COURSE PLAN

Fr. CRCE (Mechanical) **Academic year: 2022-23**

Fr. Conceicao Rodrigues College Of Engineering

Father Agnel Ashram, Bandstand, Bandra-west, Mumbai-50

Department of Production & Mechanical Engineering

S.E. (Mechanical) (Semester III) (2022-2023)

Course Plan

Subject: Engineering Mathematics III **Credits – 03**

Syllabus Engineering Mathematics III

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II,

Objectives: The course is aimed

1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills
3. To familiarize with the concept of complex variables, C-R equations with applications.
4. To study the application of the knowledge of matrices and numerical methods in complex engineering problems.

Outcomes: On successful completion of course learner/student will be able to:

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.
5. Apply Matrix algebra to solve the engineering problems.
6. Solve Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and wave equations

Module	Detailed Contents	Hrs.
01	**Module: Laplace Transform** 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, 1.2 Laplace Transform (L) of Standard Functions like e^{at}, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and t^n , $where\ n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. **Self-learning topics:** Heaviside's Unit Step function, Laplace Transform. of Periodic functions, Dirac Delta Function.	**07**

02	**Module: Inverse Laplace Transform** 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivative 2.2 Partial fractions method & first shift property to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof) **Self-learning Topics:** Applications to solve initial and boundary value problems involving ordinary differential equations.	**06**

03	**Module: Fourier Series:** 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof) 3.2 Fourier series of periodic function with period 2π and $2l$, 3.3 Fourier series of even and odd functions 3.4 Half range Sine and Cosine Series. **Self-learning Topics:** Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform.	**07**
04	**Module: Complex Variables:** 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$, Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof), 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof) 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories **Self-learning Topics:** Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations	**07**
05	**Module: Matrices:** 5.1 Characteristic equation, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors. (**No theorems/ proof**) 5.2 Cayley-Hamilton theorem (without proof): Application to find the inverse of the given square matrix and to determine the given higher degree polynomial matrix. 5.3 Functions of square matrix 5.4 Similarity of matrices, Diagonalization of matrices **Self-learning Topics:** Verification of Cayley Hamilton theorem, Minimal polynomial and Derogatory matrix & Quadratic Forms (Congruent transformation & Orthogonal Reduction)	**06**

06	**Module: Numerical methods for PDE** 6.1 Introduction of Partial Differential equations, method of separation of variables, Vibrations of string, Analytical method for one dimensional heat and wave equations. (only problems) 6.2 Crank Nicholson method 6.3 Bender Schmidt method **Self-learning Topics:** Analytical methods of solving two and three dimensional problems.	**06**

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:

1. Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
3. Advanced Engineering Mathematics, R. K. Jain and S.R.K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, H.K. Das, S. Chand Publication
5. Higher Engineering Mathematics B.V. Ramana, McGraw Hill Education
6. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education,
7. Text book of Matrices, Shanti Narayan and P K Mittal, S. Chand Publication
8. Laplace transforms, Murray R. Spiegel, Schaum's Outline Series

Links for online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/111/104/111104085/
2. https://nptel.ac.in/courses/111/106/111106139/

Co No.	Course Outcomes
CO1	Obtain the Laplace Transform of given functions and evaluate the integral (in standard form) using Laplace Transform.
CO2	Obtain inverse Laplace Transform of given functions.
CO3	Expand the given periodic function in terms of sine and cosine terms in the given interval.
CO4	Construct the analytic function and also determine the orthogonal trajectories of the given family of curves.
CO5	Apply matrix algebra to solve engineering problems.
CO6	Solve partial differential equations using numerical methods and analytical solutions for one-dimensional heat and wave equations.

CO-PO Mapping	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3	3											
CO4	3											
CO5	3											
CO6	3											

COURSE PLAN

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Target = 2 for all COs

FINAL CO	**=**	**(0.8* Direct) + (0.2* Indirect)**

Direct	**CO1**	(0.1*Tutorial)+(0.3*Test) +(0.6*Univ Exam)
	CO2	(0.1*Tutorial)+(0.3*Test) +(0.6*Univ Exam)
	CO3	(0.1*Tutorial)+(0.3*Test) +(0.6*Univ Exam)
	CO4	(0.1*Tutorial)+(0.3*Test) +(0.6*Univ Exam)
	CO5	(0.4*Tutorial) +(0.6*Univ Exam)
	CO6	(0.4*Tutorial) +(0.6*Univ Exam)

Indirect	**CO1**	(1*Exit Survey)
	CO2	(1*Exit Survey)
	CO3	(1*Exit Survey)
	CO4	(1*Exit Survey)
	CO5	(1*Exit Survey)
	CO6	(1*Exit Survey)

LESSON PLAN (THEORY)

Note: - *Content beyond syllabus (**CBS**) is in **bold***

Weekly Plan	Topic	Module	Hours
Week 1 (25/07/22 – 29/07/22)	*Laplace Transform* Definition Examples based on the definition Change of scale First shifting theorem	1	4
Week 2 (01/08/22 – 05/08/22)	*Laplace Transform* Second shifting theorem Laplace transform of the derivative Laplace transform of the integration	1	4
Week 3 (08/08/22 – 12/08/22)	*Inverse Laplace transform* Definition Basic examples of finding the inverse Laplace transform	2	3
Week 4 (15/08/22 – 19/08/22)	*Inverse Laplace transform* Examples based on the method of partial fraction Convolution	2	2
Week 5	*Fourier Series*	3	3

(22/08/22 – 26/08/22)	Definition Examples of the interval $[0,2\pi]$ Even and Odd functions		
Week 6 (29/08/22 – 02/09/22)	*Fourier series* Examples of the interval $[0,2l]$ Half-range series Parseval's identity	3	2
Week 7 (05/09/22 – 09/09/22)	05-07 September UT 1	1 & 2	1
Week 8 (12/09/22 – 16/09/22)	*Complex Variable* Introduction, limit, continuity, and differentiation Cauchy-Riemann equations Examples of a function of a complex variable	4	3
Week 9 (19/09/22 – 23/09/22)	*Complex Variable* Analytic functions Path dependency Harmonic functions Milne-Thompson method	4	3
Week 10 (25/10/21 – 27/10/21)	*Matrices* Eigen values and eigen vectors of a matrix Properties of eigen values and eigen vectors	5	3
Week 11 (26/09/22 – 30/09/22)	*Matrices* Cayley-Hamilton theorem Diagonalization of a matrix	5	2
Week 12 (03/10/22 – 07/10/22)	*Partial Differential Equations* Method of separation of variables Vibrations of a string One-dimensional heat and wave equation	6	3
Week 13 (10/10/22 – 14/10/22)	*Partial Differential Equation* Crank Nicholson method Bender Schmidt method	6	2
Week 16 17/10/22-21/10/22	**UNIT TEST – 2**	3 & 4	1

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LESSON PLAN (TUTORIAL)

Weekly Plan	Topic	Module	Hours
Week 3 (08/08/22 – 12/08/22)	Tutorial 1: Laplace Transform	1	1
Week 4 (15/08/22 – 19/08/22)	Tutorial 2: Inverse Laplace Transform	2	1
Week 6 (29/08/22 – 02/09/22)	Tutorial 3: Fourier Series	3	1
Week 7 (05/09/22 – 09/09/22)	05-07 September UT 1	1 & 2	1
Week 8 (12/09/22 – 16/09/22)	Tutorial 4: Complex Variable	4	1
Week 10 (25/10/21 – 27/10/21)	Tutorial 5: Matrices Eigen values and eigen vectors of a matrix Properties of eigen values and eigen vectors	5	1
Week 12 (03/10/22 – 07/10/22)	Tutorial 6: Partial Differential Equations	6	1
Week 16 17/10/22- 21/10/22	**UNIT TEST – 2**	3 & 4	1

Rubrics for Tutorial

Indicator	Excellent	Good	Poor
Formulation of the problem (2)	Writing all formulae correctly (2)	One or two mistakes in the formulae (1)	Wrong formulae (0)
Stepwise explanation (3)	Explained all steps clearly (3)	One or two steps are left out (2)	Important steps are skipped (1)
Accuracy in solving (3)	Final answer obtained accurately (3)	Minor error in calculation (2)	Major error in calculations (1)
Overall presentation (2)	Introduce new methods of solving (2)	Systematic presentation (2)	Moderate presentation (1)

Rubrics for Mini Project

Each mini-project will be graded out of 10 with the following rubrics:

Indicator	Excellent	Good	Poor
Objectives of the project (2)	Well-defined objectives and steps to follow them (2)	Justifying objective without detailing (1)	Incomplete/unclear justification for the objective (0)
Analysis / Description of the project (3)	A Complete explanation of the key concepts with strong justification (3)	A Complete explanation of the key concepts with insufficient justification (2)	Incomplete justification (1)
Result Analysis (3)	A Complete explanation of the key concepts with strong justification (3)	A Complete explanation of the key concepts with insufficient justification (2)	Incomplete justification (1)
Conclusions (2)	Extensive knowledge and awareness of the project (2)	Sufficient knowledge and awareness of the project (1)	Insufficient knowledge and awareness of the project (0)

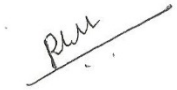
Text Books:

1. Engineering Mathematics-III (Mechanical Engineering) by G.V. Kumbhojkar, J. Jamnadas Publication

Reference Books:

1. Advance Engineering Mathematics by H.K. Dass, S. Chand & Company Limited
2. Advance Engineering Mathematics by Peter O' Neil, Cengage Learning

Verified by:



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