MUTHAYAMMAL ENGINEERING COLLEGE

An Autonomous Institution

(Approved by AICTE | Accredited by NBA & NAAC | Affiliated to Anna University)

Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Curriculum/Syllabus

Programme Code   : **ME**

Programme Name   : **B.E-Mechanical Engineering**

Regulations   : **2023**

MUTHAYAMMAL ENGINEERING COLLEGE

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Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Ph. No.: 04287-220837

Email: info@mec.ac.in

Institution Vision & Mission

Institution Vision

- To be a Centre of Excellence in Engineering, Technology and Management on par with International Standards.

Institution Mission

- To prepare the students with high professional skills and ethical values.

- To impart knowledge through best practices.

- To instill a spirit of innovation through Training, Research and Development.

- To undertake continuous assessment and remedial measures.

- To achieve academic excellence through intellectual, emotional and social stimulation.

Department Vision & Mission

Department Vision

- To prepare competent Mechanical Engineers with state of art technologies to cater industry demands

Department Mission

- To create technically proficient students to meet global challenges

- To enable the opportunities for students and faculty members to apply the knowledge

- To prepare students to excel as successful professionals and entrepreneur's in their careers

Program Educational Objectives

PEO1 : Graduates should be able to Comprehend, analyze and synthesize data in order to design and develop mechanical systems

PEO2 : Graduates should be able to resolve industrial problems and create newer opportunities

PEO3 : Graduates should be able to demonstrate leadership skills and ethical value for sustainable economical development towards the improvement of quality of life

Program Specific Outcomes

PSO1 : To apply the knowledge of design, development and analysis of Mechanical Systems

PSO2 : To demonstrate collaborative learning for making more sustainable products

PSO3 : To work as a professional entrepreneur by applying Mechanical and Management practices

Program Outcomes

PO1 : **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 : **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.

PO3 : **Design/Development solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 : **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.

PO5 : **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 : **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.

PO7 : **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

PO8 : **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 : **Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 : **Communication:** Communicate effectively on complex engineering activities with the engineering community and with 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.

PO11 : **Project management and finance:** Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 : **Lifelong learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

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B.E.- Mechanical Engineering
Grouping of Courses

I. Humanities and Social Sciences Courses (HS)

Sl.No.	Course Code	CourseTitle	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
1.	23HSS01	Technical and Communicative English - I	HS	4	3	0	3	3
2.	23HSS02	Technical and Communicative English – II	HS	4	3	0	0	3
3.	23HSS03	Technical English For Engineers	HS	3	2	0	0	2
4.	23HSS04	Communicative English for Engineers	HS	3	2	0	0	2
5.	23HSS05	Commercial English	HS	3	2	0	0	2
6.	23HSS06	Basics of Japanese Language	HS	3	2	0	0	2
7.	23HSS07	Basics of French	HS	3	2	0	0	2
8.	23HSS08	Heritage of Tamils	HS	2	1	0	0	1
9.	23HSS09	Tamils and Technology	HS	2	1	0	0	1

II. Basic Sciences (BS)

1.	23BSS01	Engineering Physics	BS	4	3	0	0	3
2.	23BSS02	Physics Laboratory	BS	4	0	0	4	2
3.	23BSS03	Bio and Nano materials Sciences	BS	4	3	0	0	3
4.	23BSS04	Materials Science	BS	4	3	0	0	3
5.	23BSS05	Applied Physics	BS	4	3	0	0	3
6.	23BSS11	Engineering Chemistry	BS	4	3	0	0	3
7.	23BSS12	Chemistry Laboratory	BS	4	0	0	4	2
8.	23BSS13	Applied Chemistry	BS	4	3	0	0	3
9.	23BSS21	Algebra and Calculus	BS	5	3	1	0	4
10.	23BSS22	Advanced Calculus and Complex Analysis	BS	5	3	1	0	4
11.	23BSS23	Differential Equations and Vector Analysis	BS	5	3	1	0	4
12.	23BSS24	Transforms and Boundary Value Problems	BS	5	3	1	0	4
13.	23BSS25	Discrete Mathematics	BS	5	3	1	0	4
14.	23BSS26	Statistics and Queuing Model	BS	5	3	1	0	4
15.	23BSS27	Statistics and Numerical Methods	BS	5	3	1	0	4

16.	23BSS28	Numerical Methods and Analysis	BS	5	3	1	0	4
17.	23BSS29	Probability and Random Processes	BS	5	3	1	0	4

III. General Engineering Science (GES)

1.	23GES01	Programming for Problem Solving Using C	GES	4	3	0	0	3
2.	23GES02	Programming in C Laboratory	GES	3	0	0	2	1
3.	23GES03	Python Programming	GES	4	3	0	0	3
4.	23GES04	Computer Peripherals and Programming Essentials	GES	4	3	0	0	3
5.	23GES05	Python Programming Laboratory	GES	3	0	0	2	1
6.	23GES06	Electrical and Electronics Sciences	GES	4	3	0	0	3
7.	23GES07	CAD Laboratory	GES	4	0	0	4	2
8.	23GES08	Electric Circuits	GES	4	3	0	0	3
9.	23GES09	Engineering Mechanics for Electrical Engineers	GES	3	3	0	0	3
10.	23GES10	Engineering Graphics	GES	3	1	0	2	3
11.	23GES11	Engineering Drawing	GES	3	1	0	2	3
12.	23GES12	Mechanical and Building Sciences	GES	3	3	0	0	3
13.	23GES13	Electric Circuits	GES	3	2	1	0	3
14.	23GES14	Electronics Product Design	GES	4	3	0	0	3
15.	23GES15	Manufacturing Processes	GES	3	3	0	0	3
16.	23GES16	Fundamentals of Civil Engineering	GES	4	3	0	0	3
17.	23GES17	Bioorganic Chemistry	GES	4	3	0	0	3
18.	23GES18	Basic Electrical and Electronics Engineering	GES	3	3	0	0	3
19.	23GES19	Renewable Energy Sources	GES	3	3	0	0	3
20.	23GES20	Basics of Human Anatomy	GES	4	3	0	0	3
21.	23GES21	Engineering Practices Laboratory	GES	3	0	0	2	1
22.	23GES22	Computer Aided Building Drawing Laboratory	GES	4	0	0	4	2
23.	23GES23	Bioorganic Chemistry Laboratory	GES	4	0	0	4	2
24.	23GES24	Electric Circuits Laboratory	GES	3	0	0	2	1
25.	23GES25	Data Structures using Python Laboratory	GES	3	0	0	2	1
26.	23GES26	Digital Principles and System Design	GES	3	3	0	0	3
27.	23GES27	Digital Principles and System Design Laboratory	GES	2	0	0	2	1
28.	23GES28	Engineering Mechanics	GES	4	3	1	0	4
29.	23GES29	Professional Skills	GES	4	3	0	0	3
30.	23GES29	Fluid Mechanics	GES	4	3	0	0	3
31.	23GES31	Electronics and Microprocessors	GES	3	3	0	0	3

IV. Professional Core (PC)

1.	23MEC01	Engineering Thermodynamics	PC	3	3	0	0	3
2.	23MEC02	Fluid Mechanics and Machinery	PC	3	3	0	0	3
3.	23MEC03	Manufacturing Technology	PC	3	3	0	0	3
4.	23MEC04	Engineering Materials and Metallurgy	PC	3	3	0	0	3
5.	23MEC05	Strength of Materials	PC	3	3	0	0	3
6.	23MEC06	Thermal Engineering	PC	3	3	0	0	3
7.	23MEC07	Hydraulics and Pneumatics	PC	3	3	0	0	3
8.	23MEC08	Engineering Metrology and Measurements	PC	3	3	0	0	3
9.	23MEC09	Mechanics of Machines	PC	3	3	0	0	3
10.	23MEC10	Design of Machine Elements	PC	3	3	0	0	3
11.	23MEC11	CAD/CAM	PC	3	3	0	0	3
12.	23MEC12	Heat and Mass Transfer	PC	3	3	0	0	3
13.	23MEC13	Design of Transmission Systems	PC	3	3	0	0	3
14.	23MEC14	Finite Element Analysis	PC	3	3	0	0	3
15.	23MEC15	Mechatronics and IoT	PC	3	3	0	0	3
16.	23MEC16	Total Quality Management	PC	3	3	0	0	3
17.	23MEC17	Computer Aided Machine Drawing and Computer Aided Manufacturing Laboratory	PC	3	0	0	3	1
18.	23MEC18	Manufacturing Technology Laboratory	PC	3	0	0	3	1
19.	23MEC19	Strength of Materials and Fluid Machinery Laboratory	PC	3	0	0	3	1
20.	23MEC20	Thermal Engineering Laboratory	PC	3	0	0	3	1
21.	23MEC21	Metrology and Dynamics Laboratory	PC	3	0	0	3	1
22.	23MEC22	Simulation Laboratory	PC	3	0	0	3	1
23.	23MEC23	Heat and Mass Transfer Laboratory	PC	3	0	0	3	1
24.	23MEC24	Mechatronics and IoT Laboratory	PC	3	0	0	3	1

V. Professional Elective (PE)

1.	23MEE01	Advanced Manufacturing Processes	PE	3	3	0	0	3
2.	23MEE02	Principles of Management	PE	3	3	0	0	3
3.	23MEE03	Process Planning and Cost Estimation	PE	3	3	0	0	3
4.	23MEE04	Automotive Electronics	PE	3	3	0	0	3
5.	23MEE05	Design of Pressure Vessel and Piping	PE	3	3	0	0	3
6.	23MEE06	Vibration and Noise Control	PE	3	3	0	0	3
7.	23MEE07	Refrigeration and Air conditioning	PE	3	3	0	0	3
8.	23MEE08	Composite Materials	PE	3	3	0	0	3
9.	23MEE09	Computational Fluid Dynamics	PE	3	3	0	0	3
10.	23MEE10	Energy Conservation in Industry	PE	3	3	0	0	3
11.	23MEE11	Gas Dynamics and Jet Propulsion	PE	3	3	0	0	3
12.	23MEE12	Design of jigs, fixtures and Press Tools	PE	3	3	0	0	3

13.	23MEE13	Lean Manufacturing	PE	3	3	0	0	3
14.	23MEE14	Advanced Metrology	PE	3	3	0	0	3
15.	23MEE15	Power Plant Engineering	PE	3	3	0	0	3
16.	23MEE16	Artificial Intelligence	PE	3	3	0	0	3
17.	23MEE17	MEMS	PE	3	3	0	0	3
18.	23MEE18	Welding Technology	PE	3	3	0	0	3
19.	23MEE19	Machine Learning For Intelligent Systems.	PE	3	3	0	0	3
20.	23MEE20	Manufacturing Automation	PE	3	3	0	0	3
21.	23MEE21	Engineering Economics And Financial Management	PE	3	3	0	0	3
22.	23MEE22	Industrial Safety	PE	3	3	0	0	3
23.	23MEE23	Operations Research	PE	3	3	0	0	3
24.	23MEE24	Automobile Engineering	PE	3	3	0	0	3
25.	23MEE25	Digital Manufacturing	PE	3	3	0	0	3

VI. Employability Enhancement Courses (EEC)

1.	23MES01	Internship -I	EEC	-	0	0	3	1
2.	23MES02	Internship –II	EEC	-	0	0	3	1
3.	23MES03	Internship –III	EEC	-	0	0	3	1
4.	23MES04	Mini-Project	EEC	6	0	0	3	1
5.	23MES05	Project Phase-I	EEC	10	0	0	6	3
6.	23MES06	Project Phase-II	EEC	18	0	0	24	12

VII. Mandatory Courses (MC)

1.	23MEM01	Constitution of India and professional Ethics	MC	2	1	0	0	0
2.	23MEM02	Disaster Risk Reduction And Management	MC	2	1	0	0	0

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B.E.- Mechanical Engineering

Curriculum | UG - R2023

Semester -I

Sl.No.	Course Code	CourseTitle	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23HSS01	Technical and Communicative English I	HS	3	0	0	3	3
2.	23BSS21	Algebra & Calculus	BS	3	2	0	4	5
3.	23BSS11	Engineering Chemistry	BS	3	0	0	3	3
4.	23GES01	Programming for Problem Solving Using C	GES	3	0	0	3	3
5.	23GES11	Engineering Drawing	GES	3	0	0	3	3
6.	23HSS08	Heritage of Tamils	HS	1	0	0	1	1
Practical								
7.	23BSS12	Chemistry Laboratory	BS	0	0	4	2	2
8.	23GES02	Programming in C Laboratory	GES	0	0	2	1	2
						Total Credit		20

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Semester -II

Sl.No.	Course Code	CourseTitle	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23HSS03	Technical and Communicative English II	HS	3	0	0	3	3
2.	23BSS22	Advanced Calculus and Complex Analysis	BS	3	2	0	4	5
3.	23BSS01	Engineering Physics	BS	3	0	0	3	3
4.	23GES15	Manufacturing Processes	GES	3	0	0	3	3
5.	23GES18	Basic Electrical and Electronics Engineering	GES	3	0	0	3	3
6.	23HSS09	Tamils and Technology	HS	1	0	0	1	1
Practical								
7.	23BSS02	Physics Laboratory	BS	0	0	4	2	2
8.	23GES21	Engineering Practices Laboratory	GES	0	0	2	1	2
						Total Credit		20

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Curriculum | UG - R2023
Semester -III

Sl.No.	Course Code	CourseTitle	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23BSS24	Transforms and Boundary value Problems	BS	3	1	0	4	4
2.	23MEC01	Engineering Thermodynamics	PC	3	0	0	3	3
3.	23GES28	Engineering Mechanics	GES	3	0	0	3	3
4.	23MEC02	Fluid Mechanics and Machinery	PC	3	0	0	3	3
5.	23MEC03	Manufacturing Technology	PC	3	0	0	3	3
6.	23MEC04	Engineering Materials and Metallurgy	PC	3	0	0	3	3
Practical								
7.	23MEC17	Computer Aided Machine Drawing & Computer Aided Manufacturing Laboratory	PC	0	0	2	1	2
8.	23MEC18	Manufacturing Technology Laboratory	PC	0	0	2	1	2
9.	23GES29	Professional Skills	GES	0	0	2	1	2
							Total Credit	**22**

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Curriculum | UG - R2023
Semester -IV

Sl.No.	Course Code	CourseTitle	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23BSS27	Statistics and Numerical Methods	BS	3	1	0	4	4
2.	23MEC05	Strength of Materials	PC	3	0	0	3	3
3.	23MEC06	Thermal Engineering	PC	3	0	0	3	3
4.	23MEC07	Hydraulics and Pneumatics	PC	3	0	0	3	3
5.	23MEC08	Engineering Metrology and Measurements	PC	3	0	0	3	3
6.	23GES31	Electronics and Microprocessors	GES	3	0	0	3	3
Practical								
7.	23MEC19	Strength of Materials and Fluid Machinery Laboratory	PC	0	0	2	1	2
8.	23MEC20	Thermal Engineering Laboratory	PC	0	0	2	1	2
9.	23MES01	Internship -I	EEC	0	0	0	1	0
							Total Credit	**22**

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Semester -V

Sl.No.	Course Code	CourseTitle	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23MEC09	Mechanics of Machines	PC	3	0	0	3	3
2.	23MEC10	Design of Machine Elements	PC	3	0	0	3	3
3.	23MEC11	CAD/CAM	PC	3	0	0	3	3
4.	23MEE**	Professional Elective -I	PE	3	0	0	3	3
5.	23MEE**	Professional Elective -II	PE	3	0	0	3	3
6.	23*****	Open Elective-I	OE	3	0	0	3	3
Practical								
7.	23MEC21	Metrology and Dynamics Laboratory	PC	0	0	2	1	2
8.	23MEC22	Simulation Laboratory	PC	0	0	2	1	2
9.	23MES02	Internship --II	EEC	0	0	0	1	0
							Total Credit	**21**

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Semester -VI

Sl.No.	Course Code	CourseTitle	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23MEC12	Heat and Mass Transfer	PC	3	0	0	3	3
2.	23MEC13	Design of Transmission Systems	PC	3	0	0	3	3
3.	23MEC14	Finite Element Analysis	PC	3	0	0	3	3
4.	23MEE**	Professional Elective -III	PE	3	0	0	3	3
5.	23MEE**	Professional Elective -IV	PE	3	0	0	3	3
6.	23*****	Open Elective-II	OE	3	0	0	3	3
Practical								
7.	23MEC23	Heat and Mass Transfer Laboratory	PC	0	0	2	1	2
8.	23MEC24	Mechatronics and IoT laboratory	PC	0	0	2	1	2
9.	23MES04	Mini Project	EEC	0	0	2	1	2
							Total Credit	**21**

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Semester -VII

Sl.No.	Course Code	CourseTitle	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23MEC15	Mechatronics and IoT	PC	3	0	0	3	3
2.	23MEC16	Total Quality Management	PC	3	0	0	3	3
3.	23MEE**	Professional Elective -V	PE	3	0	0	3	3
4.	23MEE**	Professional Elective -VI	PE	3	0	0	3	3
5.	23*****	Open Elective-III	OE	3	0	0	3	3
6.	23*****	Open Elective-IV	OE	3	0	0	3	3
Practical								
7.	23MES05	Project Phase-I	EEC	0	0	6	3	10
8.	23MES03	Internship- III	EEC	0	0	0	1	0
							Total Credit	**21**

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Semester -VIII

Sl.No.	Course Code	CourseTitle	Category	Contact Hours	Instruction Hours/Week/ Credit			
					L	T	P	C
Theory								
1.	23MES06	Project Phase-II	EEC	0	0	24	12	18
							Total Credit	**12**

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Summary of Course Component

Sl.No.	Course Area	Semesters								Total Credits	% of Credits
		I	II	III	IV	V	VI	VII	VIII		
1.	HS	4	4							8	**05.00**
2.	BS	9	9	4	4					26	**16.25**
3.	GES	7	7	4	3					21	**13.12**
4.	PC			14	14	11	11	6		56	**35.00**
5.	PE					6	6	6		18	**11.25**
6.	OE					3	3	6		12	**07.50**
7.	EEC				1	1	1	4	12	19	**11.88**
Total		**20**	**20**	**22**	**22**	**21**	**21**	**22**	**12**	**160**	**100**

Chairman-Board of Studies
Department of Mechanical Engineering
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23GES10	**ENGINEERING GRAPHICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To enable the students with various concepts like BIS Conventions, dimensioning, conventions and standards related to Engineering Drawing
- To impart knowledge on the projection of points, lines and plane surfaces
- To improve the visualization skills for better understanding of projection of solids
- To develop the imaginative skills of the students required to understand Section of solids.
- To make the students understand the viewing in Isometric projections.

Course Outcomes:

23GES10.CO1   Perform free hand sketching of basic geometrical constructions and multiple views of objects

23GES10.CO2   Draw the projections of points, straight lines and plane surfaces in given quadrant.

23GES10.CO3   Understand the projection of solids in various positions in first quadrant.

23GES10.CO4   Draw projections and solids and development of surfaces.

23GES10.CO5   Prepare isometric Projections of simple solids.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23GES10.CO1	1	2	3	3	2	-	-	-	-	1	1	1	2	1	-
23GES10.CO2	1	2	3	3	2	-	-	-	-	1	1	1	2	1	-
23GES10.CO3	1	2	3	3	2	-	-	-	-	1	1	1	2	1	-
23GES10.CO4	1	2	3	3	2	-	-	-	-	1	1	1	2	1	-
23GES10.CO5	1	2	3	3	2	-	-	-	-	1	1	1	2	1	-

Unit-I   INTRODUCTION   9

Introduction- Drawing Instruments, drawing standards - BIS, line and material conventions, Dimensioning Principles. Free hand Sketching practice- lettering, simple engineering drawing, and Electrical and Electronics circuit symbols

Unit-II   GEOMETRICAL CONSTRUCTION   9

Introduction, construction of Ellipse, Parabola, Hyperbola-eccentricity method, Cycloids, Involutes of square and circle, Tangents and Normal to above curves.

Unit-III   PROJECTION OF POINTS, LINES AND PLANE SURFACES   9

Introduction– planes of projection, reference line and conventions-first angle projection-projections of points in all quadrant, projections of straight lines – inclined to any one principal plane, true length by rotating method, projections of plane surfaces- circle, rectangle, pentagon, and hexagon inclined to any one principal plane.

Unit-IV   PROJECTION OF SOLIDS   9

Introduction – projections of simple solids- cylinder, cones, square and pentagonal prisms, and hexagonal pyramids with axis inclined to any one principal planes by rotating method.

Unit-V   ISOMETRIC PROJECTION   9

Principles of Isometric Projections-Isometric scale, Isometric projection of simple solids- cylinder, cone, sphere cube, prism, and pyramids.
Demonstration on 2D and 3D Modeling using a CAD Package (Not for Examination)

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	K.V.Natarajan	Engineering Graphics	Charotar publishing house.	2019
2.	K Venugopal	Engineering Drawing	New Age	2020

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	K.L.Narayana& P. Kannaiah	Engineering Drawing	SciTech Publishers.	2019
2.	K.C. John.	Engineering Drawing	PHI Publishers.	2018
3.	PI Varghese	Engineering Drawing	McGraw-Hill Publishers	2017
4.	N.D. Butt	Engineering Drawing	Chariot Publications.	2019

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		L	T	P	C
23GES11	**ENGINEERING DRAWING**	**3**	**0**	**0**	**3**

Course Objective:
- To enable the students with various concepts like dimensioning, conventions and standards related to
- Drawing engineering curves.
- To impart knowledge on the projection of points, lines and plane surfaces
- To improve the visualization skills for better understanding of projection of solids
- To develop the imaginative skills of the students required to understand Section of solids.
- To make the students understand the viewing perception of a solid object in Isometric and Perspective projections

Course Outcomes:

23GES11.CO1	To Draw the Engineering Curves by using Drawing Instruments and Perform freehand Sketching of basic geometrical constructions and multiple views of objects.
23GES11.CO2	Draw the projections of points, straight lines and plane surfaces in given quadrant
23GES11.CO3	Draw projections and solids
23GES11.CO4	Draw development of surfaces.
23GES11.CO5	Prepare isometric and perspective sections of simple solids.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23GES11.CO1	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
23GES11.CO2	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
23GES11.CO2	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
23GES11.CO4	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-
23GES11.CO5	3	1	2	-	2	-	-	-	-	3	-	2	2	2	-

Unit-I   PLANECURVESAND FREEHAND SKETCHING   9

Basic Geometrical constructions, Curves used in engineering practices: Conics. Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid- construction of involutes of square and circle. Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles - Representation of Three Dimensional objects - Layout of views- Freehand sketching of multiple views from pictorial views of objects. Orthographic projection- principles.

Unit-II   PROJECTIONOFPOINTS,LINESANDPLANESURFACE   9

Projection of points .Projection of straight lines (only First angle projections)inclined to one of the planes- Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to one of the planes by rotating object method.

Unit-III   PROJECTION OF SOLIDS   9

Projection of simple solids like prisms, pyramids, cylinder, and cone solids when the axis is inclined to one of the principal planes by rotating object method.
Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

Unit-IV   PROJECTION OF SOLIDS   9

Sectioning solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other - obtaining true shape of section. Development of lateral surfaces of simple and

sectioned solids - Prisms, pyramids cylinders and cones.
Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

Unit-V   PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES   9

Principles of isometric projection –isometric scale- Isometric projections of simple-Prisms, pyramids, cylinders, cones-Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.
Practicing three dimensional modeling of simple objects by CAD software (Not for examination)

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	K.V.Natarajan	Engineering Graphics	charotar publishing house.	2019
2.	K Venugopal	Engineering Drawing	New Age	2020

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	K.L.Narayana& P. Kannaiah	Engineering Drawing	SciTech Publishers.	2019
2.	K.C. John.	Engineering Drawing	PHI Publishers.	2018
3.	PI Varghese	Engineering Drawing	McGraw-Hill Publishers	2017
4.	N.D. Butt	Engineering Drawing	Chariot Publications.	2019

								L	T	P	C

23GES12   **MECHANICAL AND BUILDING SCIENCES**

L	T	P	C
3	0	0	3

Course Objective:

- To demonstrate the metal joining, removing and addition process.
- To know about the basics of Food processing Industry.
- To summaries the basic services of Refrigeration and air conditioning.
- To posses knowledge about Surveying.
- To know about the Civil Engineering materials.
- To get the knowledge on various type of Building Elements.

Course Outcomes:

23GES12.CO1   Perform welding, machining and 3D printing operations.

23GES12.CO2   Gain the basic knowledge of Food processing Industry.

23GES12.CO3   Summaries the basic infrastructure services of Refrigeration, pumps and basic drives.

23GES12.CO4   Understand the principles of field measurement in surveying.

23GES12.CO5   Acquired knowledge in civil engineering materials.

23GES12.CO6   Familiarize on about the of Building Elements.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23GES12.CO1	1	2	-	-	-	2	-	-	-	2	-	1	1	-	-
23GES12.CO2	1	2	-	-	-	2	-	2	-	2	-	-	1	-	-
23GES12.CO3	1	2	2	-	2	2	-	-	-	-	-	-	-	1	-
23GES12.CO4	1	2	-	-	-	2	-	-	-	-	-	1	1	-	-
23GES12.CO5	1	2	-	-	-	2	-	-	-	-	-	1	1	-	-
23GES12.CO6	1	2	-	-	-	2	-	-	-	-	-	1	1	-	-

A.MECHANICAL SCIENCES

Unit-I   BASIC MANUFACTURING PROCESSES   8

List types of welding, Description with sketches of Arc Welding, Soldering and Brazing and their applications, Basic Machining operations: Turning, Drilling, Milling and Grinding. Principle of CAD/CAM, and 3D printing.

Unit-II   MECHANICAL SYSTEM IN FOODPROCESSING INDUSTRIES   7

Modes of Heat Transfer, Basics of Mass Transfer, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, cold storage Device, Heat exchanger(only description),Application of Biotechnology in food processing Industry.

Unit-III   REFRIGERATION&AIR CONDITIONING   8

Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems); Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners. Description about working with sketches of: Reciprocating pump, Centrifugal pump.

B. BUILDING SCIENCES

Unit-IV   FUNDAMENTALS OF SURVEYING   7

Introduction – projections of simple solids- cylinder, cones, square and pentagonal prisms, and hexagonal pyramids with axis inclined to any one principal planes by rotating method.

Unit-V   BUILDING MATERIALS   7

Civil Engineering Materials: Bricks–Stones–Sand–Cement–Concrete–Steel Sections–Timber–Modern Materials.

Unit-IV   BUILDING ELEMENTS   8

Substructure: Foundation – Types of foundation – Requirement of good foundation – Plinth beam. Superstructure: Brick masonry–Stonemasonry– Beams–Columns–Lintels– Roofing– Flooring–Plastering.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	GShanmugam,MS Palanichamy	Basic Civil and Mechanical Engineering	McGraw Hill Education; First edition	2018
2.	Ramamrutham.S.	Basic Civil Engineering	Dhanpat Rai Publishing Co. (P) Ltd.	2015

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Benjamin,J.,	Basic Mechanical Engineering	PentexBooks,9th Edition	2018
2.	Clifford,M.,Simmons, K.andShipway,P.,	An Introduction to Mechanical Engineering Part I	CRC Press	2009
3.	SeetharamanS	Basic Civil Engineering	Anuradha Agencies	2015
4.	Satheesh Gopi	Basic Civil Engineering	Pearson Publishers	2009

23GES15	**MANUFACTURING PROCESSES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To illustrate the working principles of various metal casting processes.
- To learn and apply the working principles of various metal joining processes.
- To analyze the working principles of bulk deformation of metals.
- To learn the working principles of sheet metal forming process.
- To study and practice the working principles of plastics molding.

Course Outcomes:

23GES15.CO1   Explain the principle of different metal casting processes.

23GES15.CO2   Describe the various metal joining processes.

23GES15.CO3   Illustrate the different bulk deformation processes.

23GES15.CO4   Apply the various sheet metal forming process.

23GES15.CO5   Apply suitable molding technique for manufacturing of plastics components.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23GES15.CO1	3	-	2	-	-	2	3	1	1	-	-	1	3	1	2
23GES15.CO2	3	-	2	-	-	2	3	1	1	-	-	1	3	1	2
23GES15.CO3	3	-	2	-	-	2	3	1	1	-	-	1	3	1	2
23GES15.CO4	3	-	2	-	-	2	3	1	1	-	-	1	3	1	2
23GES15.CO5	3	-	2	-	2	2	3	1	1	-	-	1	3	1	2

Unit-I   CASTING PROCESSES   9

Sand casting process- Steps; Core; Sand Testing; Molding Processes, Gating system, Solidification Phenomena, Melting Furnaces, Special casting methods - Centrifugal casting; Hot chamber and cold chamber die casting; Investment casting; Shell mold casting; Plaster mold casting; CO2mold casting. Casting Defects and remedies.

Unit-II   WELDING PROCSSES   9

Classification of welding processes, electric arc welding, ISI classification of coated electrodes, special welding methods: GTAW, GMAW, GMAW-CO2welding, submerged arc welding, electro-slag welding, electron Beam welding, laser beam welding, ultrasonic welding, resistance welding, welding defects inspection &remedies – Brazing - soldering – Adhesive bonding.

Unit-III   BULK DEFORMATION PROCESSES   9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging, cold forging- Characteristics of the processes, Typical forging operations, Rolling of metals, Types of Rolling, Flat strip rolling, shape rolling operations, Defects in rolled parts, Principle of rod and wire drawing, Tube drawing, Principles of Extrusion, Types, Hot and Cold extrusion.

Unit-IV   METAL FORMING PROCESSES   9

Sheet metal characteristics – Typical shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes - Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning – Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming – Incremental forming.

Unit-V   MANUFACTURE OF PLASTIC COMPONENTS   9

Types and characteristics of plastics - Molding of thermoplastics & Thermosetting polymers– working principles and typical applications - injection molding – Plunger and screw machines - Compression molding, Transfer Molding - Typical industrial applications - introduction to blow molding – Rotational molding – Film blowing, Extrusion – Thermoforming – Bonding of Thermoplastics- duff molding.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	P.N .Rao	Manufacturing Technology, Volume. 1	Tata McGraw Hill Publishing Company limited, NewDelhi, 5thedition.	2018
2.	Kalpakjian. S	Manufacturing Engineering and Technology	Pearson Education India, 4th Edition.	2013

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Sharma P.C	A Text Book of Production Technology	S. Chandand Company IV Edition,	2004
2.	Hajra Choudhury	Elements of Workshop Technology Vol.1&2.	Media promoters Pvt Ltd. ,Mumbai	2007
3.	S. Gowri P. Hariharan, A.Suresh Babu,	Manufacturing Technology I	Pearson Education	2008
4.	Groover Mikell P	Fundamentals of Modern Manufacturing	John Wiley and Sons Inc.	2002
5.	Ro y. A. Lindberg	Processes and materials of manufacture	PHI / Pearson education	2006

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23GES21	ENGINEEERNG PRACTICES LABARATORY	L	T	P	C
		0	0	3	1

Course Objective:

- Sawing; planing; making joints in wood materials used in common household wood work.
- Understand the Concept of metal casting processes,
- Welding various joints in steel plates using arc welding work.
- Making a tray out of metal sheet using sheet metal work
- Perform turning operations in lathe machine.

Course Outcomes:

23GES21.CO1   Understand the concepts and equipments of casting processes.

23GES21.CO2   Make joints in wood materials used in common household wood work.

23GES21.CO3   Make a Tray, Funnel & Cone out of Metal Sheet using Sheet Metal work.

23GES21.CO4   Make different joints configuration in arc welding process.

23GES21.CO5   Machine various simple processes like turning, drilling, tapping in parts.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23GES21.CO1	2	2	-	-	1	1	2	-	-	-	-	2	2	1	-
23GES21.CO2	2	2	-	-	1	1	2	-	-	-	-	2	2	1	-
23GES21.CO3	2	2	-	-	1	1	2	-	-	-	-	2	2	1	-
23GES21.CO4	2	2	-	-	1	1	2	-	-	-	-	2	2	1	-
23GES21.CO5	2	2	-	-	1	1	2	-	-	-	-	2	2	1	-

Sl.No.	List of Experiments
1.	Study on Foundry equipments.
2.	Study on casting process: Melting, pouring and casting of metal.
3.	Carpentry: Making joints like T-Joint, Mortise joint and Dovetail joint.
4.	Study on Welding equipments: Vertical Welding and Horizontal Welding
5.	Sheet metal Work: Construction of Tray Funnel and Cone.
6.	Butt joint of two metal plates using arc welding process.
7.	Lap joint of two metal plates overlapping on one another using arc welding process.
8.	T-joint of a metal plate at perpendicular direction over another plate using Arc welding process.
9.	Basic Machining Work: a) Turning (simple). b) Drilling (simple) c) Tapping. (Simple)

Total Periods: 30

23GES28	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

Course Objective:

- To generalize the scalar and vector representation of forces and moments.
- To explore truss, beam, frame and cable problems and respond to the distributed force systems.
- To predict Centroid and Moment of Inertia.
- To realize the Laws of Motion, Principle of Work and Energy, Kinematics & Kinetics of Motion and the interrelationship.
- To comprehend the effect of friction on equilibrium.

Course Outcomes:

23GES28.CO1	Generalize the scalar and vector representation of forces and moments
23GES28.CO2	Explore truss, beam, frame and cable problems and respond to the distributed force systems.
23GES28.CO3	Predict Centroid and Moment of Inertia.
23GES28.CO4	Realize the Laws of Motion, Principle of Work and Energy, Kinematics &Kinetics of Motion and the interrelationship.
23GES28.CO5	Comprehend the effect of friction on equilibrium.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23GES28.CO1	3	2	2	1	2	-	-	-	-	-	-	2	3	1	1
23GES28.CO2	3	2	2	1	2	-	-	-	-	-	-	2	3	1	1
23GES28.CO3	3	2	3	1	2	-	-	-	-	-	-	2	3	1	2
23GES28.CO4	3	2	3	1	2	-	-	-	-	-	-	2	3	1	2
23GES28.CO5	3	2	3	1	2	-	-	-	-	-	-	2	3	1	2

Unit-I BASICS AND STATICS OF PARTICLES 9

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces – additions, subtraction, dot product, cross product – Coplanar Forces–rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space– Equivalent systems of forces–Principle of transmissibility .

Unit-II EQUILIBRIUM OF RIGID BODIES 9

Free body diagram – Types of supports – Action and reaction forces –stable equilibrium – Moments and Couples –Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem –Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Single equivalent force -Equilibrium of Rigid bodies in two dimensions–Equilibrium of Rigid bodies in three dimensions

Unit-III PROPERTIES OF SURFACES AND SOLIDS 9

Centroids and centre of mass – Centroids of lines and areas – Rectangular, circular, triangular areas by integration –T section, I section, Angle section, Hollow section by using standard formula– Theorems of Pappus – Area moments of inertia of plane areas– Rectangular, circular, triangular areas by integration– T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas –Principal axes of inertia-Mass moment of inertia

Unit-IV DYNAMICSOFPARTICLES 9

Displacements, Velocity and acceleration, their relationship– Relative motion –Curvilinear motion– Newton's

laws of motion –Work Energy Equation –Impulse and Momentum–Impact of elastic bodies.

Unit-V   FRICTION   **9**

Friction force–Laws of sliding friction– equilibrium analysis of simple systems with sliding friction–wedge friction–ladder friction- Rolling–resistance.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Beer, F.Pand Johnston.E.R.,	Vector Mechanics for Engineers: Statics and Dynamics	Tata McGraw-Hill Publishing company, New Delhi	2013
2.	S. imoshenko,D.H.Young,J.V. Rao and Sukuma rPati	Engineering Mechanics	McGraw Hill Education; 5edition	2013

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Hibbeller, R.C and Ashok Gupta	Engineering Mechanics: Statics and Dynamics	Pearson Education	2010
2.	Irving H. Shames and Krishna Mohana Rao.G	Engineering Mechanics – Statics and Dynamics	Pearson Education	2006
3.	Meriam J.L. and KraigeL.G	Engineering Mechanics	John Wiley &Sons	2013
4.	Rajasekaran S and Sankarasubramanian G	Engineering Mechanics	Vikas Publishing HousePvt.Ltd	2005
5.	Bhavikatti,S.S	Engineering Mechanics	New Age International (P)Limited Publishers	2015

			L	T	P	C
23GES29	**PROFESSIONAL SKILLS**		0	0	3	1

Course Objective:

- To be proficient in important Microsoft Office tools: MS WORD
- To be proficient in using MS WORD to create quality technical documents
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical
- To be able to create and share quality presentations by using the features of MS PowerPoint
- To be proficient in important Microsoft Office tools: MS WORD

Course Outcomes:

23GES29.CO1	Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements.
23GES29.CO2	Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding.
23GES29.CO3	Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

Sl.No.	List of Experiments

MS WORD: **10 Hours**

1. Create and format a document
2. Working with tables
3. Working with Bullets and Lists
4. Working with styles, shapes, smart art, charts
5. Inserting objects, charts and importing objects from other office tools
6. Creating and Using document templates
7. Inserting equations, symbols and special characters
8. Working with Table of contents and References, citations
9. Insert and review comments
10. Create bookmarks, hyperlinks, endnotes footnote
11. Viewing document in different modes
12. Working with document protection and security
13. Inspect document for accessibility

MS EXCEL: **10 Hours**

1. Create worksheets, insert and format data
2. Work with different types of data: text, currency, date, numeric etc.
3. Split, validate, consolidate, Convert data
4. Sort and filter data
5. Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,)

6. Work with Lookup and reference formulae

7. Create and Work with different types of charts

8. Use pivot tables to summarize and analyse data

9. Perform data analysis using own formulae and functions

10. Combine data from multiple worksheets using own formulae and built-in functions to generate results

11. Export data and sheets to other file formats

12. Working with macros

13. Protecting data and Securing the workbook

MS POWERPOINT: **10 Hours**

1. Select slide templates, layout and themes

2. Formatting slide content and using bullets and numbering

3. Insert and format images, smart art, tables, charts

4. Using Slide master, notes and handout master

5. Working with animation and transitions

6. Organize and Group slides

7. Import or create and use media objects: audio, video, animation

8. Perform slideshow recording and Record narration and create presentable videos

Total Periods: 30

PROFESSIONAL CORE

(PC)

For

Mechanical Engineering

23MEC01	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3

Course Objective:

- Impart knowledge on the basics and application of zeroth and first law of thermodynamics.
- Impart knowledge on the second law of thermodynamics in analysing the performance of thermal devices.
- Impart knowledge on availability and applications of second law of thermodynamics.
- Teach the various properties of steam through steam tables and Mollier chart.
- Impart knowledge on the macroscopic properties of ideal and real gases.

Course Outcomes:

23MEC01.CO1	Solve the thermodynamic properties of a system undergoing energy interactions by Applying energy balance.
23MEC01.CO2	Apply Laws of Thermodynamics to various thermal systems for estimating their performance
23MEC01.CO3	Outline the thermodynamic properties of the pure substances.
23MEC01.CO4	Illustrate the significance of thermodynamics relations.
23MEC01.CO5	Solve problems in various psychometric processes

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC01.CO1	3	3	2	2	1	1	1	1	2	1	1	1	3	1	1
23MEC01.CO2	3	3	3	2	1	1	1	1	2	1	1	1	3	1	1
23MEC01.CO3	3	3	3	3	1	1	1	1	2	1	1	1	3	1	1
23MEC01.CO4	3	3	3	3	1	1	1	1	2	1	1	1	3	1	1
23MEC01.CO5	3	3	2	2	1	1	1	1	2	1	1	1	3	1	1

Unit-I   BASIC CONCEPTS AND FIRST LAW   9

Basic concepts concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work. P-V diagram. Zeroth law of thermodynamics concept of temperature and thermal equilibrium- relationship between temperature scales new temperature scales. First law of thermodynamics application to closed and open systems steady and unsteady flow processes.

Unit-II   SECOND LAW AVAILABILITY ANALYSIS   9

Heat reservoir, source and sink, Heat Engine, Refrigerator, Heat pump, Statements of second law and its corollaries, Carnot eyele Reversed Carnot cycle, Performance, Clausius inequality, Concept of entropy, T-s diagram, Tds Equations, entropy change for pure substance, ideal gases different processes, principle of increase in entropy. Applications of II Law, High and low grade energy. Available and non-available energy of a source and finite body, Energy and irreversibility, Expressions for the energy of a closed system and open systems, Energy balance and entropy generation, Irreversibility, I and II law Efficiency.

Unit-III   PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE   9

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams, p-v-T surface, Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of 1 and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods Reheat and Regenerative cycles. Economiser, preheater, Binary and Combined cycle.

Unit-IV   **IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS**   **9**

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases-Reduced properties- Compressibility factor- Principle of Corresponding states. Generalized Compressibility Chart and its use. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes. Simple Calculations

Unit-V   **GAS MIXTURES AND PSYCHROMETRY**   **9**

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture Molar mass, gas constant, density, and change in internal energy, enthalpy, entropy and Gibbs function. Psychometric properties. Psychometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychometric process adiabatic saturation, sensible heating and cooling. Humidification. Dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Nag.P.K	Engineering Thermodynamics	4thEdition, Tata McGraw-Hill	2017
2.	Cengel. Y and M.Boles	Thermodynamics - An Engineering Approach	7th Edition Tata MeGraw Hill	2010
3.	Holman.JP	Thermodynamic	3rd Edition, McGraw- Hill	1995

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Arora C.P	Thermodynamics Engineering	Tata McGraw-Hill	2003
2.	Prasanna Kumar	Thermodynamics	Pearson Education	2010
3.	Chattopadhyay, P	Engineering Thermodynamics	Oxford University Press	2013

23MEC02	**FLUID MECHANICS AND MACHINERY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To introduce the students about properties of the fluids, behavior of fluids under static conditions
- To impart basic knowledge on various losses in pipes
- To expose to the importance of dimensional analysis
- To interpret the various types pumps and its principles
- To expose the students to basic principles of working of hydraulic turbines

Course Outcomes:

23MEC02.CO1	Solve the thermodynamic properties of a system undergoing energy interactions by Applying energy balance.
23MEC02.CO2	Apply Laws of Thermodynamics to various thermal systems for estimating their performance
23MEC02.CO3	Outline the thermodynamic properties of the pure substances.
23MEC02.CO4	Illustrate the significance of thermodynamics relations.
23MEC02.CO5	Solve problems in various psychometric processes

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEC02.CO1	3	3	2	2	1	2	2	1	2	1	1	2	3	1	1
23MEC02.CO2	3	3	3	2	1	2	2	1	2	1	1	2	3	1	1
23MEC02.CO3	3	3	3	3	1	2	2	1	2	1	1	2	3	1	1
23MEC02.CO4	3	3	3	3	1	2	2	1	2	1	1	3	3	1	1
23MEC02.CO5	3	3	3	3	1	2	2	1	2	1	1	3	3	1	1

Unit-I   FLUID PROPERTIES AND FLOW CHARACTERISTICS   9

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristic. concept of control volume - Continuity equation, energy equation and momentum equation

Unit-II   FLOW THROUGH PIPES AND BOUNDARY LAYER   9

Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

Unit-III   DIMENSIONAL ANALYSIS AND MODEL STUDIES   9

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

Unit-IV   PUMPS   9

Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and it's variations - Work saved by fitting air vessels - Rotary pumps.

Unit-V   TURBINES   9

Impact of jets - Velocity triangles - Theory of roto dynamic machines - Classification of turbines - Working principles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines

<div align="right">**Total Periods:** **45**</div>

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dr. P.N. Modi& Dr. S.M. Seth	Hydraulics and Fluid Mechanics	Standard Book House, New Delhi, 22nd edition	2019
2.	Dr. R. K. Bansal	A Textbook of Fluid Mechanics and Hydraulic Machines	Laxmi Publications, Ninth edition	2017
3.	Kumar K. L.,	Engineering Fluid Mechanics,	Eurasia Publishing House (p) Ltd. New Delhi	2016

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Streeter, V. L. and Wylie E. B.	Fluid Mechanics	McGraw Hill Publishing Co.	2010
2.	Kumar K. L.	Engineering Fluid Mechanics	Eurasia Publishing House(p) Ltd., New Delhi	2016
3.	Fox W.R. and McDonald A.T.	Introduction to Fluid Mechanics	John-Wiley and Sons, Singapore	2011
4.	Cengel Y A and Cimbala J M	Fluid Mechanics	McGraw Hill Education Pvt. Ltd.	2014
5.	Pani B S	Fluid Mechanics: A Concise Introduction,	Prentice Hall of India Private Ltd	2016

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23MEC03	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objective:

- To impart knowledge on the concepts and basic mechanism of metal cutting.
- To understand the constructional features and working principle of centre lathe, and special purpose lathes.
- To familiarize the working principle of various machining operations such as milling, shaping, planning, slotting, drilling and broaching.
- To understand the concepts of computer numerical control (CNC) machine tool and CNC programming
- To understand the various abrasive processes.

Course Outcomes:

23MEC03.CO1	Explain the concepts and basic mechanism of metal cutting in different working conditions.
23MEC03.CO2	Compare the constructional features and working principle of centre lathe, special purpose lathes and milling machines.
23MEC03.CO3	Distinguish between the working principle of various machining operations such as shaping, gear cutting, abrasive process and broaching.
23MEC03.CO4	Demonstrate the concepts of computer numerical control (CNC) machine tool and CNC programming.
23MEC03.CO5	Comprehend and illustrate the abrasive and broaching processes.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC03.CO1	3	3	3	1	1	1	3	-	-	3	-	2	3	3	2
23MEC03.CO2	3	3	3	1	1	1	3	-	-	3	-	2	3	2	2
23MEC03.CO3	3	3	3	1	1	1	3	-	-	3	-	2	3	2	2
23MEC03.CO4	3	3	2	1	1	1	3	-	-	3	-	2	3	2	2
23MEC03.CO5	3	3	3	1	1	1	3	-	-	3	-	2	3	2	3

Unit-I   THEORY OF METAL CUTTING   9

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools–nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

Unit-II   TURNING MACHINES   9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle

Unit-III   SHAPER, MILLING AND GEAR CUTTING MACHINES   9

Shaper - Types of operations. Drilling, reaming, boring, Tapping. Milling operations- types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling, hobbling and gear shaping processes –finishing of gears.

Unit-IV   CNC MACHINING   9

Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining centre, part programming fundamentals CNC – Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros – micromachining – wafer machining.

Unit-V ABRASIVE PROCESS AND BROACHING   9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process– cylindrical grinding, surface grinding, centerless grinding and internal grinding- Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Hajra Choudhury	Elements of Workshop Technology	Media Promoters	2008
2.	Rao.P.N	Manufacturing Technology- Metal Cutting and Machine Tools	Tata Mc Graw-Hill	2013

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Richard R Kibbe, John E. Neely,RolandO.Merges And Warren J. White	Machine Tool Practices	Prentice Hall of India	2010
2.	Jain.R.K	Production Technology : Manufacturing Processes, Technology and Automation	Khanna Publishers	2011
3.	Michael Fitzpatrick	Machining and CNC Technology	McGraw-Hill Education; 4th edition,	2018
4.	Roy. A. Lindberg	Manufacturing Technology -Metal Cutting and Machine Tools	PHI/Pearson Education	2006
5.	Mikell. P. Groover	Automation, Production Systems and Computer Integrated Manufacturing	Pearson Education, Limited	2015

23MEC04	ENGINEERING MATERIALS AND METALLURGY	L	T	P	C
		3	0	0	3

Course Objective:

- To learn about the micro-structure of materials, constructing the phase diagrams for different binary Alloys.
- To impart knowledge on selecting and applying various heat treatment processes and its microstructure formation.
- To know about different types of alloy steels with their applications, non-ferrous alloys with particular reference to copper, aluminum, magnesium, zinc, nickel, titanium, lead and tin alloys.
- To illustrate thetypes,structure,propertiesandapplicationsofpolymers,ceramicsandcomposites.
- To identify the various mechanical properties of materials through different types of tests and their significance.

Course Outcomes:

23MEC04.CO1   Gain knowledge on micro-structure of materials, iron-carbon and other phase diagrams.

23MEC04.CO2   Acquire knowledge on isothermal transformation diagram and various types of heat treatments.

23MEC04.CO3   Clarify the different types of ferrous and nonferrous alloy steels and their engineering applications.

23MEC04.CO4   Comprehend the types of nonmetallic materials and their properties

23MEC04.CO5   Explain the concepts of plastic deformation, strengthening mechanisms and fracture of metals, various mechanical testing methods for properties and their engineering importance.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC04.CO1	3	1	3	2	-	-	-	-	-	-	-	2	2	1	2
23MEC04.CO2	3	1	3	1	-	2	-	1	-	-	-	2	2	1	2
23MEC04.CO3	3	1	3	-	-	-	-	-	-	-	-	2	2	1	2
23MEC04.CO4	3	1	3	-	-	-	2	-	-	-	-	2	2	1	2
23MEC04.CO5	3	1	3	2	2	-	-	-	-	-	-	2	2	1	2

Unit-I   ALLOYS AND PHASE DIAGRAMS   9

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

Unit-II   HEAT TREATMENT   9

Definition – Full annealing, stress relief, recrystallization and spheroidising – normalizing, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T.diagram - – continuous cooling Transformation (CCT) diagram – Hardenability, Jominy end quench test - Austempering, martempering – case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening.

Unit-III   FERROUS AND NON-FERROUS METALS   9

Effect of alloying additions on steel- α and β stabilisers– stainless and tool steels – HSLA, Maraging steels – Cast Iron - Grey, white, malleable, spheroidal – alloy cast irons, Copper and copper alloys – Brass, Bronze and Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

Unit-IV   NON-METALLIC MATERIALS   9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)- Engineering Ceramics –Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON –Composites-Classifications- Metal Matrix and FRP - Applications of Composites.

Unit-V   MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS   9

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test lzod and charpy, fatigue and creep failure mechanisms.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Avner,S.H	IntroductiontoPhysicalMetallurgy	McGraw Hill BookCompany	2017
2.	Williams DCallister	MaterialScienceandEngineering	WileyIndia Pvt. Ltd.	2019

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Raghavan.V	Materials Science andEngineering	Prentice Hall of India Pvt.Ltd	2004
2.	Kenneth G.Budinskiand Michael K.Budinski	EngineeringMaterials	Prentice Hall of India PrivateLimited,4thIndian Reprint	2010
3.	Upadhyay. G.S. andAnishUpadhyay	Materials Science andEngineering	Viva Books Pvt. Ltd., NewDelhi	2020
4.	U.C.Jindal	Material Science andMetallurgy,"Engineering MaterialsandMetallurgy	First Edition, DorlingKindersley	2012
5.	P.Khanna	Text Book of MaterialScienceandMetallurgy	Dhanpat Rai Publication (P)Ltd.,New Delhi	2007
6.	A. Alavudeen, N. Venkateshwaran, and J. T.Winowlin Jappes,	A Textbook of Engineering Materials and Metallurgy	Laxmi Publications	2006

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		L	**T**	**P**	**C**
23MEC05	**STRENGTH OF MATERIALS**	**3**	**0**	**0**	**3**

Course Objective:

- To gain knowledge of simple stresses, strains and deformation in components due to external loads, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin shells, columns

Course Outcomes:

23MEC05.CO1	Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
23MEC05.CO2	Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
23MEC05.CO3	Apply basic equation of torsion in designing of shafts and helical springs
23MEC05.CO4	Calculate slope and deflection in beams using different methods.
23MEC05.CO5	Analyse stresses and deformation of thin shells and columns.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEC05.CO1	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
23MEC05.CO2	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
23MEC05.CO3	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
23MEC05.CO4	3	3	3	3	2	3	1	3	2	3	1	3	3	2	3
23MEC05.CO5	3	3	3	3	-	3	1	3	2	3	1	3	3	2	3

Unit-I   STRESS, STRAIN AND DEFORMATION OF SOLIDS   9

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads-Principal stresses and principal planes – Mohr's circle of stress.

Unit-II   TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM   9

Beams – Types - Transverse loading on beams – Shear force and Bending moment in beams – Cantilever, Simply supported and over hanging beams. Theory of simple bending – Bending stress distribution – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

Unit-III   TORSION   9

Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – Combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – springs in series and parallel.

Unit-IV   DEFLECTION OF BEAMS   9

Deflection of beams by Double integration method – Macaulay's method – Area moment theorems for computation of slopes and deflections in beams – Conjugate beam method

Unit-V   THIN CYLINDERS, COLUMNS   9

Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses- Deformation in thin cylinders- Theory of columns – Long column and short column - Euler's formula – Rankine's formula.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rajput R.K	Strength of Materials (Mechanics of Solids)	S.Chand & company Ltd., New Delhi	2018
2.	Rattan S.S	Strength of Materials	Tata McGraw Hill Education Pvt .Ltd., New Delhi	2017

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Singh. D.K	Strength of Materials	Ane Books Pvt Ltd., New Delhi	2021
2.	Egor P Popov	Engineering Mechanics of Solids	PHI Learning Pvt. Ltd., New Delhi	2015
3.	Beer. F.P. & Johnston. E.R	Mechanics of Materials	Tata McGraw Hill, New Delhi	2019
4.	Vazirani. V.N, Ratwani. M.M, Duggal .S.K	Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1	Khanna Publishers, New Delhi	2014
5.	Singh. D.K	Strength of Materials	Ane Books Pvt Ltd., New Delhi	2021

23MEC06	THERMAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objective:

- To learn the concepts and laws of thermodynamics to predict the operation of thermodynamic cycles and performance of Internal Combustion(IC) engines and Gas Turbines.
- To analyzing the performance of steam nozzle, calculate critical pressure ratio
- To Evaluating the performance of steam turbines through velocity triangles, understand the need for governing and compounding of turbines
- To evaluating the various performance of Air Compressor.
- To analyzing the performance VCR and VAR Systems.

Course Outcomes:

23MEC06.CO1   Calculate the performance parameters of Gas power cycles.

23MEC06.CO2   Explain the working principle, combustion characteristics of IC Engines and Performance of IC Engine.

23MEC06.CO3   Explain the performance characteristics of steam nozzles.

23MEC06.CO4   Calculate the various efficiencies of the air compressors.

23MEC06.CO5   Explain the working principle of VCR & VAR systems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC06.CO1	3	3	2	2	1	2	2	1	2	1	1	2	3	1	1
23MEC06.CO2	3	3	3	2	1	2	3	2	2	1	1	2	3	1	1
23MEC06.CO3	3	3	3	3	1	2	2	1	2	1	1	2	3	1	1
23MEC06.CO4	3	3	3	3	1	2	3	2	2	1	1	3	3	1	1
23MEC06.CO5	3	3	3	2	2	2	3	2	2	2	1	2	3	1	1

Unit-I   GAS POWER CYCLES   9

Otto, Diesel, Dual, Brayton cycles. Calculation of mean effective pressure, and air standard efficiency-Comparison of cycles.

Unit-II   INTERNAL COMBUSTION ENGINES   9

Classification Components and their function. Valve timing diagram and port timing diagram actual and theoretical p-V diagram of four stroke and two stroke engines. Simple and complete Carburetor. MPFI. Diesel pump and injector system. Battery and Magneto Ignition System - Principles of Combustion and knocking in Sl and CI Engines. Lubrication and Cooling systems. Performance calculation. Introduction of E-Vehicle and Hybrid Vehicle.

Unit-III   STEAM NOZZLES AND TURBINES   9

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations-Governors.

Unit-IV   AIR COMPRESSOR   9

Classification and working principle of various types of compressors, work of compression with and without

clearance, volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating compressors, multistage air compressor and inter cooling-work of multistage air compressor.

Unit-V   REFRIGERATION AND AIR CONDITIONING   9

Refrigerants – Eco Friendly Refrigerants - Vapour compression refrigeration cycle- super heat, sub cooling- Performance calculations working principle of vapour absorption system, Ammonia-Water, Lithium bromide - water systems (Description only). Air conditioning system Processes.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ballaney. P	Thermal Engineering	25th Edition, Khanna Publishers	2017
2.	Domkundwar, Kothandaraman, &Domkundwar	A Course in Thermal Engineering	6th Edition, DhanpatRai& Sons	2011
3.	Ganesan.V,	Internal Combustion Engines	4th Edition, Tata McGraw Hill	2012

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Gupta H.N	Fundamentals of Internal Combustion Engines	2nd Edition Prentice Hall of India	2013.
2.	Mathur M.L and Mehta F.S	Thermal Science and Engineering	3rd Edition, Jain Brothers Pvt. Ltd	2017
3.	Soman. K	Thermal Engineering	2nd Edition, Prentice Hall of India	2011
4.	Mahesh.M. Rathore,	Thermal Engineering	1st Edition, Tata McGraw Hill	2010

		L	T	P	C
23MEC06	**THERMAL ENGINEERING**	**3**	**0**	**0**	**3**

Course Objective:

- To learn the concepts and laws of thermodynamics to predict the operation of thermodynamic cycles and performance of Internal Combustion(IC) engines and Gas Turbines.
- To analyzing the performance of steam nozzle, calculate critical pressure ratio
- To Evaluating the performance of steam turbines through velocity triangles, understand the need for governing and compounding of turbines
- To evaluating the various performance of Air Compressor.
- To analyzing the performance VCR and VAR Systems.

Course Outcomes:

23MEC06.CO1   Calculate the performance parameters of Gas power cycles.

23MEC06.CO2   Explain the working principle, combustion characteristics of IC Engines and Performance of IC Engine.

23MEC06.CO3   Explain the performance characteristics of steam nozzles.

23MEC06.CO4   Calculate the various efficiencies of the air compressors.

23MEC06.CO5   Explain the working principle of VCR & VAR systems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC06.CO1	3	3	2	2	1	2	2	1	2	1	1	2	3	1	1
23MEC06.CO2	3	3	3	2	1	2	3	2	2	1	1	2	3	1	1
23MEC06.CO3	3	3	3	3	1	2	2	1	2	1	1	2	3	1	1
23MEC06.CO4	3	3	3	3	1	2	3	2	2	1	1	3	3	1	1
23MEC06.CO5	3	3	3	2	2	2	3	2	2	2	1	2	3	1	1

Unit-I   GAS POWER CYCLES   9

Otto, Diesel, Dual, Brayton cycles. Calculation of mean effective pressure, and air standard efficiency-Comparison of cycles.

Unit-II   INTERNAL COMBUSTION ENGINES   9

Classification Components and their function. Valve timing diagram and port timing diagram actual and theoretical p-V diagram of four stroke and two stroke engines. Simple and complete Carburetor. MPFI. Diesel pump and injector system. Battery and Magneto Ignition System - Principles of Combustion and knocking in Sl and CI Engines. Lubrication and Cooling systems. Performance calculation. Introduction of E-Vehicle and Hybrid Vehicle.

Unit-III   STEAM NOZZLES AND TURBINES   9

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations-Governors.

Unit-IV   AIR COMPRESSOR   9

Classification and working principle of various types of compressors, work of compression with and without clearance, volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating compressors,

multistage air compressor and inter cooling-work of multistage air compressor.

Unit-V   REFRIGERATION AND AIR CONDITIONING   9

Refrigerants – Eco Friendly Refrigerants - Vapour compression refrigeration cycle- super heat, sub cooling- Performance calculations working principle of vapour absorption system, Ammonia-Water, Lithium bromide - water systems (Description only). Air conditioning system Processes.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ballaney. P	Thermal Engineering	25th Edition, Khanna Publishers	2017
2.	Domkundwar, Kothandaraman, &Domkundwar	A Course in Thermal Engineering	6th Edition, DhanpatRai& Sons	2011
3.	Ganesan.V,	Internal Combustion Engines	4th Edition, Tata McGraw Hill	2012

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Gupta H.N	Fundamentals of Internal Combustion Engines	2nd Edition Prentice Hall of India	2013.
2.	Mathur M.L and Mehta F.S	Thermal Science and Engineering	3rd Edition, Jain Brothers Pvt. Ltd	2017
3.	Soman. K	Thermal Engineering	2nd Edition, Prentice Hall of India	2011
4.	Mahesh.M. Rathore,	Thermal Engineering	1st Edition, Tata McGraw Hill	2010

23MEC07	HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

Course Objective:

- To provide the knowledge on the working principles of fluid power systems.
- To study the fluids and components used in modern industrial fluid power system.
- To develop the design, construction and operation of fluid power circuits.
- To learn the working principles of pneumatic power systems and its components.
- To provide the knowledge of trouble shooting methods in fluid power systems.

Course Outcomes:

23MEC07.CO1   Apply the working principles of fluid power systems and hydraulic pumps.

23MEC07.CO2   Apply the working principles of hydraulic actuators and control components.

23MEC07.CO3   Design and develop hydraulic circuits and systems.

23MEC07.CO4   Apply the working principles of pneumatic circuits and power system and its components.

23MEC07.CO5   Identify various troubles shooting methods in fluid power systems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC07.CO1	2	1	1	-	-	-	-	-	-	-	-	1	2	-	-
23MEC07.CO2	2	1	1	-	-	-	-	-	-	-	-	1	2	-	-
23MEC07.CO3	2	1	1	-	-	-	-	-	-	-	-	1	2	-	-
23MEC07.CO4	2	1	1	-	-	-	-	-	-	-	-	1	2	-	-
23MEC07.CO5	2	1	1	-	-	-	-	-	-	-	-	1	2	-	-

Unit-I   FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS   9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque, Sources of Hydraulic power: Pumping Theory-– Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps

Unit-II   HYDRAULIC ACTUATORS AND CONTROL COMPONENTS   9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators-Hydraulic motors-Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation–Accessories: Reservoirs, Pressure Switches–Filters–types and selection-Applications – Fluid Power ANSI Symbols – Problems

Unit-III   HYDRAULIC CIRCUITS AND SYSTEMS   9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, –Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems.

Unit-IV   PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS   9

Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit –classification- single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits, Electro Pneumatic System – Elements –Ladder

diagram–timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits

Unit-V   TROUBLE SHOOTING AND APPLICATIONS   9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Anthony Esposito	Fluid Power with Applications	Prentice Hall	2009
2.	James A. Sullivan,	Fluid Power Theory and Applications	Fourth Edition, Prentice Hall	1997

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Srinivasan.R	Hydraulic and Pneumatic controls	Vijay Nicole	2006
2.	Shanmugasundaram.K	Hydraulic and Pneumatic controls	Chand & Co.	2006
3.	Majumdar S.R	Pneumatic systems– Principles and maintenance	Tata McGraw Hill	1995
4.	Anthony Lal	Oil hydraulics in the service of industry	Allied publishers	1982
5.	Harry L. Stevart D.B	Practical guide to fluid power	Taraoeala sons and Port Ltd.	1976

23MEC08	ENGINEERING METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	0	3

Course Objective:

- To learn basic concepts of the metrology and importance of measurements
- To teach measurement of linear and angular dimensions assembly and transmission elements.
- To study the tolerance analysis in manufacturing.
- To develop the fundamentals of GD & T and surface metrology.
- To provide the knowledge of the advanced measurements for quality control in manufacturing industries

Course Outcomes:

23MEC08.CO1   Discuss the concepts of measurements to apply in various metrological instruments.

23MEC08.CO2   Apply the principle and applications of linear and angular measuring instruments, assembly and transmission elements.

23MEC08.CO3   Apply the tolerance symbols and tolerance analysis for industrial applications.

23MEC08.CO4   Apply the principles and methods of form and surface metrology.

23MEC08.CO5   Apply the advances in measurements for quality control in manufacturing Industries.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC08.CO1	3	2	2	2	-	-	-	-	1	-	-	1	3	2	1
23MEC08.CO2	3	2	2	2	-	-	-	-	1	-	-	1	3	2	1
23MEC08.CO3	3	2	2	2	-	-	-	-	1	-	-	1	3	2	1
23MEC08.CO4	3	2	2	2	-	-	-	-	1	-	-	1	3	2	1
23MEC08.CO5	3	2	2	2	-	-	-	-	1	-	-	1	3	2	1

Unit-I   BASICS OF METROLOGY   9

Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards.

Unit-II   MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS   9

Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector –Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.

Unit-III   TOLERANCE ANALYSIS   9

Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

Unit-IV   METROLOGY OF SURFACES   9

Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.

Unit-V   ADVANCES IN METROLOGY   9

Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers – Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM –Types of CMM– Constructional features–Probes–Accessories–Software–Applications–Multi- sensor CMMs.
Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in- process monitoring in production - Computed tomography – White light Scanners.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dotson Connie	Dimensional Metrology	Cengage Learning, First edition	2012
2.	Mark Curtis, Francis T. Farago.	Handbook of Dimensional Measurement	Industrial Press, Fifth edition	2013

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ammar Grous.J	Applied Metrology for Manufacturing Engineering	Wiley-ISTE	2011
2.	Galyer, J.F.W. Charles Reginald Shotbolt.	Metrology for Engineers	Cengage Learning EMEA; 5th revised edition	1990
3.	Raghavendra N.V. and Krishnamurthy. L.	Engineering Metrology and Measurements	Oxford University Press	2013
4.	Venkateshan, S. P.	Mechanical Measurements	Second edition, John Wiley &Sons	2015

23MEC09	MECHANICS OF MACHINES	L	T	P	C
		3	0	0	3

Course Objective:

- To study the basic components of mechanisms, analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and design cam mechanisms for specified output motions.
- To study the basic concepts of toothed gearing and kinematics of gear trains
- To analyzing the effects of friction in machine elements
- To analyzing the force-motion relationship in components subjected to external forces and analyzing of standard mechanisms.
- To analyzing the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.

Course Outcomes:

23MEC09.CO1   Discuss the basics of mechanism.

23MEC09.CO2   Solve problems on gears and gear trains.

23MEC09.CO3   Examine friction in machine elements.

23MEC09.CO4   Calculate static and dynamic forces of mechanisms.

23MEC09.CO5   Calculate the balancing masses and their locations of reciprocating and rotating masses. Computing the frequency of free vibration, forced vibration and damping coefficient.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC09.CO1	3	2	2	-	2	-	-	1	-	-	-	1	3	-	1
23MEC09.CO2	3	2	2	-	2	-	-	1	-	-	-	1	3	-	1
23MEC09.CO3	3	2	2	-	2	-	-	1	-	-	-	1	3	-	1
23MEC09.CO4	3	2	2	-	2	-	-	1	-	-	-	1	3	-	1
23MEC09.CO5	3	2	2	-	2	-	-	1	-	-	-	1	3	-	1

Unit-I   KINEMATICS OF MECHANISMS   9

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons– Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

Unit-II   GEARS AND GEAR TRAINS   9

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

Unit-III   FRICTION IN MACHINE ELEMENTS   9

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction aspects in brakes– Friction in vehicle propulsion and braking

Unit-IV   FORCE ANALYSIS   9

Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and

Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members

Unit-V   BALANCING AND VIBRATION   9

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration isolation. (Gyroscopic principles)

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Uicker, J.J., Pennock G.R and Shigley, J.E.,	Theory of Machines and Mechanisms	Oxford University Press	2017
2.	Ramamurthi. V	Mechanics of Machines	Narosa Publishing House	2019

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Amitabha Ghosh and Ashok Kumar Mallik	Theory of Mechanisms and Machines	Affiliated East-West Pvt. Ltd.	1988
2.	Rao.J.S. and Dukkipati.R.V.	Mechanism and Machine Theory	New Age International Pvt. Ltd	2014
3.	Rattan S.S	Theory of Machines	McGraw-Hill Education Pvt. Ltd	2019
4.	Robert L. Norton	Kinematics and Dynamics of Machinery	Tata McGraw-Hill	2013
5.	Wilson and Sadler	Kinematics and Dynamics of Machinery	Pearson	2008

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	L	**T**	**P**	**C**
23MEC10 **DESIGN OF MACHINE ELEMENTS**	**3**	**0**	**0**	**3**

(Use of approved Design Data book is permitted)

Course Objective:

- To select the materials based on mechanical properties, different types of loading, simple, steady and variable stresses.
- To know the design procedure for various types of shafts, keys and couplings.
- To design the threaded fasteners, bolted joints including eccentric loading and welded joints for pressure vessels and structures.
- To design the various types of springs like helical, leaf, disc and torsional springs.
- To state the design procedure for various types of bearings and flywheel.

Course Outcomes:

23MEC10.CO1	Select the materials based on mechanical properties, different types of loading and introduction about simple, steady and variable stresses.
23MEC10.CO2	Know the design procedure for various types of shafts, keys and couplings.
23MEC10.CO3	Design the threaded fasteners, bolted joints including eccentric loading and welded joints for pressure vessels and structures.
23MEC10.CO4	Design the various types of springs like helical, leaf, disc and torsional springs.
23MEC10.CO5	Design various types of bearings like sliding contact, rolling contact bearing and flywheels.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEC10.CO1	3	3	1	2	1	1	-	-	-	1	-	1	3	-	1
23MEC10.CO2	3	3	2	2	1	1	-	-	-	1	-	1	2	2	2
23MEC10.CO3	3	2	2	2	1	1	-	-	-	1	-	2	3	2	-
23MEC10.CO4	3	2	2	1	1	1	-	-	-	-	-	2	-	2	1
23MEC10.CO5	3	2	2	1	2	1	-	-	-	1	-	1	2	2	-

Unit-I   **STEADY AND VARIABLE STRESSES**   **9**

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties, preferred numbers – application of theories of failures – design of variable stresses.

Unit-II   **DESIGN OF SHAFTS AND COUPLINGS**   **9**

Design of Solid and Hollow Shafts Based on Strength and Rigidity – Design of Keys - Design of Rigid And Flexible Couplings.

Unit-III   **DESIGN OF FASTNERS AND WELDED JOINTS**   **9**

Threaded fasteners - design of bolted joints including eccentric loading – design of welded joints for structures.

Unit-IV   **DESIGN OF ENERGY STORING ELEMENTS**   **9**

Types of springs, Design of helical, leaf and concentric torsion spring. Design of flywheels involving stresses in rim and arm.

Unit-V   **DESIGN OF BEARINGS**   **9**

Design of bearings – sliding contact and rolling contact types. – cubic mean load – design of journal bearings – mckees equation – lubrication in journal bearings – calculation of bearing dimensions.

Total Periods: **45**

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Richard G Budynas J.Keith Nisbett	Shigley's Mechanical Engineering Design	Mc Graw Hill	2011
2.	Khurmi R.S, Gupta J.K	Machine Design	Eurasia publishing house	2005

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	V B Bhandari	Design of Machine Elements	Tata Mcgraw-hill.	2007
2.	Ugural A.C	Mechanical Design – An Integral Approach	Mcgraw-hill book co	2004
3.	Spotts M.F., Shoup T.E	Design and Machine Elements	Pearson Education	2004
4.	Orthwein W	Machine Component Design	Jaico Publishing co	2003
5.	Norton R.L	Design of Machinery	Tata mcgraw-hill book co	2002

		L	**T**	**P**	**C**
23MEC11	**CAD/CAM**	**3**	**0**	**0**	**3**

(Use of approved Design Data book is permitted)

Course Objective:

- To Introduce and understand the Basic of Design.
- To study the two dimensional drafting and bill of material creation.
- To learn three dimensional modelling and its advantages.
- To study the basic and purpose of assembling modeling.
- To study the basics of computer aided machining and part programming.

Course Outcomes:

23MEC11.CO1   Discuss the basics of the design and concepts

23MEC11.CO2   Develop the two dimensional drafting and projection views.

23MEC11.CO3   Discuss the three dimensional modeling, parametric and Non-parametric modeling

23MEC11.CO4   Discuss the assembly modeling and top down, bottom up approaches.

23MEC11.CO5   Develop the computer aided machining and wirting part programming.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEC11.CO1	3	2	2	2	2	-	-	-	1	-	-	1	3	2	1
23MEC11.CO2	3	2	2	2	2	-	-	-	1	-	-	1	3	2	1
23MEC11.CO3	3	2	2	2	2	-	-	-	1	-	-	1	3	2	1
23MEC11.CO4	3	2	2	2	2	-	-	-	1	-	-	1	3	2	1
23MEC11.CO5	3	2	2	2	2	-	-	-	1	-	-	1	3	2	1

Unit-I   BASICS OF DESIGNS   9

Understanding of Projections, Scales, units, GD & T; its 14 symbols, Special characteristics & Title Block readings. Revision / ECN status of drawings – Customer Specific requirements – Drawing Grid reading.

Unit-II   2D DRAFTING   9

Projection views – Orthographic view, Axillary view, Full & Half Section views, Broken Section view, Offset Section view – Title Block creation – BOM Creation – Notes creation – Ballooning of 2D drawing and its features for Inspection reporting.

Unit-III   3D MODELING   9

Conversion of Views – 2D to 3D & 3D to 2D – Parametric and Non-Parametric Modeling – Tree features of 3D Modeling and its advantages – Surface Modeling – BIW (Body In White) – Solid Modeling, Boolean operations like Unites, Subtraction, Intersect, etc.

Unit-IV   ASSEMBLY MODELING   9

Basics of Assembly modeling, Purpose of Assembly modeling & its advantages – Top to Down & BottomUp modeling approaches – Analysis of Clearances – Undercuts – Interferences – Stack up analysis – Cumulative effect of Tolerances in after assembly conditions.- motion analysis

Unit-V   CAM   9

Basics of CNC Machining – 3, 4 & 5 Axis machines - CNC and Part Programing, CAM programing 2D & 3D. Elements of CAM Orientation, Boundary Creation, Cutter Path Selection, Cutter Compensation –Machining Stocks, Roughing, Re-roughing, Semi Finishing & Finishing - Tool Path Generation, Isl and Milling Programing. Machining program simulation, integration of program with machine; Estimation of CNC Cycle time.

– Post Process NC Code conversion and Setup Sheet Preparation.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Jacob Moses & Ruchi Agarwal	Computer Aided Design & Manufacturing	Technical Publication	2022
2.	J. Srinivas	CAD / CAM Principles & Application	OXFORD University Press	2018

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ibrahim Zaid	CAD / CAM	Prentice Hall India	2003
2.	Radhakrishnan P, Subramanyan S.and Raju V	CAD/CAM/CIM", 2nd Edition	New Age International (P) Ltd, New Delhi	2000
3.	P Rao , N Tewari & T.K. Kundra	Computer Aided Manufacturing	Tata McGraw Hill Publishing Company	2000
4.	Ostwalal P.F. and Munez J	Manufacturing Processes and systems	John Wiley, 9th Edition,	1998
5.	Ibrahim Zaid	CAD / CAM	Prentice Hall India	2003

<table>
<tr><td rowspan="2" align="center">23MEC12</td><td rowspan="2" align="center">HEAT AND MASS TRANSFER</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
</table>

Course Objective:

- To impart a comprehensive knowledge of various modes of heat and mass transfer.
- To empower the students for solving heat transfer problems in the industry.
- To equip the student in the design of heat exchangers

Course Outcomes:

23MEC12.CO1   Solve the steady and unsteady heat conduction problems for simple geometries

23MEC12.CO2   Develop the two dimensional drafting and projection views.

23MEC12.CO3   Design the heat exchangers using the LMTD and effectiveness-NTU methods

23MEC12.CO4   Solve the radiation heat transfer problems

23MEC12.CO5   Analyse the various mass transfer processes

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC12.CO1	3	3	2	1	-	1	2	1	1	2	1	1	2	2	1
23MEC12.CO2	3	3	2	1	-	1	2	1	1	2	1	1	2	2	1
23MEC12.CO3	3	3	2	1	-	1	2	1	1	2	1	1	2	2	1
23MEC12.CO4	3	3	2	1	-	1	2	1	1	2	1	1	2	2	1
23MEC12.CO5	3	3	2	1	-	1	2	1	1	2	1	1	2	2	1

Unit-I   CONDUCTION   9

Fundamental differential equation of heat conduction in Cartesian coordinates- representation of general heat conduction equation in cylindrical and spherical coordinates – Fourier law of heat conduction – boundary and initial conditions – plane wall and radial systems – critical thickness of insulation – conduction with thermal energy generation – heat transfer from extended surfaces – transient heat conduction.

Unit-II   CONVECTION   9

Principles of convection – convection boundary layer – laminar and turbulent flow – empirical relations for external and internal forced convection flows – flat plate, cylinders, spheres – empirical relations for free convection flows – horizontal cylinders, horizontal plates, vertical planes, inclined surfaces and enclosed spaces.

Unit-III   RADIATION   9

Nature of thermal radiation – radiation intensity – relation to emission, irradiation and radiosity – black body radiation – loss of radiation – emissivity – surface emission – Krichhoff"s law – gray surface – view factor – radiation exchange between black surfaces – radiation exchange between gray surfaces – electrical analogy – radiation shields

Unit-IV   HEAT EXCHANGERS   9

Types – overall heat transfer coefficient – fouling factor – heat exchanger analysis using log mean temperature difference (LMTD) and effectiveness – number of transfer units (NTU) method – compact heat exchangers, methodology of heat exchanger design calculations, Heat Pipes.

Unit-V   MASS TRANSFER   9

Introduction – concentration , velocities, fluxes – mechanisms of diffusions , diffusion in a stationary and moving medium – mass convection – analogy between convective heat and mass transfer – simultaneous heat and mass transfer.

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Sachdeva R.C	Fundamentals of Engineering Heat and Mass Transfer	New Age International Publishers, New Delhi	2010
2.	Kothandaraman C.P	Fundamentals of Heat and Mass Transfer	New Age International Publishers, New Delhi	2010

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Frank P Incropera and David P. Dewitt	Fundamentals of Engineering Heat and Mass Transfer	John Wiley and Sons	2010
2.	Holman J.P	Heat and Mass Transfer	Tata McGrawHill	2010
3.	Yadav R	Heat and Mass Transfer	Central Publishing House, Allahabad	2010
4.	Ozisik M.N	Heat Transfer	McGraw Hill Book Co	2005
5.	Yunus Cengel	Heat Transfer	McGraw Hill Company	2008

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23MEC13	**DESIGN OF TRANSMISSION SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To learn the procedure of simple selection and design the flexible elements
- To impart knowledge on spur gear force analysis dynamic effects gear materials.
- To impart knowledge on the principles and procedure for the design of helical gears
- To know about the bevel and worm gear design.
- To impart knowledge on the stresses occurred in clutch and breaks

Course Outcomes:

23MEC13.CO1   Gain knowledge on Design the various transmission systems like belt, chain, rope.

23MEC13.CO2   Acquire knowledge on Design the spur gears and its related concepts and other gear designing terms related to parallel axis helical gears.

23MEC13.CO3   Acquire knowledge on Design the bevel, worm and cross helical gears based on the mechanisms chosen for building of various machines.

23MEC13.CO4   Acquire knowledge on Design the gear box for both constant speed and variable number of speeds in the transmission systems

23MEC13.CO5   Know the concepts of Design the clutches and Brakes and also able to utilize the same to solve practical problems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEC13.CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
23MEC13.CO2	3	3	3	-	-	-	-	-	-	-	-	-	2	2	-
23MEC13.CO3	3	3	2	-	-	-	-	-	-	-	-	-	2	-	-
23MEC13.CO4	3	2	3	-	-	-	-	-	-	-	-	-	2	-	-
23MEC13.CO5	3	-	-	-	2	-	-	-	-	-	-	-	-	2	-

Unit-I   DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE LEMENTS   9

Design of flat belt, V - Belt and pulleys - Design of Wire Ropes and pulleys - Selection of flat belts and pulleys – V belts and pulleys – Selection of Wire ropes and pulleys - Introduction to modern transmission systems

Unit-II   DESIGN OF SPUR GEARS AND PARALLEL AXIS HELICAL GEARS   9

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears.

Unit-III   DESIGN OF BEVEL AND WORM GEARS   9

Design of Straight bevel gears: Tooth terminology- Tooth forces and stresses – Equivalent number of teeth. Worm Gear: Terminology – Thermal capacity – materials - forces and stresses and Efficiency - Design of Worm gear – Estimating the size of the worm gear pair, Merits and demerits- terminology of worm gears

Unit-IV   DESIGN OF GEAR BOXES   9

Geometric progression – Standard step ratio – Ray diagram – Kinematics layout – Design of sliding mesh gear box – Constant mesh gear box – Design of multi speed gear box-Variable speed gear box

Unit-V   DESIGN OF CLUTCHES AND BRAKES   9

Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-shoe and band brakes - external shoe brakes – Internal expanding shoe brake - Electromagnetic clutches.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Bhandari V	Design of Machine Elements Tata McGraw	Hill Book Co	2017
2.	Juvinall	R Fundamentals of Machine Component Design	John Wiley and Sons	2005

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Sundararajamoorthy T. V, Shanmugam .N	Machine Design	Anuradha Publications, Chennai	2003
2.	Joseph Shigley,Charles Mischke,Richard Budynas and Keith Nisbett	Mechanical Engineering Design	8th Edition, Tata McGraw-Hill	2008
3.	Maitra, G.M. and L.V.Prasad	Hand book of Mechanical Design	Tata McGraw - Hill	2015
4.	Joseph Shigley	Mechanical Engineering Design	Tata McGraw-Hill	2008
5.	Robert C. Juvinall and Kurt M. Marshek,	Fundamentals of Machine Design	4th Edition, Wiley	2005

23MEC14	**FINITE ELEMENT ANALYSIS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To obtain an understanding of the fundamental theory of the FEA method
- To learn mathematical models for one dimensional problems and their numerical Solutions
- To understand the use of the basic finite elements for structural applications using truss, bar, frame and plane elements.
- To learn two dimensional vector variable problems to determine field variables
- To understand the basic step to involve the Solutions Techniques to Dynamic problems.

Course Outcomes:

23MEC14.CO1	Compute mathematical model for solution of common engineering problems.
23MEC14.CO2	Develop mathematical models for one dimensional problems and their Numerical solutions
23MEC14.CO3	Use professional-level finite element software to solve engineering problems in solid mechanics, fluid flow and heat transfer.
23MEC14.CO4	Determine field variables for two dimensional vector variable problems
23MEC14.CO5	Apply the Natural co-ordinate systems and Solutions Techniques to Dynamic problems.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEC14.CO1	2	3	1	2	-	1	-	-	-	1	-	1	3	-	1
23MEC14.CO2	2	3	2	2	-	1	-	-	-	1	-	1	2	2	2
23MEC14.CO3	3	2	2	2	-	1	-	1	-	1	-	2	3	2	-
23MEC14.CO4	3	2	2	1	-	1	-	1	-	-	-	2	-	2	1
23MEC14.CO5	2	2	2	1	2	1	-	-	-	1	-	1	2	2	-

Unit-I   INTRODUCTION OF FINITE ELEMENT ANALYSIS   9

Historical Background — Mathematical Modeling of field problems in Engineering — Governing Equations — Discrete and continuous models – weighted residual, Galerkin and Raleigh Ritz methods – Integration by parts – Basic concepts of the Finite Element Method.

Unit-II   ONE DIMENSIONAL ANALYSIS   9

Steps in FEA – Discretization, function – derivation of element characteristics matrix, shape function, assembly and imposition of boundary conditions – solution and post processing – One dimensional analysis in bar element, Truss and heat transfer.

Unit-III   TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS   9

Second Order 2D Equations involving Scalar Variable Functions-Variational formulation-Finite Element Formulation-Triangular Elements-Shape function and Element Matrices and Vectors. Application to Field Problems.

Unit-IV   TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS   9

Equations of elasticity – Plane stress, plane strain and Axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

Unit-V   ISOPARAMETRIC FORMULATION AND APPLICATIONS   9

Natural co-ordinate systems – Isoparametric elements –Dynamic Analysis – Nonlinear and Vibration Problems - Meshing and Solution Problems - Modelling and analysis using recent softwares

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Reddy. J.N.,	An Introduction to the Finite Element Method	Tata McGraw-Hill	2010
2.	Seshu, P	Text Book of Finite Element Analysis	Prentice-Hall of India Pvt. Ltd	2010
3.	Lewis, R.W	The Finite Element Method in Heat Transfer Analysis	John Wiley & Sons	2010

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rao, S.S.	The Finite Element Method in Engineering	Butterworth Heinemann	2018
2.	Stanley Middleman Middleman	An Introduction to Fluid Dynamics 01 Edition	John Wiley & Sons	2015
3.	O. C. Zienkiewicz and R. L. Taylor	The Finite Element Method	7th edition, Butterworth-Heinemann	2013
4.	Huang Usmani	Finite Element Analysis for Heat Transfer	Springer London	2012
5.	K. J. Bathe	Finite Element Procedures in Engineering Analysis	2nd edition (reprint), Prentice-Hall	2009

			L	**T**	**P**	**C**
23MEC15	**MECHATRONICS AND IoT**		**3**	**0**	**0**	**3**

Course Objective:

- To make students get acquainted with the sensors and the actuators, which are commonly used in mechatronics systems.
- To provide insight into the signal conditioning circuits, and also to develop competency in PLC programming and control
- To make students familiarize with the fundamentals of IoT and Embedded systems. 4 To impart knowledge about the Arduino and the Raspberry Pi.
- To inculcate skills in the design and development of mechatronics and IoT based systems.
- To make students get acquainted with the sensors and the actuators, which are commonly used in mechatronics systems.

Course Outcomes:

23MEC15.CO1   Explain Select suitable sensors and actuators to develop mechatronics systems.

23MEC15.CO2   Discuss Devise proper signal conditioning circuit for mechatronics systems, and also able to implement PLC as a controller for an automated system.

23MEC15.CO3   Elucidate the fundamentals of IoT and Embedded Systems.

23MEC15.CO4   Discuss Control I/O devices through Arduino and Raspberry Pi.

23MEC15.CO5   Design and develop an apt mechatronics/IoT based system for the given real-time application.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEC15.CO1	3	-	2	-	-	2	-	-	-	-	-	3	1	-	-
23MEC15.CO2	3	1	2	-	-	2	-	-	-	-	-	2	1	-	-
23MEC15.CO3	3	1	2	-	-	2	-	-	-	-	-	3	1	-	-
23MEC15.CO4	3	1	2	-	-	2	-	-	-	-	-	3	1	-	-
23MEC15.CO5	3	1	2	-	-	3	1	-	-	-	-	3	1	2	1

Unit-I   SENSORS AND ACTUATORS   9

Introduction to Mechatronics - Modular Approach, Sensors and Transducers: Static and Dynamic Characteristics, Transducers - Resistive, Capacitive, Inductive and Resonant, Optical Sensors – Photo detectors - Vision Systems – Laser - Fibre optic - Non-fibre Optic, Solid State Sensors, Piezoelectric and Ultrasonic Sensors. Actuators – Brushless Permanent Magnet DC Motor – PM, VR and Hybrid Stepper motors – DC and AC Servo Motors

Unit-II   SIGNAL CONDITIONING CIRCUITS AND PLC   9

Operational Amplifiers – Inverting and Non-Inverting Amplifier – Wheatstone bridge Amplifier – Instrumentation Amplifier – PID Controller, Protection Circuits, Filtering Circuits, Multiplexer, Data Logger and Data Acquisition System –, Switching Loads by Power Semiconductor Devices Circuits – Thyristors – TRIAC – MOSFET and Relays. PLC – Architecture – Input / Output Processing – Logic Ladder Programming – Functional Block Programming using Timers and Counters – Applications.

Unit-III   FUNDAMENTALS OF IoT AND EMBEDDED SYSTEMS   9

The Internet of Things (IoT) - Introduction to the IoT Framework – IoT Enabling Technologies- The Effective Implementation of IoT: The Detailed Procedure. Embedded Systems: An Introduction - Single-Chip Microcontroller Systems - Single-Board Microcontroller Systems

Unit-IV   CONTROLLERS   9

Foundation topics: Programming Languages: C++ and Python - The Linux Operating System. Arduino: The Arduino Boards - Arduino Peripherals- Arduino IDE – ESP8266 Wi-Fi module. Raspberry Pi: The Raspberry Pi

Boards - The Raspberry Pi Peripherals - The Raspberry Pi Operating System. (Typical peripherals) Interfacing and Controlling I/O devices by Arduino and Raspberry Pi: LEDs - Push buttons - Light intensity sensor - Ultrasonic distance sensor – Temperature sensor- Humidity sensor - Sensor and Actuator interactions

Unit-V   MECHATRONICS AND IoT CASE STUDIES   9

Mechatronics systems: Drone actuation and Control -Autonomous Robot with Vision System, Automotive Mechatronics: Electronic Ignition System - ABS - EBD - Adaptive Cruise Control. IoT case studies: Remote Monitoring Systems- Remotely Operated Autonomous Systems - Centralized Water Management System - IoT Enabled Robotic Camera Dolly - Portable, Wireless, Interactive IoT Sensors for Agriculture - IoT Vehicle Management System with Network Selection.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Bradley D.A., Burd N.C	Mechatronics: Electronics in Products and Processes	Routledge	2017
2.	Sami S.H and Kisheen Rao G	The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers	CRC Press	2022

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John Billingsley	Essentials of Mechatronics	Wiley	2006
2.	David H., Gonzalo S., Patrick G.,Rob B. and Jerome H	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things	Pearson Education,	2018
3.	Nitin G and Sharad S	Internet of Things: Robotic and Drone Technology	CRC Press	2022
4.	Newton C. Braga	Mechatronics for The Evil Genius	TATA McGrawHill,	2005

				L	**T**	**P**	**C**
23MEC16	**TOTAL QUALITY MANAGEMENT**			**3**	**0**	**0**	**3**

Course Objective:

- To understand the total quality management concept and principles and the various tools available to achieve total quality management
- To understand the application of statistical approach for quality control
- To create an awareness about the iso and qs certification process and its need for the industries
- To apply the quality concepts in product design, manufacturing etc in order to maximize customer satisfaction
- Engineers involvement to improve quality, development and transformation

Course Outcomes:

23MEC16.CO1   Understand the concept of total quality management

23MEC16.CO2   Comprehend and illustrate the TQM principles

23MEC16.CO3   Solve quality related problems using statistical process control

23MEC16.CO4   Understand proven methodologies to enhance management processes

23MEC16.CO5   Illustrate the salient features of quality systems

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEC16.CO1	1	1	-	-	-	3	-	2	3	1	2	2	-	-	1
23MEC16.CO2	1	2	-	-	-	2	-	2	3	3	2	2	-	-	1
23MEC16.CO3	1	1	-	-	-	2	-	-	-	-	1	2	-	-	1
23MEC16.CO4	1	1	-	-	-	1	-	1	1	-	2	2	-	-	1
23MEC16.CO5	1	1	-	-	-	2	-	1	-	-	2	2	-	-	1

Unit-I   INTRODUCTION   9

Definition of Quality – Dimensions of Quality – Quality Planning – Quality costs – Analysis Techniques for Quality Costs – Basic concepts of Total Quality Management – Historical Review – Quality Statements – Strategic Planning, Deming Philosophy – Crosby philosophy – Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen – Obstacles to TQM Implementation

Unit-II   TQM PRINCIPLES   9

Principles of TQM, Leadership – Concepts – Role of Senior Management – Quality Council, Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits– Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure

Unit-III   STATISTICAL PROCESS CONTROL (SPC)   9

The seven tools of quality – Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables X bar and R chart and attributes P, nP, C, and u charts, Industrial Examples, Process capability, Concept of six sigma – New seven Management tools

Unit-IV   TQM TOOLS   9

Benchmarking – Reasons to Benchmark – Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, and Benefits – Taguchi Quality Loss Function – Total Productive Maintenance (TPM) – Concept, Improvement Needs, and FMEA – Stages of FMEA- Case studies

Need for ISO 9000 and Other Quality Systems – ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 9000:2005 (definitions), ISO 9001:2008 (requirements) and ISO 9004:2009 (continuous improvement), TS 16949, ISO 14000, AS9100 – Concept, Requirements and Benefits- Case studies

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dale H. Besterfiled	Total Quality Management	Pearson Education Inc, New Delhi	2011
2.	James R. Evans and William M. Lidsay	The Management and Control of Quality	South-Western	2010

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	N. Gupta and B. Valarmathi	Total Quality Management	Tata McGraw-Hill Publishing Company Pvt Ltd., New Delhi	2009
2.	Dr S. Kumar	Total Quality Management	Laxmi Publications Ltd., New Delhi	2006
3.	P. N. Muherjee	Total Quality Management	Prentice Hall of India, New Delhi	2006
4.	James R. Evans and William M. Lindsay	The Management and Control of Quality	8thEdition, First Indian Edition, Cengage Learning	2012
5.	Suganthi.L and Anand Samuel	Total Quality Management	Prentice Hall (India) Pvt. Ltd	2006

Chairman-Board of Studies
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23MEC17	**COMPUTER AIDED MACHINE DRAWING & COMPUTER AIDED MANUFACTURING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

Course Objective:

- Gain practical experience in handling 2D drafting software systems.
- Gain practical experience in handling 3D modelling software systems
- Know the basic steps in assembly modelling
- Study the features of CNC Machine Tool.
- Expose manual part programming in CNC machines.

Course Outcomes:

23MEC17.CO1   Learn about basics of 2D models using modeling software

23MEC17.CO2   Develop 3D models using modelling software

23MEC17.CO3   Perform basic steps in assembly modelling software

23MEC17.CO4   Learn about basics of CNC machine tool

23MEC17.CO5   Prepare CNC part programming and perform manufacturing.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEC17.CO1	2	1	1	-	-	-	-	-	-	-	-	1	2	-	-
23MEC17.CO2	2	1	1	-	-	-	-	-	-	-	-	1	2	-	-
23MEC17.CO3	2	1	1	-	-	-	-	-	-	-	-	1	2	-	-
23MEC17.CO4	2	1	1	-	-	-	-	-	-	-	-	1	2	-	-
23MEC17.CO5	2	1	1	-	-	-	-	-	-	-	-	1	2	-	-

Sl.No.   **List of Experiments**

1.   **3D GEOMETRIC MODELLING**

    a)   Creation of 3D assembly model of following machine elements using 3D Modelling Software.

        (i)   Fasteners (Hexagonal headed bolt and nut)

        (ii)   Flange coupling (protected)

        (iii) Screw Jack

        (iv) Universal Joint

        (v)   Blower

2.   **MANUAL PART PROGRAMMING**

        (i)   Step Turning

        (ii)   Threading

        (iii) Multiple Turning

        (iv) Contour Milling

        (v) Mirroring

Total Periods: 30

23MEC18	**MANUFACTURING TECHNOLOGY LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

Course Objective:

- To impart knowledge on the concepts and basic mechanism of metal cutting.
- To understand the constructional feature sand working principle of centre lathe, and special purpose lathes.
- To familiarize the working principles of various Gear generation operations using milling, hopping and shaping machine.
- To understand the various abrasive processes.
- To understand the concepts of computer numerical control (CNC) machine tool, CNC programming and additive manufacturing

Course Outcomes:

23MEC18.CO1	Explain the concepts and basic mechanism of metal cutting in different working conditions.
23MEC18.CO2	Compare the constructional features and working principle of centre lathe, and special purpose lathes.
23MEC18.CO3	Distinguish between the working principles of various Gear generation operations using milling, hopping and shaping machine.
23MEC18.CO4	Comprehend and illustrate the abrasive and broaching processes
23MEC18.CO5	Demonstrate the concepts of computer numerical control (CNC) machine tool, CNC programming and additive manufacturing

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEC18.CO1	3	-	-	-	-	-	1	-	2	-	-	1	1	2	2
23MEC18.CO2	3	-	-	-	-	-	1	-	2	-	-	1	1	2	2
23MEC18.CO3	3	-	-	-	-	-	1	-	2	-	-	1	1	2	2
23MEC18.CO4	3	-	-	-	-	-	1	-	2	-	-	1	1	2	2
23MEC18.CO5	3	-	-	-	3	-	1	-	2	-	-	1	1	2	2

Sl.No.	List of Experiments
1.	Contour milling using vertical milling machine
2.	Spur gear cutting in milling machine
3.	Gear generation in hobbing machine
4.	Gear generation in gear shaping machine
5.	Plain Surface grinding
6.	Cylindrical grinding
7.	Measurement of cutting forces in Milling /Turning Process
8.	Centreless grinding
9.	Manual part programming (using G and M codes) in CNC Lathe. Machining operations include turning, facing, taper turning, and step turning (any two operations).
10.	Manual part programming (using G and M codes) in CNC Milling. Machining operations include Linear and Circular interpolation (contour motions).

11.   Study of CNC EDM

12.   Study of Additive Manufacturing Process : FDM or SLA or SLS or LOM

Total Periods: 30

23MEC19	STRENGTH OF MATERIALS AND FLUID MACHINERY LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To study the mechanical properties of metals, wood and spring by testing in laboratory.
- To verify the principles studied in fluid mechanics and machinery theory by performing experiments in laboratory.

Course Outcomes:

23MEC19.CO1	Determine the tensile, torsion and hardness properties of metals by testing
23MEC19.CO2	Determine the stiffness properties of helical and carriage spring
23MEC19.CO3	Apply the conservation laws to determine the coefficient of discharge of a venturimeter and finding the friction factor of given pipe
23MEC19.CO4	Determine the performance characteristics of turbine
23MEC19.CO5	Determine the performance characteristics of rotodynamic pump and positive displacement pump.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC19.CO1	3	3	3	3	3	1	1	1	3	1	1	2	2	2	1
23MEC19.CO2	3	3	3	3	3	1	1	1	3	1	1	2	3	2	1
23MEC19.CO3	3	3	2	3	2	1	1	1	3	1	1	2	2	2	1
23MEC19.CO4	3	2	2	3	3	1	1	1	3	1	1	2	3	2	1
23MEC19.CO5	3	3	3	3	2	1	1	1	3	1	1	2	2	2	1

Sl.No.   **List of Experiments**

UNIT – I STRENGTH OF MATERIALS

1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Hardness test on metal (Rockwell and Brinell Hardness)
4. Compression test on helical spring
5. Deflection test on carriage spring

UNIT – II FLUID MECHANICS AND MACHINES LABORATORY

1. Determination of coefficient of discharge of a venturimeter
2. Characteristics of centrifugal pumps
3. Characteristics of reciprocating pump
4. Characteristics of Pelton wheel turbine
5. Characteristics of Kaplan turbine

Total Periods: **30**

23MEC20	THERMAL ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

(Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychometric chart permitted)

Course Objective:

- To understand the basic principles in internal combustion engines, and Refrigeration systems.
- To Evaluating the properties of fuels.
- To understand the basic principles in Solar panels.

Course Outcomes:

23MEC20.CO1   Determine the performance of IC Engines, Refrigeration and, Air-Conditioning Systems.

23MEC20.CO2   Experiment with fuels to identify their properties.

23MEC20.CO3   Examine the performance characteristics of Air Compressors.

23MEC20.CO4   Estimate the performance of Solar Photovoltaic Panel.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC20.CO1	3	2	1	2	1	2	3	1	2	1	1	2	2	1	1
23MEC20.CO2	3	2	1	2	1	2	3	2	2	1	1	2	2	1	1
23MEC20.CO3	3	2	1	2	1	2	1	1	2	1	1	2	2	1	1
23MEC20.CO4	3	2	1	2	1	2	2	1	2	1	1	3	2	1	1

Sl.No.	List of Experiments

1. Valve Timing and Port Timing Diagrams.
2. Actual p-v diagrams of IC engines
3. Performance Test on 4-stroke Diesel Engine.
4. Heat Balance Test on 4-stroke Diesel Engine.
5. Morse Test on Multicylinder Petrol Engine.
6. Retardation Test to find Frictional Power of a Diesel Engine.
7. Determination of Flash Point and Fire Point of various fuels / lubricants.
8. Determination of Viscosity – using Red Wood Viscometer.
9. To study the V-I characteristics of solar panel.
10. To study the performance of solar flat plate collector

Total Periods: 30

23MEC21	METROLOGY AND DYNAMICS LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

- To provide knowledge on various Vernier Caliper to measure the linear dimension of the components.
- To learn about operating procedure of various micrometers to measure the circular dimensions of the components.
- To educate students to measure the force and torque when the components attached to the load.
- To understand the concept of single degree of freedom of vibrations and its damping mechanism.
- To gain knowledge on the basic vibrations on the constrained body and its critical position of vibrations

Course Outcomes:

23MEC21.CO1	Demonstrate various Vernier Caliper to measure the linear dimension of the components in Industries.
23MEC21.CO2	Use the various micrometers to measure the circular dimensions of the components.
23MEC21.CO3	Understand and operate the force and torque measuring equipment in industry.
23MEC21.CO4	Understand different types of vibration occurring in the moving system.
23MEC21.CO5	Understand the effect of Dynamics of undesirable vibrations

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC21.CO1	X	X	X	X	-	-	-	-	-	-	-	X	X	X	X
23MEC21.CO2	X	X	X	X	-	-	-	-	-	-	-	X	X	-	-
23MEC21.CO3	X	X	X	X	-	-	-	-	-	-	-	X	X	X	X
23MEC21.CO4	X	X	X	X	-	-	-	-	-	-	-	X	X	X	X
23MEC21.CO5	X	X	X	X	-	-	-	-	-	-	-	X	X	-	-

Sl.No.	List of Experiments

1. Tool Maker's Microscope
2. Comparator
3. Sine Bar
4. Gear Tooth Vernier Caliper
5. Floating gauge Micrometer
6. Coordinate Measuring Machine
7. Surface Finish Measuring Equipment
8. Vernier Height Gauge
9. a)Determination of Mass moment of inertia of Flywheel and Axle system.

   b)Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.

   c)Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
10. Motorized gyroscope–Study of gyroscopic effect and couple.
11. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.

12.	a) Single degree of freedom Spring Mass System – Determination of natural frequency and verification of Laws of springs –Damping coefficient determination.
	b) Multi degree freedom suspension system– Determination of influence coefficient.
13.	a) Determination of torsional natural frequency of single and Double Rotor systems. - Undamped and Damped Natural frequencies.
	b).Vibration Absorber –Tuned vibration absorber.
14.	Vibration of Equivalent Spring mass system– undamped and damped vibration

Total Periods: 30

		L	T	P	C
23MEC22	**SIMULATION LABORATORY**	**0**	**0**	**2**	**1**

Course Objective:

- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools.

Course Outcomes:

23MEC22.CO1	Simulate the working principle of air conditioning system, hydraulic and pneumatic cylinder and cam follower mechanisms using MATLAB.
23MEC22.CO2	Analyze the stresses and strains induced in plates, brackets and beams and heat transfer problems.
23MEC22.CO3	Calculate the natural frequency and mode shape analysis of 2D components and beams.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC22.CO1	3	3	1	2	2	1	-	-	-	2	-	1	3	-	1
23MEC22.CO2	3	3	2	2	2	1	-	-	-	2	-	1	2	2	2
23MEC22.CO3	3	2	2	2	2	1	-	-	-	2	-	2	3	2	-
23MEC22.CO4	3	2	2	1	2	1	-	-	-	-	-	2	-	2	1
23MEC22.CO5	3	2	2	1	2	1	-	-	-	2	-	1	2	2	-

Sl.No.   **List of Experiments**

SIMULATION

1. MAT LAB basics, dealing with matrices, Graphing- Functions of one variable and two variables

2. Use of Mat lab to solve simple problems in vibration 3.Mechanism Simulation using Multi body Dynamic software

ANALYSIS

1. Force and Stress analysis using link elements in Trusses, cables etc.

2. Stress and deflection analysis in beams with different support conditions.

3. Stress analysis of flat plates and simple shells.

4. Stress analysis of axi–symmetric components.

5. Thermal stress and heat transfer analysis of plates.

6. Thermal stress analysis of cylindrical shells.

7. Vibration analysis of spring-mass systems.

8. Model analysis of Beams.

9. Harmonic, transient and spectrum analysis of simple systems

Total Periods: 30

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| 23MEC23 | **HEAT AND MASS TRANSFER LABORATORY** | **L** | **T** | **P** | **C** |
| | | **0** | **0** | **2** | **1** |

Course Objective:
- To learn about working principles and calculation procedures of guarded plate method and lagged pipe Apparatus.
- To familiarize the working principles and calculation procedures of natural convection and forced Convection heat transfer apparatus
- To impart the knowledge of Heat transfer testing procedure of Fin-Pin (natural & forced convection modes) and Parallel/counter flow heat exchanger apparatus.
- To learn about calculation procedure of Stefan-Boltzmann constant and emissivity of emissivity gray Surface using given equipment.
- To understand the experimental and calculation procedures of given refrigeration, air conditioning and Compressor system

Course Outcomes:

23MEC23.CO1	Recognize and calculate the Thermal conductivity using guarded plate method and lagged pipe apparatus.
23MEC23.CO2	Understand the working principles and calculate procedures of natural convection and forced convection heat transfer apparatus.
23MEC23.CO3	Conduct the testing on fin-pin and heat exchanger using Fin-Pin (natural & forced convection modes) and Parallel/counter flow heat exchanger apparatus.
23MEC23.CO4	Demonstrate and calculate the Stefan-Boltzmann constant and emissivity of emissivity gray surface using given equipment
23MEC23.CO5	Illustrate the experimental and calculation procedures to determine the COP of refrigeration system and Performance tests of Air-conditioning system and reciprocating compressors

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEC23.CO1	3	2	-	1	-	-	-	-	2	-	-	-	2	-	1
23MEC23.CO2	3	2	2	1	-	-	-	-	2	-	-	-	2	-	1
23MEC23.CO3	3	2	2	1	-	-	-	-	1	-	-	-	1	1	1
23MEC23.CO4	2	1	2	1	-	-	-	-	1	-	-	-	1	1	-
23MEC23.CO5	3	2	2	2	-	-	-	-	1	-	-	-	3	-	-

Sl.No.   **List of Experiments**

1. Thermal conductivity measurement by guarded plate method.
2. Thermal conductivity of pipe insulation using lagged pipe apparatus.
3. Natural convection heat transfer from a vertical cylinder.
4. Forced convection inside tube.
5. Heat transfer from pin-fin (natural & forced convection modes)
6. Determination of Stefan-Boltzmann constant.
7. Determination of emissivity of a gray surface.
8. Effectiveness of Parallel/counter flow heat exchanger.

REFRIGERATION AND AIR CONDITIONING

9. Determination of COP of a refrigeration system.

10. Experiments on air-conditioning system.

11. Performance test on single/two stage reciprocating air compressor.

Total Periods: 30

23MEC24	**MECHATRONICS AND IOT LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

Course Objective:

- To study the concept of mechatronics to design, modeling and analysis of basic electrical hydraulic systems.
- To provide the hands on-training in the control of linear and rotary actuators.
- To study the concepts and fundamentals of IoT, sensors, actuators and IoT boards

Course Outcomes:

23MEC24.CO1	Demonstrate the functioning of mechatronics systems with various pneumatic, hydraulic and electrical systems.
23MEC24.CO2	Demonstrate the microcontroller and plc as controllers in automation systems by executing proper interfacing of i/o devices and programming
23MEC24.CO3	Demonstrate the sensing and actuation of mechatronics elements using IoT

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEC24.CO1	3	1	1	2	-	-	1	1	2	1	-	2	1	-	-
23MEC24.CO2	3	1	1	2	-	2	1	1	2	1	-	2	1	-	-
23MEC24.CO3	3	1	1	2	-	2	1	1	2	1	-	2	1	-	-

Sl.No.   **List of Experiments**

MECHATRONICS

1. Speed and Direction control of DC Servomotor, AC Servomotor and Induction motors.
2. Addition, Subtraction and Multiplication Programming in 8051.
3. Programming and Interfacing of Stepper motor and DC motor using 8051/PLC.
4. Programming and Interfacing of Traffic Light Interface using 8051.
5. Sequencing of Hydraulic and Pneumatic circuits.
6. Sequencing of Hydraulic, Pneumatic and Electro-pneumatic circuits using Software.
7. Electro-pneumatic/hydraulic control using PLC.
8. Vision based image acquisition and processing technique for inspection and classification.

INTERNET OF THINGS

1. Familiarization with concept of IoT and its open source microcontroller/SBC.
2. Write a program to turn ON/OFF motor using microcontroller/SBC through internet.
3. Write a program to interface sensors to display the data on the screen through internet.
4. Interface the sensors with microcontroller/SBC and write a program to turn ON/OFF Solenoid valve through internet when sensor data is detected.
5. To interface sensor with microcontroller/SBC and write a program to turn ON/OFF Linear/Rotary Actuator through IoT when sensor data is detected.
6. To interface Bluetooth/Wifi with microcontroller/SBC and write a program to send sensor data to smart phone using Bluetooth/wifi.

Total Periods: **30**

PROFESSIONAL ELECTIVES

(PE)

For

Mechanical Engineering

23MEE01	ADVANCED MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the surface treatment techniques.
- To understand the non-traditional machining
- To familiarize the laser beam machining and electron beam machining.
- To understand the manufacturing processes of microelectronic devices.
- To understand the various Processing of Composites.

Course Outcomes:

23MEE01.CO1   Understand the fundamentals of Surface treatment.

23MEE01.CO2   Illustrate the concepts of non-traditional machining processes

23MEE01.CO3   Explain the working principle of laser beam machining and electron beam machining

23MEE01.CO4   Summarize the fabrication techniques of microelectronic devices.

23MEE01.CO5   Comprehend the fabrication and processing of composites

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE01.CO1	2	-	-	-	3	3	-	-	-	-	-	2	-	3	-
23MEE01.CO2	2	-	-	-	3	3	-	-	-	-	-	2	-	3	-
23MEE01.CO3	2	-	-	-	3	3	-	-	-	-	-	2	-	3	-
23MEE01.CO4	2	-	-	-	3	3	-	-	-	-	-	2	-	3	-
23MEE01.CO5	2	-	-	-	3	3	-	-	-	-	-	2	-	3	-

Unit-I   SURFACE TREATMENT   9

Scope, Cleaners, Methods of cleaning, Surface coating types. Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, and cladding.

Unit-II   NON-TRADITIONAL MACHINING   9

Introduction, need, AJM, Parametric Analysis, Process capabilities, USM –Mechanics of cutting, models, Parametric Analysis, WJM –principle, equipment, process characteristics, performance, EDM – principles, equipment, generators, analysis of R-C circuits, MRR, Surface finish, WEDM.

Unit-III   BEAM, ARC AND CHEMICAL MACHINING   9

Laser beam, electron beam, plasma arc & electro chemical machining-Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

Unit-IV   FABRICATION OF MICROELECTRONIC DEVICES   9

Film Deposition oxidation, lithography, bonding and packaging, Printed Circuit boards, surface mount technology. E-Manufacturing, Micromachining.

Unit-V   PROCESSING OF COMPOSITES   9

Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
3.	V. K. Jain	Advanced Machining Processes	Allied Publishers	2009
4.	R. Thanigaivelan,N. Rajan,T.G. Argul	Advanced Manufacturing Techniques for Engineering and Engineered Materials	IGI Global	2022

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
5.	Chang Liu	Foundation of MEMS	Pearson	2012
6.	Chawla K. K	Composite materials	Springer – Verlag	1998
7.	Hassan El-Hofy,	Advanced Machining Processes: Nontraditional and Hybrid Machining Processes	McGraw-Hill	2005
8.	V. K. Jain	Introduction to Micromachining	Alpha Science International Limited	2010

	L	T	P	C
23MEE02 **PRINCIPLES OF MANAGEMENT**	3	0	0	3

Course Objective:

- To analyze the historic development of Management thoughts
- To learn the nature and purpose of planning, forecasting and decision making
- To expose the knowledge on concepts of organizing
- To analyze the concepts of delegation of authority and Organization culture.
- To familiarize the students to the basic concepts of management in order to aid in understanding how an organization functions, and in understanding the complexity and wide variety of issues managers face in today's business firms.

Course Outcomes:

23MEE02.CO1   Understand the evolution of management thought and role of managers

23MEE02.CO2   Discuss the phases of planning process and types of plans

23MEE02.CO3   Comprehend the different types of organization structure and illustrate the HR tasks

23MEE02.CO4   Describe the communication and directing process

23MEE02.CO5   Summarize the different controlling techniques in management

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE02.CO1	1	-	-	-	-	3	3	2	3	1	-	2	-	2	-
23MEE02.CO2	1	-	-	-	-	3	3	2	3	1	-	2	-	2	-
23MEE02.CO3	1	-	-	-	-	3	3	2	3	2	-	2	-	2	-
23MEE02.CO4	1	-	-	-	-	3	3	2	3	2	-	2	-	2	-
23MEE02.CO5	1	-	-	-	-	3	3	2	3	2	-	2	-	2	-

Unit-I   INTRODUCTION TO MANAGEMENT   9

Organization- Management- Role of managers- Evolution of management thought- Organization and the environmental factors- Managing globally- Strategies for International business.

Unit-II   PLANNING   9

Nature and purpose of planning- Planning process- Types of plans- objectives- Managing by Objective (MBO) strategies- Types of strategies – Policies – Decision Making- Types of decision making process- Rational decision making process- Decision making under different conditions.

Unit-III   ORGANISING   9

Nature and purpose of organizing- Organization structure- Formal and informal groups/ organization- Line and staff authority- Departmentation- Span of control- Centralization and decentralization- Delegation of authority- Staffing- Selection and Recruitment- Orientation- Career development- Career stages- Training- Performance appraisal

Unit-IV   DIRECTING   9

Managing people- Communication- Hurdles to effective communication- Organization culture Elements and types of culture- Managing cultural diversity.

Unit-V   CONTROLLING   9

Process of controlling- Types of control- Budgetary and non-budgetary control techniques Managing productivity- Cost control- Purchase control- Maintenance control- Quality control Planning operations.

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Harold Koontz and Heinz Weihrich	Essentials of management: An International & Leadership Perspective	Tata McGraw-Hill Education	2015
2.	Charles W.L Hill and Steven L McShane	Principles of Management	McGraw Hill Education	2013

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Samuel C. Certo and Tervis Certo	Modern management: concepts and skills	Pearson education	2014
2.	Heinz Weihrich, Mark V Cannice and Harold Koontz,	Management a global entrepreneurial perspective	Tata McGraw Hill	2013
3.	Stephen P. Robbins, David A.De Cenzo and Mary Coulter	Fundamentals of management	Prentice Hall of India	2012
4.	Don Hellriegel, Susan E. Jackson and John W. Slocum,	Management a competency based approach	Thompson South Western	2008
5.	Joseph L.Massie	Essentials of Management	Pearson Education	2003

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		L	**T**	**P**	**C**
23MEE03	**PROCESS PLANNING AND COST ESTIMATION**	**3**	**0**	**0**	**3**

Course Objective:

- To introduce the process planning concepts to make cost estimation for various products
- after process planning.
- To Learn the various Process Planning Activities.
- To provide the knowledge of importance of costing and estimation.
- To provide the knowledge of estimation of production costing.
- To learn the knowledge of various Machining time calculations

Course Outcomes:

23MEE03.CO1	Discuss select the process, equipment and tools for various industrial products.
23MEE03.CO2	Explain the prepare process planning activity chart.
23MEE03.CO3	Explain the concept of cost estimation.
23MEE03.CO4	Compute the job order cost for different type of shop floor.
23MEE03.CO5	Calculate the machining time for various machining operations.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEE03.CO1	3	2	2	2	-	-	-	-	1	-	1	1	2	1	1
23MEE03.CO2	3	3	2	1	-	-	-	-	1	-	1	1	2	1	1
23MEE03.CO3	3	3	2	2	-	-	-	-	1	-	1	1	2	1	1
23MEE03.CO4	3	3	2	2	-	-	-	-	1	-	1	1	2	1	1
23MEE03.CO5	3	3	2	2	-	-	-	-	1	-	1	1	2	1	1

Unit-I INTRODUCTION TO PROCESS PLANNING 9

Introduction- methods of process Planning-Drawing Interpretation- Material evaluation – steps in process selection-. Production equipment and tooling selection

Unit-II PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

Unit-III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges- Calculation of depreciation cost

Unit-IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop.

Unit-V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning - Machining Time Calculation for Grinding.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Peter scalon	Process planning, Design/Manufacture Interface	Elsevier science technology Books	2002
2.	Sinh a B.P	Mechanical Estimating and Costing	Tata-McGraw Hill publishing co	1995

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ch itale A.V. and Gupta R.C	Product Design and Manufacturing	2nd Edition, PHI	2002
2.	Ru ssell R.S and Tailor B.W	Operations Management	4th Edition, PHI	2003
3.	K.C . Jain & L.N. Aggarwal	Production Planning Control and Industrial Management	KhannaPublishers	1990

23MEE04	AUTOMOTIVE ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objective:

- The intention and purpose of this course is to study the basics of electronics, emission controls and its Importance in automobiles.
- To study the various sensors and actuators used in automobiles for improving fuel economy and emission control.
- To study the various blocks of control units used for control of fuel, ignition and exhaust systems.

Course Outcomes:

23MEE04.CO1   Know the importance of emission standards in automobiles

23MEE04.CO2   Understand the electronic fuel injection/ignition components and their function

23MEE04.CO3   Choose and use sensors and equipment for measuring mechanical quantities, temperature and appropriate actuators.

23MEE04.CO4   Diagnose electronic engine control systems problems with appropriate diagnostic tools.

23MEE04.CO5   Analyses the chassis and vehicle safety system

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE03.CO1	1	1	2	3	-	-	-	-	-	-	-	2	-	-	-
23MEE03.CO2	1	1	2	3	-	-	-	-	-	-	-	2	1	-	-
23MEE03.CO3	1	1	2	3	-	-	-	-	-	-	-	2	1	-	-
23MEE03.CO4	1	1	2	3	-	-	-	-	-	-	-	2	1	-	-
23MEE03.CO5	1	1	2	3	-	-	-	-	-	-	-	2	-	-	-

Unit-I   INTRODUCTION   8

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

Unit-II   IGNITION AND INJECTION SYSTEMS   10

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fueling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

Unit-III   SENSOR AND ACTUATORS IN AUTOMOTIVES   9

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated actuator.

Unit-IV   ENGINE CONTROL SYSTEMS   9

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU's used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

Unit-V   CHASSIS AND SAFETY SYSTEMS   9

Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems centralized door locking system – climate control of cars.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ribbens	Understanding Automotive Electronics	Elsevier, Indian Reprint	2013

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Barry Hollembeak	Automotive Electricity, Electronics & Computer Controls	Delmar Publishers	2001
2.	Richard K. Dupuy	Fuel System and Emission controls	Check Chart Publication	2000
3.	Ronald. K. Jurgon	Automotive Electronics Handbook	McGraw-Hill	1999
4.	Tom Denton	Automobile Electrical and Electronics Systems	Edward Arnold Publishers	2000

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		L	**T**	**P**	**C**
23MEE05	**DESIGN OF PRESSURE VESSEL AND PIPING**	**3**	**0**	**0**	**3**

(*Usage of Pressure Vessels, Design Hand Bookis allowed for the students for examination*)

Course Objective:

- To obtain an understanding of the fundamental methods and Terminology and its application.
- To understand the membrane stress analysis and industrial related problems in vessels.
- To design principles for pressure vessels and enhance the understanding of reinforcement.
- To obtain the buckling of pressure vessels and tubes, cylinders etc.
- To design procedure of pressure vessel and Design of piping layout.

Course Outcomes:

23MEE05.CO1   Develop the stresses and terminology, efficiency and its applications

23MEE05.CO2   Analysis the vessels shells components such as cylindrical, spherical, conical and Thermal.

23MEE05.CO3   Design the pressure vessels and ASME vessels codes.

23MEE05.CO4   Estimate the design procedure of pressure vessel and Design of piping layout.

23MEE05.CO5   Design and analysis the pipe stress.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEE05.CO1	2	-	-	-	3	2	-	-	-	-	-	2	-	2	-
23MEE05.CO2	2	-	-	-	3	2	-	-	-	-	-	2	-	2	-
23MEE05.CO3	2	-	-	-	3	2	-	-	-	-	-	2	-	2	-
23MEE05.CO4	2	-	-	-	3	2	-	-	-	-	-	2	-	2	-
23MEE05.CO5	2	-	-	-	3	2	-	-	-	-	-	2	-	2	-

Unit-I	**INTRODUCTION**	**9**

Methods for determining stresses – Terminology and Ligament Efficiency– Applications

Unit-II	**STRESS IN PRESSURE VESSELS**	**9**

Introduction – Stresses in a circular ring, cylinder – Membrane stress Analysis of Vessel Shell components – Cylindrical shells, spherical Heads, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

Unit-III	**DESIGN OF VESSELS**	**9**

Design of Tall cylindrical self-supporting process columns –Supports for short, vertical and horizontal vessels – stress concentration – at a variable Thickness transition section in a cylindrical vessel, about a circular Hole, elliptical openings. Theory of Reinforcement – pressure vessel Design. Introduction to ASME pressure vessel codes.

Unit-IV	**BUCKLING OF VESSELS**	**9**

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

Unit-V	**PIPING**	**9**

Introduction – Flow diagram – piping layout and piping stress Analysis

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John F. Harvey	Theory and Design of Pressure Vessels	CBS Publishers and Distributors	2001
2.	Donatello Annaratone	Pressure Vessel Design	Springer	2007

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Henry H. Bedner	Pressure Vessels, Design Hand Book	CBS publishers and Distributors	2001
2.	Stanley, M. Wales	Chemical process equipment, selection and Design	Buterworths series in Chemical Engineering	1988
3.	John F. Harvey	Pressure Vessel Design: Nuclear and Chemical Applications	Priceton Inc.	1963
4.	William. J., Bees	Approximate Methods in the Design and Analysis of Pressure Vessels and Piping	Pre ASME Pressure Vessels and Piping Conference	1997
5.	Sam Kannapan	Introduction to Pipe Stress Analysis	John Wiley and Sons	1985

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23MEE06	VIBRATION AND NOISE CONTROL	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the basics of Vibration
- To understand the basics of Noise.
- To understand the Automotive Noise Sources.
- To impart clear knowledge about Control Techniques
- To understand the Source of Noise and control.

Course Outcomes:

23MEE06.CO1   Understanding causes, source and types of vibration in machineries.

23MEE06.CO2   Gaining knowledge in sources and measurement standard of noise.

23MEE06.CO3   Ability to design and develop vibrations and Noise control systems.

23MEE06.CO4   Learn the applications IC Engines and Shock Absorbers

23MEE06.CO5   Understand the Source of Noise and control methods.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE06.CO1	2	2	-	-	-	-	-	-	-	-	-	2	-	-	-
23MEE06.CO2	2	2	-	-	-	-	-	-	-	-	-	2	-	-	-
23MEE06.CO3	2	2	-	-	-	-	-	-	-	-	-	2	-	-	-
23MEE06.CO4	2	2	-	-	-	-	-	-	-	-	-	2	-	-	-
23MEE06.CO5	2	2	-	-	-	-	-	-	-	-	-	2	-	-	-

Unit-I   BASICS OF VIBRATION   9

Introduction, classification of vibration: free and forced vibration, un-damped and damped vibration, linear and nonlinear vibration, response of damped and un-damped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies..

Unit-II   BASICS OF NOISE   9

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

Unit-III   AUTOMOTIVE NOISE SOURCES   9

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

Unit-IV   CONTROL TECHNIQUES   9

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers..

Unit-V   SOURCE OF NOISE AND CONTROL   9

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Singiresu S.Rao	Mechanical Vibrations	Pearson Education,ISBM-81-297-0179-0	2004
2.	Kewal Pujara	Vibrations and Noise for Engineers	Dhanpat Rai & Sons	2013

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Bernard Challen and Rodica Baranescu	Diesel Engine Reference Book	SAE International-ISBN 0-7680-0403-9	1999
2.	Julian Happian-Smith	An Introduction to Modern Vehicle Design	Butterworth-Heinemann ISBN 0750-5044-3	2004
3.	John Fenton	Handbook of Automotive body Construction and Design Analysis	Professional Engineering Publishing, ISBN 1-86058-073	1998
4.	K. J. Bathe and F. I. Wilson	Numerical Methods in Finite Element Analysis	Prentice Hall of India, New Delhi	1978
5.	J. P. Den Harto	Mechanical Vibrations	Crastre pres	2007

Chairman-Board of Studies
Department of Mechanical Engineering
MUTHAYAMMAL ENGINEERING COLLEGE
(AUTONOMOUS)
RASIPURAM-637 408, NAMAKKAL Dist.

23MEE07	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration & Air conditioning systems
- To know about different types of refrigeration system
- To make use of psychrometric chart.
- To know different load calculations in different type of air conditioning systems.

Course Outcomes:

23MEE07.CO1	Upon completion of this course, the students can able to demonstrate the operations in refrigeration system
23MEE07.CO2	Understanding the concepts and implementing in different Refrigeration system
23MEE07.CO3	Applying different concepts to different refrigeration system and implementing to calculations
23MEE07.CO4	Solving problems in air conditioning systems
23MEE07.CO5	Load estimation and plant design in real time application of air conditioning system.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE07.CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
23MEE07.CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
23MEE07.CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
23MEE07.CO4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
23MEE07.CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-

Unit-I INTRODUCTION 9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

Unit-II VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

Vapor compression cycle : p-h and T-s diagrams - deviations from theoretical cycle – sub cooling and heating- effects of condenser and evaporator pressure on COP- multi-pressure system – low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

Unit-III OTHER REFRIGERATION SYSTEMS 9

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet Refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic -Vortex and Pulse tube refrigeration systems

Unit-IV PSYCHROMETRIC PROPERTIES AND PROCESSES 9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

Unit-V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 9

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection;fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer &winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air-conditioning Systems with Controls:

Temperature, Pressure and Humidity sensors, Actuators &Safety controls.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Arora, C.P	Refrigeration and Air Conditioning	McGraw Hill	2010
2.	W.P. Jones	Air-Conditioning Engineering	Elsevier	2007

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Roy J. Dossat,	Principles of Refrigeration	Pearson Education	2009
2.	Stoecker, W.F. and Jones J. W.,	Refrigeration and Air Conditioning	McGraw Hill	1986
3.	Jones W.P	Air conditioning engineering	Elsevier	2001
4.	R.S.Khurmi	Textbook of Refrigeration and Air-conditioning	S.Chand	2006
5.	G F Hundy, A. R. Trott, T C Welch	Refrigeration and Air-Conditioning	Elsevier	2008

<table>
<tr><td rowspan="2">23MEE08</td><td rowspan="2">COMPOSITE MATERIALS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
</table>

Course Objective:

- To understand the fundamentals of composite material strength and its mechanical behavior
- To introduce the polymer matrix composites for different applications with different orientations
- To study Characteristics of metal matrix composites in manufacturing sectors
- To study the need of ceramic composites in society and industry.
- To understand the concepts of modern composite materials; and To study residual stresses in laminates during processing

Course Outcomes:

23MEE08.CO1   Understand and explain the fundamentals of composite materials

23MEE08.CO2   Illustrate various orientation of polymer matrix composites   and its properties

23MEE08.CO3   Demonstrate the need and production of metal matrix composites

23MEE08.CO4   Summarize the ceramic matrix composites productions

23MEE08.CO5   Comprehend the lamina construction and mechanics of composites

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE08.CO1	2	-	2	-	2	-	-	-	-	-	-	3	-	-	-
23MEE08.CO2	2	-	-	-	2	-	-	-	-	-	-	3	3	-	-
23MEE08.CO3	2	-	2	-	2	-	-	-	-	-	-	3	-	-	2
23MEE08.CO4	2	-	2	-	2	-	-	-	-	-	-	3	-	-	2
23MEE08.CO5	2	-	2	-	2	-	-	-	-	-	-	3	-	-	-

Unit-I   INTRODUCTION TO COMPOSITE MATERIALS   9

Fundamentals of composites – need for composites – enhancement of properties – classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – particle reinforced composites, Fibre reinforced composites. Applications of various types of composites. Fiber production techniques for glass, carbon and ceramic fibers

Unit-II   POLYMER MATRIX COMPOSITES   9

Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibres – rovings – woven fabrics – non woven random mats – various types of fibres. PMC processes – hand layup processes – spray up processes – compression moulding – reinforced reaction injection moulding – resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass Fibre Reinforced Plastics (GFRP). Applications of PMC in aerospace, automotive industries

Unit-III   METAL MATRIX COMPOSITES   9

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement – volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process – diffusion bonding – stir casting – squeeze casting, a spray process. Applications of MMC in aerospace, automotive industries.

Unit-IV   CERAMIC MATRIX COMPOSITES   9

Engineering ceramic materials – properties – advantages – limitations – monolithic ceramics – need for CMC – ceramic matrix - various types of ceramic matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic

pressing (CIPing) – Hot isostatic pressing (HIPing). applications of CMC in aerospace, automotive industries

Unit-V   MECHANICS OF COMPOSITES   9

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Q_{ij}), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Definitions– Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mathews F	Composite Materials: Engineering and Science	1st Edition, Chapman and Hall, London, England	1994
2.	Chawla K. K	Composite materials	Second Edition, Springer – Verlag	1998

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Clyne, T. W. and Withers, P. J	Introduction to Metal Matrix Composites	Cambridge University Press	1993
2.	Mallick, P.K., Fiber,	Reinforced Composites: Materials, Manufacturing and Design	Maneel Dekker Inc.	1993
3.	Strong, A.B	Fundamentals of Composite Manufacturing	SME,Co.	1989
4.	Sharma, S.C	Composite materials	Narosa Publications	2000
5.	Mallick, P.K. and Newman, S.,	Composite Materials Technology: Processes and Properties	Hansen Publisher, Munish	1990

			L	**T**	**P**	**C**
23MEE09	**COMPUTATIONAL FLUID DYNAMICS**		**3**	**0**	**0**	**3**

Course Objective:

- To introduce Governing Equations of viscous fluid flows
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers
- To solve heat transfer problems

Course Outcomes:

23MEE09.CO1   Creating numerical modeling and its role in the field of fluid flow and heat transfer calculations

23MEE09.CO2   Using the various discretization methods, solution procedures and turbulence modeling, in one dimensional

23MEE09.CO3   Create discretization methods, numerical methods

23MEE09.CO4   Introducing numerical modeling and its role in the field of fluid flow and heat transfer

23MEE09.CO5   Creating confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers, and ANSYS analysis also.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEE09.CO1	2	2	2	2	2	1	-	-	-	-	-	2	2	-	-
23MEE09.CO2	3	2	2	2	2	1	-	-	-	-	-	2	2	-	-
23MEE09.CO3	3	2	2	2	2	1	-	-	-	-	-	2	2	-	-
23MEE09.CO4	3	2	2	2	2	1	-	-	-	-	-	2	2	-	-
23MEE09.CO5	3	2	2	2	2	1	-	-	-	-	-	2	2	-	-

| **Unit-I**   **GOVERNING EQUATIONS AND BOUNDARY CONDITIONS**   **8** |

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions –Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations

| **Unit-II**   **FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION**   **9** |

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three –dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods

| **Unit-III**   **FINITE VOLUME METHOD FOR CONVECTION DIFFUSION**   **10** |

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Tran sportiveness, Hybrid, Power-law, QUICK Schemes

| **Unit-IV**   **FLOW FIELD ANALYSIS**   **9** |

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

| **Unit-V**   **TURBULENCE MODELS AND MESH GENERATION**   **9** |

Turbulence models, mixing length model, two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement –Adaptive mesh – Software tools

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Versteeg, H.K	An Introduction to Computational Fluid Dynamics: The finite volume Method	Pearson Education Ltd.2nd Edition	2007
2.	Ghoshdastidar, P.S	Computer Simulation of flow and heat transfer	Tata McGraw Hill Publishing Company Ltd.	1998

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Muralidhar, K	Computational Fluid Flow and Heat Transfer	Narosa Publishing House, New Delhi,	1995
2.	Patankar, S.V	Numerical Heat Transfer and Fluid Flow	Hemisphere Publishing Corporation,	2004
3.	Ghoshdastidar P.S	Heat Transfer	Oxford University Press	2005
4.	ProdipNiyogi	Introduction to Computational Fluid Dynamics	Pearson Education	2005
5.	Anil W. Date	Introduction to Computational Fluid Dynamics	Cambridge University Press,	2005

23MEE10	ENERGY CONSERVATION IN INDUSTRY	L	T	P	C
		3	0	0	3

Course Objective:

- To introduce fundamentals of energy conservation in industry.
- To learn various electrical system used in energy conservations.
- To enable the students to understand the various thermal systems used in energy conservations.
- To impart the knowledge on energy conservation in major utilities.
- To learn about energy economics and utilization calculations.
- To introduce fundamentals of energy conservation in industry.

Course Outcomes:

23MEE10.CO1   Understand the fundamentals of energy conservation in industry

23MEE10.CO2   Explain and use the various electrical system used in energy conservations.

23MEE10.CO3   Understand the various thermal systems used in energy conservations.

23MEE10.CO4   Utilize the various energy conservations in major utilities

23MEE10.CO5   Do the calculation in energy economics and utilization.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE10.CO1	1	1	1	-	-	-	2	1	-	-	-	1	1	-	-
23MEE10.CO2	1	1	1	-	-	-	2	1	-	-	-	1	1	-	-
23MEE10.CO3	1	1	1	-	-	-	2	1	-	-	-	1	1	-	-
23MEE10.CO4	1	1	1	-	-	-	2	1	-	-	-	1	1	-	-
23MEE10.CO5	1	1	1	-	-	-	2	1	-	-	-	1	1	-	-

Unit-I   INTRODUCTION   9

Energy - Power – Past & Present scenario of World; National Energy Consumption Data – Environmental aspects associated with energy utilization –Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

Unit-II   ELECTRICAL SYSTEMS   9

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

Unit-III   THERMAL SYSTEMS   9

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

Unit-IV   ENERGY CONSERVATION IN MAJOR UTILITIES   9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets.

Unit-V   ECONOMICS   9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Bureau of Energy Efficiency (BEE)	Energy Manager Training Manual (4 Volumes)	Ministry of Power, Government of India	2004

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Witte. L.C., P.S. Schmidt, D.R. Brown	Industrial Energy Management and Utilisation	Hemisphere Publication Washington	1988
2.	Callaghn, P.W.	Design and Management for Energy Conservation	Pergamon Press, Oxford	1981
3.	Dryden. I.G.C.	The Efficient Use of Energy	Butterworths, London	1982
4.	Turner. W.C.	Energy Management Hand book	Wiley, New York	1982
5.	Murphy. W.R. and G. Mc KAY	Energy Management	Butterworths, London	1987

		L	T	P	C
23MEE11	**GAS DYNAMICS AND JET PROPULSION**	**3**	**0**	**0**	**3**

Course Objective:

- To understand the basic concepts of isentropic flows.
- To analyze the heat transfer and friction of flow through ducts.
- To infer about Normal shock and oblique shock.
- To summarizes the theory behind jet propulsion.
- To predict the parameters for space propulsion.
- To understand the basic concepts of isentropic flows.

Course Outcomes:

23MEE11.CO1   Understand the basic concepts of isentropic flows.

23MEE11.CO2   Analyze the heat transfer and friction of flow through ducts.

23MEE11.CO3   Infer about Normal shock and oblique shock

23MEE11.CO4   Summarizes the theory behind jet propulsion

23MEE11.CO5   Predict the parameters for space propulsion.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEE11.CO1	2	2	2	2	2	2	-	-	2	-	-	-	-	-	-
23MEE11.CO2	2	2	2	2	2	2	-	-	2	-	-	-	-	-	-
23MEE11.CO3	2	2	2	2	2	2	-	-	2	-	-	-	-	-	-
23MEE11.CO4	2	2	2	2	2	2	-	-	2	-	-	-	-	-	-
23MEE11.CO5	2	2	2	2	2	2	-	-	2	-	-	-	-	-	-

Unit-I   CONCEPTS AND ISENTROPIC FLOWS   9

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts –Nozzle and Diffusers

Unit-II   FLOW THROUGH DUCTS   9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties

Unit-III   NORMAL AND OBLIQUE SHOCKS   9

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl –Meyer relations – Applications.

Unit-IV   JET PROPULSION   9

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

Unit-V   SPACE PROPULSION   9

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications –space flights.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Anderson, J.D	Modern Compressible flow	McGraw Hill	2012
2.	Yahya, S.M	Fundamentals of Compressible Flow	New Age International (P) Limited	2014

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ganesan. V	Gas Turbines	Tata McGraw Hill Publishing Co	2003
2.	Cohen. H	Gas Turbine Theory	Longman Group Ltd	2010
3.	Shapiro. A.H	Dynamics and Thermodynamics of Compressible fluid Flow	John wiley	2017
4.	Sutton. G.P	Rocket Propulsion Elements	John wiley	2017
5.	Zucrow. N.J	Aircraft and Missile Propulsion	John Wiley	2003

		L	T	P	C
23MEE12	**DESIGN OF JIGS, FIXTURES AND PRESS TOOLS**	**3**	**0**	**0**	**3**

(Use of PSG Design Data Book is permitted in the University examination)

Course Objective:

- To understand about the tool design, functions of jigs and fixtures, principles of location and clamping, tolerances and materials used.
- To impart knowledge on different types of jigs such as post, turnover, channel, latch, box, pot, angular post jigs and fixtures.
- To understand the press working terminologies, and design of various elements of dies, design of simple blanking, piercing, compound and progressive dies.
- To impart knowledge on the structure various operations such as bulging, swaging, embossing, coining, curling, whole flanging, shaving and sizing.
- To gain proficiency in the development of required views of the final design.
- To understand about the tool design, functions of jigs and fixtures, principles of location and clamping, tolerances and materials used.

Course Outcomes:

23MEE12.CO1   Familiarize with various steps involved in the locating and clamping principle

23MEE12.CO2   List the types of jigs and fixtures and explain its functions

23MEE12.CO3   Design and develop various types of jigs and fixtures for given components.

23MEE12.CO4   Illustrate the working of press tools and solve problems in strip layout.

23MEE12.CO5   Design and develop various types of press tool dies.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE12.CO1	2	3	2	-	-	-	-	-	-	-	-	-	1	-	-
23MEE12.CO2	2	3	2	-	-	-	-	-	-	-	-	-	1	-	-
23MEE12.CO3	2	3	2	-	-	-	-	-	-	-	-	-	1	-	-
23MEE12.CO4	2	3	2	-	-	-	-	-	-	-	-	-	1	-	-
23MEE12.CO5	2	3	2	-	-	-	-	-	-	-	-	-	1	-	-

Unit-I   LOCATING AND CLAMPING PRINCIPLES   9

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

Unit-II   JIGS AND FIXTURES   9

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

Unit-III   PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES   9

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

Unit-IV   BENDING AND DRAWING DIES   9

Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads ironing – Design and development of bending,

forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies

Unit-V   OTHER FORMING TECHNIQUES   9

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Joshi P.H	Press tools - Design and Construction	wheels publishing	2010
2.	Joshi P.H	Jigs and Fixtures	Tata McGraw Hill.	2004

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Venkataraman. K	Design of Jigs Fixtures & Press Tools	McGraw Hill Book Company	1994
2.	Donaldson, Lecain and Goold	Tool Design	3rd Edition, Tata McGraw Hill	2000
3.	Hoffman	Jigs and Fixture Design	Thomson Delmar Learning, Singapore	2004
4.	David Spitler, Jeff Lantrip	Fundamentals of Tool Design	Society of Manufacturing Engineers	2003
5.	Hiram E Grant	Jigs and Fixture	Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi	2003

		L	T	P	C
23MEE13	**LEAN MANUFACTURING**	**3**	**0**	**0**	**3**

Course Objective:

- To acquire the general knowledge to deliver consistently high quality and value added products and services to the customer in a lean environment
- To understand the terminology relating to lean operations in both service and manufacturing organizations
- To understand various controlling and manufacturing techniques that effect lean manufacturing
- To comprehend the implementation process of lean manufacturing.
- To familiarize with the lean accounting system
- To acquire the general knowledge to deliver consistently high quality and value added products and services to the customer in a lean environment

Course Outcomes:

23MEE13.CO1 Understand and apply the concept of lean thinking to the processes

23MEE13.CO2 Understand the work place organization process

23MEE13.CO3 Comprehend the various work flow and control techniques.

23MEE13.CO4 Illustrate various lean manufacturing techniques

23MEE13.CO5 Understand and analyze the manufacturing time and implementation of lean manufacturing

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE13.CO1	1	1	2	-	-	-	-	-	-	-	-	2	-	-	-
23MEE13.CO2	1	1	2	-	-	-	-	-	-	-	-	2	-	-	-
23MEE13.CO3	1	1	2	-	-	-	-	-	-	-	-	2	-	-	-
23MEE13.CO4	1	1	2	-	-	-	-	-	-	-	-	2	-	-	-
23MEE13.CO5	1	1	2	-	-	-	-	-	-	-	-	2	-	-	-

Unit-I   INTRODUCTION   9

History–Evolution-Toyota production system-Lean manufacturing overview.

Unit-II   ORGANIZATION OF WORK PLACE   9

Workplace organization- Visual controls-Pull production and cellular manufacturing- Value flow pull-Value and perfection lean

Unit-III   WORK FLOW AND CONTROL TECHNIQUES   9

Mapping the present–Mapping the future-Product and process development–Value stream analysis- Over production- Waiting- Work In Progress- Transportation- In appropriate processing-Excess motion or ergonomic problems-Defected products-Underutilization of employees.

Unit-IV   LEAN MANUFACTURING TECHNIQUES   9

Just In Time-Kanban tooling-Total Productive Maintenance–5S-SingleMinuteDieExchange-Lean six sigma.

Unit-V   IMPLEMENTATION OF LEAN MANUFACTURING   9

Flowcharting –Identifying and eliminating unnecessary steps –Setup time- reduction Approaches-Steps in implementing lean strategy–Lean accounting system.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	DennisP Hobbs	Lean Manufacturing Implementation	J. Ross Publications	2009
2.	JayArthur	Lean Six-Sigma Demystified	TataMcGraw-Hill Company,New Delhi	2009

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	JeffreyK Liker	TheToyotaWay-14ManagementPrinciples	TataMcGraw-Hill Company,NewDelhi	2015
2.	Pascal Dennis	Lean Production Simplified,	Productivity Press,USA	2002
3.	James P Womack, Daniel T. Jones	Lean Thinking: Banish waste and create wealth in your corporation	Simon&Schuster UK Limited,FreePress	2003
4.	RichardJ Schonberger	World Class Manufacturing	Sp Free Press	2003
5.	Carreira B	Lean Manufacturing that Works	PHI	2007

23MEE14	ADVANCED METROLOGY	L	T	P	C
		3	0	0	3

Course Objective:

- Impart the knowledge on conceptualize fundamentals of metrology.
- Learn the advanced techniques used in metrology.
- Understand the various stage position metrology.
- Learn the working of sensors applied in inspection.
- Understand the various sensors using in instruments.
- Impart the knowledge on conceptualize fundamentals of metrology.

Course Outcomes:

23MEE14.CO1   Understand the conceptualize fundamentals of metrology.

23MEE14.CO2   Explain the advanced techniques used in metrology.

23MEE14.CO3   Understand and demonstrate the stage position metrology

23MEE14.CO4   Understand the working of sensors applied in inspection

23MEE14.CO5   Describe the various sensors used in instruments.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE14.CO1	2	2	2	2	-	-	-	-	-	-	-	2	-	-	-
23MEE14.CO2	2	2	2	2	-	-	-	-	-	-	-	2	-	-	-
23MEE14.CO3	2	2	2	2	-	-	-	-	-	-	-	2	-	-	-
23MEE14.CO4	2	2	2	2	-	-	-	-	-	-	-	2	-	-	-
23MEE14.CO5	2	2	2	2	-	-	-	-	-	-	-	2	-	-	-

Unit-I   INTRODUCTION   9

Laser Applications in Metrology: LASER light source, LASER interferometer, LASER alignment telescope, LASER micrometer, On-line and in-process measurements of diameter, Roundness and surface roughness using LASER, Micro holes and topography measurements, straightness and flatness measurement.

Unit-II   SPECIAL MEASURING INSTRUMENTS AND TECHNIQUES   9

Optoelectronic devices, contact and non-contact types, Applications in on-line and in-process monitoring systems, Tool wear measurement, Surface measurement, Machine vision, shape identification, Edge detection techniques, Normalisation, gray scale correlation, Template Techniques, Surface roughness using vision system, Interfacing robot and image processing system.

Unit-III   CO-ORDINATE MEASURING MACHINE   9

Types of CMM, Probes used, Applications, Non-contact CMM using electro optical sensors for dimensional metrology, Non-contact sensors for surface finish measurements, statistical evaluation of data using computer, Data integration of CMM and data logging in computers.

Unit-IV   STAGE POSITION METROLOGY   9

Introduction -Motorized linear and rotary stage-Drives for stage-Stage errors-Calibration of stages-Application and selection of micro/nano stages.

Unit-V   SENSORS IN INSPECTION   9

Manufacturing applications of photo detectors, deflection methods-beam detection, Reflex detection, & Proximity

detection, Applications of Inductive and Capacitive proximity sensors, Understanding microwave sensing applications laser sensors and limit switches. Advanced sensor Technology-Bar code systems, Principles and applications of Colour sensors, electro-magnetic identifier, Tactile sensors, Ultrasonic sensors, Odour sensors.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	T. Busch and R. Harlow Delmar	Fundamentals of dimensional Metrology	Delmar Publishers	2010
2.	**Sabne Soloman**	Sensors and Control systems in Manufacturing	McGraw Hill	2010

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	J. Watson Van Nostrand Rein	Optoelectronics	Hold (UK) Company	2015
2.	Doebelin	Measurement systems: Applications & Design	International Student Edition	1975
3.	Robert G. Seippel	Optoelectronics for Technology and Engineering	Prentice Hall India	1989
4.	Ulrich-Rembold, Armbruster and Ulzmann Marcel	Interface Technology for Computer Controlled Manufacturing processes	Dekker Publications, NYC	1983
5.	G. Thomas and G. Butter Worth	Engineering Metrology	Butterworth and Co., Ltd	-

		L	T	P	C
23MEE15	**POWER PLANT ENGINEERING**	**3**	**0**	**0**	**3**

Course Objective:
- To provide an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.
- To understand about Thermal power plants and working
- To know about Diesel engine power plants and working
- To know the working of Nuclear power plants and other power plants
- To understand Environmental problems related to power plants

Course Outcomes:

23MEE15.CO1   Comprehend the working principles of coal based thermal power plants

23MEE15.CO2   Illustrate the working principles of diesel, gas turbine and combined cycle power plants

23MEE15.CO3   Illustrate and explain the working principle and components of nuclear power plants

23MEE15.CO4   Explain the techniques to extract power from renewable energy sources

23MEE15.CO5   Understand the economic and environmental issues of power plants.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
23MEE15.CO1	3	1	1	1	-	1	3	-	-	1	-	1	1	1	-
23MEE15.CO2	3	1	1	1	-	1	3	-	-	1	-	1	1	1	-
23MEE15.CO3	3	1	1	1	-	1	3	-	-	1	-	1	1	1	-
23MEE15.CO4	3	1	1	1	-	1	3	-	-	1	-	1	1	1	-
23MEE15.CO5	X	1	1	1	-	1	3	-	-	1	-	1	1	1	-

Unit-I	**COAL BASED THERMAL POWER PLANTS**	**9**

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC
Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

Unit-II	**DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS**	**9**

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

Unit-III	**NUCLEAR POWER PLANTS**	**9**

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor(BWR), Pressurized Water Reactor(PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

Unit-IV	**POWER FROM RENEWABLE ENERGY**	**9**

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

Unit-V	**ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS**	**9**

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Nag. P.K.,	Power Plant Engineering	Tata McGraw – Hill	2010
2.	C. Elanchezhian, L. Saravanakumar, B. Vijaya Ramnath	Power Plant Engineering	I.K.International Publishing house pvt ltd	2007

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	El-Wakil. M.M	Power Plant Technology	Tata McGraw – Hill Publishing Company Ltd.,	2010
2.	Thomas C. Elliott	Power Plant Engineering	Standard Handbook of McGraw – Hill	2003
3.	Godfrey Boyle	Renewable energy	Oxford University Press	2004
4.	R.K.Rajput	Power Plant Engineering	Laxmi Publications	2016
5.	S.C.AroraandS.Domkundwar	A Course in Power Plant Engineering	Dhanpatrai&Sons,	2008

23MEE16	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the various characteristics of intelligent agents.
- To learn about the different search strategies in AI.
- To learn to represent knowledge in solving AI problems.
- To understand the different ways of designing software agents.
- To know about the various applications of AI.

Course Outcomes:

23MEE16.CO1   Use appropriate search algorithms for any AI problem.

23MEE16.CO2   Represent a problem using first order and predicate logic.

23MEE16.CO3   Provide the apt agent strategy to solve a given problem.

23MEE16.CO4   Design software agents to solve a problem.

23MEE16.CO5   Design applications for NLP that uses Artificial Intelligence

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE16.CO1	1	1	1	-	-	-	-	-	-	2	-	-	-	-	-
23MEE16.CO2	1	1	1	-	-	-	-	-	-	2	-	-	-	-	-
23MEE16.CO3	1	1	1	-	-	-	-	-	-	2	-	-	-	-	-
23MEE16.CO4	1	1	1	-	-	-	-	-	-	2	-	-	-	-	-
23MEE16.CO5	1	1	1	-	-	-	-	-	-	2	-	-	-	-	-

Unit-I   INTRODUCTION   9

Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

Unit-II   PROBLEM SOLVING METHODS   9

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games.

Unit-III   KNOWLEDGE REPRESENTATION   9

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information.

Unit-IV   SOFTWARE AGENTS   9

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.

Unit-V   APPLICATIONS   9

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving.

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	S. Russell and P. Norvig.	Artificial Intelligence: A Modern Approach,	Prentice Hall, Third Edition,	2009
2.	I. Bratko	Prolog: Programming for Artificial Intelligence‖	Addison-Wesley Educational Publishers Inc.,	2011

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M. Tim Jones	Artificial Intelligence: A Systems Approach	Jones and Bartlett Publishers, Inc.	2008
2.	Nils J. Nilsson	The Quest for Artificial Intelligence	Cambridge University Press	2009
3.	William F. Clocksin and Christopher S. Mellish	Programming in Prolog: Using the ISO Standard	Springer	2003
4.	Gerhard Weiss	Multi Agent Systems	MIT Press	2013
5.	David L. Poole and Alan K. Mackworth	Artificial Intelligence: Foundations of Computational Agents	Cambridge University Press	2010

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23MEE17	MEMS	L	T	P	C
		3	0	0	3

Course Objective:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices
- To educate on the rudiments of micro fabrication techniques
- To introduce various sensors and actuators
- To introduce different materials used for MEMS.
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.
- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices

Course Outcomes:

23MEE17.CO1 Describe new applications and directions of modern engineering

23MEE17.CO2 Ability to understand the sensors and actuators-I.

23MEE17.CO3 Ability to understand the sensors and actuators-II.

23MEE17.CO4 Critically analyze Microsystems and Micromachining technology for technical feasibility as well as practicality.

23MEE17.CO5 Ability to understand the Polymers and Optical MEMS

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE17.CO1	1	1	1	1	1	-	-	-	1	1	-	1	-	-	-
23MEE17.CO2	1	1	1	1	1	-	-	-	1	1	-	1	-	-	-
23MEE17.CO3	1	1	1	1	1	-	-	-	1	1	-	1	-	-	-
23MEE17.CO4	1	1	1	1	1	-	-	-	1	1	-	1	-	-	-
23MEE17.CO5	1	1	1	1	1	-	-	-	1	1	-	1	-	-	-

Unit-I   INTRODUCTION TO PROCESS PLANNING   9

Intrinsic Characteristics of MEMS-Energy Domains and Transducers-Sensors and Actuators-Introduction to Micro fabrication-Silicon based MEMS processes-New Materials-Review of Electrical and Mechanical Concepts of MEMS-Semiconductor devices-Stress and Strain analysis-Flexural beam bending-Torsional deflection

Unit-II   SENSORS AND ACTUATORS-I   9

Electrostatic sensors-Parallel plate capacitors-Applications-Interdigitated Finger capacitor-Comb drive devices-Micro Grippers-Micro Motors-Thermal Sensing and actuation- Thermal expansion-Thermal couples-Thermal resistors-Thermal Bimorph-Applications-Magnetic Actuators-Micro magnetic components

Unit-III   SENSORS AND ACTUATORS-II   9

Piezo resistive sensors-Piezo resistive sensor materials-Stress analysis mechanical elements-Applications to inertia, Pressure, Tactile and Flow sensors-Piezoelectric sensors and actuators-piezoelectric effects-piezoelectric materials-Application to inertia, Acoustic, Tactile and Flow sensors

Unit-IV   MICROMACHINING   9

Silicon Anisotropic Etching-Anisotropic Wet Etching-Dry Etching of Silicon-Plasma Etching-Deep Reaction Ion Etching(DRIE)-Isotropic Wet Etching-Gas Phase Etchants-Case studies-Basic surface micro machining processes-Structural and Sacrificial Materials-Acceleration of Sacrificial Etch-Assembly of 3D MEMS-Foundry process

Unit-V   POLYMER AND OPTICAL MEMS   9

Polymers in MEMS-Polimide-SU-8-Liquid Crystal Polymer(LCP)-PDMS-PMMA-Parylene- Fluorocation-Application to Acceleration, Pressure,Flow and Tactile sensors-Optical MEMS-Lenses and Mirrors-Actuators for Active Optical

MEMS

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Chang Liu	Foundations of MEMS	Pearson Education	2006
2.	Stephen D Senturia	Micro system Design	Springer Publication	2000

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Nadim Maluf	An Introduction to Micro Electro Mechanical System Design	Artech House	2000
2.	Mohamed Gad-el-Hal	The MEMS Handbook	CRC press Baco Raton	2000
3.	Tai Ran Hsu	MEMS&Micro systems Design and Manufacture	Tata McGraw Hill	2002
4.	E. H. Tay, Francis and W. O. Choong	Micro fluids and Bio MEMS applications	Springer	2002
5.	Gardner, W. Julian, K. Varadan Vijay and O. Awadelkarim, Osama	Micro sensors MEMS and Smart Devices	Jhon Wiley & Sons Ltd	2001

23MEE19	MACHINE LEARNING FOR INTELLIGENT SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective:

- To introduce basic machine learning techniques such as regression, classification
- To learn about introduction of clustering, types and segmentation methods
- To learn about fuzzy logic, fuzzification and defuzzification
- To learn about basics of neural networks and neuro fuzzy networks.
- To learn about Recurrent neural networks and Reinforcement learning.

Course Outcomes:

23MEE19.CO1 Understand basic machine learning techniques such as regression, classification

23MEE19.CO2 Understand about clustering and segmentation

23MEE19.CO3 Model a fuzzy logic system with fuzzification and defuzzification

23MEE19.CO4 Understand the concepts of neural networks and neuro fuzzy networks

23MEE19.CO5 Gain knowledgeon Reinforcement learning.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE19.CO1	1	2	2	2	2	-	-	-	-	-	1	1	-	-	-
23MEE19.CO2	1	2	2	2	2	-	-	-	-	-	1	1	-	-	-
23MEE19.CO3	1	2	2	2	2	-	-	-	-	-	1	1	-	-	-
23MEE19.CO4	1	2	2	2	2	-	-	-	-	-	1	1	-	-	-
23MEE19.CO5	1	2	2	2	2	-	-	-	-	-	1	1	-	-	-

Unit-I   INTRODUCTIONTO MACHINE LEARNING   9

Introduction to clustering, Types of Clustering, Agglomerative clustering, K-means clustering, Mean Shift clustering, K-means clustering application study, Introduction to recognition, K-nearest neighbor algorithm, KNN Application case study, Principal component analysis (PCA), PCA Application case study in Feature Selection for Robot Guidance.

Unit-II   CLUSTERING AND SEGMENTATION METHODS   9

Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application

Unit-III   FUZZY LOGIC   9

Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application

Unit-IV   NEURAL NETWORKS   9

Mathematical Models of Neurons, ANN architecture, Learning rules, Multi-layer Perceptrons, Back propagation, Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Application Case Study of Neural Networks in Robotics

Unit-V   RNN AND REINFORCEMENT LEARNING   9

Unfolding Computational Graphs, Recurrent neural networks, Application Case Study of recurrent networks in Robotics, Reinforcement learning, Examples for reinforcement learning, Markov decision process, Major components of RL, Q-learning. Application Case Study of reinforcement learning in Robotics

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Micheal Negnevitsky	Artificial Intelligence: A Guide to Intelligent Systems	3rd Edition, Addision Wesley, England	2011

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Bruno Siciliano, Oussama Khatib	Handbook of Robotics	Springer	2016
2.	Simon Haykin	Neural Networks and Learning Machines: A Comprehensive Foundation	Third Edition, Pearson	2016
3.	Timothy J Ross	Fuzzy Logic with Engineering Applications	4th Edition, Chichester	2011

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23MEE20	MANUFACTURING AUTOMATION	L	T	P	C
		3	0	0	3

Course Objective:

- To help students gain essential and basic knowledge of automated systems.
- To familiarize the students with the design of hydraulic and pneumatic circuits for various automated applications.
- To make students understand the Programmable Logic Controller to control the systems at industrial premises
- To enable the students to apply the knowledge of information technology in the field of automation for better enhancement.
- To help students gain essential and basic knowledge of automated systems.

Course Outcomes:

23MEE20.CO1   Apply automation principles and strategies and model manufacturing systems

23MEE20.CO2   Design automated storage and retrieval systems and employ robots in material handling

23MEE20.CO3   Implement concepts of automation in inspection and testing

23MEE20.CO4   Apply PLC timers and counters for the control of industrial processes

23MEE20.CO5   Monitor production using smart sensors based on Industry 4.0 techniques

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE20.CO1	1	2	2	-	-	-	-	-	-	-	-	-	3	-	-
23MEE20.CO2	1	2	2	-	-	-	-	-	-	-	-	-	3	-	-
23MEE20.CO3	1	2	2	-	-	-	-	-	-	-	-	-	3	-	-
23MEE20.CO4	1	2	2	-	-	-	-	-	-	-	-	-	3	-	-
23MEE20.CO5	1	2	2	-	-	-	-	-	-	-	-	-	3	-	-

Unit-I   AUTOMATION   9

Introduction, automation principles and strategies, basic elements of advanced functions, levels modeling of manufacturing systems, Introduction to CNC programming.

Unit-II   AUTOMATED HANDLING AND STORAGE SYSTEM   9

Automated material handling systems , AGV, Transfer mechanism , Buffer storage , Analysis of transfer lines, Robots in material handling, Automated storage and Retrieval Systems (AS/RS) - carousel storage, Automatic data capture, bar code technology, Automated assembly systems

Unit-III   AUTOMATED MANUFACTURING SYSTEM   9

Group Technology, Part family, Sensor technologies, Automated inspection and testing, Coordinate measuring machines, Machine vision, Rapid prototyping.

Unit-IV   PROGRAMMABLE CONTROLLERS IN AUTOMATION   9

PLC Architecture, Modes of operation, Programming methods, Instructions, Instruction addressing, latches, timers and counters. SCADA, DCS, Integration of PLC, SCADA and DCS with manufacturing systems, Man-machine interfaces, Introduction to PLM, Case studies.

Unit-V   SMART FACTORY AND SMART MANUFACTURING   9

Industry 4.0- Standard, Real-time production monitoring techniques with smart sensors, Configuration of smart shop floor, traceability and call back of defective products. Artificial Intelligence based systems, Virtual Business,

e-Commerce Technologies

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mikell P. Groover	Automation, Production Systems and Computer-Integrated Manufacturing	Pearson Education	2016
2.	Yusuf Altintas	Manufacturing Automation	Cambridge University Press	2012

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	P. Radhakrishnan, S. Subramanyan, V. Raju	CAD/CAM/CIM	New age International	-
2.	David Bedworth	Computer Integrated Design and Manufacturing	TMH	-
3.	Gupta A. K., Arora S. K.	Industrial Automation and robotics	University Science Press	2013
4.	Rajesh Mehra, Vikrant Vij	PLCs & SCADA Theory and Practice	University Science Press	2011

23MEE21	ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the various concepts of economics and pricing in industries.
- To Understand the banking systems, national income and financial management
- To aware the accounting system and the financial analysis.

Course Outcomes:

23MEE21.CO1	Evaluate the economic theories, cost concepts and pricing policies
23MEE21.CO2	Analyze the market structures and integration concepts
23MEE21.CO3	Apply the concepts of national income and understand the functions of banks and concepts of globalization
23MEE21.CO4	Apply the concepts of financial management for project appraisal and working capital management
23MEE21.CO5	Analyse accounting systems and financial statements using ratio analysis

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE21.CO1	2	2	-	-	-	2	-	-	-	-	2	2	-	-	1
23MEE21.CO2	2	2	-	-	-	2	-	-	-	-	2	2	-	-	1
23MEE21.CO3	2	2	-	-	-	2	-	-	-	-	2	2	-	-	1
23MEE21.CO4	2	2	-	-	-	2	-	-	-	-	2	2	-	-	1
23MEE21.CO5	2	2	-	-	-	2	-	-	-	-	2	2	-	-	1

Unit-I   ECONOMICS, COST AND PRICING CONCEPTS   9

Economic theories – Demand analysis – Determinants of demand – Demand forecasting – Supply – Actual Cost and opportunity Cost – Incremental Cost and sunk Cost – Fixed and variable Cost – Marginal Costing – Total Cost – Elements of Cost – Cost curves – Breakeven point and breakeven chart – Limitations of breakeven chart – Interpretation of breakeven chart – Contribution – P/V-ratio, profit volume ratio or relationship – Price fixation – Pricing policies – Pricing methods.

Unit-II   CONCEPTS ON FIRMS AND MANUFACTURING PRACTICES   9

Firm – Industry – Market – Market structure – Diversification – Vertical integration – Merger – Horizontal integration.

Unit-III   NATIONAL INCOME, MONEY AND BANKING, ECONOMIC ENVIRONMENT   9

National income concepts – GNP – NNP – Methods of measuring national income – Inflation – Deflation – Kinds of money – Value of money – Functions of bank – Types of bank – Economic liberalization – Privatization – Globalization

Unit-IV   CONCEPTS OF FINANCIAL MANAGEMENT   9

Financial management – Scope – Objectives – Time value of money – Methods of appraising project profitability – Sources of finance – Working capital and management of working capital

Unit-V   ACCOUNTING SYSTEM, STATEMENT AND FINANCIAL ANALYSIS   9

Accounting system – Systems of book-keeping – Journal – Ledger – Trail balance – Financial statements – Ratio analysis – Types of ratios – Significance – Limitations

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Prasanna Chandra	Financial Management (Theory & Practice)	Tata Mcgraw Hill Publishing	2016
2.	Bhaskar S.	Engineering Economics and Financial Accounting	Anuradha Agencies	2003

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Weston & Brigham	Essentials of Managerial Finance	The Dryden Press	1974
2.	Ramachandra Aryasri.A., and Ramana Murthy V.V	Engineering Economics & Financial Accounting	Tata McGraw Hill	2006
3.	Varshney R.L., and MaheswariK.L	Managerial Economics	Sultan Chand & Sons	2001
4.	Samvelson and Nordhaus	Economics	Tata McGraw Hill,	2002

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	L	**T**	**P**	**C**
23MEE22 **INDUSTRIAL SAFETY**	**3**	**0**	**0**	**3**

Course Objective:

- To impart awareness on various aspects of industrial safety
- To educate the purpose and responsibilities of safety organizations

Course Outcomes:

23MEE22.CO1   Understand the industrial safety, health standards and safety measures

23MEE22.CO2   Illustrate the philosophies behind industrial accidents and hazards

23MEE22.CO3   Analyze about Industrial fatigue, Environmental factors and Industrial waste

23MEE22.CO4   Discuss about human side of safety

23MEE22.CO5   Study the different types safety organization and acts

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEE22.CO1	2	-	-	-	-	3	3	2		3	-	3	-	-	-
23MEE22.CO2	2	-	-	-	-	3	3	2		3	-	3	-	-	-
23MEE22.CO3	2	-	-	-	-	3	3	2		3	-	3	-	-	-
23MEE22.CO4	2	-	-	-	-	3	3	2		3	-	3	-	-	-
23MEE22.CO5	2	-	-	-	-	3	3	2		3	-	3	-	-	-

Unit-I   INTRODUCTION - SAFETY   9

Definition-Milestones in industrial safety movement-safety responsibility and organization– Occupational safety and health administration (OSHA) –safety measures in planning, production and inspection – safety and productivity

Unit-II   INDUSTRIAL ACCIDENTS AND HAZARDS   9

Introduction- types of accidents in industry – Causes and prevention of accidents –accident reporting – accident reporting and analysis –Classification of hazards – Hazard management program- Major Industrial hazards – safety audit

Unit-III   INDUSTRIAL FATIGUE, ENVIRONMENTAL FACTORS, AND INDUSTRIALWASTE   9

Fatigue – types, factors contributing to fatigue, Environment – Temperature, noise, illumination, vibration, heat, ventilation and air-conditioning - Waste – classification –harmful effect – primary and secondary treatment-waste disposal

Unit-IV   HUMAN SIDE OF SAFETY   9

Personal protective equipment – Need, choice, respiratory and non-respiratory protective equipment, Training and maintenance- Occupational health problems – diseases and first aid - Fire hazards and prevention, Electrical hazard prevention and safety

Unit-V   SAFETY ORGANIZATION AND ACTS   9

Purpose of a safety organization-Safety policy- Safety committee- types- Role of safety coordinator- Responsibilities, Interferences and Sufferings of safety supervisor-Safety publicity- ISO14000 – Environmental management systems – ISO 9000 – Factories act 1948.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Krishnan N.V	Safety in Industry	Jaico Publisher House	2005
2.	C. Ray Asfahl, David W. Rieske	Industrial Safety and health management	Prentice Hall	2009

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Singh, U.K. and Dewan, J.M.	Safety, Security and risk management	APH Publishing Company	2005
2.	R.K. Mishra	Safety Management	AITBS publishers	2012

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23MEE23	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

Course Objective:

- To provide students the knowledge of optimization techniques and approaches.
- To enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research.
- To teach students about networking, inventory, queuing, decision and replacement models.

Course Outcomes:

23MEE23.CO1	Apply linear programming model and assignment model to domain specific situations
23MEE23.CO2	Analyze the various methods under transportation model and apply the model for testing the closeness of their results to optimal results
23MEE23.CO3	Apply the concepts of PERT and CPM for decision making and optimally managing projects
23MEE23.CO4	Analyze the various replacement and sequencing models and apply them for arriving at optimal decisions
23MEE23.CO5	Analyze and apply appropriate queuing theories in domain specific situations

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE23.CO1	3	3	3	3	-	2	-	-	-	-	-	2	-	-	2
23MEE23.CO2	3	3	3	3	-	2	-	-	-	-	-	2	-	-	2
23MEE23.CO3	3	3	3	3	-	2	-	-	-	-	-	2	-	-	2
23MEE23.CO4	3	3	3	3	-	2	-	-	-	-	-	2	-	-	2
23MEE23.CO5	3	3	3	3	-	2	-	-	-	-	-	2	-	-	2

| **Unit-I**   **LINEAR MODEL**   **9** |

The phases of OR study – formation of an L.P model – graphical solution – simplex algorithm – artificial variables technique (Big M method, two phase method), duality in simplex

| **Unit-II**   **TRANSPORTATION AND ASSIGNMENT PROBLEM**   **9** |

Transportation model – Initial solution by North West corner method – least Cost method – VAM. Optimality test – MODI method and steppingstone method. Assignment model – formulation – balanced and unbalanced assignment problems

| **Unit-III**   **PROJECT MANAGEMENT BY PERT & CPM**   **9** |

Basic terminologies – Constructing a project network – Scheduling computations – PERT - CPM – Resource smoothening, Resource leveling, PERT Cost

| **Unit-IV**   **REPLACEMENT AND SEQUENCING MODELS**   **9** |

Replacement policies - Replacement of items that deteriorate with time (value of money not changing with time) – Replacement of items that deteriorate with time (Value of money changing with time) – Replacement of items that fail suddenly (individual and group replacement policies). Sequencing models- n job on 2 machines – n jobs on 3 machines – n jobs on m machines, Traveling salesman problem

| **Unit-V**   **INVENTORY AND QUEUING THEORY**   **9** |

Variables in inventory problems, EOQ, deterministic inventory models, order quantity with price break, techniques in inventory management. Queuing system and its structure – Kendall's notation – Common queuing models - M/M/1: FCFS/∞/∞ - M/M/1: FCFS/n/∞ - M/M/C: FCFS/∞/∞ - M/M/1: FCFS/n/m

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Taha H.A	Operation Research	Pearson Education	2011
2.	Hira D S and Gupta P K	Operations Research	S. Chand & Sons	2014

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kanti Swarup, Gupta P.K., and Man Moha	Operations Research	S. Chand & Sons	2015
2.	Manohar Mahajan	Operations Research	Dhanpat Rai & Co	2013
3.	Panneerselvam.K	Operation Research	Prentice Hall of India	2002
4.	Philip and Ravindran	Operational Research	John Wiley	2000

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		L	**T**	**P**	**C**
23MEE24	**AUTOMOBILE ENGINEERING**	**3**	**0**	**0**	**3**

Course Objective:

- To identify the different structures in automobile engineering.
- To realize the engine auxiliary systems such as fuel injection system, electrical system and ignition system.
- To understand the working principles of transmission systems.
- To scrutinize the working principle of different types of steering and brake systems.
- To Familiarize about electric vehicle technology.

Course Outcomes:

23MEE24.CO1   Describe the vehicle construction and function of different parts.

23MEE24.CO2   Realize the engine auxiliary systems such as fuel injection system, electrical system and ignition system.

23MEE24.CO3   Identify the working principle of different types of transmission system.

23MEE24.CO4   Scrutinize the working principle of different types of steering and brake systems.

23MEE24.CO5   Describe about working principle of electric vehicles.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEE24.CO1	1	1	2	1	-	-	1	-	-	2	-	2	-	-	-
23MEE24.CO2	1	1	2	1	-	-	1	-	-	2	-	2	-	-	-
23MEE24.CO3	1	2	3	2	-	-	1	-	-	2	-	2	-	-	-
23MEE24.CO4	1	2	3	2	-	-	1	-	-	2	-	2	-	-	-
23MEE24.CO5	1	2	3	2	-	-	1	-	-	2	-	2	-	-	-

Unit-I   VEHICLE STRUCTURE AND ENGINES   9

Types of automobiles, vehicle construction and different layouts, chassis, frame and, body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components functions and materials, variable valve timing (VVT).

Unit-II   ENGINE AUXILIARY SYSTEMS   9

Electronically controlled gasoline injection system for SI engines, electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

Unit-III   TRANSMISSION SYSTEMS   9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

Unit-IV   STEERING, BRAKES AND SUSPENSION SYSTEMS   9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force

distribution (EBD) and Traction Control.

Unit-V   INTRODUCTION TO ELECTRIC VEHICLES   9

Electric Vehicle – Need - Types – Cost and Emissions – End of life. Electric Vehicle Technology – layouts, cables, components, Controls. Batteries – overview and its types. Battery plug-in and life. Ultra-capacitor, Charging – Methods and Standards. Alternate charging sources – Wireless & Solar.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kirpal Singh	Automobile Engineering Vol 1 & 2, 13th Edition	Standard Publishers, New Delhi	2012
2.	Jain K.K. and Asthana .R.B	Automobile Engineering	Tata McGraw Hill Publishers, New Delhi	2002

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Newton ,Steeds and Garet	Motor Vehicles	Butterworth Publishers	2010
2.	Joseph Heitner	Automotive Mechanics, Second Edition	Second Edition, East-West Press	2004
3.	Wei Liu,	Hybrid Electric Vehicle System Modeling and Control	John Wiley & Sons, Inc	2017
4.	Mehrdad Ehsani, Yimin Gao Stefano, Longo Kambiz, M. Ebrahimi	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles	Taylor & Francis Group	2018
5.	Ganesan V	Internal Combustion Engines, Third Edition	Tata McGraw-Hill.	2007

23MEE25	DIGITAL MANUFACTURING	L	T	P	C
		3	0	0	3

Course Objective:

- To familiarize with digital manufacturing techniques and its applications.
- To learn the product life cycle management concepts in the context of digital factory.
- To understand the concepts of Internet of Things and its application in industry.
- To familiarize with the various concepts of Industry 4.0

Course Outcomes:

23MEE25.CO1   Illustrate the Digital Manufacturing techniques with suitable applications.

23MEE25.CO2   Explain features of Digital Factory and PLM concepts.

23MEE25.CO3   Summarize the various features of IoT concepts.

23MEE25.CO4   Explain Industry 4.0 standards with relevance to industrial context.

23MEE25.CO5   Explain the IoT applications in the Industrial Environment.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEE25.CO1	1	2	2	1	2	3	-	-	-	-	-	1	1	-	
23MEE25.CO2	1	2	2	1	2	3	-	-	-	-	-	1	1	-	
23MEE25.CO3	1	2	2	1	2	3	-	-	-	-	-	1	1	-	
23MEE25.CO4	1	2	2	1	2	3	-	-	-	-	-	1	1	-	
23MEE25.CO5	1	2	2	1	2	3	-	-	-	-	-	1	1	-	

Unit-I   INTRODUCTION TO DIGITAL MANUFACTURING   9

Definition of digital manufacturing, Operation Mode and Architecture of Digital Manufacturing System. Design process and role of CAD, Types and applications of design models. Component modeling, Machine and tool selection, Defining process and parameters, Tool path generation, Simulation, Post processing. : Introduction, Principle, Thermo jet printer, Sander's model market, 3-D printer, Genisys Xs printer, JP system 5, object quadra system-Rapid proto typing.

Unit-II   DIGITAL FACTORY AND PRODUCT LIFE CYCLE MANAGEMENT   9

Introduction, Scope, Methods and Tools Used in Virtual Manufacturing, Benefits. Virtual factory simulation. Introduction, Types of Product Data, PLM systems, Features of PLM System, System architecture, Product information models, Functionality of the PLM Systems.

Unit-III   INTERNET OF THINGS   9

Introduction, Applications, IoT data management requirements, Architecture of IoT, Technological challenges, RFID and the Electronic Product Code (EPC) network, The web of things, Issues in implementing IoT.

Unit-IV   INDUSTRY 4.0   9

Definition of Industry 4.0, Comparison of Industry 4.0 Factory and today's Factory. Cybernetics as the scientific basis of cyber-physical models. Cybersecurity in Industry 4.0. Virtual models of process control. The application of robotics in the I4.0. Industrial internet of things. Intelligent process control and intelligent diagnostics. Cyber-Physical Systems, Cloud Computing / Cloud Manufacturing. BLOCK Chain- Value chains in manufacturing Companies

Unit-V   INDUSTRIAL IOT- APPLICATION   9

Application Domains: Factories and Assembly Line, Food Industry. Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. Oil, chemical and pharmaceutical industry.

Total Periods: 45

Text Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Gilchrist, Alasdair	Industry 4.0: The Industrial Internet of Things	Apress	2016
2.	Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat	Industrial Internet of Things: Cyber manufacturing Systems	Springer	2016

Reference Books:

Sl.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Antti Saaksvuori and Anselmi Immonen	Product Lifecycle Management	Springer	2004
2.	Gerard Jounghyun Kim	Designing Virtual Systems: The Structured Approach	Springer	2005
3.	Adrian McEwan and Hakim Cassimally	Designing the internet of things	Wiley	2013
4.	Klaus Schwab	The Fourth Industrial Revolution	-	2016

EMPOLABILITY ENHANCEMENT COURSES

(EEC)

For

Mechanical Engineering

	L	T	P	C
23MES01   **INTERNSHIP-I**

L	T	P	C
0	0	0	1

1. It is mandatory for every student to undergo this course.
2. Every student is expected to spend a minimum of 15-days in an Industry/ Company/ Organization, during the Winter vacation.
3. The type of industry must be NOT below the Medium Scale category in his / her domain of the degree programme.
4. The student must submit the "Training Completion Certificate" issued by the industry / company / Organization as well as a technical report not exceeding 15 pages, within the stipulated time to be eligible for making a presentation before the committee constituted by the department.
5. The committee will then assess the student based on the report submitted and the presentation made.
6. Marks will be awarded out of maximum 100.
7. Appropriate grades will be assigned as per the regulations.
8. Only if a student gets a minimum of pass grade, appropriate credit will be transferred towards the degree requirements, as per the regulations.
9. It is solely the responsibility of the individual student to fulfill the above conditions to earn the credits.
10. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100%, if the credits are transferred, after satisfying the above (1) to (8) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.
11. The committee must recommend redoing the course, if it collectively concludes, based on the assessment made from the report and presentations submitted by the student, that either the level of training received or the skill and / or knowledge gained is NOT satisfactory.

23MES02   **INTERNSHIP-II**

L	T	P	C
0	0	0	1

1. It is mandatory for every student to undergo this course.
2. Every student is expected to spend a minimum of 15-days in an Industry/ Company/ Organization, during the summer vacation.
3. The type of industry must be NOT below the Medium Scale category in his / her domain of the degree programme.
4. The student must submit the "Training Completion Certificate" issued by the industry / company / Organisation as well as a technical report not exceeding 15 pages, within the stipulated time to be eligible for making a presentation before the committee constituted by the department.
5. The committee will then assess the student based on the report submitted and the presentation made.
6. Marks will be awarded out of maximum 100.
7. Appropriate grades will be assigned as per the regulations.
8. Only if a student gets a minimum of pass grade, appropriate credit will be transferred towards the degree requirements, as per the regulations.
9. It is solely the responsibility of the individual student to fulfill the above conditions to earn the credits.
10. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100%, if the credits are transferred, after satisfying the above (1) to (8) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.
11. The committee must recommend redoing the course, if it collectively concludes, based on the assessment made from the report and presentations submitted by the student, that either the level of training received or the skill and / or knowledge gained is NOT satisfactory.
12. The committee will then assess the student based on the report submitted and the presentation made.

	L	**T**	**P**	**C**
23MES03 **INTERNSHIP-III**	**0**	**0**	**0**	**1**

1. It is mandatory for every student to undergo this course.
2. Every student is expected to spend a minimum of 15-days in an Industry/ Company/ Organization, during the summer vacation.
3. The type of industry must be NOT below the Medium Scale category in his / her domain of the degree programme.
4. The student must submit the "Training Completion Certificate" issued by the industry / company / Organisation as well as a technical report not exceeding 15 pages, within the stipulated time to be eligible for making a presentation before the committee constituted by the department.
5. The committee will then assess the student based on the report submitted and the presentation made.
6. Marks will be awarded out of maximum 100.
7. Appropriate grades will be assigned as per the regulations.
8. Only if a student gets a minimum of pass grade, appropriate credit will be transferred towards the degree requirements, as per the regulations.
9. It is solely the responsibility of the individual student to fulfill the above conditions to earn the credits.
10. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100%, if the credits are transferred, after satisfying the above (1) to (8) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.
11. The committee must recommend redoing the course, if it collectively concludes, based on the assessment made from the report and presentations submitted by the student, that either the level of training received or the skill and / or knowledge gained is NOT satisfactory.

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23MES04	MINI PROJECT	L	T	P	C
		0	0	2	1

Course Objective:

The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

Course Outcomes:

23MES04.CO1   Design and Fabricate the machine element or the mechanical product.

23MES04.CO2   Demonstrates the working model of the machine element or the mechanical product.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MES04.CO1	1	1	1	1	1-	1	1	1	1	1	1	1	1	1	1
23MES04.CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device/system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

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23MES05	PROJECT PHASE-I	L	T	P	C
		0	0	6	3

Course Objective:

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva -voce examination.

Course Outcomes:

23MES05.CO1	Demonstrate a sound technical knowledge of their selected project topic.
23MES05.CO2	Undertake problem identification, formulation and solution.
23MES05.CO3	Design and manufacturing engineering solutions to complex problems utilizing a systems approach
23MES05.CO4	The students will have a clear idea of their area of work and they will be in a position to carry out the remaining phase II work in a systematic way.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MES05.CO1	2	2	3	2	2	2	1	1	1	1	1	1	1	1	1
23MES05.CO2	2	2	3	2	2	2	1	1	1	1	1	1	1	1	1
23MES05.CO3	2	2	3	2	2	2	1	1	1	1	1	1	1	1	1

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 60 PERIODS

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23MES06	PROJECT PHASE-II	L	T	P	C
		0	0	24	12

Course Objective:

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions

Course Outcomes:

23MES06.CO1   Demonstrate a sound technical knowledge of their selected project topic.

23MES06.CO2   Undertake problem identification, formulation and solution.

23MES06.CO3   Design engineering solutions to complex problems utilizing a systems approach

23MES06.CO4   Demonstrate the knowledge, skills and attitudes of a professional engineer to take up any challenging practical problem in the field of engineering design and manufacturing engineering and find better solutions to it.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MES06.CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
23MES06.CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
23MES06.CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
23MES06.CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

GUIDELINE FOR REVIEW AND EVALUATION

The student should continue the phase I work on the selected topic as per the formulated methodology under the same supervisor. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the Head of the department. The students will be evaluated based on the report submitted and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 300 PERIODS

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MANDATORY COURSES
(MC)

For

Mechanical Engineering

L	T	P	C
1	0	0	0

Course Objective:

- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values and Loyalty.
- To Create awareness among engineers about their social responsibilities
- To Appreciate the Ethical issues
- To Know the Human rights and concept of women empowerment
- To know features of our constitution.

Course Outcomes:

23MEM01.CO1   Practice the moral values that ought to guide the Engineering profession.

23MEM01.CO2   Discover of the set of justified moral principles of obligation, ideals that ought to be endorsed by the engineers and apply them to concrete situations

23MEM01.CO3   Know the definitions of risk and safety also discover different factors that affect the perception of risk

23MEM01.CO4   Appreciate the Ethical issues and Know the code of ethics adopted in various professional body's and industries

23MEM01.CO5   Justify the need for protection of human rights and to know about concept of women

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MEM01.CO1	1	-	-	-	-	1	1	1	2	2	-	1	-	1	-
23MEM01.CO2	1	-	-	-	-	1	1	1	2	2	-	1	-	1	-
23MEM01.CO3	1	1	1	1	-	1	1	1	2	2	-	1	-	1	-
23MEM01.CO4	1	1	1	1	-	1	1	1	2	2	-	1	-	1	-
23MEM01.CO5	1	1	-	-	1	1	1	1	2	2	-	1	-	1	-

Unit-I   HUMAN VALUES   9

Professional Ethics-Objectives of study of professional ethics-Human values- Definition of Morals and Ethics-Difference between Morality and Ethics-Values-Definition-Types of values Definition of Integrity- Concept of Work Ethic- Service Learning- Definition Virtues-Definition Civic Virtue-Duties and Rights - Respect for Others – Attitude and values, opinions-changing attitude-beliefs-Reliability-Living Peacefully-Means to be adopted for leavingpeacefully-CaringSharing-Honesty-ValuingTime-Co-operation-Commitment-Empathy-Self-ConfidenceSpirituality.

Unit-II   ENGINEERING ETHICS   8

Engineering ethics-Definition-Approach-Senses of Engineering Ethics-variety of moral issues–Inquiry-Types-Moral dilemmas-Steps to solve dilemma-Moral autonomy –Definition-consensus & controversy –Profession-Definition–Ethical theories-Theories about right action Personality–Self-control- Self-interest –Self-respect.

Unit-III   SAFETY, RESPONSIBILITIES OF ENGINEERS   6

Safety and risk-definition- - assessment of safety and risk - risk benefit analysis and reducing risk –Personal risk-Public risk-Reducing risk-Voluntary Risk-Collegiality and loyalty– Authority Types- collective bargaining - occupational crime –Responsibilityofengineers–Types – Social responsibility-Professional responsibility-confidentiality-conflicts of interest-liability.

Unit-IV   ETHICAL ISSUES IN ENGINEERING PRACTICE   6

Ethical issues–Industrial standards-Environmental ethics –Plastic waste disposal-E-Waste Disposal-Semiconductor waste Disposal-Industrial waste disposal-Human centered environmental ethics- computer ethics –Types of issues-Computer as the Instrument and Object of Unethical Acts -Engineers as managers-Codes of ethics-Sample code of Ethics like -Institution of Engineers(India)-Institute of Electrical & Electronics engineers- Institute of Electronics & Telecommunication Engineers - Indian Institute of Materials Management.

Unit-V   HUMAN RIGHTS   8

Human Rights-Definition-constitutional provisions-right to life and liberty-Human Rights of Women-Discrimination against women- steps that are to be taken to eliminate discrimination against women in Education, employment, health care, Economic and social life, Women in rural areas- Status of Women in India - Constitutional Safeguards - Dowry Prohibition act 1961- Domestic violence act 2005- Sexual harassment at work place bill 2006-Human Rights of Children- Who is a child- list the Rights of the Child- Right to education--Protection of Children from Sexual Offences Act(POCSO)-2012- National Human Rights Commission- Constitution Powers and function of the Commission-Employee rights- Provisions made-Contractual-Non contractual employee rights-Whistle blowing-definition-Aspects-Intellectual Property Rights (IPR)–Meaning-Need for protection- Briefly description of concept of patents, Copy right, Trade mark.

Unit-VI   INDIAN CONSTITUTION   8

Introduction to constitution of India-Formation and Composition of the Constituent Assembly Salient features of the Constitution-Preamble to the Indian Constitution Fundamental Rights Fundamental Duties-Directive principles of state policy. Parliamentary system of governance- Structure of Parliament- Lokhasabha and Rajyasabha -Functions of parliament- Legislative, Executive, Financial Function, Powers of Loksabha and Rajya Sabha- Procedure followed in parliament in making Law-Structure of union executive Power and position of President, Vice President, Prime minister and council of ministers. Structure of the judiciary: Jurisdiction and functions of Supreme Court, high court, and subordinate courts Federalism in the Indian constitution, Division of Powers- Union list, State list and concurrent list, Structure of state legislation, Legislative assembly and Legislative council, Functions of state legislature, Structure of state Executive-Powers and positions of Governor, Speaker, Deputy Speaker, Chief Minister and council of minister. Local self-government- meaning-Threetiersystem-Villagepanchayath-TalukpanchayathZillapanchayath-Local Bodies-Municipalities and Corporations, BruhathmahanagaraPalike. Functions of Election commission, UPSC, KPSC.

Total Periods: 45

		L	**T**	**P**	**C**
23MEM02	**DISASTER RISK REDUCTION AND MANAGEMENT**	**1**	**0**	**0**	**0**

Course Objective:

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management.
- To acquaint with the skills for planning and organizing disaster response.

Course Outcomes:

23MEM02.CO1	To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)
23MEM02.CO2	To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction
23MEM02.CO3	To develop disaster response skills by adopting relevant tools and technology
23MEM02.CO4	Enhance awareness of institutional processes for Disaster response in the country and
23MEM02.CO5	Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
23MEM02.CO1	3	3	2	3	-	-	2	2	-	-	2	-	1	-	1
23MEM02.CO2	3	3	2	3	-	-	2	1	-	-	2	-	1	-	1
23MEM02.CO3	3	3	3	3	-	-	2	2	-	-	2	-	1	-	1
23MEM02.CO4	3	3	3	3	-	-	2	1	-	-	2	-	1	-	1
23MEM02.CO5	3	3	2	3	-	-	2	2	-	-	2	-	1	-	1

Unit-I   HAZRADS, VULNERABILITY AND DISASTER RISKS   9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals

Unit-II   DISASTER RISK REDUCTION (DRR)   8

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of-community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

Unit-III   DISASTER MANAGEMENT   6

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance-Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

Unit-IV   TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT   6

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information

Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

Unit-V   DISASTER MANAGEMENT: CASE STUDIES   8

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters- Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill

Total Periods: 45