Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Technical Education Complex Bandstand,
Bandra Mumbai -400 050

Lesson Plan

ranch: Mechanical Engineering
Semester VIII

Year: 2022-23

Course Title:	Product Design and Development 3 Hours – Theory & Oral/Practical Examination
Total Contact Hours: 36 Hours	Duration of ESE: 3 Hrs
ESE Marks: 80 (Theory) + 20 (IA)	
Lesson Plan Author: Dr. Ketaki Joshi	Date:
Checked By: Dr Varsha Shaikh	Date: 16/01/2023

Prerequisites: machine design, material science, production processes

Syllabus:

Module	Detail	Hours
01	Need for developing products, The importance of Engineering and Industrial design, The design process, Relevance of product lifecycle issues in design, Societal considerations in Engineering and Industrial Design, Generic product development process, Various phases of product development, Planning for products, Establishing markets - market segments, relevance of market research.	7
02	The design processes, Descriptive and prescriptive design models, Concept development & evaluation, Pugh's total design activity model, Concept generation and selection method, Embodiment design, Product architecture, Steps in developing product architecture.	7
03	Identifying customer needs, Voice of Customer (VoC), Customer populations, Hierarchy of human needs, Need gathering methods, Establishing engineering characteristics, Competitive benchmarking, Quality Function Deployment (QFD), House of Quality (HoQ), [redacted] specification, Development of [redacted] with specifications using QFD, Relevant case studies.	7
04	Creative thinking, Creativity and problem-solving methods, Creative thinking methods, Brainstorming technique, Gorden technique, Check listing technique, Synectic technique, Morphological Analysis, and Attribute Listing technique. Generating design concepts, Systematic methods of designing.	7
05	Industrial design, Basic forms & elements, Integrating basic forms & elements such as balance, rhythm, proportion, The golden rule of proportions, human factors, and design, User-friendly design, Design for serviceability, Design for environment.	7
06	Concept of Design for Manufacturing and Assembly (DFMA). Role of computers in [redacted] and manufacturing process, Prototyping techniques such as Stereolithography (SLA), Selective laser sintering (SLS), Fused disposition Modelling (FDM), Laminated object manufacturing (LOM), 3-D printing, and Ballistic Particle Manufacturing (BPM).	7

Course Outcomes (CO):

On successful completion of course learner will be able to:

1. Describe the process of product design & development.
2. Employ engineering, scientific, and mathematical principles to develop and execute a design project from a concept to a finished product.
3. Create 3D solid models of mechanical components using CAD software.
4. Demonstrate individual skills using selected manufacturing techniques such as rapid prototyping.
5. Fabricate an electromechanical assembly of a product from engineering drawings.
6. Work collaboratively in a team to complete a design project and effectively communicate the results of projects and other assignments both in a written and oral format.

CO-PO Mapping: (BL – Blooms Taxonomy, C – Competency, PI – Performance Indicator)

CO	BL	C	PI	PO	Mapping
MEDLO8061.1 MEDLO8061.2 MEDLO8061.3 MEDLO8061.4 MEDLO8061.5	3	1.3 1.4	1.3.1 1.4.1	PO1	3
		2.1 2.2 2.41	2.1.2 2.1.3 2.2.1 2.4.1	PO2	3
		3.2 3.3 3.4	3.2.3 3.3.2 3.4.1	PO3	3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MEDLO8061.1	3	3	3	-	2	2	2	2	2	2	-	2
MEDLO8061.2	3	3	3	-	2	2	2	2	2	2	-	2
MEDLO8061.3	3	3	3	-	2	2	2	2	2	2	-	2
MEDLO8061.4	3	3	3	-	2	2	2	2	2	2	-	2
MEDLO8061.5	3	3	3	-	2	2	2	2	2	2	-	2
MEDLO8061.6	3	3	3	-	2	2	2	2	2	2	-	2

CO-PSO Mapping:

	PSO1	PSO2
MEDLO8061.1		2
MEDLO8061.2		2

MEDLO8061.3		2
MEDLO8061.4		2
MEDLO8061.5		2
MEDLO8061.6		2

CO attainment value for students above targets values:

CO	Tool	Target Value %		Attainment
		Marks	Students	
MEDLO8061.1 MEDLO8061.2 MEDLO8061.4	Test	50%	60 70 80	1 2 3
	ESE	50%	60 70 80	1 2 3
	CES	60%	60 70 80	1 2 3
MEDLO8061.3 MEDLO8061.5 MEDLO8061.6	ESE	50%	60 70 80	1 2 3
	CES	60%	60 70 80	1 2 3

CO Measurement Weightages for Tools:

	Direct Method					Indirect Method
	80%					Course Exit Survey 20%
	Test	Lab	Assignment	ESE (O)	ESE (T)	
MEC601.1	40%				60%	
MEC601.2	40%				60%	
MEC601.3	-				100%	
MEC601.4	40%				60%	
MEC601.5	-				100%	
MEC601.6	-				100%	

Attainment:

CO MEDLO8061:

Direct Method

$CO_{MEDLO8061.1DM}$ = 0.4 * Test + 0.6* ESE(T)

Indirect Method

$CO_{MEDLO8061.1IM}$ =

CES

Final CO $CO_{MEDLO8061.1}$ = 0.8 * $CO_{MEDLO8061.1DM}$ + 0.2* $CO_{MEDLO8061.1IM}$

CO MEDLO8061:
Direct Method
$CO_{MEDLO8061.2DM}$ = 0.4 * Test + 0.6* ESE(T)
Indirect Method
$CO_{MEDLO8061IM}$ = CES
Final CO $CO_{MEDLO8061.2}$ = 0.8 * $CO_{MEDLO8061.2DM}$ + 0.2* $CO_{MEDLO8061.2IM}$

CO MEDLO8061:
Direct Method
$CO_{MEDLO8061.3DM}$ = ESE(T)
Indirect Method
$CO_{MEDLO8061.3IM}$ = CES
Final CO $CO_{MEDLO8061.3}$ = 0.8 * $CO_{MEDLO8061.3DM}$ + 0.2* $CO_{MEDLO8061.3IM}$

CO MEC601.4:
Direct Method
$CO_{MEDLO8061.4DM}$ = 0.4 * Test + 0.6* ESE(T)
Indirect Method
$CO_{MEDLO8061.4IM}$ = CES
Final CO $CO_{MEDLO8061.4}$ = 0.8 * $CO_{MEDLO8061.4DM}$ + 0.2* $CO_{MEDLO8061.4IM}$

CO MEC601.5:
Direct Method $CO_{MEDLO8061.5DM}$ = ESE(T)
Indirect Method
$CO_{MEDLO8061.5IM}$ = CES
Final CO $CO_{MEDLO8061.5}$ = 0.8 * $CO_{MEDLO8061.5DM}$ + 0.2* $CO_{MEDLO8061.5IM}$

CO MEC601.6:

Direct Method
$CO_{MEDLO8061.6DM}$ = ESE(T)
Indirect Method
$CO_{MEDLO8061.6IM}$ = CES
Final CO $CO_{MEDLO8061.6}$ = 0.8 * $CO_{MEDLO8061.6DM}$ + 0.2* $CO_{MEDLO8061.6IM}$

Course Level Gap (if any):
-

Content beyond Syllabus:
-

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Lecture Plan:

Week	Duration (Hrs.)	Topic	Module
1 (9.01.23 - 15.01.23)	3	Need for developing products, The importance of Engineering and Industrial design, The design process, Relevance of product lifecycle issues in design, Societal considerations in Engineering and Industrial Design	1
2 (16.01.23 - 22.01.23)	3	Generic product development process, Various phases of product development, Planning for products, Establishing markets – market segments - relevance of market research.	1 and 2
3 (23.01.23 - 29.01.23)	3	The design processes, Descriptive and prescriptive design models, Concept development & evaluation, Pugh's total design activity model,	2
4 (30.01.23 - 5.02.23)	3	Concept generation and selection method,	2
5 (6.02.23 - 12.02.23)	3	Embodiment design, Product architecture, and Steps in developing product architecture. Identifying customer needs, Voice of Customer (VoC), Customer populations, Hierarchy of human needs, Need gathering methods,	2 and 3
6 (13.02.23 - 19.02.23)	3	Establishing engineering characteristics, Competitive benchmarking Quality Function Deployment (QFD), House of Quality (HoQ), Product design specification, Development of product design with specifications using QFD, Relevant case studies.	3
7 (20.02.23 - 26.02.23)	3	Creative thinking, Creativity and problem-solving methods, Creative thinking methods, Brainstorming technique, Gorden technique, Check listing technique,	3
8 (27.02.23 - 5.03.23)		**Unit Test I**	
9 (6.03.23 – 12-03.23)	3	Synectic technique, Morphological Analysis, and Attribute Listing technique. Generating design concepts, Systematic methods of designing.	5
10 (13.03.23 - 19.03.23)	3	Industrial design, Basic forms & elements, Integrating basic forms & elements such as balance, rhythm, proportion,	5
11 (20.03.23 – 26.03.23)	3	The golden rule of proportions, human factors, and design, User-friendly design, Design for serviceability, Design for environment.	4
12 (27.03.23 - 2.04.23)		Euphoria	

13 (3.04.23 - 9.04.23)	3	Concept of Design for Manufacturing and Assembly (DFMA). Role of computers in product design and manufacturing process, Prototyping techniques such as Stereolithography (SLA),	5
14 (10.04.23 - 16.04.23)	3	Selective laser sintering (SLS), Fused disposition Modelling (FDM), Laminated object manufacturing (LOM), 3-D printing, and Ballistic Particle Manufacturing (BPM).	4 3
15 (17.04.23 - 23.04.23)	**Unit Test – II**		

Text Books:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development," 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9.
2. Kevin Otto, Kristin Wood, "Product Design," Indian Reprint 2004, Pearson Education, ISBN 9788177588217.

Reference Books:

1. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction," 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7.
2. George E. Dieter, Linda C.Schmidt, "Engineering Design," 4th Edition, McGraw-Hill International Edition, 2009, ISBN 978-007-127189-9.
3. Yousef Haik, T. M. M. Shahin, "Engineering Design Process," 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141.

Evaluation Scheme

CIE Scheme

Internal Assessment: 20 (Average of two tests)

Internal Assessment Scheme

Module		Lecture Hours	No. of questions in		
			Test 1	Test 2	Test 3*
1	Phases in PDD	7	5 marks	-	--
2	Concept Generation and Selection, Product architecture	7	5 marks	-	--
3	HOQ	7	5 marks	-	--
4	Creativity	7	5 marks	-	--
5	Industrial Design	7	-	-	--
6	DFMA and RPT	7	-	20 marks	--

Note: Four to six questions will be set in the Test paper

Verified by:

Programme Coordinator

Subject Expert

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Course Code	Course Name	Credits
MEL801	**Product Design and Development**	**01**

Outcomes: Learner will be able to…

MEL801.1. Identify the need for developing products
MEL801.2. Select suitable PD&D processes
MEL801.3. apply the creativity & industrial design methods to design & develop the chosen product
MEL801.4. Work collaboratively in a team to complete a PD&D project.
MEL801.5. Effectively communicate the results of projects and other assignments both in a written and oral format

Term Work:

a) Term work - Total 3 to 4 assignments have to be given
Based on module I and II
Based on module III
Based on module IV
Based on module V

Assignments/Case studies:10 marks.
Mini Project:10 marks.
Attendance: 05 Marks.

CO-PO Mapping

CO# / PO#	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	3	3	-	2	2	2	2	2	2	-	2
2	3	3	3	-	2	2	2	2	2	2	-	2
3	3	3	3	-	2	2	2	2	2	2	-	2
4	3	3	3	-	2	2	2	2	2	2	-	2
5	3	3	3	-	2	2	2	2	2	2	-	2

CO-PSO Mapping:

	PSO1	PSO2
MEL801.1		2
MEL801.2		2

MEL801.3		2
MEL801.4		2
MEL801.5		2

Week	Duration (Hrs.)	Topic
3 (23.01.23 - 29.01.23)	2	Assignment on module 1 Product planning
4 (30.01.23 - 5.02.23)	2	Assignment on module 1 Mini Project: Product planning
5 (6.02.23 - 12.02.23)	2	Assignment on Module 3 Mini Project: HOQ
6 (13.02.23 - 19.02.23)	2	Assignment on Module 4 Mini Project: Creativity Techniques
7 (20.02.23 - 26.02.23)	2	Assignment on Module 2 Mini Project: Concept Generation
8 (27.02.23 - 5.03.23)		**Unit Test I**
9 (6.03.23 – 12-03.23)	2	Assignment on Module 2 Mini Project: Concept Selection
10 (13.03.23 - 19.03.23)	2	Assignment on Module 2 Mini Project: Product Architecture
11 (20.03.23 – 26.03.23)	2	Assignment on Module 5 Mini Project: Industrial Design
12 (27.03.23 - 2.04.23)		Euphoria
13 (3.04.23 - 9.04.23)	2	Assignment on Module 6: Mini Project: DFMA
14 (10.04.23 - 16.04.23)	2	Mini Project presentations
15 (17.04.23 - 23.04.23)		**Unit Test – II**

CO attainment value for students above targets values:

CO	Tool	Target Value %		Attainment
		Marks	Students	
MEL801.1 MEL801.2 MEL801.3	Assignment	60%	60 70 80	1 2 3
MEL801.4	Oral / Practical	50%	60	1

MEL801.5			70 80	2 3
	CES	60%	60 70 80	1 2 3

CO Measurement Weightages for Tools:

	Direct Method					Indirect Method
	80%					Course Exit Survey 20%
	Test	Lab	Assignment	ESE (O)	ESE (T)	
MEL801.1		20%	20%	60%		
MEL801.2		20%	20%	60%		
MEL801.3		20%	20%	60%		
MEL801.4		20%	20%	60%		
MEL801.5		20%	20%	60%		

Attainment:

All COs

Direct Method

$CO_{MEL601.xDM}$ = 0.2 *Lab + 0.2 * Assignment + 0.6* ESE(O)

Indirect Method

$CO_{MEL801.xIM}$ = CES

Final CO $CO_{MEL801.x}$ = 0.8 * $CO_{MEL801.XDM}$ + 0.2* $CO_{MEL801.XIM}$

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MEL801.5			70 80	2 3
	CES	60%	60 70 80	1 2 3

CO Measurement Weightages for Tools:

	Direct Method					Indirect Method
	80%					Course Exit Survey 20%
	Test	Lab	Assignment	ESE (O)	ESE (T)	
MEL801.1		20%	20%	60%		
MEL801.2		20%	20%	60%		
MEL801.3		20%	20%	60%		
MEL801.4		20%	20%	60%		
MEL801.5		20%	20%	60%		

Attainment:

All COs

Direct Method

$CO_{MEL801.xDM}$ = 0.2 *Lab + 0.2 * Assignment + 0.6* ESE(O)

Indirect Method

$CO_{MEL801.xIM}$ = CES

Final CO $CO_{MEL801.x}$ = 0.8 * $CO_{MEL801.xDM}$ + 0.2* $CO_{MEL801.xIM}$

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