools.
- 3 Students will be able to apply appropriate models to solve specific healthcare problems.
- 4 Students will be able to analyze and justify the performance of specific models as applied to healthcare problems.
- 5 Students will be able to design and implement AI and ML-based healthcare applications.

**Suggested Experiments:**

Sr. No.	Name of the Experiment
1	Collect, Clean, Integrate and Transform Healthcare Data based on specific disease.
2	Perform Exploratory data analysis of Healthcare Data.
3	AI for medical diagnosis based on MRI/X-ray data.
4	AI for medical prognosis .
5	Natural language Entity Extraction from medical reports.
6	Predict disease risk from Patient data.
7	Medical Reviews Analysis from social media data.
8	Explainable AI in healthcare for model interpretation.
9	Mini Project-Design and implement innovative web/mobile based AI application using Healthcare Data.
10	Documentation and Presentation of Mini Project.

**Useful Links:**

- 1 <https://www.coursera.org/learn/introduction-tensorflow?specialization=tensorflow-in-practice>
- 2 <https://www.coursera.org/learn/convolutional-neural-networks-tensorflow?specialization=tensorflow-in-practice>
- 3 <https://datarade.ai/data-categories/electronic-health-record-ehr-data>
- 4 <https://www.cms.gov/Medicare/E-Health/EHealthRecords>
- 5 <https://www.coursera.org/learn/tensorflow-sequences-time-series-and-prediction?specialization=tensorflow-in-practice>

**Term Work:**

- 1 Term work should consist of 8 experiments and a Mini Project.
- 2 The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
- 3 Total 50Marks (Experiments: 30-Marks, Mini Project-15 Marks, Attendance- Theory & Practical: 05-marks)

**Oral & Practical exam**

- 1 Based on the entire syllabus of **AI ML for Healthcare**



# University of Mumbai



**Syllabus for**

**Honours/Minor Degree Program**

**In**

**Data Science**

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Data Science**  
**(With effect from 2022-23)**

Year & Sem	Course Code & Course Title	Teaching Scheme Hrs / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar / Tutorial	Practical	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HDSC501: Mathematics for Data Science	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	-	--	<b>100</b>	-	-	-	<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										
TE Sem VI	HDSC601: Statistical Learning for Data Science	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	-	-	<b>100</b>	-	-	-	<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										
BE Sem VII	HDSC701: Data Science for Health and Social Care	04	--	--	20	80	--	--	100	04
	HDSSBL701: Data Science for Health and Social Care: Lab	--	--	04	--	--	50	50	100	02
<b>Total</b>		<b>04</b>	-	<b>04</b>	<b>100</b>	<b>50</b>	<b>50</b>	<b>200</b>	<b>06</b>	
<b>Total Credits = 06</b>										
BE Sem VIII	HDSC801: Text, Web and Social Media Analytics	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	-	-	<b>100</b>	-	-	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V,VI, VII &amp;VIII = 04+04+06+04 = 18</b>										

Data Science: Sem V								
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HDSC501	Mathematics for Data Science	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration	Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam.				
Test1	Test2	Avg.							
HDSC501	Mathematics for Data Science	20	20	20	80	03	--	--	100

Course Prerequisites:	
1	Applied Mathematics, Discrete Mathematics
Course Objectives:	
1	To build an intuitive understanding of Mathematics and relating it to Data Analytics.
2	To provide a strong foundation for probabilistic and statistical analysis mostly used in varied applications in Engineering.
3	To focus on exploring the data with the help of graphical representation and drawing conclusions.
4	To explore optimization and dimensionality reduction techniques.
Course Outcomes:	
After successful completion of the course, the student will be able to:	
1	Use linear algebra concepts to model, solve, and analyze real-world problems.
2	Apply probability distributions and sampling distributions to various business problems.
3	Select an appropriate graph representation for the given data analysis.
4	Apply exploratory data analysis to some real data sets and provide interpretations via relevant visualization
5	Analyze various optimization techniques for data analysis.
6	Describe Dimension Reduction Algorithms in analytics

Module	Topics	Hours.
1.0	<b>Linear Algebra</b>	05
1.1	Vectors and Matrices, Solving Linear equations, The four Fundamental Subspaces, Eigenvalues and Eigen Vectors, The Singular Value Decomposition (SVD).	
2.0	<b>Probability and Statistics</b>	09
2.1	Introduction, Random Variables and their probability Distribution, Random Sampling, Sample Characteristics and their Distributions, Chi-Square, t-, and F-Distributions: Exact Sampling Distributions, Sampling from a Bivariate Normal Distribution, The Central Limit Theorem.	
3.0	<b>Introduction to Graphs</b>	10
3.1	Quantitative vs. Qualitative data, Types of Quantitative data: Continuous data, Discrete data, Types of Qualitative data: Categorical data, Binary data, Ordinary data, Plotting	

		data using Bar graph, Pie chart, Histogram, Stem and Leaf plot, Dot plot, Scatter plot, Time-series graph, Exponential graph, Logarithmic graph, Trigonometric graph, Frequency distribution graph.	
<b>4.0</b>		<b>Exploratory Data Analysis</b>	<b>09</b>
	4.1	Need of exploratory data analysis, cleaning and preparing data, Feature engineering, Missing values, understand dataset through various plots and graphs, draw conclusions, deciding appropriate machine learning models.	
<b>5.0</b>		<b>Optimization Techniques</b>	<b>10</b>
	5.1	Types of optimization-Constrained and Unconstrained optimization, Methods of Optimization-Numerical Optimization, Bracketing Methods-Bisection Method, False Position Method, Newton's Method, Steepest Descent Method, Penalty Function Method.	
<b>6.0</b>		<b>Dimension Reduction Algorithms</b>	<b>05</b>
	6.1	Introduction to Dimension Reduction Algorithms, Linear Dimensionality Reduction: Principal component analysis, Factor Analysis, Linear discriminant analysis.	
	6.2	Non-Linear Dimensionality Reduction: Multidimensional Scaling, Isometric Feature Mapping. Minimal polynomial	
		<b>Total</b>	<b>48</b>

#### Text Books:

- 1 Linear Algebra for Everyone,
- 2 Gilbert Strang, Wellesley Cambridge Press.
- 3 An Introduction to Probability and Statistics, Vijay Rohatgi, Wiley Publication
- 4 An introduction to Optimization, Second Edition, Wiley-Edwin Chong, Stanslaw Zak.
- 5 Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press.
- 6 Exploratory Data Analysis, John Tukey, Princeton University and Bell Laboratories.

#### References:

- 1 Introduction to Linear Algebra, Gilbert Strang.
- 2 Advanced Engineering Mathematics, Erwin Kreyszig
- 3 Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar. Foundations of Machine Learning. MIT Press, 2018.
- 4 Shai Shalev-Shwartz and Shai Ben-David. Understanding Machine Learning: From Theory to Algorithms. Cambridge University Press, 2014
- 5 Last updated on Sep 9, 2018.
- 6 Mathematics and Programming for Machine Learning with R, William B. Claster, CRC Press, 2020

#### Useful Links:

- 1 <https://math.mit.edu/~gs/linearalgebra/>
- 2 <https://www.coursera.org/learn/probability-theory-statistics>
- 3 <https://nptel.ac.in/courses/111/105/111105090/>
- 4 [https://onlinecourses.nptel.ac.in/noc21\\_ma01/preview](https://onlinecourses.nptel.ac.in/noc21_ma01/preview)
- 5 <https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/>

#### Assessment:

##### Internal Assessment: (20)

- 1 Assessment consists of two class tests of 20 marks each.
- 2 The first-class test is to be conducted when approx. 40% syllabus is completed and second-class test when additional 40% syllabus is completed.

3 Duration of each test shall be one hour.

**End Semester Theory Examination: (80)**

1 Question paper will comprise of **total 06** questions, each carrying **20 marks**.

2 **Question No: 01** will be **compulsory** and based on the entire syllabus wherein 4 to 5 sub-questions will be asked.

3 Remaining questions will be mixed in nature and randomly selected from all the modules.

4 Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

5 **Total 04 questions** need to be solved.

**Data Science: Sem VI**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HDSC601	Statistical Learning for Data Science	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration	Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test2	Avg.					
HDSC601	Statistical Learning for Data Science	20	20	20	80	03	--	--	100

**Course Prerequisites:**

1 Engineering Mathematics, Probability and Statistics

**Course Objectives:**

- To understand basic statistical foundations for roles of Data Scientist.
- To develop problem-solving skills.
- To infer about the population parameters using sample data and perform hypothesis testing.
- To understand importance and techniques of predicting a relationship between data and determine the goodness of model fit.

**Course Outcomes:**

After successful completion of the course, the student will be able to:

- Develop various visualizations of the data in hand.
- Analyze a real-world problem and solve it with the knowledge gained from sampling and probability distributions.
- Analyze large data sets and perform data analysis to extract meaningful insights.
- Develop and test a hypothesis about the population parameters to draw meaningful conclusions.
- Fit a regression model to data and use it for prediction.

Module No.	Topics	Hours.
1.0	<b>Introduction</b>	08
1.1	<b>Data and Statistics:</b> Elements, Variables, and Observations, Scales of Measurement, Categorical and Quantitative Data, Cross-Sectional and Time Series Data, Descriptive Statistics, Statistical Inference, Descriptive Statistics: Tabular and Graphical Summarizing Categorical Data, Summarizing Quantitative Data, Cross Tabulations and Scatter Diagram.	
1.2	<b>Descriptive Statistics: Numerical Measures:</b> Measures of Location, Measures of Variability, Measures of Distribution Shape, Relative Location, and Detecting Outliers, Box Plot, Measures of Association Between Two Variables	

<b>2.0</b>		<b>Probability</b>	<b>08</b>
	<b>2.1</b>	<b>Probability</b> : Experiments, Counting Rules, and Assigning Probabilities, Events and Their Probabilities, Complement of an Event, Addition Law Independent Events, Multiplication Law, Baye’s theorem	
	<b>2.2</b>	<b>Discrete Probability Distributions</b> Random Variables, Discrete Probability Distributions, Expected Value and Variance, Binomial Probability Distribution, Poisson Probability Distribution	
	<b>2.3</b>	<b>Continuous Probability Distributions:</b> Uniform Probability Distribution, Normal Curve, Standard Normal Probability Distribution, Computing Probabilities for Any Normal Probability Distribution	
<b>3.0</b>		<b>Sampling and Sampling Distributions</b>	<b>05</b>
	3.1	Sampling from a Finite Population, Sampling from an Infinite Population, Other Sampling Methods, Stratified Random Sampling, Cluster Sampling, Systematic Sampling, Convenience Sampling, Judgment Sampling	
	3.2	Interval Estimation: Population Mean: Known, Population Mean: Unknown, Determining the Sample Size, Population Proportion	
<b>4.0</b>		<b>Hypothesis Tests</b>	<b>05</b>
	4.1	Developing Null and Alternative Hypotheses, Type I and Type II Errors, Population Mean: Known Population Mean: Unknown Inference About Means and Proportions with Two Populations-Inferences About Population Variances, Inferences About a Population Variance, Inferences About Two Population Variances	
	4.2	Tests of Goodness of Fit and Independence, Goodness of Fit Test: A Multinomial Population, Test of Independence	
<b>5.0</b>		<b>Regression</b>	<b>08</b>
	<b>5.1</b>	<b>Simple Linear Regression:</b> Simple Linear Regression Model, Regression Model and Regression Equation, Estimated Regression Equation, Least Squares Method, Coefficient of Determination, Correlation Coefficient, Model Assumptions, testing for Significance, Using the Estimated Regression Equation for Estimation and Prediction Residual Analysis: Validating Model Assumptions, Residual Analysis: Outliers and Influential Observations	
	<b>5.2</b>	<b>Multiple Regression:</b> Multiple Regression Model, Least Squares Method, Multiple Coefficient of Determination, Model Assumptions, Testing for Significance, Categorical Independent Variables, Residual Analysis	
<b>6.0</b>		<b>Time Series Analysis and Forecasting</b>	<b>05</b>
	6.1	Time Series Patterns, Forecast Accuracy, Moving Averages and Exponential Smoothing, Trend Projection, Seasonality and Trend and Time Series Decomposition	
	<b>6.2</b>	<b>Nonparametric Methods</b> Sign Test, Wilcoxon Signed-Rank Test, Mann-Whitney-Wilcoxon Test, Kruskal-Wallis Test, Rank Correlation	
		<b>Total</b>	<b>48</b>



**Text Books:**

- 1 <https://static1.squarespace.com/static/5ff2adbe3fe4fe33db902812/t/6009dd9fa7bc363aa822d2c7/1611259312432/ISLR+Seventh+Printing.pdf>
- 2 Data Science from Scratch, FIRST PRINCIPLES WITH PYTHON, O'Reilly, Joel Grus,
- 3 Data Science from Scratch (oreillystatic.com)
- 4 Practical Time Series Analysis, Prediction with statistics and Machine Learning, O'Reilly, Aileen Nielsen [DOWNLOAD] O'Reilly Practical Time Series Analysis PDF (lunaticai.com)
- 5 R for data science: Import, Tidy, Transform, Visualize, And Model Data, O'Reilly , Garrett Grolemund, Hadley Wickham
- 6 Python for Data Analysis, 2nd Edition, O'Reilly Media, Wes McKinney.
- 7 <https://static1.squarespace.com/static/5ff2adbe3fe4fe33db902812/t/6009dd9fa7bc363aa822d2c7/1611259312432/ISLR+Seventh+Printing.pdf>

**References:**

- 1 Data Science for Dummies Paperback, Wiley Publications, Lillian Pierson
- 2 Storytelling with Data: A Data Visualization, Guide for Business Professionals, Wiley Publications, Cole Nussbaumer Knaflic
- 3 Probability and Statistics for Engineering and the Sciences, Cengage Publications Jay L. Devore.

**Assessment:****Internal Assessment: (20)**

- 1 Assessment consists of two class tests of 20 marks each.
- 2 The first-class test is to be conducted when approx. 40% syllabus is completed and second-class test when additional 40% syllabus is completed.
- 3 Duration of each test shall be one hour.

**End Semester Theory Examination: (80)**

- 1 Question paper will comprise of **total 06** questions, each carrying **20 marks**.
- 2 **Question No: 01** will be **compulsory** and based on the entire syllabus wherein 4 to 5 sub-questions will be asked.
- 3 Remaining questions will be mixed in nature and randomly selected from all the modules.
- 4 Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
- 5 **Total 04 questions** need to be solved.

**Data Science: Sem VII**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HDSC701	Data Science for Health and Social Care	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration	Term Work	Oral	Total
		Internal Assessment			End Sem. Exam.				
Test1	Test2	Avg.	Exam.						
HDSC701	Data Science for Health and Social Care	20	20	20	80	03	--	--	100

**Course Prerequisites:**

Artificial Intelligence, Machine Learning

**Course Objectives:** The course aims

- 1 To gain perspective of Data Science for Health and Social Care.
- 2 To understand different techniques of Biomedical Image Analysis.
- 3 To learn NLP techniques for processing Clinical text.
- 4 To understand the role of social media analytics for Healthcare data .
- 5 To learn advanced analytics techniques for Healthcare Data.
- 6 To investigate the current scope, potential, limitations, and implications of data science and its applications for healthcare.

**Course Outcomes:**

After successful completion of the course, the student will be able to:

- 1 Identify sources and structure of healthcare data.
- 2 Apply structured lifecycle approach for handling Healthcare data science projects.
- 3 Analyze the data, create models, and identify insights from Healthcare data.
- 4 Apply various data analysis and visualization techniques for Healthcare and social media data.
- 5 Apply various algorithms and develop models for Healthcare data science projects.
- 6 To Provide data science solutions for solving problems of Health and Social Care.

Module		Topics	Hours.
<b>1.0</b>		<b>Data Science for Healthcare</b>	<b>05</b>
	1.1	Introduction, Healthcare Data Sources and Data Analytics for Healthcare, Applications and Practical Systems for Healthcare.	
	1.2	Electronic Health Records(EHR), Components of EHR, Benefits of EHR, Barriers to Adopting EHR, Challenges of using EHR data, Phenotyping Algorithms	
<b>2.0</b>		<b>Biomedical Image Analysis</b>	<b>06</b>
	2.1	Biomedical Imaging Modalities, Object detection ,Image segmentation, Image Registration, Feature Extraction	
	2.2	Mining of Sensor data in Healthcare, Challenges in Healthcare Data Analysis	
	2.3	Biomedical Signal Analysis, Genomic Data Analysis for Personalized Medicine.	
<b>3.0</b>		<b>Data Science and Natural Language Processing for Clinical Text</b>	<b>06</b>

	3.1	NLP, Mining information from Clinical Text, Information Extraction, Rule Based Approaches, Pattern based algorithms, Machine Learning Algorithms.	
	3.2	Clinical Text Corpora and evaluation metrics, challenges in processing clinical reports, Clinical Applications.	
<b>4.0</b>		<b>Social Media Analytics for Healthcare</b>	<b>06</b>
	4.1	Social Media analysis for detection and tracking of Infectious Disease outbreaks.	
	4.2	Outbreak detection, Social Media Analysis for Public Health Research, Analysis of Social Media Use in Healthcare.	
<b>5.0</b>		<b>Advanced Data Analytics for Healthcare</b>	<b>08</b>
	5.1	Review of Clinical Prediction Models, Temporal Data Mining for Healthcare Data	
	5.2	Visual Analytics for Healthcare Data, Information Retrieval for Healthcare- Data Publishing Methods in Healthcare.	
<b>6.0</b>		<b>Data Science Practical Systems for Healthcare</b>	<b>08</b>
	6.1	Data Analytics for Pervasive Health, Fraud Detection in Healthcare	
	6.2	Data Analytics for Pharmaceutical discoveries, Clinical Decision Support Systems	
	6.3	Computer-Assisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data.	
		<b>Total</b>	<b>48</b>

#### Textbooks:

- 1 Chandan K. Reddy and Charu C Aggarwal, "Healthcare data analytics", Taylor & Francis, 2015.
- 2 Hui Yang and Eva K. Lee, "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016.

#### References:

- 1 Madsen, L. B. (2015). Data-driven healthcare: how analytics and BI are transforming the industry. Wiley India Private Limited
- 2 Strome, T. L., & Liefer, A. (2013). Healthcare analytics for quality and performance improvement. Hoboken, NJ, USA: Wiley
- 3 McNeill, D., & Davenport, T. H. (2013). Analytics in Healthcare and the Life Sciences: Strategies, Implementation Methods, and Best Practices. Pearson Education.
- 4 Rachel Schutt and Cathy O'Neil, "Doing Data Science", O'Reilly Media
- 5 Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly Media
- 6 EMC Education Services, "Data Science and Big Data Analytics", Wiley

#### Assessment:

##### Internal Assessment: (20)

- 1 Assessment consists of two class tests of 20 marks each.
- 2 The first-class test is to be conducted when approx. 40% syllabus is completed and second-class test when additional 40% syllabus is completed.
- 3 Duration of each test shall be one hour.

##### End Semester Theory Examination: (80)

- 1 Question paper will comprise of **total 06** questions, each carrying **20 marks**.
- 2 **Question No: 01** will be **compulsory** and based on the entire syllabus wherein 4 to 5 sub-questions will be asked.
- 3 Remaining questions will be mixed in nature and randomly selected from all the modules.
- 4 Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
- 5 **Total 04 questions** need to be solved.

**Data Science: Sem VIII**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HDSC801	Text, Web and Social Media Analytics	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration	Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test2	Avg.					
HDSC801	Text, Web and Social Media Analytics	20	20	20	80	03	--	--	100

**Course Prerequisites:**

Python, Data Mining

**Course Objectives:** The course aims

- 1 To have a strong foundation on text, web and social media analytics.
- 2 To understand the complexities of extracting the text from different data sources and analysing it.
- 3 To enable students to solve complex real-world problems using sentiment analysis and Recommendation systems.

**Course Outcomes:**

After successful completion of the course, the student will be able to:

- 1 Extract Information from the text and perform data pre-processing
- 2 Apply clustering and classification algorithms on textual data and perform prediction.
- 3 Apply various web mining techniques to perform mining, searching and spamming of web data.
- 4 Provide solutions to the emerging problems with social media using behaviour analytics and Recommendation systems.
- 5 Apply machine learning techniques to perform Sentiment Analysis on data from social media.

Module No.	Topics	Hours.
1.0	<b>Introduction</b>	06
	1.1 <b>Introduction to Text Mining:</b> Introduction, Algorithms for Text Mining, Future Directions	
	1.2 <b>Information Extraction from Text:</b> Named Entity Recognition, Relation Extraction, Unsupervised Information Extraction	
	1.3 <b>Text Representation:</b> tokenization, stemming, stop words, NER, N-gram modelling	
2.0	Clustering and Classification	10

	2.1	<b>Text Clustering:</b> Feature Selection and Transformation Methods, distance based Clustering Algorithms, Word and Phrase based Clustering, Probabilistic document Clustering	
	2.2	<b>Text Classification:</b> Feature Selection, Decision tree Classifiers, Rule-based Classifiers, Probabilistic based Classifiers, Proximity based Classifiers.	
	2.3	<b>Text Modelling:</b> Bayesian Networks, Hidden Markovian Models, Markov random Fields, Conditional Random Fields	
<b>3.0</b>		<b>Web-Mining:</b>	<b>05</b>
	3.1	<b>Introduction to Web-Mining:</b> Inverted indices and Compression, Latent Semantic Indexing, Web Search,	
	3.2	<b>Meta Search:</b> Using Similarity Scores, Rank Positons	
	3.3	<b>Web Spamming:</b> Content Spamming, Link Spamming, hiding Techniques, and Combating Spam	
<b>4.0</b>		<b>Web Usage Mining:</b>	<b>05</b>
	4.1	Data Collection and Pre-processing, Sources and types of Data, Data Modelling, Session and Visitor Analysis, Cluster Analysis and Visitor segmentation, Association and Correlation Analysis, Analysis of Sequential and Navigational Patterns, Classification and Prediction based on Web User Transactions.	
<b>5.0</b>		<b>Social Media Mining:</b>	<b>05</b>
	5.1	Introduction, Challenges, Types of social Network Graphs	
	5.2	Mining Social Media: Influence and Homophily, Behaviour Analytics, Recommendation in Social Media: Challenges, Classical recommendation Algorithms, Recommendation using Social Context, Evaluating recommendations.	
<b>6.0</b>		<b>Opinion Mining and Sentiment Analysis:</b>	<b>08</b>
	6.1	The problem of opinion mining,	
	6.2	<b>Document Sentiment Classification:</b> Supervised, Unsupervised	
	6.3	<b>Opinion Lexicon Expansion:</b> Dictionary based, Corpus based	
	6.4	<b>Opinion Spam Detection:</b> Supervised Learning, Abnormal Behaviours, Group Spam Detection.	
		<b>Total</b>	<b>48</b>

#### Textbooks:

- 1 Daniel Jurafsky and James H. Martin, "Speech and Language Processing," 3rd edition, 2020
- 2 Charu. C. Aggarwal, Cheng Xiang Zhai, Mining Text Data, Springer Science and Business Media, 2012.
- 3 BingLiu, "Web Data Mining-Exploring Hyperlinks, Contents, and Usage Data", Springer, Second Edition, 2011.

- 4 Reza Zafarani, Mohammad Ali Abbasi and Huan Liu, "Social Media Mining- An Introduction", Cambridge University Press, 2014

**Assessment:**

**Internal Assessment: (20)**

- 1 Assessment consists of two class tests of 20 marks each.
- 2 The first-class test is to be conducted when approx. 40% syllabus is completed and second-class test when additional 40% syllabus is completed.
- 3 Duration of each test shall be one hour.

**End Semester Theory Examination: (80)**

- 1 Question paper will comprise of **total 06** questions, each carrying **20 marks**.
- 2 **Question No: 01** will be **compulsory** and based on the entire syllabus wherein 4 to 5 sub-questions will be asked.
- 3 Remaining questions will be mixed in nature and randomly selected from all the modules.
- 4 Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.
- 5 **Total 04 questions** need to be solved.

**Data Science: Sem VII**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HDSSBL701	Data Science for Health and Social Care: Lab	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme							
		Theory Marks				Exam Duration	Term Work	Oral	Total
		Internal Assessment			End Sem. Exam.				
		Test1	Test2	Avg.					
HDSSBL701	Data Science for Health and Social Care: Lab						50	50	100

**Course Prerequisites:**

Python

**Course Outcomes:**

After successful completion of the course, the student will be able to:

- 1 Students will be able to, Identify sources of data, suggest methods for collecting, sharing and analyzing Healthcare data.
- 2 Students will be able to Clean, integrate and transform healthcare data.
- 3 Students will be able to apply various data analysis and visualization techniques on healthcare data.
- 4 Students will be able to apply various algorithms and develop models for healthcare data Analytics.
- 5 Students will be able to implement data science solutions for solving healthcare problems.

**Suggested Experiments:**

Sr. No.	Name of the Experiment
	<b>Introduction</b>
1	Clean, Integrate and Transform Electronic Healthcare Records.
2	Apply various data analysis and visualization techniques on EHR.
3	Bio Medical Image Preprocessing, Segmentation.
4	Bio Medical Image Analytics.
5	Text Analytics for Clinical Text Data.
6	Diagnose disease risk from Patient data.
7	Social Media Analytics for outbreak prediction/ Drug review analytics.
8	Visual Analytics for Healthcare Data.



9	Implement an innovative Data Science application based on Healthcare Data.
10	Documentation and Presentation of Mini Project.

**Useful Links:**

- 1 <http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=MachineLearning>
- 2 <http://www.cse.wustl.edu/~kilian/cse517a2010/>
- 3 <https://datarade.ai/data-categories/electronic-health-record-ehr-data>
- 4 <https://www.cms.gov/Medicare/E-Health/EHealthRecords>
- 5 [https://onlinecourses.nptel.ac.in/noc20\\_ee40](https://onlinecourses.nptel.ac.in/noc20_ee40)

**Term Work:**

- 1 Term work should consist of 8 experiments and a Mini Project.
- 2 The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
- 3 Total 50Marks (Experiments: 30-Marks, Mini Project-15 Marks, Attendance- Theory & Practical: 05-marks)

**Oral & Practical exam**

- 1 Based on the entire syllabus of **Data Science for Health and Social Care**

# University of Mumbai



## Syllabus

**Honours/Minor Degree Program**

**In**

**Internet of Things**

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Internet of Things**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HloTC501: IoT Sensor Technologies	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>--</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
TE Sem. VI	HloTC601: IoT System Design	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
BE Sem. VII	HloTC701: Dynamic Paradigm in IoT	04	--	--	20	80	--	--	100	04
	HloTSBL701: Interfacing & Programming with IoT Lab (SBL)	--	--	04	--	--	50	50	100	02
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>04</b>	<b>100</b>	<b>50</b>	<b>50</b>	<b>200</b>	<b>06</b>	
<b>Total Credits = 06</b>										
BE Sem. VIII	HloTC801: Industrial IoT	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V,VI, VII &amp;VIII = 04+04+06+04=18</b>										

Internet of Things: Sem V								
Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
HloTC501	IoT Sensor Technologies	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme							
		Theory Marks			End Sem. Exam	Term Work	Practical	Oral	Total
		Internal assessment							
		Test1	Test 2	Avg					
HloTC501	IoT Sensor Technologies	20	20	20	80	--	--	--	100

#### Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To provide in depth knowledge about the sensing mechanism.
2	To make students understand about the use of sensors in design of IoT based systems.
3	To familiarize students various types of sensors used to measure the physical quantities.
4	To develop reasonable level of competence in the design, construction and development of sensor suitable to the system requirements.
5	To Introduce students the current state of the art in sensor technology.
6	To familiarize students with electronics used to interface with sensors.

#### Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the sensing mechanism and structural details of sensors.	L1, L2
2	Explain principles and working of the sensors.	L1,L2
3	Evaluate the performance of various types of sensors.	L5
4	Select the sensor suitable to system requirements.	L5
5	Interface the sensors with microcontrollers and Arduino	L6
6	Understand the current state of the art in sensor technology.	L2

#### DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	1. Basics of Electrical and Electronics Engineering 2. Applied Mechanics 3. Applied Physics, Applied Chemistry	2	CO 1, CO2, CO3, CO4, CO5

I	<b>Sensor Fundamental s and Properties</b>	<p><b>Sensor Fundamentals and Properties:</b> Introduction to IoT, Need for sensors in IoT, Data Acquisition – sensor characteristics – electric charges, fields, potentials – capacitance – magnetism – inductance – resistance – piezoelectric – pyroelectric – Hall effect thermoelectric effects – sound waves – heat transfer – light – dynamic models of sensors. Need of actuators, all types of actuators and their working. Identification of sensor and actuator for real-time application</p> <p><b>Self-learning Topics: IoT Systems, Transfer function and modelling of sensors</b></p>	8	CO1, CO2
II	<b>Optical, radiation and Displacement sensors</b>	<p><b>Optical, radiation and Displacement sensors</b> Photosensors: Photodiode, phototransistor and photo resistor, imaging sensors, UV detectors, Basic Characteristics of radiation sensors, Thermal infrared sensors, X-ray and Nuclear Radiation Sensors, Fibre Optic Sensors, Capacitive and Inductive Displacement Sensor, Electromagnetism and Inductance, Magnetic Field Sensors</p> <p><b>Self-learning Topics: Optical sources and detectors, Sensors based on polymer optical fibers, Micro-structured and solid fibers</b></p>	8	CO1, CO2, CO3, CO4
III	<b>Presence, force, Pressure, Flow Sensors</b>	<p><b>Presence, force, Pressure, Flow Sensors</b></p> <p>Potentiometric Sensors, Piezoresistive Sensors, Capacitive Sensors for presence, Inductive and Magnetic Sensors, Strain gages, Pressure sensitive films, piezoelectric force sensor, Piezoelectric Cables, Concept of Pressure, Mercury Pressure Sensor, Bellows, Membranes, and Thin Plates, Piezo resistive Sensors, Capacitive Sensors, VRP Sensors, Optoelectronic Pressure Sensors, Indirect Pressure Sensor, Vacuum Sensors, Basics of Flow Dynamics, Pressure Gradient Technique, Thermal Transport Sensors, Ultrasonic Sensors, Level Sensors</p> <p><b>Self-learning Topics: Vibration energy harvesting with Piezoelectric, MEMS systems. Develop a sensor system for force measurement using piezoelectric transducer. Develop Resistance Temperature Detector</b></p>	9	CO1, CO2, CO3, CO4
IV	<b>Humidity, Moisture Chemical and Biological Sensors</b>	<p><b>Humidity, Moisture Chemical and Biological Sensors</b></p> <p>Microphones: Characteristics, Resistive, condenser, Electret, Optical, Pizeoelectric, Dynamic,</p> <p>Concept of humidity, Capacitive Humidity Sensors, Resistive Humidity Sensors, Thermal Conductivity Sensors, Optical Hygrometers, Oscillating Hygrometer, Soil Moisture</p> <p>Chemical Sensor Characteristics, Electrical and Electrochemical Sensors, Photoionization Detectors, Physical</p>	8	CO1, CO2, CO3, CO4, CO5

		Transducers, Spectrometers, Thermal Sensors, Optical Transducers, Multi-sensor Arrays  Artificial Microsystems for Sensing Airflow, Temperature, and Humidity by Combining MEMS and CMOS Technologies  <b>Self-learning Topics: Biosensors for biomedical applications</b>		
V	<b>Interface Electronic Circuits</b>	<b>Interface Electronic Circuits</b>  Introduction, Signal Conditioners, Sensor Connections, Excitation Circuits, Analog to Digital Converters, Integrated Interfaces, Data Transmission, Noise in Sensors and Circuits, Batteries for Low-Power Sensors, Types of Single board computers, various sensor interfacing with Arduino, Embedded C Programming. data communication protocol interfacing, study the properties of LDR, Build a simple LED light intensity controller, Linux on Raspberry Pi, Interfaces, and Programming.  <b>Self-learning Topics: Python Programming to interface sensors</b>	<b>8</b>	CO1, CO2, CO5
VI	<b>Current Trends in sensors and Technology</b>	<b>Current Trends in sensors and Technology</b>  Smart Sensors: Introduction, Primary sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, The Automation  Sensor Technologies: Introduction, Film Sensors, Thick Film Sensors, Thin Film Sensors, Semiconductor IC Technology— Standard Methods, Microelectromechanical Systems (MEMS), Nano-sensors  Sensor Applications: Onboard Automobile sensors, Home appliances sensors, Aerospace Sensors, Sensors for Environmental Monitoring  <b>Self-learning Topics: Energy Harvesting, Self-powered Wireless Sensing in ground, Ground penetrating sensors</b>	<b>9</b>	CO1, CO2, CO3, CO4, CO5, CO6

#### Text Books:

1. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.
2. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland
3. D. Patranabis – Sensor and Transducers (2e) Prentice Hall, New Delhi, 2003
4. Vijay Madiseti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014

#### References:

1. Edited by Qusay F Hasan, Atta ur rehman Khan, Sajid A madani, "Internet of Things Challenges, Advances, and Application", CRC Press
2. Triethy HL - Transducers in Electronic and Mechanical Designs, Mercel Dekker, 2003
3. Gerd Keiser, "Optical Fiber Communications", 2017, 5th edition, McGraw-Hill Science, Delhi.

4. John G Webster, Halit Eren, "Measurement, Instrumentation and sensor Handbook", 2014, 2nd edition, CRC Press, Taylor and Fransis Group, New York.
5. Adrian McEwen, "Designing the Internet of Things", Wiley Publishers, 2013, ISBN: 978-1-118-43062-0
6. Nathan Ida, "Sensors, Actuators and their Interfaces: A Multidisciplinary Introduction", Second Edition, IET Control, Robotics and Sensors Series 127, 2020

**Online References:**

Sr. No.	Website Name
3.	<a href="https://nptel.ac.in/courses/108/108/108108123/">https://nptel.ac.in/courses/108/108/108108123/</a>
4.	<a href="https://nptel.ac.in/courses/108/108/108108098/">https://nptel.ac.in/courses/108/108/108108098/</a>
3.	<a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee41/">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee41/</a>
4.	<a href="https://nptel.ac.in/courses/108/106/108106165/">https://nptel.ac.in/courses/108/106/108106165/</a>

**Assessment:**

**Internal Assessment (IA) for 20 marks:**

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➤ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered



### Internet of Things: Sem VI

Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
HloTC601	IoT System Design	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam					
		Test1	Test 2	Avg.						
HloTC601	IoT System Design	20	20	20	80	--	--	--	100	

#### Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To learn basic principles, concepts, and technologies for internet of things.
2	To understand various architectures of IOT.
3	To train the students to build IoT systems using sensors, single board computers and open source IoT platform for given application.
4	To learn and implement various networking and communication protocols.
5	To design and analyze IoT for given applications.
6	To Evaluate performance of given IoT system.

#### Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Able to explain principles, concepts, and technologies for internet of things.	L1, L2
2	Able to identify various building blocks of IoT system	L1,L2
3	Able to analyze and evaluate various networking and communication protocols used in IoT system	L3,L4
4	Able to select appropriate interface for given application	L3
5	Able to design and analyze IoT system for given application	L4,L5
6	Able to evaluate performance of given IOT System	L5

#### DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Comment (Prerequisite syllabus should not be considered for paper setting) Basics of Embedded System, IoT Sensors, Digital design	2	--

I	<b>Overview of IoT System</b>	<p>What is IoT System? IoT Impact, Current Trends in IoT, IoT Challenges, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack How are IoT Systems different from traditional system Values and Uses of IoT Functional View and Infrastructure view of IoT Systems</p> <p><b>Self-learning Topics:</b> <i>Understanding the Issues and Challenges of a More Connected World</i></p>	6	CO1, CO2
II	<b>Networking Protocols</b>	<p>OSI Model for the IoT/M2M System Lightweight M2M Communication Protocols, Internet based Communications, IP addressing in IoT, Network Model, TCP &amp; UDP, Client-Server architecture</p> <p><b>Self-learning Topics:</b> <i>How to choose correct protocol for our network.</i></p>	8	CO3
III	<b>Communication Protocols</b>	<p>IoT Edge to Cloud protocols: HTTP, REST APIs, WebSocket, MQTT, COAP, Comparison of Protocols.M2M Communication Protocols, Bluetooth BR/EDR and Bluetooth low energy. RFID IoT System , RFID IoT Network Architecture, ZigBee IP/ZigBee SE2.0, Wifi(WLAN), Message Communication protocols for connected devices Data exchange formats: JSON &amp; XML, Node-Red, Flow control using Node-Red, learning the different nodes of Node-RED for implementing the Communication Protocols</p> <p><b>Self-learning Topics:</b> <i>Types of Communication</i></p>	10	CO3,CO4
IV	<b>Sensor Interfaces</b>	<p>Digital Interfaces: UART, Serial Peripheral Interface (SPI), I2C (Inter-Integrated Circuit), Controller Area Network (CAN), Middleware Technologies, Communication Protocols and Models. Practical Components Programming with interface in Arduino, MBed and Raspberry Pi</p> <p><b>Self-learning Topics:</b> <i>SMART SENSOR INTERFACES</i></p>	10	CO4
V	<b>Design principles for prototyping</b>	<p>Design solution for ubiquitous and utility, Interface design for user experience, Designing for data privacy, Interfacing – Apps &amp; Webs, Designing for Affordability, Cost v/s Ease of Prototyping, Prototypes and Production, Selection of embedded platform, Prototype and Mass personalization, Open Source v/s Closed Source ,Amplification and Signal Conditioning- Integrated Signal Conditioning- Digital conversion- MCU Control MCUs for Sensor Interface- Techniques and System Considerations- Sensor Integration</p> <p><b>Self-learning Topics:</b> <i>Principles for Prototyping and moving towards Product Development</i></p>	8	CO5
VI	<b>IoT, case studies</b>	<p>Arduino Programming for Ethernet and Wifi connectivity, Networking and Data logging with Raspberry Pi Applications-Agriculture, Medical, Fire detection, Air pollution prediction, Earthquake early detection; for smart environmental care, smart traveling, Home Automation</p> <p><b>Self-learning Topics:</b> <i>IoT enabled Business solution in Supply Chain</i></p>	8	CO6

#### Text Books:

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2. Adrian McEwen and Hakim Cassimally, —Designing the Internet of Things||, John Wiley and Sons Ltd, UK, 2014.

3. Milan Milenkovic, Internet of Things: Concepts and System Design, Springer International Publishing, May 2020
4. Dr. Raj Kamal, Internet of Things (IoT), Architecture and Design Principles. McGraw Hill Education.

#### References:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things
2. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.
3. Editors Ovidiu Vermesan Peter Friess, 'Internet of Things – From Research and Innovation to Market
4. Dr. Guillaume Girardin, Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024', Yole Development Copyrights, 2014

#### Assessment:

##### Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

##### ➤ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

### Internet of Things: Sem VII

Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
HloTC701	Dynamic Paradigm in IoT	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam					
		Test1	Test 2	Avg. of 2 Tests						
HloTC701	Dynamic Paradigm in IoT	20	20	20	80	--	--	--	100	

#### Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To explore the role of the cloud in Internet of Things deployment.
2	To introduce the usage of different machine learning algorithms on IoT Data.
3	To explore data analytics and data visualization on IoT Data.
4	To explore the role of Fog computing in Internet of Things.
5	To explore design issues and working principles of various security measures and various standards for secure communication in IoT.
6	To develop the ability to integrate IoT with Dev-ops.

#### Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify the need for the cloud in IoT deployment and describe different Cloud provider's architecture.	L1,L2
2	Use and correlate machine learning techniques on IoT Data.	L3,L4
3	Apply IoT analytics and data visualization.	L3
4	Recognize the use of Fog Computing in the Internet of things.	L1,L2
5	Explain the need of security measures in the Internet of Things.	L4
6	Apply the knowledge of Dev-ops in IoT applications.	L3

#### DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basics of Cloud Computing, Basics of Machine learning and primitives of cryptography	2	--

I	<b>IoT and CLOUD</b>	<p><b>Cloud Computing Concept, Grid/SOA and Cloud Computing, Cloud Middleware</b>  <b>NIST's SPI Architecture and Cloud Standards, The Cloud of Things--</b> The Internet of Things and Cloud Computing  <b>The Cloud of Things Architecture--</b> Four Deployment Models, Vertical Applications, Fifteen Essential Features, Four Technological Pillars, Three Layers of IoT Systems, Foundational Technological Enabler <b>Cloud Providers and Systems</b> -- Microsoft Azure IoT, Amazon Web Services, Google's cloud IoTs.</p> <p><b>Self-learning Module:</b> IBM Watson Cloud</p>	10	CO1
II	<b>IoT and Machine Learning</b>	<p><b>Advantages of IoT and Machine Learning Integration, Implementation of Supervised Algorithm-</b> Regression (Linear and Logistic), SVM for IoT-Neural Network <b>on case study:</b> Agriculture and IoT, Smart Home etc.</p> <p><b>Self-Learning Module:</b> Regression, SVM</p>	6	CO2
III	<b>IoT and Data Analytics</b>	<p><b>Defining IoT Analytics, IoT Analytics challenges, IoT analytics for the cloud-</b>Microsoft Azure overview– Strategies to organize Data for IoT Analytics, Linked Analytics Data Sets, Managing Data lakes, The data retention strategy. <b>Communicating with Others- Visualization and Dash boarding-</b> Designing visual analysis for IoT data, creating a dashboard –creating and visualizing alerts.</p> <p><b>Self-learning Topics:</b> Study real time case study on IoT Analytics.</p>	8	CO3
IV	<b>IoT and Fog Computing</b>	<p><b>Fog computing Basics, The Hadoop philosophy for Fog computing, Fog Computing versus Edge Computing versus cloud computing, Open Fog Reference Architecture Application services--</b> Application support, Node management and software backplane, Hardware virtualization, Open Fog node security, Network Accelerators Compute, Storage Hardware platform infrastructure, Protocol abstraction, Sensors, actuators, and control systems, Fog Topology.</p> <p><b>Self-learning Module:</b> Amazon Green grass and Lambda (implementation)</p>	8	CO4
V	<b>IoT and it's Security</b>	<p>Cyber security vernacular Attack and threat terms, Defense terms, Anatomy of IoT cyber attacks – Mirai, Stuxnet, Chain Reaction, Physical and hardware security, Root of Trust, Key management and trusted platform modules, Processor and memory space, Storage security, Network stack – Transport Layer Security, Software defined perimeter, Software-Defined Perimeter architecture,</p> <p><b>Self-learning Module:</b> OWASP-Existing Security attacks and its prevention methods.</p>	8	CO5
VI	<b>IoT and Devops</b>	<p><u>Introduction to DevOps, DevOps application - business scenarios, DevOps process -- Source Code Management (SCM), Code review, Configuration Management, Build management, Artifacts repository management, Release management, Test automation, Continuous integration, Continuous delivery, Continuous deployment, Infrastructure as Code, Routine automation, Key application performance monitoring/indicators. DevOps frameworks--DevOps maturity life cycle, DevOps maturity map, DevOps progression</u></p>	10	CO6

	<p><u>framework/readiness model, DevOps maturity checklists, Agile framework for DevOps process projects, Agile ways of development</u></p> <p><b>Tool for IoT</b>—Chef and Puppet, Setting up Chef and Puppet, Multi-tier Application Deployment, NETCONF-YANG Case Studies- Steps for IoT device management with NETCONF-YANG, Managing Smart irrigation IoT system with NETCONF-YANG, Managing Home Intrusion Detection IoT system with NETCONF-YANG</p> <p><b>Self-learning Topics:</b> Compare different tool of IoT.</p>		
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#### Text Books:

1. The Internet of Things in the Cloud A Middleware Perspective, Honbo Zhou – CRC Publication.
2. Analytics for the Internet of Things (IoT), Andrew Minter, Packt Publication 2017
3. Internet of Things- Hands on Approach, Arshdeep Bagha, Vijay Mediseti, Published by Arshdeep Bagha and Vijay Mediseti,2014.
4. Hands-on DevOps, Sricharan Vadapalli, Packt Publication, 2017
5. Internet of things For Architects, Perry Lea Packt Publication,2018

#### References:

1. Enterprise Cloud Computing, Gautam Shroff, Cambridge,2010
2. Mastering Cloud Computing -Foundations and Applications Programming, Raj Kumar Buyya, Christian Vecchiola, S. Thamarai Selvi, MK Publication, 2013.
3. Machine Learning in Action||, Peter Harrington, DreamTech Press
4. Introduction to Machine Learning||, Ethem Alpaydin, MIT Press
5. Learning AWS IoT- Effectively Manage Connected Devices on the AWS Cloud Using Services Such as AWS Greengrass, AWS Button, Predictive Analytics and Machine Learning, Agus Kurniawan, Packt Publication,2018
6. Practical Dev-Ops, Joakim Verona, Packt Publication, 2016

#### Online References:

Sr. No.	Website Name
1.	<a href="https://hub.packtpub.com/25-datasets-deep-learning-iot/">https://hub.packtpub.com/25-datasets-deep-learning-iot/</a>
2.	<a href="https://data.world/datasets/iot">https://data.world/datasets/iot</a>
3.	<a href="https://dashboard.healthit.gov/datadashboard/data.php">https://dashboard.healthit.gov/datadashboard/data.php</a>
4.	<a href="https://www.data.gov/">https://www.data.gov/</a>
5.	<a href="https://dev.socrata.com/data/">https://dev.socrata.com/data/</a>
6.	<a href="https://www.kaggle.com/">https://www.kaggle.com/</a>

#### Assessment:

##### Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

##### ➤ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks** Q.1 will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

### Internet of Things: Sem VII

		Teaching Scheme (Contact Hours)			Credits Assigned			
Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
HloTSBL701	Interfacing & Programming with IoT Lab (SBL)	--	4	--	--	2	--	02

Course Code	Course Title	Examination Scheme							
		Theory Marks				End Sem. Exam	Term Work	Oral	Total
		Internal assessment			Avg. of 2 Tests				
		Test1	Test 2						
HloTSBL701	Interfacing & Programming with IoT Lab (SBL)	--	--	--	--	50	50	100	

#### Lab Objectives:

Sr. No.	Lab Objectives
The Lab aims:	
1	To Understand the definition and significance of the Internet of Things.
2	To Discuss the architecture, operation, and business benefits of an IoT solution.
3	To Examine the potential business opportunities that IoT can uncover.
4	To Explore the relationship between IoT, cloud computing, and DevOps.
5	To Identify how IoT differs from traditional data collection systems.
6	To Explore the interconnection and integration of the physical world and able to design & develop IOT Devices.

#### Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of lab, learner/student will be able to:		
1	Adapt different techniques for data acquisition using various IoT sensors for different applications.	L6
2	Demonstrate the working of actuators based on the collected data.	L2
3	Use different IoT simulators and correlate working of IoT protocols.	L3
4	Adapt different techniques for Integrating IoT services to other third-party Clouds.	L6
5	Execute DevOps methodologies for continuous integration and continuous deployment of IoT application.	L3
6	Implement IoT protocols like MQTT for communication to realize the revolution of internet in mobile devices, cloud and sensor networks.	L3

#### Prerequisite:



## IoT introduction course: Basics of IoT, Introduction to Embedded systems

### Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With Following Configuration 1. Intel PIV Processor 2. 4 GB RAM 3. 500 GB Harddisk 4. Network interface card 5. Sensors 6. IoT Kit (Arduino/ARM/Raspberry Pi)	1. Windows or Linux Desktop OS 2. DeVops 3. Python 4. IoT Simulator/Emulator (open source)	1. Internet Connection for installing additional packages if required

This lab will describe the market around the Internet of Things (IoT), the technology used to build these kinds of devices, how they communicate, how they store data, and the kinds of distributed systems needed to support them. Divided into four main modules, we will learn by doing. We will start with simple examples and integrate the techniques we learn into a class project in which we design and build an actual IoT system. The client will run in an emulated ARM environment, communicating using common IoT protocols with a cloud enabled backend system with DevOps integration.

### Suggested List of Experiments

Sr. No.	Detailed Content	Hours	LO Mapping
1	To study and implement interfacing of different IoT sensors with Raspberry Pi/Arduino/ModemCU	4	LO1
2	To study and implement interfacing of actuators based on the data collected using IoT sensors. (like led switch ON/OFF, stepper word)	4	LO2
3	To study and demonstrate Contiki OS for RPL (like Create 2 border router and 10 REST clients, Access border router from other network (Simulator))	4	LO3
4	To study and demonstrate use of IoT simulators (like Beviswise) on any real time device (LED/stepper motor)	4	LO3
5	Select any one case study (in a group of 2-3) and perform the experiments 5 to 10. The sample case studies can be as follows: 1. Smart home automation system 2. Healthcare management system 3. Smart traffic management system & so on...  Write a program on Raspberry Pi to push and retrieve the data from cloud like thingspeak, thingsboard, AWS, Azure etc.	8	LO4
6	To install MySQL database on Raspberry Pi and perform basic SQL queries for analysis data collected.	6	LO4
7	To study and implement IoT Data processing using Pandas.	4	LO4

8	To study and implement Continuous Integration using Jenkins on IoT data and also perform interfacing of Raspberry Pi into Jenkins.	6	LO6
9	To study and implement Continuous Deployment (Infrastructure as a code) for IoT using Ansible.	6	LO6
10	To study MQTT Mosquitto server and write a program on Arduino/Raspberry Pi to publish sensor data to MQTT broker.	6	LO5

### Books / References:

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly publication, 2016
2. Joakim Verona, "Practical DevOps", PACKT publishing, 2016
3. Honbo Zhou, "The internet of things in the cloud", CRC press, Taylor and Francis group, 2012
4. Perry Lea, "Internet of things for architects", PACKT publishing, 2018

### Online Resources:

Sr. No.	Website Name
1.	<a href="https://spoken-tutorial.org/watch/Arduino/Introduction+to+Arduino/English/">https://spoken-tutorial.org/watch/Arduino/Introduction+to+Arduino/English/</a>
2.	<a href="https://pythonprogramming.net/introduction-raspberry-pi-tutorials/">https://pythonprogramming.net/introduction-raspberry-pi-tutorials/</a>
3.	<a href="https://iotbytes.wordpress.com/basic-iot-actuators/">https://iotbytes.wordpress.com/basic-iot-actuators/</a>
4.	<a href="http://www.contiki-os.org/">http://www.contiki-os.org/</a>
5.	<a href="https://www.bevywise.com/iot-simulator/">https://www.bevywise.com/iot-simulator/</a>
6.	<a href="https://mqtt.org/">https://mqtt.org/</a>

### Term Work:

The Term work shall consist of at least 10 practical based on the above list. The term work Journal must include at least 2 assignments. The assignments should be based on real world applications which cover concepts from all above list.

**Term Work Marks:** 50 Marks (Total marks) = 40 Marks (Experiment) + 5 Marks (Assignments/tutorial/write up) + 5 Marks (Attendance)

**Oral Exam:** An Oral exam will be held based on the above syllabus.

### Internet of Things: Sem VIII

Course Code	Course Title	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
HloTC801	Industrial IoT	04	--	--	04	--	--	04

Course Code	Course Title	Examination Scheme								
		Theory Marks					Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam					
		Test1	Test 2	Avg. of 2 Tests						
HloTC801	Industrial IoT	20	20	20	80	--	--	--	100	

#### Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To learn the concepts of Industry 4.0 and IIOT.
2	To learn reference Architecture of IIOT.
3	To learn Industrial Data Transmission and Industrial Data Acquisition.
4	To learn middleware and WAN technologies.
5	To learn IIOT Block chain and Security.
6	To learn different applications and securities in IIOT.

#### Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the concepts of Industry 4.0 and IIOT.	L1,L2
2	Understand reference Architecture of IIOT.	L1,L2
3	Understand Industrial Data Transmission and Industrial Data Acquisition.	L1,L2
4	Understand middleware and WAN technologies in IIOT.	L1,L2
5	Understand the concepts of Blockchain and Security in IIOT.	L1,L2
6	Apply security in IIOT applications.	L3

#### DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	IOT Concepts, Sensor Technology, IOT Stack and Protocols, Design IoT systems, WSN etc.	02	--

I	<b>Introduction</b>	<p>Overview of Industry 4.0 and Industrial Internet of Things, Industry 4.0: Industrial Revolution: Phases of Development, Evolution of Industry 4.0, Environment impacts of industrial revolution, Industrial Internet, Basics of CPS, CPS and IIOT, Design requirements of Industry 4.0, Drivers of Industry 4.0, Sustainability Assessment of Industries, Smart Business Perspective, Cyber security, Impacts of Industry 4.0, Industrial Internet of Things: Basics, IIOT and Industry 4.0, Industrial Internet Systems, Industrial Sensing, Industrial Processes, IIOT Challenges – Identifying Things within the internet, Discovering Things and the Data they possess, Managing massive amount of data, Navigating Connectivity Outages, IIOT Edge - Leveraging the Power of Cloud Computing, Communicating with Devices on the Edge, Determining a Request/Response Model</p> <p><b>Self-learning Topics:</b> Study real time IIoT challenges in industry.</p>	<b>06</b>	CO1
II	<b>IIOT Reference Architecture</b>	<p>The IIC Industrial Internet Reference Architecture - Industrial Internet Architecture Framework (IIAF), Industrial Internet Viewpoints -Functional, Operational, Information Application and Business Domain of IIAF.</p> <p>The Three-Tier Topology, Key Functional Characteristics of Connectivity.</p> <p>Software Architectural Style for the Industrial Internet of Things - Software Architecture Practice, Advanced Architectural Styles, Systems of Systems, Challenges of Software Engineering in IIoT, Principles for Software Architecture design in IIoT, The Principled Decomposition, The Architectural Style</p> <p><b>Self-learning Topics:</b> Study IIoT Architecture.</p>	<b>08</b>	CO2
III	<b>Industrial Data Transmission and Industrial Data Acquisition</b>	<p>Introduction, (Features and Components of - Foundation Fieldbus, Profibus, HART, Interbus, Bitbus, CC-Link, Modbus, Batibus, DigitalSTROM, Controller Area Network, DeviceNet, LonWorks, ISA 100.11a, Wireless HART, LoRa and LoRaWAN) NB-IoT, IEEE 802.11AH,</p> <p>Distributed Control System, PLC, SCADA</p> <p><b>Self-learning Topics:</b> Study SCADA, PLC in detail.</p>	<b>10</b>	CO3
IV	<b>IIOT Middleware and WAN Technologies</b>	<p>(From Industrial Application Perspective)</p> <p>Examining Middleware Transport Protocols (TCP/IP, UDP, RTP, CoAP), Middleware Software Patterns (Publish Subscribe Pattern, Delay Tolerant Networks),</p> <p>Software Design Concepts – Application Programming Interface – A Technical Perspective, Why Are APIs Important for Business? Web Services,</p> <p>IIOT Middleware Platforms – Middleware Architecture</p>	<b>10</b>	CO4

		<p>IIOT WAN Technologies and Protocols - IIoT Device Low-Power WAN Optimized Technologies for M2M, SigFox, LoRaWAN, nWave, Dash7 Protocol, Ingénue RPMA, Low Power Wi-Fi, LTE Category-M, Weightless, Millimeter Radio</p> <p><b>Self-learning Topics:</b> Study different IIoT Middleware and WAN Technologies.</p>		
V	<b>IIOT Blockchain and Security</b>	<p>Blockchains and cryptocurrencies in IoT, Bitcoin (blockchain-based), IOTA- distributed ledger (directed a cyclical graph-based), Government regulations and intervention, US Congressional Bill – Internet of Things (IoT) Cyber security Improvement Act of 2017, Other governmental bodies, IoT security best practices, Holistic security.</p> <p><b>Self-learning Topics:</b> Case study on IIoT Block chain and Security.</p>	<b>08</b>	CO5
VI	<b>IIOT Applications and Securities</b>	<p>The IoT Security Lifecycle-</p> <p>The secure IoT system implementation lifecycle, Implementation and integration, IoT security CONOPS document, Network and security integration, System security verification and validation (V&amp;V), Security training, Secure configurations, Operations and maintenance, Managing identities, roles, and attributes, Security monitoring, Penetration testing, Compliance monitoring, Asset and configuration management, Incident management, Forensics, Dispose, Secure device disposal and zeroization, Data purging, Inventory control, Data archiving and records management</p> <p>Securing the Industrial Internet - Security in Manufacturing, PLCs and DCS, Securing the OT (Operation Technology), Network, System Level: Potential Security Issues, Identity Access Management</p> <p>Develop New Business Models –</p> <p>Adopt Smart Architectures and Technologies, Sensor-Driven Computing, Industrial Analytics, Intelligent Machine Applications, Transform the Workforce</p> <p>Case Studies –</p> <p>Healthcare Applications in Industries – Challenges associated with Healthcare, Introduction, Smart Devices, Advanced technologies used in Healthcare.</p> <p>Inventory Management and Quality Control – Introduction, Inventory Management and IIOT, Quality Control</p> <p>Manufacturing Industry, Automotive Industry and Mining Industry</p> <p><b>Self-learning Topics:</b> Study real time IIoT application.</p>	<b>08</b>	CO6

### Text Books:

1. "Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress)
2. "Introduction to Industrial Internet of Things and Industry 4.0", by Sudip Misra, Chandana Roy And Anandarup Mukherjee, CRC Press (Taylor & Francis Group)
3. "Internet **of Things** Principles and Paradigms", by Rajkumar Buyya, Amir Vahid Dastjerdi, ELSEVIER Inc.
4. Internet of things For Architects, Perry Lea Packt Publication, 2018

### References:

1. "Practical Internet of Things Security", by Brian Russell, Drew Van Duren (Packt Publishing)
2. "Industrial Internet of Things and Communications at the Edge", by Tony Paine, CEO, Kepware Technologies
3. "Architectural Design Principles For Industrial Internet of Things", Hasan Derhamy, Luleå University of Technology, Graphic Production

### Online References:

Sr. No.	Website Name
1.	<a href="https://onlinecourses.nptel.ac.in/noc20_cs69/preview">https://onlinecourses.nptel.ac.in/noc20_cs69/preview</a>
2.	<a href="https://www.coursera.org/specializations/developing-industrial-iot">https://www.coursera.org/specializations/developing-industrial-iot</a>
3.	<a href="https://www.coursera.org/lecture/advanced-manufacturing-enterprise/the-industrial-internet-of-things-iiot-59Evl">https://www.coursera.org/lecture/advanced-manufacturing-enterprise/the-industrial-internet-of-things-iiot-59Evl</a>
4.	<a href="https://www.coursera.org/lecture/industrial-iot-markets-security/segment-12-blockchains-l4aG9">https://www.coursera.org/lecture/industrial-iot-markets-security/segment-12-blockchains-l4aG9</a>

### Assessment:

#### Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

#### ➤ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

# University of Mumbai



## Syllabus

Honours/Minor Degree Program

In

Waste Technology

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)



**University of Mumbai**  
**Waste Technology**  
**(With effect from 2022-23)**

Year and Sem	Course Code and Course Title	Teaching Scheme Hours/ Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/ Tutorial.	Pract.	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HCWC501: Solid And Hazardous Waste Management	4	–	–	20	80	–	–	100	4
	<b>Total</b>	<b>4</b>	<b>–</b>	<b>–</b>	<b>100</b>		<b>–</b>	<b>–</b>	<b>100</b>	<b>4</b>
<b>Total Credits=04</b>										
TE Sem VI	HCWC601: Liquid Effluent Management	4	–	–	20	80	–	–	100	4
	<b>Total</b>	<b>4</b>	<b>–</b>	<b>–</b>	<b>100</b>		<b>–</b>	<b>–</b>	<b>100</b>	<b>4</b>
<b>Total Credits=04</b>										
BE Sem VII	HCWC701: Waste Valorization I	4	–	–	20	80	–	–	100	4
	HCWSBL701: Waste Technology .Skill Based Lab -1	–	–	2	–	–	50	50	100	2
	<b>Total</b>	<b>4</b>	<b>–</b>	<b>2</b>	<b>100</b>		<b>50</b>	<b>50</b>	<b>200</b>	<b>6</b>
<b>Total Credits=06</b>										
BE Sem VIII	HCWC801: Sustainable Waste Valorization II	4	–	–	20	80	–	–	100	4
	<b>Total</b>	<b>4</b>	<b>–</b>	<b>–</b>	<b>100</b>		<b>–</b>	<b>–</b>	<b>100</b>	<b>4</b>
<b>Total Credits=04</b>										
<b>Total Credit for Semester V+VI+VII+VIII=18</b>										

Waste Technology: Semester V		
Course Code	Course Name	Credits
HCWC501	SOLID AND HAZARDOUS WASTE MANAGEMENT	04

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory		Tutorial	Total
04	-	-	04	-	-	04

Theory					Term Work / Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	--		--	100

#### Course Objectives:

1. To recognize the relevant, regulations that apply for facilities used for disposal and destruction of waste.
2. To provide in depth knowledge of municipal solid waste management
3. To provide in-depth knowledge of hazardous waste management
4. To provide in-depth knowledge of Physico-chemical processes useful for the treatment of municipal and solid wastes
5. To provide in-depth knowledge of biological processes useful for the treatment of municipal and solid wastes.
6. Know the necessity of environment risk assessment.

Module	Content	Hours
1	<b>Rules and Regulations</b> Municipal solid waste (management and handling) rules, hazardous waste (management and handling) rules, biomedical waste handling rules, fly ash rules, recycled plastics usage rules, batteries (management and handling) rules	4
2	<b>Municipal Solid Waste Management</b> Need for management, sources, composition, generation rates, collection of waste, separation, transfer and transport of waste, treatment and disposal options, source reduction of wastes, recycling and reuse.	9
3	<b>Hazardous Waste Management</b> Need for management, hazardous characterization of waste, compatibility and flammability of chemicals, waste sampling, TCLP tests, fate and transport of chemicals, health effects	9
4	<b>Physicochemical Treatment of Solid and Hazardous Waste</b> Chemical treatment processes for MSW (combustion, stabilization and solidification of hazardous wastes), physicochemical processes for hazardous wastes (soil vapour extraction, air stripping, chemical oxidation), ground water contamination and remediation	9

5	<b>Biological Treatment of Solid and Hazardous Waste</b> Composting, bioreactors, anaerobic decomposition of solid waste, principles of biodegradation of toxic waste, inhibition, co-metabolism, oxidative and reductive processes, slurry phase bioreactor, in-situ remediation. Landfill design for solid and hazardous wastes, leachate collection and removal, landfill covers, incineration	14
6	<b>Environmental Risk Assessment</b> Defining risk and environmental risk, methods of risk assessment, case studies	7

### Course Outcome:

#### On completion of the course the students will:

- 1 understand rules and regulations for handling solid waste.
- 2 understand principals of municipal solid waste management.
- 3 understand hazardous waste management.
- 4 learn physicochemical treatment of solid and hazardous waste.
- 5 understand biological treatment of solid and hazardous waste.
- 6 understand environment risk assessment.

### Assessment

#### Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**.

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).

#### End Semester Examination (80 marks):

1. Weightage of each module in end semester examination will be proportional to number of respective lectures.
2. Question paper will comprise of total **six questions, each carrying 20 marks**.
3. **Question 1** will be compulsory and should cover **maximum contents of the curriculum**.
4. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
5. Only **Four questions need to be solved**.

### Test Books/Reference Books:

- 1 Tchobanoglous G., Theisen H. and Vigil S.A., "Integrated Solid Waste Management", McGraw-Hill International editions.
- 2 Bhide A.D. and Sundaresan B.B., "Solid Waste Management, Collection, Processing and Disposal", Nagpur.
- 3 "Manual on Municipal Solid Waste Management", CPHEEO, Ministry of Urban Development, Government of India.
- 4 Management and Handling Rules for: municipal solid waste, biomedical waste, hazardous waste and radioactive wastes, Government of India Publications.
- 5 Solid Waste Management Hand Book – Pavoni

Waste Technology: Semester VI		
Course Code	Course Name	Credits
HCWC601	LIQUID EFFLUENT MANAGEMENT	04

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory		Tutorial	Total
04	-	-	04	-	-	04

Theory					Term Work / Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	--		--	100

#### Course Objectives:

- 1 To learn how to minimize waste and study available treatment options.
- 2 To know concept of pollution control.
- 3 To learn ion exchange process and various adsorption techniques.
- 4 To study advanced methods for effluent management.
- 5 To know methods of waste reduction and how to recover byproducts.
- 6 To learn concepts and design of natural treatment system.

Module	Contents	Hours
1	<b>Waste Minimization and Treatment options</b> Methods of waste volume and strength reductions, Waste minimization - 4 R concepts, Waste audit, Classification of treatment and development of treatment flow sheets.	9
2	<b>Pollution control</b> Zero discharge concept. Concept of common effluent treatment plant- objectives, types of CETP, technical and financial aspects. Rural wastewater systems – septic tanks, two-pit latrines, ecotoilet, soak pits.	8
3	<b>Ion Exchange and Adsorption</b> Ion exchange process, ion exchange resins, exchange capacity, ion exchange, chemistry and reactions, Design of ion exchange units, Disposal of concentrate waste streams. Types of adsorption, adsorption isotherms, activated carbon adsorption kinetics, analysis and design of adsorption column.	9
4	<b>Advanced methods for effluent management</b> Ozonation, photocatalysis, wet air oxidation, evaporation, reverse osmosis, biological treatment for toxic waste	9
5	<b>Waste Reduction/Byproduct recovery</b> Waste reduction/ byproduct recovery for sugar, paper mill, petroleum and oil refineries, steel and engineering industries, fertilizer and pesticide industries, organic & inorganic manufacturing industries	9

6	<b>Natural Treatment Systems</b> Constructed wetland and aquatic treatment systems; Types- free water surface and subsurface constructed wetlands, selection of plants, removal mechanisms, applications, design procedure for constructed wetlands, management of constructed wetlands	8
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#### Course Outcomes:

- 1 Understand minimizing the waste and available treatment options.
- 2 Understand concept of pollution control.
- 3 Understand ion exchange process/design and adsorption techniques.
- 4 Advanced methods for effluent management.
- 5 Waste reduction/byproducts recovery for manufacturing industries.
- 6 Concepts and design of natural treatment system.

#### Assessment

##### Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).

##### End Semester Examination (80 marks):

1. Weightage of each module in end semester examination will be proportional to number of respective lectures.
2. Question paper will comprise of total **six questions, each carrying 20 marks**.
3. **Question 1** will be compulsory and should cover **maximum contents of the curriculum**.
4. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
5. Only **Four questions need to be solved**.

#### Text Books and References:

- 1 Eckenfelder, W.W., Industrial Water Pollution Control, McGraw-Hill, 1999.
- 2 Arceivala, S.J., Wastewater Treatment for Pollution Control, McGraw-Hill, 1998.
- 3 Frank Woodard, Industrial waste treatment Handbook, Butterworth Heinemann, New Delhi, 2001

Waste Technology: Semester VII		
Course Code	Course Name	Credits
HCWC701	WASTE VALORIZATION I	04

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory		Tutorial	Total
04	-	-	04	-	-	04

Theory					Term Work / Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs	--		--	100

#### Course Outcomes:

1. To know waste valorization process used for reduce, reuse and recycle.
2. To learn biovalorization of industrial waste.
3. To know concept of biorefineries and related factors.
4. To learn recent trends and vermiculture.
5. To know biovalorisation of agriculture biomass.
6. To study case studies based on waste recycling.

Module	Contents	Hours
1	<b>Wastes valorization processes:</b> Preparation for reuse, recycling, and other valorisation processes. Analysis of advantages and limitations.	5
2	<b>Bio-valorisation of industrial wastes:</b> Anaerobic bio-valorisation of leather industry solid waste and production of high value-added biomolecules and biofuels, Anaerobic bio-valorisation of pulp and paper mill waste, Bio-valorisation of winery industry waste to produce value-added products, Conversion of textile effluent wastewater into fertilizer using marine cyanobacteria along with different agricultural waste.	12
3	<b>Biorefineries:</b> Biorefinery for hydrocarbons and emerging contaminants, Biodesulfurization of petroleum wastes, Microbial leaching of heavy metals from e- waste, opportunities and challenges.	8
4	<b>Biovalorisation of agricultural biomass:</b> Recent trends in biorefinery-based valorisation of lignocellulosic biomass, Protein engineering approaches for lignocellulosic ethanol biorefinery, Biovalorization potential of agro forestry/industry biomass for optically pure lactic acid fermentation, Opportunities and challenges, Agro-based sugarcane industry wastes for production of high-value bioproducts	11
5	<b>Recent trends and vermiculture</b> Recent trends and challenges in bioleaching technologies, membrane separation technologies for downstream processing. Definition, scope and importance – common species for culture	8

	– environmental requirements – culture methods- applications of vermiculture-Potentials and constraints for composting in India-large scale and decentralized plants.	
6	<b>Case studies on waste recycling</b> Recycling technologies for paper, glass, metal, plastic, used lead acid battery, end of life vehicle recycling, electronic waste recycling, waste oil, recycling solvent recovery, drivers and barriers for material recycling, social, legal and economic factors, environmental impacts of waste recycling, design for the environment the life cycle approach.	8

### Course Outcomes:

On completion of this course students will

- 1 understand the waste valorization process to reduce, reuse and recycle.
- 2 understand Biovalorization of industrial waste
- 3 understand concept of biorefineries, their opportunities and challenges
- 4 understand recent trends and vermiculture.
- 5 understand biovalorisation of agriculture biomass.
- 6 understand waste recycling using case studies.

### Assessment

#### Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).

#### End Semester Examination (80 marks):

1. Weightage of each module in end semester examination will be proportional to number of respective lectures.
2. Question paper will comprise of total six questions, each carrying 20 marks.
3. Question 1 will be compulsory and should cover maximum contents of the curriculum.
4. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
5. Only Four questions need to be solved.

#### Text Books/ Reference Books

- 1 Aarne Vesilind and Alan E Rimer (1981), Unit operations in Resource Recovery Engineering , Prentice Hall Inc., London
- 2 Manser A G R, Keeling A A (1996). Practical handbook of processing and recycling on municipal waste. Pub CRC Lewis London, ISBN 1-56670-164
- 3 Chiumenti, Chiumenti, Diaz, Savage, Eggerth, and Goldstein, Modern Composting Technologies JG Press October 2005
- 4 Charles R Rhyner (1995),Waste Management and Resource Recovery, Lewis



Waste Technology: Semester VII		
Course Code	Course Name	Credits
HCWSBL701	WASTE TECHNOLOGY SKILL BASED LAB	02

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	04	-	--	02	-	02

Theory					Term Work / Practical/Oral		Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	Oral	
Test-I	Test-II	Average					
-	-	-	-	-----	50	50	100

### Course Objectives:-

Students will able to

- 1 Understand analyze properties of MSW
- 2 Understand vermicomposting on a lab scale.
- 3 Understand aerobic and anaerobic digesting of solid waste.
- 4 Will know of incineration process and handling of HSW.
- 5 Understand ecology baseline and impact of waste on environment.
- 6 Understand process of project report preparation based on case studies.

### List of Experiments (minimum eight)

Waste Technology based experiments should be conducted.

1. Determination of pH of MSW
2. Determination of Total Solids, fixed solids and volatile solids
3. Determination of nutrient value (NPK)
4. Lab scale study on vermicomposting
5. Lab scale study of aerobic and anaerobic digesting of solid wastes (Both industrial & Municipal)
6. A Visit to the Hazardous waste Generation or disposal site.
7. Practical knowledge and working of incinerators
8. Visit to Industrial area, especially the handling of Hazardous materials
9. Ecology baseline and impact of waste – disposal on vegetation

10. Preparation of Project report based on a case study of one hospital. Study of the source, generation rates and characteristics of hazardous wastes and their regulation, handling, treatment, and disposal. Special emphasis is placed on process design of waste handling, treatment and disposal systems.

**Course Outcomes:**

At the end of the course the student will be able to:

- 1 Learn to analyze properties of MSW.
- 2 To study vermicomposting on a lab scale.
- 3 To carry out aerobic and anaerobic digesting of solid waste.
- 4 To acquire knowledge of incineration process and handling of HSW.
- 5 Learn to analyze ecology baseline and impact of waste.
- 6 Learn about project report preparation based on case studies.

**Term work (25 marks)**

Term work should be evaluated based on performance in practical/Assignments.

Practical Journal/Assignments:	45 marks
Attendance:	05 marks
Total:	50 marks

**End Semester Oral Examination (50 marks)**

- A student will become eligible for Oral examination after completing 8 out of 10 experiments/Assignments

Waste Technology: Semester VIII		
Course Code	Course Name	Credits
HCWC801	WASTE VALORIZATION II	04

Course Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory		Tutorial	Total
04	-	-	04	-	-	04

Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test -II	Average						
20	20	20	80	03 Hrs	--	-	--	100

#### Course Objective:

- 1 To know concept of energy from waste.
- 2 To study devices for converting waste into energy.
- 3 To undertake case studies based on impact of pollution on environmental and health.
- 4 To learn biohydrogen processes its applications and briquetting techniques.
- 5 To know microalgal biovalorization.
- 6 To learn process of converting biomass to energy.

Module	Contents	Hours
1	<b>Introduction to Energy from waste</b> Present status of technologies for conversion of waste into energy, design of waste to energy plants for cities, small townships and villages. Sources of energy generation, Classification of waste as fuel – agro based, forest residue, industrial waste	8
2	<b>MSW –conversion devices</b> Incinerators, gasifiers, digestors. , land fill gas generation and utilization, ,Anaerobic Digestion: Biogas production	9
3	<b>Environmental and health impacts-case studies</b> Environmental and health impacts of waste to energy conversion, case studies of commercial waste to energy plants, waste to energy- potentials and constraints in India, eco-technological alternatives for waste to energy conversions.	10
4	<b>Briquetting</b> Industrial Application of Gasifiers-Utilization and Advantages of Briquetting, environmental and health impacts of incineration; strategies for reducing environmental impacts.	9
5	<b>Biohydrogen:</b> Overview on Processes involved, and from Biohydrogen and applications.	8
6	<b>Microalgal biovalorization:</b> Conventional and nonconventional approach, Integration of wastewater valorization with microalgae for biofuel production,	8

#### Course Outcome:

Students will be able to

- 1 understand the concept of energy from waste.

- 2 understand various devices to convert energy from waste.
- 3 understand environmental and health impacts using case studies.
- 4 understand biohydrogen processes, applications and briquetting techniques.
- 5 understand concept of microalgal biovalorization.
- 6 understand process for biomass to energy.

## Assessment

### Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I).

### End Semester Examination (80 marks):

1. Weightage of each module in end semester examination will be proportional to number of respective lectures.
2. Question paper will comprise of total **six questions, each carrying 20 marks**.
3. **Question 1** will be compulsory and should cover **maximum contents of the curriculum**.
4. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
5. Only **Four questions need to be solved**.

## Textbooks /References

- 1 Rada E.C. Waste Management and Valorization: Alternative Technologies., CRC Press, Taylor and Francis Group, 2016.
- 2 Rathinam N.K. and Sani, R.K. Biovalorisation of Wastes to Renewable Chemicals and Biofuels. Elsevier Inc. 2020.

# University of Mumbai



## Syllabus

**Honours/Minor Degree Program**

**In**

**Electric Vehicles**

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Electric Vehicles**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HEVC501: Vehicular Systems and Dynamics	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>--</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
TE Sem. VI	HEVC601: EV Drive and Energy Sources	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
BE Sem. VII	HEVC701: Automotive Controllers and Auxiliary Systems	04	--	--	20	80	--	--	100	04
	HEVSBL701: Electric Vehicles Lab	--	--	04	--	--	50	50	100	02
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>04</b>	<b>100</b>	<b>50</b>	<b>50</b>	<b>200</b>	<b>06</b>	
<b>Total Credits = 06</b>										
BE Sem. VIII	HEVC801: Electric Vehicle System Design	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V,VI, VII &amp;VIII = 04+04+06+04 = 18</b>										

‘Electric Vehicle’ - SEM-V						
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned	
		Theory	Tutorial	Theory	Tutorial	Total
HEVC501	<b>Vehicular Systems and Dynamics</b>	04	-	04	-	04

Course code	Course Name	Examination Scheme								
		Theory					End Sem. Exam	Exam Duration (Hrs.)	Term Work	Total
		Internal Assessment			Avg.					
		Test 1	Test 2	Avg.						
HEVC501	<b>Vehicular Systems and Dynamics</b>	20	20	20	80	03	-	100		

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To study different automotive components and subsystems</li> <li>To explore and compare the transition of automotive domain from ICE to electric vehicles</li> </ol>
<b>Course Outcomes</b>	<p><b>Upon successful completion of this course, the learner will be able:</b></p> <ol style="list-style-type: none"> <li>To illustrate the general configuration and identify various components of automobile.</li> <li>To define the functionality and working principles of different types of Automotive Powertrains</li> <li>To illustrate the working of various automotive transmission systems</li> <li>To identify and illustrate the various hybrid electric powertrains and their different modes of operations</li> <li>To explain the basic and state of the art of Electric vehicles and its major parts.</li> <li>To compare and contrast the performance of ICE vehicles, HEVs and EVs.</li> </ol>

Module	Contents	Hours
1.	<p><b><u>Vehicle Mechanics:</u></b> History of Vehicle Development, General Configuration of Automobile, Body and Chassis Fundamentals: General Packaging, Types of Structural System, Backbone Construction; Body and Chassis Materials. Automotive Powertrain, Mechanical Suspensions system, Steering System, NVH, Control System Integration and Implementation. Front-Wheel Drive (FWD) Powertrains, Rear-Wheel Drive Powertrains (RWD), Multi-Wheel Drive Powertrains (AWD and 4WD)</p>	10
2.	<p><b><u>Transmission Systems:</u></b> Transmission gears, Manual Transmission (MT), Automatic Transmission (AT), Automated Manual Transmissions (AMT) and Continuously Variable Transmissions (CVT); Manual Transmissions Powertrain Layout and Manual Transmission Structure, Power Flows and Gear Ratios, Manual Transmission Clutch and its structure. Drivetrain and Differential</p>	10
3.	<p><b><u>Automotive Subsystems:</u></b> Automotive Aero-dynamics, Vehicle Power Demand Analysis; Types of suspension and drive, Braking systems; Tyre Mechanics: Tyres and wheels, Tyre characteristics; Vehicle handling &amp; stability; Automotive instrumentation</p>	06
4.	<p><b><u>ICE Performance Characteristics:</u></b> Power and torque generation, specific fuel consumption; Engine emissions, control and norms; Efficiencies- fuel conversion efficiency, mechanical efficiency, volumetric efficiency</p>	06



5.	<b>Hybrid Powertrain:</b> Series HEVs, Parallel HEVs, Series-Parallel HEVs, Complex HEVs, Operating Modes, Degree of Hybridization, Comparison of HEVs, Plug-in Hybrid Electric Vehicles (PHEVs); Real Life examples of HEVs	10
6.	<b>Electric Vehicles:</b> Basics of Electric Vehicles, Current Status and Trends for EVs, Battery Electric Vehicles (BEVs), Fuel-Cell Electric Vehicles (FCEVs), Electric Machines for EV applications, EV Transmission: Single-Speed EV Transmission, Multiple Ratio EV Transmissions. Comparison of ICE vehicle with HEVs and EVs. National Policy for adoption of EVs	10

#### Text Books:-

1. Vehicle Powertrain Systems by Behrooz Mashadi and David Crolla, Wiley, 2012
2. Automotive Aerodynamics by Joseph Katz, Wiley, 2016
3. Automotive Chassis Engineering, by David C. Barton and John D. Fieldhouse, Springer, 2018
4. Automotive Engineering Powertrain, Chassis System and Vehicle Body Edited by David A. Crolla, Elsevier, 2009
5. Automotive Power Transmission Systems by Yi Zhang and Chris Mi, Wiley, 2018
6. Linear Electric Machines, Drives, and MAGLEVs Handbook, by Ion Boldea, CRC Press. 2013
7. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles by Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, and Ali Emadi, CRC Press 2005
8. Electric Vehicle Technology Explained by James Larminie and John Lowry, John Wiley, 2003
9. Electric and Hybrid Vehicles- Design Fundamentals by Iqbal Husain, CRC Press, 2005

#### Reference Books:-

1. Encyclopaedia of Automotive Engineering edited by David Crolla et al, Wiley, 2014
2. Design and Control of Automotive Propulsion Systems by Zongxuan Sun and Guoming Zhu, CRC Press, 2015
3. The Automotive Transmission Book by Robert Fischer, Ferit Küçükay, Gunter Jürgens, Rolf Najork, and Burkhard Pollak, Springer, 2015
4. Noise and Vibration Control in Automotive Bodies by Jian Pang, Wiley, 2019

#### Website Reference / Video Courses:

1. NPTEL Web course: Fundamentals of Automotive Systems, by Prof. C.S. Shankar Ram, IIT Madras, <https://nptel.ac.in/courses/107/106/107106088/>

#### Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

#### Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

‘Electric Vehicle’ - SEM-VI						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Tutorial	Theory	Tutorial	Total
HEVC601	EV Drive and Energy Sources	04	-	04	-	04

Course code	Course Name	Examination Scheme							
		Theory				End Sem. Exam	Exam Duration (Hrs.)	Term Work	Total
		Internal Assessment			Avg.				
		Test 1	Test 2						
HEVC601	EV Drive and Energy Sources	20	20	20	80	03	-	100	

Course Objectives	<ol style="list-style-type: none"> <li>To explore and understand various traction motors, power drives and control strategies used in EVs.</li> <li>To get conversant with the energy sources used in EVs and their state of the art.</li> <li>To understand the various battery charging and management systems</li> </ol>
Course Outcomes	<p><b>Upon successful completion of this course, the learner will be able to:</b></p> <ol style="list-style-type: none"> <li>To identify and assess various traction motors along with their suitability in various EV segments</li> <li>To describe and differentiate various power converters and their control used in EV drives</li> <li>To evaluate the battery specifications using various design considerations for EVs</li> <li>To illustrate different battery charging methods and protocols</li> <li>To explain the impact of large scale integration of EV charging infra in existing grid and its mitigation techniques.</li> <li>To illustrate the need and importance of drive cycles used in testing of automobiles.</li> </ol>

Module	Contents	Hours
1.	<p><b>Introduction to Traction Motors:</b> DC Machines- Brushed and Brushless DC motors (BLDC); AC Motors: Induction motors (IM), permanent-magnet ac synchronous motor-surface-permanent-magnet (SPM) motors and interior-permanent-magnet (IPM) motors; PM Materials; Switched Reluctance Motor (SRM); Basic construction details and working principles of each of the machine. In-Wheel Motors Comparison of Traction Machines; Specifications of the motors, Characteristic Curves of a Machines: Constant-Torque Mode, Constant-Power Mode; Efficiency Map; Suitability of each machine in Electric vehicle domain for 2W, 3W, 4 wheeler and large size vehicles. Real life examples; Review of advancement in EV Motors and Drives.</p>	10
2.	<p><b>Power Converters for EV drive:</b> Power Conversion –Basic Principle, review of DC-DC converters, DC-AC Converters used in EV applications; Power topologies for IM, BLDC, PMSM and SRM motors. Traction Drives, Modulation schemes: Sinusoidal Pulse Width Modulation, SPWM with third harmonic injection, Space vector modulation, comparison of modulation techniques. Converter / Inverter Loss calculation, Heat-sinking: passive and active cooling.</p>	08

3.	<p><b>Control of Power converters and Motors:</b>  Induction Motor Control: Variable-Voltage Variable-Frequency Control (VVVF), Field-Oriented Control (FOC), Direct Torque Control (DTC);  PM Synchronous Motor Control: Field-Oriented Control of PMSM, Flux-Weakening Control of PMSM, Position Sensorless Control of PMSM.  SRM motor control: Current chopping control (CCC), Torque-Ripple Minimization Control  BLDC Motor Control: Trapezoidal back EMF BLDC motor control</p>	10
4.	<p><b>Energy Sources for EV:</b>  Overview of energy sources for electric vehicle: Batteries, Fuel Cell, Ultra-capacitor and flywheel energy storage; Hybridization of energy sources for electric and hybrid vehicles; Comparison of sources.  Batteries: Lead-acid battery, Nickel-based batteries, Sodium based batteries, lithium batteries Metal/air batteries;  Battery parameters, Battery pack formation and testing, SoC &amp; SoH, Estimation of SoC. Battery cell balancing, Battery management System (BMS), Thermal and safety considerations in battery pack design.  Voltage and AHr/ kWhr ratings of ES for EV applications: Major design considerations</p>	10
5.	<p><b>Battery charging Infrastructure:</b>  AC and DC charging, CC-CV charging, Pulse charging; On-board and off-board charging; Standards and protocols for charging;  Fast DC chargers, Home and Public charging infrastructure; Wireless power transfer (WPT) technologies for EVs, Move-and-charge technology.  Charging Infrastructure-standardization and connectivity issues; SAE J1772, CHAdeMo, GB/T, CCS2 battery charging protocols. OCPP protocol  Impact on existing power grid, G2V and V2X- Vehicle-to-home (V2H), vehicle-to-vehicle (V2V), and vehicle-to-grid (V2G) energy systems. Renewable Energy Based Charging infra.</p>	10
6.	<p><b>EV Drive Cycle Testing:</b>  Need for a driving cycle, different Drive Cycles: NEDC, EUDC, EPA, WLTP, and FTP-75;  Testing of EV for range per charge for a given drive cycle</p>	04

**Text/Reference Books:-**

1. Fundamentals And Applications Of Lithium-Ion Batteries In Electric Drive Vehicles by Jiuchun Jiang and Caiping Zhang, Wiley, 2015
2. Battery Management Systems for Large Lithium-Ion Battery Packs, by Davide Andrea, Artech House Publication, 2010
3. Electric Vehicle Battery Systems by Sandeep Dhameja, Newens, 2002
4. Fundamentals And Applications Of Lithium-Ion Batteries In Electric by Jiuchun Jiang and Caiping Zhang, Wiley, 2015
5. Optimal Charging Control of Electric Vehicles in Smart Grids by Wanrong Tang and Ying Jun Zhang, Springer, 2017
6. Plug In Electric Vehicles in Smart Grids Charging Strategies Edited by Sumedha Rajakaruna, Farhad Shahnia and Arindam Ghosh, Springer 2015
7. Technologies and Applications for Smart Charging of Electric and Plug-in Hybrid Vehicles edited by Ottorino Veneri, Springer, 2017
8. Solar Powered Charging Infrastructure for Electric Vehicles A Sustainable Development Edited by Larry E. Erickson, Jessica Robinson, Gary Brase, and Jackson Cutsor, CRC Press, 2017
9. Energy Systems for Electric and Hybrid Vehicles Edited by K.T. Chau, IET, 2016

10. Handbook of Automotive Power Electronics and Motor Drive Edited by Ali Emadi, CRC Press, 2005
11. Electric And Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure And The Market by Gianfranco Pistoia, Elsevier, 2013
12. AC Motor Control and Electrical Vehicle Applications, Second Edition by Kwang Hee Nam CRC Press, 2019

**Website Reference / Video Courses:**

1. **NPTEL Web Course:** Electric Vehicles - Part 1 by PROF. AMIT KUMAR JAIN Department of Electrical Engineering IIT Delhi; <https://nptel.ac.in/courses/108/102/108102121/>
2. **NPTEL Web Course:** Fundamentals of Electric vehicles: Technology & Economics: by Prof. Ashok Jhunjunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha and Prof. L Kannan, IIT Madras, <https://nptel.ac.in/courses/108/106/108106170/>
3. **NPTEL Web Course:** Introduction to Hybrid and Electric Vehicles by Dr. Praveen Kumar and Prof. S. Majhi, IIT Guwahati, <https://nptel.ac.in/courses/108/103/108103009/>

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

**Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

‘Electric Vehicle’ - SEM-VII						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Tutorial	Theory	Tutorial	Total
HEVC701	<b>Automotive Controllers and Auxiliary Systems</b>	04	-	04	-	04

Course code	Course Name	Examination Scheme						
		Theory			End Sem. Exam	Exam Duration (Hrs.)	Term Work	Total
		Internal Assessment						
Test 1	Test 2	Avg.						
HEVC701	<b>Automotive Controllers and Auxiliary Systems</b>	20	20	20	80	03	-	100

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To Identify functionalities of various automotive controllers and auxiliary systems</li> <li>To study various automotive sensors and actuators</li> <li>To explore details of energy sources management system, thermal management system and overall system integration in EVs/ HEVs</li> </ol>
<b>Course Outcomes</b>	<p><b>Upon successful completion of this course, the learner will be able:</b></p> <ol style="list-style-type: none"> <li>To illustrate functionality of various auxiliary subsystems used EVs</li> <li>To demonstrate the use of VCUS and ECUS in automobile</li> <li>To describe the <b>need and functionality of automotive sensors / actuators and networking</b></li> <li>To illustrate the design and management aspects of EV energy sources</li> <li>To describe the various heat losses, and thermal management systems incorporated in EVs</li> <li>To elaborate on System Integration and resource optimization in EVs</li> </ol>

Module	Contents	Hours
1.	<p><b>Introduction:</b> Review of Automotive electrical, electronic, communication and thermal subsystems; Review of Energy Storage (Power Plant) system, Main Traction Inverter, On-Board Charger (OBC), LV Auxiliary Power Source, HV Battery Disconnect; Vehicle Control Unit (VCU) and ECUs. Braking Systems: Energy Consumption in Braking, Braking Power and Energy on Front and Rear Wheels, Brake System of EVs and HEVs, Series Brake-Optimal Feel, Series Brake-Optimal Energy Recovery; Parallel Brake; Antilock Brake System (ABS); Fundamentals of Regenerative Braking. Steering System: In-car system networking, Steering ratio characteristic, Steering Stabilization, Over-steer, understeer, Electric-Power-Assisted Steering (EPAS); Autonomous vehicles, Principle of object detection.</p>	12
2.	<p><b>Vehicle Control Unit and Electronic Control Unit:</b> VCU functionality: Inverter control, battery management, charging control, vehicle functions in transmission and engine control; Advanced Driver Assistance System (ADAS); Electronic control units (ECUs): Various Section ECUs and their networking; Body and Lighting ECU (Key-less Entry, Sonar, HID, LED Lamps), Body ECU (Airbag).</p>	08
3.	<p><b>Automotive sensors / actuators and networking:</b> Radar Sensor Detectors for Vehicle Safety Systems; Airborne Ultrasonic Imaging: SONAR Based Image Generation for Autonomous Vehicles, Motor angle sensor, Steering angle sensor, Tyre Pressure Monitoring Systems (TPMS);</p>	10

	In Vehicle communication system: CAN, LIN, Ethernet, Flexray	
4.	<b>Energy Storage (Power Plant) Management system:</b> Battery cell packaging, Battery Management System (BMS), Design of battery pack and safety considerations; High voltage cabling and cut-outs; Battery pack installation. Use of Battery-UC Hybrid source; Fuel Cell (FC): FC management and Hydrogen storage in EV.	10
5.	<b>Thermal Management System:</b> Heat Calculation in various subsystems; HVAC system: HVAC compressor drive; Liquid cooling system for Battery, Electric drive and On board charger. Design considerations for thermal management system	06
6.	<b>System Integration and Implementation:</b> Vehicular Power Control Strategy and Energy Management: A Generic Framework, Definition, and Needs, Methodologies for Optimization, Cost Function Optimization, Benefits of Energy Management.	06

#### Text/Reference Books:-

1. Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles by John G. Hayes and G. Abas Goodarzi, Wiley, 2018.
2. Handbook of Automotive Power Electronics and Motor Drive Edited by Ali Emadi, CRC Press, 2005
3. Encyclopaedia of Automotive Engineering edited by David Crolla *et al.*, Wiley, 2014
4. Electric and Hybrid Vehicles Technologies, Modeling and Control: A Mechatronic Approach by Amir Khajepour, Saber Fallah and Avesta Goodarzi, Wiley, 2014.
5. Hybrid Electric Vehicles Principles and Applications with Practical Perspectives, Second Edition Chris Mi and M. Abul Masrur, Wiley 2018.
6. Autonomous Vehicles Intelligent Transport Systems And Smart Technologies edited by Nicu Bizon, Lucian Dascalescu and Naser Mahdavi Tabatabaei, Nova Publishers, 2014
7. Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles by Sheldon S. Williamson, Springer, 2013
8. Electric and Hybrid Buses for Urban Transport Energy Efficiency Strategies, by Bogdan Ovidiu Varga, Calin Iclodean and Florin Mariasiu, Springer, 2016

#### Website Reference / Video Courses:

1. NPTEL Web Course: Electric Vehicles - Part 1 by PROF. AMIT KUMAR JAIN Department of Electrical Engineering IIT Delhi; <https://nptel.ac.in/courses/108/102/108102121/>
2. NPTEL Web Course: by Fundamentals of Electric vehicles: Technology & Economics: Prof. Ashok Jhunjhunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha and Prof. L Kannan, IIT Madras, <https://nptel.ac.in/courses/108/106/108106170/>
3. NPTEL Web Course: Introduction to Hybrid and Electric Vehicles by Dr. Praveen Kumar and Prof. S. Majhi, IIT Guwahati, <https://nptel.ac.in/courses/108/103/108103009/>

#### Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

#### Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

**'Electric Vehicle' - SEM-VII**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
HEVSBL701	<b>Electric Vehicles Lab</b>		<b>04</b>	--	<b>02</b>	<b>02</b>

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)			
		Test 1	Test 2	Avg.					
HEVSBL701	<b>Electric Vehicles Lab</b>	-	-	-	-	-	50	50	100

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To provide hands-on with various major components used in EV/HEVs</li> <li>To explore EV drives &amp; control implementation along with analysis using simulation tool or with hardware.</li> <li>To study various auxiliary systems commonly used in EV.</li> </ol>
<b>Course Outcomes</b>	<p><b>Upon successful completion of this course, the learner will be able to:</b></p> <ol style="list-style-type: none"> <li>Compare and contrast conventional vehicles and EV/HEVs.</li> <li>Illustrate operations and features of Conventional, hybrid electric vehicle and electrical vehicle Powertrains.</li> <li>Describe the working of EV drives used for different kinds of electric motors.</li> <li>Illustrate battery characteristics and working of BMS.</li> <li>Describe the operation of On-board and Off-board EV chargers</li> <li>Demonstrate the use of simulations tools along with hardware implementation for evaluation of EV subsystems.</li> </ol>

**Contents**

**Electric Vehicles Lab: Experimental study based on the following topics**

- Conventional and electrical vehicle sub-systems and components
  - Conventional, hybrid electric vehicle and electrical vehicle Powertrains
  - Motor performance test - for BLDC /PMSM/ IM/SRM motors;
  - EV drive for BLDC/PMSM/IM /SRM motors
  - Battery cell and module- characterization
  - Battery Management System (BMS)
  - On-board and Off-board charger for EV
  - Study of Automotive Electronics-HVAC control, Steering Control, VCU; 2/3 or 4 Wheeler EV.
- (or any other experiments based on EV/HEV related systems/ subsystems)**

**Use of software tools:**

Use of tools like ADVISOR, MATLAB, SEMIKRON SEMISEL, Python, C, Java platforms (or similar) etc. for the following

- Simulation/ Emulation of Vehicle performance analysis for Conventional and Electrical Vehicle
- Design simulation of a battery pack with given specifications and constraints.
- Simulation/ Emulation of BLDC motor drive for performance analysis

4. Simulation/ Emulation of PMSM motor drive for performance analysis
5. Simulation/ Emulation of IM motor drive for performance analysis
6. Simulation/ Emulation of SRM motor drive for performance analysis
7. Simulation/ Emulation of On board and Off board charger.
8. Simulation/ Emulation of regenerative braking.

**(or any other simulation based on EV/HEV related systems/ subsystems)**

**Visit to industrial/ manufacturing facility:**

1. Visit to EV manufacturing facility.
2. Visit to Battery pack /BMS design facility
3. Visit to battery Charger facility
4. Visit to Automotive Research Association of India (ARAI), Pune EV COE

**(or a visit to any facility / industry / research institute carrying out work in the domain of EV)**

**Course Project**

Course project to be carried out to design /fabricate/ program one of the vehicular sub-systems used in EV

**Note:** Students and teachers are encouraged to use the virtual labs whose links are as given below. The remote-access to Labs in various disciplines of Science and Engineering is available. Students can conduct online experiments which would help them in learning basic and advanced concepts through remote experimentation.

**Virtual Lab Website Reference**

1. <http://vlab.co.in/broad-area-electrical-engineering>
2. <https://www.vlab.co.in/broad-area-mechanical-engineering> - Energy Storage Labs, Solar Energy lab, Wind Energy Lab

**Term work:**

Term work shall consist of minimum eight experiments, at least one plant visit, and one course project. The distribution of marks shall be as follows:

Journal / Experiments Performance	: 25 marks
Attendance	: 05 marks
Plant Visit report	: 10 marks
Course Project report	: 10 Marks

The final certification and acceptance of term work ensures the minimum passing in the term work.

**Oral Examination:**

Oral examination will be based on entire lab work of **HCEVSBL701-Electric Vehicles Lab**



‘Electric Vehicle’ - SEM-VIII						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Tutorial	Theory	Tutorial	Total
HEVC801	Electric Vehicle System Design	04	-	04	-	04

Course code	Course Name	Examination Scheme							
		Theory				End Sem. Exam	Exam Duration (Hrs.)	Term Work	Total
		Internal Assessment			Avg.				
		Test 1	Test 2	Avg.					
HEVC801	Electric Vehicle System Design	20	20	20	80	03	-	100	

Course Objectives	<ol style="list-style-type: none"> <li>To illustrate the design philosophies used in the EV domain.</li> <li>To explore the selection of power and control architecture of EV drives</li> <li>To study the design aspects of EV battery packs and other auxiliary systems</li> </ol>
Course Outcomes	<p>Upon successful completion of this course, the learner will be able to:</p> <ol style="list-style-type: none"> <li>To select and size the electric motor for a particular EV application and performance criteria</li> <li>To select and size the battery pack to meet desired EV performance and</li> <li>To design the EV drive system with functional safety considerations.</li> <li>To illustrate the use of hybrid energy source for EV performance improvement</li> <li>To illustrate the design aspects of Automotive Subsystem</li> <li>To design the EV chargers and charging infrastructure</li> </ol>

Module	Contents	Hours
1.	<p><b>Selection/ Sizing of EV Electric Motors:</b>            Electric Vehicle modelling, Tractive force calculations, Design considerations for 2W, 3W and 4W EVs; Torque, power and Speed requirement, Traction Limit, Maximum Acceleration Limit, Maximum Grade Limit, Vehicle Power Demand Vehicle Performance Envelope, and Vehicle Power Envelope; Vehicle Power Demand during Driving Cycles.            Design considerations for EV motors and their cooling system. Application Examples of EV /HEV motors with vehicles and motor specifications.</p>	08
2.	<p><b>Selection/ Sizing of Battery pack and other Energy Resource:</b>            Selection of type of Battery pack for 2W, 3W and 4W EVs; Battery pack sizing: Design considerations: Range per charge, range anxiety, EV motor power requirement; Impact of road conditions, environmental conditions and traffic conditions.            High-Voltage Cabling and Disconnects, Safety in Battery Design, Testing for safety. Accelerated Reliability Testing of Electric Vehicles, Battery Cycle Life versus Peak Power and Rest Period.            Selection and sizing of Fuel cell for FCEV, design considerations; Battery-ultra-capacitor hybrid combination sizing, performance analysis.            Design considerations for Ultra-capacitor based EV, requirement of charging infra. Flywheel selection and sizing for EV/HEV applications.</p>	12
3.	<p><b>Automotive Subsystem Design:</b>            Electronic Control Unit (ECU) and its Control Features, Communications between ECUs, Control Software Development: Software-in-the-Loop (SIL) Simulation and Hardware-in-the-Loop (HIL) Simulation.            Acceleration and braking control, regenerative braking; Automotive Steering Systems.</p>	06

	Design considerations of HVAC controller	
4.	<b>EV System integration:</b> EMC design on ECU level, EMC design on system level and in special subsystems, Radiated emissions and Conducted emissions, EMI EMC measurements.	06
5.	<b>Design of Charging Infrastructure:</b> Design considerations for AC charger: vehicle interface and charging protocol design. applicable charging standards Design of On-Board Charger (OBC)-Schematic, power topology and control, Power capacities, regenerative braking control. Design considerations of DC fast charger: vehicle interface and charging protocol design. Connectivity and applicable charging standards Installation guidelines and grid requirement for charger installations.	12
6.	<b>Design with Functional Safety of Automotive Electronics:</b> Functional Safety requirements of Automotive Electronics; ASIL identification and safety goal finalization, ISO 26262. Energy Storage integrity / protection: rupture and toxic gas management; low energy stranding, Unintended vehicle movement, shock protection, and Elimination of potential thermal/ explosive event. Hazard and Risk Analysis (HARA) for different situations, Testing of vehicles for compliance of safety norms	08

#### Text/Reference Books:-

1. Design and Control of Automotive Propulsion Systems by Zongxuan Sun and Guoming Zhu, CRC Press, 2015
2. Electric Vehicle Machines and Drives Design, Analysis and Application by K. T. Chau, IEEE Press, and Wiley, 2015
3. EMC and Functional Safety of Automotive Electronics by Kai Borgeest, IET, 2018

#### Website Reference / Video Courses:

1. NPTEL Web Course: Electric Vehicles - Part 1 by PROF. AMIT KUMAR JAIN Department of Electrical Engineering IIT Delhi; <https://nptel.ac.in/courses/108/102/108102121/>
2. NPTEL Web Course: Fundamentals of Electric vehicles: Technology & Economics, by Prof. Ashok Jhunjunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha and Prof. L Kannan, IIT Madras, <https://nptel.ac.in/courses/108/106/108106170/>
3. NPTEL Web Course: Introduction to Hybrid and Electric Vehicles by Dr. Praveen Kumar and Prof. S. Majhi, IIT Guwahati, <https://nptel.ac.in/courses/108/103/108103009/>

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4. Remaining question will be randomly selected from all the modules.

# University of Mumbai



## Syllabus

Honours/Minor Degree Program

In

Microgrid Technology

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Microgrid Technology**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HMTC501: Futuristic Power Systems	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	-	--	<b>100</b>	-	-	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
TE Sem. VI	HMTC601: Power Electronic Converters for Energy Sources	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	-	-	<b>100</b>	-	-	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
BE Sem. VII	HMTC701: Microgrid Power and Control Architecture	04	--	--	20	80	--	--	100	04
	HMTSBL701: Microgrid and RES Lab	--	--	04	--	--	50	50	100	02
	<b>Total</b>	<b>04</b>	-	<b>04</b>	<b>100</b>	<b>50</b>	<b>50</b>	<b>200</b>	<b>06</b>	
<b>Total Credits = 06</b>										
BE Sem. VIII	HMTC801: Microgrid System Design	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	-	-	<b>100</b>	-	-	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V,VI, VII &amp;VIII = 04+04+06+04 = 18</b>										

**'Microgrid Technology - SEM-V**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Tutorial	Theory	Tutorial	Total
HMTC501	<b>Futuristic Power Systems</b>	<b>04</b>	-	<b>04</b>	-	<b>04</b>

Course code	Course Name	Examination Scheme						Term Work	Total
		Theory			End Sem. Exam	Exam Duration (Hrs.)			
		Internal Assessment							
		Test 1	Test 2	Avg.					
HMTC501	<b>Futuristic Power Systems</b>	20	20	20	80	03	-	100	

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To explore the state of the art and future trends in power systems.</li> <li>To understand the technical, economic and social challenges in power system evolution.</li> <li>To realize the role and importance of Microgrids if futuristic power systems.</li> </ol>
<b>Course Outcomes</b>	<p>Upon successful completion of this course, the learner will be able:</p> <ol style="list-style-type: none"> <li>To solicit the importance of large scale renewable energy integration with existing grid infrastructure.</li> <li>To understand the importance and utility of Energy storage systems in futuristic power systems.</li> <li>To explore large scale micro-grid deployment with RES and ESS integration.</li> <li>To understand the role of communication and IT Infrastructure in power system and related challenges.</li> <li>To explore the potential of Microgrids and its importance in Indian context.</li> </ol>

Module	Contents	Hours
1.	<p><b>Introduction:</b> Present status of worldwide scenario of electricity generation, transmission and distribution; Energy infrastructure-Resilience and Security; Social, Technical and economic challenges; Major trends driving power system evolution; State of the art technologies in power system.</p>	06
2.	<p><b>Renewable Energy Integration:</b> Review of renewable energy (RE) resources and systems: Solar- PV, Solar Thermal, Wind, Biomass, Micro-hydro and Fuel Cell, comparison of various RE resources; Renewable Energy Policies and present status of integration with existing grid; Large scale integration of renewable energy-Technical challenges, enabling technologies, International requirements; Renewable energy forecasting</p>	12
3.	<p><b>Energy Storage Systems (ESS):</b> Review of energy storage components: Battery, VRB, Ultra-capacitor, Fuel Cells, Pumped Hydro-Storage and flywheels, comparison of ESS technologies; Importance of ESS in futuristic power systems; Aggregated ESS, Distributed ESS; Applications of ESS: Energy Management (Load Leveling and Peak Shifting), Fluctuation Suppression (Intermittency Mitigation), Uninterruptible Power System Low-Voltage Ride Through; Placement of the ESS to Improve Power Quality, Voltage Regulation Using ESS, ESS as Spinning Reserve.</p>	12
4.	<p><b>Micro-grid and Smart-grid</b> Micro-grid evolution: Micro-grid concept, importance in futuristic power system, basic architectures and control, objectives and state of the art technologies; Microgrid as a building block of Smart-grid; Smart-grid concept, Smart Grid versus conventional electrical networks, Smart-grid infrastructure, Smart Grid communication system and its cyber security, International standard IEC 61850 and its application to Smart-grid;</p>	12

	Microgrids /smart grid and Electric Vehicles integration. Technical, Economic, Environmental and Social Benefits of Microgrid Operation.	
5.	<b><u>Communication and IT infrastructure:</u></b> Requirements of Communication and IT infrastructure in futuristic power systems: various communication protocols, comparison of performance; IEEE standard: IEEE 802.11 Mesh Networking, IEEE 802.15.4-Wireless Sensor Networks; Communications Technologies for Smart metering; Cyber security issues and mitigation techniques.	05
6.	<b><u>Microgrids in India:</u></b> Microgrids for Rural Electrification, Review of Microgrid Best Practices through Case Studies: Strategic Planning, Operations: Commercial and Financial Considerations; Technical and Social Context.	05

#### Text Books:-

1. Microgrids Architectures and Control Edited by Nikos Hatziargyriou, IEEE and Wiley, 2014
2. Energy Storage for Sustainable Microgrid by David Wenzhong Gao, Elsevier, 2015
3. Introduction to the Smart Grid- Concepts, Technologies and Evolution by Salman K. Salman, IET, 2017
4. Energy Storage Systems and Components by Alfred Rufer, CRC Press, 2018

#### Reference Books:-

1. Energy Efficiency and Renewable Energy Handbook Edited by D. Yogi Goswami and Frank Kreith, 2<sup>nd</sup> Edition- 2016, CRC
2. Clean Energy Microgrids, Edited by Shin'ya Obara and Jorge Morel IET, 2017
3. Hybrid-Renewable Energy Systems in Microgrids- Integration, Developments and Control edited by Hina Fathimaby *et al.*, Elsevier WoodHead Publishing, 2018
4. Smart Microgrids: Lessons from Campus Microgrid Design and Implementation edited by Hassan Farhangi, CRC Press 2017

#### Website Reference / Video Courses:

1. NPTEL Web Course on: DC Microgrid And Control System Prof. Avik Bhattacharya, IIT Roorkee
2. NPTEL Web Course on Electronics and Distributed Generation Dr. Vinod John Department of Electrical Engineering IISc Bangalore
3. NPTEL Web Course on Introduction to Smart Grid, PROF. N.P. PADHY Department of Electrical Engineering IIT Roorkee PROF. PREMALATA JENA Department of Electrical Engineering
4. NPTEL Web Course on Electric vehicles and Renewable energy, Prof. Ashok Jhunjunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha and Prof. L Kannan, IIT Madras

#### Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

#### Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
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4. Remaining question will be randomly selected from all the modules.

**'Microgrid Technology - SEM-VI**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Tutorial	Theory	Tutorial	Total
HMTC601	<b>Power Electronic Converters for Energy Sources</b>	04	-	04	-	04

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
HMTC601	<b>Power Electronic Converters for Energy Sources</b>	20	20	20	80	03	-	100

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To illustrate the design philosophies used in the domain of microgrid power converters.</li> <li>To explore the control implementations in power converters for voltage, current and power regulation for various DC and AC energy sources</li> </ol>
<b>Course Outcomes</b>	<p>Upon successful completion of this course, the learner will be able to:</p> <ol style="list-style-type: none"> <li>Select and size various passive and active components for power converters</li> <li>Design power converters used with DC energy resources with their control implementation</li> <li>Design power converters used with AC energy resources with their control implementation</li> <li>Understand the design considerations of power conditioning unit for ESS, SPV and Wind applications.</li> <li>Understand the design and selection aspects of various auxiliary systems and components used in PCUs</li> </ol>

Module	Contents	Hours
1.	<b><u>Selection of components for Power Electronics Converters (PEC):</u></b> Selection and Sizing of capacitors and magnetic components for PECs, design of Magnetic Components; Selection and sizing of Power Devices, Commonly used software tools for selection and sizing; Heatsink- selection and sizing.	06
2.	<b><u>Design and Control of DC-DC Converters:</u></b> Design of Buck and Boost converters, Design examples; Design of Bidirectional Converters. Design of gate driver circuits; Review of DC-DC converter modelling; Closed loop PI controller design for buck and boost converters; Current control mode and voltage control mode.	10
3.	<b><u>Design and Control of DC-AC converters:</u></b> Design of Inverter for standalone applications; Design of grid connected Inverter with different grid synchronization strategies- ZCD, PLL; Strategies for Control of voltage, current and power output.	10
4.	<b><u>Design of PCU for SPV and Wind Application:</u></b> Various topologies of Power Converter Unit (PCU) for SPV and Wind energy systems. Design considerations of PCU for SPV and Wind energy Systems and Design Examples.	10
5.	<b><u>Design of PCU for ESS Applications:</u></b> Design consideration for BDC converter based PCU for batteries and Ultra-capacitors.	08
6.	<b><u>Design of Auxiliary System and Interfaces:</u></b>	08

Design of current and voltage sensor interfaces; Design considerations for auxiliary power supplies; Design of protection and snubber components: Introduction to Digital Signal Processors (DSP) and microcontroller interfaces
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#### Text Books:-

1. Microgrids Design and Implementation edited by Antonio Carlos Zambroni de Souza and Miguel Castilla, Springer, 2019
2. Power Electronic Converters for Microgrids by Suleiman M. Sharkh, Mohammad A. Abusara, Georgios I. Orfanoudakis Babar Hussain, IEEE and Wiley, 2014
3. Microgrids Architectures and Control Edited by Nikos Hatziargyriou, IEEE and Wiley, 2014
4. Energy Storage for Sustainable Microgrid by David Wenzhong Gao, Elsevier, 2015
5. Control Circuits In Power Electronics Practical Issues In Design And Implementation Edited by Miguel Castilla, IET, 2016
6. Control and Dynamics in Power Systems and Microgrids by Lingling Fan, CRC Press, 2017
7. Integrated Power Electronic Converters and Digital Control, by Ali Emadi, Alireza Khaligh, Zhong Nie, and Young Joo, Lee 2009, CRC Press.

#### Reference Books:-

1. Cooperative Synchronization in Distributed Microgrid Control by Ali Bidram, Vahidreza Nasirian Ali Davoudi, and Frank L. Lewis, Springer, 2017
2. Hybrid-Renewable Energy Systems in Microgrids- Integration, Developments and Control edited by Hina Fathimaby et al., Elseiver WoodHead Publishing, 2018
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4. Remaining question will be randomly selected from all the modules.



**'Microgrid Technology - SEM-VII**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Tutorial	Theory	Tutorial	Total
HMTC701	<b>Microgrid Power and Control Architecture</b>	04	-	04	-	04

Course code	Course Name	Examination Scheme						
		Theory			End Sem. Exam	Exam Duration (Hrs.)	Term Work	Total
		Internal Assessment						
		Test 1	Test 2	Avg.				
HMTC701	<b>Microgrid Power and Control Architecture</b>	20	20	20	80	03	-	100

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To study various power and control architectures adopted in DC and AC Microgrids.</li> <li>To explore various control strategies used in power control</li> <li>To take insight into operations stability and protection issues related to Microgrids</li> </ol>
<b>Course Outcomes</b>	<p><b>Upon successful completion of this course, the learner will be able to:</b></p> <ol style="list-style-type: none"> <li>Understand various types Microgrids based on applications, power and control architecture.</li> <li>Illustrate various power control strategies adopted in DC, AC and Hybrid Microgrids</li> <li>Compare and contrast various control architectures used DC, AC and Hybrid Microgrids</li> <li>Illustrate the various operational challenges in Microgrids</li> <li>Comprehend the various aspects related to the stability in Microgrids</li> <li>Understand the protection challenges in Microgrids along with various protection methods to overcome these challenges,</li> </ol>

Module	Contents	Hours
1.	<b>Microgrid Power Architecture:</b> Types of Microgrid system, AC and DC and Hybrids Microgrids, Application based Suitability of Microgrid type; Review of power architecture of various Microgrids deployed world-wide. Comparison of various Microgrid power architectures.	08
2.	<b>AC Microgrid and Control Architecture:</b> Black-start operation, Grid Synchronisation- various Grid synchronization methods, Grid forming and grid following operations; Power Control- Real and reactive power control in AC Microgrid, simple droop control and other variants of droop control, Unit Power Flow Control, Feeder power flow control and Mixed mode control, source optimization; Centralized, decentralised, distributed and hierarchical control architecture, Local and system / supervisory level control strategies, Multi Agent System (MAS) Based Control; Control approaches used in AC Microgrids deployed worldwide. Microgrid standards IEEE 1547 series. Communication in AC Microgrids	12
3.	<b>DC Microgrid and Control Architecture:</b> Power sharing in DC Microgrids, source optimization; Control approaches: Centralized, decentralised, distributed and hierarchical control architecture. Control approaches used in hybrid Microgrids. Communication in DC/Hybrid Microgrids	08

4.	<b><u>Operational Control in Microgrids:</u></b> Energy management in Microgrids, coordinated control, load management, grid synchronisation and islanding, Anti-islanding schemes; Various Architectural and Operational Challenges in Microgrid, Optimal operation of Microgrids.	08
5.	<b><u>Microgrid Stability</u></b> Steady-state and dynamic stability in AC and DC Microgrids, Methods to improve the stability in Microgrids; introduction to small signal and large signal stability analysis in Microgrids.	06
6.	<b><u>Protection in Microgrids</u></b> Fault scenarios in DC and AC Microgrids, Protection in DC and AC Microgrids, adaptive protection, Fault current source (FCS) based protection; Protection challenges in islanded and autonomous modes of operation and ways to mitigate.	10

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6. Hybrid-Renewable Energy Systems in Microgrids- Integration, Developments and Control edited by Hina Fathimaby et al., Elseiver WoodHead Publishing, 2018
7. Urban DC Microgrid Intelligent Control and Power Flow Optimization by Manuela Sechilariu and Fabrice Locment, 2016 Elsevier
8. Integrated Power Electronic Converters and Digital Control, by Ali Emadi, Alireza Khaligh, Zhong Nie, and Young Joo, Lee 2009, CRC Press.
9. Island Power Systems by Lukas Sigrist, Enrique Lobato, Francisco M. Echavarren Ignacio Egido, and Luis Rouco, CRC Press, 2016

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### Microgrid Technology - SEM-VII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
HMTSBL701	<b>Microgrid and RES Lab</b>	--	<b>04</b>	--	<b>02</b>	<b>02</b>

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)			
Test 1	Test 2	Avg							
HMTSBL701	<b>Microgrid and RES Lab</b>	--	--	--	--	--	50	50	100

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>1. To provide hands-on with power converters used in AC, DC Microgrids</li> <li>2. To explore various control implementation incorporated in Microgrids in simulation or with hardware</li> <li>3. To study various auxiliary systems commonly used in Microgrids.</li> </ol>
<b>Course Outcomes</b>	<p><b>Upon successful completion of this course, the learner will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Test the various power converters used AC, DC Microgrids</li> <li>2. Illustrate various operational modes of power converters</li> <li>3. Illustrate various operational modes of Microgrid.</li> <li>4. Describe the working of various auxiliary system interfaces (communication / sensors)</li> <li>5. Analyse the steady-state and transient behaviour of Microgrid</li> <li>6. Demonstrate the design the Microgrid and its sub-systems.</li> </ol>

### Contents

#### **Microgrid / RES Lab: Experimental Setups (Any Five of the following)**

1. Testing of Power Conversion Unit for DC Microgrid
2. Testing of Power Conversion Unit for AC Microgrid
3. DC Microgrid: Power Sharing between the sources
4. AC Microgrid: Power Sharing between the sources
5. Grid Connected Inverter
6. Grid Forming Inverter
7. Grid Interactive Inverter
8. Solar MPPT Control
9. Islanding detection
10. Island mode of operation of DC or AC Microgrid
11. Data transfer through Microgrid Communication Interfaces
12. Standalone Microgrid operation
13. Voltage and current sensing circuits
14. DSP / Microcontroller interface circuits
15. DSP / Microcontroller programming for converter control.

(or any other experiments based on Microgrid related systems/ subsystems)

#### **Use of software tools: (Any three of the following)**

Use of tools like MATLAB, Scilab, PSIM, LTSpice, python, C, Java platforms etc. for the following

1. Simulation/ Emulation of DC Microgrid with steady state performance analysis.
2. Simulation/ Emulation of AC Microgrid with steady state performance analysis.
3. Simulation/ Emulation of DC Microgrid with transient performance analysis.
4. Simulation/ Emulation of AC Microgrid with transient performance analysis.
5. Microgrid Stability analysis with study of impact of ESS on stability  
(or any other simulations based on Microgrid related systems/ subsystems)

**Plant Visit:**

Visit to existing Microgrid facility or a Solar PV/ Wind Installation or a power converters manufacturing / research facility.

**Course Project**

Course project to be carried out to design /fabricate/ program one of the PCU used in Microgrid.

**Note:** Students and teachers are encouraged to use the virtual labs whose links are as given below. The remote-access to Labs in various disciplines of Science and Engineering is available. Students can conduct online experiments which would help them in learning basic and advanced concepts through remote experimentation.

**Virtual Lab Website Reference**

1. <http://vlab.co.in/broad-area-electrical-engineering>
2. <https://www.vlab.co.in/broad-area-mechanical-engineering> - Energy Storage Labs, Solar Energy lab, Wind Energy Lab

**Term work:**

Term work shall consist of minimum eight experiments, at least one plant visit, and one course project. The distribution of marks shall be as follows:

Journal / Experiments Performance	: 25 marks
Attendance	: 05 marks
Plant Visit report	: 10 marks
Course Project report	: 10 Marks

The final certification and acceptance of term work ensures the minimum passing in the term work.

**Oral Examination:**

Oral examination will be based on entire lab work of **HCMTSBL701-Microgrid and RES Lab**

**'Microgrid Technology - SEM-VIII**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Tutorial	Theory	Tutorial	Total
HMTC801	<b>Microgrid System Design</b>	<b>04</b>	-	<b>04</b>	-	<b>04</b>

Course code	Course Name	Examination Scheme						
		Theory			End Sem. Exam	Exam Duration (Hrs.)	Term Work	Total
		Internal Assessment						
		Test 1	Test 2	Avg.				
HMTC801	<b>Microgrid System Design</b>	20	20	20	80	03	-	100

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To illustrate the design philosophies used in the domain of Microgrid.</li> <li>To explore the selection of power and control architecture of Microgrids</li> <li>To study the design aspects of AC Microgrid, DC Microgrid and their auxiliary systems</li> </ol>
<b>Course Outcomes</b>	<p>Upon successful completion of this course, the learner will be able to:</p> <ol style="list-style-type: none"> <li>Select and size various Microgrid energy resources</li> <li>Select the power and control architecture of the Microgrid</li> <li>Select and design the Microgrid's communication architecture.</li> <li>Illustrate the design aspects DC Microgrids with their control strategies.</li> <li>Illustrate the design aspects AC Microgrids with their control strategies.</li> <li>Illustrate the implementation of the Microgrid islanding detection and anti-islanding scheme/ blackstart operation</li> </ol>

Module	Contents	Hours
1.	<p><b><u>Selection/ Sizing of Microgrid Energy Resources</u></b>                      Factors affecting the selection and sizing of energy resources for Microgrid applications, dependency on type of loads connected, Selection/ Sizing: Renewable energy resources, Energy Storage components. Hybrid combination of RES and ESS.</p>	07
2.	<p><b><u>Selection of Power and Control Architecture:</u></b>                      Factors affecting the selection of Microgrid power and control architecture; Design Consideration for control implementation; Sensors: Selection of sensors and design of sensor Interfaces, design of control Interfaces. Design considerations for DSP/ Microcontroller interfaces</p>	07
3.	<p><b><u>Selection and Design of Communication Architecture</u></b>                      Design considerations for selection of communication network for Microgrid applications; Design and implementation of communication links/ interfaces. Microg4controller programming for Data transfer on communication network. Practical design considerations for Communication networks.</p>	08
4.	<p><b><u>Design of DC Microgrid</u></b>                      Design DC Power Conditioning Units for RES and ESS, Unidirectional and Bidirectional Converter design, implementation of Control loop with DSP; Programming for Power sharing and Energy Management algorithms; Design of Protection system for DC Microgrid</p>	12

5.	<b><u>Design of AC Microgrid</u></b> Design AC Power Conditioning Units for RES and ESS, Unidirectional and Bidirectional Converter design, implementation of Control loop with DSP; Grid Synchronization. Programming for Power sharing and Energy Management algorithms; Design of Protection system for AC Microgrid.	12
6.	<b><u>Islanding in Microgrids</u></b> Selection and implementation of Islanding detection and anti-islanding scheme; Black-start and Autonomous operations in Microgrids;	06

**Text Books:-**

1. Microgrids Design and Implementation edited by Antonio Carlos Zambroni de Souza and Miguel Castilla, Springer, 2019
2. Microgrids Architectures and Control Edited by Nikos Hatziargyriou, IEEE and Wiley, 2014
3. Power Electronic Converters For Microgrids by Suleiman M. Sharkh, Mohammad A. Abusara, Georgios I. Orfanoudakis Babar Hussain, IEEE and Wiley, 2014

**Reference Books:-**

1. Energy Storage for Sustainable Microgrid by David Wenzhong Gao, Elsevier, 2015
2. Cooperative Synchronization in Distributed Microgrid Control by Ali Bidram, Vahidreza Nasirian Ali Davoudi, and Frank L. Lewis, Springer, 2017
3. Energy Efficiency and Renewable Energy Handbook Edited by D. Yogi Goswami and Frank Kreith, 2<sup>nd</sup> Edition- 2016, CRC
4. Control Circuits In Power Electronics Practical Issues In Design And Implementation Edited by Miguel Castilla, IET, 2016
5. Hybrid-Renewable Energy Systems in Microgrids- Integration, Developments and Control edited by Hina Fathimaby et al., Elseiver WoodHead Publishing, 2018
6. Urban DC Microgrid Intelligent Control and Power Flow Optimization by Manuela Sechilariu and Fabrice Locment, 2016 Elsevier
7. Integrated Power Electronic Converters and Digital Control, by Ali Emadi, Alireza Khaligh, Zhong Nie, and Young Joo, Lee 2009, CRC Press.

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

**Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

# University of Mumbai



## Syllabus

Honours/Minor Degree Program

In

Robotics

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Robotics**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theor y	Seminar /Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	<b>HRBC501: Industrial Robotics</b>	04	--	--	20	80	--	--	100	04
	Total	04	-	--	100		-	-	100	04
<b>Total Credits = 04</b>										
TE Sem VI	<b>HRBC601: Mechatronics &amp;IoT</b>	04	--	--	20	80	--	--	100	04
	Total	04	-	-	100		-	-	100	04
<b>Total Credits = 04</b>										
BE Sem VII	<b>HRBC701: Artificial Intelligence &amp; Data Analysis</b>	04	--	--	20	80	--	--	100	04
	<b>HRBSBL701: Robotics and Automation Lab</b>	--	--	04	--	--	50	50	100	02
	Total	04	-	04	100		50	50	200	06
<b>Total Credits = 06</b>										
BE Sem VIII	<b>HRBC801: Autonomous Vehicle</b>	04	-	--	20	80	--	--	100	04
	Total	04	-	-	100		-	-	100	04
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V,VI, VII &amp;VIII = 04+04+06+04 = 18</b>										



Robotics - SEM-VI		
Course Code	Course Name	Credits
HRBC501	Industrial Robotics	4

### Course Objectives:

1. To acquaint with significance of robotic system in agile and automated manufacturing processes.
2. To make conversant with robotic elements/ peripherals, their selection and interface with manufacturing equipment's.
3. To study the basics of robot kinematics

**Course Outcomes:** Upon successful completion the course, learner will be able to

1. Acquire skills in understanding robot language and programming.
2. Acquire skill in robot task planning for problem solving.
3. Develop skills in understanding various sensors, robot peripherals and their use & deployment in manufacturing system.
4. Develop skills in identifying areas in manufacturing where robotics can be deployed for enhancing productivity.

Module	Details	Hours
1	Introduction Automation, robotics, Robotic system & Anatomy, Classification and Future Prospects	2
2	<b>Drives</b> Control Loops, Basic Control System Concepts & Models, Control System Analysis, Robot Activation & Feedback Components, Position & Velocity Sensors, Actuators and Power Transmission system. <b>Robot &amp; its Peripherals</b> <b>End Effectors:</b> Type mechanical and other grippers, Tool as end effector. <b>Sensors:</b> Sensors in Robotics, Tactile Sensors, Proximity & Range Sensors, Sensor Based Systems, Vision systems and Equipment	10
3	<b>Machine vision</b> Introduction, Low level & High level Vision, Sensing & Digitizing, Image Processing & analysis, Segmentation, Edge detection, Object Description & recognition, interpretation and Applications. <b>Programming for Robots</b> Method, Robot Programme as a path in space, Motion interpolation, motion & task level Languages, Robot languages, Programming in suitable languages and characteristics of robot.	10
4	<b>Robot Kinematics</b> Forward, reverse & Homogeneous Transformations, Manipulator Path control and Robot Dynamics. <b>Introduction to wheeled and legged robots including humanoids</b>	10
5	<b>Robot Intelligence &amp; Task Planning</b> Introduction, State space search, Problem reduction, use of predictive logic, Means. Ends Analysis, Problem solving, Robot learning and Robot task planning.	10

6	<b>Robot application in manufacturing Material transfer, machine loading &amp; unloading, processing operation, Assembly &amp; inspectors, robotic Cell design &amp; control, Social issues &amp; Economics of Robotics.</b>	10
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**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

1. Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.
2. Question paper will comprise of total six questions, each carrying 20 marks
3. Question 1 will be compulsory and should cover maximum contents of the curriculum
4. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. Only four questions need to be solved

**Text/References**

1. Industrial Robotics, Technology, Programming & Applications, Grover, Weiss, Nagel, Ordey, Mc Graw Hill.
2. Robotics: Control, Sensing, Vision & Intelligence, Fu, Gonzalez, Lee, Mc Graw Hill.
3. Robotic technology & Flexible Automation, S R Deb. TMH.
4. Robotics for Engineers, Yoram Koren, Mc Graw Hill.
5. Fundamentals of Robotics, Larry Heath.
6. Robot Analysis & Control, H Asada, JJE Slotine.
7. Robot Technology, Ed. A Pugh, Peter Peregrinus Ltd. IEE, UK. 8. Handbook of Industrial Robotics, Ed. Shimon. John Wiley
8. Roland Siegwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", Bradford Company Scituate, USA

Robotics - SEM-VI		
Course Code	Course Name	Credits
HRBC601	Mechatronics & IoT	4

**Course Objectives:**

1. To associate a mechatronic System with IOT
2. To relate data analytics with IOT
3. To understand Cloud Computing in IOT

**Course Outcomes:** Upon successful completion of this course, the learner will be able to

1. Describe a Mechatronic System
2. Demonstrate the use of a Micro-controller
3. Understand an IOT System
4. Identify Wireless Technologies Supporting IOT
5. Use Data Analytics in conjunction with IOT & Cloud

Module	Details	Hours
1.	Introduction to Mechatronics: Traditional and Mechatronics Design, Mechatronics Key Elements, Basic Components of Mechatronic Systems , Integrated Design issues in Mechatronics, Mechatronics Design Process, Mechatronics System in Factory, Home and Business Applications, Objectives, Advantages and Disadvantages of Mechatronics	6
2.	Overview of Micro-processor and Micro-controller: 8051 Micro-controllers, Functional Block Diagram and Architecture, Instruction set and Assembly Language Programming, Analog and Data Acquisition , Digital I/O interfacing, Special Function interfacing, Signal Conditioning, Special Utility Support hardware Interfacing of HEX – Keyboards, LCD Display, ADC, DAC and Stepper Motor with 8051 Micro-controller	10
3.	Introduction and application to Internet of Things: Need of IoT, history of IOT, Objects of IOT, Level of IOT, Technologies in IOT, Introduction to Arduino and Raspberry Pi, understanding its components, recognizing the Input/Output, GPIO Connectivity	10
4.	Wireless Technologies Supporting IoT: Protocol Standardization for IoT, Machine to machine (M2M) and WSN protocols, Basics of RFID , RFID Protocols, Issues with IOT Standardization, Protocols – IEEE 802.15.4, Zigbee, IPv6 Technologies for IOT	10
5.	Data Analytics for IOT: Introduction Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real Time Data Analysis, Structural Health Monitoring, Case Study: Chef Case Study, puppet Case Study	10
6.	Introduction to Cloud Computing, Difference between Cloud Computing and Fog Computing: The Next Evolution of Cloud Computing, Role of Cloud Computing in IOT, Connecting IoT to Cloud, Cloud Storage for IoT Challenge in Integration of IoT with Cloud	8

## **Assessment:**

### **Internal Assessment for 20 marks:**

#### **Consisting Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

### **End Semester Examination:**

1. Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.
2. Question paper will comprise of total six questions, each carrying 20 marks
3. Question 1 will be compulsory and should cover maximum contents of the curriculum
4. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. Only four questions need to be solved

### **Text/Reference Books:**

1. Bolton, William. Mechatronics: electronic control systems in mechanical and electrical engineering. Pearson Education, 2003.
2. De Silva, Clarence W. Mechatronics: an integrated approach. CRC press, 2004.
3. Ayala, Kenneth J. The 8051 microcontrollers. Thomson Delmar Learning, 2005.
4. Zhang, Dan, and Bin Wei, eds. Mechatronics and Robotics Engineering for Advanced and Intelligent Manufacturing. Springer International Publishing, 2017.
5. Greengard, Samuel. The internet of things. MIT press, 2021.
6. Chaouchi, Hakima, ed. The internet of things: Connecting objects to the web. John Wiley & Sons, 2013.
7. Hintz, Kenneth, and Daniel Tabak. Microcontrollers: architecture, implementation, and programming. McGraw-Hill, Inc., 1992.

Robotics - SEM-VII		
Course Code	Course Name	Credits
HRBC701	Artificial Intelligence and Data Analytics	04

#### Course Objectives:

1. To gain perspective of AI, its foundations, agent architectures and properties of the environment.
2. To understand the basic principles of AI towards problem solving, inference, perception, knowledge representation, and learning.
3. To investigate probabilistic reasoning under uncertain and incomplete information.
4. To gain the perspective of the concepts of data Mining, modelling and visualization, data warehousing.
5. To understand various machine learning algorithms.

**Course Outcomes:** Upon successfully completion of this course, learner will able to...

1. Demonstrate knowledge of the building blocks of AI, intelligent agents and knowledge representation systems.
2. Explain artificial intelligence planning, reasoning, uncertainty handling and expert systems.
3. Describe the concept of data mining, big data, data analytics, business intelligence.
4. Comprehend and implement data mining and machine learning algorithms.

Module	Contents	Hours.
01	<p><b>Introduction to Artificial Intelligence (AI):</b> A. I. Representation, Representation of knowledge, knowledge base systems, state space search, production systems, problem characteristics, types of production systems, Intelligent Agents and Environments, nature of environments, structure of agents</p> <p><b>Knowledge and Reasoning:</b> Knowledge Representation Systems, Properties of Knowledge Representation Systems, Propositional Logic (PL), First Order Logic: Syntax and Semantic, Inference in FOL, Forward v/s Backward Chaining</p>	6
02	<p><b>Planning:</b> Introduction to Planning, Planning with State Space Search, Partial Ordered planning, Hierarchical Planning, Conditional Planning, Brief introduction to single layer and multiplayer networks</p> <p><b>Reasoning Under Uncertainty:</b> Handling Uncertain Knowledge, Random Variables, Prior and Posterior Probability, Inference using Full Joint Distribution, Bayes' Rule and its use, Bayesian Belief Networks, Reasoning in Belief Networks</p> <p><b>Introduction to Expert Systems:</b> Components of Expert System: Knowledge base, Inference engine, user interface, working memory, Development of Expert Systems</p>	10

03	<p><b>Introduction to Data Mining:</b> What is Data Mining; Kind of patterns to be mined; Technologies used; Major issues in Data Mining, associative Rule Mining</p> <p><b>Introduction to Big Data:</b> Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Case Studies of Big Data Solutions, Introduction to parallel Processing (MPP) architecture, Hadoop/HDFS and cloud based solutions</p> <p><b>Introduction to Business Intelligence:</b> Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results</p>	8
04	<p><b>Data Pre-processing:</b> Notion of data quality. Typical pre-processing operations: combining values into one, handling incomplete/ incorrect / missing values, recoding values, sub setting, sorting, transforming scale, determining percentiles, removing noise, removing inconsistencies, transformations, standardizing, normalizing - min-max normalization, z-score standardization.</p> <p><b>Data Modeling and visualization:</b> Logic driven modeling, data driven modeling, basic what-if spreadsheet models</p> <p><b>Data Warehousing:</b> What is a data warehouse, need for a data warehouse, architecture, data marts, OLTP vs OLAP</p>	10
05	<p><b>Machine Learning:</b> Supervised and Unsupervised Learning, Concepts of Classification, Clustering and prediction</p> <p><b>Performance Measures:</b> Measuring Quality of model- ConfusionMatrix, Accuracy, Recall, Precision, Specificity, F1 Score, RMSE</p>	8
06	<p><b>Classification:</b> Rule based classification, classification by Bayesian Belief networks, Hidden Markov Models.</p> <p><b>Clustering:</b> Hebbian Learning rule, Expectation -Maximization algorithm for clustering</p> <p><b>Dimensionality Reduction:</b> Principal Component Analysis Feature Selection and Feature Extraction</p> <p><b>Time Series Analysis and Forecasting:</b> Time series patterns, forecast accuracy, moving averages and exponential smoothing</p>	10

### Assessment:

#### **Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

#### **End Semester Examination:**

1. Weightage of each module in end semester examination will be proportional to the number of

respective lecture hours mentioned in the curriculum.

2. Question paper will comprise of total six questions, each carrying 20 marks
3. Question 1 will be compulsory and should cover maximum contents of the curriculum
4. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. Only four questions need to be solved

#### **Text Books:**

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach — Second Edition" Pearson Education.
2. Elaine Rich and Kevin Knight — Artificial Intelligence|| Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
3. George F Luger "Artificial Intelligence" Low Price Edition, Pearson Education, Fourth edition.
4. Deepak Khemani, A first course in Artificial Intelligence, Mc Graw Hill
5. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education.
6. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", 2nd Edition, Wiley India.
7. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press
8. Peter Flach, "Machine Learning", Cambridge University Press

#### **Reference Books:**

1. Tom M. Mitchell, "Machine Learning", McGraw Hill
2. Kevin P. Murphy, "Machine Learning — A Probabilistic Perspective", MIT Press
3. Stephen Marsland, "Machine Learning an Algorithmic Perspective", CRC Press
4. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning", Cambridge University Press
5. Peter Harrington, "Machine Learning in Action", DreamTech Press
6. D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall.
7. Saroj Kaushik "Artificial Intelligence", Cengage Learning.

#### **Links for online NPTEL/SWAYAM courses:**

[https://onlinecourses.nptel.ac.in/noc19\\_me71/preview](https://onlinecourses.nptel.ac.in/noc19_me71/preview) [https://onlinecourses.nptel.ac.in/noc22\\_cs56/preview](https://onlinecourses.nptel.ac.in/noc22_cs56/preview)

[https://onlinecourses.nptel.ac.in/noc22\\_cs29/preview](https://onlinecourses.nptel.ac.in/noc22_cs29/preview) [https://onlinecourses.nptel.ac.in/noc22\\_cs08/preview](https://onlinecourses.nptel.ac.in/noc22_cs08/preview)

Robotics - SEM-VII		
Course Code	Course Name	Credits
HRBSBL701	Robotics and Automation Lab	2

**Course Objectives:**

1. To learn the implementation of image processing algorithms.
2. To acquaint with programming of robots.
3. To acquaint with data acquisition over cloud environment
4. To demonstrate the working of machine learning algorithms for data prediction.

**Course Outcomes:** learner will able to...

1. Develop simple image processing algorithms.
2. Program robots for simple and inverse kinematics and trajectory planning.
3. Acquire sensor data over cloud using microcontroller.
4. Perform predictive data analysis using clustering, classification and regression models.

**List of Experiments:**

1. Edge detection / segmentation using image processing
2. programming the robots to solve direct and inverse kinematics problems
3. Trajectory planning for Robots
4. Acquisition of sensor data over cloud using microcontroller
5. Implementation of Clustering algorithm (K-means / K-medoids)
6. Data Classification using data prediction tool (classification tree / artificial neural networks,Support Vector Machines etc.) (Any One)
7. Linear Regression using data predictive tool (multiple regression / artificial neural networksetc.) (Any One)
8. PLC to operate actuators for automation application

**Assessment:**

**Term Work**

Term work shall consist of the experiments as mentioned above.The distribution of marks for term work shall be as follows:

1. Laboratory work (Experiments): 40 marks
2. Attendance: 10 marks

**Oral Examination:**

Oral examination will be based on entire lab work of **Robotics and Automation Lab**



Robotics - SEM-VIII		
Course Code	Course Name	Credits
HRBC801	Autonomous Vehicle Systems	4

**Course Objectives:**

1. To comprehend fundamental aspects of Autonomous Vehicles.
2. To Acquire knowledge of levels of automation of autonomous systems.
3. To Understand the Connectivity Aspects of autonomous automobiles

**Course Outcomes:** The student will be able to

1. Gain perspective of autonomous systems
2. Understand Automotive Electronics and the operation of ECUs.
3. Discuss about the use of computer vision and learning algorithms in vehicles.
4. Learn Localization, Perception, Prediction planning and control.
5. Summarize the aspects of connectivity
6. Understand cloud platform and ROS.

Module	Details	Hours
1	<b>An over view of autonomous driving technologies:</b> Algorithms, client systems, cloud Platforms	6
2	<b>Overview of Automotive Electronics:</b> Control Systems for Autonomous vehicles, Electronic Engine control, Chassis and Powertrain Electronics, Vehicle motion control, Instrumentation and Telematics & ADAS	8
3	<b>Sensing Technologies</b> Radar & Sonar, Camera, Lidar, GNSS.GPS/IMU Use of Sensor Data, Sensor Fusion and Kalman Filters	8
4	<b>Computer Vision and Deep Learning</b> Computer Vision Fundamentals -Advanced Computer Vision , Neural Networks for Image Processing , TensorFlow ,Convolutional Neural Networks	10
5	<b>Levels of Automation</b> Localization - GNSS, LiDAR, Wheel and Visual Odometry, sensorfusion Perception – Detection and Tracking, DrivingPerception and deeplearning Prediction and Routing- Trffic prediction and Lane level routing Decision, Planning and Control- Motion Planning,Feed back control Cloud System- Operating systems-ROS, Cloud Platforms	12
6	<b>Connected Car Technology:</b> Connectivity Fundamentals - DSRC (Direct Short Range Communication), Connectivity types -Vehicle-to-Vehicle, Vehicle-to-Roadside and Vehicle-to-Infrastructure, Vehicle-to-pedestrian, Vehicle- to-clous, Vehicle-to-everything, Applications -Security Issues Technical Issues, Security Issues, Moral and Legal Issues.	8

**Text Books:**

1. Shaoshan Liu, Liyun Li, "Creating Autonomous Vehicle Systems", Morgan and Claypool Publishers, 2017.
2. Liu, Shaoshan. Engineering autonomous vehicles and robots: the DragonFly modular-based approach. John Wiley & Sons, 2020.
3. Hong Cheng, "Autonomous Intelligent Vehicles: Theory, Algorithms and Implementation", Springer, 2011.
4. Williams. B. Ribbens: "Understanding Automotive Electronics", 7th Edition, Elsevier Inc, 2012.

**Reference Books:**

1. Marcus Maurer, J.Christian Gerdes, "Autonomous Driving: Technical, Legal and Social Aspects" Springer, 2016.
2. Ronald.K.Jurgen, "Autonomous Vehicles for Safer Driving", SAE International, 2013.
3. James Anderson, KalraNidhi, Karlyn Stanly, "Autonomous Vehicle Technology: A Guide for Policymakers", Rand Co, 2014.
4. Lawrence. D. Burns, Chrostopher Shulgan, "Autonomy – The quest to build the driverless car and how it will reshape our world", Harper Collins Publishers, 2018

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

**Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

# University of Mumbai



## Syllabus

Honours/Minor Degree Program

In

3D Printing

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**3D Printing**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	H3DPC501: Introduction to CAD	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>--</b>	<b>100</b>		<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										
TE Sem. VI	H3DPC601: 3D Printing: Introduction & Processes	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>		<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										
BE Sem. VII	H3DPC701: Applications of 3D Printing	04	--	--	20	80	--	--	100	04
	H3DPSBL701: Skill Based Lab – Digital Fabrication	--	--	04	--	--	50	50	100	02
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>04</b>	<b>100</b>		<b>50</b>	<b>50</b>	<b>200</b>	<b>06</b>
<b>Total Credits = 06</b>										
BE Sem. VIII	H3DPC801: 3D Printing in Medical Technology	04	-	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>		<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V, VI, VII &amp; VIII = 04+04+04+06 = 18</b>										

<b>'3D Printing':SEM-V</b>						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Tutorial	Theory	Tutorial	Total
<b>H3DPC501</b>	<b>Introduction to CAD</b>	<b>04</b>	<b>-</b>	<b>04</b>	<b>-</b>	<b>04</b>

Course code	Course Name	Examination Scheme						
		Theory					Term Work	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)		
		Test 1	Test 2	Avg.				
<b>H3DPC501</b>	<b>Introduction to CAD</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>80</b>	<b>03</b>	<b>-</b>	<b>100</b>

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To impart the 3D modelling skills for development of 3D models of basic engineering components.</li> <li>To familiarize with basic concepts of computer graphics.</li> <li>To familiarize with basic concepts of additive and subtractive manufacturing process.</li> </ol>
<b>Course Outcomes</b>	<p><b>Upon successful completion of this course, the learner will be able:</b></p> <ol style="list-style-type: none"> <li>Illustrate basic understanding of design.</li> <li>Create the CAM Toolpath for specific given operations.</li> <li>Illustrate basic understanding of types of CAD model creation.</li> <li>Generate assembly models of given objects using assembly tools of a modelling software.</li> <li>Identify suitable computer graphics techniques for 3D modelling.</li> <li>Transform, manipulate objects &amp; store and manage data.</li> </ol>

Module	Contents	Hours
1.	<b>Design thinking:</b> Identification of need, Embodiment of design, Generation of ideas and research topics	5
2.	<b>Subtractive Manufacturing:</b> Introduction to NC/CNC/DNC machines <b>Additive Manufacturing:</b> Introduction to 3D Printing, Limitations of Subtractive manufacturing, Digital fabrication	8
3.	<b>CAD Introduction:</b> History & Scope of CAD, CAD hardware and software, Advantages, Disadvantages and Applications of CAD	7
4.	<b>Introduction to 2D modelling:</b> CAD models Creation, Types and uses of models from different perspectives <b>Introduction to assembly drawing:</b> Types of assembly drawings, part drawings, drawings for catalogues and instruction manuals, patent drawings, drawing standards	12

5.	<b>Computer Graphics:</b> Overview of 2D and 3D Computer Graphics, Parametric representation of curves: Synthetic Curves - Bezier curves, Hermite Curves, B-spline curves <b>Geometric Modelling:</b> Wire Frame Modelling, Solid Modelling, Surface Modelling, Parametric Modelling, Feature based Modelling, Constraint Based Modelling.	12
6.	<b>Geometric Transformation:</b> 2D & 3D Transformations (Translation, Rotation, & Scaling & Reflection), Concatenations	8

#### Text/Reference Books:-

1. Machine Drawing by N.D. Bhatt.
2. A textbook of Machine Drawing by Laxminarayan and M.L.Mathur, Jain brothers Delhi
3. CAD/ CAM, Theory & Practice, Ibrahim Zeid, R. Sivasubramanian, Tata McGraw Hill Publications
4. CAD/CAM Principles and Applications, P. N. Rao, Tata McGraw Hill Publications
5. CAD/CAM Computer Aided and Manufacturing, Mikell P. Groover and Emory W. Zimmers, Jr., Eastern Economy Edition
6. CNC Technology and Programming, Krar, S., and Gill, A., McGraw Hill Publishers.
7. Medical Modelling The Application of Advanced Design and Rapid Prototyping Techniques in Medicine, Richard Bibb, Dominic Eggbeer and Abby Paterson, Woodhead Publishing Series in Biomaterials: Number 91, Elsevier Ltd.
8. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, I. Gibson | D. W. Rosen | B. Stucker, Springer Publication.

#### Website Reference / Video Courses:

1. <https://nptel.ac.in/courses/112/102/112102101/>
2. <https://nptel.ac.in/courses/106/102/106102065/>
3. <https://nptel.ac.in/courses/106/102/106102065/>
4. <https://nptel.ac.in/courses/112/102/112102103/>
5. <https://nptel.ac.in/courses/112/105/112105211/>
6. <https://nptel.ac.in/courses/112/104/112104265/>
7. <https://www.youtube.com/watch?v=2cCMty9v3Tg>
8. <https://www.youtube.com/watch?v=2zPh26Q1BT8>

#### Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

#### Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

‘3D Printing’ - SEM-VI						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Tutorial	Theory	Tutorial	Total
H3DPC601	3D Printing: Introduction & Processes	04	-	04	-	04

Course code	Course Name	Examination Scheme								
		Theory					End Sem. Exam	Exam Duration (Hrs.)	Term Work	Total
		Internal Assessment			Avg.					
		Test 1	Test 2	Avg.						
H3DPC601	3D Printing: Introduction & Processes	20	20	20	80	03	-	100		

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To familiarise with importance of Rapid Prototyping.</li> <li>To study programming aspects of subtractive manufacturing process.</li> <li>To familiarize with basic process of additive manufacturing in particularly 3D printing.</li> </ol>
<b>Course Outcomes</b>	<p><b>Upon successful completion of this course, the learner will be able to:</b></p> <ol style="list-style-type: none"> <li>Illustrate understanding of various cost-effective alternatives for manufacturing products and select the feasible RP process for specific technical applications</li> <li>Build and create data for 3D printing of any given object using liquid based rapid prototyping and tooling processes</li> <li>Build and create data for 3D printing of any given object using solid based rapid prototyping and tooling processes</li> <li>Build and create data for 3D printing of any given object using powder based rapid prototyping and tooling processes</li> <li>Select an appropriate material and tools to develop a given product using rapid prototyping machine</li> <li>Select proper rapid prototyping and reverse engineering techniques for specific technical applications.</li> <li>Demonstrate basics of virtual reality</li> </ol>

Module	Contents	Hours
1.	<p><b>Additive Manufacturing:</b></p> <p>Introduction to AM, Classification of AM Processes, Advantages &amp; disadvantages, AM Applications; in Design, Concept Models, Form &amp; fit checking, Functional testing, CAD data verification, Rapid Tooling, and bio fabrication.</p>	9

2.	<p><b>Liquid based systems:</b></p> <p><b>Stereo lithography apparatus (SLA):</b> Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies.</p> <p><b>Solid ground curing (SGC):</b> Models and specifications, process, working, principle, applications, advantages and disadvantages, case studies.</p>	9
3.	<p><b>Solid based systems:</b></p> <p><b>Laminated object manufacturing (LOM):</b> Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies.</p> <p><b>Fused Deposition Modeling (FDM):</b> Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies.</p>	8
4.	<p><b>Powder Based Systems:</b></p> <p><b>Selective laser sintering (SLS):</b> Models and specifications, process, working principle, applications, advantages and disadvantages, case studies.</p> <p><b>Three-dimensional printing (3DP):</b> Models and specification, process, working principle, applications, advantages and disadvantages, case studies.</p> <p><b>Electron Beam Melting (EBM):</b> Models and specification, process, working principle, applications, advantages and disadvantages, case studies.</p>	8
5.	<p><b>Materials for Additive manufacturing</b></p> <p>Types of material: polymers, metals, ceramics and composites, liquid-based materials, photo polymer development, solid based materials, powder-based materials.</p> <p><b>Material properties</b></p> <p>Colour, dimensional accuracy, stability, surface finish, machinability, environmental resistance, operational properties.</p>	10
6.	<p><b>Reverse Engineering</b></p> <p>Introduction to Digitizing Methods, Contact type and Non-contact type, Brief introduction to the types of medical imaging.</p> <p>Virtual reality: Definition, features of VR, Technologies used in VR, Introduction to Augmented reality</p>	8

#### Text/Reference Books:-

1. Rapid Prototyping, Principles and Applications by Rafiq I. Noorani, Wiley & Sons
2. Rapid Prototyping: Principles and Applications by Chua C.K, Leong K.F and Lim C.S, 2nd Edition, World Scientific
3. Rapid Manufacturing – An Industrial revolution for the digital age by N.Hopkinson, R.J. M. Hauge, P M, Dickens, Wiley



4. Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototyping by Ian Gibson, Wiley
5. Rapid Prototyping and Manufacturing: Fundamentals of Stereolithography by Paul F. Jacobs, McGraw Hill
6. Rapid Manufacturing by Pham D T and Dimov S S, Springer Verlag
7. "Rapid Prototyping" Chee Kai Chua, World Scientific Publishing

**Website Reference / Video Courses:**

**NPTEL Web Course:**

1. Rapid Manufacturing, By Prof. J. Ramkumar, Prof. Amandeep Singh, IIT Kanpur, [https://onlinecourses.nptel.ac.in/noc20\\_me50/preview](https://onlinecourses.nptel.ac.in/noc20_me50/preview)
2. Fundamentals of Additive Manufacturing Technologies, By Prof. Sajan Kapil, IIT Guwahati, [https://onlinecourses.nptel.ac.in/noc21\\_me115/preview](https://onlinecourses.nptel.ac.in/noc21_me115/preview)

**Assessment:**

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

**Theory Examination:**

5. Question paper will comprise of 6 questions, each carrying 20 marks.
6. Total four questions need to be solved.
7. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
8. Remaining question will be randomly selected from all the modules.

‘3D Printing’ - SEM-VII						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Tutorial	Theory	Tutorial	Total
H3DPC701	Applications of 3D Printing	04	-	04	-	04

Course code	Course Name	Examination Scheme								
		Theory					End Sem. Exam	Exam Duration (Hrs.)	Term Work	Total
		Internal Assessment			Test 1	Test 2				
		Test 1	Test 2	Avg.						
H3DPC701	Applications of 3D Printing	20	20	20	80	03	-	100		

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To familiarise with applications of 3D Printing technologies.</li> <li>To acquaint with the process of using biomedical data for 3D modelling.</li> <li>To familiarize with basic process of additive manufacturing in different industries.</li> </ol>
<b>Course Outcomes</b>	<p><b>Upon successful completion of this course, the learner will be able:</b></p> <ol style="list-style-type: none"> <li>To understand the perspectives for 3D printing in Jewellery industries for selection of an appropriate material and tools to develop a given product using rapid prototyping techniques.</li> <li>Develop 3D model using various types of available biomedical data.</li> <li>To understand the perspectives for 3D printing in Aerospace industries for selection of an appropriate material and tools to develop a given product using rapid prototyping techniques.</li> <li>Illustrate understanding of various cost-effective alternatives for manufacturing products.</li> <li>Use rapid prototyping and tooling concepts in any real-life applications.</li> <li>Contribute towards the Product Development at the respective domain in the industry</li> </ol>

Module	Contents	Hours
1.	<p><b>Applications in Jewellery Industries</b></p> <p><b>Introduction to 3D Printing Jewellery:</b> Steps Involved in Jewellery 3D Printing, Why 3D Printing for Jewellery Making, Techniques Involved in Jewellery 3D Printing, 3D Printing Processes for Jewellery Designing, Challenges with Jewellery 3D Printing, 3D Printing vs Traditional Methods, Types of Jewellery can be 3D Printed,</p> <p><b>3D Printers for Jewellery Making – How They Work &amp; Which to Choose</b></p>	10
2.	<p><b>Medical Applications in Additive manufacturing</b></p> <p>Presurgical Planning Models, Mechanical Bone Replicas, Teaching Aids and Simulators, Customized Surgical Implants, Prosthetics and Orthotics’, Anthropology, Forensics</p>	8

3.	<b>Applications in Aerospace Industries</b> Use of AM in Aerospace, Metal AM in Aerospace, Super alloys, Non-Destructive Evaluation, Space technology	8
4.	<b>Applications in Tooling</b> <b>Methods of Rapid tooling:</b> Direct Soft Tooling, Indirect Soft Tooling, Direct Hard Tooling, Indirect Hard Tooling.	9
5.	<b>Applications in various industries</b> Automotive, Défense, Coin industries, Household appliance, Toy industry, Ship building, Un-manned Aerial Vehicles (UAV), Furniture, Construction and food	9
6.	<b>Applications in Design</b> Design for Additive Manufacturing (DFAM), Topology optimization for AM, Generative design  <b>Applications in Engineering, Analysis and Planning</b>	8

#### Text/ Reference Books:-

1. Makers: The New Industrial Revolution (Telord 1403), by Chris Anderson
2. Medical Modelling The Application of Advanced Design and Rapid Prototyping Techniques in Medicine, Richard Bibb, Dominic Eggbeer and Abby Paterson, Woodhead Publishing Series in Biomaterials: Number 91, Elsevier Ltd.
3. 3D Printing in Aerospace and Defense Standard Requirements, by Gerardus Blokdyk
4. Additive Manufacturing for the Aerospace Industry, by Francis Froes, Rodney Boyer
5. 3D Printing in Medicine, 1st Edition - April 1, 2017, by Deepak Kalaskar
6. An Update on Medical 3D Printing Hardcover – 1 January 2019, by Dr Raju Vaishya, Dr Abid Haleem, Dr Lalit Maini
7. 3D Printing in Medicine: A Practical Guide for Medical Professionals Hardcover – Import, 12 October 2017, by Frank J. Rybicki, Gerald T. Grant
8. Rapid Prototyping, Principles and Applications by Rafiq I. Noorani, Wiley & Sons
9. Rapid Prototyping: Principles and Applications by Chua C.K, Leong K.F and Lim C.S, 2nd Edition, World Scientific
10. Rapid Manufacturing – An Industrial revolution for the digital age by N.Hopkinson, R.J. M. Hauge, P M, Dickens, Wiley
11. Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototyping by Ian Gibson, Wiley

#### Website Reference / Video Courses:

##### NPTEL Web Course:

1. Rapid Manufacturing, By Prof. J. Ramkumar, Prof. Amandeep Singh, IIT Kanpur, [https://onlinecourses.nptel.ac.in/noc20\\_me50/preview](https://onlinecourses.nptel.ac.in/noc20_me50/preview)
2. Fundamentals of Additive Manufacturing Technologies, By Prof. Sajan Kapil, IIT Guwahati, [https://onlinecourses.nptel.ac.in/noc21\\_me115/preview](https://onlinecourses.nptel.ac.in/noc21_me115/preview)

#### Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

**Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

<b>'3D Printing' - SEM-VIII</b>						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Tutorial	Theory	Tutorial	Total
<b>H3DPC801</b>	<b>3D Printing in Medical Technology</b>	<b>04</b>	-	<b>04</b>	-	<b>04</b>

Course code	Course Name	Examination Scheme								
		Theory					End Sem. Exam	Exam Duration (Hrs.)	Term Work	Total
		Internal Assessment			Avg.	-				
		Test 1	Test 2	Avg.						
<b>H3DPC801</b>	<b>3D Printing in Medical Technology</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>80</b>	<b>03</b>	-	<b>100</b>		

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To acquaint with the process of using biomedical data for 3D modeling.</li> <li>To familiarize with basic process of additive manufacturing in particularly 3D printing</li> </ol>
<b>Course Outcomes</b>	<p><b>Upon successful completion of this course, the learner will be able to:</b></p> <ol style="list-style-type: none"> <li>Describe the creation of highly accurate physical models of human anatomy</li> <li>Identify medical imaging for human body</li> <li>Understand the modelling based on Biomedical data</li> <li>Build and create data for 3D printing of any given object using rapid prototyping and tooling processes.</li> <li>Illustrate the understanding of different manufacturing processes</li> <li>To Identify the processes and tooling concepts in Biomedical</li> </ol>

Module	Contents	Hours
<b>1.</b>	<b>Introduction</b> Stages of the medical modelling process, The human form, Basic anatomical terminology, technical terminology	8
<b>2.</b>	<b>Introduction to medical imaging</b> Computed tomography (CT), Cone beam CT (CBCT), Magnetic resonance (MR), Noncontact surface scanning, Medical scan data, Point cloud data	10
<b>3.</b>	<b>Working with medical scan data</b> Pixel data operations, Using CT data: a worked example, Point cloud data operations, Two-dimensional formats, Pseudo 3D formats, True 3D formats, File management and exchange	12
<b>4.</b>	<b>Physical reproduction</b> Basic principles of medical modelling: orientation, sectioning, separating and joining, trapped volumes	8

5.	Introduction to Additive manufacturing processes used for Bio-Modelling, Computer numerical controlled machining, Cleaning and Sterilizing medical models	8
6.	<b>Case Studies based on Bio-Modelling &amp; Future Development</b>	6

#### Text/Reference Books:-

1. Medical Modelling The Application of Advanced Design and Rapid Prototyping Techniques in Medicine, Richard Bibb, Dominic Eggbeer and Abby Paterson, Woodhead Publishing Series in Biomaterials: Number 91, Elsevier Ltd.
2. 3D Printing in Medicine, 1st Edition - April 1, 2017, by Deepak Kalaskar
3. An Update on Medical 3D Printing Hardcover – 1 January 2019, by Dr Raju Vaishya, Dr Abid Haleem, Dr Lalit Maini
4. 3D Printing in Medicine: A Practical Guide for Medical Professionals Hardcover – Import, 12 October 2017, by Frank J. Rybicki, Gerald T. Grant
5. Rapid Prototyping, Principles and Applications by Rafiq I. Noorani, Wiley & Sons
6. Rapid Prototyping: Principles and Applications by Chua C.K, Leong K.F and Lim C.S, 2nd Edition, World Scientific
7. Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototyping by Ian Gibson, Wiley

#### Website Reference / Video Courses:

##### NPTEL Web Course:

1. Rapid Manufacturing, By Prof. J. Ramkumar, Prof. Amandeep Singh, IIT Kanpur, [https://onlinecourses.nptel.ac.in/noc20\\_me50/preview](https://onlinecourses.nptel.ac.in/noc20_me50/preview)
2. Fundamentals of Additive Manufacturing Technologies, By Prof. Sajan Kapil, IIT Guwahati, [https://onlinecourses.nptel.ac.in/noc21\\_me115/preview](https://onlinecourses.nptel.ac.in/noc21_me115/preview)

#### Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project

#### Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

<b>'3D Printing' - SEM-VII</b>						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical/ Tutorial	Theory	Practical/ Tutorial	Total
<b>H3DPSBL701</b>	<b>Skill Based Lab – Digital Fabrication</b>		<b>04</b>	--	<b>02</b>	<b>02</b>

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (Hrs.)			
		Test 1	Test 2	Avg.					
<b>H3DPSBL701</b>	<b>Skill Based Lab – Digital Fabrication</b>	-	-	-	-	-	<b>50</b>	<b>50</b>	<b>100</b>

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>1. To impart the geometric modeling skills for development of 3D models of engineering components.</li> <li>2. To familiarize with production drawings with important features like GD &amp;T, surface finish, heat treatments etc.</li> <li>3. To familiarize with additive manufacturing process</li> <li>4. To acquaint with basic process of 3D modeling using biomedical data.</li> </ol>
<b>Course Outcomes</b>	<p><b>Upon successful completion of this course, the learner will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Illustrate basic understanding of types of CAD model creation.</li> <li>2. Build geometric model of a given object using 3D modeling software</li> <li>3. Generate assembly models of given objects using assembly tools of a modeling software</li> <li>4. Demonstrate CAM Tool path and prepare NC- G code</li> <li>5. Develop 3D model using available biomedical data</li> <li>6. Build any given real life object using 3D printing process</li> </ol>

<b>Module</b>	<b>Contents</b>	<b>Hours</b>
<b>1.</b>	Geometric modeling of an Engineering component, demonstrating skills in sketching commands of creation (line, arc, circle etc.) modification (Trim, move, rotate etc.) and viewing using (Pan, Zoom, Rotate etc.)	06
<b>2.</b>	Demonstrating modeling skills using commands like Extrude, Revolve, Sweep, Blend, Loft etc. Mesh of curves, free form surfaces etc. Feature manipulation using Copy, Edit, Pattern, Suppress, History operations etc.	04
<b>3.</b>	Assembly: Constraints, Exploded views, interference check. Drafting (Layouts, Standard & Sectional Views, Detailing & Plotting).	04
<b>4.</b>	Solid modeling of any engineering component using any 3D modeling software.	04
<b>5.</b>	Non - Contact Scanning – Generation of CAD model using 3D scanning equipment.	04
<b>6.</b>	Reverse Engineering of a legacy component – Selection of components, 3D scanning, CAD model verification, 3D print of CAD model.	04

7.	Modeling of a component using 3D modelling software and development of G – Code output using Fractal Software.	06
8.	Design an object with free form surface using Autodesk Fusion 360 and development of G – Code output using Fractal Software.	04
9.	Segmentation in Slicer’s Segment Editor module for the purpose of 3D printing.	04
10.	Creation of 3D model from 2D images using any image processing software and printing it. (3D Slicer open source) (Application: Any body organ like Heart, Gallbladder etc. as per available Dicom files)	04
11.	Development of physical 3D mechanical structure using any one of the Additive manufacturing processes – Material to be used Metal	06
12.	Development of physical 3D mechanical structure using any one of the Additive manufacturing processes - Material to be used Plastic	04

### Text/Reference Books:-

1. Machine Drawing by N.D. Bhatt.
2. A textbook of Machine Drawing by Laxminarayan and M.L.Mathur, Jain brothers Delhi
3. Machine Drawing by K.I. Narayana, P. Kannaiah, K.Venkata Reddy
4. Medical Modelling - The Application of Advanced Design and Rapid Prototyping Techniques in Medicine, Richard Bibb, Dominic Eggbeer and Abby Paterson, Woodhead Publishing Series in Biomaterials: Number 91, Elsevier Ltd
5. Biomaterials, artificial organs and tissue engineering, Edited by Larry L. Hench and Julian R. Jones, Woodhead Publishing and Maney Publishing, CRC Press 2005
6. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, I. Gibson I D. W. Rosen I B. Stucker, Springer Publication.

### Website Reference / Video Courses:

1. <https://www.autodesk.in/products/fusion-360/learn-support>
2. <https://knowledge.autodesk.com/support/inventor>
3. <https://www.slicer.org/wiki/Documentation/4.10/Training>

### Term work:

Term work shall consist of all twelve experiments.

The distribution of marks shall be as follows:

Experiments Performance	: 20 marks
Course Project	: 20 marks
Attendance	: 10 marks

The final certification and acceptance of term work ensures the minimum passing in the term work.

### Oral Examination:

Oral examination will be based on entire lab work of **H3DPSBL701 - Skill Based Lab – Digital Fabrication**



# University of Mumbai



**Syllabus for**

**Honours/Minor Degree Program**

**In**

**Industrial Automation**

**FACULTY OF SCIENCE & TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2022-2023)

**University of Mumbai**  
**Industrial Automation**  
**(With effect from 2022-23)**

Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar /Tutorials	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HIAC501: Fundamentals of Industrial Automation	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>--</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
TE Sem. VI	HIAC601: Industrial Internet of Thing (IIOT)	04	--	--	20	80	--	--	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>04</b>	
<b>Total Credits = 04</b>										
BE Sem VII	HIAC701: AI and ML for Automation	04	--	--	20	80	-	-	100	04
	HIASBL701: AI and ML for Automation-Lab	-	-	04	-	-	50	50	100	02
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>04</b>	<b>100</b>	<b>100</b>	<b>200</b>	<b>06</b>		
<b>Total Credits = 06</b>										
BE Sem VIII	HIAC801: Applied Predictive Analytics	04	--	--	20	80	-	-	100	04
	<b>Total</b>	<b>04</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>-</b>	<b>100</b>	<b>04</b>		
<b>Total Credits = 04</b>										
<b>Total Credits for Semesters V, VI, VII &amp; VIII = 04+04+06+04 = 18</b>										

Industrial Automation : Sem. V								
Course code	Course Name	Teaching scheme			Credit assigned			
HIAC501	Fundamentals of Industrial Automation	Theory	Pract.	Tut.	Theory	Pract	Tut.	Total
		4	-	-	4	-	-	4

Course Code	Course Name	Examination scheme								
		Theory (out of 100)					Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam					
Test1	Test2	Avg.								
HIAC501	Fundamentals of Industrial Automation	20	20	20	80	-	-	-	100	

<b>Course objective</b>	<ol style="list-style-type: none"> <li>To impart knowledge of Industrial Automation.</li> <li>To make the students learn industrial sensors.</li> <li>To make the students learn various actuators.</li> <li>To make the students learn about controller strategy and various automation tools like PLC.</li> <li>To give the students an overview of DCS and HMI.</li> <li>To give students an overview of communication protocols.</li> </ol>
<b>Course Outcome</b>	<p>The students will able to</p> <ol style="list-style-type: none"> <li>Recognize Industrial automation.</li> <li>Select and configure industrial sensors.</li> <li>Comprehend and work with various actuators.</li> <li>Know various automation tools.</li> <li>Work with DCS and HMI.</li> <li>Select various communication protocols.</li> </ol>

**Pre requisites: Sensors and Transducers basics**

Module	Contents	Hours.	CO
1	<p><b>Introduction</b></p> <p>Introduction- Automation in production system, Principles and strategies of automation, Basic elements of an automated system, types of Automation, Hierarchical level in automation, Advanced automation functions, Automated flow lines and transfer mechanisms.</p> <p>Material handling and identification technologies, Conveyor system, Automated guided vehicle system, Automated storage systems, Automatic Identification Methods.</p>	6	CO1

2	<p><b>Sensors</b> Introduction to Industrial Measurement, overview of sensors, classification, sensor characteristics, physical principles of sensing, sensor Materials and Technologies.</p> <p>Inductive sensors, capacitive sensors, vision sensors, ultrasonic sensors, Electronic SMART Digital remote sensor , Robotic sensors, Tactile sensing, Proximity sensors, Range sensor, Position sensors, Fibre optic sensors, Guided microwave sensor, wireless sensors, Electrical characteristics of sensors,</p> <p>specifications of sensors, performance testing, selection guidelines.</p>	8	CO2
3	<p><b>Actuators</b> Pneumatic and hydraulic-directional and pressure control valves, cylinders, servo proportional control valves, rotary actuators.</p> <p>Electrical actuation: A.C and DC motors, stepper motors, mechanical switches and solid state switches.</p> <p>Mechanical Actuation: types of motion, kinematic chain, cams, gears, ratchets and pawl, belt and chain drives, bearings, mechanical aspects of motor selection, piezoelectric actuators, magneto-strictive actuators, memory metal actuators. Selection Criteria of Actuators</p>	8	CO3
4	<p><b>Controller strategy / Automation Tools. PLC</b> Overview and Features, Types, specifications, PLC Architecture, PLC working, PLC SCAN, new trends in PLC, PLC programming Languages, PLC instructions set, Development of Ladder programme, case study Example, PLC Applications, Overview of Motion control.PLC Installation and wiring.</p> <p><b>SCADA</b> Overview, SCADA Architecture, SCADA-Hardware functions, New trends in scada systems, applications, case study examples.</p>	10	CO4
5	<p><b>DCS &amp; HMI</b> DCS: Overview and Features of DCS, DCS Architecture, Hardware elements, working of DCS, DCS displays, DCS interfacing with PLC , DCS wiring diagram. Applications and suppliers.</p> <p>HMI : Overview, need, Types, wiring practice, Data Handling , configuration and interfacing with <b>PLC &amp; PC, Communication standards. ASM Graphics</b></p>	10	CO5
6	<p><b>Communication protocols</b> Overview of sensor networks, AS interface,CAN, HART, FF, Profibus, Interbus, Mbus, Wireless sensor network, networks-IEEE, Zigbee, sensor interfaces.</p>	6	CO6

**Internal Assessment:**

Internal Assessment consists of two tests out of which, one should be a compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will consist of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 or 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books Recommended:

1. Jacob K Freden; Handbook of Modern sensors, Springer, 5th Edition
2. Tony Kuphaldt; Lessons in industrial instrumentation, version 4
3. Walt Boyes; Instrumentation Reference book, Fourth Edition.
4. William C Dunn; Fundamentals of Industrial Instrumentation and process control, McGraw Hill.
5. C.L. Albert and D.A. Coggan, Fundamentals of Industrial Control, ISA, 1992.
6. Bela G. Liptak, Instrument Engineer's HandBook – Process Measurement and Analysis, ISA CRC Press , 4th Edition, 2003.
7. Andrew Williams, Applied instrumentation in the process industries, 2<sup>nd</sup> Edition, Vol. 1 & 3, Gulf publishing company.
8. Douglas. M.Considine; Process Instruments & Control Handbook, McGraw-Hill
9. S C Mukhopadhyay; Intelligent sensing, Instrumentation and Measurement, Springer.

Industrial Automation : Sem. VI								
Course code	Course Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
HIAC601	Industrial Internet of Thing (IIOT)	4	-	-	4	-	-	4

Course Code	Course Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
HIAC601	Industrial Internet of Thing (IIOT)	20	20	20	80	-	-	-	100

<b>Course objective</b>	<ol style="list-style-type: none"> <li>1. Introduce how IoT has become a game changer in the new economy where the customers are looking for integrated value</li> <li>2. Bring the IoT perspective in thinking and building solutions</li> <li>3. Introduce the tools and techniques that enable IoT solution and Security aspects.</li> </ol>
<b>Course Outcome</b>	<p>The students will able to</p> <ol style="list-style-type: none"> <li>1. Describe IOT, IIOT</li> <li>2. Design and develop the real-life IoT applications using off the shelf hardware and software</li> <li>3. Know various IoT Layers and their relative importance</li> <li>4. Recognize various IoT platforms and Security</li> <li>5. Realize the importance of Data Analytics in IoT</li> <li>6. Design and thinking concepts of IIOT</li> </ol>

Prerequisites: Microcontroller based Architecture and Programming			
Module	Content	Hours	CO
1	<p><b>Introduction:</b> Introduction of Industry 4.0, Elements of industry 4.0, Introduction to IOT, what is IIOT? IOT Vs. IIOT, History of IIOT, Components of IIOT - Sensors, Interface, Networks, People &amp; Process, Hype cycle, IOT Market, Trends &amp; future Real-life examples, Key terms – IOT Platform, Interfaces, API, clouds, Role of IIOT in Manufacturing Processes</p> <p>Use of IIOT in plant maintenance practices, Sustainability through Business excellence tools Challenges &amp; Benefits in implementing IIOT</p>	6	CO1

2	<p><b>Architectures:</b> Overview of IOT components; Various Architectures of IOT and IIOT, Advantages &amp; disadvantages, Industrial Internet - Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN,  WSN network design for IOT</p>	8	CO2
3	<p><b>Sensor and Interfacing:</b> Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators, IT and OT Integration.</p>	10	CO3
4	<p><b>Protocols and Cloud:</b> Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, BACnet, BLE, Modbus, SPI, I2C, IIOT protocols –COAP, MQTT, 6lowpan, lwm2m, AMPQ  IIOT cloud platforms: Overview of cots cloud platforms, Predix, thingworks, azure etc. Data analytics, cloud services, Business models: Saas, Paas, Iaas.</p>	8	CO4
5	<p><b>Cyber security for industry, Privacy, and Governance</b> Cyber physical system, cyber security life cycle, cyber security guidelines, standard IEC 62443  Introduction to web security, Conventional web technology and relationship with IIOT, Vulnerabilities of IoT, Privacy, Security requirements, Threat analysis, Trust, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, non-repudiation and availability, Security model for IoT.</p>	8	CO5
6	<p><b>IOT Analytics and CASE study:</b> Role of Analytics in IOT, Data visualization Techniques, Introduction to R Programming, Statistical Methods.  Internet of Things Applications: Smart Metering, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Plant Automation,  Real life examples of IIOT in Manufacturing Sector.</p>	8	CO6

#### Internal Assessment:

Internal Assessment consists of two tests out of which, one should be a compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

#### Theory Examination:

1. Question paper will consist of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 or 5 marks will be asked.

4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

**Text Books:**

1. Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, ISBN: 978-1-118-47347-4, Willy Publications
2. Bernd Scholz-Reiter, Florian Michahelles, Architecting the Internet of Things, ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer

**Reference Books:**

1. Hakima Chaouchi, The Internet of Things Connecting Objects to the Web, ISBN : 978-1-84821-140-7, Willy Publications
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications
3. Inside the Internet of Things (IoT), Deloitte University Press
4. Internet of Things- From Research and Innovation to Market Deployment; By Ovidiu & Peter; River Publishers Series
5. Five thoughts from the Father of the Internet of Things; by Phil Wainewright - Kevin Ashton
6. How Protocol Conversion Addresses IIoT Challenges: White Paper By Red Lion.



Industrial Automation: Sem. VII								
Subject Code	Subject Name	Teaching Scheme			Credit Assigned			
		Th	Pract.	Tut.	Th	Pract.	Tut.	Total
HIAC701	Artificial Intelligence and Machine Learning for Automation	4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
HIAC701	Artificial Intelligence and Machine Learning for Automation	20	20	20	80	-	-	-	100

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To familiarize student with basic concepts of Artificial Intelligence and Machine learning.</li> <li>To provide understanding of the concepts of regression, classification, clustering and deep learning algorithms.</li> <li>To introduce the students to various applications of Artificial Intelligence and Machine learning for industrial automation</li> </ol>
<b>Course Outcomes</b>	<p>Students will be able to:</p> <ol style="list-style-type: none"> <li>Introduce concepts of Artificial Intelligence and Machine learning</li> <li>Explicate statistical tools and development of database for AI/ML.</li> <li>Analyze the various algorithms for Regression, Classification and Clustering.</li> <li>Evaluate metrics for ML/AI algorithms.</li> <li>Examine the algorithms for deep learning.</li> <li>Explain examples of ML/AI algorithms for industrial automation.</li> </ol>

Module	Contents	Hrs.	CO Mapping
1.	<b>Introduction to Artificial Intelligence:</b> Evolution, definition, types, application examples, benefits/advantages, limitations/issues, comparison.	06	CO1
2.	<b>Review of statistical concepts:</b> Mean, variance, covariance, standard deviation, random variable, probability distribution, probability distribution function, normal distribution, binomial distribution, poisson distribution, central limit theorem, vector norms, principal component analysis. <b>Data collection and preparation:</b> Collecting, cleaning, normalization, standardization, missing data, underfitting and overfitting, neglecting outliers, annotation, labelling. Data Splitting: Training, Validation, and Test Datasets. Public datasets for machine learning.	08	CO2

3.	<b>Regression:</b> Simple Linear regression, Multiple Linear Regression, Polynomial Regression, Logistic regression. <b>Classifiers:</b> k-Nearest Neighbours, Decision trees, naïve Bayes, SVM for Linearly separable data, Kernel SVM for Non-Linearly separable data. <b>Clustering:</b> k-means clustering.	10	CO3
4.	<b>Evaluation Metrics:</b> True Positive, True Negative, False Positive, False Negative, accuracy, precision, recall or True Positive Rate, False Positive Rate, Receiver Operating Characteristic, Area Under the Curve, Confusion matrix, F-score.	04	CO4
5.	<b>Deep Learning:</b> Multilayer Perceptron (MLP), Convolutional Neural Network (CNN), Recurrent Neural Network (RNN)	08	CO5
6.	<b>Application in Industrial Automation: Robotics, Factory automation, Process control, Electrical Engineering</b> Challenges, Data Screening, Feature Engineering, Projected improvement, Model Design, Limitations, Future scope, References.	12	CO6

#### Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on Minimum 02 Modules) and the other is either a class test or assignment on live problems or Course project.

#### Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 or 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

#### Text Books:

1. Harrington, Peter. *Machine learning in action*. Simon and Schuster, 2012.
2. Zheng, Alice, and Amanda Casari. *Feature engineering for machine learning: principles and techniques for data scientists*. " O'Reilly Media, Inc.", 2018.
3. Jiang, Hui. *Machine Learning Fundamentals: A Concise Introduction*. Cambridge University Press, 2021.
4. Huyen, C. *“Designing Machine Learning Systems: An Iterative Process for Production-Ready Applications”*, O'Reilly Media, 2022.
5. Gupta, Itisha, and Garima Nagpal. *Artificial Intelligence and Expert Systems*. Stylus Publishing, LLC, 2020.

#### Reference Books:

1. Pandey, Yogendra Narayan, et al. *Machine Learning in the Oil and Gas Industry*. apress, Texas, 2020.
2. Bangert, Patrick, ed. *Machine learning and data science in the oil and gas industry: Best practices, tools, and case studies*. Gulf Professional Publishing, 2021.
3. Das, Santosh Kumar, et al., eds. *Machine learning algorithms for industrial applications*. Cham: Springer, 2021.

Industrial Automation: SEM VII								
Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Th	Pract.	Tut.	Th	Pract.	Tut.	Total
HIASBL701	Artificial Intelligence and Machine Learning for Automation Lab	-	4	-	-	4	-	2

Subject Code	Subject Name	Examination scheme						
		Theory (out of 100)				Term work	Oral	Total
		Internal Assessment			End sem Exam			
		Test1	Test2	Avg.				
HIASBL701	Artificial Intelligence and Machine Learning for Automation Lab	--	--	--	--	50	50	100

<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>1. To familiarize student with basic concepts of Artificial Intelligence and Machine learning.</li> <li>2. To provide understanding of the concepts of regression, classification, clustering and deep learning algorithms.</li> <li>3. To introduce the students to various applications of Artificial Intelligence and Machine learning for industrial automation</li> </ol>
<b>Course Outcomes</b>	<p>Students will be able to</p> <ol style="list-style-type: none"> <li>1. Write programs based on data compression and dimensionality reduction.</li> <li>2. Write programs for regression, classification and clustering.</li> <li>3. Calculate evaluation metrics for various algorithms.</li> <li>4. Write programs based on deep learning algorithms.</li> <li>5. Demonstrate working of AI/ML in Robotics and Factory automation.</li> <li>6. Validate working of AI/ML in Process control and Electrical Engineering.</li> </ol>

**Syllabus: Same as that of Subject HIAC701.**

**List of the Laboratory Experiments:**

Sr. No.	Contents	CO Mapping
1.	Write a python program to perform PCA for dimension reduction or data compression.	CO1
2.	Develop/download database of any industrial machine/system. Explain hardware system used for data collection. Explain specifications/characteristics of collected data.	CO2

3.	Write a python program to implement linear regression with one variable, two variables for given dataset.	CO2
4.	Demonstrate the working of SVM classifier for a linearly separable data set.	CO2
5.	Demonstrate the working of Kernel SVM classifier for a non-linearly separable data set.	CO2
6.	Demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	CO2
7.	Calculate evaluation metrics such as accuracy, precision, recall, confusion matrix, F-score, etc for regression, classification and clustering algorithms.	CO3
8.	Calculate evaluation metrics such as Receiver Operating Characteristic, Area Under the Curve, etc for regression, classification and clustering algorithms.	CO3
9.	Implement multilayer Perceptron (MLP) for predicting stock price. Time series forecasting.	CO4
10.	Implement Convolutional Neural Network (CNN) to recognize hand-written digits dataset.	CO4
11.	Implement Recurrent Neural Network (RNN) for speech recognition.	CO4
12.	Case study or mini project on application of AI/ML in Robotics.	CO5
13.	Case study or mini project on application of AI/ML in Factory automation.	CO5
14.	Case study or mini project on application of AI/ML in Process control.	CO6
15.	Case study or mini project on application of AI/ML in Electrical Engineering.	CO6

Any other experiment based on syllabus which will help students to understand topic/concept.

**Oral Examination:**

Oral examination will be based on entire syllabus.

**Term Work:**

Term work shall consist of minimum 12 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments): : 20 Marks

Laboratory work (programs / journal): 20 Marks

Attendance: : 10 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

### Industrial Automation: SEM VIII

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
HIAC801	Applied Predictive Analytics	4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme								
		Theory (out of 100)					Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam					
		Test1	Test2	Avg.						
HIAC801	Applied Predictive Analytics	20	20	20	80	-	-	-	100	

<b>Course objective</b>	<ol style="list-style-type: none"> <li>To deliver Knowledge of core operations in Energy Vertical Solving complex issues analyzing available data in Operations, Maintenance, Reliability, Safety, Procurement, Inventory etc.,</li> <li>To introduce forecasting and predictive techniques.</li> </ol>
<b>Course Outcome</b>	<p>The students will able to</p> <ol style="list-style-type: none"> <li>Identify the use of analytics and its tools</li> <li>Interpret data and preparation of data</li> <li>Use descriptive modeling techniques</li> <li>Practice predictive modeling techniques such as decision tree, logistic regression and neural network</li> <li>Apply and build models using clustering, regression and classification techniques and its corresponding algorithms</li> <li>Discuss the case studies of Predictive Analytics and Predictive Maintenance</li> </ol>

Pre requisites: Data Science concepts			
Module	Content	Hours.	CO
1	<p><b>Overview of Predictive Analytics:</b>                      What and Why Analytics, Predictive Analytics? Supervised vs. Unsupervised Learning, Parametric vs. Non-Parametric Models, Business Intelligence, Predictive Analytics vs. Business Intelligence, Predictive Analytics vs. Statistics, Statistics and Analytics, Predictive Analytics and Statistics Contrasted, Predictive Analytics vs. Data Mining, Challenges in Using Predictive Analytics. Concept of hb</p>	06	CO1
2	<p><b>Data Understanding and Data Preparation:</b>                      Single Variable Summaries, Applying Simple Statistics in Data Understanding, Categorical Variable Assessment, Data Visualization in One Dimension, Two or Higher Dimensions.                       Data Preparation, Fixing Missing Data, Feature Creation, Simple Variable Transformations, Fixing Skew, Binning Continuous Variables, Numeric Variable</p>	08	CO2

	Scaling, Nominal Variable Transformation, Ordinal Variable Transformations, Date and Time Variable Features, Multidimensional Features		
3	<b>Descriptive Modeling:</b> Data Preparation, Issues with Descriptive Modeling, Principal Component Analysis, The PCA Algorithm, Applying PCA to New Data, PCA for Data Interpretation, Additional Considerations before Using PCA, The Effect of Variable Magnitude on PCA Models, Clustering Algorithms, The K-Means Algorithm, Data Preparation for K-Means	07	CO3
4	<b>Predictive Modeling:</b> Decision Trees, The Decision Tree Landscape, Building Decision Trees, Logistic Regression, Interpreting Logistic Regression Models, Other Practical Considerations for Logistic Regression, Neural Networks,  Building Blocks: The Neuron, Neural Network Training, The Flexibility of Neural Networks, Neural Network Settings, Neural Network Pruning, Interpreting Neural Networks, Neural Network Decision Boundaries, Other Practical Considerations for Neural Networks	09	CO4
5	<b>Predictive Modeling:</b> K-Nearest Neighbor, the k-NN Learning Algorithm, Distance Metrics for k-NN, Other Practical Considerations for k-NN, Naïve Bayes, Bayes' Theorem, The Naïve Bayes Classifier Interpreting Naïve Bayes Classifiers, Other Practical Considerations for Naïve Bayes, Regression Models, Linear Regression, Linear Regression Assumptions, Variable Selection in Linear Regression, Interpreting Linear Regression Models, Using Linear Regression for Classification, Other Regression Algorithms	09	CO5
6	<b>Assessing Predictive Models:</b> Batch Approach to Model Assessment, Percent Correct Classification, Rank-Ordered Approach to Model Assessment, Assessing Regression Models.  <b>Case studies:</b> Quality Prediction in a Mining Process, predicting the consumption of electricity in the coming future (refer Kaggle data set)  <b>Predictive Maintenance:</b> Find a defect in the production, Sensor Fault Detection(refer Kaggle data set), Boiler Fault Detection ((refer <a href="https://iee-dataport.org/">https://iee-dataport.org/</a> )	09	CO6

#### Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on Minimum 02 Modules) and the other is either a class test or assignment on live problems or Course project.

#### Theory Examination:

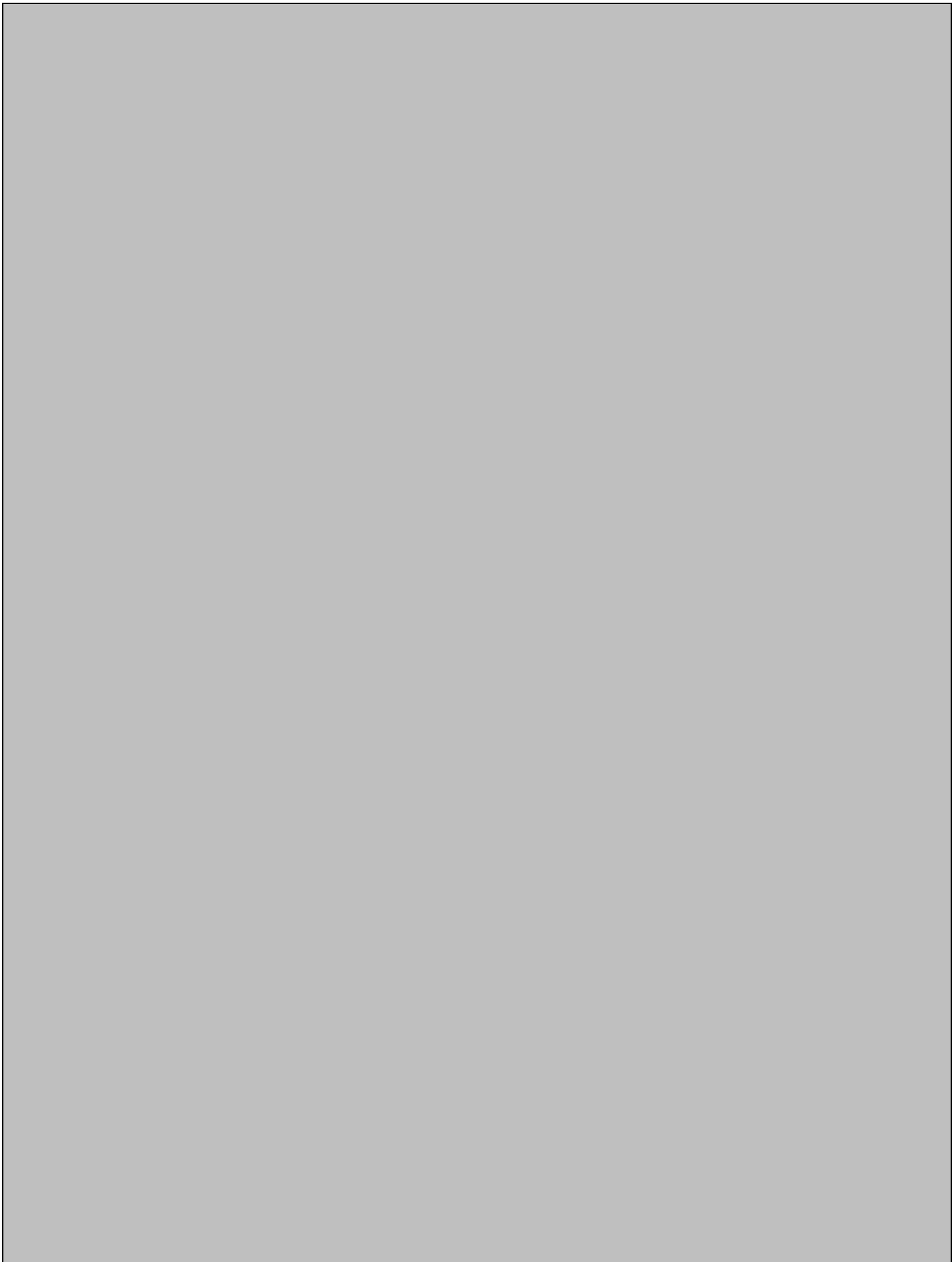
1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 or 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

**Text Books:**

1. Dean Abbott, "Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst" , ISBN: 978-1-118-72796-6
2. P. Kaliraj, T. Devi, "Big Data Applications in Industry 4.0", ISBN 9781032008110, Published February 10, 2022 by Auerbach Publications
3. Mahir Oner, Sultan Ceren Oner, "Data Analytics in Industry 4.0: In the Perspective of Big Data".

**Reference Books:**

1. Gareth James, Daniela Witten, Trevor Hastie Robert Tibshirani. "An Introduction to Statistical Learning with Applications in R"
2. Joel Grus, "Data science from scratch", Orielly publication, ISBN: 9781492041139, May 2019
3. David Roi Haroon, Galit Shmueli, "Getting Started with Business Analytics: Insightful Decision-Making", CRC Press, ISBN 9781498787413
4. James R Evans, "Business Analytics", Pearson publication, ISBN: 9780135231678





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# National Educational Policy





सत्यमेव जयते

# **National Education Policy 2020**

**Ministry of Human  
Resource Development**

**Government of India**

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# **National Education Policy 2020**

## **Introduction**

Education is fundamental for achieving full human potential, developing an equitable and just society, and promoting national development. Providing universal access to quality education is the key to India's continued ascent, and leadership on the global stage in terms of economic growth, social justice and equality, scientific advancement, national integration, and cultural preservation. Universal high-quality education is the best way forward for developing and maximizing our country's rich talents and resources for the good of the individual, the society, the country, and the world. India will have the highest population of young people in the world over the next decade, and our ability to provide high-quality educational opportunities to them will determine the future of our country.

The global education development agenda reflected in the Goal 4 (SDG4) of the 2030 Agenda for Sustainable Development, adopted by India in 2015 - seeks to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" by 2030. Such a lofty goal will require the entire education system to be reconfigured to support and foster learning, so that all of the critical targets and goals (SDGs) of the 2030 Agenda for Sustainable Development can be achieved.

The world is undergoing rapid changes in the knowledge landscape. With various dramatic scientific and technological advances, such as the rise of big data, machine learning, and artificial intelligence, many unskilled jobs worldwide may be taken over by machines, while the need for a skilled workforce, particularly involving mathematics, computer science, and data science, in conjunction with multidisciplinary abilities across the sciences, social sciences, and humanities, will be increasingly in greater demand. With climate change, increasing pollution, and depleting natural resources, there will be a sizeable shift in how we meet the world's energy, water, food, and sanitation needs, again resulting in the need for new skilled labour, particularly in biology, chemistry, physics, agriculture, climate science, and social science. The growing emergence of epidemics and pandemics will also call for collaborative research in infectious disease management and development of vaccines and the resultant social issues heightens the need for multidisciplinary learning. There will be a growing demand for humanities and art, as India moves towards becoming a developed country as well as among the three largest economies in the world.

Indeed, with the quickly changing employment landscape and global ecosystem, it is becoming increasingly critical that children not only learn, but more importantly learn how to learn. Education thus, must move towards less content, and more towards learning about how to think critically and solve problems, how to be creative and multidisciplinary, and how to innovate, adapt, and absorb new material in novel and changing fields. Pedagogy must evolve to make education more experiential, holistic, integrated, inquiry-driven, discovery-oriented, learner-centred, discussion-based, flexible, and, of course, enjoyable. The curriculum must include basic arts, crafts, humanities, games, sports and fitness, languages, literature, culture, and values, in addition to science and mathematics, to develop all aspects and capabilities of learners; and make education more well-rounded, useful, and fulfilling to the learner. Education must build character, enable learners to be ethical, rational, compassionate, and caring, while at the same time prepare them for gainful, fulfilling employment.

The gap between the current state of learning outcomes and what is required must be bridged through undertaking major reforms that bring the highest quality, equity, and integrity into the system, from early childhood care and education through higher education.

The aim must be for India to have an education system by 2040 that is second to none, with equitable access to the highest-quality education for all learners regardless of social or economic background.

This National Education Policy 2020 is the first education policy of the 21<sup>st</sup> century and aims to address the many growing developmental imperatives of our country. This Policy proposes the revision and revamping of all aspects of the education structure, including its regulation and governance, to create a new system that is aligned with the aspirational goals of 21<sup>st</sup> century education, including SDG4, while building upon India's traditions and value systems. The National

## **National Education Policy 2020**

Education Policy lays particular emphasis on the development of the creative potential of each individual. It is based on the principle that education must develop not only cognitive capacities - both the 'foundational capacities' of literacy and numeracy and 'higher-order' cognitive capacities, such as critical thinking and problem solving – but also social, ethical, and emotional capacities and dispositions.

The rich heritage of ancient and eternal Indian knowledge and thought has been a guiding light for this Policy. The pursuit of knowledge (*Jnan*), wisdom (*Pragyaa*), and truth (*Satya*) was always considered in Indian thought and philosophy as the highest human goal. The aim of education in ancient India was not just the acquisition of knowledge as preparation for life in this world, or life beyond schooling, but for the complete realization and liberation of the self. World-class institutions of ancient India such as Takshashila, Nalanda, Vikramshila, Vallabhi, set the highest standards of multidisciplinary teaching and research and hosted scholars and students from across backgrounds and countries. The Indian education system produced great scholars such as Charaka, Susruta, Aryabhata, Varahamihira, Bhaskaracharya, Brahmagupta, Chanakya, Chakrapani Datta, Madhava, Panini, Patanjali, Nagarjuna, Gautama, Pingala, Sankardev, Maitreyi, Gargi and Thiruvalluvar, among numerous others, who made seminal contributions to world knowledge in diverse fields such as mathematics, astronomy, metallurgy, medical science and surgery, civil engineering, architecture, shipbuilding and navigation, yoga, fine arts, chess, and more. Indian culture and philosophy have had a strong influence on the world. These rich legacies to world heritage must not only be nurtured and preserved for posterity but also researched, enhanced, and put to new uses through our education system.

The teacher must be at the centre of the fundamental reforms in the education system. The new education policy must help re-establish teachers, at all levels, as the most respected and essential members of our society, because they truly shape our next generation of citizens. It must do everything to empower teachers and help them to do their job as effectively as possible. The new education policy must help recruit the very best and brightest to enter the teaching profession at all levels, by ensuring livelihood, respect, dignity, and autonomy, while also instilling in the system basic methods of quality control and accountability.

The new education policy must provide to all students, irrespective of their place of residence, a quality education system, with particular focus on historically marginalized, disadvantaged, and underrepresented groups. Education is a great leveler and is the best tool for achieving economic and social mobility, inclusion, and equality. Initiatives must be in place to ensure that all students from such groups, despite inherent obstacles, are provided various targeted opportunities to enter and excel in the educational system.

These elements must be incorporated taking into account the local and global needs of the country, and with a respect for and deference to its rich diversity and culture. Instilling knowledge of India and its varied social, cultural, and technological needs, its inimitable artistic, language, and knowledge traditions, and its strong ethics in India's young people is considered critical for purposes of national pride, self-confidence, self-knowledge, cooperation, and integration.

### **Previous Policies**

The implementation of previous policies on education has focused largely on issues of access and equity. The unfinished agenda of the National Policy on Education 1986, modified in 1992 (NPE 1986/92), is appropriately dealt with in this Policy. A major development since the last Policy of 1986/92 has been the Right of Children to Free and Compulsory Education Act 2009 which laid down legal underpinnings for achieving universal elementary education.

### **Principles of this Policy**

The purpose of the education system is to develop good human beings capable of rational thought and action, possessing compassion and empathy, courage and resilience, scientific temper and

## National Education Policy 2020

creative imagination, with sound ethical moorings and values. It aims at producing engaged, productive, and contributing citizens for building an equitable, inclusive, and plural society as envisaged by our Constitution.

A good education institution is one in which every student feels welcomed and cared for, where a safe and stimulating learning environment exists, where a wide range of learning experiences are offered, and where good physical infrastructure and appropriate resources conducive to learning are available to all students. Attaining these qualities must be the goal of every educational institution. However, at the same time, there must also be seamless integration and coordination across institutions and across all stages of education.

The fundamental principles that will guide both the education system at large, as well as the individual institutions within it are:

- **recognizing, identifying, and fostering the unique capabilities of each student**, by sensitizing teachers as well as parents to promote each student’s holistic development in both academic and non-academic spheres;
- **according the highest priority to achieving Foundational Literacy and Numeracy** by all students by Grade 3;
- **flexibility**, so that learners have the ability to choose their learning trajectories and programmes, and thereby choose their own paths in life according to their talents and interests;
- **no hard separations** between arts and sciences, between curricular and extra-curricular activities, between vocational and academic streams, etc. in order to eliminate harmful hierarchies among, and silos between different areas of learning;
- **multidisciplinarity** and a **holistic education** across the sciences, social sciences, arts, humanities, and sports for a multidisciplinary world in order to ensure the unity and integrity of all knowledge;
- **emphasis on conceptual understanding** rather than rote learning and learning-for-exams;
- **creativity and critical thinking** to encourage logical decision-making and innovation;
- **ethics and human & Constitutional values** like empathy, respect for others, cleanliness, courtesy, democratic spirit, spirit of service, respect for public property, scientific temper, liberty, responsibility, pluralism, equality, and justice;
- **promoting multilingualism and the power of language** in teaching and learning;
- **life skills** such as communication, cooperation, teamwork, and resilience;
- **focus on regular formative assessment for learning** rather than the summative assessment that encourages today’s ‘coaching culture’;
- **extensive use of technology** in teaching and learning, removing language barriers, increasing access for *Divyang* students, and educational planning and management;
- **respect for diversity** and **respect for the local context** in all curriculum, pedagogy, and policy, always keeping in mind that education is a concurrent subject;
- **full equity and inclusion** as the cornerstone of all educational decisions to ensure that all students are able to thrive in the education system;
- **synergy in curriculum across all levels of education** from early childhood care and education to school education to higher education;
- **teachers and faculty as the heart of the learning process** – their recruitment, continuous professional development, positive working environments and service conditions;
- a **‘light but tight’ regulatory framework** to ensure **integrity, transparency, and resource efficiency** of the educational system through audit and public disclosure while encouraging innovation and out-of-the-box ideas through **autonomy, good governance, and empowerment**;
- **outstanding research** as a corequisite for outstanding education and development;
- **continuous review** of progress based on sustained research and regular assessment by educational experts;

## National Education Policy 2020

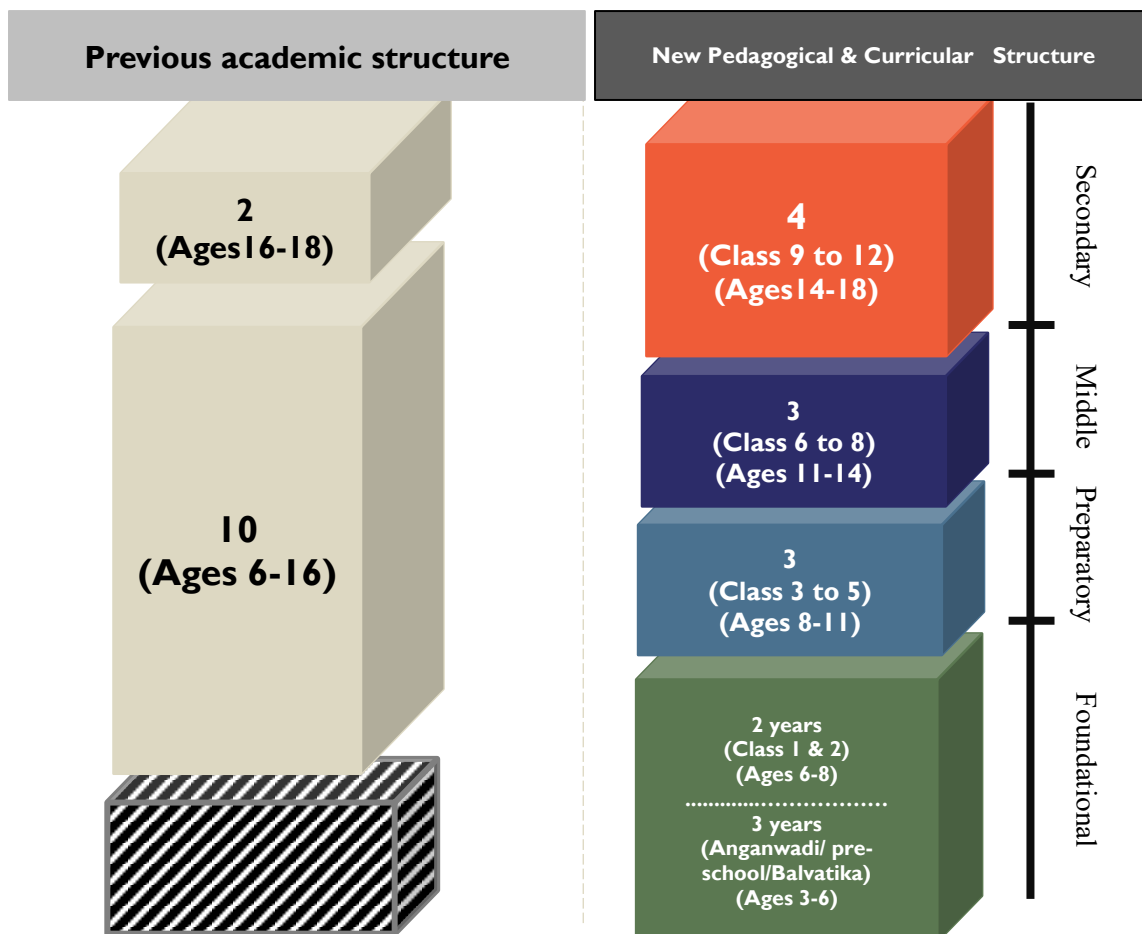
- **a rootedness and pride in India**, and its rich, diverse, ancient and modern culture and knowledge systems and traditions;
- **education is a public service**; access to quality education must be considered a basic right of every child;
- **substantial investment in a strong, vibrant public education system** as well as the encouragement and facilitation of true philanthropic private and community participation.

### The Vision of this Policy

This National Education Policy envisions an education system rooted in Indian ethos that contributes directly to transforming India, that is Bharat, sustainably into an equitable and vibrant knowledge society, by providing high-quality education to all, and thereby making India a global knowledge superpower. The Policy envisages that the curriculum and pedagogy of our institutions must develop among the students a deep sense of respect towards the Fundamental Duties and Constitutional values, bonding with one's country, and a conscious awareness of one's roles and responsibilities in a changing world. The vision of the Policy is to instill among the learners a deep-rooted pride in being Indian, not only in thought, but also in spirit, intellect, and deeds, as well as to develop knowledge, skills, values, and dispositions that support responsible commitment to human rights, sustainable development and living, and global well-being, thereby reflecting a truly global citizen.

### Part I. SCHOOL EDUCATION

This policy envisages that the extant 10+2 structure in school education will be modified with a new pedagogical and curricular restructuring of 5+3+3+4 covering ages 3-18 as shown in the representative figure and elaborated in detail later under Chapter 4.



## **National Education Policy 2020**

Currently, children in the age group of 3-6 are not covered in the 10+2 structure as Class 1 begins at age 6. In the new 5+3+3+4 structure, a strong base of Early Childhood Care and Education (ECCE) from age 3 is also included, which is aimed at promoting better overall learning, development, and well-being.

### **1. Early Childhood Care and Education: The Foundation of Learning**

1.1. Over 85% of a child's cumulative brain development occurs prior to the age of 6, indicating the critical importance of appropriate care and stimulation of the brain in the early years in order to ensure healthy brain development and growth. Presently, quality ECCE is not available to crores of young children, particularly children from socio-economically disadvantaged backgrounds. Strong investment in ECCE has the potential to give all young children such access, enabling them to participate and flourish in the educational system throughout their lives. Universal provisioning of quality early childhood development, care, and education must thus be achieved as soon as possible, and no later than 2030, to ensure that all students entering Grade 1 are school ready.

1.2. ECCE ideally consists of flexible, multi-faceted, multi-level, play-based, activity-based, and inquiry-based learning, comprising of alphabets, languages, numbers, counting, colours, shapes, indoor and outdoor play, puzzles and logical thinking, problem-solving, drawing, painting and other visual art, craft, drama and puppetry, music and movement. It also includes a focus on developing social capacities, sensitivity, good behaviour, courtesy, ethics, personal and public cleanliness, teamwork, and cooperation. The overall aim of ECCE will be to attain optimal outcomes in the domains of: physical and motor development, cognitive development, socio-emotional-ethical development, cultural/artistic development, and the development of communication and early language, literacy, and numeracy.

1.3. A National Curricular and Pedagogical Framework for Early Childhood Care and Education (NCPFECCE) for children up to the age of 8 will be developed by NCERT in two parts, namely, a sub-framework for 0-3 year-olds, and a sub-framework for 3-8 year-olds, aligned with the above guidelines, the latest research on ECCE, and national and international best practices. In particular, the numerous rich local traditions of India developed over millennia in ECCE involving art, stories, poetry, games, songs, and more, will also be suitably incorporated. The framework will serve as a guide both for parents and for early childhood care and education institutions.

1.4. The overarching goal will be to ensure universal access to high-quality ECCE across the country in a phased manner. Special attention and priority will be given to districts and locations that are particularly socio-economically disadvantaged. ECCE shall be delivered through a significantly expanded and strengthened system of early-childhood education institutions consisting of (a) stand-alone Anganwadis; (b) Anganwadis co-located with primary schools; (c) pre-primary schools/sections covering at least age 5 to 6 years co-located with existing primary schools; and (d) stand-alone pre-schools - all of which would recruit workers/teachers specially trained in the curriculum and pedagogy of ECCE.

1.5. For universal access to ECCE, Anganwadi Centres will be strengthened with high-quality infrastructure, play equipment, and well-trained Anganwadi workers/teachers. Every Anganwadi will have a well-ventilated, well-designed, child-friendly and well-constructed building with an enriched learning environment. Children in Anganwadi Centres shall take activity-filled tours - and meet the teachers and students of their local primary schools, in order to make the transition from Anganwadi Centres to primary schools a smooth one. Anganwadis shall be fully integrated into school complexes/clusters, and Anganwadi children, parents, and teachers will be invited to attend and participate in school/school complex programmes and vice versa.

1.6. It is envisaged that prior to the age of 5 every child will move to a "Preparatory Class" or "Balavatika" (that is, before Class 1), which has an ECCE-qualified teacher. The learning in the Preparatory Class shall be based primarily on play-based learning with a focus on developing cognitive, affective, and psychomotor abilities and early literacy and numeracy. The mid-



## **National Education Policy 2020**

day meal programme shall also be extended to the Preparatory Classes in primary schools. Health check-ups and growth monitoring that are available in the Anganwadi system shall also be made available to Preparatory Class students of Anganwadi as well as of primary schools.

1.7. To prepare an initial cadre of high-quality ECCE teachers in Anganwadis, current Anganwadi workers/teachers will be trained through a systematic effort in accordance with the curricular/pedagogical framework developed by NCERT. Anganwadi workers/teachers with qualifications of 10+2 and above shall be given a 6-month certificate programme in ECCE; and those with lower educational qualifications shall be given a one-year diploma programme covering early literacy, numeracy, and other relevant aspects of ECCE. These programmes may be run through digital/distance mode using DTH channels as well as smartphones, allowing teachers to acquire ECCE qualifications with minimal disruption to their current work. The ECCE training of Anganwadi workers/teachers will be mentored by the Cluster Resource Centres of the School Education Department which shall hold at least one monthly contact class for continuous assessment. In the longer term, State Governments shall prepare cadres of professionally qualified educators for early childhood care and education, through stage-specific professional training, mentoring mechanisms, and career mapping. Necessary facilities will also be created for the initial professional preparation of these educators and their Continuous Professional Development (CPD).

1.8. ECCE will also be introduced in Ashramshalas in tribal-dominated areas and in all formats of alternative schooling in a phased manner. The process for integration and implementation of ECCE in Ashramshalas and alternative schooling will be similar to that detailed above.

1.9. The responsibility for ECCE curriculum and pedagogy will lie with MHRD to ensure its continuity from pre-primary school through primary school, and to ensure due attention to the foundational aspects of education. The planning and implementation of early childhood care and education curriculum will be carried out jointly by the Ministries of HRD, Women and Child Development (WCD), Health and Family Welfare (HFW), and Tribal Affairs. A special joint task force will be constituted for continuous guidance of the smooth integration of early childhood care and education into school education.

## **2. Foundational Literacy and Numeracy: An Urgent & Necessary Prerequisite to Learning**

2.1. The ability to read and write, and perform basic operations with numbers, is a necessary foundation and an indispensable prerequisite for all future schooling and lifelong learning. However, various governmental, as well as non-governmental surveys, indicate that we are currently in a learning crisis: a large proportion of students currently in elementary school - estimated to be over 5 crore in number - have not attained foundational literacy and numeracy, i.e., the ability to read and comprehend basic text and the ability to carry out basic addition and subtraction with Indian numerals.

2.2. Attaining foundational literacy and numeracy for all children will thus become an urgent national mission, with immediate measures to be taken on many fronts and with clear goals that will be attained in the short term (including that every student will attain foundational literacy and numeracy by Grade 3). The highest priority of the education system will be to achieve universal foundational literacy and numeracy in primary school by 2025. The rest of this Policy will become relevant for our students only if this most basic learning requirement (i.e., reading, writing, and arithmetic at the foundational level) is first achieved. To this end, a National Mission on Foundational Literacy and Numeracy will be set up by the Ministry of Human Resource Development (MHRD) on priority. Accordingly, all State/UT governments will immediately prepare an implementation plan for attaining universal foundational literacy and numeracy in all primary schools, identifying stage-wise targets and goals to be achieved by 2025, and closely tracking and monitoring progress of the same.

2.3. First, teacher vacancies will be filled at the earliest, in a time-bound manner - especially in disadvantaged areas and areas with large pupil-to-teacher ratios or high rates of illiteracy. Special

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attention will be given to employing local teachers or those with familiarity with local languages. A pupil-teacher ratio (PTR) of under 30:1 will be ensured at the level of each school; areas having large numbers of socio-economically disadvantaged students will aim for a PTR of under 25:1. Teachers will be trained, encouraged, and supported - with continuous professional development - to impart foundational literacy and numeracy.

2.4. On the curricular side, there will be an increased focus on foundational literacy and numeracy - and generally, on reading, writing, speaking, counting, arithmetic, and mathematical thinking - throughout the preparatory and middle school curriculum, with a robust system of continuous formative/adaptive assessment to track and thereby individualize and ensure each student's learning. Specific hours daily - and regular events over the year-on activities involving these subjects will be dedicated to encourage and enthuse students. Teacher education and the early grade curriculum will be redesigned to have a renewed emphasis on foundational literacy and numeracy.

2.5. Currently, with the lack of universal access to ECCE, a large proportion of children already fall behind within the first few weeks of Grade 1. Thus, to ensure that all students are school ready, an interim 3-month play-based 'school preparation module' for all Grade 1 students, consisting of activities and workbooks around the learning of alphabets, sounds, words, colours, shapes, and numbers, and involving collaborations with peers and parents, will be developed by NCERT and SCERTs.

2.6. A national repository of high-quality resources on foundational literacy and numeracy will be made available on the Digital Infrastructure for Knowledge Sharing (DIKSHA). Technological interventions to serve as aids to teachers and to help bridge any language barriers that may exist between teachers and students, will be piloted and implemented

2.7. Due to the scale of the current learning crisis, all viable methods will be explored to support teachers in the mission of attaining universal foundational literacy and numeracy. Studies around the world show one-on-one peer tutoring to be extremely effective for learning not just for the learner, but also for the tutor. Thus, peer tutoring can be taken up as a voluntary and joyful activity for fellow students under the supervision of trained teachers and by taking due care of safety aspects. Additionally, it will also be made far easier for trained volunteers - from both the local community and beyond - to participate in this large-scale mission. Every literate member of the community could commit to teaching one student/person how to read, it would change the country's landscape very quickly. States may consider establishing innovative models to foster such peer-tutoring and volunteer activities, as well as launch other programmes to support learners, in this nationwide mission to promote foundational literacy and numeracy.

2.8. Enjoyable and inspirational books for students at all levels will be developed, including through high-quality translation (technology assisted as needed) in all local and Indian languages, and will be made available extensively in both school and local public libraries. Public and school libraries will be significantly expanded to build a culture of reading across the country. Digital libraries will also be established. School libraries will be set up - particularly in villages - to serve the community during non-school hours, and book clubs may meet in public/school libraries to further facilitate and promote widespread reading. A National Book Promotion Policy will be formulated, and extensive initiatives will be undertaken to ensure the availability, accessibility, quality, and readership of books across geographies, languages, levels, and genres.

2.9. Children are unable to learn optimally when they are undernourished or unwell. Hence, the nutrition and health (including mental health) of children will be addressed, through healthy meals and the introduction of well-trained social workers, counsellors, and community involvement into the schooling system. Furthermore, research shows that the morning hours after a nutritious breakfast can be particularly productive for the study of cognitively more demanding subjects and hence these hours may be leveraged by providing a simple but energizing breakfast in addition to midday meals. In locations where hot meals are not possible, a simple but nutritious meal, e.g., groundnuts/chana mixed with jaggery and/or local fruits may be provided. All school children shall undergo regular

health check-ups especially for 100% immunization in schools and health cards will be issued to monitor the same.

### **3. Curtailing Dropout Rates and Ensuring Universal Access to Education at All Levels**

3.1. One of the primary goals of the schooling system must be to ensure that children are enrolled in and are attending school. Through initiatives such as the Sarva Shiksha Abhiyan (now the Samagra Shiksha) and the Right to Education Act, India has made remarkable strides in recent years in attaining near-universal enrolment in elementary education. However, the data for later grades indicates some serious issues in retaining children in the schooling system. The GER for Grades 6-8 was 90.9%, while for Grades 9-10 and 11-12 it was only 79.3% and 56.5%, respectively - indicating that a significant proportion of enrolled students drop out after Grade 5 and especially after Grade 8. As per the 75th round household survey by NSSO in 2017-18, the number of out of school children in the age group of 6 to 17 years is 3.22 crore. It will be a top priority to bring these children back into the educational fold as early as possible, and to prevent further students from dropping out, with a goal to achieve 100% Gross Enrolment Ratio in preschool to secondary level by 2030. A concerted national effort will be made to ensure universal access and afford opportunity to all children of the country to obtain quality holistic education—including vocational education - from pre-school to Grade 12.

3.2. There are two overall initiatives that will be undertaken to bring children who have dropped out back to school and to prevent further children from dropping out. The first is to provide effective and sufficient infrastructure so that all students have access to safe and engaging school education at all levels from pre-primary school to Grade 12. Besides providing regular trained teachers at each stage, special care shall be taken to ensure that no school remains deficient on infrastructure support. The credibility of Government schools shall be re-established and this will be attained by upgrading and enlarging the schools that already exist, building additional quality schools in areas where they do not exist, and providing safe and practical conveyances and/or hostels, especially for the girl children, so that all children have the opportunity to attend a quality school and learn at the appropriate level. Alternative and innovative education centres will be put in place in cooperation with civil society to ensure that children of migrant labourers, and other children who are dropping out of school due to various circumstances are brought back into mainstream education.

3.3. The second is to achieve universal participation in school by carefully tracking students, as well as their learning levels, in order to ensure that they (a) are enrolled in and attending school, and (b) have suitable opportunities to catch up and re-enter school in case they have fallen behind or dropped out. For providing equitable and quality education from the Foundational Stage through Grade 12 to all children up to the age of 18, suitable facilitating systems shall be put in place. Counsellors or well-trained social workers connected to schools/school complexes and teachers will continuously work with students and their parents and will travel through and engage with communities to ensure that all school-age children are attending and learning in school. Trained and qualified social workers from civil society organizations/departments of Social Justice and Empowerment and government functionaries dealing with empowerment of Persons with Disabilities at the State and district level, could be connected to schools, through various innovative mechanisms adopted by State/UT Governments, to help in carrying out this important work.

3.4. Once infrastructure and participation are in place, ensuring quality will be the key in retention of students, so that they (particularly, girls and students from other socio-economically disadvantaged groups) do not lose interest in attending school. This will require a system of incentives for deploying teachers with knowledge of the local language to areas with high dropout rates, as well as overhauling the curriculum to make it more engaging and useful.

3.5. To facilitate learning for all students, with special emphasis on Socio-Economically Disadvantaged Groups (SEDGs), the scope of school education will be broadened to facilitate multiple pathways to learning involving both formal and non-formal education modes. Open and Distance Learning (ODL) Programmes offered by the National Institute of Open Schooling (NIOS)

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and State Open Schools will be expanded and strengthened for meeting the learning needs of young people in India who are not able to attend a physical school. NIOS and State Open Schools will offer the following programmes in addition to the present programmes: A, B and C levels that are equivalent to Grades 3, 5, and 8 of the formal school system; secondary education programmes that are equivalent to Grades 10 and 12; vocational education courses/programmes; and adult literacy and life-enrichment programmes. States will be encouraged to develop these offerings in regional languages by establishing new/strengthening existing State Institutes of Open Schooling (SIOS).

3.6. To make it easier for both governments as well as non-governmental philanthropic organizations to build schools, to encourage local variations on account of culture, geography, and demographics, and to allow alternative models of education, the requirements for schools will be made less restrictive. The focus will be to have less emphasis on input and greater emphasis on output potential concerning desired learning outcomes. Regulations on inputs will be limited to certain areas as enumerated in Chapter 8. Other models for schools will also be piloted, such as public-philanthropic partnerships.

3.7. Efforts will be made to involve community and alumni in volunteer efforts for enhancing learning by providing at schools: one-on-one tutoring; the teaching of literacy and holding of extra-help sessions; teaching support and guidance for educators; career guidance and mentoring to students; etc. In this regard, the support of active and healthy senior citizens, school alumni and local community members will be suitably garnered. Databases of literate volunteers, retired scientists/government/semi government employees, alumni, and educators will be created for this purpose.

### **4. Curriculum and Pedagogy in Schools: Learning Should be Holistic, Integrated, Enjoyable, and Engaging**

#### **Restructuring school curriculum and pedagogy in a new 5+3+3+4 design**

4.1. The curricular and pedagogical structure of school education will be reconfigured to make it responsive and relevant to the developmental needs and interests of learners at different stages of their development, corresponding to the age ranges of 3-8, 8-11, 11-14, and 14-18 years, respectively. The curricular and pedagogical structure and the curricular framework for school education will therefore be guided by a 5+3+3+4 design, consisting of the Foundational Stage (in two parts, that is, 3 years of Anganwadi/pre-school + 2 years in primary school in Grades 1-2; both together covering ages 3-8), Preparatory Stage (Grades 3-5, covering ages 8-11), Middle Stage (Grades 6-8, covering ages 11-14), and Secondary Stage (Grades 9-12 in two phases, i.e., 9 and 10 in the first and 11 and 12 in the second, covering ages 14-18).

4.2. The Foundational Stage will consist of five years of flexible, multilevel, play/activity-based learning and the curriculum and pedagogy of ECCE as mentioned in para 1.2. The Preparatory Stage will comprise three years of education building on the play, discovery, and activity-based pedagogical and curricular style of the Foundational Stage, and will also begin to incorporate some light text books as well as aspects of more formal but interactive classroom learning, in order to lay a solid groundwork across subjects, including reading, writing, speaking, physical education, art, languages, science, and mathematics. The Middle Stage will comprise three years of education, building on the pedagogical and curricular style of the Preparatory Stage, but with the introduction of subject teachers for learning and discussion of the more abstract concepts in each subject that students will be ready for at this stage across the sciences, mathematics, arts, social sciences, and humanities. Experiential learning within each subject, and explorations of relations among different subjects, will be encouraged and emphasized despite the introduction of more specialized subjects and subject teachers. The Secondary Stage will comprise of four years of multidisciplinary study, building on the subject-oriented pedagogical and curricular style of the Middle Stage, but with greater depth, greater critical thinking, greater attention to life aspirations, and greater flexibility and student choice of subjects. In particular students would continue to have the option of exiting after Grade 10

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and re-entering in the next phase to pursue vocational or any other courses available in Grades 11-12, including at a more specialized school, if so desired.

4.3. The above-described stages are purely curricular and pedagogical, designed to optimize learning for students based on the cognitive development of children; they will inform the development of National and State curricula and teaching-learning strategies at each stage, but parallel changes to physical infrastructure will not be required.

### **Holistic development of learners**

4.4. The key overall thrust of curriculum and pedagogy reform across all stages will be to move the education system towards real understanding and towards learning how to learn - and away from the culture of rote learning as is largely present today. The aim of education will not only be cognitive development, but also building character and creating holistic and well-rounded individuals equipped with the key 21<sup>st</sup> century skills. Ultimately, knowledge is a deep-seated treasure and education helps in its manifestation as the perfection which is already within an individual. All aspects of curriculum and pedagogy will be reoriented and revamped to attain these critical goals. Specific sets of skills and values across domains will be identified for integration and incorporation at each stage of learning, from pre-school to higher education. Curriculum frameworks and transaction mechanisms will be developed for ensuring that these skills and values are imbibed through engaging processes of teaching and learning. NCERT will identify these required skill sets and include mechanisms for their transaction in the National Curriculum Framework for early childhood and school education.

### **Reduce curriculum content to enhance essential learning and critical thinking**

4.5. Curriculum content will be reduced in each subject to its core essentials, to make space for critical thinking and more holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning. The mandated content will focus on key concepts, ideas, applications, and problem-solving. Teaching and learning will be conducted in a more interactive manner; questions will be encouraged, and classroom sessions will regularly contain more fun, creative, collaborative, and exploratory activities for students for deeper and more experiential learning.

### **Experiential learning**

4.6. In all stages, experiential learning will be adopted, including hands-on learning, arts-integrated and sports-integrated education, story-telling-based pedagogy, among others, as standard pedagogy within each subject, and with explorations of relations among different subjects. To close the gap in achievement of learning outcomes, classroom transactions will shift, towards competency-based learning and education. The assessment tools (including assessment “as”, “of”, and “for” learning) will also be aligned with the learning outcomes, capabilities, and dispositions as specified for each subject of a given class.

4.7. Art-integration is a cross-curricular pedagogical approach that utilizes various aspects and forms of art and culture as the basis for learning of concepts across subjects. As a part of the thrust on experiential learning, art-integrated education will be embedded in classroom transactions not only for creating joyful classrooms, but also for imbibing the Indian ethos through integration of Indian art and culture in the teaching and learning process at every level. This art-integrated approach will strengthen the linkages between education and culture.

4.8. Sports-integration is another cross-curricular pedagogical approach that utilizes physical activities including indigenous sports, in pedagogical practices to help in developing skills such as collaboration, self-initiative, self-direction, self-discipline, teamwork, responsibility, citizenship, etc. Sports-integrated learning will be undertaken in classroom transactions to help students adopt fitness as a lifelong attitude and to achieve the related life skills along with the levels of fitness as envisaged in the Fit India Movement. The need to integrate sports in education is well recognized as it serves to

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foster holistic development by promoting physical and psychological well-being while also enhancing cognitive abilities.

### **Empower students through flexibility in course choices**

4.9. Students will be given increased flexibility and choice of subjects to study, particularly in secondary school - including subjects in physical education, the arts and crafts, and vocational skills – so that they can design their own paths of study and life plans. Holistic development and a wide choice of subjects and courses year to year will be the new distinguishing feature of secondary school education. There will be no hard separation among ‘curricular’, ‘extracurricular’, or ‘co-curricular’, among ‘arts’, ‘humanities’, and ‘sciences’, or between ‘vocational’ or ‘academic’ streams. Subjects such as physical education, the arts and crafts, and vocational skills, in addition to science, humanities, and mathematics, will be incorporated throughout the school curriculum, with a consideration for what is interesting and safe at each age.

4.10. Each of the four stages of school education, in accordance with what may be possible in different regions, may consider moving towards a semester or any other system that allows the inclusion of shorter modules, or courses that are taught on alternate days, in order to allow an exposure to more subjects and enable greater flexibility. States may look into innovative methods to achieve these aims of greater flexibility and exposure to and enjoyment of a wider range of subjects, including across the arts, sciences, humanities, languages, sports, and vocational subjects.

### **Multilingualism and the power of language**

4.11. It is well understood that young children learn and grasp nontrivial concepts more quickly in their home language/mother tongue. Home language is usually the same language as the mother tongue or that which is spoken by local communities. However, at times in multi-lingual families, there can be a home language spoken by other family members which may sometimes be different from mother tongue or local language. Wherever possible, the medium of instruction until at least Grade 5, but preferably till Grade 8 and beyond, will be the home language/mother tongue/local language/regional language. Thereafter, the home/local language shall continue to be taught as a language wherever possible. This will be followed by both public and private schools. High-quality textbooks, including in science, will be made available in home languages/mother tongue. All efforts will be made early on to ensure that any gaps that exist between the language spoken by the child and the medium of teaching are bridged. In cases where home language/mother tongue textbook material is not available, the language of transaction between teachers and students will still remain the home language/mother tongue wherever possible. Teachers will be encouraged to use a bilingual approach, including bilingual teaching-learning materials, with those students whose home language may be different from the medium of instruction. All languages will be taught with high quality to all students; a language does not need to be the medium of instruction for it to be taught and learned well.

4.12. As research clearly shows that children pick up languages extremely quickly between the ages of 2 and 8 and that multilingualism has great cognitive benefits to young students, children will be exposed to different languages early on (but with a particular emphasis on the mother tongue), starting from the Foundational Stage onwards. All languages will be taught in an enjoyable and interactive style, with plenty of interactive conversation, and with early reading and subsequently writing in the mother tongue in the early years, and with skills developed for reading and writing in other languages in Grade 3 and beyond. There will be a major effort from both the Central and State governments to invest in large numbers of language teachers in all regional languages around the country, and, in particular, for all languages mentioned in the Eighth Schedule of the Constitution of India. States, especially States from different regions of India, may enter into bilateral agreements to hire teachers in large numbers from each other, to satisfy the three-language formula in their respective States, and also to encourage the study of Indian languages across the country. Extensive use of technology will be made for teaching and learning of different languages and to popularize language learning.

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4.13. The three-language formula will continue to be implemented while keeping in mind the Constitutional provisions, aspirations of the people, regions, and the Union, and the need to promote multilingualism as well as promote national unity. However, there will be a greater flexibility in the three-language formula, and no language will be imposed on any State. The three languages learned by children will be the choices of States, regions, and of course the students themselves, so long as at least two of the three languages are native to India. In particular, students who wish to change one or more of the three languages they are studying may do so in Grade 6 or 7, as long as they are able to demonstrate basic proficiency in three languages (including one language of India at the literature level) by the end of secondary school.

4.14. All efforts will be made in preparing high-quality bilingual textbooks and teaching-learning materials for science and mathematics, so that students are enabled to think and speak about the two subjects both in their home language/mother tongue and in English.

4.15. As so many developed countries around the world have amply demonstrated, being well educated in one's language, culture, and traditions is not a detriment but indeed a huge benefit to educational, social, and technological advancement. India's languages are among the richest, most scientific, most beautiful, and most expressive in the world, with a huge body of ancient as well as modern literature (both prose and poetry), film, and music written in these languages that help form India's national identity and wealth. For purposes of cultural enrichment as well as national integration, all young Indians should be aware of the rich and vast array of languages of their country, and the treasures that they and their literatures contain.

4.16. Thus, every student in the country will participate in a fun project/activity on 'The Languages of India', sometime in Grades 6-8, such as, under the '*Ek Bharat Shrestha Bharat*' initiative. In this project/activity, students will learn about the remarkable unity of most of the major Indian languages, starting with their common phonetic and scientifically-arranged alphabets and scripts, their common grammatical structures, their origins and sources of vocabularies from Sanskrit and other classical languages, as well as their rich inter-influences and differences. They will also learn what geographical areas speak which languages, get a sense of the nature and structure of tribal languages, and learn to say commonly spoken phrases and sentences in every major language of India and also learn a bit about the rich and uplifting literature of each (through suitable translations as necessary). Such an activity would give them both a sense of the unity and the beautiful cultural heritage and diversity of India and would be a wonderful icebreaker their whole lives as they meet people from other parts of India. This project/activity would be a joyful activity and would not involve any form of assessment.

4.17. The importance, relevance, and beauty of the classical languages and literature of India also cannot be overlooked. Sanskrit, while also an important modern language mentioned in the Eighth Schedule of the Constitution of India, possesses a classical literature that is greater in volume than that of Latin and Greek put together, containing vast treasures of mathematics, philosophy, grammar, music, politics, medicine, architecture, metallurgy, drama, poetry, storytelling, and more (known as 'Sanskrit Knowledge Systems'), written by people of various religions as well as non-religious people, and by people from all walks of life and a wide range of socio-economic backgrounds over thousands of years. Sanskrit will thus be offered at all levels of school and higher education as an important, enriching option for students, including as an option in the three-language formula. It will be taught in ways that are interesting and experiential as well as contemporarily relevant, including through the use of Sanskrit Knowledge Systems, and in particular through phonetics and pronunciation. Sanskrit textbooks at the foundational and middle school level may be written in Simple Standard Sanskrit (SSS) to teach Sanskrit through Sanskrit (STS) and make its study truly enjoyable.

4.18. India also has an extremely rich literature in other classical languages, including classical Tamil, Telugu, Kannada, Malayalam, Odia. In addition to these classical languages Pali, Persian, and Prakrit; and their works of literature too must be preserved for their richness and for the pleasure and enrichment of posterity. As India becomes a fully developed country, the next generation will want to

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partake in and be enriched by India's extensive and beautiful classical literature. In addition to Sanskrit, other classical languages and literatures of India, including Tamil, Telugu, Kannada, Malayalam, Odia, Pali, Persian, and Prakrit, will also be widely available in schools as options for students, possibly as online modules, through experiential and innovative approaches, to ensure that these languages and literature stay alive and vibrant. Similar efforts will be made for all Indian languages having rich oral and written literatures, cultural traditions, and knowledge.

4.19. For the enrichment of the children, and for the preservation of these rich languages and their artistic treasures, all students in all schools, public or private, will have the option of learning at least two years of a classical language of India and its associated literature, through experiential and innovative approaches, including the integration of technology, in Grades 6-12, with the option to continue from the middle stage through the secondary stage and beyond.

4.20. In addition to high quality offerings in Indian languages and English, foreign languages, such as Korean, Japanese, Thai, French, German, Spanish, Portuguese, and Russian, will also be offered at the secondary level, for students to learn about the cultures of the world and to enrich their global knowledge and mobility according to their own interests and aspirations.

4.21. The teaching of all languages will be enhanced through innovative and experiential methods, including through gamification and apps, by weaving in the cultural aspects of the languages - such as films, theatre, storytelling, poetry, and music - and by drawing connections with various relevant subjects and with real-life experiences. Thus, the teaching of languages will also be based on experiential-learning pedagogy.

4.22. Indian Sign Language (ISL) will be standardized across the country, and National and State curriculum materials developed, for use by students with hearing impairment. Local sign languages will be respected and taught as well, where possible and relevant.

### **Curricular Integration of Essential Subjects, Skills, and Capacities**

4.23. While students must have a large amount of flexibility in choosing their individual curricula, certain subjects, skills, and capacities should be learned by all students to become good, successful, innovative, adaptable, and productive human beings in today's rapidly changing world. In addition to proficiency in languages, these skills include: scientific temper and evidence-based thinking; creativity and innovativeness; sense of aesthetics and art; oral and written communication; health and nutrition; physical education, fitness, wellness, and sports; collaboration and teamwork; problem solving and logical reasoning; vocational exposure and skills; digital literacy, coding, and computational thinking; ethical and moral reasoning; knowledge and practice of human and Constitutional values; gender sensitivity; Fundamental Duties; citizenship skills and values; knowledge of India; environmental awareness including water and resource conservation, sanitation and hygiene; and current affairs and knowledge of critical issues facing local communities, States, the country, and the world.

4.24. Concerted curricular and pedagogical initiatives, including the introduction of contemporary subjects such as Artificial Intelligence, Design Thinking, Holistic Health, Organic Living, Environmental Education, Global Citizenship Education (GCED), etc. at relevant stages will be undertaken to develop these various important skills in students at all levels.

4.25. It is recognized that mathematics and mathematical thinking will be very important for India's future and India's leadership role in the numerous upcoming fields and professions that will involve artificial intelligence, machine learning, and data science, etc. Thus, mathematics and computational thinking will be given increased emphasis throughout the school years, starting with the foundational stage, through a variety of innovative methods, including the regular use of puzzles and games that make mathematical thinking more enjoyable and engaging. Activities involving coding will be introduced in Middle Stage.



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4.26. Every student will take a fun course, during Grades 6-8, that gives a survey and hands-on experience of a sampling of important vocational crafts, such as carpentry, electric work, metal work, gardening, pottery making, etc., as decided by States and local communities and as mapped by local skilling needs. A practice-based curriculum for Grades 6-8 will be appropriately designed by NCERT while framing the NCFSE 2020-21. All students will participate in a 10-day bagless period sometime during Grades 6-8 where they intern with local vocational experts such as carpenters, gardeners, potters, artists, etc. Similar internship opportunities to learn vocational subjects may be made available to students throughout Grades 6-12, including holiday periods. Vocational courses through online mode will also be made available. Bagless days will be encouraged throughout the year for various types of enrichment activities involving arts, quizzes, sports, and vocational crafts. Children will be given periodic exposure to activities outside school through visits to places/monuments of historical, cultural and tourist importance, meeting local artists and craftsmen and visits higher educational institutions in their village/Tehsil/District/State.

4.27. “Knowledge of India” will include knowledge from ancient India and its contributions to modern India and its successes and challenges, and a clear sense of India’s future aspirations with regard to education, health, environment, etc. These elements will be incorporated in an accurate and scientific manner throughout the school curriculum wherever relevant; in particular, Indian Knowledge Systems, including tribal knowledge and indigenous and traditional ways of learning, will be covered and included in mathematics, astronomy, philosophy, yoga, architecture, medicine, agriculture, engineering, linguistics, literature, sports, games, as well as in governance, polity, conservation. Specific courses in tribal ethno-medicinal practices, forest management, traditional (organic) crop cultivation, natural farming, etc. will also be made available. An engaging course on Indian Knowledge Systems will also be available to students in secondary school as an elective. Competitions may be held in schools for learning various topics and subjects through fun and indigenous games. Video documentaries on inspirational luminaries of India, ancient and modern, in science and beyond, will be shown at appropriate points throughout the school curriculum. Students will be encouraged to visit different States as part of cultural exchange programmes.

4.28. Students will be taught at a young age the importance of “doing what's right”, and will be given a logical framework for making ethical decisions. In later years, this would then be expanded along themes of cheating, violence, plagiarism, littering, tolerance, equality, empathy, etc., with a view to enabling children to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. As consequences of such basic ethical reasoning, traditional Indian values and all basic human and Constitutional values (such as *seva*, *ahimsa*, *swachchhata*, *satya*, *nishkam karma*, *shanti*, sacrifice, tolerance, diversity, pluralism, righteous conduct, gender sensitivity, respect for elders, respect for all people and their inherent capabilities regardless of background, respect for environment, helpfulness, courtesy, patience, forgiveness, empathy, compassion, patriotism, democratic outlook, integrity, responsibility, justice, liberty, equality, and fraternity) will be developed in all students. Children will have the opportunity to read and learn from the original stories of the Panchatantra, Jataka, Hitopadesh, and other fun fables and inspiring tales from the Indian tradition and learn about their influences on global literature. Excerpts from the Indian Constitution will also be considered essential reading for all students. Basic training in health, including preventive health, mental health, good nutrition, personal and public hygiene, disaster response and first-aid will also be included in the curriculum, as well as scientific explanations of the detrimental and damaging effects of alcohol, tobacco, and other drugs.

4.29. All curriculum and pedagogy, from the foundational stage onwards, will be redesigned to be strongly rooted in the Indian and local context and ethos in terms of culture, traditions, heritage, customs, language, philosophy, geography, ancient and contemporary knowledge, societal and scientific needs, indigenous and traditional ways of learning etc. – in order to ensure that education is maximally relatable, relevant, interesting, and effective for our students. Stories, arts, games, sports, examples, problems, etc. will be chosen as much as possible to be rooted in the Indian and local geographic context. Ideas, abstractions, and creativity will indeed best flourish when learning is thus rooted.

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### **National Curriculum Framework for School Education (NCFSE)**

4.30. The formulation of a new and comprehensive National Curricular Framework for School Education, NCFSE 2020-21, will be undertaken by the NCERT - based on the principles of this National Education Policy 2020, frontline curriculum needs, and after discussions with all stakeholders including State Governments, Ministries, relevant Departments of the Central Government, and other expert bodies, and will be made available in all regional languages. The NCFSE document shall henceforth be revisited and updated once every 5-10 years, taking into account frontline curriculum.

### **National Textbooks with Local Content and Flavour**

4.31. The reduction in content and increased flexibility of school curriculum - and the renewed emphasis on constructive rather than rote learning - must be accompanied by parallel changes in school textbooks. All textbooks shall aim to contain the essential core material (together with discussion, analysis, examples, and applications) deemed important on a national level, but at the same time contain any desired nuances and supplementary material as per local contexts and needs. Where possible, schools and teachers will also have choices in the textbooks they employ - from among a set of textbooks that contain the requisite national and local material - so that they may teach in a manner that is best suited to their own pedagogical styles as well as to their students and communities' needs.

4.32. The aim will be to provide such quality textbooks at the lowest possible cost -namely, at the cost of production/printing - in order to mitigate the burden of textbook prices on the students and on the educational system. This may be accomplished by using high-quality textbook materials developed by NCERT in conjunction with the SCERTs; additional textbook materials could be funded by public-philanthropic partnerships and crowd sourcing that incentivize experts to write such high-quality textbooks at cost price. States will prepare their own curricula (which may be based on the NCFSE prepared by NCERT to the extent possible) and prepare textbooks (which may be based on the NCERT textbook materials to the extent possible), incorporating State flavour and material as needed. While doing so, it must be borne in mind that NCERT curriculum would be taken as the nationally acceptable criterion. The availability of such textbooks in all regional languages will be a top priority so that all students have access to high-quality learning. All efforts will be made to ensure timely availability of textbooks in schools. Access to downloadable and printable versions of all textbooks will be provided by all States/UTs and NCERT to help conserve the environment and reduce the logistical burden.

4.33. Concerted efforts, through suitable changes in curriculum and pedagogy, will be made by NCERT, SCERTs, schools, and educators to significantly reduce the weight of school bags and textbooks.

### **Transforming Assessment for Student Development**

4.34. The aim of assessment in the culture of our schooling system will shift from one that is summative and primarily tests rote memorization skills to one that is more regular and formative, is more competency-based, promotes learning and development for our students, and tests higher-order skills, such as analysis, critical thinking, and conceptual clarity. The primary purpose of assessment will indeed be for learning; it will help the teacher and student, and the entire schooling system, continuously revise teaching-learning processes to optimize learning and development for all students. This will be the underlying principle for assessment at all levels of education.

4.35. The progress card of all students for school-based assessment, which is communicated by schools to parents, will be completely redesigned by States/UTs under guidance from the proposed National Assessment Centre, NCERT, and SCERTs. The progress card will be a holistic, 360-degree, multidimensional report that reflects in great detail the progress as well as the uniqueness of each

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learner in the cognitive, affective, and psychomotor domains. It will include self-assessment and peer assessment, and progress of the child in project-based and inquiry-based learning, quizzes, role plays, group work, portfolios, etc., along with teacher assessment. The holistic progress card will form an important link between home and school and will be accompanied by parent-teacher meetings in order to actively involve parents in their children's holistic education and development. The progress card would also provide teachers and parents with valuable information on how to support each student in and out of the classroom. AI-based software could be developed and used by students to help track their growth through their school years based on learning data and interactive questionnaires for parents, students, and teachers, in order to provide students with valuable information on their strengths, areas of interest, and needed areas of focus, and to thereby help them make optimal career choices.

4.36. The current nature of secondary school exams, including Board exams and entrance exams - and the resulting coaching culture of today - are doing much harm, especially at the secondary school level, replacing valuable time for true learning with excessive exam coaching and preparation. These exams also force students to learn a very narrow band of material in a single stream, rather than allowing the flexibility and choice that will be so important in the education system of the future.

4.37. While the Board exams for Grades 10 and 12 will be continued, the existing system of Board and entrance examinations shall be reformed to eliminate the need for undertaking coaching classes. To reverse these harmful effects of the current assessment system, Board exams will be redesigned to encourage holistic development; students will be able to choose many of the subjects in which they take Board exams, depending on their individualized interests. Board exams will also be made 'easier', in the sense that they will test primarily core capacities/competencies rather than months of coaching and memorization; any student who has been going to and making a basic effort in a school class will be able to pass and do well in the corresponding subject Board Exam without much additional effort. To further eliminate the 'high stakes' aspect of Board Exams, all students will be allowed to take Board Exams on up to two occasions during any given school year, one main examination and one for improvement, if desired.

4.38. In addition to introducing greater flexibility, student choice, and best-of-two attempts, assessments that primarily test core capacities must be the immediate key reforms to all Board exams. Boards may over time also develop further viable models of Board Exams that reduce pressure and the coaching culture. Some possibilities include: a system of annual/semester/modular Board Exams could be developed - that each test far less material, and are taken immediately after the corresponding course is taken in school - so that the pressure from exams is better distributed, less intense, and less high-stakes across the Secondary Stage; all subjects and corresponding assessments, beginning with mathematics, could be offered at two levels, with students doing some of their subjects at the standard level and some at a higher level; and Board exams in certain subjects could be redesigned to have two parts - one part of an objective type with multiple-choice questions and the other of a descriptive type.

4.39. With regard to all of the above, guidelines will be prepared by NCERT, in consultation with major stakeholders, such as SCERTs, Boards of Assessment (BoAs), the proposed new National Assessment Centre etc., and teachers prepared, for a transformation in the assessment system by the 2022-23 academic session, to align with the NCFSE 2020-21.

4.40. To track progress throughout the school years, and not just at the end of Grades 10 and 12 - for the benefit of students, parents, teachers, principals, and the entire schooling system in planning improvements to schools and teaching-learning processes - all students will take school examinations in Grades 3, 5, and 8 which will be conducted by the appropriate authority. These examinations would test achievement of basic learning outcomes, through assessment of core concepts and knowledge from the national and local curricula, along with relevant higher-order skills and application of knowledge in real-life situations, rather than rote memorization. The Grade 3 examination, in particular, would test basic literacy, numeracy, and other foundational skills. The results of school examinations will be used only for developmental purposes of the school education

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system, including for public disclosure by schools of their overall (anonymized) student outcomes, and for continuous monitoring and improvement of the schooling system.

4.41. It is proposed to set up a National Assessment Centre, PARAKH (Performance Assessment, Review, and Analysis of Knowledge for Holistic Development), as a standard-setting body under MHRD that fulfils the basic objectives of setting norms, standards, and guidelines for student assessment and evaluation for all recognized school boards of India, guiding the State Achievement Survey (SAS) and undertaking the National Achievement Survey (NAS), monitoring achievement of learning outcomes in the country, and encouraging and helping school boards to shift their assessment patterns towards meeting the skill requirements of the 21<sup>st</sup> century in consonance with the stated objectives of this Policy. This Centre will also advise school boards regarding new assessment patterns and latest researches, promote collaborations between school boards. It will also become an instrument for the sharing of best practices among school boards, and for ensuring equivalence of academic standards among learners across all school boards.

4.42. The principles for university entrance exams will be similar. The National Testing Agency (NTA) will work to offer a high-quality common aptitude test, as well as specialized common subject exams in the sciences, humanities, languages, arts, and vocational subjects, at least twice every year. These exams shall test conceptual understanding and the ability to apply knowledge and shall aim to eliminate the need for taking coaching for these exams. Students will be able to choose the subjects for taking the test, and each university will be able to see each student's individual subject portfolio and admit students into their programmes based on individual interests and talents. The NTA will serve as a premier, expert, autonomous testing organization to conduct entrance examinations for undergraduate and graduate admissions and fellowships in higher education institutions. The high quality, range, and flexibility of the NTA testing services will enable most universities to use these common entrance exams - rather than having hundreds of universities each devising their own entrance exams - thereby drastically reducing the burden on students, universities and colleges, and the entire education system. It will be left up to individual universities and colleges to use NTA assessments for their admissions.

### **Support for Gifted Students/Students with Special Talents**

4.43. There are innate talents in every student, which must be discovered, nurtured, fostered, and developed. These talents may express themselves in the form of varying interests, dispositions, and capacities. Those students that show particularly strong interests and capacities in a given realm must be encouraged to pursue that realm beyond the general school curriculum. Teacher education will include methods for the recognition and fostering of such student talents and interests. The NCERT and NCTE will develop guidelines for the education of gifted children. B.Ed. programmes may also allow a specialization in the education of gifted children.

4.44. Teachers will aim to encourage students with singular interests and/or talents in the classroom by giving them supplementary enrichment material and guidance and encouragement. Topic-centered and Project-based Clubs and Circles will be encouraged and supported at the levels of schools, school complexes, districts, and beyond. Examples include Science Circles, Math Circles, Music & Dance Performance Circles, Chess Circles, Poetry Circles, Language Circles, Drama Circles, Debate Circles, Sports Circles, Eco-Clubs, Health & Well-being Clubs/ Yoga Clubs and so on. Along these lines, high-quality national residential summer programmes for secondary school students in various subjects will also be encouraged, with a rigorous merit-based but equitable admission process to attract the very best students and teachers from across the country including from socio-economically disadvantaged groups.

4.45. Olympiads and competitions in various subjects will be conducted across the country, with clear coordination and progression from school to local to state to national levels, to ensure that all students may participate at all levels for which they qualify. Efforts will be made to make these available in rural areas and in regional languages to ensure widespread participation. Public and private universities, including premier institutions like the IITs and NITs, would be encouraged to use merit-

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based results from National, and International Olympiads, and results from other relevant national programmes, as part of the criteria for admissions into their undergraduate programmes.

4.46. Once internet-connected smart phones or tablets are available in all homes and/or schools, online apps with quizzes, competitions, assessments, enrichment materials, and online communities for shared interests will be developed, and will work to enhance all the aforementioned initiatives, as group activities for students with appropriate supervision of parents and teachers. Schools will develop smart classrooms, in a phased manner, for using digital pedagogy and thereby enriching the teaching-learning process with online resources and collaborations.

### **5. Teachers**

5.1. Teachers truly shape the future of our children - and, therefore, the future of our nation. It is because of this noblest role that the teacher in India was the most respected member of society. Only the very best and most learned became teachers. Society gave teachers, or gurus, what they needed to pass on their knowledge, skills, and ethics optimally to students. The quality of teacher education, recruitment, deployment, service conditions, and empowerment of teachers is not where it should be, and consequently the quality and motivation of teachers does not reach the desired standards. The high respect for teachers and the high status of the teaching profession must be restored so as to inspire the best to enter the teaching profession. The motivation and empowerment of teachers is required to ensure the best possible future for our children and our nation.

### **Recruitment and Deployment**

5.2. To ensure that outstanding students enter the teaching profession - especially from rural areas - a large number of merit-based scholarships shall be instituted across the country for studying quality 4-year integrated B.Ed. programmes. In rural areas, special merit-based scholarships will be established that also include preferential employment in their local areas upon successful completion of their B.Ed. programmes. Such scholarships will provide local job opportunities to local students, especially female students, so that these students serve as local-area role models and as highly qualified teachers who speak the local language. Incentives will be provided for teachers to take up teaching jobs in rural areas, especially in areas that are currently facing acute shortage of quality teachers. A key incentive for teaching in rural schools will be the provision of local housing near or on the school premises or increased housing allowances.

5.3. The harmful practice of excessive teacher transfers will be halted, so that students have continuity in their role models and educational environments. Transfers will occur in very special circumstances, as suitably laid down in a structured manner by State/UT governments. Furthermore, transfers will be conducted through an online computerized system that ensures transparency.

5.4. Teacher Eligibility Tests (TETs) will be strengthened to inculcate better test material, both in terms of content and pedagogy. The TETs will also be extended to cover teachers across all stages (Foundational, Preparatory, Middle and Secondary) of school education. For subject teachers, suitable TET or NTA test scores in the corresponding subjects will also be taken into account for recruitment. To gauge passion and motivation for teaching, a classroom demonstration or interview will become an integral part of teacher hiring at schools and school complexes. These interviews would also be used to assess comfort and proficiency in teaching in the local language, so that every school/school complex has at least some teachers who can converse with students in the local language and other prevalent home languages of students. Teachers in private schools also must have qualified similarly through TET, a demonstration/interview, and knowledge of local language(s).

5.5. To ensure an adequate number of teachers across subjects - particularly in subjects such as art, physical education, vocational education, and languages - teachers could be recruited to a school or school complex and the sharing of teachers across schools could be considered in accordance with the grouping-of-schools adopted by State/UT governments.

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5.6. Schools/school complexes will be encouraged to hire local eminent persons or experts as ‘master instructors’ in various subjects, such as in traditional local arts, vocational crafts, entrepreneurship, agriculture, or any other subject where local expertise exists, to benefit students and help preserve and promote local knowledge and professions.

5.7. A technology-based comprehensive teacher-requirement planning forecasting exercise will be conducted by each State to assess expected subject-wise teacher vacancies over the next two decades. The above described initiatives in recruitment and deployment will be scaled as needed over time, to fill all vacancies with qualified teachers, including local teachers, with suitable incentives for career management and progression as described below. Teacher education programmes and offerings will also align with the vacancies thus projected.

### **Service Environment and Culture**

5.8. The primary goal of overhauling the service environment and culture of schools will be to maximize the ability of teachers to do their jobs effectively, and to ensure that they are part of vibrant, caring, and inclusive communities of teachers, students, parents, principals, and other support staff, all of whom share a common goal: to ensure that our children are learning.

5.9. The first requirement in this direction will be to ensure decent and pleasant service conditions at schools. Adequate and safe infrastructure, including working toilets, clean drinking water, clean and attractive spaces, electricity, computing devices, internet, libraries, and sports and recreational resources will be provided to all schools to ensure that teachers and students, including children of all genders and children with disabilities, receive a safe, inclusive, and effective learning environment and are comfortable and inspired to teach and learn in their schools. In-service training will have inputs on safety, health and environment at workplace in schools to ensure that all teachers are sensitized to these requirements.

5.10. State/UT Governments may adopt innovative formats, such as school complex, rationalization of schools, without in any way reducing accessibility, for effective school governance, resource sharing, and community building. The creation of school complexes could go a long way towards building vibrant teacher communities. The hiring of teachers to school complexes could automatically create relationships among schools across the school complex; it would also help ensure excellent subject-wise distribution of teachers, creating a more vibrant teacher knowledge base. Teachers at very small schools will not remain isolated any longer and may become part of and work with larger school complex communities, sharing best practices with each other and working collaboratively to ensure that all children are learning. School complexes could also share counsellors, trained social workers, technical and maintenance staff, etc. to further support teachers and help create an effective learning environment.

5.11. In collaboration with parents and other key local stakeholders, teachers will also be more involved in the governance of schools/school complexes, including as members of the School Management Committees/School Complex Management Committees.

5.12. To prevent the large amounts of time spent currently by teachers on non-teaching activities, teachers will not be engaged any longer in work that is not directly related to teaching; in particular, teachers will not be involved in strenuous administrative tasks and more than a rationalized minimum time for mid-day meal related work, so that they may fully concentrate on their teaching-learning duties.

5.13. To help ensure that schools have positive learning environments, the role expectations of principals and teachers will explicitly include developing a caring and inclusive culture at their schools, for effective learning and the benefit of all stakeholders.

5.14. Teachers will be given more autonomy in choosing aspects of pedagogy, so that they may teach in the manner they find most effective for the students in their classrooms. Teachers will also focus

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on socio-emotional learning - a critical aspect of any student's holistic development. Teachers will be recognized for novel approaches to teaching that improve learning outcomes in their classrooms.

### **Continuous Professional Development (CPD)**

5.15. Teachers will be given continuous opportunities for self-improvement and to learn the latest innovations and advances in their professions. These will be offered in multiple modes, including in the form of local, regional, state, national, and international workshops as well as online teacher development modules. Platforms (especially online platforms) will be developed so that teachers may share ideas and best practices. Each teacher will be expected to participate in at least 50 hours of CPD opportunities every year for their own professional development, driven by their own interests. CPD opportunities will, in particular, systematically cover the latest pedagogies regarding foundational literacy and numeracy, formative and adaptive assessment of learning outcomes, competency-based learning, and related pedagogies, such as experiential learning, arts-integrated, sports-integrated, and storytelling-based approaches, etc.

5.16. School Principals and school complex leaders will have similar modular leadership/management workshops and online development opportunities and platforms to continuously improve their own leadership and management skills, and so that they too may share best practices with each other. Such leaders will also be expected to participate in 50 hours or more of CPD modules per year, covering leadership and management, as well as content and pedagogy with a focus on preparing and implementing pedagogical plans based on competency-based education.

### **Career Management and Progression (CMP)**

5.17. Teachers doing outstanding work must be recognized and promoted, and given salary raises, to incentivize all teachers to do their best work. Therefore, a robust merit-based structure of tenure, promotion, and salary structure will be developed, with multiple levels within each teacher stage, that incentivizes and recognizes outstanding teachers. A system of multiple parameters for proper assessment of performance will be developed for the same by State/UT Governments that is based on peer reviews, attendance, commitment, hours of CPD, and other forms of service to the school and the community or based on NPST given in Para 5.20. In this Policy, in the context of careers, 'tenure' refers to confirmation for permanent employment, after due assessment of performance and contribution, while 'tenure track' refers to the period of probation preceding tenure.

5.18. Further, it will be ensured that career growth (in terms of tenure, promotions, salary increases, etc.) is available to teachers within a single school stage (i.e., Foundational, Preparatory, Middle, or Secondary), and that there is no career progression-related incentive to move from being teachers in early stages to later stages or vice versa (though such career moves across stages will be allowed, provided the teacher has the desire and qualifications for such a move). This is to support the fact that all stages of school education will require the highest-quality teachers, and no stage will be considered more important than any other.

5.19. Vertical mobility of teachers based on merit will also be paramount; outstanding teachers with demonstrated leadership and management skills would be trained over time to take on academic leadership positions in schools, school complexes, BRCs, CRCs, BITEs, DIETs as well as relevant government departments.

### **Professional Standards for Teachers**

5.20. A common guiding set of National Professional Standards for Teachers (NPST) will be developed by 2022, by the National Council for Teacher Education in its restructured new form as a Professional Standard Setting Body (PSSB) under the General Education Council (GEC), in consultation with NCERT, SCERTs, teachers from across levels and regions, expert organizations in teacher preparation and development, expert bodies in vocational education, and higher education institutions. The standards would cover expectations of the role of the teacher at different levels of expertise/stage, and the competencies required for that stage. It will also comprise standards for

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performance appraisal, for each stage, that would be carried out on a periodic basis. The NPST will also inform the design of pre-service teacher education programmes. This could be then adopted by States and determine all aspects of teacher career management, including tenure, professional development efforts, salary increases, promotions, and other recognitions. Promotions and salary increases will not occur based on the length of tenure or seniority, but only on the basis of such appraisal. The professional standards will be reviewed and revised in 2030, and thereafter every ten years, on the basis of rigorous empirical analysis of the efficacy of the system.

### **Special educators**

5.21. There is an urgent need for additional special educators for certain areas of school education. Some examples of such specialist requirements include subject teaching for children with disabilities/*Divyang* children at the Middle and Secondary school level, including teaching for specific learning disabilities. Such teachers would require not only subject-teaching knowledge and understanding of subject-related aims of education, but also the relevant skills for understanding of special requirements of children. Therefore, such areas could be developed as secondary specializations for subject teachers or generalist teachers, during or after pre-service teacher preparation. They will be offered as certificate courses, in the pre-service as well as in-service mode, either full time or as part-time/blended courses - again, necessarily, at multidisciplinary colleges or universities. Greater synergy will be enabled between the course curriculum of NCTE and RCI to ensure adequate availability of qualified special educators who can handle subject teaching as well.

### **Approach to Teacher Education**

5.22. Recognizing that the teachers will require training in high-quality content as well as pedagogy, teacher education will gradually be moved by 2030 into multidisciplinary colleges and universities. As colleges and universities all move towards becoming multidisciplinary, they will also aim to house outstanding education departments that offer B.Ed., M.Ed., and Ph.D. degrees in education.

5.23. By 2030, the minimum degree qualification for teaching will be a 4-year integrated B.Ed. degree that teaches a range of knowledge content and pedagogy and includes strong practicum training in the form of student-teaching at local schools. The 2-year B.Ed. programmes will also be offered, by the same multidisciplinary institutions offering the 4-year integrated B.Ed., and will be intended only for those who have already obtained Bachelor's Degrees in other specialized subjects. These B.Ed. programmes may also be suitably adapted as 1-year B.Ed. programmes, and will be offered only to those who have completed the equivalent of 4-year multidisciplinary Bachelor's Degrees or who have obtained a Master's degree in a specialty and wish to become a subject teacher in that specialty. All such B.Ed. degrees would be offered only by accredited multidisciplinary higher education institutions offering 4-year integrated B.Ed. programmes. Multidisciplinary higher education institutions offering the 4-year in-class integrated B.Ed. programme and having accreditation for ODL may also offer high-quality B.Ed. programmes in blended or ODL mode to students in remote or difficult-to-access locations and also to in-service teachers who are aiming to enhance their qualification, with suitable robust arrangements for mentoring and for the practicum-training and student-teaching components of the programme.

5.24. All B.Ed. programmes will include training in time-tested as well as the most recent techniques in pedagogy, including pedagogy with respect to foundational literacy and numeracy, multi-level teaching and evaluation, teaching children with disabilities, teaching children with special interests or talents, use of educational technology, and learner-centered and collaborative learning. All B.Ed. programmes will include strong practicum training in the form of in-classroom teaching at local schools. All B.Ed. programmes will also emphasize the practice of the Fundamental Duties (Article 51A) of the Indian Constitution along with other Constitutional provisions while teaching any subject or performing any activity. It will also appropriately integrate environmental awareness and sensitivity towards its conservation and sustainable development, so that environment education becomes an integral part of school curricula.



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5.25. Special shorter local teacher education programmes will also be available at BITEs, DIETs, or at school complexes themselves for eminent local persons who can be hired to teach at schools or school complexes as ‘master instructors’, for the purpose of promoting local professions, knowledge, and skills, e.g., local art, music, agriculture, business, sports, carpentry, and other vocational crafts.

5.26. Shorter post-B.Ed. certification courses will also be made widely available, at multidisciplinary colleges and universities, to teachers who may wish to move into more specialized areas of teaching, such as the teaching of students with disabilities, or into leadership and management positions in the schooling system, or to move from one stage to another between foundational, preparatory, middle, and secondary stages.

5.27. It is recognized that there may be several pedagogical approaches internationally for teaching particular subjects; NCERT will study, research, document, and compile the varied international pedagogical approaches for teaching different subjects and make recommendations on what can be learnt and assimilated from these approaches into the pedagogies being practiced in India.

5.28. By 2021, a new and comprehensive National Curriculum Framework for Teacher Education, NCFTE 2021, will be formulated by the NCTE in consultation with NCERT, based on the principles of this National Education Policy 2020. The framework will be developed after discussions with all stakeholders including State Governments, relevant Ministries/Departments of Central Government and various expert bodies, and will be made available in all regional languages. The NCFTE 2021 will also factor in the requirements of teacher education curricula for vocational education. The NCFTE will thereafter be revised once every 5-10 years by reflecting the changes in revised NCFs as well as emerging needs in teacher education.

5.29. Finally, in order to fully restore the integrity of the teacher education system, stringent action will be taken against substandard stand-alone Teacher Education Institutions (TEIs) running in the country, including shutting them down, if required.

## **6. Equitable and Inclusive Education: Learning for All**

6.1. Education is the single greatest tool for achieving social justice and equality. Inclusive and equitable education - while indeed an essential goal in its own right - is also critical to achieving an inclusive and equitable society in which every citizen has the opportunity to dream, thrive, and contribute to the nation. The education system must aim to benefit India’s children so that no child loses any opportunity to learn and excel because of circumstances of birth or background. This Policy reaffirms that bridging the social category gaps in access, participation, and learning outcomes in school education will continue to be one of the major goals of all education sector development programmes. This Chapter may be read in conjunction with Chapter 14 which discusses analogous issues of Equity and Inclusion in Higher Education.

6.2. While the Indian education system and successive government policies have made steady progress towards bridging gender and social category gaps in all levels of school education, large disparities still remain - especially at the secondary level - particularly for socio-economically disadvantaged groups that have been historically underrepresented in education. Socio-Economically Disadvantaged Groups (SEDGs) can be broadly categorized based on gender identities (particularly female and transgender individuals), socio-cultural identities (such as Scheduled Castes, Scheduled Tribes, OBCs, and minorities), geographical identities (such as students from villages, small towns, and aspirational districts), disabilities (including learning disabilities), and socio-economic conditions (such as migrant communities, low income households, children in vulnerable situations, victims of or children of victims of trafficking, orphans including child beggars in urban areas, and the urban poor). While overall enrolments in schools decline steadily from Grade 1 to Grade 12, this decline in enrolments is significantly more pronounced for many of these SEDGs, with even greater declines for female students within each of these SEDGs and often even steeper in higher education. A brief status overview of the SEDGs that come within socio-cultural identities is given in following sub-sections.

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6.2.1. According to U-DISE 2016-17 data, about 19.6% of students belong to Scheduled Castes at the primary level, but this fraction falls to 17.3% at the higher secondary level. These enrolment drop-offs are more severe for Scheduled Tribes students (10.6% to 6.8%), and differently-abled children (1.1% to 0.25%), with even greater declines for female students within each of these categories. The decline in enrolment in higher education is even steeper.

6.2.2. A multiplicity of factors, including lack of access to quality schools, poverty, social mores & customs, and language have had a detrimental effect on rates of enrolment and retention among the Scheduled Castes. Bridging these gaps in access, participation, and learning outcomes of children belonging to Scheduled Castes will continue to be one of the major goals. Also, the Other Backward Classes (OBCs) which have been identified on the basis of historically being socially and educationally backward also need special focus.

6.2.3. Tribal communities and children from Scheduled Tribes also face disadvantages at multiple levels due to various historical and geographical factors. Children from tribal communities often find their school education irrelevant and foreign to their lives, both culturally and academically. While several programmatic interventions to uplift children from tribal communities are currently in place, and will continue to be pursued, special mechanisms need to be made to ensure that children belonging to tribal communities receive the benefits of these interventions.

6.2.4. Minorities are also relatively underrepresented in school and higher education. The Policy acknowledges the importance of interventions to promote education of children belonging to all minority communities, and particularly those communities that are educationally underrepresented.

6.2.5. The Policy also recognizes the importance of creating enabling mechanisms for providing Children With Special Needs (CWSN) or *Divyang*, the same opportunities of obtaining quality education as any other child.

6.2.6. Separate strategies will be formulated for focused attention on reducing the social category gaps in school education as outlined in the following sub-sections.

6.3. The critical problems and recommendations regarding ECCE, foundational literacy and numeracy, access, enrolment and attendance discussed in Chapters 1–3, are particularly relevant and important for underrepresented and disadvantaged groups. Therefore, the measures from Chapters 1–3 will be targeted in a concerted way for SEDGs.

6.4. In addition, there have been various successful policies and schemes such as targeted scholarships, conditional cash transfers to incentivize parents to send their children to school, providing bicycles for transport, etc., that have significantly increased participation of SEDGs in the schooling system in certain areas. These successful policies and schemes must be significantly strengthened across the country.

6.5. It will also be essential to take into account research that ascertains which measures are particularly effective for certain SEDGs. For example, providing bicycles and organizing cycling and walking groups to provide access to school have been shown to be particularly powerful methods in increasing participation of female students - even at lesser distances - because of the safety benefits and comfort to parents that they provide. One-on-one teachers and tutors, peer tutoring, open schooling, appropriate infrastructure, and suitable technological interventions to ensure access can be particularly effective for certain children with disabilities. Schools providing quality ECCE reap the greatest dividends for children who come from families that are economically disadvantaged. Meanwhile, counsellors and/or well-trained social workers that work with and connect with students, parents, schools, and teachers in order to improve attendance and learning outcomes have been found to be especially effective for children in urban poor areas.

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6.6. Data shows that certain geographical areas contain significantly larger proportions of SEDGs. Also, there are geographical locations that have been identified as Aspirational Districts which require special interventions for promoting their educational development. Hence, it is recommended that regions of the country with large populations from educationally-disadvantaged SEDGs should be declared Special Education Zones (SEZs), where all the schemes and policies are implemented to the maximum through additional concerted efforts, in order to truly change their educational landscape.

6.7. It must be noted that women cut across all underrepresented groups, making up about half of all SEDGs. Unfortunately, the exclusion and inequity that SEDGs face is only amplified for the women in these SEDGs. The policy additionally recognizes the special and critical role that women play in society and in shaping social mores; therefore, providing a quality education to girls is the best way to increase the education levels for these SEDGs, not just in the present but also in future generations. The policy thus recommends that the policies and schemes designed to include students from SEDGs should be especially targeted towards girls in these SEDGs.

6.8. In addition, the Government of India will constitute a ‘Gender-Inclusion Fund’ to build the nation’s capacity to provide equitable quality education for all girls as well as transgender students. The fund will be available to States to implement priorities determined by the Central government critical for assisting female and transgender children in gaining access to education (such as the provisions of sanitation and toilets, bicycles, conditional cash transfers, etc.); funds will also enable States to support and scale effective community-based interventions that address local context-specific barriers to female and transgender children’s access to and participation in education. Similar ‘Inclusion Fund’ schemes shall also be developed to address analogous access issues for other SEDGs. In essence, this Policy aims to eliminate any remaining disparity in access to education (including vocational education) for children from any gender or other socio-economically disadvantaged group.

6.9. Free boarding facilities will be built - matching the standard of Jawahar Navodaya Vidyalayas - in school locations where students may have to come from far, and particularly for students who from socio-economically disadvantaged backgrounds, with suitable arrangements for the safety of all children, especially girls. Kasturba Gandhi Balika Vidyalayas will be strengthened and expanded to increase the participation in quality schools (up to Grade 12) of girls from socio-economically disadvantaged backgrounds. Additional Jawahar Navodaya Vidyalayas and Kendriya Vidyalayas will be built around the country, especially in aspirational districts, Special Education Zones, and other disadvantaged areas, to increase high-quality educational opportunities. Pre-school sections covering at least one year of early childhood care and education will be added to Kendriya Vidyalayas and other primary schools around the nation, particularly in disadvantaged areas.

6.10. Ensuring the inclusion and equal participation of children with disabilities in ECCE and the schooling system will also be accorded the highest priority. Children with disabilities will be enabled to fully participate in the regular schooling process from the Foundational Stage to higher education. The Rights of Persons with Disabilities (RPWD) Act 2016 defines inclusive education as a ‘system of education wherein students with and without disabilities learn together and the system of teaching and learning is suitably adapted to meet the learning needs of different types of students with disabilities’. This Policy is in complete consonance with the provisions of the RPWD Act 2016 and endorses all its recommendations with regard to school education. While preparing the National Curriculum Framework, NCERT will ensure that consultations are held with expert bodies such as National Institutes of DEPWD.

6.11. To this end, schools/school complexes will be provided resources for the integration of children with disabilities, recruitment of special educators with cross-disability training, and for the establishment of resource centres, wherever needed, especially for children with severe or multiple disabilities. Barrier free access for all children with disabilities will be enabled as per the RPWD Act. Different categories of children with disabilities have differing needs. Schools and school complexes will work and be supported for providing all children with disabilities accommodations and support

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mechanisms tailored to suit their needs and to ensure their full participation and inclusion in the classroom. In particular, assistive devices and appropriate technology-based tools, as well as adequate and language-appropriate teaching-learning materials (e.g., textbooks in accessible formats such as large print and Braille) will be made available to help children with disabilities integrate more easily into classrooms and engage with teachers and their peers. This will apply to all school activities including arts, sports, and vocational education. NIOS will develop high-quality modules to teach Indian Sign Language, and to teach other basic subjects using Indian Sign Language. Adequate attention will be paid to the safety and security of children with disabilities.

6.12. As per the RPWD Act 2016, children with benchmark disabilities shall have the choice of regular or special schooling. Resource centres in conjunction with special educators will support the rehabilitation and educational needs of learners with severe or multiple disabilities and will assist parents/guardians in achieving high-quality home schooling and skilling for such students as needed. Home-based education will continue to be a choice available for children with severe and profound disabilities who are unable to go to schools. The children under home-based education must be treated as equal to any other child in the general system. There shall be an audit of home-based education for its efficiency and effectiveness using the principle of equity and equality of opportunity. Guidelines and standards for home-based schooling shall be developed based on this audit in line with the RPWD Act 2016. While it is clear that the education of all children with disabilities is the responsibility of the State, technology-based solutions will be used for the orientation of parents/caregivers along with wide-scale dissemination of learning materials to enable parents/caregivers to actively support their children's learning needs will be accorded priority.

6.13. Most classrooms have children with specific learning disabilities who need continuous support. Research is clear that the earlier such support begins, the better the chances of progress. Teachers must be helped to identify such learning disabilities early and plan specifically for their mitigation. Specific actions will include the use of appropriate technology allowing and enabling children to work at their own pace, with flexible curricula to leverage each child's strengths, and creating an ecosystem for appropriate assessment and certification. Assessment and certification agencies, including the proposed new National Assessment Centre, PARAKH, will formulate guidelines and recommend appropriate tools for conducting such assessment, from the foundational stage to higher education (including for entrance exams), in order to ensure equitable access and opportunities for all students with learning disabilities.

6.14. The awareness and knowledge of how to teach children with specific disabilities (including learning disabilities) will be an integral part of all teacher education programmes, along with gender sensitization and sensitization towards all underrepresented groups in order to reverse their underrepresentation.

6.15. Alternative forms of schools, will be encouraged to preserve their traditions or alternative pedagogical styles. At the same time, they will be supported to integrate the subject and learning areas prescribed by the NCFSE into their curricula in order to reduce and eventually eliminate the underrepresentation of children from these schools in higher education. In particular, financial assistance will be provided to introduce science, mathematics, social studies, Hindi, English, State languages, or other relevant subjects in the curriculum, as may be desired by these schools. This would enable children studying in these schools to attain the learning outcomes defined for Grades 1–12. Furthermore, students in such schools would be encouraged to appear for State or other Board examinations and assessments by the NTA, and thereby enroll in higher education institutions. Capacities of teachers in the teaching of science, mathematics, language, and social studies will be developed including orientation to new pedagogical practices. Libraries and laboratories will be strengthened and adequate reading materials like books, journals, etc., and other teaching-learning materials will be made available.

6.16. Within SEDGs, and with respect to all the above policy points, special attention will be given to reduce the disparities in the educational development of Scheduled Castes and Scheduled Tribes. As a part of the efforts to enhance participation in school education, special hostels in dedicated regions, bridge courses, and financial assistance through fee waivers and scholarships will be offered to

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talented and meritorious students from all SEDGs on a larger scale, especially at the secondary stage of education, to facilitate their entry into higher education.

6.17. Under the aegis of the Ministry of Defence, State Governments may encourage opening NCC wings in their secondary and higher secondary schools, including those located in tribal dominated areas. This will enable harnessing of the natural talent and unique potential of students, which in turn would help them to aspire to a successful career in the defence forces.

6.18. All scholarships and other opportunities and schemes available to students from SEDGs will be coordinated and announced by a single agency and website to ensure that all students are aware of, and may apply in a simplified manner on such a 'single window system', as per eligibility.

6.19. All the above policies and measures are absolutely critical to attaining full inclusion and equity for all SEDGs - but they are not sufficient. What is also required is a change in school culture. All participants in the school education system, including teachers, principals, administrators, counsellors, and students, will be sensitized to the requirements of all students, the notions of inclusion and equity, and the respect, dignity, and privacy of all persons. Such an educational culture will provide the best pathway to help students become empowered individuals who, in turn, will enable society to transform into one that is responsible towards its most vulnerable citizens. Inclusion and equity will become a key aspect of teacher education (and training for all leadership, administrative, and other positions in schools); efforts will be made to recruit more high-quality teachers and leaders from SEDGs in order to bring in excellent role models for all students.

6.20. Students will be sensitized through this new school culture, brought in by teachers, trained social workers and counsellors as well as through corresponding changes to bring in an inclusive school curriculum. The school curriculum will include, early on, material on human values such as respect for all persons, empathy, tolerance, human rights, gender equality, non-violence, global citizenship, inclusion, and equity. It would also include more detailed knowledge of various cultures, religions, languages, gender identities, etc. to sensitize and develop respect for diversity. Any biases and stereotypes in school curriculum will be removed, and more material will be included that is relevant and relatable to all communities.

## **7. Efficient Resourcing and Effective Governance through School Complexes/Clusters**

7.1. While the establishment of primary schools in every habitation across the country-driven by the Sarva Shiksha Abhiyan (SSA), now subsumed under the Samagra Shiksha Scheme and other important efforts across the States - has helped to ensure near-universal access to primary schools, it has also led to the development of numerous very small schools. According to U-DISE 2016–17 data, nearly 28% of India's public primary schools and 14.8% of India's upper primary schools have less than 30 students. The average number of students per grade in the elementary schooling system (primary and upper primary, i.e., Grades 1–8) is about 14, with a notable proportion having below 6; during the year 2016–17, there were 1,08,017 single-teacher schools, the majority of them (85743 ) being primary schools serving Grades 1–5.

7.2. These small school sizes have rendered it economically suboptimal and operationally complex to run good schools, in terms of deployment of teachers as well as the provision of critical physical resources. Teachers often teach multiple grades at a time, and teach multiple subjects, including subjects in which they may have no prior background; key areas such as music, arts, and sports are too often simply not taught; and physical resources, such as lab and sports equipment and library books, are simply not available across schools.

7.3. The isolation of small schools also has a negative effect on education and the teaching-learning process. Teachers function best in communities and teams, and so do students. Small schools also present a systemic challenge for governance and management. The geographical dispersion, challenging access conditions, and the very large numbers of schools make it difficult to reach all schools equally. Administrative structures have not been aligned with the increases in the number of school or with the unified structure of the Samagra Shiksha Scheme.

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7.4. Although consolidation of schools is an option that is often discussed, it must be carried out very judiciously, and only when it is ensured that there is no impact on access. Such measures are nevertheless likely to result only in limited consolidation, and would not solve the overall structural problem and challenges presented by the large numbers of small schools.

7.5. These challenges will, by 2025, be addressed by State/UT governments by adopting innovative mechanisms to group or rationalize schools. The objective behind this intervention would be to ensure that every school has: (a) adequate number of counsellors/trained social workers and teachers (shared or otherwise) for teaching all subjects including art, music science, sports, languages, vocational subjects, etc; (b) adequate resources (shared or otherwise), such as a library, science labs, computer labs, skill labs, playgrounds, sports equipment and facilities, etc.; (c) a sense of community is built to overcome the isolation of teachers, students, and schools, through joint professional development programmes, sharing of teaching-learning content, joint content development, holding joint activities such as art and science exhibitions, sports meets, quizzes and debates, and fairs; (d) cooperation and support across schools for the education of children with disabilities; and (e) improved governance of the schooling system by devolving all finer decisions, to Principals, teachers, and other stakeholders within each group of schools and treating such a group of schools, which range from the foundational stage through the secondary stage, as an integrated semi-autonomous unit.

7.6. One possible mechanism for accomplishing the above would be the establishment of a grouping structure called the school complex, consisting of one secondary school together with all other schools offering lower grades in its neighbourhood including Anganwadis, in a radius of five to ten kilometers. This suggestion was first made by the Education Commission (1964–66) but was left unimplemented. This Policy strongly endorses the idea of the school complex/cluster, wherever possible. The aim of the school complex/cluster will be greater resource efficiency and more effective functioning, coordination, leadership, governance, and management of schools in the cluster.

7.7. The establishment of school complexes/clusters and the sharing of resources across complexes will have a number of other benefits as a consequence, such as improved support for children with disabilities, more topic-centred clubs and academic/sports/arts/crafts events across school complexes, better incorporation of art, music, language, vocational subjects, physical education, and other subjects in the classroom through the sharing of teachers in these subjects including use of ICT tools to conduct virtual classes, better student support, enrolment, attendance, and performance through the sharing of social workers and counsellors, and School Complex Management Committees (rather than simply School Management Committees) for more robust and improved governance, monitoring, oversight, innovations, and initiatives by local stakeholders. Building such larger communities of schools, school leaders, teachers, students, supporting staff, parents, and local citizens would energize and empower the schooling system, and in a resource-efficient manner.

7.8. The governance of schools will also improve and become far more efficient with school complexes/clusters. First, the DSE will devolve authority to the school complex/cluster, which will act as a semi-autonomous unit. The District Education Officer (DEO) and the Block Education Officers (BEO) will interact primarily with each school complex/cluster as a single unit and facilitate its work. The complex itself will perform certain tasks delegated by the DSE and will deal with the individual schools within it. The school complex/cluster will be given significant autonomy by the DSE to innovate towards providing integrated education and to experiment with pedagogies, curriculum, etc., while adhering to the National Curricular Framework (NCF) and State Curricular Framework (SCF). Under this organization, schools will gain in strength, will be able to exercise greater freedom, and will contribute towards making the complex more innovative and responsive. Meanwhile, the DSE will be able to focus on the aggregate level goals that need to be achieved, improving overall system effectiveness.

7.9. The culture of working to a plan, both short-term and long-term ones, will be developed through such complexes/clusters. Schools will develop their plans (SDPs) with the involvement of their SMCs. These plans will then become the basis for the creation of School Complex/Cluster Development Plans (SCDPs). The SCDP will also involve the plans of all other institutions

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associated with the school complex, such as vocational education institutions, and will be created by the principals and teachers of the school complex with the involvement of the SCMC and will be made available publicly. The plans will include human resources, learning resources, physical resources and infrastructure, improvement initiatives, financial resources, school culture initiatives, teacher development plans, and educational outcomes. It will detail the efforts to leverage the teachers and students across the school complex to develop vibrant learning communities. The SDP and SCDP will be the primary mechanism to align all stakeholders of the school, including the DSE. The SMC and SCMC will use the SDP and SCDP for oversight of the functioning and direction of the school and will assist in the execution of these plans. The DSE, through its relevant official, e.g., the BEO, will endorse and confirm the SCDP of each school complex. It will then provide the resources (financial, human, physical, etc.) necessary to achieve the SCDPs, both short-term (1-year) and long-term (3-5 years). It will also provide all other relevant support to the school complexes to achieve the educational outcomes. The DSE and the SCERT may share specific norms (e.g., financial, staffing, process) and frameworks for development of the SDP and SCDP with all schools, which may be revised periodically.

7.10. To further enhance cooperation and positive synergy among schools, including between public and private schools, the twinning/pairing of one public school with one private school will be adopted across the country, so that such paired schools may meet/interact with each other, learn from each other, and also share resources, if possible. Best practices of private schools will be documented, shared, and institutionalized in public schools, and vice versa, where possible.

7.11. Every State will be encouraged to strengthen existing or establish “Bal Bhavans” where children of all ages can visit once a week (e.g., on weekends) or more often, as a special daytime boarding school, to partake in art-related, career-related, and play-related activities. Such Bal Bhavans may be incorporated as a part of school complexes/clusters if possible.

7.12. The school should be a point of celebration and honour for the whole community. The dignity of the school as an institution should be restored and important dates, such as the foundation day of the school, will be celebrated along with the community and the list of important alumni may be displayed and honoured. Furthermore, the un-utilized capacity of school infrastructure could be used to promote social, intellectual, and volunteer activities for the community and to promote social cohesion during non-teaching / schooling hours and may be used as a “Samajik Chetna Kendra”.

## **8. Standard-setting and Accreditation for School Education**

8.1. The goal of the school education regulatory system must be to continually improve educational outcomes; it must not overly restrict schools, prevent innovation, or demoralize teachers, principals, and students. All in all, regulation must aim to empower schools and teachers with trust, enabling them to strive for excellence and perform at their very best, while ensuring the integrity of the system through the enforcement of complete transparency and full public disclosure of all finances, procedures, and educational outcomes.

8.2. At present, all main functions of governance and regulation of the school education system - namely, the provision of public education, the regulation of education institutions, and policymaking - are handled by a single body, i.e., the Department of School Education or its arms. This leads to conflict of interests and excessive centralized concentration of power; it also leads to ineffective management of the school system, as efforts towards quality educational provision are often diluted by the focus on the other roles, particularly regulation, that the Departments of School Education also perform.

8.3. The current regulatory regime also has not been able to curb the commercialization and economic exploitation of parents by many for-profit private schools, yet at the same time it has all too often inadvertently discouraged public-spirited private/philanthropic schools. There has been far too much asymmetry between the regulatory approaches to public and private schools, even though the goals of both types of schools should be the same: to provide quality education.

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8.4. The public education system is the foundation of a vibrant democratic society, and the way it is run must be transformed and invigorated in order to achieve the highest levels of educational outcomes for the nation. At the same time, the private/philanthropic school sector must also be encouraged and enabled to play a significant and beneficial role.

8.5. The key principles and recommendations of this Policy regarding the State school education system, the independent responsibilities within that system, and the approach to its regulation are as follows:

- (a) The Department of School Education, which is the apex state-level body in school education, will be responsible for overall monitoring and policymaking for continual improvement of the public education system; it will not be involved with the provision and operation of schools or with the regulation of schools, in order to ensure due focus on the improvement of public schools and to eliminate conflict of interests.
- (b) The educational operations and service provision for the public schooling system of the whole State will be handled by the Directorate of School Education (including the offices of the DEO and BEO, etc.); it will work independently to implement policies regarding educational operations and provision.
- (c) An effective quality self-regulation or accreditation system will be instituted for all stages of education including pre-school education - private, public, and philanthropic - to ensure compliance with essential quality standards. To ensure that all schools follow certain minimal professional and quality standards, States/UTs will set up an independent, State-wide, body called the State School Standards Authority (SSSA). The SSSA will establish a minimal set of standards based on basic parameters (namely, safety, security, basic infrastructure, number of teachers across subjects and grades, financial probity, and sound processes of governance), which shall be followed by all schools. The framework for these parameters will be created by the SCERT in consultation with various stakeholders, especially teachers and schools.

Transparent public self-disclosure of all the basic regulatory information, as laid down by the SSSA, will be used extensively for public oversight and accountability. The dimensions on which information has to be self-disclosed, and the format of disclosure will be decided by the SSSA in accordance with global best practices for standard-setting for schools. This information will have to be made available and kept updated and accurate by all schools, on the aforementioned public website maintained by the SSSA and on the schools' websites. Any complaints or grievances from stakeholders or others arising out of the information placed in the public domain shall be adjudicated by the SSSA. Feedback from randomly selected students will be solicited online to ensure valuable input at regular intervals. Technology will be employed suitably to ensure efficiency and transparency in all work of the SSSA. This will bring down significantly the heavy load of regulatory mandates currently borne by schools.

- (d) Academic matters, including academic standards and curricula in the State will be led by the SCERT (with close consultation and collaboration with the NCERT), which will be reinvigorated as an institution. The SCERT will develop a School Quality Assessment and Accreditation Framework (SQAAF) through wide consultations with all stakeholders. The SCERT will also lead a "change management process" for the reinvigoration of CRCs, BRCs, and DIETs which must change the capacity and work culture of these institutions in 3 years, developing them into vibrant institutions of excellence. Meanwhile, certification of competencies of students at the school-leaving stage will be handled by the Boards of Assessment/Examination in each State.

8.6. The culture, structures, and systems that empower and provide adequate resources to schools, institutions, teachers, officials, communities, and other stakeholders, will also build concomitant accountability. Each stakeholder and participant of the education system will be accountable to perform their role with the highest level of integrity, full commitment, and exemplary work ethic.



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Each role of the system will have explicitly articulated role expectations and rigorous assessment of their performance vis-à-vis these expectations. The assessment system will be objective and developmentally oriented, while ensuring accountability. It will have multiple sources of feedback and assessment, to ensure a full view of the performance (and will not just be linked simplistically, e.g., to ‘marks’ of students). The assessment will recognize that outcomes such as educational attainment of students have multiple intervening variables and extraneous influences. It will also recognize that education requires teamwork, particularly at the level of the school. Promotion, recognition, and accountability of all individuals will be based on such performance assessment. All functionaries will be responsible to ensure that this development, performance, and accountability system is run with high integrity, and systematically, within their span of control.

8.7. Public and private schools (except the schools that are managed/aided/controlled by the Central government) will be assessed and accredited on the same criteria, benchmarks, and processes, emphasizing online and offline public disclosure and transparency, so as to ensure that public-spirited private schools are encouraged and not stifled in any way. Private philanthropic efforts for quality education will be encouraged - thereby affirming the public-good nature of education - while protecting parents and communities from arbitrary increases in tuition fees. Public disclosure on the school website and on the SSSA website - for both public and private schools - would include (at the very least) information on the numbers of classrooms, students, and teachers, subjects taught, any fees, and overall student outcomes on standardized evaluations such as the NAS and SAS. For schools controlled/managed/aided by the Central government, the CBSE in consultation with the MHRD shall prepare a framework. All the education institutions will be held to similar standards of audit and disclosure as a 'not-for-profit' entity. Surpluses, if any, will be reinvested in the educational sector.

8.8. The standard-setting/regulatory framework and the facilitating systems for school regulation, accreditation, and governance shall be reviewed to enable improvements on the basis of the learnings and experiences gained in the last decade. This review will aim to ensure that all students, particularly students from underprivileged and disadvantaged sections, shall have universal, free and compulsory access to high-quality and equitable schooling from early childhood care and education (age 3 onwards) through higher secondary education (i.e., until Grade 12). The overemphasis on inputs, and the mechanistic nature of their specifications – physical and infrastructural – will be changed and requirements made more responsive to realities on the ground, e.g., regarding land areas and room sizes, practicalities of playgrounds in urban areas, etc. These mandates will be adjusted and loosened, leaving suitable flexibility for each school to make its own decisions based on local needs and constraints, while ensuring safety, security, and a pleasant and productive learning space. Educational outcomes and the transparent disclosure of all financial, academic, and operational matters will be given due importance and will be incorporated suitably in the assessment of schools. This will further improve India's progress towards achieving Sustainable Development Goal 4 (SDG4) of ensuring free, equitable, and quality primary and secondary education for all children.

8.9. The aim of the public-school education system will be to impart the highest quality education so that it becomes the most attractive option for parents from all walks of life for educating their children.

8.10. For a periodic ‘health check-up’ of the overall system, a sample-based National Achievement Survey (NAS) of student learning levels will be carried out by the proposed new National Assessment Centre, PARAKH with suitable cooperation with other governmental bodies- such as the NCERT– that may assist in assessment procedures as well as data analysis. The assessment will cover students across government as well as private schools. States will also be encouraged to conduct their own census-based State Assessment Survey (SAS), the results of which will be used only for developmental purposes, public disclosure by schools of their overall and anonymized student outcomes, and for continuous improvement of the school education system. Until the establishment of the proposed new National Assessment Centre, PARAKH, NCERT may continue to carry out NAS.

8.11. Finally, the children and adolescents enrolled in schools must not be forgotten in this whole process; after all, the school system is designed for them. Careful attention must be paid to their safety and rights- particularly girl children - and the various difficult issues faced by adolescents, such as substance or drug abuse and forms of discrimination and harassment including violence, with clear, safe, and efficient mechanisms for reporting and for due process on any infractions against children's/adolescents' rights or safety. The development of such mechanisms that are effective, timely, and well-known to all students will be accorded high priority.

## **Part II. HIGHER EDUCATION**

### **9. Quality Universities and Colleges: A New and Forward-looking Vision for India's Higher Education System**

9.1. Higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution - a democratic, just, socially-conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all. Higher education significantly contributes towards sustainable livelihoods and economic development of the nation. As India moves towards becoming a knowledge economy and society, more and more young Indians are likely to aspire for higher education.

9.1.1. Given the 21<sup>st</sup> century requirements, quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals. It must enable an individual to study one or more specialized areas of interest at a deep level, and also develop character, ethical and Constitutional values, intellectual curiosity, scientific temper, creativity, spirit of service, and 21<sup>st</sup> century capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects. A quality higher education must enable personal accomplishment and enlightenment, constructive public engagement, and productive contribution to the society. It must prepare students for more meaningful and satisfying lives and work roles and enable economic independence.

9.1.2. For the purpose of developing holistic individuals, it is essential that an identified set of skills and values will be incorporated at each stage of learning, from pre-school to higher education.

9.1.3. At the societal level, higher education must enable the development of an enlightened, socially conscious, knowledgeable, and skilled nation that can find and implement robust solutions to its own problems. Higher education must form the basis for knowledge creation and innovation thereby contributing to a growing national economy. The purpose of quality higher education is, therefore, more than the creation of greater opportunities for individual employment. It represents the key to more vibrant, socially engaged, cooperative communities and a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation.

9.2. Some of the major problems currently faced by the higher education system in India include:

- (a) a severely fragmented higher educational ecosystem;
- (b) less emphasis on the development of cognitive skills and learning outcomes;
- (c) a rigid separation of disciplines, with early specialisation and streaming of students into narrow areas of study;
- (d) limited access particularly in socio-economically disadvantaged areas, with few HEIs that teach in local languages
- (e) limited teacher and institutional autonomy;
- (f) inadequate mechanisms for merit-based career management and progression of faculty and institutional leaders;
- (g) lesser emphasis on research at most universities and colleges, and lack of competitive peer-reviewed research funding across disciplines;
- (h) suboptimal governance and leadership of HEIs;
- (i) an ineffective regulatory system; and
- (j) large affiliating universities resulting in low standards of undergraduate education.

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9.3. This policy envisions a complete overhaul and re-energising of the higher education system to overcome these challenges and thereby deliver high-quality higher education, with equity and inclusion. The policy's vision includes the following key changes to the current system:

- (a) moving towards a higher educational system consisting of large, multidisciplinary universities and colleges, with at least one in or near every district, and with more HEIs across India that offer medium of instruction or programmes in local/Indian languages;
- (b) moving towards a more multidisciplinary undergraduate education;
- (c) moving towards faculty and institutional autonomy;
- (d) revamping curriculum, pedagogy, assessment, and student support for enhanced student experiences;
- (e) reaffirming the integrity of faculty and institutional leadership positions through merit-appointments and career progression based on teaching, research, and service;
- (f) establishment of a National Research Foundation to fund outstanding peer-reviewed research and to actively seed research in universities and colleges;
- (g) governance of HEIs by high qualified independent boards having academic and administrative autonomy;
- (h) "light but tight" regulation by a single regulator for higher education;
- (i) increased access, equity, and inclusion through a range of measures, including greater opportunities for outstanding public education; scholarships by private/philanthropic universities for disadvantaged and underprivileged students; online education, and Open Distance Learning (ODL); and all infrastructure and learning materials accessible and available to learners with disabilities.

## **10. Institutional Restructuring and Consolidation**

10.1. The main thrust of this policy regarding higher education is to end the fragmentation of higher education by transforming higher education institutions into large multidisciplinary universities, colleges, and HEI clusters/Knowledge Hubs, each of which will aim to have 3,000 or more students. This would help build vibrant communities of scholars and peers, break down harmful silos, enable students to become well-rounded across disciplines including artistic, creative, and analytic subjects as well as sports, develop active research communities across disciplines including cross-disciplinary research, and increase resource efficiency, both material and human, across higher education.

10.2. Moving to large multidisciplinary universities and HEI clusters is thus the highest recommendation of this policy regarding the structure of higher education. The ancient Indian universities Takshashila, Nalanda, Vallabhi, and Vikramshila, which had thousands of students from India and the world studying in vibrant multidisciplinary environments, amply demonstrated the type of great success that large multidisciplinary research and teaching universities could bring. India urgently needs to bring back this great Indian tradition to create well-rounded and innovative individuals, and which is already transforming other countries educationally and economically.

10.3. This vision of higher education will require, in particular, a new conceptual perception/understanding for what constitutes a higher education institution (HEI), i.e., a university or a college. A university will mean a multidisciplinary institution of higher learning that offers undergraduate and graduate programmes, with high quality teaching, research, and community engagement. The definition of university will thus allow a spectrum of institutions that range from those that place equal emphasis on teaching and research i.e., Research-intensive Universities, those that place greater emphasis on teaching but still conduct significant research i.e. Teaching-intensive Universities. Meanwhile, an Autonomous degree-granting College (AC) will refer to a large multidisciplinary institution of higher learning that grants undergraduate degrees and is primarily focused on undergraduate teaching though it would not be restricted to that and it need not be restricted to that and it would generally be smaller than a typical university.

10.4. A stage-wise mechanism for granting graded autonomy to colleges, through a transparent system of graded accreditation, will be established. Colleges will be encouraged, mentored, supported, and incentivized to gradually attain the minimum benchmarks required for each level of

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accreditation. Over a period of time, it is envisaged that every college would develop into either an Autonomous degree-granting College, or a constituent college of a university - in the latter case, it would be fully a part of the university. With appropriate accreditations, Autonomous degree-granting Colleges could evolve into Research-intensive or Teaching-intensive Universities, if they so aspire.

10.5. It must be clearly stated that these three broad types of institutions are not in any natural way a rigid, exclusionary categorization, but are along a continuum. HEIs will have the autonomy and freedom to move gradually from one category to another, based on their plans, actions, and effectiveness. The most salient marker for these categories of institutions will be the focus of their goals and work. The Accreditation System will develop and use appropriately different and relevant norms across this range of HEIs. However, the expectations of high quality of education, and of teaching-learning, across all HEIs will be the same.

10.6. In addition to teaching and research, HEIs will have other crucial responsibilities, which they will discharge through appropriate resourcing, incentives, and structures. These include supporting other HEIs in their development, community engagement and service, contribution to various fields of practice, faculty development for the higher education system, and support to school education.

10.7. By 2040, all higher education institutions (HEIs) shall aim to become multidisciplinary institutions and shall aim to have larger student enrolments preferably in the thousands, for optimal use of infrastructure and resources, and for the creation of vibrant multidisciplinary communities. Since this process will take time, all HEIs will firstly plan to become multidisciplinary by 2030, and then gradually increase student strength to the desired levels.

10.8. More HEIs shall be established and developed in underserved regions to ensure full access, equity, and inclusion. There shall, by 2030, be at least one large multidisciplinary HEI in or near every district. Steps shall be taken towards developing high-quality higher education institutions both public and private that have medium of instruction in local/Indian languages or bilingually. The aim will be to increase the Gross Enrolment Ratio in higher education including vocational education from 26.3% (2018) to 50% by 2035. While a number of new institutions may be developed to attain these goals, a large part of the capacity creation will be achieved by consolidating, substantially expanding, and also improving existing HEIs.

10.9. Growth will be in both public and private institutions, with a strong emphasis on developing a large number of outstanding public institutions. There will be a fair and transparent system for determining increased levels of public funding support for public HEIs. This system will give an equitable opportunity for all public institutions to grow and develop, and will be based on transparent, pre-announced criteria from within the accreditation norms of the Accreditation System. HEIs delivering education of the highest quality as laid down in this Policy will be incentivized in expanding their capacity.

10.10. Institutions will have the option to run Open Distance Learning (ODL) and online programmes, provided they are accredited to do so, in order to enhance their offerings, improve access, increase GER, and provide opportunities for lifelong learning (SDG 4). All ODL programmes and their components leading to any diploma or degree will be of standards and quality equivalent to the highest quality programmes run by the HEIs on their campuses. Top institutions accredited for ODL will be encouraged and supported to develop high-quality online courses. Such quality online courses will be suitably integrated into curricula of HEIs, and blended mode will be preferred.

10.11. Single-stream HEIs will be phased out over time, and all will move towards becoming vibrant multidisciplinary institutions or parts of vibrant multidisciplinary HEI clusters, in order to enable and encourage high-quality multidisciplinary and cross-disciplinary teaching and research across fields. Single-stream HEIs will, in particular, add departments across different fields that would strengthen the single stream that they currently serve. Through the attainment of suitable accreditations, all HEIs will gradually move towards full autonomy - academic and administrative - in order to enable this vibrant culture. The autonomy of public institutions will be backed by adequate public financial

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support and stability. Private institutions with a public-spirited commitment to high-quality equitable education will be encouraged.

10.12. The new regulatory system envisioned by this Policy will foster this overall culture of empowerment and autonomy to innovate, including by gradually phasing out the system of ‘affiliated colleges’ over a period of fifteen years through a system of graded autonomy, and to be carried out in a challenge mode. Each existing affiliating university will be responsible for mentoring its affiliated colleges so that they can develop their capabilities and achieve minimum benchmarks in academic and curricular matters; teaching and assessment; governance reforms; financial robustness; and administrative efficiency. All colleges currently affiliated to a university shall attain the required benchmarks over time to secure the prescribed accreditation benchmarks and eventually become autonomous degree-granting colleges. This will be achieved through a concerted national effort including suitable mentoring and governmental support for the same.

10.13. The overall higher education sector will aim to be an integrated higher education system, including professional and vocational education. This Policy and its approach will be equally applicable to all HEIs across all current streams, which would eventually merge into one coherent ecosystem of higher education.

10.14. University, worldwide, means a multidisciplinary institution of higher learning that offers undergraduate, graduate, and Ph.D programmes, and engages in high-quality teaching and research. The present complex nomenclature of HEIs in the country such as ‘deemed to be university’, ‘affiliating university’, ‘affiliating technical university’, ‘unitary university’ shall be replaced simply by ‘university’ on fulfilling the criteria as per norms.

### **11. Towards a More Holistic and Multidisciplinary Education**

11.1. India has a long tradition of holistic and multidisciplinary learning, from universities such as Takshashila and Nalanda, to the extensive literatures of India combining subjects across fields. Ancient Indian literary works such as Banabhatta’s *Kadambari* described a good education as knowledge of the 64 Kalaas or arts; and among these 64 ‘arts’ were not only subjects, such as singing and painting, but also ‘scientific’ fields, such as chemistry and mathematics, ‘vocational’ fields such as carpentry and clothes-making, ‘professional’ fields, such as medicine and engineering, as well as ‘soft skills’ such as communication, discussion, and debate. The very idea that all branches of creative human endeavour, including mathematics, science, vocational subjects, professional subjects, and soft skills should be considered ‘arts’, has distinctly Indian origins. This notion of a ‘knowledge of many arts’ or what in modern times is often called the ‘liberal arts’ (i.e., a liberal notion of the arts) must be brought back to Indian education, as it is exactly the kind of education that will be required for the 21<sup>st</sup> century.

11.2. Assessments of educational approaches in undergraduate education that integrate the humanities and arts with Science, Technology, Engineering and Mathematics (STEM) have consistently showed positive learning outcomes, including increased creativity and innovation, critical thinking and higher-order thinking capacities, problem-solving abilities, teamwork, communication skills, more in-depth learning and mastery of curricula across fields, increases in social and moral awareness, etc., besides general engagement and enjoyment of learning. Research is also improved and enhanced through a holistic and multidisciplinary education approach.

11.3. A holistic and multidisciplinary education would aim to develop all capacities of human beings -intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner. Such an education will help develop well-rounded individuals that possess critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines.

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11.4. A holistic and multidisciplinary education, as described so beautifully in India's past, is indeed what is needed for the education of India to lead the country into the 21st century and the fourth industrial revolution. Even engineering institutions, such as IITs, will move towards more holistic and multidisciplinary education with more arts and humanities. Students of arts and humanities will aim to learn more science and all will make an effort to incorporate more vocational subjects and soft skills.

11.5. Imaginative and flexible curricular structures will enable creative combinations of disciplines for study, and would offer multiple entry and exit points, thus, removing currently prevalent rigid boundaries and creating new possibilities for life-long learning. Graduate-level, master's and doctoral education in large multidisciplinary universities, while providing rigorous research-based specialization, would also provide opportunities for multidisciplinary work, including in academia, government, and industry.

11.6. Large multidisciplinary universities and colleges will facilitate the move towards high-quality holistic and multidisciplinary education. Flexibility in curriculum and novel and engaging course options will be on offer to students, in addition to rigorous specialization in a subject or subjects. This will be encouraged by increased faculty and institutional autonomy in setting curricula. Pedagogy will have an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking.

11.7. Departments in Languages, Literature, Music, Philosophy, Indology, Art, Dance, Theatre, Education, Mathematics, Statistics, Pure and Applied Sciences, Sociology, Economics, Sports, Translation and Interpretation, and other such subjects needed for a multidisciplinary, stimulating Indian education and environment will be established and strengthened at all HEIs. Credits will be given in all Bachelor's Degree programmes for these subjects if they are done from such departments or through ODL mode when they are not offered in-class at the HEI.

11.8. Towards the attainment of such a holistic and multidisciplinary education, the flexible and innovative curricula of all HEIs shall include credit-based courses and projects in the areas of community engagement and service, environmental education, and value-based education. Environment education will include areas such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living. Value-based education will include the development of humanistic, ethical, Constitutional, and universal human values of truth (*satya*), righteous conduct (*dharma*), peace (*shanti*), love (*prem*), nonviolence (*ahimsa*), scientific temper, citizenship values, and also life-skills; lessons in *seva*/service and participation in community service programmes will be considered an integral part of a holistic education. As the world is becoming increasingly interconnected, Global Citizenship Education (GCED), a response to contemporary global challenges, will be provided to empower learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies. Finally, as part of a holistic education, students at all HEIs will be provided with opportunities for internships with local industry, businesses, artists, crafts persons, etc., as well as research internships with faculty and researchers at their own or other HEIs/research institutions, so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

11.9. The structure and lengths of degree programmes shall be adjusted accordingly. The undergraduate degree will be of either 3 or 4-year duration, with multiple exit options within this period, with appropriate certifications, e.g., a certificate after completing 1 year in a discipline or field including vocational and professional areas, or a diploma after 2 years of study, or a Bachelor's degree after a 3-year programme. The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student. An Academic Bank of Credit (ABC) shall be established which would digitally store the academic credits earned from various recognized HEIs so that the degrees from an HEI can be awarded taking into account credits earned. The 4-year programme may also lead to a degree 'with

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Research' if the student completes a rigorous research project in their major area(s) of study as specified by the HEI.

11.10. HEIs will have the flexibility to offer different designs of Master's programmes: (a) there may be a 2-year programme with the second year devoted entirely to research for those who have completed the 3-year Bachelor's programme; (b) for students completing a 4-year Bachelor's programme with Research, there could be a 1-year Master's programme; and (c) there may be an integrated 5-year Bachelor's/Master's programme. Undertaking a Ph.D. shall require either a Master's degree or a 4-year Bachelor's degree with Research. The M.Phil. programme shall be discontinued.

11.11. Model public universities for holistic and multidisciplinary education, at par with IITs, IIMs, etc., called MERUs (Multidisciplinary Education and Research Universities) will be set up and will aim to attain the highest global standards in quality education. They will also help set the highest standards for multidisciplinary education across India.

11.12. HEIs will focus on research and innovation by setting up start-up incubation centres; technology development centres; centres in frontier areas of research; greater industry-academic linkages; and interdisciplinary research including humanities and social sciences research. Given the scenario of epidemics and pandemics, it is critical that HEIs take the lead to undertake research in areas of infectious diseases, epidemiology, virology, diagnostics, instrumentation, vaccinology and other relevant areas. HEIs will develop specific hand holding mechanisms and competitions for promoting innovation among student communities. The NRF will function to help enable and support such a vibrant research and innovation culture across HEIs, research labs, and other research organizations.

## **12. Optimal Learning Environments and Support for Students**

12.1. Effective learning requires a comprehensive approach that involves appropriate curriculum, engaging pedagogy, continuous formative assessment, and adequate student support. The curriculum must be interesting and relevant, and updated regularly to align with the latest knowledge requirements and to meet specified learning outcomes. High-quality pedagogy is then necessary to successfully impart the curricular material to students; pedagogical practices determine the learning experiences that are provided to students, thus directly influencing learning outcomes. The assessment methods must be scientific, designed to continuously improve learning and test the application of knowledge. Last but not least, the development of capacities that promote student wellness such as fitness, good health, psycho-social well-being, and sound ethical grounding are also critical for high-quality learning.

Thus, curriculum, pedagogy, continuous assessment, and student support are the cornerstones for quality learning. Along with providing suitable resources and infrastructure, such as quality libraries, classrooms, labs, technology, sports/recreation areas, student discussion spaces, and dining areas, a number of initiatives will be required to ensure that learning environments are engaging and supportive, and enable all students to succeed.

12.2. First, in order to promote creativity, institutions and faculty will have the autonomy to innovate on matters of curriculum, pedagogy, and assessment within a broad framework of higher education qualifications that ensures consistency across institutions and programmes and across the ODL, online, and traditional 'in-class' modes. Accordingly, curriculum and pedagogy will be designed by institutions and motivated faculty to ensure a stimulating and engaging learning experience for all students, and continuous formative assessment will be used to further the goals of each programme. All assessment systems shall also be decided by the HEI, including those that lead to final certification. The Choice Based Credit System (CBCS) will be revised for instilling innovation and flexibility. HEIs shall move to a criterion-based grading system that assesses student achievement based on the learning goals for each programme, making the system fairer and outcomes more comparable. HEIs shall also move away from high-stakes examinations towards more continuous and comprehensive evaluation.

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12.3. Second, each institution will integrate its academic plans ranging from curricular improvement to quality of classroom transaction - into its larger Institutional Development Plan (IDP). Each institution will be committed to the holistic development of students and create strong internal systems for supporting diverse student cohorts in academic and social domains both inside and outside formal academic interactions in the classroom. For example, all HEIs will have mechanisms and opportunities for funding of topic-centred clubs and activities organized by students with the help of faculty and other experts as needed, such as clubs and events dedicated to science, mathematics, poetry, language, literature, debate, music, sports, etc. Over time, such activities could be incorporated into the curriculum once appropriate faculty expertise and campus student demand is developed. Faculty will have the capacity and training to be able to approach students not just as teachers, but also as mentors and guides.

12.4. Third, students from socio-economically disadvantaged backgrounds require encouragement and support to make a successful transition to higher education. Universities and colleges will thus be required to set up high-quality support centres and will be given adequate funds and academic resources to carry this out effectively. There will also be professional academic and career counselling available to all students, as well as counsellors to ensure physical, psychological and emotional well-being.

12.5. Fourth, ODL and online education provide a natural path to increase access to quality higher education. In order to leverage its potential completely, ODL will be renewed through concerted, evidence-based efforts towards expansion while ensuring adherence to clearly articulated standards of quality. ODL programmes will aim to be equivalent to the highest quality in-class programmes available. Norms, standards, and guidelines for systemic development, regulation, and accreditation of ODL will be prepared, and a framework for quality of ODL that will be recommendatory for all HEIs will be developed.

12.6. Finally, all programmes, courses, curricula, and pedagogy across subjects, including those in-class, online, and in ODL modes as well as student support will aim to achieve global standards of quality.

### **Internationalization**

12.7. The various initiatives mentioned above will also help in having larger numbers of international students studying in India, and provide greater mobility to students in India who may wish to visit, study at, transfer credits to, or carry out research at institutions abroad, and vice versa. Courses and programmes in subjects, such as Indology, Indian languages, AYUSH systems of medicine, yoga, arts, music, history, culture, and modern India, internationally relevant curricula in the sciences, social sciences, and beyond, meaningful opportunities for social engagement, quality residential facilities and on-campus support, etc. will be fostered to attain this goal of global quality standards, attract greater numbers of international students, and achieve the goal of 'internationalization at home'.

12.8. India will be promoted as a global study destination providing premium education at affordable costs thereby helping to restore its role as a Vishwa Guru. An International Students Office at each HEI hosting foreign students will be set up to coordinate all matters relating to welcoming and supporting students arriving from abroad. Research/teaching collaborations and faculty/student exchanges with high-quality foreign institutions will be facilitated, and relevant mutually beneficial MOUs with foreign countries will be signed. High performing Indian universities will be encouraged to set up campuses in other countries, and similarly, selected universities e.g., those from among the top 100 universities in the world will be facilitated to operate in India. A legislative framework facilitating such entry will be put in place, and such universities will be given special dispensation regarding regulatory, governance, and content norms on par with other autonomous institutions of India. Furthermore, research collaboration and student exchanges between Indian institutions and global institutions will be promoted through special efforts. Credits acquired in foreign universities will be permitted, where appropriate as per the requirements of each HEI, to be counted for the award of a degree.



### **Student Activity and Participation**

12.9. Students are the prime stakeholders in the education system. Vibrant campus life is essential for high-quality teaching-learning processes. Towards this end, students will be given plenty of opportunities for participation in sports, culture/arts clubs, eco-clubs, activity clubs, community service projects, etc. In every education institution, there shall be counselling systems for handling stress and emotional adjustments. Furthermore, a systematized arrangement shall be created to provide the requisite support to students from rural backgrounds, including increasing hostel facilities as needed. All HEIs will ensure quality medical facilities for all students in their institutions.

### **Financial support for students**

12.10. Financial assistance to students shall be made available through various measures. Efforts will be made to incentivize the merit of students belonging to SC, ST, OBC, and other SEDGs. The National Scholarship Portal will be expanded to support, foster, and track the progress of students receiving scholarships. Private HEIs will be encouraged to offer larger numbers of free ships and scholarships to their students.

## **13. Motivated, Energized, and Capable Faculty**

13.1. The most important factor in the success of higher education institutions is the quality and engagement of its faculty. Acknowledging the criticality of faculty in achieving the goals of higher education, various initiatives have been introduced in the past several years to systematize recruitment and career progression, and to ensure equitable representation from various groups in the hiring of faculty. Compensation levels of permanent faculty in public institutions have also been increased substantially. Various initiatives have also been taken towards providing faculty with professional development opportunities. However, despite these various improvements in the status of the academic profession, faculty motivation in terms of teaching, research, and service in HEIs remains far lower than the desired level. The various factors that lie behind low faculty motivation levels must be addressed to ensure that each faculty member is happy, enthusiastic, engaged, and motivated towards advancing her/his students, institution, and profession. To this end, the policy recommends the following initiatives to achieve the best, motivated, and capable faculty in HEIs.

13.2. As the most basic step, all HEIs will be equipped with the basic infrastructure and facilities, including clean drinking water, clean working toilets, blackboards, offices, teaching supplies, libraries, labs, and pleasant classroom spaces and campuses. Every classroom shall have access to the latest educational technology that enables better learning experiences.

13.3. Teaching duties also will not be excessive, and student-teacher ratios not too high, so that the activity of teaching remains pleasant and there is adequate time for interaction with students, conducting research, and other university activities. Faculty will be appointed to individual institutions and generally not be transferable across institutions so that they may feel truly invested in, connected to, and committed to their institution and community.

13.4. Faculty will be given the freedom to design their own curricular and pedagogical approaches within the approved framework, including textbook and reading material selections, assignments, and assessments. Empowering the faculty to conduct innovative teaching, research, and service as they see best will be a key motivator and enabler for them to do truly outstanding, creative work.

13.5. Excellence will be further incentivized through appropriate rewards, promotions, recognitions, and movement into institutional leadership. Meanwhile, faculty not delivering on basic norms will be held accountable.

13.6. In keeping with the vision of autonomous institutions empowered to drive excellence, HEIs will have clearly defined, independent, and transparent processes and criteria for faculty recruitment. Whereas the current recruitment process will be continued, a 'tenure-track' i.e., suitable probation period shall be put in place to further ensure excellence. There shall be a fast-track promotion system

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for recognizing high impact research and contribution. A system of multiple parameters for proper performance assessment, for the purposes of ‘tenure’ i.e., confirmed employment after probation, promotion, salary increases, recognitions, etc., including peer and student reviews, innovations in teaching and pedagogy, quality and impact of research, professional development activities, and other forms of service to the institution and the community, shall be developed by each HEI and clearly enunciated in its Institutional Development Plan (IDP).

13.7. The presence of outstanding and enthusiastic institutional leaders that cultivate excellence and innovation is the need of the hour. Outstanding and effective institutional leadership is extremely important for the success of an institution and of its faculty. Excellent faculty with high academic and service credentials as well as demonstrated leadership and management skills will be identified early and trained through a ladder of leadership positions. Leadership positions shall not remain vacant, but rather an overlapping time period during transitions in leadership shall be the norm to ensure the smooth running of institutions. Institutional leaders will aim to create a culture of excellence that will motivate and incentivize outstanding and innovative teaching, research, institutional service, and community outreach from faculty members and all HEI leaders.

### **14. Equity and Inclusion in Higher Education**

14.1. Entry into quality higher education can open a vast array of possibilities that can lift both individuals as well as communities out of the cycles of disadvantage. For this reason, making quality higher education opportunities available to all individuals must be among the highest priorities. This Policy envisions ensuring equitable access to quality education to all students, with a special emphasis on SEDGs.

14.2. The dynamics and also many of the reasons for exclusion of SEDGs from the education system are common across school and higher education sectors. Therefore, the approach to equity and inclusion must be common across school and higher education. Furthermore, there must be continuity across the stages to ensure sustainable reform. Thus, the policy initiatives required to meet the goals of equity and inclusion in higher education must be read in conjunction with those for school education.

14.3. There are certain facets of exclusion, that are particular to or substantially more intense in higher education. These must be addressed specifically, and include lack of knowledge of higher education opportunities, economic opportunity cost of pursuing higher education, financial constraints, admission processes, geographical and language barriers, poor employability potential of many higher education programmes, and lack of appropriate student support mechanisms.

14.4. For this purpose, additional actions that are specific to higher education shall be adopted by all Governments and HEIs:

#### 14.4.1. Steps to be taken by Governments

- (a) Earmark suitable Government funds for the education of SEDGs
- (b) Set clear targets for higher GER for SEDGs
- (c) Enhance gender balance in admissions to HEIs
- (d) Enhance access by establishing more high-quality HEIs in aspirational districts and Special Education Zones containing larger numbers of SEDGs
- (e) Develop and support high-quality HEIs that teach in local/Indian languages or bilingually
- (f) Provide more financial assistance and scholarships to SEDGs in both public and private HEIs
- (g) Conduct outreach programmes on higher education opportunities and scholarships among SEDGs
- (h) Develop and support technology tools for better participation and learning outcomes.

#### 14.4.2. Steps to be taken by all HEIs

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- (a) Mitigate opportunity costs and fees for pursuing higher education
- (b) Provide more financial assistance and scholarships to socio-economically disadvantaged students
- (c) Conduct outreach on higher education opportunities and scholarships
- (d) Make admissions processes more inclusive
- (e) Make curriculum more inclusive
- (f) Increase employability potential of higher education programmes
- (g) Develop more degree courses taught in Indian languages and bilingually
- (h) Ensure all buildings and facilities are wheelchair-accessible and disabled-friendly
- (i) Develop bridge courses for students that come from disadvantaged educational backgrounds
- (j) Provide socio-emotional and academic support and mentoring for all such students through suitable counselling and mentoring programmes
- (k) Ensure sensitization of faculty, counsellor, and students on gender-identity issue and its inclusion in all aspects of the HEI, including curricula
- (l) Strictly enforce all no-discrimination and anti-harassment rules
- (m) Develop Institutional Development Plans that contain specific plans for action on increasing participation from SEDGs, including but not limited to the above items.

### **15. Teacher Education**

15.1. Teacher education is vital in creating a pool of schoolteachers that will shape the next generation. Teacher preparation is an activity that requires multidisciplinary perspectives and knowledge, formation of dispositions and values, and development of practice under the best mentors. Teachers must be grounded in Indian values, languages, knowledge, ethos, and traditions including tribal traditions, while also being well-versed in the latest advances in education and pedagogy.

15.2. According to the Justice J. S. Verma Commission (2012) constituted by the Supreme Court, a majority of stand-alone TEIs - over 10,000 in number are not even attempting serious teacher education but are essentially selling degrees for a price. Regulatory efforts so far have neither been able to curb the malpractices in the system, nor enforce basic standards for quality, and in fact have had the negative effect of curbing the growth of excellence and innovation in the sector. The sector and its regulatory system are, therefore, in urgent need of revitalization through radical action, in order to raise standards and restore integrity, credibility, efficacy, and high quality to the teacher education system.

15.3. In order to improve and reach the levels of integrity and credibility required to restore the prestige of the teaching profession, the Regulatory System shall be empowered to take stringent action against substandard and dysfunctional teacher education institutions (TEIs) that do not meet basic educational criteria, after giving one year for remedy of the breaches. By 2030, only educationally sound, multidisciplinary, and integrated teacher education programmes shall be in force.

15.4. As teacher education requires multidisciplinary inputs, and education in high-quality content as well as pedagogy, all teacher education programmes must be conducted within composite multidisciplinary institutions. To this end, all multidisciplinary universities and colleges - will aim to establish, education departments which, besides carrying out cutting-edge research in various aspects of education, will also run B.Ed. programmes, in collaboration with other departments such as psychology, philosophy, sociology, neuroscience, Indian languages, arts, music, history, literature, physical education, science and mathematics. Moreover, all stand-alone TEIs will be required to convert to multidisciplinary institutions by 2030, since they will have to offer the 4-year integrated teacher preparation programme.

15.5. The 4-year integrated B.Ed. offered by such multidisciplinary HEIs will, by 2030, become the minimal degree qualification for school teachers. The 4-year integrated B.Ed. will be a dual-major holistic Bachelor's degree, in Education as well as a specialized subject such as a language, history, music, mathematics, computer science, chemistry, economics, art, physical education, etc. Beyond

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the teaching of cutting-edge pedagogy, the teacher education will include grounding in sociology, history, science, psychology, early childhood care and education, foundational literacy and numeracy, knowledge of India and its values/ethos/art/traditions, and more. The HEI offering the 4-year integrated B.Ed. may also run a 2-year B.Ed., for students who have already received a Bachelor's degree in a specialized subject. A 1-year B.Ed. may also be offered for candidates who have received a 4-year undergraduate degree in a specialized subject. Scholarships for meritorious students will be established for the purpose of attracting outstanding candidates to the 4-year, 2-year, and 1-year B.Ed. programmes.

15.6. HEIs offering teacher education programmes will ensure the availability of a range of experts in education and related disciplines as well as specialized subjects. Each higher education institution will have a network of government and private schools to work closely with, where potential teachers will student-teach along with participating in other activities such as community service, adult and vocational education, etc.

15.7. In order to maintain uniform standards for teacher education, the admission to pre-service teacher preparation programmes shall be through suitable subject and aptitude tests conducted by the National Testing Agency, and shall be standardized keeping in view the linguistic and cultural diversity of the country.

15.8. The faculty profile in Departments of Education will necessarily aim to be diverse and but teaching/field/research experience will be highly valued. Faculty with training in areas of social sciences that are directly relevant to school education e.g., psychology, child development, linguistics, sociology, philosophy, economics, and political science as well as from science education, mathematics education, social science education, and language education programmes will be attracted and retained in teacher education institutions, to strengthen multidisciplinary education of teachers and provide rigour in conceptual development.

15.9. All fresh Ph.D. entrants, irrespective of discipline, will be required to take credit-based courses in teaching/education/pedagogy/writing related to their chosen Ph.D subject during their doctoral training period. Exposure to pedagogical practices, designing curriculum, credible evaluation systems, communication, and so on will be ensured since many research scholars will go on to become faculty or public representatives/communicators of their chosen disciplines. Ph.D students will also have a minimum number of hours of actual teaching experience gathered through teaching assistantships and other means. Ph.D. programmes at universities around the country will be re-oriented for this purpose.

15.10. In-service continuous professional development for college and university teachers will continue through the existing institutional arrangements and ongoing initiatives; these will be strengthened and substantially expanded to meet the needs of enriched teaching-learning processes for quality education. The use of technology platforms such as SWAYAM/DIKSHA for online training of teachers will be encouraged, so that standardized training programmes can be administered to large numbers of teachers within a short span of time.

15.11. A National Mission for Mentoring shall be established, with a large pool of outstanding senior/retired faculty – including those with the ability to teach in Indian languages – who would be willing to provide short and long-term mentoring/professional support to university/college teachers.

## **16. Reimagining Vocational Education**

16.1. The 12<sup>th</sup> Five-Year Plan (2012–2017) estimated that only a very small percentage of the Indian workforce in the age group of 19–24 (less than 5%) received formal vocational education Whereas in countries such as the USA the number is 52%, in Germany 75%, and South Korea it is as high as 96%. These numbers only underline the urgency of the need to hasten the spread of vocational education in India.

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16.2. One of the primary reasons for the small numbers of students receiving vocational education is the fact that vocational education has in the past focused largely on Grades 11–12 and on dropouts in Grade 8 and upwards. Moreover, students passing out from Grades 11–12 with vocational subjects often did not have well-defined pathways to continue with their chosen vocations in higher education. The admission criteria for general higher education were also not designed to provide openings to students who had vocational education qualifications, leaving them at a disadvantage relative to their compatriots from ‘mainstream’ or ‘academic’ education. This led to a complete lack of vertical mobility for students from the vocational education stream, an issue that has only been addressed recently through the announcement of the National Skills Qualifications Framework (NSQF) in 2013.

16.3. Vocational education is perceived to be inferior to mainstream education and meant largely for students who are unable to cope with the latter. This is a perception that affects the choices students make. It is a serious concern that can only be dealt with by a complete re-imagining of how vocational education is offered to students in the future.

16.4. This policy aims to overcome the social status hierarchy associated with vocational education and requires integration of vocational education programmes into mainstream education in all education institutions in a phased manner. Beginning with vocational exposure at early ages in middle and secondary school, quality vocational education will be integrated smoothly into higher education. It will ensure that every child learns at least one vocation and is exposed to several more. This would lead to emphasizing the dignity of labour and importance of various vocations involving /Indian arts and artisanship.

16.5. By 2025, at least 50% of learners through the school and higher education system shall have exposure to vocational education, for which a clear action plan with targets and timelines will be developed. This is in alignment with Sustainable Development Goal 4.4 and will help to realize the full potential of India’s demographic dividend. The number of students in vocational education will be considered while arriving at the GER targets. The development of vocational capacities will go hand-in-hand with the development of ‘academic’ or other capacities. Vocational education will be integrated in the educational offerings of all secondary schools in a phased manner over the next decade. Towards this, secondary schools will also collaborate with ITIs, polytechnics, local industry, etc. Skill labs will also be set up and created in the schools in a hub and spoke model which will allow other schools to use the facility. Higher education institutions will offer vocational education either on their own or in partnership with industry and NGOs. The B.Voc. degrees introduced in 2013 will continue to exist, but vocational courses will also be available to students enrolled in all other Bachelor’s degree programmes, including the 4-year multidisciplinary Bachelor’s programmes. HEIs will also be allowed to conduct short-term certificate courses in various skills including soft skills. ‘Lok Vidya’, i.e., important vocational knowledge developed in India, will be made accessible to students through integration into vocational education courses. The possibility of offering vocational courses through ODL mode will also be explored.

16.6. Vocational education will be integrated into all school and higher education institutions in a phased manner over the next decade. Focus areas for vocational education will be chosen based on skills gap analysis and mapping of local opportunities. MHRD will constitute a National Committee for the Integration of Vocational Education (NCIVE), consisting of experts in vocational education and representatives from across Ministries, in collaboration with industry, to oversee this effort.

16.7. Individual institutions that are early adopters must innovate to find models and practices that work and then share these with other institutions through mechanisms set up by NCIVE, so as to help extend the reach of vocational education. Different models of vocational education, and apprenticeships, will also be experimented by higher education institutions. Incubation centres will be set up in higher education institutions in partnership with industries.

16.8. The National Skills Qualifications Framework will be detailed further for each discipline vocation and profession. Further, Indian standards will be aligned with the International Standard Classification of Occupations maintained by the International Labour Organization. This Framework will provide the basis for Recognition of Prior Learning. Through this, dropouts from the formal

system will be reintegrated by aligning their practical experience with the relevant level of the Framework. The credit-based Framework will also facilitate mobility across ‘general’ and vocational education.

## **17. Catalysing Quality Academic Research in All Fields through a new National Research Foundation**

17.1. Knowledge creation and research are critical in growing and sustaining a large and vibrant economy, uplifting society, and continuously inspiring a nation to achieve even greater heights. Indeed, some of the most prosperous civilizations (such as India, Mesopotamia, Egypt, and Greece) to the modern era (such as the United States, Germany, Israel, South Korea, and Japan), were/are strong knowledge societies that attained intellectual and material wealth in large part through celebrated and fundamental contributions to new knowledge in the realm of science as well as art, language, and culture that enhanced and uplifted not only their own civilizations but others around the globe.

17.2. A robust ecosystem of research is perhaps more important than ever with the rapid changes occurring in the world today, e.g., in the realm of climate change, population dynamics and management, biotechnology, an expanding digital marketplace, and the rise of machine learning and artificial intelligence. If India is to become a leader in these disparate areas, and truly achieve the potential of its vast talent pool to again become a leading knowledge society in the coming years and decades, the nation will require a significant expansion of its research capabilities and output across disciplines. Today, the criticality of research is more than ever before, for the economic, intellectual, societal, environmental, and technological health and progress of a nation.

17.3. Despite this critical importance of research, the research and innovation investment in India is, at the current time, only 0.69% of GDP as compared to 2.8% in the United States of America, 4.3% in Israel and 4.2% in South Korea.

17.4. The societal challenges that India needs to address today, such as access for all its citizens to clean drinking water and sanitation, quality education and healthcare, improved transportation, air quality, energy, and infrastructure, will require the implementation of approaches and solutions that are not only informed by top-notch science and technology but are also rooted in a deep understanding of the social sciences and humanities and the various socio-cultural and environmental dimensions of the nation. Facing and addressing these challenges will require high-quality interdisciplinary research across fields that must be done in India and cannot simply be imported; the ability to conduct one’s own research also enables a country to much more easily import and adapt relevant research from abroad.

17.5. Furthermore, in addition to their value in solutions to societal problems, any country's identity, upliftment, spiritual/intellectual satisfaction and creativity is also attained in a major way through its history, art, language, and culture. Research in the arts and humanities, along with innovations in the sciences and social sciences, are, therefore, extremely important for the progress and enlightened nature of a nation.

17.6. Research and innovation at education institutions in India, particularly those that are engaged in higher education, is critical. Evidence from the world’s best universities throughout history shows that the best teaching and learning processes at the higher education level occur in environments where there is also a strong culture of research and knowledge creation; conversely, much of the very best research in the world has occurred in multidisciplinary university settings.

17.7. India has a long historical tradition of research and knowledge creation, in disciplines ranging from science and mathematics to art and literature to phonetics and languages to medicine and agriculture. This needs to be further strengthened to make India lead research and innovation in the

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21<sup>st</sup> century, as a strong and enlightened knowledge society and one of the three largest economies in the world.

17.8. Thus, this Policy envisions a comprehensive approach to transforming the quality and quantity of research in India. This includes definitive shifts in school education to a more play and discovery-based style of learning with emphasis on the scientific method and critical thinking. This includes career counselling in schools towards identifying student interests and talents, promoting research in universities, the multidisciplinary nature of all HEIs and the emphasis on holistic education, the inclusion of research and internships in the undergraduate curriculum, faculty career management systems that give due weightage to research, and the governance and regulatory changes that encourage an environment of research and innovation. All of these aspects are extremely critical for developing a research mindset in the country.

17.9. To build on these various elements in a synergistic manner, and to thereby truly grow and catalyze quality research in the nation, this policy envisions the establishment of a National Research Foundation (NRF). The overarching goal of the NRF will be to enable a culture of research to permeate through our universities. In particular, the NRF will provide a reliable base of merit-based but equitable peer-reviewed research funding, helping to develop a culture of research in the country through suitable incentives for and recognition of outstanding research, and by undertaking major initiatives to seed and grow research at State Universities and other public institutions where research capability is currently limited. The NRF will competitively fund research in all disciplines. Successful research will be recognized, and where relevant, implemented through close linkages with governmental agencies as well as with industry and private/philanthropic organizations.

17.10. Institutions that currently fund research at some level, such as the Department of Science and Technology (DST), Department of Atomic Energy (DAE), Department of Bio-Technology (DBT), Indian Council of Agriculture Research (ICAR), Indian Council of Medical Research (ICMR), Indian Council of Historical Research (ICHR), and University Grants Commission (UGC), as well as various private and philanthropic organizations, will continue to independently fund research according to their priorities and needs. However, NRF will carefully coordinate with other funding agencies and will work with science, engineering, and other academies to ensure synergy of purpose and avoid duplication of efforts. The NRF will be governed, independently of the government, by a rotating Board of Governors consisting of the very best researchers and innovators across fields.

17.11. The primary activities of the NRF will be to:

- (a) fund competitive, peer-reviewed grant proposals of all types and across all disciplines;
- (b) seed, grow, and facilitate research at academic institutions, particularly at universities and colleges where research is currently in a nascent stage, through mentoring of such institutions;
- (c) act as a liaison between researchers and relevant branches of government as well as industry, so that research scholars are constantly made aware of the most urgent national research issues, and so that policymakers are constantly made aware of the latest research breakthroughs; so as to allow breakthroughs to be optimally brought into policy and/or implementation; and
- (d) recognise outstanding research and progress

## **18. Transforming the Regulatory System of Higher Education**

18.1. Regulation of higher education has been too heavy-handed for decades; too much has been attempted to be regulated with too little effect. The mechanistic and disempowering nature of the regulatory system has been rife with very basic problems, such as heavy concentrations of power within a few bodies, conflicts of interest among these bodies, and a resulting lack of accountability. The regulatory system is in need of a complete overhaul in order to re-energize the higher education sector and enable it to thrive.

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18.2. To address the above-mentioned issues, the regulatory system of higher education will ensure that the distinct functions of regulation, accreditation, funding, and academic standard setting will be performed by distinct, independent, and empowered bodies. This is considered essential to create checks-and-balances in the system, minimize conflicts of interest, and eliminate concentrations of power. To ensure that the four institutional structures carrying out these four essential functions work independently yet at the same time and work in synergy towards common goals. These four structures will be set up as four independent verticals within one umbrella institution, the Higher Education Commission of India (HECI).

18.3. The first vertical of HECI will be the National Higher Education Regulatory Council (NHERC). It will function as the common, single point regulator for the higher education sector including teacher education and excluding medical and legal education, thus eliminating the duplication and disjunction of regulatory efforts by the multiple regulatory agencies that exist at the current time. It will require a relook and repealing of existing Acts and restructuring of various existing regulatory bodies to enable this single point regulation. NHERC will be set up to regulate in a ‘light but tight’ and facilitative manner, meaning that a few important matters particularly financial probity, good governance, and the full online and offline public self-disclosure of all finances, audits, procedures, infrastructure, faculty/staff, courses, and educational outcomes will be very effectively regulated. This information will have to be made available and kept updated and accurate by all higher education institutions on a public website maintained by NHERC and on the institutions’ websites. Any complaints or grievances from stakeholders and others arising out of the information placed in public domain shall be adjudicated by NHERC. Feedback from randomly selected students including differently-abled students at each HEI will be solicited online to ensure valuable input at regular intervals.

18.4. The primary mechanism to enable such regulation will be accreditation. The second vertical of HECI will, therefore, be a ‘meta-accrediting body’, called the National Accreditation Council (NAC). Accreditation of institutions will be based primarily on basic norms, public self-disclosure, good governance, and outcomes, and it will be carried out by an independent ecosystem of accrediting institutions supervised and overseen by NAC. The task to function as a recognized accreditor shall be awarded to an appropriate number of institutions by NAC. In the short term, a robust system of graded accreditation shall be established, which will specify phased benchmarks for all HEIs to achieve set levels of quality, self-governance, and autonomy. In turn, all HEIs will aim, through their Institutional Development Plans (IDPs), to attain the highest level of accreditation over the next 15 years, and thereby eventually aim to function as self-governing degree-granting institutions/clusters. In the long run, accreditation will become a binary process, as per the extant global practice.

18.5. The third vertical of HECI will be the Higher Education Grants Council (HEGC), which will carry out funding and financing of higher education based on transparent criteria, including the IDPs prepared by the institutions and the progress made on their implementation. HEGC will be entrusted with the disbursement of scholarships and developmental funds for launching new focus areas and expanding quality programme offerings at HEIs across disciplines and fields.

18.6. The fourth vertical of HECI will be the General Education Council (GEC), which will frame expected learning outcomes for higher education programmes, also referred to as ‘graduate attributes’. A National Higher Education Qualification Framework (NHEQF) will be formulated by the GEC and it shall be in sync with the National Skills Qualifications Framework (NSQF) to ease the integration of vocational education into higher education. Higher education qualifications leading to a degree/diploma/certificate shall be described by the NHEQF in terms of such learning outcomes. In addition, the GEC shall set up facilitative norms for issues, such as credit transfer, equivalence, etc., through the NHEQF. The GEC will be mandated to identify specific skills that students must acquire during their academic programmes, with the aim of preparing well-rounded learners with 21<sup>st</sup> century skills.

18.7. The professional councils, such as the Indian Council for Agricultural Research (ICAR), Veterinary Council of India (VCI), National Council for Teacher Education (NCTE), Council of Architecture (CoA), National Council for Vocational Education and Training (NCVET) etc., will act



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as Professional Standard Setting Bodies (PSSBs). They will play a key role in the higher education system and will be invited to be members of the GEC. These bodies, after restructuring as PSSBs, will continue to draw the curricula, lay down academic standards and coordinate between teaching, research and extension of their domain/discipline, as members of the GEC. As members of the GEC, they would help in specifying the curriculum framework, within which HEIs may prepare their own curricula. Thus, PSSBs would also set the standards or expectations in particular fields of learning and practice while having no regulatory role. All HEIs will decide how their educational programmes respond to these standards, among other considerations, and would also be able to reach out for support from these standard-setting bodies or PSSBs, if needed.

18.8. Such a system architecture will ensure the principle of functional separation by eliminating conflicts of interests between different roles. It will also aim to empower HEIs, while ensuring that the few key essential matters are given due attention. Responsibility and accountability shall devolve to the HEIs concomitantly. No distinction in such expectations shall be made between public and private HEIs.

18.9. Such a transformation will require existing structures and institutions to reinvent themselves and undergo an evolution of sorts. The separation of functions would mean that each vertical within HECI would take on a new, single role which is relevant, meaningful, and important in the new regulatory scheme.

18.10. The functioning of all the independent verticals for Regulation (NHERC), Accreditation (NAC), Funding (HEGC), and Academic Standard Setting (GEC) and the overarching autonomous umbrella body (HECI) itself will be based on transparent public disclosure, and use technology extensively to reduce human interface to ensure efficiency and transparency in their work. The underlying principle will be that of a faceless and transparent regulatory intervention using technology. Strict compliance measures with stringent action, including penalties for false disclosure of mandated information, will be ensured so that Higher Education Institutions are conforming to the basic minimum norms and standards. HECI itself will be resolving disputes among the four verticals. Each vertical in HECI will be an independent body consisting of persons having high expertise in the relevant areas along with integrity, commitment, and a demonstrated track record of public service. HECI itself will be a small, independent body of eminent public-spirited experts in higher education, which will oversee and monitor the integrity and effective functioning of HECI. Suitable mechanisms will be created within HECI to carry out its functions, including adjudication.

18.11. Setting up new quality HEIs will also be made far easier by the regulatory regime, while ensuring with great effectiveness that these are set up with the spirit of public service and with due financial backing for long-term stability. HEIs performing exceptionally well will be helped by Central and State governments to expand their institutions, and thereby attain larger numbers of students and faculty as well as disciplines and programmes. Public Philanthropic Partnership models for HEIs may also be piloted with the aim to further expand access to high-quality higher education.

### **Curbing Commercialization of Education**

18.12. Multiple mechanisms with checks and balances will combat and stop the commercialization of higher education. This will be a key priority of the regulatory system. All education institutions will be held to similar standards of audit and disclosure as a 'not for profit' entity. Surpluses, if any, will be reinvested in the educational sector. There will be transparent public disclosure of all these financial matters with recourse to grievance-handling mechanisms to the general public. The accreditation system developed by NAC will provide a complementary check on this system, and NHERC will consider this as one of the key dimensions of its regulatory objective.

18.13. All HEIs - public and private - shall be treated on par within this regulatory regime. The regulatory regime shall encourage private philanthropic efforts in education. There will be common national guidelines for all legislative Acts that will form private HEIs. These common minimal guidelines will enable all such Acts to establish private HEIs, thus enabling common standards for

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private and public HEIs. These common guidelines will cover Good Governance, Financial Stability & Security, Educational Outcomes, and Transparency of Disclosures.

18.14. Private HEIs having a philanthropic and public-spirited intent will be encouraged through a progressive regime of fees determination. Transparent mechanisms for fixing of fees with an upper limit, for different types of institutions depending on their accreditation, will be developed so that individual institutions are not adversely affected. This will empower private HEIs to set fees for their programmes independently, though within the laid-out norms and the broad applicable regulatory mechanism. Private HEIs will be encouraged to offer freeships and scholarships in significant numbers to their students. All fees and charges set by private HEIs will be transparently and fully disclosed, and there shall be no arbitrary increases in these fees/charges during the period of enrolment of any student. This fee determining mechanism will ensure reasonable recovery of cost while ensuring that HEIs discharge their social obligations.

### **19. Effective Governance and Leadership for Higher Education Institutions**

19.1. It is effective governance and leadership that enables the creation of a culture of excellence and innovation in higher education institutions. The common feature of all world-class institutions globally including India has indeed been the existence of strong self-governance and outstanding merit-based appointments of institutional leaders.

19.2. Through a suitable system of graded accreditation and graded autonomy, and in a phased manner over a period of 15 years, all HEIs in India will aim to become independent self-governing institutions pursuing innovation and excellence. Measures will be taken at all HEIs to ensure leadership of the highest quality and promote an institutional culture of excellence. Upon receiving the appropriate graded accreditations that deem the institution ready for such a move, a Board of Governors (BoG) shall be established consisting of a group of highly qualified, competent, and dedicated individuals having proven capabilities and a strong sense of commitment to the institution. The BoG of an institution will be empowered to govern the institution free of any external interference, make all appointments including that of head of the institution, and take all decisions regarding governance. There shall be overarching legislation that will supersede any contravening provisions of other earlier legislation and would provide for constitution, appointment, modalities of functioning, rules and regulations, and the roles and responsibilities of the BoG. New members of the Board shall be identified by an expert committee appointed by the Board; and the selection of new members shall be carried out by the BoG itself. Equity considerations will also be taken care of while selecting the members. It is envisaged that all HEIs will be incentivized, supported, and mentored during this process, and shall aim to become autonomous and have such an empowered BoG by 2035.

19.3. The BoG shall be responsible and accountable to the stakeholders through transparent self-disclosures of all relevant records. It will be responsible for meeting all regulatory guidelines mandated by HECI through the National Higher Education Regulatory Council (NHERC).

19.4. All leadership positions and Heads of institutions will be offered to persons with high academic qualifications and demonstrated administrative and leadership capabilities along with abilities to manage complex situations. Leaders of an HEI will demonstrate strong alignment to Constitutional values and the overall vision of the institution, along with attributes such as a strong social commitment, belief in teamwork, pluralism, ability to work with diverse people, and a positive outlook. The selection shall be carried out by the BoG through a rigorous, impartial, merit-based, and competency-based process led by an Eminent Expert Committee (EEC) constituted by the BoG. While stability of tenure is important to ensure the development of a suitable culture, at the same time leadership succession will be planned with care to ensure that good practices that define an institution's processes do not end due to a change in leadership; leadership changes will come with sufficient overlaps, and not remain vacant, in order to ensure smooth transitions. Outstanding leaders will be identified and developed early, working their way through a ladder of leadership positions.

19.5. While being provided with adequate funding, legislative enablement, and autonomy in a phased manner, all HEIs, in turn, will display commitment to institutional excellence, engagement with their

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local communities, and the highest standards of financial probity and accountability. Each institution will make a strategic Institutional Development Plan on the basis of which institutions will develop initiatives, assess their own progress, and reach the goals set therein, which could then become the basis for further public funding. The IDP shall be prepared with the joint participation of Board members, institutional leaders, faculty, students, and staff.

### **Part III. OTHER KEY AREAS OF FOCUS**

#### **20. Professional Education**

20.1. Preparation of professionals must involve an education in the ethic and importance of public purpose, an education in the discipline, and an education for practice. It must centrally involve critical and interdisciplinary thinking, discussion, debate, research, and innovation. For this to be achieved, professional education should not take place in the isolation of one's specialty.

20.2. Professional education thus becomes an integral part of the overall higher education system. Stand-alone agricultural universities, legal universities, health science universities, technical universities, and stand-alone institutions in other fields, shall aim to become multidisciplinary institutions offering holistic and multidisciplinary education. All institutions offering either professional or general education will aim to organically evolve into institutions/clusters offering both seamlessly, and in an integrated manner by 2030.

20.3. Agricultural education with allied disciplines will be revived. Although Agricultural Universities comprise approximately 9% of all universities in the country, enrolment in agriculture and allied sciences is less than 1% of all enrolment in higher education. Both capacity and quality of agriculture and allied disciplines must be improved in order to increase agricultural productivity through better skilled graduates and technicians, innovative research, and market-based extension linked to technologies and practices. The preparation of professionals in agriculture and veterinary sciences through programmes integrated with general education will be increased sharply. The design of agricultural education will shift towards developing professionals with the ability to understand and use local knowledge, traditional knowledge, and emerging technologies while being cognizant of critical issues such as declining land productivity, climate change, food sufficiency for our growing population, etc. Institutions offering agricultural education must benefit the local community directly; one approach could be to set up Agricultural Technology Parks to promote technology incubation and dissemination and promote sustainable methodologies.

20.4. Legal education needs to be competitive globally, adopting best practices and embracing new technologies for wider access to and timely delivery of justice. At the same time, it must be informed and illuminated with Constitutional values of Justice - Social, Economic, and Political - and directed towards national reconstruction through instrumentation of democracy, rule of law, and human rights. The curricula for legal studies must reflect socio-cultural contexts along with, in an evidence-based manner, the history of legal thinking, principles of justice, the practice of jurisprudence, and other related content appropriately and adequately. State institutions offering law education must consider offering bilingual education for future lawyers and judges - in English and in the language of the State in which the institution is situated.

20.5. Healthcare education needs to be re-envisioned so that the duration, structure, and design of the educational programmes need to match the role requirements that graduates will play. Students will be assessed at regular intervals on well-defined parameters primarily required for working in primary care and in secondary hospitals. Given that people exercise pluralistic choices in healthcare, our healthcare education system must be integrative meaning thereby that all students of allopathic medical education must have a basic understanding of Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy (AYUSH), and vice versa. There shall also be a much greater emphasis on preventive healthcare and community medicine in all forms of healthcare education.

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20.6. Technical education includes degree and diploma programmes in, engineering, technology, management, architecture, town planning, pharmacy, hotel management, catering technology etc., which are critical to India's overall development. There will not only be a greater demand for well-qualified manpower in these sectors, it will also require closer collaborations between industry and higher education institutions to drive innovation and research in these fields. Furthermore, influence of technology on human endeavours is expected to erode the silos between technical education and other disciplines too. Technical education will, thus, also aim to be offered within multidisciplinary education institutions and programmes and have a renewed focus on opportunities to engage deeply with other disciplines. India must also take the lead in preparing professionals in cutting-edge areas that are fast gaining prominence, such as Artificial Intelligence (AI), 3-D machining, big data analysis, and machine learning, in addition to genomic studies, biotechnology, nanotechnology, neuroscience, with important applications to health, environment, and sustainable living that will be woven into undergraduate education for enhancing the employability of the youth.

### **21. Adult Education and Lifelong Learning**

21.1. The opportunity to attain foundational literacy, obtain an education, and pursue a livelihood must be viewed as basic rights of every citizen. Literacy and basic education open up whole new worlds of personal, civic, economic, and lifelong-learning opportunities for individuals that enable them to progress personally and professionally. At the level of society and the nation, literacy and basic education are powerful force multipliers which greatly enhance the success of all other developmental efforts. Worldwide data on nations indicate extremely high correlations between literacy rates and per capita GDP.

21.2. Meanwhile, being a non-literate member of a community, has innumerable disadvantages, including the inability to: carry out basic financial transactions; compare the quality/quantity of goods purchased against the price charged; fill out forms to apply for jobs, loans, services, etc.; comprehend public circulars and articles in the news media; use conventional and electronic mail to communicate and conduct business; make use of the internet and other technology to improve one's life and profession; comprehend directions and safety directives on the street, on medicines, etc.; help children with their education; be aware of one's basic rights and responsibilities as a citizen of India; appreciate works of literature; and pursue employment in medium or high-productivity sectors that require literacy. The abilities listed here are an illustrative list of outcomes to be achieved through adoption of innovative measures for Adult Education.

21.3. Extensive field studies and analyses, both in India and across the world, clearly demonstrate that volunteerism and community involvement and mobilization are key success factors of adult literacy programmes, in conjunction with political will, organizational structure, proper planning, adequate financial support, and high-quality capacity building of educators and volunteers. Successful literacy programmes result not only in the growth of literacy among adults, but also result in increased demand for education for all children in the community, as well as greater community contribution to positive social change. The National Literacy Mission, when it was launched in 1988, was largely based on the voluntary involvement and support of the people, and resulted in significant increases in national literacy during the period of 1991–2011, including among women, and also initiated dialogue and discussions on pertinent social issues of the day.

21.4. Strong and innovative government initiatives for adult education - in particular, to facilitate community involvement and the smooth and beneficial integration of technology - will be affected as soon as possible to expedite this all-important aim of achieving 100% literacy.

21.5. First, an outstanding adult education curriculum framework will be developed by a new and well-supported constituent body of the NCERT that is dedicated to adult education, so as to develop synergy with and build upon NCERT's existing expertise in establishing outstanding curricula for literacy, numeracy, basic education, vocational skills, and beyond. The curriculum framework for adult education will include at least five types of programmes, each with clearly defined outcomes: (a) foundational literacy and numeracy; (b) critical life skills (including financial literacy, digital literacy, commercial skills, health care and awareness, child care and education, and family welfare);

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(c) vocational skills development (with a view towards obtaining local employment); (d) basic education (including preparatory, middle, and secondary stage equivalency); and (e) continuing education (including engaging holistic adult education courses in arts, sciences, technology, culture, sports, and recreation, as well as other topics of interest or use to local learners, such as more advanced material on critical life skills). The framework would keep in mind that adults in many cases will require rather different teaching-learning methods and materials than those designed for children.

21.6. Second, suitable infrastructure will be ensured so that all interested adults will have access to adult education and lifelong learning. A key initiative in this direction will be to use schools/ school complexes after school hours and on weekends and public library spaces for adult education courses which will be ICT-equipped when possible and for other community engagement and enrichment activities. The sharing of infrastructure for school, higher, adult, and vocational education, and for other community and volunteer activities, will be critical for ensuring efficient use of both physical and human resources as well as for creating synergy among these five types of education and beyond. For these reasons, Adult Education Centres (AECs) could also be included within other public institutions such as HEIs, vocational training centres, etc.

21.7. Third, the instructors/educators will be required to deliver the curriculum framework to mature learners for all five types of adult education as described in the Adult Education Curriculum Framework. These instructors will be trained by the National, State, and district level resource support institutions to organize and lead learning activities at Adult Education Centres, as well as coordinate with volunteer instructors. Qualified community members including from HEIs as part of each HEI's mission to engage with their local communities will be encouraged and welcomed to take a short training course and volunteer, as adult literacy instructors, or to serve as one-on-one volunteer tutors, and will be recognized for their critical service to the nation. States will also work with NGOs and other community organizations to enhance efforts towards literacy and adult education.

21.8. Fourth, all efforts will be undertaken to ensure the participation of community members in adult education. Social workers/counsellors travelling through their communities to track and ensure participation of non-enrolled students and dropouts will also be requested, during their travels, to gather data of parents, adolescents, and others interested in adult education opportunities both as learners and as teachers/tutors. The social workers/counsellors will then connect them with local Adult Education Centres (AECs). Opportunities for adult education will also be widely publicized, through advertisements and announcements and through events and initiatives of NGOs and other local organizations.

21.9. Fifth, improving the availability and accessibility of books is essential to inculcating the habit of reading within our communities and educational institutions. This Policy recommends that all communities and educational institutions - schools, colleges, universities and public libraries - will be strengthened and modernized to ensure an adequate supply of books that cater to the needs and interests of all students, including persons with disabilities and other differently-abled persons. The Central and State governments will take steps to ensure that books are made accessible and affordable to all across the country including socio-economically disadvantaged areas as well as those living in rural and remote areas. Both public and private sector agencies/institutions will devise strategies to improve the quality and attractiveness of books published in all Indian languages. Steps will be taken to enhance online accessibility of library books and further broad basing of digital libraries. For ensuring vibrant libraries in communities and educational institutions, it will be imperative to make available adequate library staff and also devise appropriate career pathways and CPD for them. Other steps will include strengthening all existing libraries, setting up rural libraries and reading rooms in disadvantaged regions, making widely available reading material in Indian languages, opening children's libraries and mobile libraries, establishing social book clubs across India and across subjects, and fostering greater collaborations between education institutions and libraries.

21.10. Finally, technology will be leveraged to strengthen and even undertake the above initiatives. Quality technology-based options for adult learning such as apps, online courses/modules, satellite-based TV channels, online books, and ICT-equipped libraries and Adult Education Centres, etc. will

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be developed, through government and philanthropic initiatives as well as through crowd sourcing and competitions. In many cases, quality adult education could thereby be conducted in an online or blended mode.

### **22. Promotion of Indian Languages, Arts, and Culture**

22.1. India is a treasure trove of culture, developed over thousands of years and manifested in the form of arts, works of literature, customs, traditions, linguistic expressions, artefacts, heritage sites, and more. Crores of people from around the world partake in, enjoy, and benefit from this cultural wealth daily, in the form of visiting India for tourism, experiencing Indian hospitality, purchasing India's handicrafts and handmade textiles, reading the classical literature of India, practicing yoga and meditation, being inspired by Indian philosophy, participating in India's unique festivals, appreciating India's diverse music and art, and watching Indian films, amongst many other aspects. It is this cultural and natural wealth that truly makes India, "Incredible India", as per India's tourism slogan. The preservation and promotion of India's cultural wealth must be considered a high priority for the country, as it is truly important for the nation's identity as well as for its economy.

22.2. The promotion of Indian arts and culture is important not only for the nation but also for the individual. Cultural awareness and expression are among the major competencies considered important to develop in children, in order to provide them with a sense of identity, belonging, as well as an appreciation of other cultures and identities. It is through the development of a strong sense and knowledge of their own cultural history, arts, languages, and traditions that children can build a positive cultural identity and self-esteem. Thus, cultural awareness and expression are important contributors both to individual as well as societal well-being.

22.3. The arts form a major medium for imparting culture. The arts - besides strengthening cultural identity, awareness, and uplifting societies - are well known to enhance cognitive and creative abilities in individuals and increase individual happiness. The happiness/well-being, cognitive development, and cultural identity of individuals are important reasons that Indian arts of all kinds must be offered to students at all levels of education, starting with early childhood care and education.

22.4. Language, of course, is inextricably linked to art and culture. Different languages 'see' the world differently, and the structure of a language, therefore, determines a native speaker's perception of experience. In particular, languages influence the way people of a given culture speak with others, including with family members, authority figures, peers, and strangers, and influence the tone of conversation. The tone, perception of experience, and familiarity/'*apnapan*' inherent in conversations among speakers of a common language are a reflection and record of a culture. Culture is, thus, encased in our languages. Art, in the form of literature, plays, music, film, etc. cannot be fully appreciated without language. In order to preserve and promote culture, one must preserve and promote a culture's languages.

22.5. Unfortunately, Indian languages have not received their due attention and care, with the country losing over 220 languages in the last 50 years alone. UNESCO has declared 197 Indian languages as 'endangered'. Various unscripted languages are particularly in danger of becoming extinct. When senior member(s) of a tribe or community that speak such languages pass away, these languages often perish with them; too often, no concerted actions or measures are taken to preserve or record these rich languages/expressions of culture.

22.6. Moreover, even those languages of India that are not officially on such endangered lists, such as the 22 languages of Eighth Schedule of the Constitution of India, are facing serious difficulties on many fronts. Teaching and learning of Indian languages need to be integrated with school and higher education at every level. For languages to remain relevant and vibrant, there must be a steady stream of high-quality learning and print materials in these languages including textbooks, workbooks, videos, plays, poems, novels, magazines, etc. Languages must also have consistent official updates to their vocabularies and dictionaries, widely disseminated, so that the most current issues and concepts can be effectively discussed in these languages. Enabling such learning materials, print materials, and

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translations of important materials from world languages, and constantly updating vocabularies, are carried out by countries around the world for languages such as English, French, German, Hebrew, Korean, and Japanese. However, India has remained quite slow in producing such learning and print materials and dictionaries to help keep its languages optimally vibrant and current with integrity.

22.7. Additionally, there has been a severe scarcity of skilled language teachers in India, despite various measures being taken. Language-teaching too must be improved to be more experiential and to focus on the ability to converse and interact in the language and not just on the literature, vocabulary, and grammar of the language. Languages must be used more extensively for conversation and for teaching-learning.

22.8. A number of initiatives to foster languages, arts, and culture in school children have been discussed in Chapter 4, which include a greater emphasis on music, arts, and crafts throughout all levels of school; early implementation of the three-language formula to promote multilingualism; teaching in the home/local language wherever possible; conducting more experiential language learning; the hiring of outstanding local artists, writers, craftspersons, and other experts as master instructors in various subjects of local expertise; accurate inclusion of traditional Indian knowledge including tribal and other local knowledge throughout into the curriculum, across humanities, sciences, arts, crafts, and sports, whenever relevant; and a much greater flexibility in the curriculum, especially in secondary schools and in higher education, so that students can choose the ideal balance among courses for themselves to develop their own creative, artistic, cultural, and academic paths.

22.9. To enable the key latter initiatives, a number of further actions will be taken in tandem at the higher education level and beyond. First, to develop and teach many of the courses of the type mentioned above, an excellent team of teachers and faculty will have to be developed. Strong departments and programmes in Indian languages, comparative literature, creative writing, arts, music, philosophy, etc. will be launched and developed across the country, and degrees including 4-year B.Ed. dual degrees will be developed in these subjects. These departments and programmes will, in particular help to develop a large cadre of high-quality language teachers - as well as teachers of art, music, philosophy and writing - who will be needed around the country to carry out this Policy. The NRF will fund quality research in all these areas. Outstanding local artists and craftspersons will be hired as guest faculty to promote local music, art, languages, and handicraft, and to ensure that students are aware of the culture and local knowledge where they study. Every higher education institution and even every school or school complex will aim to have Artist(s)-in-Residence to expose students to art, creativity, and the rich treasures of the region/country.

22.10. More HEIs, and more programmes in higher education, will use the mother tongue/local language as a medium of instruction, and/or offer programmes bilingually, in order to increase access and GER and also to promote the strength, usage, and vibrancy of all Indian languages. Private HEIs too will be encouraged and incentivized to use Indian languages as medium of instruction and/or offer bilingual programmes. Four-year B.Ed. dual degree programmes offered bilingually will also help, e.g. in training cadres of science and mathematics teachers to teach science bilingually at schools across the country.

22.11. High-quality programmes and degrees in Translation and Interpretation, Art and Museum Administration, Archaeology, Artefact Conservation, Graphic Design, and Web Design within the higher education system will also be created. In order to preserve and promote its art and culture, develop high-quality materials in various Indian languages, conserve artefacts, develop highly qualified individuals to curate and run museums and heritage or tourist sites, thereby also vastly strengthening the tourism industry.

22.12. The Policy recognizes that the knowledge of the rich diversity of India should be imbibed first hand by learners. This would mean including simple activities, like touring by students to different parts of the country, which will not only give a boost to tourism but will also lead to an understanding and appreciation of diversity, culture, traditions and knowledge of different parts of India. Towards this direction under '*Ek Bharat Shrestha Bharat*', 100 tourist destinations in the country will be identified where educational institutions will send students to study these destinations and their

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history, scientific contributions, traditions, indigenous literature and knowledge, etc., as a part of augmenting their knowledge about these areas.

22.13. Creating such programmes and degrees in higher education, across the arts, languages, and humanities, will also come with expanded high-quality opportunities for employment that can make effective use of these qualifications. There are already hundreds of Academies, museums, art galleries, and heritage sites in dire need of qualified individuals for their effective functioning. As positions are filled with suitably qualified candidates, and further artefacts are procured and conserved, additional museums, including virtual museums/e-museums, galleries, and heritage sites may contribute to the conservation of our heritage as well as to India's tourism industry.

22.14. India will also urgently expand its translation and interpretation efforts in order to make high-quality learning materials and other important written and spoken material available to the public in various Indian and foreign languages. For this, an Indian Institute of Translation and Interpretation (IITI) will be established. Such an institute would provide a truly important service for the country, as well as employ numerous multilingual language and subject experts, and experts in translation and interpretation, which will help to promote all Indian languages. The IITI shall also make extensive use of technology to aid in its translation and interpretation efforts. The IITI could naturally grow with time, and be housed in multiple locations including in HEIs to facilitate collaborations with other research departments as demand and the number of qualified candidates grows.

22.15. Due to its vast and significant contributions and literature across genres and subjects, its cultural significance, and its scientific nature, rather than being restricted to single-stream Sanskrit Pathshalas and Universities, Sanskrit will be mainstreamed with strong offerings in school - including as one of the language options in the three-language formula - as well as in higher education. It will be taught not in isolation, but in interesting and innovative ways, and connected to other contemporary and relevant subjects such as mathematics, astronomy, philosophy, linguistics, dramatics, yoga, etc. Thus, in consonance with the rest of this policy, Sanskrit Universities too will move towards becoming large multidisciplinary institutions of higher learning. Departments of Sanskrit that conduct teaching and outstanding interdisciplinary research on Sanskrit and Sanskrit Knowledge Systems will be established/strengthened across the new multidisciplinary higher education system. Sanskrit will become a natural part of a holistic multidisciplinary higher education if a student so chooses. Sanskrit teachers in large numbers will be professionalized across the country in mission mode through the offering of 4-year integrated multidisciplinary B.Ed. dual degrees in education and Sanskrit.

22.16. India will similarly expand its institutes and universities studying all classical languages and literature, with strong efforts to collect, preserve, translate, and study the tens of thousands of manuscripts that have not yet received their due attention. Sanskrit and all Indian language institutes and departments across the country will be significantly strengthened, with adequate training given to large new batches of students to study, in particular, the large numbers of manuscripts and their interrelations with other subjects. Classical language institutes will aim to be merged with universities, while maintaining their autonomy, so that faculty may work, and students too may be trained as part of robust and rigorous multidisciplinary programmes. Universities dedicated to languages will become multidisciplinary, towards the same end; where relevant, they may then also offer B.Ed. dual degrees in education and a language, to develop outstanding language teachers in that language. Further, it is also proposed that a new institution for Languages will be established. National Institute (or Institutes) for Pali, Persian and Prakrit will also be set up within a university campus. Similar initiatives will be carried out for institutes and universities studying Indian arts, art history, and Indology. Research for outstanding work in all these areas will be supported by the NRF.

22.17. Efforts to preserve and promote all Indian languages including classical, tribal and endangered languages will be taken on with new vigour. Technology and crowdsourcing, with extensive participation of the people, will play a crucial role in these efforts.

22.18. For each of the languages mentioned in the Eighth Schedule of the Constitution of India, Academies will be established consisting of some of the greatest scholars and native speakers to



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determine simple yet accurate vocabulary for the latest concepts, and to release the latest dictionaries on a regular basis (analogous to the successful efforts for many other languages around the world). The Academies would also consult with each other, and in some cases take the best suggestions from the public, in order to construct these dictionaries attempting to adopt common words whenever possible. These dictionaries would be widely disseminated, for use in education, journalism, writing, speechmaking, and beyond, and would be available on the web as well as in book form. These Academies for Eighth Schedule languages will be established by the Central Government in consultation or collaboration with State Governments. Academies for other highly spoken Indian languages may also be similarly established by the Centre and/or States.

22.19. All languages in India, and their associated arts and culture will be documented through a web-based platform/portal/wiki, in order to preserve endangered and all Indian languages and their associated rich local arts and culture. The platform will contain videos, dictionaries, recordings, and more, of people (especially elders) speaking the language, telling stories, reciting poetry, and performing plays, folk songs and dances, and more. People from across the country will be invited to contribute to these efforts by adding relevant material onto these platforms/portals/wikis. Universities and their research teams will work with each other and with communities across the country towards enriching such platforms. These preservation efforts, and the associated research projects, e.g., in history, archaeology, linguistics, etc., will be funded by the NRF.

22.20. Scholarships for people of all ages to study Indian Languages, Arts, and Culture with local masters and/or within the higher education system will be established. The promotion of Indian languages is possible only if they are used regularly and if they are used for teaching and learning. Incentives, such as prizes for outstanding poetry and prose in Indian languages across categories, will be established to ensure vibrant poetry, novels, nonfiction books, textbooks, journalism, and other works in all Indian languages. Proficiency in Indian languages will be included as part of qualification parameters for employment opportunities.

### **23. Technology Use and Integration**

23.1. India is a global leader in information and communication technology and in other cutting-edge domains, such as space. The Digital India Campaign is helping to transform the entire nation into a digitally empowered society and knowledge economy. While education will play a critical role in this transformation, technology itself will play an important role in the improvement of educational processes and outcomes; thus, the relationship between technology and education at all levels is bi-directional.

23.2. Given the explosive pace of technological development allied with the sheer creativity of tech-savvy teachers and entrepreneurs including student entrepreneurs, it is certain that technology will impact education in multiple ways, only some of which can be foreseen at the present time. New technologies involving artificial intelligence, machine learning, block chains, smart boards, handheld computing devices, adaptive computer testing for student development, and other forms of educational software and hardware will not just change what students learn in the classroom but how they learn, and thus these areas and beyond will require extensive research both on the technological as well as educational fronts.

23.3. Use and integration of technology to improve multiple aspects of education will be supported and adopted, provided these interventions are rigorously and transparently evaluated in relevant contexts before they are scaled up. An autonomous body, the National Educational Technology Forum (NETF), will be created to provide a platform for the free exchange of ideas on the use of technology to enhance learning, assessment, planning, administration, and so on, both for school and higher education. The aim of the NETF will be to facilitate decision making on the induction, deployment, and use of technology, by providing to the leadership of education institutions, State and Central governments, and other stakeholders, the latest knowledge and research as well as the opportunity to consult and share best practices. The NETF will have the following functions:

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- a) provide independent evidence-based advice to Central and State Government agencies on technology-based interventions;
- b) build intellectual and institutional capacities in educational technology;
- c) envision strategic thrust areas in this domain; and
- d) articulate new directions for research and innovation.

23.4. To remain relevant in the fast-changing field of educational technology, the NETF will maintain a regular inflow of authentic data from multiple sources including educational technology innovators and practitioners and will engage with a diverse set of researchers to analyze the data. To support the development of a vibrant body of knowledge and practice, the NETF will organize multiple regional and national conferences, workshops, etc. to solicit inputs from national and international educational technology researchers, entrepreneurs, and practitioners.

23.5. The thrust of technological interventions will be for the purposes of improving teaching-learning and evaluation processes, supporting teacher preparation and professional development, enhancing educational access, and streamlining educational planning, management, and administration including processes related to admissions, attendance, assessments, etc.

23.6. A rich variety of educational software, for all the above purposes, will be developed and made available for students and teachers at all levels. All such software will be available in all major Indian languages and will be accessible to a wide range of users including students in remote areas and *Divyang* students. Teaching-learning e-content will continue to be developed by all States in all regional languages, as well as by the NCERT, CIET, CBSE, NIOS, and other bodies/institutions, and will be uploaded onto the DIKSHA platform. This platform may also be utilized for Teacher's Professional Development through e-content. CIET will be strengthened to promote and expand DIKSHA as well as other education technology initiatives. Suitable equipment will be made available to teachers at schools so that teachers can suitably integrate e-content into teaching-learning practices. Technology-based education platforms, such as DIKSHA/SWAYAM, will be better integrated across school and higher education, and will include ratings/reviews by users, so as to enable content developers create user friendly and qualitative content.

23.7. Particular attention will need to be paid to emerging disruptive technologies that will necessarily transform the education system. When the 1986/1992 National Policy on Education was formulated, it was difficult to predict the disruptive effect that the internet would have brought. Our present education system's inability to cope with these rapid and disruptive changes places us individually and nationally at a perilous disadvantage in an increasingly competitive world. For example, while computers have largely surpassed humans in leveraging factual and procedural knowledge, our education at all levels excessively burdens students with such knowledge at the expense of developing their higher-order competencies.

23.8. This policy has been formulated at a time when an unquestionably disruptive technology - Artificial Intelligence (AI) 3D/7D Virtual Reality - has emerged. As the cost of AI-based prediction falls, AI will be able to match or outperform and, therefore, be a valuable aid to even skilled professionals such as doctors in certain predictive tasks. AI's disruptive potential in the workplace is clear, and the education system must be poised to respond quickly. One of the permanent tasks of the NETF will be to categorize emergent technologies based on their potential and estimated timeframe for disruption, and to periodically present this analysis to MHRD. Based on these inputs, MHRD will formally identify those technologies whose emergence demands responses from the education system.

23.9. In response to MHRD's formal recognition of a new disruptive technology, the National Research Foundation will initiate or expand research efforts in the technology. In the context of AI, NRF may consider a three-pronged approach: (a) advancing core AI research, (b) developing and deploying application-based research, and (c) advancing international research efforts to address global challenges in areas such as healthcare, agriculture, and climate change using AI.

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23.10. HEIs will play an active role not only in conducting research on disruptive technologies but also in creating initial versions of instructional materials and courses including online courses in cutting-edge domains and assessing their impact on specific areas such as professional education. Once the technology has attained a level of maturity, HEIs with thousands of students will be ideally placed to scale these teaching and skilling efforts, which will include targeted training for job readiness. Disruptive technologies will make certain jobs redundant, and hence approaches to skilling and deskilling that are both efficient and ensure quality will be of increasing importance to create and sustain employment. Institutions will have autonomy to approve institutional and non-institutional partners to deliver such training, which will be integrated with skills and higher education frameworks.

23.11. Universities will aim to offer Ph.D. and Masters programmes in core areas such as Machine Learning as well as multidisciplinary fields “AI + X” and professional areas like health care, agriculture, and law. They may also develop and disseminate courses in these areas via platforms, such as SWAYAM. For rapid adoption, HEIs may blend these online courses with traditional teaching in undergraduate and vocational programmes. HEIs may also offer targeted training in low-expertise tasks for supporting the AI value chain such as data annotation, image classification, and speech transcription. Efforts to teach languages to school students will be dovetailed with efforts to enhance Natural Language Processing for India’s diverse languages.

23.12. As disruptive technologies emerge, schooling and continuing education will assist in raising the general populace’s awareness of their potential disruptive effects and will also address related issues. This awareness is necessary to have informed public consent on matters related to these technologies. In school, the study of current affairs and ethical issues will include a discussion on disruptive technologies such as those identified by NETF/MHRD. Appropriate instructional and discussion materials will also be prepared for continuing education.

23.13. Data is a key fuel for AI-based technologies, and it is critical to raise awareness on issues of privacy, laws, and standards associated with data handling and data protection, etc. It is also necessary to highlight ethical issues surrounding the development and deployment of AI-based technologies. Education will play a key role in these awareness raising efforts. Other disruptive technologies that are expected to change the way we live, and, therefore, change the way we educate students, include those relating to clean and renewable energy, water conservation, sustainable farming, environmental preservation, and other green initiatives; these will also receive prioritized attention in education.

## **24. Online and Digital Education: Ensuring Equitable Use of Technology**

24.1. New circumstances and realities require new initiatives. The recent rise in epidemics and pandemics necessitates that we are ready with alternative modes of quality education whenever and wherever traditional and in-person modes of education are not possible. In this regard, the National Education Policy 2020 recognizes the importance of leveraging the advantages of technology while acknowledging its potential risks and dangers. It calls for carefully designed and appropriately scaled pilot studies to determine how the benefits of online/digital education can be reaped while addressing or mitigating the downsides. In the meantime, the existing digital platforms and ongoing ICT-based educational initiatives must be optimized and expanded to meet the current and future challenges in providing quality education for all.

24.2. However, the benefits of online/digital education cannot be leveraged unless the digital divide is eliminated through concerted efforts, such as the Digital India campaign and the availability of affordable computing devices. It is important that the use of technology for online and digital education adequately addresses concerns of equity.

24.3. Teachers require suitable training and development to be effective online educators. It cannot be assumed that a good teacher in a traditional classroom will automatically be a good teacher in an online classroom. Aside from changes required in pedagogy, online assessments also require a

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different approach. There are numerous challenges to conducting online examinations at scale, including limitations on the types of questions that can be asked in an online environment, handling network and power disruptions, and preventing unethical practices. Certain types of courses/subjects, such as performing arts and science practical have limitations in the online/digital education space, which can be overcome to a partial extent with innovative measures. Further, unless online education is blended with experiential and activity-based learning, it will tend to become a screen-based education with limited focus on the social, affective and psychomotor dimensions of learning.

24.4. Given the emergence of digital technologies and the emerging importance of leveraging technology for teaching-learning at all levels from school to higher education, this Policy recommends the following key initiatives:

- (a) **Pilot studies for online education:** Appropriate agencies, such as the NETF, CIET, NIOS, IGNOU, IITs, NITs, etc. will be identified to conduct a series of pilot studies, in parallel, to evaluate the benefits of integrating education with online education while mitigating the downsides and also to study related areas, such as, student device addiction, most preferred formats of e-content, etc. The results of these pilot studies will be publicly communicated and used for continuous improvement.
- (b) **Digital infrastructure:** There is a need to invest in creation of open, interoperable, evolvable, public digital infrastructure in the education sector that can be used by multiple platforms and point solutions, to solve for India's scale, diversity, complexity and device penetration. This will ensure that the technology-based solutions do not become outdated with the rapid advances in technology.
- (c) **Online teaching platform and tools:** Appropriate existing e-learning platforms such as SWAYAM, DIKSHA, will be extended to provide teachers with a structured, user-friendly, rich set of assistive tools for monitoring progress of learners. Tools, such as, two-way video and two-way-audio interface for holding online classes are a real necessity as the present pandemic has shown.
- (d) **Content creation, digital repository, and dissemination:** A digital repository of content including creation of coursework, Learning Games & Simulations, Augmented Reality and Virtual Reality will be developed, with a clear public system for ratings by users on effectiveness and quality. For fun based learning student-appropriate tools like apps, gamification of Indian art and culture, in multiple languages, with clear operating instructions, will also be created. A reliable backup mechanism for disseminating e-content to students will be provided.
- (e) **Addressing the digital divide:** Given the fact that there still persists a substantial section of the population whose digital access is highly limited, the existing mass media, such as television, radio, and community radio will be extensively used for telecast and broadcasts. Such educational programmes will be made available 24/7 in different languages to cater to the varying needs of the student population. A special focus on content in all Indian languages will be emphasized and required; digital content will need to reach the teachers and students in their medium of instruction as far as possible.
- (f) **Virtual Labs:** Existing e-learning platforms such as DIKSHA, SWAYAM and SWAYAMPARBHA will also be leveraged for creating virtual labs so that all students have equal access to quality practical and hands-on experiment-based learning experiences. The possibility of providing adequate access to SEDG students and teachers through suitable digital devices, such as tablets with pre-loaded content, will be considered and developed.
- (g) **Training and incentives for teachers:** Teachers will undergo rigorous training in learner-centric pedagogy and on how to become high-quality online content creators themselves using online teaching platforms and tools. There will be emphasis on the teacher's role in facilitating active student engagement with the content and with each other.

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- (h) **Online assessment and examinations:** Appropriate bodies, such as the proposed National Assessment Centre or PARAKH, School Boards, NTA, and other identified bodies will design and implement assessment frameworks encompassing design of competencies, portfolio, rubrics, standardized assessments, and assessment analytics. Studies will be undertaken to pilot new ways of assessment using education technologies focusing on 21<sup>st</sup> century skills.
- (i) **Blended models of learning:** While promoting digital learning and education, the importance of face-to-face in-person learning is fully recognized. Accordingly, different effective models of blended learning will be identified for appropriate replication for different subjects.
- (j) **Laying down standards:** As research on online/digital education emerges, NETF and other appropriate bodies shall set up standards of content, technology, and pedagogy for online/digital teaching-learning. These standards will help to formulate guidelines for e-learning by States, Boards, schools and school complexes, HEIs, etc.

### **24.5 Creating a Dedicated Unit for Building of World Class, Digital Infrastructure, Educational Digital Content and Capacity**

Technology in education is a journey and not a destination and capacity will be needed to orchestrate the various ecosystem players to implement policy objectives. A dedicated unit for the purpose of orchestrating the building of digital infrastructure, digital content and capacity building will be created in the Ministry to look after the e-education needs of both school and higher education. Since technology is rapidly evolving, and needs specialists to deliver high quality e-learning, a vibrant ecosystem has to be encouraged to create solutions that not only solve India's challenges of scale, diversity, equity, but also evolve in keeping with the rapid changes in technology, whose half-life reduces with each passing year. This centre will, therefore, consist of experts drawn from the field of administration, education, educational technology, digital pedagogy and assessment, e-governance, etc.

## **Part IV. MAKING IT HAPPEN**

### **25. Strengthening the Central Advisory Board of Education**

25.1. Achieving successful implementation of this policy demands a long-term vision, availability of expertise on a sustained basis, and concerted action from all concerned encompassing National, State, institutional, and individual levels. In this context, the Policy recommends strengthening and empowering the Central Advisory Board of Education (CABE) which will have a much greater mandate and not only a forum for widespread consultation and examination of issues relating to educational and cultural development. The remodeled and rejuvenated CABE shall also be responsible for developing, articulating, evaluating, and revising the vision of education in the country on a continuous basis, in close collaboration with MHRD and the corresponding apex bodies of States. It shall also create and continuously review the institutional frameworks that shall help attain this vision.

25.2. To bring the focus back on education and learning, it is desirable that the Ministry of Human Resource Development (MHRD) be re-designated as the Ministry of Education (MoE).

### **26. Financing: Affordable and Quality Education for All**

26.1. The Policy commits to significantly raising educational investment, as there is no better investment towards a society's future than the high-quality education of our young people. Unfortunately, public expenditure on education in India has not come close to the recommended level of 6% of GDP, as envisaged by the 1968 Policy, reiterated in the Policy of 1986, and which was further reaffirmed in the 1992 review of the Policy. The current public (Government - Centre and States) expenditure on education in India has been around 4.43% of GDP (Analysis of Budgeted

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Expenditure 2017-18) and only around 10% of the total Government spending towards education (Economic Survey 2017-18). These numbers are far smaller than most developed and developing countries.

26.2. In order to attain the goal of education with excellence and the corresponding multitude of benefits to this Nation and its economy, this Policy unequivocally endorses and envisions a substantial increase in public investment in education by both the Central government and all State Governments. The Centre and the States will work together to increase the public investment in Education sector to reach 6% of GDP at the earliest. This is considered extremely critical for achieving the high-quality and equitable public education system that is truly needed for India's future economic, social, cultural, intellectual, and technological progress and growth.

26.3. In particular, financial support will be provided to various critical elements and components of education, such as ensuring universal access, learning resources, nutritional support, matters of student safety and well-being, adequate numbers of teachers and staff, teacher development, and support for all key initiatives towards equitable high-quality education for underprivileged and socio-economically disadvantaged groups.

26.4. In addition to one-time expenditures, primarily related to infrastructure and resources, this Policy identifies the following key long-term thrust areas for financing to cultivate an education system: (a) universal provisioning of quality early childhood care education; (b) ensuring foundational literacy and numeracy; (c) providing adequate and appropriate resourcing of school complexes/clusters; (d) providing food and nutrition (breakfast and midday meals); (e) investing in teacher education and continuing professional development of teachers; (f) revamping colleges and universities to foster excellence; (g) cultivating research; and (h) extensive use of technology and online education.

26.5. Even the low level of funding on education in India, is frequently not spent in a timely manner at the District/institution level, hampering the achievement of the intended targets of those funds. Hence, the need is to increase efficiency in use of available budget by suitable policy changes. Financial governance and management will focus on the smooth, timely, and appropriate flow of funds, and their usage with probity; administrative processes will be suitably amended and streamlined so that the disbursement mechanism may not lead to a high volume of unspent balances. The provisions of GFR, PFMS and 'Just in Time' release to implementing agencies will be followed for efficient use of government resources and avoiding parking of funds. Mechanism of performance-based funding to States / HEIs may be devised. Similarly, efficient mechanism will be ensured for the optimal allocation and utilization of funds earmarked for SEDGs. The new suggested regulatory regime, with clear separations of roles and transparent self-disclosures, empowerment and autonomy to institutions, and the appointment of outstanding and qualified experts to leadership positions will help to enable a far smoother, quicker, and more transparent flow of funds.

26.6. The Policy also calls for the rejuvenation, active promotion, and support for private philanthropic activity in the education sector. In particular, over and above the public budgetary support which would have been otherwise provided to them, any public institution can take initiatives towards raising private philanthropic funds to enhance educational experiences.

26.7. The matter of commercialization of education has been dealt with by the Policy through multiple relevant fronts, including: the 'light but tight' regulatory approach that mandates full public self-disclosure of finances, procedures, course and programme offerings, and educational outcomes; the substantial investment in public education; and mechanisms for good governance of all institutions, public and private. Similarly, opportunities for higher cost recovery without affecting the needy or deserving sections will also be explored.

## **27. Implementation**

27.1. Any policy's effectiveness depends on its implementation. Such implementation will require multiple initiatives and actions, which will have to be taken by multiple bodies in a synchronized and

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systematic manner. Therefore, the implementation of this Policy will be led by various bodies including MHRD, CABE, Union and State Governments, education-related Ministries, State Departments of Education, Boards, NTA, the regulatory bodies of school and higher education, NCERT, SCERTs, schools, and HEIs along with timelines and a plan for review, in order to ensure that the policy is implemented in its spirit and intent, through coherence in planning and synergy across all these bodies involved in education.

27.2. Implementation will be guided by the following principles. First, implementation of the spirit and intent of the Policy will be the most critical matter. Second, it is important to implement the policy initiatives in a phased manner, as each policy point has several steps, each of which requires the previous step to be implemented successfully. Third, prioritization will be important in ensuring optimal sequencing of policy points, and that the most critical and urgent actions are taken up first, thereby enabling a strong base. Fourth, comprehensiveness in implementation will be key; as this Policy is interconnected and holistic, only a full-fledged implementation, and not a piecemeal one, will ensure that the desired objectives are achieved. Fifth, since education is a concurrent subject, it will need careful planning, joint monitoring, and collaborative implementation between the Centre and States. Sixth, timely infusion of requisite resources - human, infrastructural, and financial - at the Central and State levels will be crucial for the satisfactory execution of the Policy. Finally, careful analysis and review of the linkages between multiple parallel implementation steps will be necessary in order to ensure effective dovetailing of all initiatives. This will also include early investment in some of the specific actions (such as the setting up of early childhood care and education infrastructure) that will be imperative to ensuring a strong base and a smooth progression for all subsequent programmes and actions.

27.3. Subject-wise implementation committees of experts in cooperation and consultation with other relevant Ministries will be set up at both the Central and State levels to develop detailed implementation plans for each aspect of this Policy in accordance with the above principles to achieve the goals of the Policy in a clear and phased manner. Yearly joint reviews of the progress of implementation of the policy, in accordance with the targets set for each action, will be conducted by designated teams constituted by MHRD and the States, and reviews will be shared with CABE. In the decade of 2030-40, the entire policy will be in an operational mode, following which another comprehensive review will be undertaken.

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**Abbreviations**

ABC	Academic Bank of Credit
AI	Artificial Intelligence
AC	Autonomous degree-granting College
AEC	Adult Education Centre
API	Application Programming Interface
AYUSH	Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy
B.Ed.	Bachelor of Education
BEO	Block Education Officer
BITE	Block Institute of Teacher Education
BoA	Board of Assessment
BoG	Board of Governors
BRC	Block Resource Centre
B.Voc	Bachelor of Vocational Education
CABE	Central Advisory Board of Education
CBCS	Choice Based Credit System
CBSE	Central Board of Secondary Education
CIET	Central Institute of Educational Technology
CMP	Career Management and Progression
CoA	Council of Architecture
CPD	Continuous Professional Development
CRC	Cluster Resource Centre
CWSN	Children With Special Needs
DAE	Department of Atomic Energy
DBT	Department of Biotechnology
DEO	District Education Officer
DIET	District Institute of Education and Training
DIKSHA	Digital Infrastructure for Knowledge Sharing
DSE	Directorate of School Education
DST	Department of Science and Technology
ECCE	Early Childhood Care and Education
EEC	Eminent Expert Committee
GCED	Global Citizenship Education
GDP	Gross Domestic Product
GEC	General Education Council
GER	Gross Enrolment Ratio
GFR	General Financial Rule
HECI	Higher Education Commission of India
HEGC	Higher Education Grants Council
HEI	Higher Education Institutions
ICAR	Indian Council of Agricultural Research
ICHR	Indian Council of Historical Research
ICMR	Indian Council of Medical Research
ICT	Information and Communication Technology
IDP	Institutional Development Plan
IGNOU	Indira Gandhi National Open University
IIM	Indian Institute of Management
IIT	Indian Institute of Technology
IITI	Indian Institute of Translation and Interpretation
ISL	Indian Sign Language
ITI	Industrial Training Institute
M.Ed.	Master of Education
MBBS	Bachelor of Medicine and Bachelor of Surgery
MERU	Multidisciplinary Education and Research Universities
MHFW	Ministry of Health and Family Welfare



## *National Education Policy 2020*

MHRD	Ministry of Human Resource Development
MoE	Ministry of Education
MOOC	Massive Open Online Course
MOU	Memorandum of Understanding
M. Phil	Master of Philosophy
MWCD	Ministry of Women and Child Development
NAC	National Accreditation Council
NAS	National Achievement Survey
NCC	National Cadet Corps
NCERT	National Council of Educational Research and Training
NCF	National Curriculum Framework
NCFSE	National Curriculum Framework for School Education
NCFTE	National Curriculum Framework for Teacher Education
NCIVE	National Committee for the Integration of Vocational Education
NCPFECCE	National Curricular and Pedagogical Framework for Early Childhood Care and Education
NCTE	National Council for Teacher Education
NCVET	National Council for Vocational Education and Training
NETF	National Educational Technology Forum
NGO	Non-Governmental Organization
NHEQF	National Higher Education Qualifications Framework
NHERC	National Higher Education Regulatory Council
NIOS	National Institute of Open Schooling
NIT	National Institute of Technology
NITI	National Institution for Transforming India
NPE	National Policy on Education
NPST	National Professional Standards for Teachers
NRF	National Research Foundation
NSQF	National Skills Qualifications Framework
NSSO	National Sample Survey Office
NTA	National Testing Agency
OBC	Other Backward Classes
ODL	Open and Distance Learning
PARAKH	Performance Assessment, Review and Analysis of Knowledge for Holistic development
PCI	Pharmacy Council of India
PFMS	Public Financial Management System
Ph.D	Doctor of Philosophy
PSSB	Professional Standard Setting Body
PTR	Pupil Teacher Ratio
R&I	Research and Innovation
RCI	Rehabilitation Council of India
RPWD	Rights of Persons with Disabilities
SAS	State Achievement Survey
SC	Scheduled Caste(s)
SCDP	School Complex/Cluster Development Plans
SCERT	State Council of Educational Research and Training
SCF	State Curricular Framework
SCMC	School Complex Management Committee
SDG	Sustainable Development Goal
SDP	School Development Plan
SEDG	Socio-Economically Disadvantaged Group
SEZ	Special Education Zone
SIOS	State Institutes of Open Schooling
SMC	School Management Committee
SQAAF	School Quality Assessment and Accreditation Framework
SSA	Sarva Shiksha Abhiyan
SSS	Simple Standard Sanskrit

## **National Education Policy 2020**

SSSA	State School Standards Authority
ST	Scheduled Tribe(s)
STEM	Science, Technology, Engineering, and Mathematics
STS	Sanskrit Through Sanskrit
SWAYAM	Study Webs of Active Learning for Young Aspiring Minds
TEI	Teacher Education Institution
TET	Teacher Eligibility Test
U-DISE	Unified District Information System for Education
UGC	University Grants Commission
UNESCO	United Nations Educational, Scientific and Cultural Organization
UT	Union Territory
VCI	Veterinary Council of India

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# Examination Reform Policy

# Examination Reform Policy



# Examination Reform Policy

November 2018

**ALL INDIA COUNCIL FOR TECHNICAL EDUCATION**  
Nelson Mandela Marg, Vasant Kunj, New Delhi-110070



# Examination Reform Policy

November 2018





# MESSAGE

AICTE is taking a multi-pronged approach to recalibrate the technical education in the country, to provide competent professionals. Challenged by keeping the pace of education with the advancements in the technology and industry needs, AICTE has pushed reforms by way of a model curriculum for various engineering disciplines, providing good quality self-learning content through MOOCs, framing a policy for the training of technical teachers 3-week student induction program and enunciating guidelines for the mandatory internship for student among others. Continuing with the streak, AICTE has now come out with an Examination Reform Policy, which would not only improve the quality of technical education in general but also examine the effectiveness of earlier initiatives of AICTE and also those on the anvil.

Evaluation, grading and certification in our system rest on examinations which play an important role in the progression of a learner on the learning path. The examinations not only indicate whether the desired learning outcomes have been achieved but also assess the level of achievements against benchmarks. Thus, examinations serve as checkpoints for both the learner and the external world, allowing appropriate certification to be issued reflecting the proficiency of an individual operating in socio-economic spheres.

This policy comes at a time when knowledge is freely available for creating resources, opportunities for more knowledge, which requires skill of higher order beyond remembering and comprehension. This policy intends to push the evaluation notches up on the Bloom's taxonomy and examine the learner for higher order cognitive skills to drive critical thinking, creativity and problem solving which have to be the attributes of any technical professional. It is hoped that this will also force necessary alignment in the teaching-learning processes on one hand to the bridging of the gap between theory and practicals on the other and prepare students for innovation and creativity.

We request the technical institutions and universities in the country to adopt this examination reform policy. To facilitate this, model question papers and question banks will be developed/ shared through AICTE website. With a view to impart momentum to this much-awaited reform, AICTE shall be conducting a series of training workshops for faculty, across the country.

We thank members of the committee led by Prof. Shettar, Vice-Chancellor, KLE University for developing the policy which will go a long way to enhance the employability ratio and also enable youngsters to become problem-solvers, innovators and job creators. We especially thank MHRD for providing guidance and support throughout the process of creation of this Policy.

**(Prof. Anil D. Sahasrabudhe)**



# PREFACE

Globalisation of the world economy and higher education are driving profound changes in engineering education system. Worldwide adaptation of Outcome-Based Education (OBE) framework and enhanced focus on higher-order learning and professional skills necessitates paradigm shift in traditional practices of curriculum design, education delivery and assessment. In recent years, worldwide sweeping reforms are being undertaken to bring about essential changes in engineering education in terms of what to teach (content) and how to teach (knowledge delivery) and how to assess (student learning).

Examinations/student assessments play a very important role in deciding the quality of education. The academic quality of examinations (question papers) in Indian engineering education system has been a matter of concern from a long time. This report attempts to bring out recommendations for reforms in examination system to meet challenges of emerging engineering education landscape.

The recommendations are presented in four sections. Beginning in Section-1, the most important drivers for examination reforms in Indian engineering education system are discussed. Section-2 brings out strategies to be adopted to align assessment with the desired student learning outcomes. A two-step method is proposed for mapping the examination questions with course outcomes. Section-3 highlights the necessity of designing question papers to test higher order abilities and skills. Application of blooms taxonomy framework to create an optimal structure of examination papers to test the different cognitive skills is discussed in detail. Challenge of assessing higher order abilities and professional skills through traditional examination system is brought out in Section-4. Several educational experiences and assessment opportunities are identified to overcome the challenges. Appendices contain the supplement material that is helpful for Universities/Colleges to implement recommendations.

At this juncture, reforms in examinations are critical for the improvement of the quality and relevance of Indian engineering education. It is hoped that the Report will be of use to Universities and Colleges to bring out the much-needed change. The cooperation received from AICTE officials in bringing out the Report is gratefully acknowledged.

Prof. Ashok S. Shettar

Prof. Rama Krishna Challa

Prof. Sanjay Agarwal

Prof. Upendra Pandel



# ACKNOWLEDGEMENT

The development of an outcome based Examination Reform Policy for technical education is a result of thoughtful deliberations, involving dedicated and specialized experts. This Policy has been framed to meet the expectations of an academically challenging environment, develop problem-solving skills by students, aligning with current global standards and to enrich the students learning to make them self-enablers and/or match job requirements on successful completion of their degree.

The performance-based new-age reforms in the examination will benefit each student for preparing him/her for success in the knowledge society. This will create proper mapping between program outcomes and assessment tools that lead to the accurate and reliable measurement of attainment of outcomes of the students. In short, the Policy focuses on providing the ability of student to understand the subject and apply the knowledge to real world problems.

We are thankful to the members of the committee Prof. Ashok S. Shettar, Prof. Rama Krishna Challa, Prof. Sanjay Agarwal and Prof. Upendra Pandel who were devotedly committed towards framing this Policy. We thank them for identifying Competencies and Performance Indicators (PIs) with Program Outcomes (POs); Sample Questions for all six levels of Bloom's Taxonomy; Model Question Papers for end semester examinations based on Bloom's Taxonomy; and Sample Scoring Rubrics for communication (written & oral), and assessment of design projects and semester mini projects.

Special thanks and gratitude to Prof. Anil D. Sahasrabdhe, Chairman; Prof M.P. Poonia, Vice Chairman and Prof. A.P. Mittal, Member Secretary, AICTE who have been pivotal in developing this Policy and encouraging throughout the process.

I appreciate the officers and officials of Policy & Academic Planning Bureau for their contribution and support in the exercise that has led to this Policy.

I also sincerely thank all officers and officials of AICTE, who have contributed in one way or other for the development of this Policy.

Thanking all once again and seeking continued support and also feedback on the Policy.

**(Prof. Rajive Kumar)**

Adviser-I

Policy & Academic Planning Bureau, AICTE



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# INTRODUCTION

Globalisation of the world economy and higher education are driving profound changes in engineering education system. There is a continuing need to dynamically adapt to these changes, to ensure that we remain competitive and can respond effectively to the challenges of globalisation. Future engineering graduates not only need to be knowledgeable in his/her discipline but also needs a new set of soft, professional skills and competencies [1].

In recent years, there have been essential changes in engineering education in terms of what to teach (content) and how to teach (knowledge delivery) and how to assess (student learning).

AICTE has already taken initiation to come out with model curriculum for engineering programs. The digital initiatives of MHRD and AICTE have made available very large number of MOOC courses through SWAYAM, that can help the colleges and teachers to adopt innovative methodologies in the delivery of course.

The present report focusses on the recommendations for reforms in examinations (assessment of student) in the context of emerging landscape of engineering education.

Examinations/student assessments play a very important role in deciding the quality of education. They must not only assess student's achievements (and grades) but also measure whether the desired learning outcomes have been achieved. The achievement of objectives and program outcomes are crucial and needs to be proven through accurate and reliable assessments.

The academic quality of examinations (question papers) in Indian engineering education system has been a matter of concern from a long time. It is widely acknowledged that “assessment drives learning”, what and how students learn depends to a major extent on how they think they will be assessed [2]. The question papers that require simple memory recall will not ensure deep, meaningful learning. High expectations for learning motivate the students to rise to the occasion. The assessment (examination) must embed those high expectations to ensure that the learner is motivated to attain them.

Considering the above imperatives, it is clear that reforms in Examinations are critical for improvement of the quality of Indian engineering education. The most important drivers for reforms in examination system of Indian engineering education are:

## 1. Adaptation of Outcome-Based Education Framework

Outcome-based education (OBE)- a performance-based approach has emerged as a major reform model in the global engineering education scenario [3]. The country that wants to be a signatory member of a multinational agreement for the mutual recognition of engineering degrees, i.e. the Washington Accord (WA) must implement OBE. This will be an endorsement that the engineering education system has demonstrated a strong, long-term commitment to quality assurance in producing engineers ready for industry practice in the international scene. Being signatory to the Washington Accord, Indian accreditation agency 'National Board of Accreditation (NBA)' has made it mandatory for engineering institutions to adapt OBE framework for their curriculum design, delivery and assessment. In OBE framework, the educational outcomes of a program are clearly and unambiguously specified. These determine the curriculum content and its organization, the teaching methods and strategies and the assessment process.

Though Indian Universities and Colleges have started adapting OBE framework for their engineering programs, the focus is limited to the curriculum design part, i.e. connecting curriculum components to the program outcomes. Very little attention is being given for connecting examination questions/assessment tools to the program outcomes. The absence of proper mapping between program outcomes and assessment tools lead to the inaccurate and unreliable measurement of attainment of outcomes by the students. This missing connect creates a big gap in the effective adaptation of OBE framework, making the whole exercise futile.

## 2. Importance of Higher-order Abilities and Professional Skills

In the present examination system, memorization occupies a dominant place. The recall of factual knowledge, though essential to any examination, is only one of several major abilities to be demonstrated by the graduates. The assessment process must also test higher level skills viz. ability to apply knowledge, solve complex problems, analyse, synthesise and design. Further, professional skills like the ability to communicate, work in teams, lifelong learning have become important elements for employability of the graduates [4]. It is important that the examinations also give appropriate weightage to the assessment of these higher-level skills and professional competencies.

Keeping in view of the above challenges and looking at some of the worldwide best practices in assessment, the present report comes up with several recommendations that can be used by Universities/Colleges to design their assessment strategies.

# ASSESSMENT STRATEGY FOR OUTCOME-BASED EDUCATION

## 1. Mapping Program Outcomes to Assessment (Examinations)

Graduate attributes (GAs) articulate the generic abilities to be looked for in a graduate of any undergraduate degree program. They form the Program Outcomes (POs) that reflect the skills, knowledge and abilities of graduates regardless of the field of study. This does not mean that POs are necessarily independent of disciplinary knowledge –rather, these qualities may be developed in various disciplinary contexts.

In outcome-based education, a “design down” process is employed which moves from POs to Course Outcomes (COs) and outcomes for individual learning experiences. Outcomes at each successive level need to be aligned with, and contribute to, the program outcomes.

Courses are the building blocks of a program. Teaching strategies, learning activities, assessments and resources should all be designed and organized to help students achieve the learning outcomes at the course level. In the assessment activities, students demonstrate their level of achievement of the course learning outcomes. In a constructively aligned program, the courses are carefully coordinated to ensure steady development or scaffolding from the introduction to mastery of the learning outcomes, leading to achievement of the intended POs. For the effectiveness of the program, the achievement of POs is crucial which needs to be proven through accurate and reliable assessments.

## 2. Two-step Process for Bringing Clarity to POs

POs give useful guidance at the program level for the curriculum design, delivery and assessment of student learning. However, they represent fairly high-level generic goals that are not directly measurable. Real observability and measurability of the POs at course level is very difficult. To connect high-level learning outcomes (POs) with course content, course outcomes and assessment, there is a necessity to bring further clarity and specificity to the program outcomes [5]. This can be achieved through the following two-step process of identifying Competencies and Performance Indicators (PI).

- (1) Identify Competencies to be attained: For each PO define competencies –different abilities implied by program outcome statement that would generally require different assessment measures. This helps us to create a shared understanding of the competencies we want students to achieve. They serve as an intermediate step to the creation of measurable indicators.

**Example:**

Program Outcome (Attribute 3)

**Design:**

PO3: Design/Development of Solutions: Design solutions for complex engineering problems and

design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

### **Competencies**

1. Demonstrate an ability to define a complex, open-ended problem in engineering terms.
  2. Demonstrate an ability to generate a diverse set of alternative design solutions.
  3. Demonstrate an ability to select the optimal design scheme for further development.
  4. Demonstrate an ability to advance an engineering design to the defined end state.
- (2) Define Performance Indicators: For each of the competencies identified, define performance Indicators (PIs) that are explicit statements of expectations of the student learning. They can act as measuring tools in assessment to understand the extent of attainment of outcomes. They can also be designed to determine the appropriate achievement level or competency of each indicator so that instructors can target and students can achieve the acceptable level of proficiency.

### **Example:**

For the Competency -2

Demonstrate an ability to generate a diverse set of alternative design solutions

### **Performance Indicators:**

1. Apply formal idea generation tools to develop multiple engineering design solutions
2. Build models, prototypes, algorithms to develop a diverse set of design solutions
3. Identify the functional and non-functional criteria for evaluation of alternate design solutions.

It should be noted that, when we consider the program outcome, it looks like, it can be achieved only in the Capstone project. But if we consider the competencies and performance indicators, we start seeing the opportunities of addressing them (and hence PO) in various courses of the program.

Once the above process is completed for the program, the assessment of COs for all the courses is designed by connecting assessment questions (used in various assessment tools) to the PIs. By following this process, where examination questions map with PIs, we get clarity and better resolution for the assessment of COs and POs. The pictorial representation of the process is given in Fig. 1

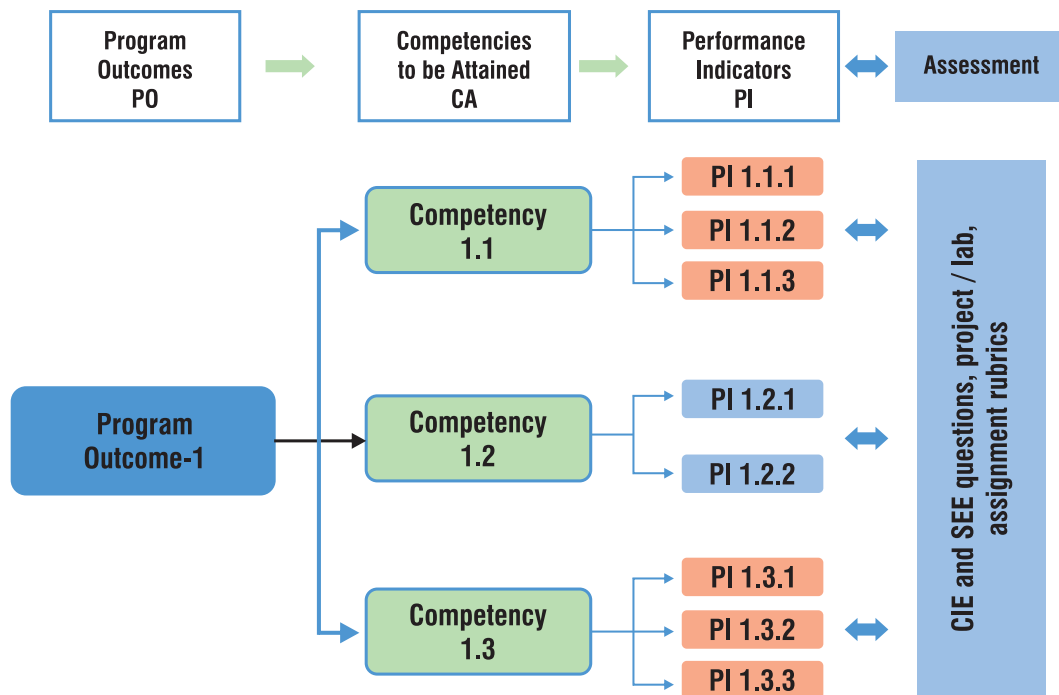


Fig. 1: Connecting POs to Assessment

### 3. Program Outcomes – Competencies – Performance Indicators

Following table gives the suggestive list of competencies and associated performance indicators for each of the PO in Mechanical Engineering Program.

<b>PO 1: Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.	
Competency	Indicators
1.1 Demonstrate competence in mathematical modelling	1.1.1 Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems 1.1.2 Apply advanced mathematical techniques to model and solve mechanical engineering problems
1.2 Demonstrate competence in basic sciences	1.2.1 Apply laws of natural science to an engineering problem
1.3 Demonstrate competence in engineering fundamentals	1.3.1 Apply fundamental engineering concepts to solve engineering problems
1.4 Demonstrate competence in specialized engineering knowledge to the program	1.4.1 Apply Mechanical engineering concepts to solve engineering problems.
<b>PO 2: Problem analysis:</b> Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	
Competency	Indicators
2.1 Demonstrate an ability to identify and formulate complex engineering problem	2.1.1 Articulate problem statements and identify objectives 2.1.2 Identify engineering systems, variables, and parameters to solve the problems 2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem

2.2	Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.1 Reframe complex problems into interconnected sub-problems 2.2.2 Identify, assemble and evaluate information and resources. 2.2.3 Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions 2.2.4 Compare and contrast alternative solution processes to select the best process.
2.3	Demonstrate an ability to formulate and interpret a model	2.3.1 Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy. 2.3.2 Identify assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required.
2.4	Demonstrate an ability to execute a solution process and analyze results	2.4.1 Apply engineering mathematics and computations to solve mathematical models 2.4.2 Produce and validate results through skilful use of contemporary engineering tools and models 2.4.3 Identify sources of error in the solution process, and limitations of the solution. 2.4.4 Extract desired understanding and conclusions consistent with objectives and limitations of the analysis

**PO 3: Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

Competency		Indicators	
3.1	Demonstrate an ability to define a complex/open-ended problem in engineering terms	3.1.1 Recognize that need analysis is key to good problem definition 3.1.2 Elicit and document, engineering requirements from stakeholders 3.1.3 Synthesize engineering requirements from a review of the state-of-the-art 3.1.4 Extract engineering requirements from relevant engineering Codes and Standards such as ASME, ASTM, BIS, ISO and ASHRAE. 3.1.5 Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues 3.1.6 Determine design objectives, functional requirements and arrive at specifications	
3.2	Demonstrate an ability to generate a diverse set of alternative design solutions	3.2.1 Apply formal idea generation tools to develop multiple engineering design solutions 3.2.2 Build models/prototypes to develop a diverse set of design solutions 3.2.3 Identify suitable criteria for the evaluation of alternate design solutions	
3.3	Demonstrate an ability to select an optimal design scheme for further development	3.3.1 Apply formal decision-making tools to select optimal engineering design solutions for further development 3.3.2 Consult with domain experts and stakeholders to select candidate engineering design solution for further development	
3.4	Demonstrate an ability to advance an engineering design to defined end state	3.4.1 Refine a conceptual design into a detailed design within the existing constraints (of the resources) 3.4.2 Generate information through appropriate tests to improve or revise the design	

**PO 4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Competency		Indicators	
4.1	Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding	4.1.1 Define a problem, its scope and importance for purposes of investigation 4.1.2 Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation 4.1.3 Apply appropriate instrumentation and/or software tools to make measurements of physical quantities 4.1.4 Establish a relationship between measured data and underlying physical principles.	

4.2	Demonstrate an ability to design experiments to solve open-ended problems	4.2.1 Design and develop an experimental approach, specify appropriate equipment and procedures 4.2.2 Understand the importance of the statistical design of experiments and choose an appropriate experimental design plan based on the study objectives
4.3	Demonstrate an ability to analyze data and reach a valid conclusion	4.3.1 Use appropriate procedures, tools and techniques to conduct experiments and collect data 4.3.2 Analyze data for trends and correlations, stating possible errors and limitations 4.3.3 Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions 4.3.4 Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions

**PO 5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Competency		Indicators
5.1	Demonstrate an ability to identify/ create modern engineering tools, techniques and resources	5.1.1 Identify modern engineering tools such as computer-aided drafting, modeling and analysis; techniques and resources for engineering activities 5.1.2 Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2	Demonstrate an ability to select and apply discipline-specific tools, techniques and resources	5.2.1 Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs. 5.2.2 Demonstrate proficiency in using discipline-specific tools
5.3	Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.3.1 Discuss limitations and validate tools, techniques and resources 5.3.2 Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.

**PO 6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Competency		Indicators
6.1	Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.1.1 Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level
6.2	Demonstrate an understanding of professional engineering regulations, legislation and standards	6.2.1 Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public

**PO 7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

Competency		Indicators
7.1	Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	7.1.1 Identify risks/impacts in the life-cycle of an engineering product or activity 7.1.2 Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability

7.2	Demonstrate an ability to apply principles of sustainable design and development	7.2.1 Describe management techniques for sustainable development 7.2.2 Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline
<b>PO 8: Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.		
<b>Competency</b>		<b>Indicators</b>
8.1	Demonstrate an ability to recognize ethical dilemmas	8.1.1 Identify situations of unethical professional conduct and propose ethical alternatives
8.2	Demonstrate an ability to apply the Code of Ethics	8.2.1 Identify tenets of the ASME professional code of ethics 8.2.2 Examine and apply moral & ethical principles to known case studies
<b>PO 9: Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.		
<b>Competency</b>		<b>Indicators</b>
9.1	Demonstrate an ability to form a team and define a role for each member	9.1.1 Recognize a variety of working and learning preferences; appreciate the value of diversity on a team 9.1.2 Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.2	Demonstrate effective individual and team operations--communication, problem-solving, conflict resolution and leadership skills	9.2.1 Demonstrate effective communication, problem-solving, conflict resolution and leadership skills 9.2.2 Treat other team members respectfully 9.2.3 Listen to other members 9.2.4 Maintain composure in difficult situations
9.3	Demonstrate success in a team-based project	9.3.1 Present results as a team, with smooth integration of contributions from all individual efforts
<b>PO 10: Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions		
<b>Competency</b>		<b>Indicators</b>
10.1	Demonstrate an ability to comprehend technical literature and document project work	10.1.1 Read, understand and interpret technical and non-technical information 10.1.2 Produce clear, well-constructed, and well-supported written engineering documents 10.1.3 Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
10.2	Demonstrate competence in listening, speaking, and presentation	10.2.1 Listen to and comprehend information, instructions, and viewpoints of others 10.2.2 Deliver effective oral presentations to technical and non-technical audiences
10.3	Demonstrate the ability to integrate different modes of communication	10.3.1 Create engineering-standard figures, reports and drawings to complement writing and presentations 10.3.2 Use a variety of media effectively to convey a message in a document or a presentation



**PO 11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Competency	Indicators
11.1 Demonstrate an ability to evaluate the economic and financial performance of an engineering activity	11.1.1 Describe various economic and financial costs/benefits of an engineering activity 11.1.2 Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.2 Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.2.1 Analyze and select the most appropriate proposal based on economic and financial considerations.
11.3 Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.3.1 Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks. 11.3.2 Use project management tools to schedule an engineering project, so it is completed on time and on budget.

**PO 12: Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Competency	Indicators
12.1 Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.1.1 Describe the rationale for the requirement for continuing professional development 12.1.2 Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
12.2 Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.2.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current 12.2.2 Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
12.3 Demonstrate an ability to identify and access sources for new information	12.3.1 Source and comprehend technical literature and other credible sources of information 12.3.2 Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

The above table can be used for most of the engineering programs. However, for Computer Science & Engineering/ Information Technology programs it requires some modifications.

**A suggestive list of competencies and associated performance indicators for Computer Science & Engineering/ Information Technology Programs is given in Appendix- A.**



# IMPROVING STRUCTURE AND QUALITY OF ASSESSMENTS

For improving the structure and quality of assessment in various engineering programs following points need to be remembered:

1. In Indian engineering education system, written examinations play a major role in assessing the learning and awarding of grades to the student. Universities and colleges give highest weightage to the outcomes of the written examinations in overall grading. Questions raised in the examination/test papers play an important role in defining the level of learning the student is expected to achieve in the courses and hence in the program. Since assessment drives learning, the design of question papers needs to go beyond the mere test of memory recall. They also need to test higher-order abilities and skills.
2. Written examinations assess a very limited range of outcomes and cognitive levels. Particularly in the courses, where course outcomes (COs) cover a broad range of expectations, written examinations alone will not be sufficient to make valid judgements about student learning. A wide range of assessment methods (e.g., term papers, open-ended problem-solving assignments, course/lab project rubrics, portfolios etc.) need to be employed to ensure that assessment methods match with learning outcomes.
3. It is advisable to formulate assessment plans for each of the course in the program that brings clarity to the following:
  - a. Alignment of assessment with learning outcome of the course
  - b. Level of learning (cognitive) student is expected to achieve
  - c. Assessment method to be adapted

The method to align examination questions/assessment to COs and hence POs was discussed in the section-1. The following sections discuss the application of Bloom's taxonomy framework to create the optimal structure of examination papers to test the different cognitive skills.

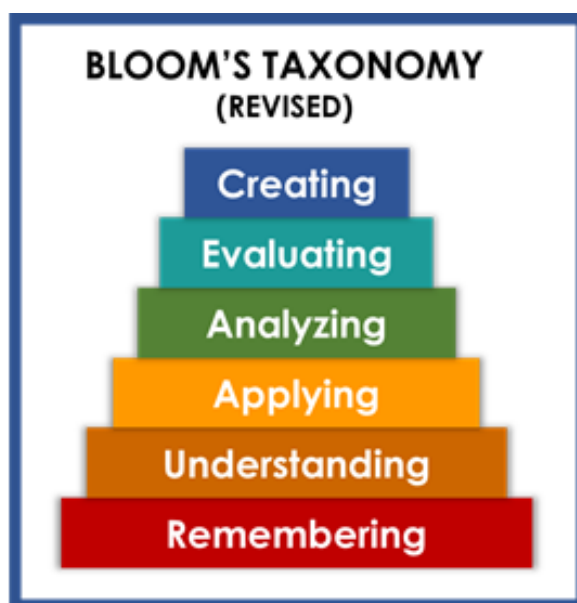
## 1. Bloom's Taxonomy for Assessment Design

Bloom's Taxonomy provides an important framework to not only design curriculum and teaching methodologies but also to design appropriate examination questions belonging to various cognitive levels. Bloom's Taxonomy of Educational Objectives developed in 1956 by Benjamin Bloom [6] was widely accepted by educators for curriculum design and assessment. In 2001, Anderson and Krathwohl modified Bloom's taxonomy [7] to make it relevant to the present-day requirements. It attempts to divide learning into three types of domains (cognitive, affective, and behavioural) and then defines the level of performance for each domain. Conscious efforts to map the curriculum and assessment to these levels can help the programs to aim for higher-level abilities which go beyond remembering or understanding, and require application, analysis, evaluation or creation.

Revised Bloom’s taxonomy in the cognitive domain includes thinking, knowledge, and application of knowledge. It is a popular framework in engineering education to structure the assessment as it characterizes complexity and higher-order abilities. It identifies six levels of competencies within the cognitive domain (Fig. 2) which are appropriate for the purposes of engineering educators.

According to revised Bloom’s taxonomy, the levels in the cognitive domain are as follows:

Level	Descriptor	Level of attainment
1	Remembering	Recalling from the memory of the previously learned material
2	Understanding	Explaining ideas or concepts
3	Applying	Using the information in another familiar situation
4	Analysing	Breaking information into the part to explore understandings and relationships
5	Evaluating	Justifying a decision or course of action
6	Creating	Generating new ideas, products or new ways of viewing things



**Fig. 2: Revised Bloom’s Taxonomy**

Bloom’s taxonomy is hierarchical, meaning that learning at the higher level requires that skills at a lower level are attained.

## 2. Action Verbs for Assessment

Choice of action verbs in constructing assessment questions is important to consider. Quite often, the action verbs are indicators of the complexity (level) of the question. Over time, educators have come up with a taxonomy of measurable verbs corresponding to each of the Bloom’s cognitive levels [8]. These verbs help us not only to describe and classify observable knowledge, skills and abilities but also to frame the examination or assignment questions that are appropriate to the level we are trying to assess.

Suggestive list of skills/ competencies to be demonstrated at each of the Bloom’s level and corresponding cues/ verbs for the examination/ test questions is given below:

Level	Skill Demonstrated	Question cues / Verbs for tests
1. Remember	<ul style="list-style-type: none"> <li>Ability to recall of information like facts, conventions, definitions, jargon, technical terms, classifications, categories, and criteria</li> <li>ability to recall methodology and procedures, abstractions, principles, and theories in the field</li> <li>knowledge of dates, events, places</li> <li>mastery of subject matter</li> </ul>	list, define, tell, describe, recite, recall, identify, show, label, tabulate, quote, name, who, when, where
2. Understand	<ul style="list-style-type: none"> <li>understanding information</li> <li>grasp meaning</li> <li>translate knowledge into new context</li> <li>interpret facts, compare, contrast</li> <li>order, group, infer causes</li> <li>predict consequences</li> </ul>	describe, explain, paraphrase, restate, associate, contrast, summarize, differentiate interpret, discuss
3. Apply	<ul style="list-style-type: none"> <li>use information</li> <li>use methods, concepts, laws, theories in new situations</li> <li>solve problems using required skills or knowledge</li> <li>Demonstrating correct usage of a method or procedure</li> </ul>	calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model, experiment, show, examine, modify
4. Analyse	<ul style="list-style-type: none"> <li>break down a complex problem into parts</li> <li>Identify the relationships and interaction between the different parts of a complex problem</li> <li>identify the missing information, sometimes the redundant information and the contradictory information, if any</li> </ul>	classify, outline, break down, categorize, analyze, diagram, illustrate, infer, select
5. Evaluate	<ul style="list-style-type: none"> <li>compare and discriminate between ideas</li> <li>assess value of theories, presentations</li> <li>make choices based on reasoned argument</li> <li>verify value of evidence</li> <li>recognize subjectivity</li> <li>use of definite criteria for judgments</li> </ul>	assess, decide, choose, rank, grade, test, measure, defend, recommend, convince, select, judge, support, conclude, argue, justify, compare, summarize, evaluate
6. Create	<ul style="list-style-type: none"> <li>use old ideas to create new ones</li> <li>Combine parts to make (new) whole,</li> <li>generalize from given facts</li> <li>relate knowledge from several areas</li> <li>predict, draw conclusions</li> </ul>	design, formulate, build, invent, create, compose, generate, derive, modify, develop, integrate

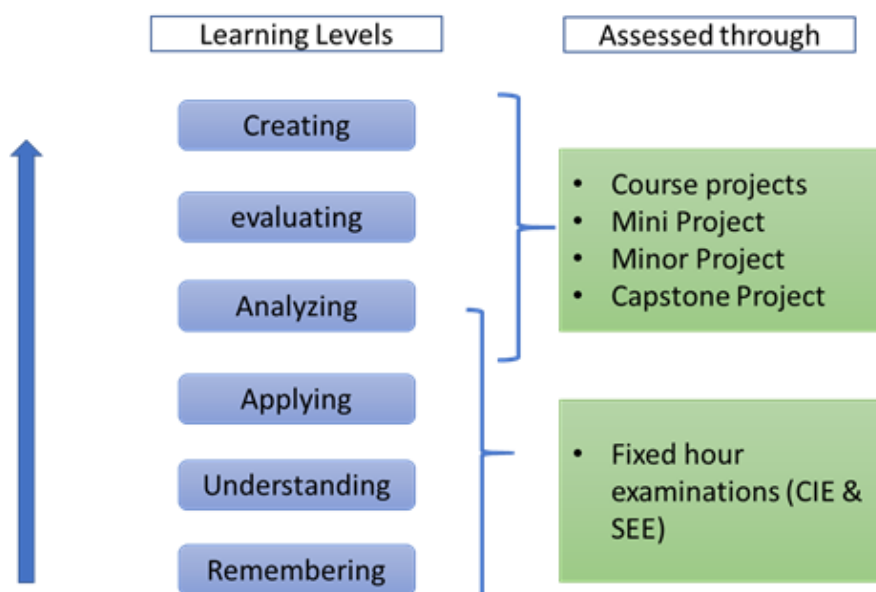
It may be noted that some of the verbs in the above table are associated with multiple Bloom's Taxonomy levels. These verbs are actions that could apply to different activities. We need to keep in mind that it's the skill, action or activity we need students to demonstrate that will determine the contextual meaning of the verb used in the assessment question.

### 3. Assessment Planning

While using Bloom's taxonomy framework in planning and designing of assessment of student learning, following points need to be considered:

1. Normally the first three learning levels; remembering, understanding and applying and to some extent fourth level analysing are assessed in the Continuous Internal Evaluation (CIE) and Semester End

Examinations (SEE), where students are given a limited amount of time. And abilities; analysis, evaluation and creation can be assessed in extended course works or in a variety of student works like course projects, mini/ minor projects, internship experience and final year projects.



**Fig. 3: Assessment methods for different Bloom's cognitive levels**

2. Before adopting this framework for reforms in examination system of a University/Institution, it is worthwhile to study the present pattern of assessment in each of the course in the program to gain insight about:
  - a) Alignment of assessment questions with course learning outcomes
  - b) Whether all the learning outcomes are tested; sometimes some learning outcomes are over tested at the expense of others which may be not tested at all.
  - c) Overall weightage in the assessment, to each of Bloom's learning levels
  - d) Assessment methods used to adequately assess the content and desired learning outcomes

Based on the study, improvement priorities for each of the above factors need to be arrived at. The reform process needs to be well planned and implemented through institutional strategy and communicated to all stakeholders particularly to the students.

3. A good and reasonable examination paper must consist of various difficulty levels to accommodate the different capabilities of students. Bloom's taxonomy framework helps the faculty to set examination papers that are well balanced, testing the different cognitive skills without a tilt towards a tough or easy paper perception. If the present examination questions are more focused towards lower cognitive skills, conscious efforts need to be made to bring in application skills or higher cognitive skills in the assessment. It is recommended that at institution/ University level, upper limit need to be arrived for lower order skills (for example, no more than 40% weightage for knowledge-oriented questions). It is important to note that, as nature of every course is different, the weightage for different cognitive levels in the question papers can also vary from course to course.
  - Examples of typical questions for each of Bloom's cognitive level are given in Appendix-B
  - Model Question Papers are given in Appendix- C

# ASSESSING HIGHER-ORDER ABILITIES & PROFESSIONAL SKILLS

In the 21st century, professional skills (also known as soft skills, generic skills or transferable skills) have emerged as important attributes of a graduate engineer. Studies show that Industry/ employers around the world value these abilities more than the disciplinary knowledge. This is also reflected in the NBA graduate attributes wherein six out of twelve attributes belong to this category, viz. (1) communication, (2) teamwork, (3) understanding ethics and professionalism, (4) understanding global and societal contexts, (5) lifelong learning, and (6) knowledge of contemporary issues. Further, higher-order cognitive abilities like critical thinking, problem-solving and making informed decisions are also crucial for a graduate to succeed in the emerging world. Though the employers consider these professional skills and higher abilities as important, students are weak in them. The main challenge surrounding them is that they are difficult to assess through existing conventional examination system.

## 1. Innovative Educational Experiences to Teach and Assess

One of the main obstacles in addressing these outcomes is the limitation of educational experience we create within our engineering programs. Most of the coursework in our programs are oriented towards teaching technical knowledge and skills; hence, the assessment is limited to those abilities. However, acquiring the professional outcomes may not result simply from participation in a particular class or set of classes. Rather, these outcomes are more often acquired or influenced through sources both in and outside the classroom [4].

To address these challenges, comprehensive reforms are needed in the way we design our curriculum, student learning experiences and assessment of the outcomes. Worldwide several attempts are being made to address these challenges. Following are the few educational experiences that are recommended to teach and assess professional outcomes and higher-order cognitive abilities:

- Course projects
- Open-ended experiments in laboratories
- Project-based learning modules
- MOOCs
- Co-Curricular experiences
- Mini / Minor projects
- Final year projects
- Internship experiences
- E-portfolios of student works

## 2. Using Scoring Rubrics as Assessment Tool

To evaluate the above, student works for attainment of course outcomes and hence POs, it is of

utmost importance to have reliable methods / proper assessment tools. Rubrics provide a powerful tool for assessment and grading of student work. They can also serve as a transparent and inspiring guide to learning. Rubrics are scoring, or grading tool used to measure a students' performance and learning across a set of criteria and objectives. Rubrics communicate to students (and to other markers) your expectations in the assessment, and what you consider important.

There are three components within rubrics namely (i) criteria / performance Indicator: the aspects of performance that will be assessed, (ii) descriptors: characteristics that are associated with each dimension, and (iii) scale/level of performance: a rating scale that defines students' level of mastery within each criterion.

Communication Skills				
	Unsatisfactory 1	Developing 2	Satisfactory 3	Exemplary 4
Performance criteria				
Performance criteria				
Performance criteria				
Performance criteria				
<b>Scales</b>				
<b>Dimensions</b>				
<b>Descriptors</b>				

Fig. 4: Examples of Rubrics (Accessed from Rogers 2010)

### 3. Open-Book Examinations

In the earlier sections it was noted that the traditional written examinations have a significant weakness that they tend to encourage rote learning and more superficial application of knowledge. This deficiency can be overcome by “open-book examination”. Open-book examination is similar to time constrained written examinations but designed in a way that allows students to refer to either class notes, textbooks, or other approved material while answering questions. They are particularly useful if you want to test skills in application, analysis and evaluation, i.e. higher levels of Bloom’s taxonomy. However, in a program, the courses or the curriculum areas that are best suited to an open-book exam are to be carefully chosen.

#### **Advantages of open-book examinations**

1. Less demanding on memory and hence less stressful
2. Questions can emphasise more on problem-solving, application of knowledge and higher-order thinking rather than simple recall of facts.
3. Assessment questions can reflect real-life situations that require comprehension, information retrieval and synthesising skills of the students to solve.

#### **Designing a good open-book examination**

- Set questions that require students to do things with the information available to them, rather than to merely locate the correct information and then summarize or rewrite it.
- The questions in open-book exam must take advantage of the format, and give more weightage



to the application of knowledge, critical thinking and use of resources for solving real complex engineering problems.

- As the nature of questions is complex, it is to be ensured that the students get enough time. Open book test questions typically take longer time compared to traditional examinations. It is advisable either to set less number of questions that encompass 2 or 3 concepts taught or allocate longer duration of time for the examinations.

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# APPENDIX

Competencies and Performance Indicators (PIs)

Computer Science & Engineering/Information Technology Programs

## Appendix-A

**PO 1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.

Competency	Indicators
1.2 Demonstrate competence in mathematical modelling	1.2.1 Apply the knowledge of discrete structures, linear algebra, statistics and numerical techniques to solve problems 1.2.2 Apply the concepts of probability, statistics and queuing theory in modeling of computer-based system, data and network protocols.
1.5 Demonstrate competence in basic sciences	1.5.1 Apply laws of natural science to an engineering problem
1.6 Demonstrate competence in engineering fundamentals	1.6.1 Apply engineering fundamentals
1.7 Demonstrate competence in specialized engineering knowledge to the program	1.7.1 Apply theory and principles of computer science and engineering to solve an engineering problem

**PO 2: Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Competency	Indicators
2.1 Demonstrate an ability to identify and formulate complex engineering problem	2.5.1 Evaluate problem statements and identifies objectives 2.5.2 Identify processes/modules/algorithms of a computer-based system and parameters to solve a problem 2.5.3 Identify mathematical algorithmic knowledge that applies to a given problem
2.6 Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.6.1 Reframe the computer-based system into interconnected subsystems 2.6.2 Identify functionalities and computing resources. 2.6.3 Identify existing solution/methods to solve the problem, including forming justified approximations and assumptions 2.6.4 Compare and contrast alternative solution/methods to select the best methods 2.6.5 Compare and contrast alternative solution processes to select the best process.
2.7 Demonstrate an ability to formulate and interpret a model	2.7.1 Able to apply computer engineering principles to formulate modules of a system with required applicability and performance. 2.7.2 Identify design constraints for required performance criteria.
2.8 Demonstrate an ability to execute a solution process and analyze results	2.8.1 Applies engineering mathematics to implement the solution. 2.8.2 Analyze and interpret the results using contemporary tools. 2.8.3 Identify the limitations of the solution and sources/causes. 2.8.4 Arrive at conclusions with respect to the objectives.

**PO 3: Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

Competency	Indicators
3.5 Demonstrate an ability to define a complex/open-ended problem in engineering terms	3.5.1 Able to define a precise problem statement with objectives and scope. 3.5.2 Able to identify and document system requirements from stake- holders. 3.5.3 Able to review state-of-the-art literature to synthesize system requirements. 3.5.4 Able to choose appropriate quality attributes as defined by ISO/IEC/IEEE standard. 3.5.5 Explore and synthesize system requirements from larger social and professional concerns. 3.5.6 Able to develop software requirement specifications (SRS).
3.6 Demonstrate an ability to generate a diverse set of alternative design solutions	3.6.1 Able to explore design alternatives. 3.6.2 Able to produce a variety of potential design solutions suited to meet functional requirements. 3.6.3 Identify suitable non-functional requirements for evaluation of alternate design solutions.
3.7 Demonstrate an ability to select optimal design scheme for further development	3.7.1 Able to perform systematic evaluation of the degree to which several design concepts meet the criteria. 3.7.2 Consult with domain experts and stakeholders to select candidate engineering design solution for further development
3.8 Demonstrate an ability to advance an engineering design to defined end state	3.8.1 Able to refine architecture design into a detailed design within the existing constraints. 3.8.2 Able to implement and integrate the modules. 3.8.3 Able to verify the functionalities and validate the design.

**PO 4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Competency	Indicators
4.4 Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding	4.4.1 Define a problem for purposes of investigation, its scope and importance 4.4.2 Able to choose appropriate procedure/algorithm, dataset and test cases. 4.4.3 Able to choose appropriate hardware/software tools to conduct the experiment.
4.5 Demonstrate an ability to design experiments to solve open-ended problems	4.5.1 Design and develop appropriate procedures/methodologies based on the study objectives
4.6 Demonstrate an ability to analyze data and reach a valid conclusion	4.6.1 Use appropriate procedures, tools and techniques to collect and analyze data 4.6.2 Critically analyze data for trends and correlations, stating possible errors and limitations 4.6.3 Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions 4.6.4 Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions

**PO 5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Competency		Indicators	
5.4	Demonstrate an ability to identify/create modern engineering tools, techniques and resources	5.4.1	Identify modern engineering tools, techniques and resources for engineering activities
		5.4.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
5.5	Demonstrate an ability to select and apply discipline-specific tools, techniques and resources	5.5.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
		5.5.2	Demonstrate proficiency in using discipline-specific tools
5.6	Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.6.1	Discuss limitations and validate tools, techniques and resources
		5.6.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.

**PO 6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Competency		Indicators	
6.3	Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.3.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level
6.4	Demonstrate an understanding of professional engineering regulations, legislation and standards	6.4.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public

**PO 7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

Competency		Indicators	
7.3	Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	7.3.1	Identify risks/impacts in the life-cycle of an engineering product or activity
		7.3.2	Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
7.4	Demonstrate an ability to apply principles of sustainable design and development	7.4.1	Describe management techniques for sustainable development
		7.4.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline

**PO 8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Competency		Indicators	
8.3	Demonstrate an ability to recognize ethical dilemmas	8.3.1	Identify situations of unethical professional conduct and propose ethical alternatives

8.4	Demonstrate an ability to apply the Code of Ethics	8.4.1 Identify tenets of the ASME professional code of ethics 8.4.2 Examine and apply moral & ethical principles to known case studies
<b>PO 9: Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.		
<b>Competency</b>		<b>Indicators</b>
9.4	Demonstrate an ability to form a team and define a role for each member	9.4.1 Recognize a variety of working and learning preferences; appreciate the value of diversity on a team 9.4.2 Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.5	Demonstrate effective individual and team operations--communication, problem-solving, conflict resolution and leadership skills	9.5.1 Demonstrate effective communication, problem-solving, conflict resolution and leadership skills 9.5.2 Treat other team members respectfully 9.5.3 Listen to other members 9.5.4 Maintain composure in difficult situations
9.6	Demonstrate success in a team-based project	9.6.1 Present results as a team, with smooth integration of contributions from all individual efforts
<b>PO 10: Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions		
<b>Competency</b>		<b>Indicators</b>
10.4	Demonstrate an ability to comprehend technical literature and document project work	10.4.1 Read, understand and interpret technical and non-technical information 10.4.2 Produce clear, well-constructed, and well-supported written engineering documents 10.4.3 Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
10.5	Demonstrate competence in listening, speaking, and presentation	10.5.1 Listen to and comprehend information, instructions, and viewpoints of others 10.5.2 Deliver effective oral presentations to technical and non-technical audiences
10.6	Demonstrate the ability to integrate different modes of communication	10.6.1 Create engineering-standard figures, reports and drawings to complement writing and presentations 10.6.2 Use a variety of media effectively to convey a message in a document or a presentation
<b>PO 11: Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.		
<b>Competency</b>		<b>Indicators</b>
11.4	Demonstrate an ability to evaluate the economic and financial performance of an engineering activity	11.4.1 Describe various economic and financial costs/benefits of an engineering activity 11.4.2 Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.5	Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.5.1 Analyze and select the most appropriate proposal based on economic and financial considerations.

11.6 Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.6.1 Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks. 11.6.2 Use project management tools to schedule an engineering project, so it is completed on time and on budget.
<b>PO 12: Life-long learning:</b> Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	
<b>Competency</b>	<b>Indicators</b>
12.4 Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.4.1 Describe the rationale for the requirement for continuing professional development 12.4.2 Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
12.5 Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.5.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current 12.5.2 Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
12.6 Demonstrate an ability to identify and access sources for new information	12.6.1 Source and comprehend technical literature and other credible sources of information 12.6.2 Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.





# APPENDIX

Sample questions for Bloom's Taxonomy levels

## Appendix-B

### SAMPLES QUESTIONS FOR BLOOMS TAXONOMY LEVELS:

#### 1. REMEMBER

Skill Demonstrated	Question Ques / Verbs for tests
<ul style="list-style-type: none"><li>Ability to recall of information like, facts, conventions, definitions, jargon, technical terms, classifications, categories, and criteria</li><li>ability to recall methodology and procedures, abstractions, principles, and theories in the field</li><li>knowledge of dates, events, places</li><li>mastery of subject matter</li></ul>	list, define, describe, state, recite, recall, identify, show, label, tabulate, quote, name, who, when, where, etc.

#### Sample Questions:

1. State Ohm's law
2. List the physical and chemical properties of silicon
3. List the components of A/D converter
4. List the arithmetic operators available in C in increasing order of precedence.
5. Define the purpose of a constructor.
6. Define the terms: Sensible heat, Latent heat and Total heat of evaporation
7. List the assembler directives.
8. Describe the process of galvanisation and tinning
9. Write truth table and symbol of AND, OR, NOT, XNOR gates
10. Define the terms: Stress, Working stress and Factor of safety.
11. What is the difference between declaration and definition of a variable/function?
12. List the different storage class specifiers in C.
13. What is the use of local variables?
14. What is a pointer to a pointer?
15. What are the valid places for the keyword "break" to appear?
16. What is a self-referential structure?

## 2. UNDERSTAND

Skill Demonstrated	Question Ques / Verbs for tests
<ul style="list-style-type: none"><li>• understanding information</li><li>• grasp meaning</li><li>• translate knowledge into new context</li><li>• interpret facts, compare, contrast</li><li>• order, group, infer causes</li><li>• predict consequences</li></ul>	describe, explain, paraphrase, restate, associate, contrast, summarize, differentiate interpret, discuss

### Sample Questions:

1. Explain the importance of sustainability in Engineering design
2. Explain the behaviour of PN junction diode under different bias conditions
3. Describe the characteristics of SCR and transistor equivalent for a SCR
4. Explain the terms: Particle, Rigid body and Deformable body giving two examples for each.
5. How many values of the variable num must be used to completely test all branches of the following code fragment?

```
if (num>0)
    if (value<25)
    {
        value=10*num;
        if(num<12)
            value=value/10;
    }
else
    Value=20*num;
else
    Value=30*num
```

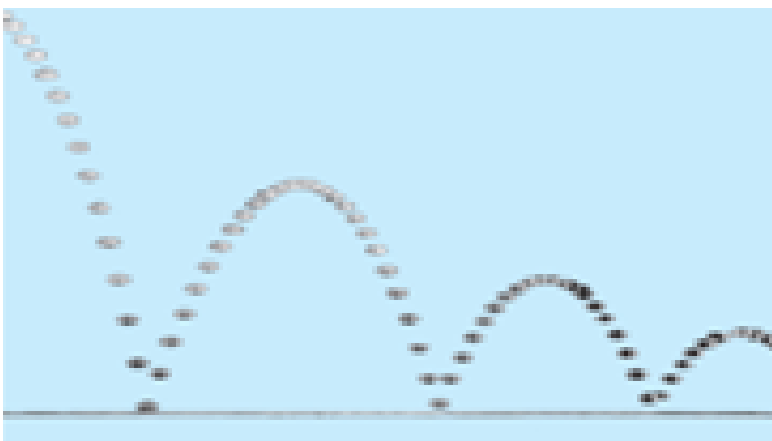
6. Discuss the effect of Make in India initiative on the Indian manufacturing Industry.
7. Summarise the importance of ethical code of conduct for engineering professionals
8. Explain the syntax for 'for loop'.
9. What is the difference between including the header file with-in angular braces < > and double quotes " "?
10. What is the meaning of base address of the array?
11. What is the difference between actual and formal parameters?
12. Explain the different ways of passing parameters to the functions.
13. Explain the use of comma operator (,).
14. Differentiate between entry and exit controlled loops.
15. How is an array different from linked list?

### 3. APPLY

Skill Demonstrated	Question Ques / Verbs for tests
<ul style="list-style-type: none"> <li>use information</li> <li>use methods, concepts, laws, theories in new situations</li> <li>solve problems using required skills or knowledge</li> <li>Demonstrating correct usage of a method or procedure</li> </ul>	calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model, experiment, show, examine, modify

#### Sample Questions:

- Model and realize the following behaviors using diodes with minimum number of digital inputs.
  - Turning on of a burglar alarm only during night time when the locker door is opened.
  - Providing access to an account if either date of birth or registered mobile number or both are correct.
  - Updating the parking slot empty light in the basement of a shopping mall.
- One of the resource persons needs to address a huge crowd (nearly 400 members) in the auditorium. A system is to be designed in such a way that everybody attending the session should be able to hear properly and clearly without any disturbance. Identify the suitable circuit to boost the voice signal and explain its functionality in brief.
- A ladder 5.0 m long rests on a horizontal ground & leans against a smooth vertical wall at an angle  $20^\circ$  with the vertical. The weight of the ladder is 900 N and acts at its middle. The ladder is at the point of sliding, when a man weighing 750 N stands on a rung 1.5 m from the bottom of the ladder. Calculate the coefficient of friction between the ladder & the floor.
- A ball is dropped from 6 meters above a flat surface. Each time the ball hits the surface after falling a distance  $h$ , it rebounds a distance  $rh$ . What will be the total distance the ball travels in each of the following cases.
  - $r > 1$
  - $0 < r < 1$
  - $r = 1$



- The region bounded by the curves  $y = e^{(-1)x}$ ,  $y = 0$ ,  $x = 1$ , and  $x = 5$  is rotated about the x-axis. Use Simpson's Rule with  $n = 8$  to estimate the volume of the resulting solid.
- An electric train is powered by machine which takes the supply from 220 V DC rail running above the train throughout. Machine draws current of 100 A from the DC rail to account for high torque during starting and runs at 700 r.p.m initially. Calculate the new speed of the train once it picks up the speed

where the torque output required is only 70% of starting torque. Assume the motor has a resistance of  $0.1\Omega$  across its terminals.

7. Write an algorithm to implement a stack using queue.
8. A single array  $A[1..MAXSIZE]$  is used to implement two stacks. The two stacks grow from opposite ends of the array. Variables  $top1$  and  $top2$  ( $top1 < top2$ ) point to the location of the topmost element in each of the stacks. What is the condition for “stack full”, if the space is to be used efficiently.
9. Consider the following table of arrival time and burst time for three processes P0, P1 and P2.

Process	Arrival time	Burst Time
P0	0 ms	9 ms
P1	1 ms	4 ms
P2	2 ms	9 ms

The pre-emptive shortest job first scheduling algorithm is used. Scheduling is carried out only at arrival or completion of processes. What is the average waiting time for the three processes?

10. A CPU generates 32-bit virtual addresses. The page size is 4 KB. The processor has a translation look-aside buffer (TLB) which can hold a total of 128-page table entries and is 4-way set associative. What is the minimum size of the TLB tag?

## 4. ANALYZE

Skill Demonstrated	Question Ques / Verbs for tests
<ul style="list-style-type: none"> <li>• break down a complex problem into parts.</li> <li>• Identify the relationships and interaction between the different parts of complex problem</li> </ul>	classify, outline, break down, categorize, analyse, diagram, illustrate, infer, select

### Sample Questions:

1. A class of 10 students consists of 5 males and 5 females. We intend to train a model based on their past scores to predict the future score. The average score of females is 60 whereas that of male is 80. The overall average of the class is 70. Give two ways of predicting the score and analyse them for fitting model.
2. Suppose that we want to select between two prediction models, M1 and M2. We have performed 10 rounds of 10-fold cross-validation on each model, whereas the same data partitioning in round one is used for both M1 and M2. The error rates obtained for M1 are 30.5, 32.2, 20.7, 20.6, 31.0, 41.0, 27.7, 26.0, 21.5, 26.0. The error rates for M2 are 22.4, 14.5, 22.4, 19.6, 20.7, 20.4, 22.1, 19.4, 16.2, 35.0. Comment on whether one model is significantly better than the other considering a significance level of 1%.
3. Return statement can only be used to return a single value. Can multiple values be returned from a function? Justify your answer.
4. Bob wrote a program using functions to find sum of two numbers whereas Alex wrote the statements to find the sum of two numbers in the main() function only. Which of the two methods is efficient in execution and why?
5. Carly wants to store the details of students studying in 1st year and later on wishes to retrieve the

information about the students who score the highest marks in each subject. Specify the scenario where the data can be organized as a single 2-D array or as multiple 1-D arrays.

6. Dave is working on a Campus Management Software but is unable to identify the maximum number of students per course. He decided to implement the same using arrays but discovered that there is memory wastage due to over-provisioning. Which method of memory storage should be used by Dave and how it can be implemented using C?
7. Albert is working on a 32-bit machine whereas Julie is working on a 64-bit machine. Both wrote the same code to find factorial of a number but Albert is unable to find factorial of a number till 9 whereas Julie is able to find the factorial of higher number. Identify the possible reason why Albert is unable to find the factorial. Suggest some changes in the code so that Albert can handle bigger inputs.
8. While writing a C code, the problem faced by the programmers is to find if the parenthesis is balanced or not. Write an algorithm to check if the parenthesis in C code are balanced. Initially your code should work for balanced { and } braces.
9. Swapping of the data in a linked list can be performed by swapping the contents in the linked list. Can the contents of a linked list be swapped without actually swapping the data?

## 5. EVALUATE

Skill Demonstrated	Question Ques / Verbs for tests
<ul style="list-style-type: none"> <li>• compare and discriminate between ideas</li> <li>• assess value of theories, presentations</li> <li>• make choices based on reasoned argument</li> <li>• verify value of evidence</li> <li>• recognize subjectivity</li> <li>• use of definite criteria for judgments</li> </ul>	assess, decide, choose, rank, grade, test, measure, defend, recommend, convince, select, judge, support, conclude, argue, justify, compare, summarize, evaluate

## 6. CREATE

Skill Demonstrated	Question Ques / Verbs for tests
<ul style="list-style-type: none"> <li>• use old ideas to create new ones</li> <li>• Combine parts to make (new) whole,</li> <li>• generalize from given facts</li> <li>• relate knowledge from several areas</li> <li>• predict, draw conclusions</li> </ul>	design, formulate, build, invent, create, compose, generate, derive, modify, develop, integrate

Both higher order cognitive skills 'Evaluate' and 'Create' are difficult to assess in time-limited examinations. These need to be assessed in variety of student works like projects, open ended problem-solving exercises etc. Typical examples of problem statements or need statements which need higher order abilities to solve are given below

### Sample Problem / Need statements:

1. Automatic tethering of milking machine to the udder of a cow. A milk diary wants to automate the milking process. The milking process involves attaching the milking cups to the teats. Design a system for the same.
2. An electric vehicle uses LiON batteries. The batteries have to be charged and get discharged during use.

The batteries require continuous monitoring during charging and discharging so that they remain healthy and yield a long life. Design a system to monitor and manage the health of the batteries.

3. A Biotech industry needs automation for filling its product into 20 ltr bottles. Design a system to meter the flow into the bottles so that each bottle has 20 ltr of the liquid. There will be more than one filling station and the system has to monitor all the filling stations as well as keep count of the total production on a daily basis.
4. Microwave Doppler radar with a range of 9m are available for motion detection. Design a surround view monitoring system for a 3 wheeler to detect human obstacles while the vehicle is in motion.
5. Design a system to assist the driver by using cameras to detect lane markers and pedestrians while the vehicle is in motion.
6. Develop a small size USB 2.0 / 3.0 CMOS camera system which can be used for industrial inspection, medical applications, microscopy, etc. The system should be able to capture the image quickly and be able to process the captured image and then store it also

# APPENDIX

## Model Question Papers

### Appendix-C

## MODEL QUESTION PAPER

Course: Programming for Problem solving (ESC 103)

Maximum Marks :100; Duration: 03 hours

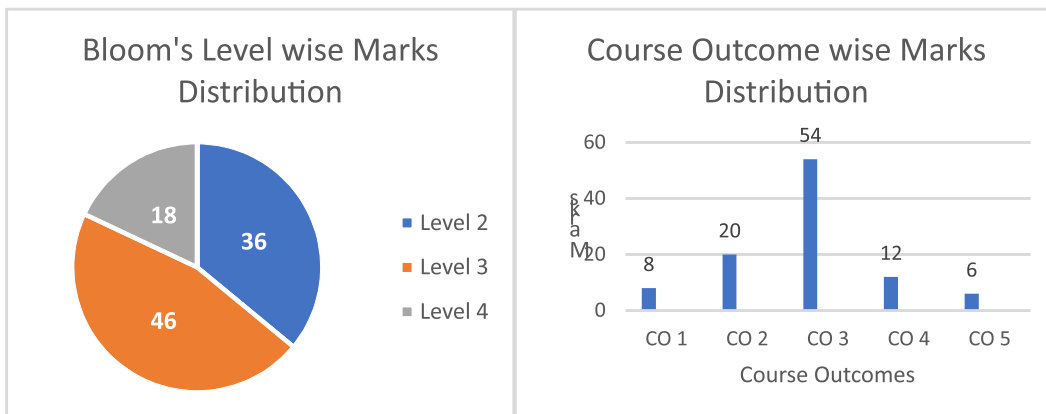
Q.No	Questions	Marks	CO	BL	PI
1(a)	Explain the steps involved in solving a problem using computer.	08	CO1	L2	1.4.1
1(b)	Write an algorithm to find roots of a quadratic equation $ax^2 + bx + c = 0$ reading the values of a, b and c.	12	CO2	L3	1.4.1
2(a)	Compare if-else-if and switch statement giving examples for their relevant use.	08	CO2	L2	1.4.1
2b	Write a C program that reads a given integer number and checks whether it a palindrome. A palindrome is a number that has same value even when it is reversed. Eg: 12321 is a palindrome.	12	CO3	L3	1.4.1
3a	Compare the working of three looping constructs of C language giving their syntax.	08	CO3	L2	1.4.1
3b	What does the following program do? <pre>#include &lt;stdio.h&gt; int main() {     char ch;     int vcnt = 0, ccnt=0;     for ( ch = getchar(); ch != '\n'; ch=getchar()){         if(ch=='a'    ch=='e'    ch=='i'    ch=='o'    ch=='u'               ch=='A'    ch=='E'    ch=='I'    ch=='O'    ch=='U')             vcnt++;         else if((ch &gt;= 'a' &amp;&amp; ch &lt;= 'z')    (ch &gt;= 'A' &amp;&amp; ch &lt;= 'Z'))             ccnt++;     }     printf( " %d  %d\n", vcnt, ccnt); }</pre> Rewrite the above program using while and switch constructs.	12	CO4	L4	1.4.1
4a	Compare call by value and call by reference with relevant examples.	8	CO3	L2	1.4.1
4b	Write a C function to find the largest and smallest in a given list of integers of size n using call by reference: void minmax( int list[ ], int n, int *min, int *max);	12	CO3	L3	1.4.1
5a	Explain at least four file handling operations available in C language giving their syntax.	4	CO3	L2	1.4.1
5b	Identify the bug in the following function written to return the swapped values of two integer variables given:				

	<pre>int swap( int *x, int *y) {   int *temp;   temp = x, x=y, y = temp; }</pre>	6	C05	L4	1.4.1
5c	Define a structure to store time with three components hours, mins and seconds. Write a modular C program to compute the time taken by an athlete to complete a marathon reading the start and end time of his run.	10	C03	L3	1.4.1

BL – Bloom’s Taxonomy Levels (1- Remembering, 2- Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 - Creating)

CO – Course Outcomes

PO – Program Outcomes; PI Code – Performance Indicator Code





## MODEL QUESTION PAPER FOR END SEMESTER EXAMINATION

**Course Name:** Programming for Problem Solving

**Duration:** 3 hrs. ; Max. Marks: 100

### Instructions:

- Attempt five questions selecting ONE from each section. Question 9 (Section E) is compulsory.
- All the questions carry equal marks.
- Draw neat diagrams wherever applicable.

Q. No	Question	Marks	BL	CO	PO	PI Code
<b>Section-A</b>						
1.	a. What is an algorithm? Explain the characteristics of an algorithm.	2+6	1,2	2	1	1.4.1
	b. Write an algorithm to find angle between hour and minute hands of a clock at a given time.	7	3	3	1	1.4.1
	c. Is it mandatory to declare main() function with return type as void or int. What will be the effect if there is no return type declared for main() function?	3+2	4	3	1	1.4.1
<b>OR</b>						
2.	a. What is the difference between definition and declaration in C? When a user writes "int x;" is it treated as declaration or definition in C.	3+2	2,4	3	1	1.4.1
	b. Write a program in C to find largest of 3 positive integer numbers using conditional operators.	7	3	3	1,2	1.4.1, 2.2.4
	c. What is meant by iterative statements? What are the different types of iterative statements in C?	8	1,2	3	1	1.4.1
<b>Section-B</b>						
3.	a. Bob has placed N objects in a row which are marked with a number equal to their weight in Kg. He wants to check whether the objects are in increasing order of their weights or not. Write a C program to help Bob.	12	3	3,6,7	1,2	1.4.1, 2.2.4
	b. Differentiate between Big-O and Big-Omega notation.	4	2	3	1	1.4.1
	c. What is the role of index in an array? How are the elements of a 2D array accessed in C?	2+2	2	3	1	1.4.1
<b>OR</b>						
4.	a. Ram is conducting a study which is based on counting the number of cars crossing the highway. Every hour he generates a random string containing sequence of characters <rbwbwr...>, where r represents red color, w denotes white color and b denotes blue color cars. The string is forwarded to Shyam for analysis who computes the number of red, blue and white color cars crossing Ram every hour. Assume that Ram works for 5 hours in a day, help Shyam generate a daily report containing the following: <ol style="list-style-type: none"> <li>Total number of different colour cars crossing Ram in an hour.</li> <li>Total number of different colour cars crossing Ram in a day.</li> <li>Total number of cars crossing Ram in a day.</li> </ol>	4+4+4	3	3,6,7	1,2	1.4.1, 2.2.4

	b. What is a variable? Explain the ways to declare scope of a variable.	2+6	1,2	3	1	1.4.1
<b>Section-C</b>						
5.	a. Write a program which will read positive integer numbers from the users and compute the sum if the number can be expressed as power of 2. The test whether a number can be expressed as power of 2 will be done using a function power_of_two(int a).	12	3	3,6,7	1,2	1.4.1
	b. What is recursion? Differentiate between homogeneous and heterogeneous recursion with the help of an example.	2+3+3	2	3	1	1.4.1
OR						
6.	a. What are the different ways to pass parameters to a function? Explain with the help of a suitable example.	4+4	2	3,5	1	1.4.1
	b. Is it possible to return multiple values from a function? Justify the statement with the help of an example.	4+8	3	3,6,7	1,2	1.4.1
<b>Section-D</b>						
7.	a. What is a structure? What is the benefit offered by using a structure over multiple arrays?	2+6	2	5	1	1.4.1
	b. Ram is working on a project which requires returning multiple values from a function. He observed that a return statement can only be used to return a single value from a function. How the function should be implemented so that multiple values can be returned by Ram?	12	4	5	1	1.4.1
OR						
8.	a. Write a program that reads a number as input from the user. The entered number is written to a file "even.txt" if the input is even else it is written to "odd.txt". Write a C code to perform the desired task.	12	3	5	1	1.4.1
	b. What are the different methods to open a file? Explain each with the help of a C program.	3+5	2	5	1	1.4.1
<b>Section-E (Compulsory Question)</b>						
9.	a. What is a compiler? List names of any 2 compilers.	2 ½	1	1	1	1.4.1
	b. What are the benefits of designing a flowchart for solving a problem?	2 ½	4	2	1	1.4.1
	c. What is the output of the following code? int main(){ int x=10; int y=sizeof(x/2); printf("%d",y); }	2 ½	3	4	1	1.4.1
	d. What is the difference between creating constant using #define macro and const keyword?	2 ½	3	3	1	1.4.1
	e. What is the role of function prototype? When is it required in C?	2 ½	2	3	1	1.4.1
	f. Which of the following are unary operators in C? State reason for your answer. a. ! b. sizeof c. ~ d. &&	2 ½	2	3	1	1.4.1

g. Which of the following special symbol allowed in a variable name? State reason for your answer. a. * (asterisk) b.   (pipeline) c. - (hyphen) d. _ (underscore)	2 ½	2	3	1	1.4.1
h. In which header file is the NULL macro defined? State reason for your answer. a. stdio.h b. stddef.h c. stdio.h and stddef.h d. math.h	2 ½	2	3	1	1.4.1

BL – Bloom’s Taxonomy Levels (1- Remembering, 2- Understanding, 3 – Applying, 4 – Analysing, 5 – Evaluating, 6 - Creating)

CO – Course Outcomes

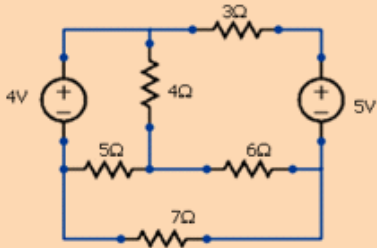
PO – Program Outcomes; PI Code – Performance Indicator Code

## MODEL QUESTION PAPER

**Total Duration (H:M): 3:00**

**Course :** Basic Electrical Engineering (ESC101)

**Maximum Marks :100**

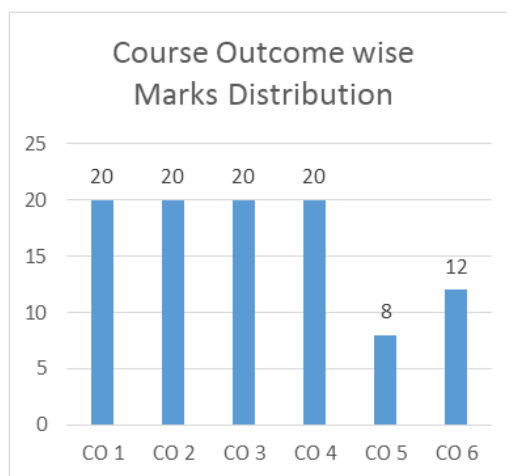
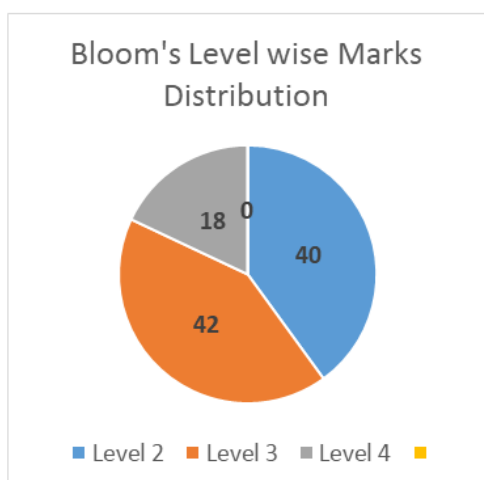
Q.No	Questions	Marks	CO	BL	PI
1(a)	Calculate current through 4 Ω resistor using Kirchoff’s Laws? Verify the same using Superposition Theorem. 	12	CO1	L3	1.3.1
1(b)	Derive the expression for the transient current in a series ‘R-L’ circuit when a ‘dc’ voltage of V volts is applied. Sketch time variation of current in the circuit.	8	CO1	L2	1.3.1
2(a)	Two impedances $Z_1 = 15 + j12\Omega$ and $Z_2 = 8 - j5\Omega$ are connected in parallel. If the potential difference across one of the impedance is 250 V, calculate i) total current and branch currents ii) total power and power consumed in each branch iii) overall p.f. IV) draw the phasor diagram	12	CO2	L3	1.3.1
2b	It is desired to operate a 100 W, 120 V, electric bulb at its rated current on a 240 V, 50 Hz supply. The simplest arrangement is to use either (a) a resistor, or (b) a capacitor or (c) an inductor having 10 Ω resistance in series with the electric bulb so as to drop the excess voltage. Determine the value of the component used, the total power consumed and the power factor in each case. Giving reasons, state which alternative is the best.	8	CO2	L4	1.3.1

3a	A single phase 25 kVA 1000/2000 V, 50 Hz transformer has maximum efficiency of 98% at full load upf. Determine its efficiency at, (a) 3/4th full load, unity power factor (b) 3/4th full load 0.8 power factor	12	C03	L3	1.3.1
3b	Explain the working of a practical transformer with relevant phasor diagram. and define voltage regulation.	8	C03	L2	1.3.1
4a	A two pole 3 phase 50 Hz induction motor is running on load with a slip of 4%. Calculate the actual speed and the synchronous speed of the machine. Sketch the speed/ load characteristic of the machine.	8	C04	L2	1.3.1
4b	A wireless battery powered drilling machine operates on 24 V DC with constant speed and negligible field current. Initially when the machine is powered it runs at 1200 rpm and draws 0.5 A from the battery. Further when the drill bit starts drilling the hole, the speed reduces to 1120 rpm. Determine power requirement from the battery for drilling if the resistance of the armature is 0.2Ω. What is the power drawn initially?	12	C04	L4	1.3.1
5a	Explain the working principle of a single phase pulse width modulated voltage source inverter with relevant circuit diagram and draw the output voltage wave form.	8	C05	L2	1.3.1
5b	To protect an expensive circuit component from being delivered too much power, you decide to incorporate a fast blowing fuse into the design. Knowing that the circuit component is connected to 12 V, its minimum power consumption is 12 watts and the maximum power it can safely dissipate is 100 watts, which of the three available fuse ratings should you select: 1A , 4A or 10 A? Give reasons.	6	C06	L4	1.3.1
5c	Calculate the i) ampere-hour and ii) watt-hour efficiency of a secondary cell which is discharged at a uniform rate of 30 A for 6 hours at an average terminal voltage of 2 V. It is then charged at a uniform rate of 40 A for 5 hours to restore it to its original condition. The terminal voltage during charging is 2.5 V.	6	C06	L3	1.3.1

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# APPENDIX

## Sample Scoring Rubrics

### Appendix-D

## RUBRICS FOR COMMUNICATION (WRITTEN & ORAL)

Component	Proficient	Acceptable	Needs Improvements
Written Communication	Report is well organized and clearly written. The underlying logic is clearly articulated and easy to follow. Words are chosen that precisely express the intended meaning and support reader comprehension. Diagrams or analyses enhance and clarify presentation of ideas. Sentences are grammatical and free from spelling errors.	Report is organized and clearly written for the most part. In some areas the logic or flow of ideas is difficult to follow. Words are well chosen with some minor exceptions. Diagrams are consistent with the text. Sentences are mostly grammatical and only a few spelling errors are present but they do not hinder the reader.	Report lacks an overall organization. Reader has to make considerable effort to understand the underlying logic and flow of ideas. Diagrams are absent or inconsistent with the text. Grammatical and spelling errors make it difficult for the reader to interpret the text in places.
Presentation Visual Aids	Slides are error-free and logically present the main components of the process and recommendations. Material is readable and the graphics highlight and support the main ideas.	Slides are error-free and logically present the main components of the process and recommendations. Material is mostly readable and graphics reiterate the main ideas.	Slides contain errors and lack a logical progression. Major aspects of the analysis or recommendations are absent. Diagrams or graphics are absent or confuse the audience.
Oral Presentation	Speakers are audible and fluent on their topic, and do not rely on notes to present or respond. Speakers respond accurately and appropriately to audience questions and comments.	Speakers are mostly audible and fluent on their topic, and require minimal referral to notes. Speakers respond to most questions accurately and appropriately.	Speakers are often inaudible or hesitant, often speaking in incomplete sentences. Speakers rely heavily on notes. Speakers have difficulty responding clearly and accurately to audience questions.
Body Language	Body language, as indicated by appropriate and meaningful gestures (e.g., drawing hands inward to convey contraction, moving arms up to convey lift, etc.) eye contact with audience, and movement, demonstrates a high level of comfort and connection with the audience.	Body language, as indicated by a slight tendency to repetitive and distracting gestures (e.g., tapping a pen, wringing hands, waving arms, clenching fists, etc.) and breaking eye contact with audience, demonstrates a slight discomfort with the audience.	Body language, as indicated by frequent, repetitive and distracting gestures, little or no audience eye-contact, and /or stiff posture and movement, indicate a high degree of discomfort interacting with audience.

## RUBRICS FOR ASSESSMENT OF DESIGN PROJECTS

Category	Needs Improvements	Acceptable	Proficient
Purpose of the Project	Does not clearly explain the intended outcome of the project or provides little information about the problem that was being solved, the need being met, or why the project was selected	Provides a description of the intended outcome of the project which includes information about the problem that was being solved or the need being met, and why the project was selected	Provides a detailed intended outcome of the project which includes information about the problem that was being solved or the need being met, and clearly articulates the reasons and decision-making process used to select the project
Research	Lacks awareness of similar work done by others in an unacceptable literary form	Reflects awareness of similar work done by others and presents it in an acceptable literary format	• Reflects thorough understanding of similar work done by others and presents it in an acceptable literary format
Choices	Lacks justification of choices with little or no references to functional, aesthetic, social, economic, or environmental considerations	Justifies choices made with reference to functional, aesthetic, social, economic, or environmental considerations	Demonstrates sophisticated justification of choices with reference to functional, aesthetic, social, economic, or environmental consideration
Alternative Designs	Only one design presented or clearly infeasible alternative given. Serious deficiencies in exploring and identifying alternative designs.	Alternative approaches identified to some degree.	Final design achieved after review of reasonable alternatives.
Application of Engineering Principles	No or erroneous application of engineering principles yielding unreasonable solution. Serious deficiencies in proper selection and use of engineering principles.	Effective application of engineering principles resulting in reasonable solution.	Critical selection and application of engineering principles ensuring reasonable results.
Final Design	Not capable of achieving desired objectives.	Design meets desired objectives.	Design meets or exceeds desired objectives.
Interpretation of Results	No or erroneous conclusions based on achieved results. Serious deficiencies in support for stated conclusions.	Sound conclusions reached based on achieved results.	Insightful, supported conclusions and recommendations.

Rubrics can also be used effectively to design the continuous assessment of the student projects. The Performance Indicators referred to in the previous sections can be used measurement criteria in the rubric. In the following example, we can see that for different phases of the students projects, we can design the rubrics keeping in mind the deliverables of the project at that particular stage.

## 5 - SEMESTER MINI PROJECT

### RUBRICS FOR REVIEW – I

PI Code	PI	Marks	Very Poor Up to 20%	Poor Up to 40%	Average Up to 60%	Good Up to 80%	Very good Up to 100%
2.1.1	Articulate problem statements and identify objectives - GA	02	Problem statement and objectives are not identified	Problem statement and objectives are not clear	Problem statement is clear and objectives are not in line with problem statement	Problem statement is clear and objectives are not completely defined.	Problem statement is clear and objectives are completely defined
2.1.2	Identify engineering systems, variables, and parameters to solve the problems - IA	02	Engineering systems are not identified. Variables, and parameters to solve the problems are not defined	Engineering systems are identified but not clear. Variables, and parameters to solve the problems are not defined	Engineering systems are clear. Variables, and parameters to solve the problems are not defined	Engineering systems are identified. Variables, and parameters to solve the problems are partially defined	Engineering systems are identified. Variables, and parameters to solve the problems are completely defined
2.2.3	Identify existing processes/ solution methods for solving the problem, including forming justified approximations and assumptions - GA	02	Not able to identify existing solution for solving the problem. The assumptions, approximations and justifications are also not identified.	Not able to identify existing solution for solving the problem. The assumptions, approximations and justifications are identified but not clear	Not able to identify existing solution for solving the problem. But assumptions and approximations are aligned to the objectives.	Able to identify existing solution for solving the problem. Assumptions, and approximations are clear	Able to identify existing solution for solving the problem. But assumptions, approximations and justifications are clear
2.2.4	Compare and contrast alternative solution processes to select the best process - GA	02	Not able to identify alternative solution processes	Not able to compare alternative solution processes	Able to compare alternative solution processes but could not contrast clearly	Able to compare alternative solution processes and contrast clearly but not able to select best process	Able to compare alternative solution processes, contrast it and also able to select best process
10.1.1	Read, understand and interpret technical and non-technical information - GA	02	Not able to identify technical and non-technical information	Able to identify non-technical information	Able to read technical and non-technical information, but could not understand and interpret	Able to read, understand technical and non-technical information, but could not interpret	Able to read, understand and interpret technical and non-technical information

## RUBRICS FOR REVIEW – II

PI Code	PI	Marks	Very Poor Up to 20%	Poor Up to 40%	Average Up to 60%	Good Up to 80%	Very good Up to 100%
3.2.1	Apply formal idea generation tools to develop multiple engineering design solutions - GA	02	Not able to identify tools to develop solutions	Able to identify but not able to use it effectively	Able to use the tool but not able to generate engineering designs	Able to generate engineering designs but not able to justify	Able to generate engineering designs with justification
3.2.3	Identify suitable criteria for evaluation of alternate design solutions - GA	02	Not able to identify criteria	Able to identify criteria but not able to use them	Able to use criteria but not able to compare alternatives	Not able to justify the comparison with criteria	Able to justify the comparison with criteria
3.3.1	Apply formal decision-making tools to select optimal engineering design solutions for further development - GA	02	Not able to identify decision-making tools	Able to identify but not able to choose optimum one	Able to identify optimum one but not able to use it	Able to use optimum one but not able to justify	Able to use optimum one with justification
3.2.2	Build models/ prototypes to develop diverse set of design solutions - IA	02	Not able to identify tool to build model/ prototype	Able to choose the tool but not able to use it effectively	Able to use the tool but not able to generate alternatives	Able to generate alternatives but not able to justify the best solution	Able to generate and justify the best solution
13.1.1	Develop 2D drawings of components/ systems using modern CAD tools - IA	02	Not able to identify CAD tools	Able to identify but not able to use CAD tool	Able to use CAD tool but not able to generate drawings	Able to generate drawings but not able to follow drawing standards	Able to generate drawings with standards
13.1.2	Develop 3D models of components/systems using modern CAD tools - IA	03	Not able to identify CAD tools	Able to identify but not able to use CAD tool	Able to use CAD tool but not able to generate 3D models	Able to generate models but not able to follow standards	Able to generate models with standards
13.1.3	Apply GD&T principles as per ASME standards to manufacturing drawings, with all relevant data like material, hardness, surface finish, and tolerances - IA	02	Not able to extract GD&T principles from ASME standards	Able to extract but not able to understand them	Able to understand but not able to apply GD&T standards	Able to apply GD&T standards to drawings but not able to justify	Able to apply and justify GD&T standards to drawings



**RUBRICS FOR REVIEW – III**

PI Code	PI	Marks	Very Poor Up to 20%	Poor Up to 40%	Average Up to 60%	Good Up to 80%	Very good Up to 100%
3.4.2	Generate information through appropriate tests to improve or revise design - GA	02	Not able to identify suitable tests to be done	Able to identify but not able to follow testing procedure	Able to follow testing procedures but not able to collect information	Able to collect information but not able to apply it for improvement	Able to apply information for the improvement
4.3.1	Use appropriate procedures, tools and techniques to conduct experiments and collect data - GA	04	Not able to identify tools, techniques and procedures	Able to identify but not able to conduct experiments	Able to conduct experiments but not able to follow procedure	Able to follow procedure but not able to collect data	Able to collect data as per the standards
4.3.2	Analyze data for trends and correlations, stating possible errors and limitations - GA	03	Not able to understand data	Able to understand but not able to analyze data	Able to analyze data but not able to correlate them	Able to correlate but not able to identify errors and limitations	Able to identify errors and limitations
10.2.2	Deliver effective oral presentations to technical and non-technical audiences - IA	03	Could not deliver effective presentations.	Could not deliver presentation, but presentation was prepared and attempted.	Able to deliver fair presentation but not able to answer to the audiences	Deliver effective presentations but able to answer partially to the audience queries.	Deliver effective presentation and able to answer all queries of the audience.
9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts – GA + IA	03	No Contribution from an individual to a team	Contributions from an individual to a team is minimal	Contributions from an individual to a team is moderate	A contribution from an individual to a team is good but not well groomed in team.	Contribution from an individual to a team is good and results in an integrated team presentation.

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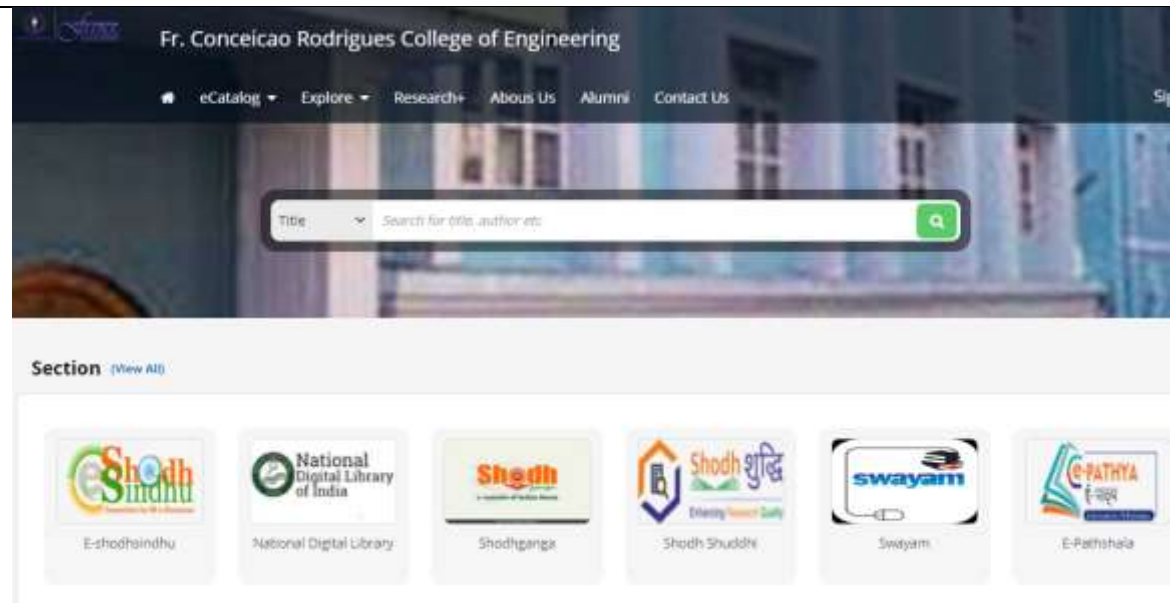




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