SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(AN AUTONOMOUS INSTITUTION)

B.TECH. - MECHANICAL ENGINEERING

ACADEMIC REGULATIONS 2023
(R-2023)

CURRICULUM AND SYLLABI
Volume – IV

COLLEGE VISION AND MISSION

VISION

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society.

Mission

M1: Quality Education:

To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation:

To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship:

To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values:

To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

DEPARTMENT VISION AND MISSION

VISION

The Mechanical Engineering department strives to be recognized as an excellent academic and research center for creating outstanding Engineers, Entrepreneurs and Leaders

Mission

M1: Professional Skills:

To provide quality education to enhance students inter-personal and intra-personal skills

M2: State-of-art facilities:

To render excellent infrastructure facilities and laboratories to excel as skilled professionals

M3: Research Exposure:

To Strengthen Research and Development within the department through industrial associations

M4: Employability:

To put enthusiastic exertions to enhance employability and entrepreneurship skills of students

M5: Human Values:

To empower students with professional ethics and human values to serve the society

PROGRAMME OUTCOMES (POs)

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, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions:

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for 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 and 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: Life-long learning:

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Technical knowledge

To foster our young graduates with cogent technical knowledge so as to make them employable

PEO2: Real-Time Applications

To apply the acquired knowledge in the field of Mathematics, Science and Engineering in developing real-time projects

PEO 3: Design Ability

To design a system, component or process to meet the desired needs within realistic constraints such as manufacturing, economy, environmental sustainability, social, health and safety

PEO 4: Ethics

To prepare the students to become entrepreneurs with professional attitude in the broader ethical perspective

PEO 5: Life - Long Learning

To craft curiosity among students for life-long learning through self-study

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Solving real time problems

To develop capability to identify, analyze and solve engineering problems in concern to mechanical engineering along with associated engineering streams.

PSO 2: Pursue Professional career

To bestow quality learning environment to pursue professional career in mechanical engineering with integrated knowledge

PSO 3: Concentrating on skill development

To enflame the student's technical capabilities in engineering design process, intra and inter personnel, linguistic and higher level professional skills required in engineering.

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

S.No	Course Category	Breakdown of Credits
1	Humanities and Social Science and Management courses (HS)	15
2	Basic Sciences (BS)	20
3	Engineering Sciences (ES)	29
4	Professional Core (PC)	66
5	Professional Electives (PE)	18
6	Open Electives (OE)	09
7	Professional Activities (PA)	13
8	Ability Enhancement Courses (AEC*)	-
9	Mandatory courses (MC*)	-
Total		**170**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl. No	Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences and Management courses (HS)	3	5	1	1	2	-	-	3	15
2	Basic Sciences(BS)	7	4	5	4	-	-	-	-	20
3	Engineering Sciences (ES)	9	8	4	4	4	-	-	-	29
4	Professional Core (PC)	3	4	14	11	8	15	11	-	66
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	-	3	3	3	-	09
7	Professional Activities (PA)	-	-	-	-	1	1	3	8	13
8	Ability Enhancement Courses (AEC*)	-	-	-	-	-	-	-	-	-
9	Mandatory courses (MC*)	-	-	-	-	-	-	-	-	-
Total		**22**	**21**	**24**	**23**	**21**	**22**	**20**	**17**	**170**

**** AEC and MC are not included for CGPA calculation***

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC01	Engineering Mathematics - I	BS	3	1	0	4	25	75	100
2	U23BSTC01	Physical Science for Engineers	BS	3	0	0	3	25	75	100
3	U23ESTC02	Engineering Mechanics	ES	2	1	0	3	25	75	100
4	U23ESTC03	Basics of Electrical and Electronics Engineering	ES	3	0	0	3	25	75	100
5	U23MET101	Concept of Engineering Design	PC	3	0	0	3	25	75	100
Theory cum Practical										
6	U23ENBC01	Communicative English - I	HS	2	0	2	3	50	50	100
Practical										
7	U23ESPC01	Basics of Electrical and Electronics Engineering Laboratory	ES	0	0	2	1	50	50	100
8	U23ESPC02	Design Thinking and IDEA Lab	ES	0	0	2	1	50	50	100
9	U23ESP101	Engineering Mechanics Laboratory	ES	0	0	2	1	50	50	100
Ability Enhancement Course										
10	U23MEC1XX	Certification Course - I **	AEC	0	0	4	-	100	-	100
Mandatory Course										
11	U23MEM101	Induction Programme	MC	2 Weeks			-	-	-	-
TOTAL							**22**	**425**	**575**	**1000**

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC02	Engineering Mathematics – II	BS	3	1	0	4	25	75	100
2	U23CSTC01	Programming in C	ES	3	0	0	3	25	75	100
3	U23ESTC01	Basics of Civil and Mechanical Engineering	ES	3	0	0	3	25	75	100
4	U23MET202	Engineering Metallurgy	PC	3	0	0	3	25	75	100
5	U23HSTC01	Universal Human Values-II	HS	2	0	0	2	25	75	100
Theory cum Practical										
6	U23ENBC02	Communicative English - II	HS	2	0	2	3	50	50	100
Practical										
7	U23CSPC01	Programming in C Laboratory	ES	0	0	2	1	50	50	100
8	U23ESPC03	Engineering Graphics using AutoCAD	ES	0	0	2	1	50	50	100
9	U23MEP201	Manufacturing and Metallurgy Laboratory	PC	0	0	2	1	50	50	100
Ability Enhancement Course										
10	U23MEC2XX	Certification Course – II **	AEC	0	0	4	-	100	-	100
Mandatory Course										
11	U23MEM202	Sports, Yoga and NSS	MC	0	0	2	-	100	-	100
TOTAL							**21**	**525**	**575**	**1100**

 # Professional Electives are to be selected from the list given in Annexure I

$ Open electives are to be selected from the list Annexure II

*** Certification courses are to be selected from the list given in Annexure III*

SEMESTER – III										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC03	Probability and Statistics	BS	3	1	0	4	25	75	100
2	U23ADTC01	Programming in Python	ES	3	0	0	3	25	75	100
3	U23MET303	Applied Thermodynamics	PC	2	1	0	3	25	75	100
4	U23MET304	Fluid Mechanics and Hydraulic Machines	PC	2	1	0	3	25	75	100
5	U23MET305	Manufacturing Processes	PC	3	0	0	3	25	75	100
Theory cum Practical										
6	U23MEB301	Strength of Materials	PC	2	0	2	3	50	50	100
Practical										
7	U23ENPC01	General Proficiency - I	HS	0	0	2	1	50	50	100
8	U23MAPC01	Engineering Mathematics Laboratory	BS	0	0	2	1	50	50	100
9	U23ADPC01	Programming in Python Laboratory	ES	0	0	2	1	50	50	100
10	U23MEP302	Manufacturing Processes Laboratory	PC	0	0	2	1	50	50	100
11	U23MEP303	Fluid Mechanics and Hydraulic Machines Laboratory	PC	0	0	2	1	50	50	100
Ability Enhancement Course										
12	U23MEC3XX	Certification Course – III	AEC	0	0	4	-	100	-	100
13	U23MES301	Skill Enhancement Course - I: Two wheeler Troubleshooting	AEC	0	0	2	-	100	-	100
Mandatory Course										
14	U23MEM303	Climate Change	MC	2	0	0	-	100	-	100
TOTAL							**24**	**725**	**675**	**1400**

SEMESTER – IV										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC04	Numerical Methods and Optimization	BS	3	1	0	4	25	75	100
2	U23ITTC02	Programming in Java	ES	3	0	0	3	25	75	100
3	U23MET406	Heat and Mass Transfer	PC	2	1	0	3	25	75	100
4	U23MET407	Computer Aided Design	PC	3	0	0	3	25	75	100
5	U23MEE4XX	Professional Elective – I #	PE	3	0	0	3	25	75	100
Theory cum Practical										
6	U23MEB402	Kinematics of Machinery	PC	2	0	2	3	50	50	100
Practical										
7	U23ENPCO2	General Proficiency - II	HS	0	0	2	1	50	50	100
8	U23ITPC02	Programming in Java Laboratory	ES	0	0	2	1	50	50	100
9	U23MEP404	CAD/CAM Laboratory	PC	0	0	2	1	50	50	100
10	U23MEP405	Heat Transfer Laboratory	PC	0	0	2	1	50	50	100
Ability Enhancement Course										
11	U23MEC4XX	Certification Course – IV	AEC	0	0	4	-	100	-	100
12	U23MES402	Skill Enhancement Course- II*	AEC	0	0	2	-	100	-	100
Mandatory Course										
13	U23MEM404	Right to Information and Good Governance	MC	2	0	0	-	100	-	100
TOTAL							**23**	**675**	**625**	**1300**

**** Skill Enhancement Courses (I and II) are to be selected from the list given in Annexure III***

SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23HSTC02	Research Methodology	HS	2	0	0	2	25	75	100
2	U23CSTC03	Data Structures	ES	3	0	0	3	25	75	100
3	U23MET508	Dynamics of Machinery	PC	2	1	0	3	25	75	100
4	U23MET509	Design of Machine Elements	PC	2	1	0	3	25	75	100
5	U23MEE5XX	Professional Elective – II #	PE	3	0	0	3	25	75	100
6	U23XXO5XX	Open Elective - I	OE	3	0	0	3	25	75	100
Practical										
7	U23CSPC02	Data Structures Laboratory	ES	0	0	2	1	50	50	100
8	U23MEP506	Analysis and Simulation Laboratory	PC	0	0	2	1	50	50	100
9	U23MEP507	Dynamics of Machinery Laboratory	PC	0	0	2	1	50	50	100
Project Work										
10	U23MEW501	Micro Project	PA	0	0	2	1	100	-	100
Ability Enhancement Course										
11	U23MEC5XX	Certification Course – V	AEC	0	0	4	-	100	-	100
Mandatory Course										
12	U23MEM505	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
TOTAL							**21**	**600**	**600**	**1200**

SEMESTER – VI										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MET610	Metrology and Measurement	PC	3	0	0	3	25	75	100
2	U23MET611	Thermal Engineering	PC	2	1	0	3	25	75	100
3	U23MET612	Manufacturing Technology and Automation	PC	3	0	0	3	25	75	100
4	U23MEE6XX	Professional Elective – III #	PE	3	0	0	3	25	75	100
5	U23XXO6XX	Open Elective - II	OE	3	0	0	3	25	75	100
Theory cum Practical										
6	U23MEB603	Automobile Engineering	PC	2	0	2	3	50	50	100
Practical										
7	U23MEP608	Thermal Engineering Laboratory	PC	0	0	2	1	50	50	100
8	U23MEP609	Metrology and Measurements Laboratory	PC	0	0	2	1	50	50	100
9	U23MEP610	Advanced Manufacturing Laboratory	PC	0	0	2	1	50	50	100
Project Work										
10	U23MEW602	Mini Project	PA	0	0	2	1	100	-	100
Ability Enhancement Course										
11	U23MEC6XX	Certification Course – VI	AEC	0	0	4	-	100	-	100
Mandatory Course										
12	U23MEM606	Gender Equality	MC	2	0	0	-	100	-	100
TOTAL							**22**	**625**	**575**	**1200**

SEMESTER – VII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MEDC01	Production Planning and Cost Estimation	PC	3	0	0	3	25	75	100
2	U23MET713	Industrial Automation and Robotics	PC	3	0	0	3	25	75	100
3	U23MET714	Design of Transmission System	PC	2	1	0	3	25	75	100
4	U23MEE7XX	Professional Elective - IV #	PE	3	0	0	3	25	75	100
5	U23XXO7XX	Open Elective - III	OE	3	0	0	3	25	75	100
Practical										
6	U23MEP711	Industrial Automation and Robotics Laboratory	PC	0	0	2	1	50	50	100
7	U23MEP712	Seminar	PC	0	0	2	1	100	-	100
Project Work										
8	U23MEW703	Project Phase – I	PA	0	0	4	2	50	50	100
9	U23MEW704	Internship / Inplant Training	PA	-	-	2	1	100	-	100
TOTAL							**20**	**425**	**475**	**900**

SEMESTER – VIII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23HSTC03	Entrepreneurship and Business Management	HS	3	0	0	3	25	75	100
2	U23MEE8XX	Professional Elective – V#	PE	3	0	0	3	25	75	100
3	U23MEE8XX	Professional Elective – V I #	PE	3	0	0	3	25	75	100
Project Work										
4	U23MEW805	Project Phase – II	PA	0	0	16	8	50	100	150
Total							**17**	**125**	**325**	**450**

ANNEXURE - I

PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U23MEE401	Gas Dynamics and Jet propulsion
2	U23MEE402	Geometric Tolerance and Dimensioning
3	U23MEDC02	Product Design and Development
4	U23MEE403	Industrial Casting Technology
5	U23MEE404	Non-Conventional Energy Sources
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U23MEE505	Turbo Machinery
2	U23MEE506	Powder Metallurgy and Surface Coating
3	U23MEE507	Green Manufacturing
4	U23MEE508	Fluid Power Automation
5	U23MEE509	IoT and Smart Manufacturing
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U23MEE610	Finite Element Analysis For Mechanical Engineers
2	U23MEE611	Computational Fluid Dynamics
3	U23MEE612	Quality Control and Improvement
4	U23MEE613	Additive Manufacturing
5	U23MEE614	Energy and Climate Change
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U23MEE715	Industrial Tribology
2	U23MEE716	Advanced Welding Technology
3	U23MEE717	Power Plant Engineering
4	U23MEE718	Nano Technology in Materials
5	U23MEDC05	Simulation Modeling of Manufacturing System
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U23MEE819	Lean Manufacturing
2	U23MEE820	Cryogenic Engineering
3	U23MEE821	Autotronics
4	U23MEE822	Optimization Techniques in Engineering Design
5	U23MEE823	Total Quality Management
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U23MEE824	Composites Material
2	U23MEE825	Engineering Failure Analysis
3	U23MEE826	Maintenance and Safety Engineering
4	U23MEE827	Integrated Materials Management
5	U23MEDC03	Supply Chain Management

ANNEXURE - II

OPEN ELECTIVE COURSES

S. No.	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester V/VI)				
1	U23MEOC01	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME, FT
2	U23MEOC02	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
Open Elective – II (Offered in Semester VII)				
3	U23MEOC03	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
4	U23MEDC03	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics

ANNEXURE – III

ABILITY ENHANCEMENT COURSES – (A) CERTIFICATION COURSES

S. No	Course Code	Course Title	Certified By
1	U23MECX01	Adobe Photoshop	Adobe
2	U23MECX02	Adobe Animate	Adobe
3	U23MECX03	Adobe Dreamweaver	Adobe
4	U23MECX04	Adobe After Effects	Adobe
5	U23MECX05	Adobe Illustrator	Adobe
6	U23MECX06	Adobe InDesign	Adobe
7	U23MECX07	Autodesk AutoCAD -ACU	Autodesk
8	U23MECX08	Autodesk Inventor - ACU	Autodesk
9	U23MECX09	Autodesk Revit - ACU	Autodesk
10	U23MECX10	Autodesk Fusion 360 - ACU	Autodesk
11	U23MECX11	Autodesk 3ds Max - ACU	Autodesk
12	U23MECX12	Autodesk Maya - ACU	Autodesk
13	U23MECX13	Cloud Security Foundations	AWS
14	U23MECX14	Cloud Computing Architecture	AWS
15	U23MECX15	Cloud Foundation	AWS
16	U23MECX16	Cloud Practitioner	AWS
17	U23MECX17	Cloud Solution Architect	AWS
18	U23MECX18	Data Engineering	AWS
19	U23MECX19	Machine Learning Foundation	AWS
20	U23MECX20	Robotic Process Automation / Medical Robotics	Blue Prism
21	U23MECX21	Advance Programming Using C	CISCO
22	U23MECX22	Advance Programming Using C ++	CISCO
23	U23MECX23	C Programming	CISCO
24	U23MECX24	C++ Programming	CISCO
25	U23MECX25	CCNP Enterprise: Advanced Routing	CISCO
26	U23MECX26	CCNP Enterprise: Core Networking	CISCO

27	U23MECX27	Cisco Certified Network Associate - Level 2	CISCO
28	U23MECX28	Cisco Certified Network Associate- Level 1	CISCO
29	U23MECX29	Cisco Certified Network Associate- Level 3	CISCO
30	U23MECX30	Fundamentals Of Internet of Things	CISCO
31	U23MECX31	Internet Of Things / Solar and Smart Energy System with IoT	CISCO
32	U23MECX32	Java Script Programming	CISCO
33	U23MECX33	NGD Linux Essentials	CISCO
34	U23MECX34	NGD Linux I	CISCO
35	U23MECX35	NGD Linux II	CISCO
36	U23MECX36	Advance Java Programming	Ethnotech
37	U23MECX37	Android Programming / Android Medical App Development	Ethnotech
38	U23MECX38	Angular JS	Ethnotech
39	U23MECX39	Catia	Ethnotech
40	U23MECX40	Communication Skills for Business	Ethnotech
41	U23MECX41	Coral Draw	Ethnotech
42	U23MECX42	Data Science Using R	Ethnotech
43	U23MECX43	Digital Marketing	Ethnotech
44	U23MECX44	Embedded System Using C	Ethnotech
45	U23MECX45	Embedded System with IOT / Arduino	Ethnotech
46	U23MECX46	English For IT	Ethnotech
47	U23MECX47	Plaxis	Ethnotech
48	U23MECX48	Sketch Up	Ethnotech
49	U23MECX49	Financial Planning, Banking and Investment Management	Ethnotech
50	U23MECX50	Foundation Of Stock Market Investing	Ethnotech
51	U23MECX51	Machine Learning / Machine Learning for Medical Diagnosis	Ethnotech
52	U23MECX52	IOT Using Python	Ethnotech
53	U23MECX53	Creo (Modelling & Simulation)	Ethnotech
54	U23MECX54	Soft Skills, Verbal, Aptitude	Ethnotech
55	U23MECX55	Software Testing	Ethnotech
56	U23MECX56	MX-Road	Ethnotech
57	U23MECX57	CLO 3D	Ethnotech
58	U23MECX58	Solid works	Ethnotech
59	U23MECX59	Staad Pro	Ethnotech
60	U23MECX60	Total Station	Ethnotech
61	U23MECX61	Hydraulic Automation	Festo
62	U23MECX62	Industrial Automation	Festo
63	U23MECX63	Pneumatics Automation	Festo
64	U23MECX64	Agile Methodologies	IBM
65	U23MECX65	Block Chain	IBM
66	U23MECX66	Devops	IBM
67	U23MECX67	Artificial Intelligence	ITS
68	U23MECX68	Cloud Computing	ITS

69	U23MECX69	Computational Thinking	ITS
70	U23MECX70	Cyber Security	ITS
71	U23MECX71	Data Analytics	ITS
72	U23MECX72	Databases	ITS
73	U23MECX73	Java Programming	ITS
74	U23MECX74	Networking	ITS
75	U23MECX75	Python Programming	ITS
76	U23MECX76	Web Application Development (HTML, CSS, JS)	ITS
77	U23MECX77	Network Security	ITS & Palo alto
78	U23MECX78	MATLAB	MathWorks
79	U23MECX79	Azure Fundamentals	Microsoft
80	U23MECX80	Azure AI (AI-900)	Microsoft
81	U23MECX81	Azure Data (DP -900)	Microsoft
82	U23MECX82	Microsoft 365 Fundamentals (SS-900)	Microsoft
83	U23MECX83	Microsoft Security, Compliance and Identity (SC-900)	Microsoft
84	U23MECX84	Microsoft Power Platform (Pl-900)	Microsoft
85	U23MECX85	Microsoft Dynamics Fundamentals 365 – CRM	Microsoft
86	U23MECX86	Microsoft Excel	Microsoft
87	U23MECX87	Microsoft Excel Expert	Microsoft
88	U23MECX88	Securities Market Foundation	NISM
89	U23MECX89	Derivatives Equinity	NISM
90	U23MECX90	Research Analyst	NISM
91	U23MECX91	Portfolio Management Services	NISM
92	U23MECX92	Cyber Security	Palo alto
93	U23MECX93	Cloud Security	Palo alto
94	U23MECX94	PMI – Ready	PMI
95	U23MECX95	Tally – GST & TDS	Tally
96	U23MECX96	Advance Tally	Tally
97	U23MECX97	Associate Artist	Unity
98	U23MECX98	Certified Unity Programming	Unity
99	U23MECX99	VR Development	Unity

ABILITY ENHANCEMENT COURSES – (B) SKILL ENHANCEMENT COURSES

Sl. No.	Course Code	Course Title
1	U23MES301	**Skill Enhancement Course - I:** Two wheeler Troubleshooting
2	**Skill Enhancement Course - II:**	
	U23MES402	1) Four wheeler Troubleshooting
	U23MES403	2) Demonstration Wood routing
	U23MES404	3) Demonstration LASER cutting

SEMESTER I

Department	**Mathematics**	Programme : **B.Tech.**						
Semester	**I**	Course Category: **BS**			End Semester Exam Type: **TE**			
Course Code	**U23MATC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ENGINEERING MATHEMATICS – I**	**3**	**1**	**0**	**4**	**25**	**75**	**100**

(Common to **All** Branches Except CSBS)

Prerequisite	Basic Mathematics	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the concept of Eigen values and Eigen vectors, Diagonalization of a Matrix	**K3**
	CO2 Solve higher order differential equations	**K3**
	CO3 Understand the different types of partial differential equations	**K3**
	CO4 Know about the Applications of double and triple integrals	**K3**
	CO5 Gain the knowledge about Vector Calculus and its Applications	**K3**

UNIT – I	**Matrices**	**Periods:12**
Rank of a Matrix – Systems of Linear Equations – Characteristic equation – Cayley Hamilton Theorem – Eigen values and Eigen vectors of a real Matrix – Diagonalization of Matrices.		**CO1**
UNIT – II	**Differential Equations (Higher Order)**	**Periods:12**
Linear Differential equations of higher order with constant coefficients – Euler's linear equation of higher order with variable coefficients – Method of Variation of parameters.		**CO2**
UNIT – III	**Functions of Several Variables**	**Periods:12**
Partial derivatives – Total derivatives – Maxima and Minima of two variables – Lagrange's Method of multipliers.		**CO3**
UNIT – IV	**Multiple Integrals**	**Periods:12**
Multiple Integrals – Change of order of integration (Cartesian form). Applications: Area as a double integral (Cartesian form) – Volume as a triple integral (Cartesian form).		**CO4**
UNIT – V	**Vector Calculus**	**Periods:12**
Gradient – Divergence and Curl – Directional derivatives – Irrotational and Solenoidal vector fields – Properties (Statement only) – Gauss Divergence Theorem and Stoke's Theorem (without proofs).		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Text Books

1. M.K. Venkataraman, "Engineering Mathematics", The National Publishing Company, 2nd Edition Chennai, 2016.
2. N. P Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Lakshmi Publications, New Delhi, 9th Edition, 2018.
3. S.Narayanan and T.K. Manickavasagam Pillay," Differential Equations and Its Applications", Viswanathan. S, Printers & Publishers Pvt Ltd, 2009.

Reference Books

1. G. Balaji, "Matrices and Calculus (Engineering Mathematics – I)" Balaji Publications, 9th Edition June 2023
2. A. Singaravelu, "Engineering Mathematics – I", Meenakshi publications, 1998.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", Wiley, 10th Edition, 2019.
4. B.V. Ramana," Higher Engineering Mathematics", Tata McGraw – Hill, New Delhi, 6th Edition, 2018.
5. C W. Evans, "Engineering Mathematics", A Programmed Approach, 3rd Edition, 2019.

Web References

1. http://www.yorku.ca/yaoguo/math1025/slides/chapter/kuttler-linearalgebra –slides- systems of equation-handout.pdf
2. http://www.math.cum.edu/~wn0g/2ch6a.pdf
3. https://nptel.ac.in/courses/122/104/122104017/
4. https://nptel.ac.in/courses/111/106/111106051/
5. https://nptel.ac.in/courses/111/108/111108081/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	2	1	1	-	-	-	-	1	3	-	-
2	3	2	1	1	-	1	1	-	-	-	-	1	3	-	-
3	3	2	1	1	-	1	1	-	-	-	-	1	3	-	-
4	3	2	1	1	-	1	1	-	-	-	-	1	3	-	-
5	2	2	1	-	-	-	1	-	-	-	-	1	3	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Physics / Chemistry**	Programme : **B.Tech.**						
Semester	**I**	Course Category: **BS**			End Semester Exam Type: **TE**			
Course Code	**U23BSTC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**PHYSICAL SCIENCE FOR ENGINEERS**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

(Common to **All** Branches)

Prerequisite	Physics of 12th standard or equivalent / Chemistry of 12th standard or equivalent.	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the basic of properties of magnetic, dielectric and superconductors.	**K2**
	CO2 Identify the wave nature of the particles, physical significance of wave functions	**K3**
	CO3 Understand the basic principles of laser and fiber optics communication	**K2**
	CO4 Understand and familiar with the water treatment.	**K2**
	CO5 Understand the electrode potential for its feasibility in electrochemical reaction and uses of various batteries.	**K2**
	CO6 Understand the specific operating condition under which corrosion occurs and suggest a method to control corrosion.	**K2**

SECTION A - PHYSICS

UNIT- I	**Magnetic, Dielectric and Superconducting Materials**	**Periods: 08**
Introduction to magnetic materials, Ferromagnetism- Domain theory-Types of energy-Hysteresis-Hard and Soft magnetic materials-ferrites-Dielectric materials-Typesof polarization – Langevin-Debye equation-Frequency effects on polarization-Dielectric breakdown- Ferroelectric materials-Superconducting materials and their properties.		**CO1**

UNIT- II	**Quantum Mechanics**	**Periods: 07**
Matter Waves - de Broglie Wavelength - Uncertainty Principle –Physical Significance of wave functions - Schrodinger wave Equation - Time Dependent - Time Independent - Application to Particle in a One Dimensional Box - Tunnel Diode.		**CO2**

UNIT- III	**Laser and Fiber Optics**	**Periods: 07**
Lasers - Principles of Laser - Spontaneous and Stimulated Emissions - Einstein's Coefficients - Population Inversion and Laser Action – components of laser - Types of Lasers - NdYAG, CO_2 laser, GaAs Laser Fiber Optics - Principle and Propagation of light in optical fiber - Numerical aperture and acceptance angle - Types of optical fibers (material, refractive index, mode)		**CO3**

SECTION B – CHEMISTRY

UNIT- IV	**Water and its treatment**	**Periods: 08**
Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD. Desalination of brackish water: Reverse osmosis-disadvantages of using hard water in boiler - Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning) and External treatment–Ion exchange demineralization and zeolite process.		**CO4**

UNIT- V	**Electrochemical Cells and Storage Devices**	**Periods: 08**
Galvanic cells, single electrode potential, standard electrode potential, electrochemical series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes-hydrogen, calomel andAg/AgCl. Batteries and fuel cells: Types of batteries - alkaline battery-lead storage battery- nickel-cadmium battery- fuel cell H2 -O2 fuel cell-applications.		**CO5**

UNIT- VI	**Corrosion**	**Periods: 07**
Corrosion – Introduction - factors – types – chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control – material selection and design aspects – electrochemical protection – sacrificial anode method and impressed current cathodic method. Uses of inhibitors, metallic coating – anodic coating, cathodic coating. Metal cladding, Electroplating of Copper and electroless plating of nickel.		**CO6**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. V Rajendran, “Engineering Physics”, 2nd Edition, TMH, New Delhi 2011.
2. S.S Dara – “A text book of Engineering Chemistry” - 15th Edition, 2021. S.Chand Publications.
3. C.Jain, Monica Jain, ” Engineering Chemistryll” 17thEd. DhanpatRai Pub. Co., NewDelhi, (2015).

Reference Books

1. R.Murugeshan, “Modern Physics”, S. Chand &Co, New Delhi 2006.
2. William D Callister Jr., “Material Science and Engineering”, 6th Edition, John Wiley and sons, 2009.
3. Jain & Jain “Engineering chemistry”, 23rd Edition, DhanpatRai Publishing Company. 2022
4. Mars Fontana “Corrosion Engineering”, July 2017
5. JinaRedlin, “Handbook of Electrochemistry”, March 28, 2005

Web References

1. https://www.sciencedaily.com/terms/materials_science.htm.
2. https://www.acs.org/content/acs/en/careers/college-to-career/chemistry-careers/materials science.html.
3. https://study.com/academy/lesson/semiconductors-superconductors-definition-properties.html
4. https://mechanicalc.com/reference/engineering-materials
5. http://ndl.ethernet.edu.et/bitstream/123456789/89589/1/%5BPerez_N.%5D_Electrochemistry_and_corrosion%28BookZZ.org%29.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
2	3	2	3	2	-	-	-	-	-	-	-	-	-	-	-
3	3	2	3	2	-	-	-	-	-	-	-	-	-	-	-
4	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**			Programme : **B.Tech.**			
Semester	**I**			Course Category: **ES**		End Semester Exam Type: **TE**	
Course Code	**U23ESTC02**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	CAM	ESE	TM
Course Name	**ENGINEERING MECHANICS**	**2**	**1**	**0**	**3**	**25**	**75**	**100**

(Common to EEE, ECE, MECH, CIVIL, Mechatronics Branches)

Prerequisite	Engineering Physics	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Recognize the basics of equilibrium of particles in 2D and 3D	**K2**
	CO2 Review the requirements of equilibrium of rigid bodies in 2D and 3D.	**K2**
	CO3 Solve problem related to friction force.	**K3**
	CO4 Compute the center of mass and moment of inertia of surfaces and solids.	**K3**
	CO5 Predict displacement, velocity and acceleration of dynamic particles.	**K3**

UNIT- I	**Basics and Statics of Particles**	**Periods: 09**
Introduction - Units and Dimensions - Vectorial representation of forces and moments – Coplanar Forces - Lami's theorem, Parallelogram and triangular Law of forces -Resolution of forces - Equilibrium of a particle - Principle of transmissibility - Equivalent system of force - Free body diagram		**CO1**
UNIT- II	**Equilibrium of Rigid Bodies**	**Periods: 09**
Types of supports and their reactions -requirements of 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 - Equilibrium of Rigid bodies in two dimensions – Forces in space -Equilibrium of a particle in space - Equivalent systems of forces - Equilibrium of Rigid bodies in three dimensions (Descriptive only).		**CO2**
UNIT - III	**Structural Analysis of Trusses and Friction**	**Periods: 09**
Trusses - Definition of a truss - Simple Trusses - Analysis of Trusses - Method of joints - Method of sections - Friction force - Laws of sliding friction - equilibrium analysis of simple systems with sliding friction -wedge friction- Rolling resistance.		**CO3**
UNIT - IV	**Properties of Surfaces and Solids**	**Periods: 09**
Determination of centroid of areas, volumes and mass - Pappus and Guldinus theorems - moment of inertia of plane and areas- Parallel axis theorem and perpendicular axis theorem, radius of gyration of area- product of inertia- mass moment of inertia.		**CO4**
UNIT - V	**Dynamics of Particles**	**Periods: 09**
Displacements, Velocity and acceleration, their relationship - Relative motion - Curvilinear motion - Newton's law - Work Energy Equation of particles -Impulse and Momentum -Impact of elastic bodies.		**CO5**

Lecture Periods: 30	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Beer, and Johnston Jr. E.R. "Vector Mechanics for Engineers", McGraw-Hill Education India Pvt Ltd., 11th Edition, 2016.
2. J.L. Meriam & L.G. Karidge, Engineering Volume I and Engineering Mechanics: Dynamics, 8th edition, Wiley student edition, 2016.
3. R.C, Hibbeller, "Engineering Mechanics", Prentice Hall, 14th edition, 2016.

Reference Books

1. Arthur P. Boresi and Richard J. Schmidt, "Engineering Mechanics: Statics and Dynamics", Thomson Asia Private Limited, Singapore, 2010.
2. D.P.Sharma "Engineering Mechanics", Dorling Kindersley India Pvt. Ltd, New Delhi, 2010
3. S.Rajasekaran, Sankarasubramanian, G., Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt., Ltd., 2012.
4. S.S.Bhavikatti and K.G. Rajashekarappa, Engineering Mechanics, New Age International(P) Ltd, New Delhi, 7th Edition, 2019.
5. Dr.I.SGujral, "Engineering Mechanical" second edition, Lakshmi Publication (P), Ltd., 2011.

Web References

1. http://nptel.iitm.ac.in/video.php?subjectId=112103108
2. http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/Engineeringmechanics/Table of Contents.html

3.	https://nptel.ac.in/courses/112/106/112106286/
4.	https://www.coursera.org/learn/engineering-mechanics-statics
5.	https://nptel.ac.in/courses/122/104/122104014/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	1	2	-	2
2	3	2	2	3	-	-	-	-	-	-	-	1	2	-	2
3	3	2	2	3	-	-	-	-	-	-	-	1	2	-	2
4	3	2	2	3	-	-	-	-	-	-	-	1	2	-	2
5	3	2	2	3	-	-	-	-	-	-	-	1	2	-	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**EEE and ECE**	Programme : **B.Tech.**						
Semester	**I**	Course Category: **ES**			End Semester Exam Type: **TE**			
Course Code	**U23ESTC03**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

(Common to CSE, IT, MECH, CIVIL, MCTR, CCE, AI&DS, FT and CSBS Branches)

Prerequisite	Mathematics and Physics		
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Apply the basic concepts and various laws in DC circuits.	**K3**
	CO2	Analyze the AC circuits and develop resonance conditions for transmitter and receiver circuits.	**K3**
	CO3	Gain the knowledge of power system components, importance of electrical safety measures and real time applications of transformer and motor.	**K2**
	CO4	Understand the operator of semiconductor diode and its applications.	**K2**
	CO5	Explain the characteristics and operation of BJT and FET.	**K2**
	CO6	Relate and Explain Different Communication Systems.	**K2**

SECTION A - Electrical Engineering

UNIT- I	**DC Circuits**	**Periods: 08**
Concept of Potential Difference, Current, Resistance, Inductance and Capacitance, Work, Power, Energy, Current and Voltage sources - ideal and practical sources - concept of dependent and independent sources, Ohm's law, Kirchhoff's law, Series parallel combination of R, L, C components, Voltage Divider and Current Divider Rules, Mesh and Nodal analysis, Star/Delta transformation, Network Theorems - Superposition, Thevenin, Norton and Maximum Power Transfer.		**CO1**
UNIT- II	**AC Circuits**	**Periods: 08**
AC waveform definitions - form factor, peak factor, R-L, R-C, RLC series circuit, R-L-C parallel circuit, phasor representation in polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, Resonance in series and parallel circuits, band-width and quality factor, Three Phase balanced AC Circuits (Y-Δ and Y-Y) - Power Measurement – Two Wattmeter method.		**CO2**
UNIT- III	**Electrical Safety and Electrical Machines**	**Periods: 07**
Layout of electrical power system and its functions, Wiring Accessories, Types of domestic wiring, Necessity of earthing, insulators and cables, Safety devices - fuse, relay and circuit breaker - Sensors and its types. Faraday's Law of electromagnetic induction, Fleming's Right and Left hand rule - DC Generator and DC Motor - construction, principle, load test and performance characteristics - Auto transformer, Single phase transformer- construction, principle, load test - Single phase capacitor start and run induction motor – Load test.		**CO3**

SECTION B – Electronics Engineering

UNIT- IV	**Semiconductor Diodes and Applications**	**Periods: 07**
Introduction semiconductor materials – Doping - Intrinsic and Extrinsic Semiconductor – PN junction diode, structure, characteristics - diffusion and depletion capacitance - Rectifier, Half wave and Full wave rectifier - zener diode characteristics - zener diode as regulator – Light Emitting Diode (LED) - Solar Cell.		**CO4**
UNIT- V	**Transistors**	**Periods: 07**
Bipolar Junction Transistor - construction – operation - Common Base, Common Emitter, Common collector Configuration – characteristics – Biasing - numerical application. Junction Field Effect Transistor (JFET), Metal oxide semiconductor Field Effect Transistor, EMOSFET-DMOSFET operation characteristics - Numerical application.		**CO5**
UNIT- VI	**Communication systems**	**Periods: 08**
Need for Modulation – Block diagram of analog communication System - AM, FM, PM Definitions and Waveforms – Comparison of digital and analog communication system- Block diagram of digital communication system – Electromagnetic Spectrum. Wired and wireless Channel – Block diagram of communication systems – satellite communication – Cellular Mobile Communication – Fibre Optical Communication System.		**CO6**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. R. K. Rajput, “Basic Electrical and Electronics Engineering”, University Science Press, 2nd Edition, 2017.
2. Dr. R. Saravanakumar, Dr.V. Jegathesan, Dr. K. Vinoth Kumar, Dr. K. Kowsalya, “Basic Electrical and Electronics Engineering”, Wiley Publisher, 2nd Edition, 2022.
3. R. Muthusubramaniam, S. Salivahanan and K. A. Mureleedharan, “Basic Electrical Electronics and Computer Engineering”, Tata McGraw Hill, 2018

Reference Books

1. A. Sudhakar and S. P. Shyam Mohan, “Circuits and Networks: Analysis and Synthesis”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 4th Edition, 2017.
2. D.P.Kothari and I.J. Nagrath, “Electric Machines”, Tata McGraw Hill, New Delhi, 5th Edition, 2017.
3. B. L. Theraja, A. K. Theraja, “A Textbook of Electrical Technology – Volume - II”, S Chand & Co. Ltd., New Delhi, 23rd Edition, 2009.
4. David. A. Bell, “Electronic Devices and Circuits”, PHI Learning Private Ltd, India, Fourth Edition, 2020
5. Wayne Tomasi, “Electronic Communication Systems- Fundamentals Theory Advanced”, Sixth Edition, Pearson Education, 2018.

Web References

1. https://nptel.ac.in/courses/108/108/108108076/
2. https://www.electrical4u.com/
3. https://nptel.ac.in/courses/108/102/108102146/
4. https://onlinecourses.nptel.ac.in/noc21_ee55/
5. https://nptel.ac.in/courses/117/102/117102059

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	-	2	-	-	-	-	-	-	1	3	2	-
2	3	3	3	-	2	-	-	-	-	-	-	1	3	2	-
3	3	3	3	-	2	-	-	-	-	-	-	1	3	2	-
4	3	3	3	-	2	-	-	-	-	-	-	1	3	2	-
5	3	3	3	-	2	-	-	-	-	-	-	1	3	2	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical**	Programme : **B.Tech.**						
Semester	**I**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MET101**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**CONCEPT OF ENGINEERING DESIGN**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Material Science							
Course Objectives	To provide a board overview of generic concept of design, weld symbols and standards.							
	To enable students to attain knowledge on design principles.							
	To define various engineering materials and properties.							
	To expand in depth knowledge on stress, strain and various loading conditions.							
	To know about the applications of green design in industry.							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the concepts of work, energy, torque, power and free body diagrams.	**K2**
	CO2 Understand various design principles.	**K2**
	CO3 Explain different classes of material and their properties.	**K3**
	CO4 Illustrate the various loading and failures theory methods.	**K3**
	CO5 Exposed to light engineering product and green design process.	**K3**

UNIT- I	**Design Consideration**	**Periods: 9**
Review of basics of work, energy, torque, power, load analysis, equilibrium equations, free-body diagrams, internal loads, force flow concept, locating critical sections, practical considerations, Fits and tolerances, surface roughness, basic of weld symbols.		**CO1**

UNIT- II	**Design Terminology**	**Periods: 9**
Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-bench marking		**CO2**

UNIT- III	**Creativity in Design**	**Periods: 9**
Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks-Creativity methods-brainstorming, synectics, force fitting methods, mind map, concept map Theory of innovative problem solving (TRIZ) – conceptual decomposition creating design concepts.		**CO3**

UNIT- IV	**Materials and Their Properties**	**Periods: 9**
Engineering materials and their classification: Metals, Ceramics and polymers, Stress-strain diagrams of metallic, Ceramics and polymers materials, Moduli of elasticity, Poisson's ratio, shear modulus – material strength, resilience and toughness, thermal conductivity, linear thermal expansion coefficient, specific heat capacity.		**CO4**

UNIT- V	**Green Design Process**	**Periods: 9**
Comparison of materials, material saving by form design, possible weight and cost reduction, design concepts for light engineering products, Material life cycle, embodied energy, 80-20 rule, carbon footprint, green design in industry, sustainability.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Dieter, George E., Engineering Design - "A Materials and Processing Approach", McGraw Hill International Editions Singapore, 3rd Edition, 2000.
2. Horenstein, M. N., Design Concepts for Engineers, Prentice Hall, 2010
3. Atif Aziz. ''Concepts in Engineering Design'' 1st Edition, New Age International, 2017.

Reference Books

1. Michael Ashby, Hugh Shercliff and David Cebon, "Materials Engineering, Science, Processing and Design", Butterworth Heinemann, 2009.
2. Robert C Juvinall, "Fundamentals of Machine Component Design", Wiley, 2011.
3. George Dieter,Linda Schmidt, ''Engineering Design' ' Fifth Edition McGraw 2012.
4. Yousef Haik, Tamer M. Shahin, ''Engineering Design Process'' Second Edition .Cengage learning, 2016.
5. Aarron Walter,'' Principles of product design' Design better, 2019

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1. nptel.ac.in/courses/107/108/107108010/

2.	https://nptel.ac.in/courses/113/104/113104096/
3.	https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-842
4.	https://www.ifeu.de/en/methods/life-cycle-assessment-and-material-flow-analyses
5.	https://www.webdesignerdepot.com/2011/02/the-8020-rule-applied-to-web-design

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	2	1	1	1	1	1	2	2	1	1
2	3	1	1	1	-	1	1	1	2	1	1	2	2	2	2
3	3	2	1	1	-	2	2	1	2	1	1	2	2	2	3
4	3	1	1	1	-	1	1	1	2	1	1	2	2	2	2
5	3	1	1	1	-	2	2	2	1	1	2	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**English**	Programme : **B.Tech.**						
Semester	**I**	Course Category: **HS**			End Semester Exam Type: **TE**			
Course Code	**U23ENBC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**COMMUNICATIVE ENGLISH - I**	**2**	**0**	**2**	**3**	**50**	**50**	**100**

(Common to ALL Branches except CSBS)

Prerequisite	Basics of English Language	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the communication flow in organization and its objectives	**K2**
	CO2 Write the technical contents with grammatically precise sentences	**K2**
	CO3 Articulate with correct pronunciation and overcome vernacular impact in speaking	**K3**
	CO4 Express opinions confidently in formal and informal communicative contexts	**K2**
	CO5 Attend interview with assertiveness	**K3**

UNIT- I	**Workstead Communication**	**Periods: 10**
Communication, Definition, Process, Channels, Barriers, Strategies for Effective Communication, Verbal and Nonverbal Communication - Listening, Types, Barriers, Enhancing Listening Skills - Bibliography: Book, Journal and Internet References		**CO1**
UNIT- II	**Common Errors In Writing And Comprehension Strategies**	**Periods: 10**
Subject Verb Agreement, Misplaced Modifiers, Squinting Modifiers, Dangling Modifier, Fused Sentence, Comma Splice, Sentence Fragment - Reading Comprehension: Technical passage, Strategies: Skimming, Scanning, Intensive and Extensive Reading, Prediction, and Contextual Meaning		**CO2**
UNIT- III	**Phonetics**	**Periods: 10**
Pronunciation Guidelines to consonants and vowels, Sounds Mispronounced, Silent and Non-silent Letters, Intonation, Spelling Rules and Words often misspelled, Mother Tongue Influence (MTI), Various Techniques for Neutralization of Mother Tongue		**CO3**
UNIT- IV	**Communication Practice - I**	**Periods: 15**
List of Exercises **Listening**: Self Introduction videos **Speaking**: Self-Introduction, Extempore, and Role Play **Reading**: Non-Technical Comprehension Passage **Writing:** Common Errors in Writing		**CO4**
UNIT- V	**Interpersonal Communication - I**	**Periods: 15**
List of Exercises **Listening:** Speech Sounds, Interview Videos **Speaking**: Debate, Structured Group Discussion, and Conversation **Reading**: Commonly Confused Words **Writing:** Transcription		**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 60**

Text Books

1. Richa Mishra , RatnaRao, “A textbook of English Language Communication Skills”, Macmillan Publishers India Private Ltd., Revised Edition 2021.
2. Rizvi M. Ashraf, “Effective Technical Communication”, New Delhi: Tata-McGraw-Hill Publishing Company Limited, 4th Edition, 2010.
3. Balasubramanian T, “English Phonetics for Indian students workbook”, 2nd Edition, Trinity Press, 2016.

Reference Books

1. N.P.Sudharshana, C. Savitha,” English for Engineers”, Cambridge University Press, 2018.
2. Raman, Meenakshi, and Sharma, Sangeetha, “Technical Communication - Principles and Practice”, 3rd Edition, Oxford University Press, 2017.
3. Comfort, Jeremy,etal., “Speaking Effectively: Developing Speaking Skills for Business English”, Cambridge University Press, Cambridge, Reprint 2011.
4. Wren & Martin, “High School English Grammar and Composition”, S Chandh &Co. Ltd, 2015.
5. Boove, Courtland L, “Business Communication Today”, Pearson Education, New Delhi, 2002.

Web References

1. https://lemongrad.com/subject-verb-agreement-rules/

2.	https://opentextbc.ca/advancedenglish/chapter/misplaced-and-dangling-modifiers/
3.	https://www.hitbullseye.com/Reading-Comprehension-Tricks.php
4.	https://www.softwaretestinghelp.com/how-to-crack-the-gd/
5.	https://worldscholarshipvault.com/neutralize-mother-tongue-interference/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
2	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
3	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
4	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
5	1	-	-	-	-	-	-	-	1	3	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Theory						
Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Attendance		
Marks	5	5	5	5	75	60
	20 (to be weighted for 10 marks)				(to be weighted for 50 marks)	

Practical				
Continuous Assessment Internal Evaluation		End Semester Internal Evaluation		Total Marks
30 (to be weighted for 10 marks)		30 marks		40
Listening (L)*	10	Listening (L)*	10	
Speaking(S)	5	Speaking(S)	5	
Reading(R)*	10	Reading(R)*	10	
Writing(W)*	5	Writing(W)*	5	

- **LRW components of Practical can be evaluated through Language Lab Software**

Department	EEE/ ECE	Programme : **B.Tech.**						
Semester	I	Course Category: **ES**			End Semester Exam Type: **LE**			
Course Code	**U23ESPC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

(Common to CSE, IT, MECH, CIVIL, CCE, AI&DS, FT, MCTR, CSBS Branches)

Prerequisite	Basic Knowledge of Science	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Build the different wiring for domestic and commercial applications.	**K3**
	CO2 Design and analyze the domestic power distribution.	**K3**
	CO3 Estimate the performance of transformer and motors by conducting load test.	**K3**
	CO4 Describe characteristics of semiconductor diode and utilize it for different applications	**K5**
	CO5 Relate the characteristics of various transistor	**K2**
	CO6 Understand Rectifiers and Regulators	**K2**

List of Experiments

Section – A Electrical Experiments

Demonstration on Power Sources, Ammeter, Voltmeter, Wattmeter and Energy meter are Pre-requisite for conducting this Electrical Engineering Lab.

1. Electrical safety precautions and study of tools, accessories, electrical joints and electrical symbols.
2. Domestic Wiring Practice
   - Staircase wiring
   - Doctor's room wiring
   - Godown wiring
   - Wiring of Ceiling fan, LED lamps and Iron Box.
3. Design of Domestic power distribution.
4. Measurement of 3-phase power using two wattmeter method
5. Load test on DC shunt motor.
6. Load test on single phase transformer.
7. Load test on single phase Induction Motor.

Section – B Electronics Experiments

1. Study of Electronic components and equipment: Resistor, Capacitor
2. Measurement of AC signal parameter (Peak-Peak, rms period, frequency) using CRO.
3. VI Characteristics of PN junction diode, Zener diode
4. Input and output characteristics of Common Emitter configuration of BJT
5. Characteristics of JFET
6. Measurement of Ripple factor of HWR, FWR
7. Voltage Regulator using Zener Diode

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. S. Gowri, T. Jeyapoovan Nadar, "Engineering Practices Lab Manual", Vikas Publishing House Private Limited, New Delhi, 5th Edition, 2014.
2. A.Sudhakar and Shyam Mohan.S.P, "Circuits and Networks Analysis and Synthesis", Tata McGraw Hill Publishing Company Ltd., New Delhi, 4th edition, 2017.
3. D.P.Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill, New Delhi, 5th Edition, 2017.
4. Edward Hughes, John Hiley, Keith Brown, Ian McKenzie Smith, Electrical and Electronics Technology, Pearson Education Limited, New Delhi, 12th edition 2016.
5. S.K. Sahdev, "Fundamentals of Electrical Engineering and Electronics", DhanpatRai and Co, 2017.

Web References

1. http://eie.sliet.ac.in/laboratories/basic-electrical-engineering-lab/
2. https://www.electronics-tutorials.ws/accircuits/series-circuit.html
3. https://www.allaboutcircuits.com/textbook/experiments/
4. https://www.electronicshub.org/measurements-of-ac-current/
5. http://www.electronics-tutorials.ws

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	-	-	1	-	-	3	-	-	1	3	2	-
2	3	2	3	-	-	1	-	-	3	-	-	1	3	2	-
3	3	2	3	-	-	1	-	-	3	-	-	1	3	2	-
4	3	2	3	-	-	1	-	-	3	-	-	1	3	2	-
5	3	2	3	-	-	1	-	-	3	-	-	1	3	2	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in Practical classes			Model Practical Examination	Attendance		
	Conduction of Practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**I**	Course Category: **ES**			End Semester Exam Type: **LE**			
Course Code	**U23ESPC02**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**DESIGN THINKING AND IDEA LAB**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

(Common to ALL Branches)

Prerequisite	Basic Knowledge of Science	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Demonstrate a comprehensive understanding of the tools and inventory associated with the IDEA Lab.	**K2**
	CO2 Develop proficiency in ideation techniques to generate creative and innovative solutions for various design challenges and problems	**K3**
	CO3 Acquire practical knowledge of mechanical and electronic fabrication processes, including hands-on experience with machinery, tools, and techniques used in the manufacturing and assembly of physical components.	**K3**
	CO4 Cultivate the skills necessary for developing innovative and desirable products, including the ability to integrate user needs, market trends, and technological advancements into the design process.	**K4**
	CO5 Apply iterative design methodologies to refine and improve solutions based on feedback, user testing, and evaluation of functional, aesthetic, and usability aspects	**K4**

Design process: Traditional design, Design thinking, Existing sample design projects, Study on designs around us, Compositions/structure of a design, Innovative design: Breaking of patterns, Reframe existing design problems, Principles of creativity Empathy: Customer Needs, Insight-leaving from the lives of others/standing on the shoes of others, Observation

Design team-Team formation, Conceptualization: Visual thinking, Drawing/sketching, New concept thinking, Patents and Intellectual Property, Concept Generation Methodologies, Concept Selection, Concept Testing, Opportunity identification Prototyping: Principles of prototyping, Prototyping technologies, Prototype using simple things, Wooden model, Clay model, 3D printing; Experimenting/testing.

Sustainable product design, Ergonomics, Semantics, Entrepreneurship/business ideas, Product Data Specification, Establishing target specifications, Setting the final specifications. Design projects for teams.

List of Lab Activities and Experiments

1. Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.
2. Machining of 3D geometry on soft material such as softwood or modelling wax.
3. 3D scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer.
4. 2D profile cutting of press fit box/casing in acrylic (3 or 6 mm thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver.
5. 2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.
6. Familiarity and use of welding equipment.
7. Familiarity and use of normal and wood lathe.
8. Embedded programming using Arduino and/or Raspberry Pi.
9. Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.
10. Discussion and implementation of a mini project.
11. Documentation of the mini project (Report and video).

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Text Books

1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers Ltd
2. Workshop / Manufacturing Practices (with Lab Manual), Khanna Book Publishing.

Reference Books

1. Ulrich and Eppinger, Product Design and Development, 3rd Edition, McGraw Hill, 2004
2. The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018.
3. The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product. Sean Michael Ragan, Weldon Owen; 2017.
4. The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill. Cambridge University Press.
5. Practical Electronics for Inventors. 4th edition. Paul Sherz and Simon Monk. McGraw Hill.
6. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education.
7. Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill.
8. Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer
9. Chapman W.A.J, “Workshop Technology”, Volume I, II, III, CBS Publishers and Distributors, 5th Edition,2002.

Web References

1. https://onlinecourses.nptel.ac.in/noc23_mg72

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	2	2	-	-	2	-	3	2	-	-	-
2	3	3	3	2	2	2	-	-	2	-	3	2	-	-	-
3	3	3	3	2	3	2	-	-	2	-	3	2	-	-	-
4	3	3	3	2	3	2	-	-	2	-	3	2	-	-	-
5	3	3	3	2	3	2	-	-	2	-	3	2	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in Practical classes			Model Practical Examination	Attendance		
	Conduction of Practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**I**	Course Category: **ES**			End Semester Exam Type: **LE**			
Course Code	**U23ESP101**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ENGINEERING MECHANICS LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
MECH								
Prerequisite	Basic Knowledge of Science							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
CO1	Applies the concept of law of forces, principle of moments and equilibrium of forces	**K2**
CO2	Computes the axial forces acting in the truss members and centroid of a lamina.	**K3**
CO3	Applies the coefficient of friction and Newton's law of motion.	**K2**
CO4	Infers about the concept of moment of inertia of a flywheel.	**K2**
CO5	Demonstrates the concept of conservation of energy.	**K2**

List of Experiments

1. Verification of triangle law & parallelogram law of forces
2. Verification of polygon law of forces
3. Verification of the Principle of Moments using the Bell Crank Lever apparatus
4. Verification of support reactions of a simply supported beam
5. Verification of condition of equilibrium of a system of forces
6. Verification of equilibrium of three-dimensional forces.
7. Verification of axial forces in the members of a truss
8. Verification of centroid of different lamina
9. Determination of coefficient of friction between two surfaces
10. Verification of newton's laws of motion
11. Determination of moment of inertia of a flywheel
12. Verification of motion parameters using conservation of energy.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. A.K.Gupta, Mohit Bhoot, Engineering Mechanics laboratory manual, Scientific Publishers, 2015.
2. A.K.Sharma, Engineering mechanics practicals, University Science Press, 2009.
3. U.C.Jindal, Basics of Engineering Mechanics, Galgotia Publications, 2002.
4. S.Rajasekaran, G.Sankarasubramanian, Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt., Ltd., 2012.
5. S.S.Bhavikatti and K.G. Rajashekarappa, Engineering Mechanics, New Age International(p) Ltd, New Delhi, 7th Edition, 2019.

Web References

1. http://nptel.iitm.ac.in/video.php?subjectId=112103108
2. http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR / Engineering mechanics / Table of Contents.html
3. https://nptel.ac.in/courses/112/106/112106286/
4. https://www.coursera.org/learn/engineering-mechanics-statics
5. https://nptel.ac.in/courses/122/104/122104014/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
4	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
5	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in Practical classes			Model Practical Examination	Attendance		
	Conduction of Practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme: **B.Tech.**						
Semester	**I**	Course Category: **MC**			End Semester Exam Type: -			
Course Code	**U23MEMC01**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**INDUCTION PROGRAMME**	-	-	-	Non-Credit	-	-	-
Prerequisite	**-**							

Course Outcome	The course will enable the student to	BT Mapping (Highest Level)
	CO1 Develop holistic attitude and harmony in the individual, family, and Society	**K2**
	CO2 Acquire grammar skills and capable to write and speak English confidently	**K2**
	CO3 Understand the basic concepts in Mathematics and Programming	**K2**
	CO4 Know about the art and culture, language and literature of this vast secular nation	**K2**
	CO5 Identify the inherent talent and develop it professionally	**K3**

UNIT- I	**Universal Human Values**	**Periods: 12**

Welcome and Introductions - Getting to know each other, Aspirations and Concerns - Individual Academic and Career, Expectations of Family, Peers, Society, Nation, Fixing one's Goals, Self-Management - Self-confidence, Peer Pressure, Time Management, Anger, Stress Personality Development, Self-improvement, Health - Health issues, Healthy diet, Healthy lifestyle, Hostel life, Relationships - Home sickness, Gratitude towards Parents, Teachers and others Ragging and interaction, Competition and Cooperation, Peer Pressure, Society - Participation in Society, Natural Environment - Participation in Nature, Sum Up - Role of Education, Need for a Holistic Perspective, Self-evaluation and Closure - Sharing and feedback. **CO1**

UNIT- II	**Proficiency in English**	**Periods: 12**

Communication skills - Prognostic test on Grammar - Synonyms, Antonyms, Tenses, Sentence Completion, Idioms and Phrases, One- word Substitution, Homophones, Homonyms, Use of Prepositions, Subject-verb Agreement - Writing - Paragraph writing, Letter writing, Essay writing, Story Development. **CO2**

UNIT- III	**Bridge Course in Mathematics and C Programming**	**Periods: 12**

Mathematics:

Fundamentals of differential and integral calculus: Theory and Practice, Limit of function - Fundamental results on limits - Continuity of a function - Concept of differentiation - Concept of derivative - Slope of a curve -Differentiation Techniques - Derivatives of elementary functions from first principle - Derivatives of inverse functions - Logarithmic differentiation - Method of substitution - Differentiation of parametric functions -Differentiation of implicit functions - Higher order derivatives. Integrals of functions containing linear functions -Method of integration (Decomposition method, method of substitution, integration by parts) - Definite integrals. Simple definite integrals - Properties of Definite integrals - Reduction formulae - Area and volume - Length of curve - surface area of a solid.

C Programming:

Features of C and its basic Structure - Keywords - constants - variables - operators - Data types - Formatted input and output statements - Control and Looping statement - Arrays - Functions - Strings - writing simple C programs. **CO3**

UNIT- IV	**Literary activities**	**Periods: 12**

Team building activities - Quiz - Oral Exercises - Group discussion, Debate, Extempore, Role play, சிறப்பு சொற்பொழிவு - தமிழர் மரபு மற்றும் தமிழர் தொழில்நுட்பம். **CO4**

UNIT- V	**Creative arts**	**Periods: 12**

Introduction to painting and renowned artworks - Documentary and Short films - Music - Vocal, Instrumental - Dance - Classical, Cinematic - Mimicry - Mime. **CO5**

Lecture Periods: 60	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 60**

Reference Books

1. R.R Gaur, R. Asthana, G.P. Bagaria," A Foundation Course in Human Values and Professional Ethics", Excel Books, New Delhi, 2nd Revised Edition, 2019.
2. Kumar Mohan R, "English Grammar for all (Functional and Applied Grammar)", Unicare Academy, 2022.
3. Seely, John," Oxford A-Z of Grammar and Punctuation, Oxford Publication, 2013.
4. B.V. Ramana," Higher Engineering Mathematics", Tata McGraw – Hill, New Delhi, 6th Edition, 2018.
5. Dr. A. Singaravelu, "Engineering Mathematics - I", Meenakshi publications, Tamil Nadu, 2019.
6. E. Balagurusamy, "PROGRAMMING IN ANSI C", Mc Graw Hill, 8th Edition, 2019.
7. Dr.K.K.Pillay,"Social Life of Tamils", A joint publication of TNTB & ESC and RMRL
8. R.Balakrishnan, "Journey of Civilization",Roja muthiah research publishers, 1st Edition 2019

9. தமிழக வரலாறு - மக்களும் பண்பாடும், பிள்ளை, கே. கே. , சென்னை : உலகத் தமிழாராய்ச்சி நிறுவனம் , 2002.
10. கணினித்தமிழ் - முனைவர் இல.சுந்தரம், விகடன் பிரசுரம்.
11. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம், தமிழக தொல்லியல் துறை

Web References

1. http://www.newsociety.com/Books/S/Slow-isBeautiful
2. https://www.aplustopper.com/formal-letter/
3. https://www.javatpoint.com/c-programming-language-tutorial
4. http://www.math.cum.edu/~wn0g/2ch6a.pdf
5. https://education.nsw.gov.au/teaching-and-learning/curriculum/creative-arts

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**I**	Course Category: **AEC**			End Semester Exam Type: **-**			
Course Code	**U23MEC1XX**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**CERTIFICATION COURSE - I**	**0**	**0**	**4**	**-**	**100**	**-**	**100**

MECH

Students shall choose an International / Reputed organization certification course of 40-50 hours duration specified in the curriculum (It is mandatory to do a minimum of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation.

(i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks.

(ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as “pass” on satisfactory completion. A letter grade “P” is awarded to declare pass.

(iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.

Evaluation Methods

Assessment	**Continuous Assessment Marks (CAM)**		**Total Marks**
	Report	**MCQ Test**	
Marks	10	90	100

SEMESTER II

Department	**Mathematics**			Programme : **B.Tech.**			
Semester	**II**			Course Category: **BS**		End Semester Exam Type: **TE**	
Course Code	**U23MATC02**	Periods/Week			Credit	Maximum Marks	
		L	T	P	C	CAM	ESE	TM
Course Name	**ENGINEERING MATHEMATICS – II**	**3**	**1**	**0**	**4**	**25**	**75**	**100**

(Common to **ALL** Branches Except CSBS, FT)

Prerequisite	Basic Mathematics	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Convert a periodic function into series form.	**K2**
	CO2 Compute Fourier transforms of various functions.	**K3**
	CO3 Solve Differential Equations using Laplace transforms.	**K3**
	CO4 Apply inverse Laplace transform of simple functions.	**K3**
	CO5 Solve difference equations using Z – transforms.	**K3**

UNIT - I	**Fourier Series**	**Periods:12**
Dirichlet's conditions – General Fourier series – Odd and Even functions – Half-Range sine series and cosine series – Change of intervals – Parseval's Identity.		**CO1**
UNIT - II	**Fourier Transforms**	**Periods:12**
Fourier Transforms and its inverse – Properties of Fourier Transform (without proof) – Fourier sine and cosine Transforms and their properties (excluding proof).		**CO2**
UNIT - III	**Laplace Transforms**	**Periods:12**
Laplace transforms of elementary functions and Periodic functions – Basic properties (excluding proof) – Laplace transforms of derivatives and integrals – Initial and final value theorems.		**CO3**
UNIT - IV	**Inverse Laplace Transforms**	**Periods:12**
Definition of inverse Laplace Transforms – Convolution theorem (excluding proof) – Solutions of Linear Ordinary Differential Equations of second order with constant coefficients.		**CO4**
UNIT - V	**Z – Transforms**	**Periods:12**
Z-transforms – Elementary Properties – Inverse Z-transforms (using partial fraction and Residues) – Solution of difference equations using Z - transform.		**CO5**

Lecture Periods:45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Text Books

1. T. Veerarajan, "Engineering Mathematics", Tata McGraw Hill, New Delhi, 3rd Edition, 2011.
2. C. P. Gupta, Shree Ram Singh. M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, New Delhi, 2nd Edition, 2016.
3. H.K. Dass, "Advanced Engineering Mathematics", S. Chand, New Delhi, 22nd Edition 2019.

Reference Books

1. N.P. Bali and Dr. Manish Goyal, "A Textbook of Engineering Mathematics", University Science Press, India, 8th Edition, 2016.
2. P. Sivaramakrishna Das and C. Vijayakumari, "Engineering Mathematics", Pearson India Education services Pvt. Ltd, India 1st 2017.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition, 2019.
4. G. Balaji, "Engineering Mathematics - Transforms and Partial Differential Equations", G. Balaji Publishers, 18th Edition, 2022.
5. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2017.

Web References

1. https://nptel.ac.in/courses/111105121/
2. https://nptel.ac.in/courses/111105035/
3. https://nptel.ac.in/courses/11110711
4. https://swayam.gov.in/nd1_noc20_ma17/preview
5. https://nptel.ac.in/courses/111/103/111103021/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	-	1	-	-	-	-	-	1	1	-	-
2	3	2	1	1	-	1	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	1	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	1	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	1	-	-	-	-	-	1	3	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Computer Science and Engineering**	Programme : **B.Tech.**						
Semester	**II**	Course Category: **ES**			End Semester Exam Type: **TE**			
Course Code	**U23CSTC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**PROGRAMMING IN C**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

(Common to **ALL** Branches)

Prerequisite: Nil

Course Outcome		BT Mapping (Highest Level)
	On completion of the course, the students will be able to	
	CO1 Comprehend the basics of Computers.	**K2**
	CO2 Illustrate the concepts of control structures and looping.	**K2**
	CO3 Implement programs using arrays and functions.	**K3**
	CO4 Demonstrate programs using Structure and Pointers.	**K3**
	CO5 Build the programs using Union and File management Operations.	**K3**

UNIT - I	**Introduction**	**Periods: 09**
Generation and Classification of Computers - Block Diagram of a Computer –Categories of Software – Network Structure - Number System – Binary – Decimal – Conversion – Algorithm – Pseudo code – Flow Chart		**CO1**
UNIT - II	**C Programming Basics**	**Periods: 09**
Introduction to ' C' Programming – Basic structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements.		**CO2**
UNIT - III	**Arrays and Functions**	**Periods: 09**
Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations- Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion		**CO3**
UNIT - IV	**Structure and Pointers**	**Periods: 09**
Structure Introduction – Structure definition – Structure declaration – Structure within a structure – Self Referential Structure. Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays -Pointer to Function – Pointer and Structure- Simple programs.		**CO4**
UNIT - V	**Unions and Files**	**Periods: 09**
Union Introduction - Programs Using Structures and Unions – Introduction to File - File Operations - File Input and Output Functions - Random Access to Files - File System Functions - Command Line Arguments- Storage Classes - Pre-Processor Directives- Dynamic Memory Functions.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Balagurusamy. E, "Programming in ANSI C", Tata McGraw Hill, 8th Edition, 2019.
2. Yashvant Kanetkar, "Let us C", BPB Publications, 16th Edition, 2017
3. Herbert Schildt," C: The Complete Reference", McGraw Hill, FourthEdition, 2014

Reference Books

1. Vikas B. Agarwal Jyoti P. Mirani, "Computer Fundamentals, Nirali Prakashan Aug-2019,
2. Ashok N Kamthane, "Computer Programming", Pearson education, Second Impression, 2012.
3. VikasVerma, "A Workbook on C ", Cengage Learning, Second Edition, 2012.
4. P.Visu, R.Srinivasan and S.Koteeswaran, "Fundamentals of Computing and Programming", Fourth Edition, Sri Krishna Publications, 2012.
5. PradipDev, ManasGhoush, "Programming in C", Second Edition, Oxford University Press, 2011.

Web References

1. https://www.programiz.com/c-programming
2. https://www.geeksforgeeks.org/c-language-set-1-introduction/
3. https://www.tutorialspoint.com/cprogramming
4. https://www.assignment2do.wordpress.com/.../solution-programming-in-ansi-c
5. https://nptel.ac.in/courses/106/104/106104128/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	3	-	3
2	2	1	-	-	3	-	-	-	-	-	-	-	3	-	3
3	3	2	1	1	3	-	-	-	-	-	-	-	3	-	3
4	3	2	1	1	3	-	-	-	-	-	-	-	3	-	3
5	3	2	1	1	3	-	-	-	-	-	-	-	3	-	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	Civil / Mechanical			Programme : B.Tech.			
Semester	II			Course Category: ES		End Semester Exam Type: TE	
Course Code	U23ESTC01	Periods / Week			Credit	Maximum Marks	
		L	T	P	C	CAM	ESE	TM
Course Name	BASICS OF CIVIL AND MECHANICAL ENGINEERING	3	0	0	3	25	75	100

(Common to ECE, EEE, ICE, MECH, Civil, Mechatronics Branches)

Prerequisite	Basic Science	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the types of buildings and materials.	**K2**
	CO2 Summarize on the various components of buildings and surveying concepts	**K2**
	CO3 Identify the various infrastructure facilities	**K2**
	CO4 Familiarize the working principles of IC engines and automobile systems	**K2**
	CO5 Understand about the power generation systems and its components	**K2**
	CO6 Acquire knowledge about the various machining process.	**K2**

SECTION A - CIVIL ENGINEERING

UNIT - I	**Buildings and Buildings Materials**	**Periods: 08**
Buildings – Definition – Classification according to NBC-plinth area, Floor area, carpet area, floor space index - Development of Smart cities - Green building, Benefits from green building. Building Materials - stone, brick, cement, cement mortar, concrete, steel, Timber - their properties and uses		**CO1**

UNIT - II	**Buildings Components and Surveying**	**Periods: 08**
Various Buildings Components and their functions. Foundation: function and types - Brick masonry, Stone Masonry and its types – Floors, Roofs and its types. Surveying: Objects – Classification – Principles – Measurements of Distances and areas –Leveling		**CO2**

UNIT - III	**Basic Infrastructure**	**Periods: 07**
Roads and Bridges – types, components advantage and disadvantages. Railways - Permanent way and its elements. Sources of Water - Quality of Water- Domestic sewage Treatment – Rain Water harvesting – Dams - site selection for dam construction, types of dams.		**CO3**

SECTION B – MECHANICAL ENGINEERING

UNIT- IV	**Internal and External Combustion Systems**	**Periods: 08**
IC engines – Classification – Working principles – Diesel and Petrol Engines: Two stroke and four stroke engines – merits and demerits. Steam generators (Boilers) – Classification – Constructional features (of only low-pressure boilers) – Boiler mountings and accessories – Merits and demerits – Applications.		**CO4**

UNIT- V	**Power Generation Systems, Refrigeration and Air Conditioning System**	**Periods: 07**
Power plants: Thermal – Nuclear, Hydraulic, Solar, Wind, Geothermal, Wave, Tidal and Ocean Thermal Energy Conversion systems - Functions, Applications - Schemes and layouts (Description only) Refrigeration and Air Conditioning System: Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.		**CO5**

UNIT- VI	**Manufacturing Process**	**Periods: 07**
Lathe - types, Specifications, Operations of a centre lathe. Casting - Pattern making, Allowances, Green sand and dry sand moulding, casting defects. Welding - Arc and Gas welding process, brazing and soldering (process description only).		**CO6**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Dr. S. Jayakumar, “Basic Civil Engineering”, Aagash Nekaa Publications, 2011
2. G Shanmugam, MS Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education, 1st Edition, 2018.
3. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.

Reference Books

1. M.P. Poonia, S.C. Sharma and T.R. Banga, Basic Mechanical Engineering, Khanna Publishing House 2018.

2.	S.S.Bhavikatti, Basic Civil engineering, New Age International Ltd. 2018.
3.	V. Rameshbabu, Basic Civil & Mechanical Engineering, VRB Publishers Private Limited, January 2017.
4.	Serope Kalpakjian, Steven Schmid, Manufacturing Engineering and Technology, 7th Edition, Pearson Publication, 2014.
5.	Gopi Satheesh, Basic Civil engineering, Pearson Publications, 3rd Edition, 2015.
Web References	
1.	https://nptel.ac.in/courses/112107291/
2.	https://nptel.ac.in/courses/112/103/112103262/
3.	https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/ lecture-notes/
4.	https://nptel.ac.in/courses/105102088/
5.	https://nptel.ac.in/courses/105104101/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	-	-	-	-	-	-	1	-	-	-
2	3	1	1	-	1	-	-	-	-	-	-	1	-	-	-
3	3	1	1	-	1	-	-	-	-	-	-	1	-	-	-
4	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-
5	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**II**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MET202**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ENGINEERING METALLURGY**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Nil							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Understand the fundamentals of solidification, metal structure, and solid solution metals.	**K2**
	CO2	Recognize the phase and equilibrium diagram with reactions.	**K2**
	CO3	Apply the principles of heat-treatment processes.	**K3**
	CO4	Understand the polymers processing methods and its engineering applications.	**K3**
	CO5	Perform mechanical testing and Analyse the failures.	**K4**

UNIT - I	**Solidification and Theory of Alloys**	**Periods: 09**
Mechanism of crystallization, solidification of metals: pure metals and alloys, concept of super cooling, Nucleation: homogenous nucleation and heterogeneous nucleation. Solid solutions: Substitution solid solution-Interstitial solid solution, Hume-Rothery Rule, Lever Rule-Allotropy		**CO1**
UNIT - II	**Phase Diagram and Iron - Carbon Equilibrium Diagram**	**Periods: 09**
Construction and interpretation of binary phase diagrams – Types – Eutectic, Eutectoid, Peritectic and Peritectoid systems – Iron Carbon equilibrium diagrams – Classification of steel making processes; production of primary and secondary steel-Manufacturing methods of Cast Iron, Alloy cast iron.		**CO2**
UNIT - III	**Heat Treatment of Steels**	**Periods: 09**
Introduction to heat treatment- Classifications, Heat treatment of ferritic steels: constant temperature transformation-Continuous cooling curves-Important of heat treatment of steels- Surface Hardening process: classifications- Martempering and Austempering - Heat treatment of stainless steel: austenite stainless steel and Duplex stainless steel- shot peening-laser peening.		**CO3**
UNIT - IV	**Polymers and Ceramics**	**Periods: 09**
Introduction – Preparation – types - PMMA, PET, PVC- Processing of polymers, Extrusion, Injection molding, Blow molding, Transfer molding, Properties of polymers and Applications, Engineering Ceramics –Properties and applications of Alumina (Al_2O_3) - Silicon Carbide (SiC) – Silicon Nitride (Si_3N_4) - Partially Stabilized Zirconia (PSZ) and Sialon.		**CO4**
UNIT - V	**Deformation and Materials Testing**	**Periods: 09**
Mechanical properties of materials - Deformation – types - Testing of materials, Tensile, Compression, Hardness (micro & macro), Impact, Fatigue and Creep testing. Mechanism creep behavior, fatigue behavior- S-N Curve-design against creep and fatigue.		**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. S. K.Mandal, Steel Metallurgy: Properties, Specifications and Applications, McGraw-Hill Education, 2014.
2. Srinivasan, Engineering Materials and Metallurgy, Tata McGraw-Hill Education,2nd edition,2015
3. A. Lavakumar, Concept of in physical metallurgy, Morgan & clay publication,2017

Reference Books

1. Sidney H. Avner, Introduction to Physical Metallurgy, Tata McGraw-Hill Publishing company Ltd, 2nd Edition 2008.
2. Romesh C. Sharma, Principles of heat treatment of steels, New Age International, 2010.
3. L. Krishna reddy, Principles of Engineering Metallurgy, New Age Publishing Company Ltd, 10th Edition 2011.
4. Kannadi Palankeezhe Balan, Metallurgical Failure Analysis, Elsevier, 2018.
5. William E. Hosford, Physical Metallurgy, Taylor and Francis , 1st Edition 2018

Web References

1. https://nptel.ac.in/courses/113106088/
2. https://nptel.ac.in/courses/113104074/

3. https://fractory.com/heat-treatment-methods/
4. http://www.phase-trans.msm.cam.ac.uk/2005/growth.html
5. https://www.vssut.ac.in/lecture_notes/lecture1450443095.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	1	1	-	1	-	1	-	1	1	1	1
2	3	1	2	-	-	-	-	1	-	1	-	1	2	1	1
3	3	1	1	-	-	1	-	-	-	1	-	2	1	1	1
4	3	1	1	1	-	1	1	1	-	1	1	2	1	1	2
5	3	2	1	1	2	1	-	1	2	2	1	2	1	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**II**	Course Category: **HS**			End Semester Exam Type: **TE**			
Course Code	**U23HSTC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**UNIVERSAL HUMAN VALUES - II**	**2**	**0**	**0**	**2**	**25**	**75**	**100**
(Common to all Branch)								
Prerequisite	UHV - I							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Evaluate the significance of value inputs in formal education and start applying them in their life and profession	**K2**
	CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	**K2**
	CO3	Analyze the value of harmonious relationship based on trust and respect in their life and profession	**K32**
	CO4	Examine the role of a human being in ensuring harmony in society and nature.	**K2**
	CO5	Apply the understanding of ethical conduct to formulate the strategy for ethical life and profession.	**K2**

UNIT - I	**Introduction to Value Education**	**Periods: 06**
Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) - Understanding Value Education - Self-exploration as the Process for Value Education - Basic Human Aspirations - Happiness and Prosperity - Current Scenario- Method to Fulfil the Basic Human Aspirations		**CO1**
UNIT - II	**Harmony in the Human Being**	**Periods: 06**
Understanding Human being as the Co-existence of the Self and the Body-Distinguishing between the Needs of the Self and the Body-The Body as an Instrument of the Self-Understanding Harmony in the Self-Harmony of the Self with the Body-Programme to ensure self-regulation and Health		**CO2**
UNIT - III	**Harmony in the Family and Society**	**Periods: 06**
Harmony in the Family - Basic Unit of Human Interaction- 'trust' - Foundational Value in Relationship - 'Respect' - as the Right Evaluation - Other Feelings, Justice in Human-to-Human Relationship - Understanding Harmony in the Society-Vision for the Universal Human Order.		**CO3**
UNIT - IV	**Harmony in the Nature / Existence**	**Periods: 06**
Understanding Harmony in the Nature-Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature - Realizing Existence as Co-existence at All Levels - Holistic Perception of Harmony in Existence		**CO4**
UNIT - V	**Implications of the Holistic Understanding - A Look at Professional Ethics**	**Periods: 06**
Natural Acceptance of Human Values - Definitiveness of (Ethical) Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Competence in Professional Ethics-Holistic Technologies, Production Systems and Management Models-Typical Case Studies-Strategies for Transition towards Value - based Life and Profession		**CO5**

Lecture Periods: 30	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 30**

Text Books

1. R. R. Gaur, R. Asthana, G. P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", Excel Books, 2nd Revised Edition, New Delhi, 2019.

Reference Books

1. A Nagraj, Jeevan Vidya Prakashan, Amarkantak, "Jeevan Vidya: EkParichaya", 2013.
2. A.N. Tripathi, "Human Values", New Age International Publishers, New Delhi, 3rd Edition, 2019.
3. Annie Leonard, "The Story of Stuff", Free Press, Reprint Edition, 2011.
4. Mohandas Karam chand Gandhi, "The Story of My Experiments with Truth – Mahatma Gandhi Autobiography", Finger print Publisher, 2009.
5. E. F Schumacher, "Small is Beautiful", Vintage Publisher, 1993.
6. Cecile Andrews, "Slow is Beautiful", New Society Publishers, 2006.
7. J C Kumarappa, "Economy of Permanence", Sarva Seva Sangh Prakashan, 2017.
8. Pandit Sunderlal, "Bharat Mein Angreji Raj", Prabhat Prakashan Publisher, 2021.

9. Dharampal, “Rediscovering India”, Stosius Inc/Advent Books Division Publisher, 1983.
10. Mohandas K. Gandhi, “Hind Swaraj or Indian Home Rule”, Gyan Publishing House, 2023.
11. Maulana Abdul Kalam Azad, “India Wins Freedom”, Orient BlackSwan Publisher, 1st Edition, 1988.
12. Life of Vivekananda, **“**Romain Rolland (English)”, Advaita Ashrama Publisher, India, 4th Edition, 2010.
13. Mahatma Gandhi, “Romain Rolland (English)”, Srishti Publishers & Distributors, 2020.

Web References

1. https://www.uhv.org.in/uhv-ii
2. http://www.storyofstuff.com
3. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
4. https://fdp-si.aicte-india.org/8dayUHV_download.php
5. https://www.youtube.com/watch?v=8ovkLRYXIjE

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	-	2	3	2	2	-	-	3	-	-	-
2	-	-	-	-	-	2	3	2	2	-	-	3	-	-	-
3	-	-	-	-	-	3	3	2	2	-	-	3	-	-	-
4	-	-	-	-	-	2	3	2	2	-	-	3	-	-	-
5	-	-	-	-	-	2	3	2	2	-	-	3	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**English**	Programme : **B.Tech.**						
Semester	**II**	Course Category: **HS**			End Semester Exam Type: **TE**			
Course Code	**U23ENBC02**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**COMMUNICATIVE ENGLISH - II**	**2**	**0**	**2**	**3**	**50**	**50**	**100**

(Common to ALL Branches except CSBS)

Prerequisite	Basics of English Language	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Draft effective written communication in professional environment	**K2**
	CO2 Apply the mechanics of creative writing with precision and clarity	**K3**
	CO3 Acquire language skills professionally to groom the overall personality through sensitizing various etiquettes in real time situation	**K2**
	CO4 Develop language fluency and gain self-confidence	**K3**
	CO5 Express thoughts and ideas with clarity and focus	**K2**

UNIT- I	**Business Correspondence**	**Periods: 10**
Business Writing: Circular, Agenda, Memoranda, Notice, Instruction, Minutes, Email Writing ,Report Writing- Official and Demi Official Letters : Applying for Educational / Car / Home Loans / Joining Report, Leave Letter, Industrial Visit, In plant Training, Letter to the Editor, Calling for a quotation, Placing Order, Letter of Complaints, Letter seeking Clarification, Resume', Job Application Letter, Bio-data, CV		**CO1**

UNIT- II	**Functional Writing Skills**	**Periods: 10**
Four Modes of Writing, Sentence Structure, Art of condensation: Summary Writing and Note Making, Use of phrase and clause in sentence, Principles of paragraph writing, Techniques of Essay Writing, Jumbled Sentence, Paraphrasing		**CO2**

UNIT- III	**Etiquettes**	**Periods: 10**
Etiquette: Meaning, Kinds: Corporate Etiquette, Meeting Etiquette, Telephone Etiquette, Email Etiquette, Social Media Etiquette, Dining Etiquette, Communication Etiquette		**CO3**

UNIT- IV	**Communication Practice - II**	**Periods: 15**
List of Exercises **Listening**: Letter writing tips **Speaking**: Just a Minute, Impromptu Speech, Contemporary Issues **Reading**: Variety of examples for Modes of Writing **Writing:** Different types of letters		**CO4**

UNIT- V	**Interpersonal Communication - II**	**Periods: 15**
List of Exercises **Listening:** Videos on different types of Etiquettes **Speaking**: Team Presentation, Negotiation Skills **Reading**: Phrase and Clause **Writing:** Free writing on any given topic, Paraphrasing Practice		**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 60**

Text Books

1. PC Das, "Letter Writing including Official and Business Letters", New Central Book Agency, 2020.
2. Kumar, Sanjay, Pushpalatha," Communication Skills". Oxford University Press, 2018.
3. Raman, Meenakshi&Sangeetha Sharma," Communication Skills", New Delhi: OUP, 2018.

Reference Books

1. Sahukar, Nimeran, Bhalla, Prem,, "The book of Etiquettes and Manners".PustakMahal Publisher, New Delhi; 1st Edition 2009.
2. Gerson Sharon J, Steven M. Gerson, "Technical Writing Process and Product", Pearson Education Pvt. Ltd. 3rd Edition, 2009.
3. Grussendorf, Marion, "English for Presentations". Oxford University Press, Oxford, 2007.
4. Seely John, "The Oxford Guide to Writing and Speaking", Oxford University Press, 2006.
5. R.C. Sharma, Krishna Mohan, "Business Correspondence and Report Writing", Tata McGraw Hill &Co.Ltd., New Delhi, 2001

Web References

1. https://www.indeed.com/career-advice/finding-a-job/how-to-write-an-application-letter

2.	https://owlcation.com/humanities/Four-Types-of-Writing
3.	https://targetstudy.com/languages/english/paragraph-writing.html
4.	https://www.businessnewsdaily.com/8262-email-etiquette-tips.html
5.	https://www.youtube.com/watch?v=UOceysteIjo

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
2	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
3	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
4	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
5	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Theory						
Assessment	Continuous Assessment Marks (CAM)				End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Attendance		
Marks	5	5	5	5	75	60
	20 (to be weighted for 10 marks)				(to be weighted for 50 marks)	

Practical				
Continuous Assessment Internal Evaluation		End Semester Internal Evaluation		Total Marks
30 (to be weighted for 10 marks)		30 marks		40
Listening (L)*	10	Listening (L)*	10	
Speaking(S)	5	Speaking(S)	5	
Reading(R)*	10	Reading(R)*	10	
Writing(W)*	5	Writing(W)*	5	

- **LRW components of Practical can be evaluated through Language Lab Software**

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**II**	Course Category: **ES**			End Semester Exam Type: **LE**			
Course Code	**U23ESPC03**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ENGINEERING GRAPHICS USING AUTOCAD**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

(Common to all Branches)

Prerequisite	Nil	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Familiarize with the fundamentals and standards of engineering graphics.	**K3**
	CO2 Perform drawing of basic geometrical constructions and multiple views of objects.	**K2**
	CO3 Visualize the isometric and perspective sections of simple solids.	**K3**
	CO4 Connect side view associate on front view.	**K4**
	CO5 Correlate sectional views and lateral surface developments of various solids.	**K4**

List of Experiments

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing a Title Block with necessary text and projection symbol.
3. Drawing 2D sketch by applying modify tools like fillet, mirror, array, etc.,
4. Drawing front view and top view of simple solids like prism, pyramid, cylinder, cone, etc., and Dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. Simple stool, V-block, Mixie Base).
6. Drawing a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
8. Drawing lateral surface development of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creating 3D model of simple object and obtaining 2D multi-view drawings.
11. Note: Plotting of drawings must be made for each exercise and attached to the records written by Students.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. James D. Bethune, Engineering Graphics with AutoCAD A Spectrum book 1st Edition, Macromedia Press, Pearson, 2020.
2. NS Parthasarathy and Vela Murali, Engineering Drawing, Oxford university press, 2015.
3. M.B Shah, Engineering Graphics, ITL Education Solutions Limited, Pearson Education Publication, 2011.
4. Bhatt N.D and Panchal V.M, Engineering Drawing: Plane and Solid Geometry, Charotar Publishing House, 2017.
5. Jeyapoovan T, Engineering Drawing and Graphics Using AutoCAD, Vikas Publishing House Pvt Ltd., 7th Edition, New Delhi, 2016.
6. C M Agrawal, Basant Agrawal, Engineering Graphics, McGraw Hill, 2012.
7. Dhananjay A. Jolhe, Engineering Drawing: With An Introduction To CAD McGraw Hill, 2016.
8. James Leach, AutoCAD 2017 Instructor, SDC Publications, 2016.

Web References

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/egraphics_lab/labs/index.php
2. http://www.nptelvideos.in/2012/12/computer-aided-design.html
3. https://mech.iitm.ac.in/meiitm/course/cad-in-manufacturing/
4. https://autocadtutorials.com
5. https://dwgmodels.com

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	-	3	-	-	-	3	-	-	2	3	3	3
2	3	1	-	-	3	-	-	-	3	-	-	3	3	3	3
3	3	1	-	-	3	-	-	-	3	-	-	3	3	3	3
4	3	1	-	-	3	-	-	-	3	-	-	2	3	3	3
5	3	1	-	-	3	-	-	-	3	-	-	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Computer Science Engineering**	Programme: **B.Tech.**						
Semester	**II**	Course Category: **ES**			End Semester Exam Type: **LE**			
Course Code	**U23CSPC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**PROGRAMMING IN C LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

(Common to All Branches)

Prerequisite	Nil	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Implement logical formulations to solve simple problems leading to specific applications.	**K3**
	CO2 Execute C programs for simple applications making use of basic constructs, arrays and strings.	**K3**
	CO3 Experiment C programs involving functions, recursion, pointers, and structures.	**K3**
	CO4 Demonstrate applications using sequential and random access file processing.	**K3**
	CO5 Build solutions for online coding challenges.	**K3**

List of Experiments

1. Write a C program to find the Area of the triangle.
2. Develop a C program to read a three digit number and produce output like
   1 hundreds
   7 tens
   2 units
   For an input of 172.
3. Write a C program to check whether a given character is vowel or not using Switch – Case statement.
4. Write a C program to Print the numbers from 1 to 10 along with their squares.
5. Demonstrate do—While loop in C to find the sum of ‘n’ numbers.
6. Find the factorial of a given number using Functions in C.
7. Write a C program to check whether a given string is palindrome or not?
8. Write a C program to check whether a value is prime or not?
9. Develop a C program to swap two numbers using call by value and call by reference.
10. Construct a C program to find the smallest and largest element in an array.
11. Implement matrix multiplication using C program.
12. Write a C program to perform various string handling functions like strlen, strcpy, strcat, strcmp.
13. Develop a C program to remove all characters in a string except alphabets.
14. Write a C program to find the sum of an integer array using pointers.
15. Write a C program to find the Maximum element in an integer array using pointers.
16. Construct a C program to display Employee details using Structures
17. Write a C program to display the contents of a file on the monitor screen.
18. Write a File by getting the input from the keyboard and retrieve the contents of the file using file operation commands.
19. Write a C program to create two files with a set of values. Merge the two file contents to form a single file
20. Write a C program to pass the parameter using command line arguments.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. Zed A Shaw,” Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (Like C)”, Addison Wesley,2016.
2. Anita Goel and Ajay Mittal,” Computer Fundamentals and programming in C”, Pearson Education, First edition, 2011.
3. Maureen Sprankle, Jim Hubbard,” Problem Solving and Programming Concepts,” Pearson,9th Edition, 2011.
4. Yashwanth Kanethkar, “Let us C”, BPB Publications,13th Edition,2008.
5. B.W.Kernighan and D.M. Ritchie, “The C Programming Language”, Pearson Education, 2nd Edition, 2006.

Web References

1. https://alison.com/course/introduction-to-c-programming
2. https://www.geeksforgeeks.org/c-programming-language/
3. http://cad-lab.github.io/cadlab_data/files/1993_prog_in_c.pdf
4. https://www.tenouk.com/clabworksheet/clabworksheet.html
5. https://fresh2refresh.com/c-programming/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	3	-	3
2	2	1	-	-	3	-	-	-	-	-	-	-	3	-	3
3	3	2	1	1	3	-	-	-	-	-	-	-	3	-	3
4	3	2	1	1	3	-	-	-	-	-	-	-	3	-	3
5	3	2	1	1	3	-	-	-	-	-	-	-	3	-	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**II**	Course Categor: **PC**			End Semester Exam Type: **LE**			
Course Code	**U23MEP201**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MANUFACTURING AND METALLURGY LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
MECH								
Prerequisite	Basics of Mechanical Engineering							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Be conversant with the basic manufacturing processes.	**K3**
	CO2	Identify and apply suitable tools and instruments for machining, assembly and fitting	**K3**
	CO3	Use different moulding tools, patterns and prepare sand moulds	**K3**
	CO4	Select suitable welding for the given material and perform various operations.	**K3**
	CO5	Evaluate the effect of heat treatment on properties of steel and measure the hardness	**K3**

List of Experiments

Lathe

1. Study of Lathe machines and its operations
2. Plain Turning and Facing
3. Step Turning
4. Taper turning
5. Thread cutting
6. Drilling and boring

Foundry

7. Preparation of a sand mold using solid pattern

Welding

8. Preparation of butt joints and lap joints by using manual metal arc welding

Metallurgy Laboratory

9. Study of metallurgical microscope and sample preparation.
10. Preparation and study of the microstructure of copper and its alloys
11. Preparation and study of microstructure of aluminum and its alloys
12. Jominy End Quenching Test

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. Hajra Choudhury S.K., Hajra Choudhury A.K., Nirjhar Roy, “Elements of Workshop Technology - Vol. I”, 14th Edition, Media Promoters & Publishers Private Limited, Mumbai, 2008.
2. Hajra Choudhury S.K., Nirjhar Roy, “Elements of Workshop Technology-Volume-2”, 15th Edition, Media Promoters & Publishers Pvt Ltd, Mumbai, 2010.
3. R.C. Sharma, Principles of Heat Treatment of Steel.1 Edition, New Age International Publishers, 2018.
4. Vijendra Singh, heat treatment of metals. Standard Publishers, 2020.
5. K. Rajput, Manufacturing Processes, Lakshmi Publications, 2020.

Web References

1. http://www.nptelvideos.in/2012/12/manufacturing-processes-ii.html
2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=3804
3. https://www.tpctraining.com/collections/machine-shop-practices-training
4. https://www.rubig.com/en/heat-treatment/rubig-heat-treatment/
5. https://nptel.ac.in/courses/112/107/112107219/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	1	-	-	-	-	2	1	-	-	2	2	3
2	2	1	-	1	-	-	-	-	1	1	-	-	2	1	2
3	2	1	-	1	-	-	-	-	1	1	-	-	2	2	1
4	2	1	-	1	-	-	-	-	1	1	-	-	1	2	2
5	2	1	-	1	-	-	-	-	1	1	-	-	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**II**	Course Category: **AEC**			End Semester Exam Type: **-**			
Course Code	**U23MEC2XX**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**CERTIFICATION COURSE - II**	**0**	**0**	**4**	**-**	**100**	**-**	**100**

MECH

Students shall choose an International / Reputed organization certification course of 40-50 hours duration specified in the curriculum (It is mandatory to do a minimum of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation.

(i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks.

(ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as “pass” on satisfactory completion. A letter grade “P” is awarded to declare pass.

(iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.

Evaluation Methods

Assessment	**Continuous Assessment Marks (CAM)**		**Total Marks**
	Report	**MCQ Test**	
Marks	10	90	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**II**	Course Category: **MC**			End Semester Exam Type: -			
Course Code	**U23MEM202**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**SPORTS, YOGA AND NSS**	**0**	**0**	**2**	**Non-Credit**	**100**	**-**	**100**

(Common to all Branch)

Prerequisite	-	
Course Outcome	**On completion of the course, the students will be able**	BT Mapping (Highest Level)
	CO1 Practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility and relaxation.	**K2**
	CO2 Understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.	**K2**
	CO3 Develop understanding of psychological problems associated with age and lifestyle.	**K2**
	CO4 Recognize the importance of national service in community development.	**K2**
	CO5 Convert existing skills into socially relevant life skills.	**K2**

UNIT - I	**Introduction to Physical Education**	**Periods: 06**
Definition, Aims and Objectives of Physical Education - Changing trends in Physical Education **Physical Fitness, Wellness and Lifestyle:** Importance of Physical Fitness and Wellness - Components of Physical fitness - Components of Health related fitness - Components of wellness - Preventing Health Threats through Lifestyle Change - Concept of Positive Lifestyle.		**CO1**

UNIT - II	**Yoga and Lifestyle**	**Periods: 06**
Importance of Yoga - Elements of Yoga - Introduction - Asanas, Pranayama, Meditation and Yogic Kriyas - Yoga for concentration and related Asanas (Sukhasana, Tadasana, Padmasana and Shashankasana) - Relaxation Techniques for improving concentration - Yog-nidra. Asanas as preventive measures – Hypertension – Obesity - Back Pain-Diabetes - Asthema.		**CO2**

UNIT - III	**Training and Planning in Sports**	**Periods: 06**
Training - Warming up and limbering down-Skill, Technique and Style - Objectives of Planning – Tournament - Knock-Out, League/Round Robin and Combination. **Psychology and Sports** - Important of Psychology in Physical Education and Sports - Differentiate Between Growth and Development - Adolescent problems and their Management - Emotion: Concept, Type and Controlling of emotions - Concepts and Types of Aggressions in Sports - Psychological benefits of exercise - Anxiety and Fear and its effects on Sports Performance - Motivation, its type and techniques - Understanding Stress and Coping strategies		**CO3**

UNIT - IV	**Introduction To National Service Scheme**	**Periods: 06**
Orientation of NSS volunteers: History, motto, symbol, awards, structure and activities of NSS - Days of National and International Importance - Sensitizing about the thrust areas and awareness activities - Importance of tree plantation and voluntary blood donation - The role of SHGs and NGOs in community development – CSR - Life skills and youth development-extension activities in HEIs - various clubs and schemes like RRC, ELC, YRC, UBA, SBA, etc.,		**CO4**

UNIT - V	**Community Issues and the use of Technology**	**Periods: 06**
Common Problems of rural India - Technology development and its suitability – Sustainability - Value addition to agricultural products - Service learning and youth volunteering – Shramdaan - Campus cleaning - Field visit to nearby communities - village survey - Initiatives to clean and green environment - preservation of water bodies in adopted villages.		**CO5**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. Brar Ajmer Singh, Gill Jagtar Singh, Bains Jagdish, “Modern Textbook of Physical Education Health and Sports- I”, Kalyani Publishers, 6th Edition, 2014
2. B.K.S. Iyengar, “Light on Yoga: The Definitive Guide to Yoga Practice”, Thorsons Publishers, Thorsons Classics edition, 2015
3. Joseph, Siby K, Mahodaya, “Bharat Essays on Conflict Resolution”, Institute of Gandhian Studies Publishers, 2007
4. Barman Prateeti, Goswami, “Document on Peace Education”, Triveni Akansha Publishing House, New Delhi, 2009
5. Prof R.B.S. Verma, “Field Work Practicum in Social Work-Emerging Concerns”, Rapid Publisher, Lucknow, 2020
6. Sibereisen, K, Richard M, “Lerner Approaches to Positive Youth Development”, Sage Publications, New Delhi, 2007
7. Hoshiar Singh, “Administration of Rural Development in India”, Sterling Publisher, the University of Michigan, 2009

Web References	
1.	http://www.thebetterindia.com/140/national-service-scheme-nss
2.	http://en.wikipedia.org/wiki/national-service-scheme 19=http://nss.nic.in/adminstruct
3.	http://nss.nic. in
4.	http://socialworknss.org/about.html
5.	Young Journal on Youth published by SAGE: http://you.sagepub.com

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100

SEMESTER III

Department	**Mathematics**			Programme : **B.Tech.**			
Semester	**III**			Course Category: **BS**		End Semester Exam Type: **TE**	
Course Code	**U23MATC03**	Periods/Week			Credit	Maximum Marks	
		L	T	P	C	CAM	ESE	TM
Course Name	**PROBABILITY AND STATISTICS**	**3**	**1**	**0**	**4**	**25**	**75**	**100**

(Common to **ALL** Branches Except CSBS)

Prerequisite	Basic Mathematics	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Apply the concept of probability.	**K3**
	CO2 Solve the problem on Random variables.	**K3**
	CO3 Evaluate the correlation and Regression.	**K3**
	CO4 Find Correlation between variables.	**K3**
	CO5 Analyze the problems in small samples.	**K3**

UNIT - I	**Theory of Probability**	**Periods:12**
Random Experiments - Sample Space - Exhaustive events- Axioms of probability – Conditional probability – Total probability – Bayes theorem.		**CO1**
UNIT - II	**Random Variables**	**Periods:12**
Moments–Moment generating functions and their properties. Binomial distribution – Poisson distribution – Exponential distribution – Normal distribution (Excluding Derivation of Mean, Variance and MGF)		**CO2**
UNIT - III	**Design Of Experiments**	**Periods:12**
Analysis of variance: One way and two-way classifications. Correlation – Rank correlation and Regression.		**CO3**
UNIT - IV	**Large Samples**	**Periods:12**
Large Samples: Single Propositions – Difference of Proportions – Single Mean – Difference of Mean – Difference of Standard Deviations		**CO4**
UNIT - V	**Small Samples**	**Periods:12**
Test for Mean – Test for Ratio of Variances – Chi-Square test for Goodness of Fit and Independence of Attributes.		**CO5**

Lecture Periods:45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Text Books

1. B.S. Grewal, “Higher Engineering Mathematics”, Khanna publishers, 3rd Edition, 2017.
2. T. Veerarajan, “Probability, Statistics and Random Processes”, Tata McGraw-Hill, 3rd Edition, 2008.
3. A. Singaravelu, “Probability and Statistics”, Meenakshi Agency, 2019.

Reference Books

1. Ravish R. Singh, Mukul Bhatt “Engineering Mathematics”, McGraw-Hill, 1stEdition, 2017.
2. William Mendenhall, Robert J. Beaver and Barbara M. Beaver: “Introduction to Probability & Statistics”, Cengage Learning, 15thEdition, 2019.
3. Richard. A. Johnson, Irwin Miller and John E. Freund,” Probability and Statistics for Engineers”, Pearson Education, Asia, 9th Edition, 2018.
4. Vijay K. Rohatgi and A.K. Md. Ehsanes Saleh, “An Introduction to Probability and Statistics”, Wiley, 3rd Edition 2008.

Web References

1. www.stat110.net
2. http://www.nptel.ac.in/courses/111105035 (R.V)
3. http:// www.probabilitycourse.com.
4. www.edx.org/Probability
5. http://www2.aueb.gr/users/demos/pro-stat.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	1	1	1	1
2	3	2	1	1	-	-	-	-	-	-	-	1	1	1	1
3	2	2	-	-	-	1	-	-	-	-	-	1	1	1	1
4	3	2	1	1	-	1	-	-	-	-	-	1	1	1	1
5	3	2	1	1	-	1	-	-	-	-	-	1	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Artificial Intelligence and Data Science**	Programme : **B.Tech.**						
Semester	**III**	Course Category: **ES**			End Semester Exam Type: **TE**			
Course Code	**U23ADTC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**PROGRAMMING IN PYTHON**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

(Common to All Branches)

Prerequisite	-	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Interpret the basic concepts of Python programs.	**K2**
	CO2 Articulate the concepts of Sets, Dictionaries and Object-Oriented concepts.	**K2**
	CO3 Experiment with Numpy package.	**K3**
	CO4 Apply and analyze Data Manipulation with Pandas.	**K3**
	CO5 Illustrate programming concept for Visualization with Matplotlib.	**K3**

UNIT - I	**Introduction to Python**	**Periods: 09**
Structure of Python Program – Underlying mechanism of Module Execution – Branching and Looping – Problem Solving Using Branches and Loops – Functions – Lambda Functions – Lists and Mutability – Problem Solving Using Lists and Functions.		**CO1**

UNIT - II	**Sequence Datatypes and Object-Oriented Programming**	**Periods: 09**
Sequences – Mapping and Sets – Dictionaries. Classes: Classes and Instances – Inheritance – Exception Handling – Introduction to Regular Expressions using “re” module.		**CO2**

UNIT - III	**Using Numpy**	**Periods: 09**
Basics of NumPy – Computation on NumPy – Aggregations – Computation on Arrays – Comparisons – Masks and Boolean Arrays – Fancy Indexing – Sorting Arrays – Structured Data: NumPy’s Structured Array.		**CO3**

UNIT - IV	**Data Manipulation with Pandas**	**Periods: 09**
Introduction to Pandas Objects – Data indexing and Selection – Operating on Data in Pandas – Handling Missing Data – Hierarchical Indexing – Combining Data Sets. Aggregation and Grouping – Pivot Tables –Vectorized String Operations – Working with Time Series – High Performance Pandas – eval() and query().		**CO4**

UNIT - V	**Visualization With Matplotlib**	**Periods: 09**
Basic functions of Matplotlib – Simple Line Plot – Scatter Plot – Density and Contour Plots – Histograms – Binnings and Density – Customizing Plot Legends – Colour Bars – Three-Dimensional Plotting in Matplotlib.		**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Jake VanderPlas, “Python Data Science Handbook - Essential Tools for Working with Data”, O’Reily Media Inc, 2016.
2. Zhang.Y, “An Introduction to Python and Computer Programming”, Springer Publications, 2016.
3. Wesley J Chun, “Core Python Programming”, Pearson Education, 2nd Edition, 2006.

Reference Books

1. John Paul Mueller, Luca Massaron, “Python for Data Science for Dummies”, 2nd Edition, John Wiley& Sons, 2019.
2. Jesus Rogel-Salazar, “Data Science and Analytics with Python”, CRC Press Taylor and Francis Group, 2017.
3. Brian Draper, “Python Programming A Complete Guide for Beginners to Master and Become an Expert in Python Programming Language”, CreateSpace Independent Publishing Platform, 2016.
4. Mark Lutz, Laura Lewin, Frank Willison, “Programming Python”, O'Reilly Media, 3rd Edition, 2006.
5. Gowrishankar S, Veena A, “Introduction to Python Programming”, CRC Press, 2018.

Web References

1. https://nptel.ac.in/courses/106/106/106106212/
2. https://www.geeksforgeeks.org/data-analysis-visualization-python/
3. https://www.coursera.org/learn/python-data-analysis
4. https://www.python.org/
5. https://www.programiz.com/python-programming

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	3	-	3
2	2	2	1	3	-	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	-	-	-	-	-	-	-	2	3	2	3
4	3	3	2	3	-	-	-	-	-	-	-	3	3	3	3
5	3	3	2	3	-	-	-	-	-	-	-	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical**	Programme: **B.Tech.**						
Semester	**III**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MET303**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**APPLIED THERMODYNAMICS**	**2**	**1**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Physical Science for Engineers							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Execute the laws of thermodynamics in closed and open systems.	**K2**
	CO2	Apply the second law and exergy concepts in the thermodynamic devices.	**K3**
	CO3	Illustrate the phase change process and formation of pure substances.	**K3**
	CO4	Categorize the substance properties using ideal gas, real gas and thermodynamic relations.	**K3**
	CO5	Recognize the properties of air and psychrometric processes.	**K3**

UNIT- I	**First law of thermodynamics**	**Periods: 09**
Systems and control volume - properties of a system - state and equilibrium - quasi-static equilibrium - processes and cycles – pressure – temperature - Zeroth law of thermodynamics - work and heat transfer - First law of thermodynamics - Energy analysis of closed and open systems.		**CO1**
UNIT- II	**Second law of thermodynamics**	**Periods: 09**
Heat engines, heat pumps and refrigerators - Kelvin-Planck and Clausius statements and their equivalence - reversible and irreversible processes - Entropy - Inequality of Clausius – Exergy - availability and irreversibility.		**CO2**
UNIT- III	**Properties of pure substances**	**Periods: 09**
Phases of a pure substance - phase change process of pure substances - property diagrams for phase change processes - Steam - Formation of Steam – Thermodynamic Properties of Steam - Use of steam tables and mollier chart.		**CO3**
UNIT- IV	**Ideal and Real Gases and Thermodynamic Relations**	**Periods: 09**
Concept of Ideal and Real Gases and its Properties - Equation of State - Van der Waals Equation of State - Thermodynamic Relations – TdS Equations - Difference and ratio of Heat Capacities - Maxwell's Equations - Clausius-Clapeyron Equation – Joule-Kelvin Coefficient.		**CO4**
UNIT- V	**Psychrometry**	**Periods: 09**
Properties of Atmospheric Air - Psychrometric Chart – Psychrometric Processes - Sensible Heating – Sensible cooling – Cooling and dehumidification – heating – humidification – adiabatic mixing.		**CO5**

Lecture Periods: 30	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. P.K Nag, "Engineering Thermodynamics", 6th Edition, McGraw-Hill, New Delhi, 2018.
2. Y.Cengel and M.Boles, "Thermodynamics - An Engineering Approach", 9th Edition, McGraw Hill, 2019.
3. C.P.Arora, "Thermodynamics", 25th Reprint, McGraw-Hill, New Delhi, 2013.

Reference Books

1. C.Borgnakke, R.E. Sonntag, "Fundamentals of Thermodynamics, 10th Edition, John Wiley & Sons, Inc., 2019.
2. M.J.Moran, H.N.Shapiro, D.D.Boettner and M.B. Bailey., "Fundamentals of Engineering Thermodynamics, 9th Edition, John Wiley & Sons, Inc., 2018.
3. E.Rathakrishnan, "Fundamentals of Engineering Thermodynamics", 2nd Edition, 10th Reprint, Prentice- Hall of India Pvt. Ltd, 2013.
4. R.K.Rajput, "A Textbook of Engineering Thermodynamics, Laxmi Publications (P) Ltd, 6th Edition, 2023.
5. S.K.Gupta, "Engineering Thermodynamics", Chand and Company Pvt. Ltd., New Delhi, 2013.

Web References

1. https://archive.nptel.ac.in/courses/112/105/112105266/
2. https://archive.nptel.ac.in/courses/112/106/112106310/
3. https://archive.nptel.ac.in/courses/101/104/101104063/
4. https://archive.nptel.ac.in/courses/112/103/112103307/
5. https://web.mit.edu/16.unified/www/FALL/thermodynamics/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	2	2	2	-	-	-	-	2	3	2	1
2	3	3	3	2	2	2	2	1	-	-	-	2	3	2	2
3	3	2	2	2	2	2	2	-	-	-	-	2	3	2	1
4	3	3	2	3	1	1	1	-	-	-	-	2	3	1	1
5	3	2	3	2	2	2	3	1	-	-	-	2	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical**	Programme : **B.Tech.**						
Semester	**III**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MET304**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**FLUID MECHANICS AND HYDRAULIC MACHINES**	**2**	**1**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Fundamentals of Physics							

Course Outcome			BT Mapping (Highest Level)
	On completion of the course, the students will be able to		
	CO1	Demonstrate the significance of fluid properties and laws of fluid statics to engineering systems	**K2**
	CO2	Apply the momentum and energy equations to fluid flow problems.	**K3**
	CO3	Analyze the viscous flow through pipes and determine various losses.	**K4**
	CO4	Apply impulse momentum principle to calculate power required / developed by hydraulic machines.	**K3**
	CO5	Analyze the performance of hydraulic pumps.	**K4**

UNIT - I	**Fluid Properties and Fluid Statics**	**Periods: 09**	
Properties of fluids: Fluid density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension and capillarity. Fluid statics: Pascal's Law, Pressure Variation in a Fluid at Rest, Absolute Pressure, Gauge Pressure, Atmospheric Pressure, Vacuum Pressures, Manometer, Hydrostatic Forces, Buoyancy, Floatation, Metacenter.			**CO1**
UNIT - II	**Fluid Kinematics and Fluid Dynamics**	**Periods: 09**	
Flow characteristics, concept of control volume, application of continuity equation, energy equation and momentum equation. Euler's Equation of Motion along a Streamline Bernoulli's equation, applications, Venturi meter, Orifice meter, Pitot tube, Navier Stokes Equation, Boundary layer separation.			**CO2**
UNIT - III	**Incompressible Fluids and Flow Through Pipes**	**Periods: 09**	
Viscous flow, laminar flow between parallel plates, Reynolds experiment to classify laminar and turbulent flows, significance of Reynolds number, critical Reynolds number, Darcy - Weisbach equation, Major and minor energy losses, head loss due to friction, flow through pipes in series and in parallel, Selection criteria for pipes and pipe sizes.			**CO3**
UNIT - IV	**Impact of Jet and Hydraulic Turbines**	**Periods: 09**	
Principles of Turbo Machinery: Fluid Machines, Classification, Introduction to Impact of jet Stationary plates, Moving Plates and Vanes, Construction of Velocity Vector Diagram, Unit and Specific Quantities. Classification of hydraulic turbines, Pelton wheel, Francis turbine and Kaplan turbines, Specific speed, Theory of draft tube, Governing of turbine, Performance characteristics of turbines.			**CO4**
UNIT - V	**Hydraulic Pumps**	**Periods: 09**	
Classification, Centrifugal Pump, Velocity Triangle, Estimation of Power Required and efficiency, characteristics curve of Centrifugal Pump, Cavitation in Pump. Reciprocating Pump, Air Vessels, Estimation of Power Required, Percentage Slip and Efficiency, Cavitation, Working principles of gear and vane pumps. Industrial pump applications.			**CO5**

Lecture Periods: 30	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. R.K.Bansal, "Fluid Mechanics and Hydraulics Machines", Laxmi publications (P) Ltd., New Delhi, 11th Edition, 2023.
2. V.L, Streeter and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 9th Edition, 2010.
3. K.L.Kumar, "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, 8th Edition, 2009.

Reference Books

1. S.S.Rattan - Fluid Mechanics and Hydraulic Machines- Khanna Publishers, 2019
2. Mahesh, Fluid Mechanics and Hydraulic Machines, Pearson India, 2019.
3. Yunus Çengel, John M. Cimbala - Fluid Mechanics Fundamentals and Applications-Mc Graw Hill, 4th Edition, 2017
4. F.M.White, "Fluid Mechanics", Tata McGraw-Hill, New Delhi, 8th Edition, 2016.
5. P.N.Modi and S.M.Seth "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 20th Edition, 2015.

Web References

1. https://nptel.ac.in/courses/112/104/112104117/

2.	https://nptel.ac.in/courses/112104118/
3.	http://fm-nitk.vlabs.ac.in
4.	https://www.coursera.org/courses?query=fluid%20mechanics
5.	https://apm.iitm.ac.in/fluid_mechanics.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	-	1	-	1	-	-	-	1	1	2	1
2	3	2	1	2	-	1	-	1	-	-	-	1	1	2	2
3	3	2	1	1	-	1	-	1	-	-	-	1	2	2	2
4	3	3	2	2	2	3	-	1	1	-	1	2	2	3	3
5	3	3	2	2	2	3	-	1	1	-	2	2	2	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**III**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MET305**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	CAM	ESE	TM
Course Name	**MANUFACTURING PROCESSES**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Basics of Mechanical Engineering							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Expertise in a variety of casting and molding practices.	**K2**
	CO2 Apply variety of joining techniques in real life.	**K3**
	CO3 Exhibit the knowledge of different drilling techniques.	**K2**
	CO4 Recognize the extrusion, rolling, and forging processes.	**K2**
	CO5 Understand in plastic manufacturing and surface finishing process	**K2**

UNIT- I	**Casting Processes**	**Periods: 09**
Introduction to Molding and Casting. Pattern making: Pattern materials, types of patterns and Pattern allowances. Molding sand: properties - ingredients - Preparation of green sand and dry molding process - Defects in casting and remedies.		**CO1**
UNIT- II	**Joining Processes**	**Periods: 09**
Fusion welding processes - Electric Arc Welding – Electrodes - Manual metal arc welding, Carbon Arc Welding, Inert - Gas Shielded Arc Welding, Tungsten Inert - Gas Welding, Gas Metal - Arc Welding , Submerged Arc - Welding, Resistance Welding and its types and - applications - Welding Defects.		**CO2**
UNIT - III	**Drilling and Allied Operations**	**Periods: 09**
Drilling Machines – Classification – Sensitive, Upright, Gang and Radial drilling machine – Specifications - Tool mounting devices – Various Operations – Reaming and Tapping Tool – Cutting speed, Feed and depth of cut.		**CO3**
UNIT - IV	**Bulk Deformation Processes**	**Periods: 09**
Hot working and Cold working of metals - Forging machines – Press forging, Drop forging, Open and closed die forging, Roll and Rotary forging. Rolling of metals - Types of rolling mills - Defects in rolled parts - Principles of extrusion - Types of Extrusion - hot and cold extrusion.		**CO4**
UNIT - V	**Surface Finishing and Plastic Manufacturing**	**Periods: 09**
Surface finishing processes – Honing, Lapping, Polishing, Buffing - Plastics and polymers – structure of polymers – additives in plastics - thermoplastics and thermosetting plastics – different moulding methods - industrial applications of plastics.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. R.K. Rajput “Text Book of Manufacturing Technology” Laxmi Publications, Second edition, 2020.
2. P.N.Rao, “Manufacturing Technology, Volume I & II”, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition, 2018.
3. S.Kalpakjian and R.Schmid, “Manufacturing Processes for Engineering Materials”, Pearson Education India Edition, 2018.

Reference Books

1. S.K. Sharma, Savita Sharma, “Manufacturing Processes”, Wiley publisher, 2022.
2. N Khurmi, R.S Khurmi, “Workshop Technology: Manufacturing Processes” S Chand & Company; 16th edition, 2021.
3. B.S. Raghuwanshi, “Manufacturing Processes”, Dhanpat Rai & Co. (P) Ltd, January 2020.
4. PC Sharma, “Manufacturing Technology - 1 Technology”, S Chand & Company, Sixteenth Edition, 2014.
5. R.K.Mittal and B.S. Nagendra Parashar, “Elements of Manufacturing Processes”, Prentice Hall India Pvt. Ltd., 2011.

Web References

1. https://nptel.ac.in/courses/112/107/112107219/#
2. https://www.sciencedirect.com/topics/engineering/manufacturing-process
3. https://www.coursera.org/courses?query=manufacturing%20process
4. https://www.edx.org/course/fundamentals-of-manufacturing-processes
5. https://onlinecourses.nptel.ac.in/noc19_me20/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	-	2	1	1	2	-	-	2	2	1	2
2	3	2	2	-	-	2	1	1	2	-	-	2	2	1	2
3	3	2	2	-	-	2	1	1	2	-	-	2	2	1	2
4	3	2	2	-	-	2	1	1	2	-	-	2	2	1	2
5	3	2	2	-	-	2	1	1	2	-	-	2	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**III**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MEB301**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**STRENGTH OF MATERIALS**	**2**	**0**	**2**	**3**	**50**	**50**	**100**
MECH								
Prerequisite	Engineering Mechanics							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Understand the concepts of stress and strain in simple and compound bars	**K2**
	CO2	Comprehend the load transferring mechanism in beams and stress distribution due to shearing force and bending moment	**K2**
	CO3	Calculate the slope and deflection in beams and buckling failure in columns.	**K2**
	CO4	Develop the theoretical understanding of the mechanical properties of materials	**K3**
	CO5	Measure the various mechanical properties such as tensile and compressive strength, impact strength, torsion strength and hardness of materials.	**K3**

UNIT- I	**Stresses and Strains**	**Periods: 10**
Introduction , Definition and concept and of stress and strain, Elastic constant, Hook's law- Factor of safety- stresses and strain in uniformly varying sections- stresses in composite bar- Relation between the modulus and Poisson's ratio.		**CO1**
UNIT- II	**Beams and Simple Bending**	**Periods: 10**
Introduction to types of beams, supports and loadings. Definition of bending moment and shear force Cantilever, Simply supported: Shear Force and Bending Moment Diagrams (Point load and uniformily distributed load). Theory of simple bending – Bending stress in beams.		**CO2**
UNIT- III	**Deflection of Beams and Columns**	**Periods: 10**
Deflection of beams: Cantilever and simply supported beam by Double integration method (only) for computation of slopes and deflections. Theory of columns – Long column and short column - Euler's formula – Rankine's formula. Deformation of Thin and thick cylinders.		**CO3**
UNIT- IV	**Strength of Materials Practice I**	**Periods:15**
1. To study the universal testing machine. 2. Tension test 3. Torsion test 4. Compression test 5. Impact test on a metallic specimen - Izod test 6. Impact test on a metallic specimen - Charpy test 7. To study the various hardness testing machine.		**CO4**
UNIT- V	**Strength of Materials Practice II**	**Periods:15**
8. Hardness test on metallic specimen - (Brinell) 9. Hardness test on metallic specimen (Rockwell) 10. Hardness test on metallic specimen (Vicker's hardness) 11. Ductility test: Sheet metals (Al, GI and MS) 12. Spring test –Tension 13. Spring test - Compression		**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 60**

Text Books

1. R.K. Bansal, "Strength of Materials", Laxmi Publications, 6th edition 2019.
2. D.S. Bedi, "Strength of Materials", Khanna Publishing, 6th edition 2019.
3. R.K. Rajput, "Strength of Materials", S. Chand Publications, 7th edition 2018.

Reference Books

1. Punmia, Jain and Jain, "Mechanics of Materials" , Laxmi Publications .2019
2. R.C.Hibbeler, "Mechanics of Materials", Pearson Education, 9th Edition, 2018
3. U.C.Jindal., "Strength of Materials", Asian Books Pvt. Ltd., 2nd edition New Delhi, 2018.
4. S.S. Rattan " Strength of Materials" McGraw Hill Education (India) Pvt. Ltd., 3rd Edition, 2016
5. Egor. P.Popov "Mechanics of Materials" Pearson Education, 2nd Edition, 2016.
6. C.Ravichawla ,Kukreja, K.Kishore, Material Testing Laboratory, by standard publishers, 2016

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1.	https://nptel.ac.in/courses/112107146/#
2.	https://nptel.ac.in/courses/112/102/112102284/
3.	https://www.iitk.ac.in/me/research/specialization-areas/solid-mechanics-and-design/mechanics-of-solids
4.	http://www.facweb.iitkgp.ac.in/~jeevanjyoti/teaching/mechsolids/2019/
5.	https://www.coursera.org/courses?query=mechanics%20of%20materials
6.	https://virtlabs.tech/strength-of-materials

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	1	-	-	-	-	-	1	2	2	1
2	3	2	2	2	1	1	-	-	-	-	-	1	2	2	1
3	3	2	2	2	1	1	-	-	-	-	-	1	2	2	1
4	3	2	1	2	1	-	-	2	2	1	-	1	2	2	1
5	3	2	1	2	1	-	-	2	2	1	-	1	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment method for theory cum practical courses

Assessment	Continuous Assessment Marks (CAM)									End Semester Examination (ESE) Marks (Practical – Internal Evaluation)	End Semester Examination (ESE) Marks (Theory)	Total Marks
	Continuous ssessment (Theory)					Continuous ssessment (Practical)						
	CAT 1	CAT 2	Model	Attendance	Total	Conduction of Practical	Report	Viva	Total			
Marks	5	5	5	5	20*	15	10	5	30*	30	75**	-
*To be weighted for 10 Marks					10	*To be weighted for 10 Marks			10		*To be weighted for 50 Marks	100

Department	**English**	Programme: **B.Tech.**						
Semester	**III**	Course Category Code: **HS**			*End Semester Exam Type:**LE**			
Course Code	**U23ENPC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**GENERAL PROFICIENCY- I**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

(Common to ALL Branches except CSBS)

Prerequisite	Basics of English Language	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Interpret meaning and apply reading strategies in technical and non-technical context	**K3**
	CO2 Develop interpersonal communication skills professionally	**K4**
	CO3 Demonstrate various forms of formal writing	**K3**
	CO4 Decode graphical data coherently	**K2**
	CO5 Apply the techniques of verbal aptitude in competitive exams	**K3**

UNIT- I	**Comprehension Analysis**	**Periods: 06**
Listening: Dialogue based on social contexts (IELTS based) - Speaking: Break the iceberg (IELTS based) Submitting Video Recording - Reading: Reading technical passage (IELTS based) - Writing: Writing Task: 2 (IELTS Academic) - Vocabulary: Synonyms (IELTS)		**CO1**
UNIT- II	**Personality Development**	**Periods: 06**
Listening: Monologue about the everyday social issues (IELTS based) - Interview Videos - Speaking: Speak about the topic in the Flash Card (IELTS based) - Reading: British & American Vocabulary - Writing: SWOT Analysis - Vocabulary: Idioms and Phrases (IELTS)		**CO2**
UNIT- III	**Inferential Learning**	**Periods: 06**
Listening: Conversation between 4 people regarding education (IELTS based), Anecdotes - Speaking: Structure Discussion (IELTS based) - Reading: Distinguish between facts & opinions (IELTS based), - Writing: Writing Conversation to different context - Vocabulary: Phrasal Verbs (IELTS)		**CO3**
UNIT- IV	**Interpretation and Functional Writing**	**Periods: 06**
Listening: Monologue on an academic subject (IELTS based), Group Discussion videos - Speaking: Group Discussion Practice - Reading: Read and review (Books, Magazines) - Writing: Writing Task 1: (IELTS Academic: Graph/ chart/tables description) - Vocabulary: Collocations (IELTS)		**CO4**
UNIT-V	**Verbal Aptitude - I**	**Periods: 06**
Language Enhancement: Articles, Preposition, Conjunction **Verbal Ability Enhancement:** Ordering of sentences, Blood Relation, Completing Statements- Cloze test, Spotting Errors - Sentence Improvement, Word Analogy, Word Groups (GATE)		**CO5**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods:30**	**Total Periods:30**

Reference Books

1. Lewis, Norman, “Word Power Made Easy”.Goyal Publishers and Distributors Pvt.Ltd., Latest Edition, 2020.
2. Patterson,Kerry, Joseph Grenny,Ron McMillan, Al Switzler, “Crucial Conversation Tools for talking when Stakes are High”, Kindle Publication,2nd Edition, 2011.
3. Comfort, Jeremy, et.al. “Speaking Effectively: Developing Speaking Skills for Business English”, Cambridge University Press, Cambridge: Reprint 2011.
4. Agarwal, R. S. “A Modern Approach to Verbal & Non Verbal Reasoning”. S. Chand, 2010.
5. Wren, Percival Christopher, and Wren Martin. “High School English Grammar and Composition”. S Chand, 2005.

Web References

1. https://www.ielts-exam.net/grammar/
2. https://ieltsfocus.com/2017/08/02/collocations-ielts/
3. https://www.fresherslive.com/online-test/blood-relations-questions-and-answers
4. https://www.toppr.com/guides/english-language/reading-comprehension/cloze-test/
5. https://www.examsbook.com/word-analogy-test-questions-with-answers

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	1	-	3	-	2	1	1	1
2	1	-	-	-	-	-	-	1	-	3	-	2	1	1	1
3	1	-	-	-	-	-	-	1	-	3	-	2	1	1	1
4	1	-	-	-	-	-	-	1	-	3	-	2	1	1	1
5	1	-	-	-	-	-	-	1	-	3	-	2	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Practical				
Continuous Assessment Internal Evaluation		**End Semester External Evaluation**		**Total Marks**
50 marks		**50 marks**		100
Conduction of Practical (Assignment 1&2 -10 Marks Performance in practical classes - 5 Marks)	15	Listening (L)	20	
Record	5	Speaking(S)	10	
Viva	5	Reading(R)	10	
Model Practical Examination (Model Exam is conducted for 50 Marks that will be converted to 15 Marks)	15	Writing(W)	10	
Attendance	10			

Department	**Mathematics**	Programme: **B.Tech.**						
Semester	**III**	Course Category: **BS**			End Semester Exam Type: **LE**			
Course Code	**U23MAPC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ENGINEERING MATHEMATICS LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

(Common to all Branches Except CSBS)

Prerequisite	Matrices, Fourier Transforms, Laplace Transforms	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Perform and evaluate Matrix Operations	**K3**
	CO2 Solve Differential and Integral Equations	**K3**
	CO3 Construct Fourier series and Fourier Transforms of the given function	**K3**
	CO4 Find the Measures of Central tendency	**K3**
	CO5 Analyze Correlation and Regression lines	**K3**

List of Experiments

1. Find the Inverse, Rank, Eigen values and Eigen Vectors of the matrix.
2. Solve the first order differential equation.
3. Find the integration of $\int_a^b f(x)dx$.
4. Find the Fourier series of f(x).
5. Find the Fourier Transform of f(x).
6. Find the Laplace Transform of f(x).
7. Find the Mean, Median and Mode.
8. Construct the Pie and Bar Diagram.
9. Find the Correlation coefficient.
10. Find the Regression lines.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. T. Veerarajan, “Engineering Mathematics, Tata McGraw Hill Education (India) Private Limited Chennai 2nd Edition Paperback – 1 January 2018.
2. M.K. Venkataraman, “Engineering Mathematics, The National Publishing Company, Madras, 2016.
3. Dr. A. Singaravelu, “Probability and Statistics”, Meenakshi Agency, Paperback – 1, 2019.

Web References

1. https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf
2. https://www.nrigroupindia.com/niist/wp-content/uploads/sites/6/2022/02/lab-manual-it406matlab.pdf
3. https://www.studocu.com/row/document/comsats-university-islamabad/signals-and-systems/lab-lab-manual/38332410

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	-	1	-	-	-	-	-	1	1	-	-
2	3	2	1	1	-	1	-	-	-	-	-	1	1	-	-
3	2	1	-	-	-	1	-	-	-	-	-	1	1	-	1
4	2	1	-	-	-	1	-	-	-	-	-	1	1	-	-
5	3	2	1	1	-	1	-	-	-	-	-	1	1	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Artificial Intelligence and Data Science**	Programme: **B.Tech.**						
Semester	**III**	Course Category: **ES**			End Semester Exam Type: **LE**			
Course Code	**U23ADPC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**PROGRAMMING IN PYTHON LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

(Common to all Branches)

Prerequisite	Nil	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Describe common Python functionality and features used for data science.	**K2**
	CO2 Query Data Frame structures for cleaning and processing.	**K2**
	CO3 Configure your programming environment	**K3**
	CO4 Experiment the concept using data visualization.	**K3**
	CO5 Analyze real time datasets,	**K3**

List of Experiments

1. Build a python program to implement Fibonacci series.
2. Build a python program to get a range of numbers from user and to separate even numbers and odd numbers respectively.
3. Build a function in Python to check duplicate letters. It must accept a string, i.e., a sentence. The function should return True if the sentence has any word with duplicate letters, else return False.
4. Build a program to perform arithmetic operations using lambda function.
5. Build a Python program that takes a list of numbers as input and returns a new list containing only the even numbers from the input list.
6. Build a python program to create a class called Car with attributes Company, model, and year. Implement a method that returns the age of the car in years.
7. Build a python program to create a base class called Shape that has a method called area which returns the area of the shape (set it to 0 for now). Then, create two derived classes Rectangle and Circle that inherit from the Shape class to calculate the area of derived classes.
8. Build a python program to implement aggregation using Numpy.
9. Build a python program to perform Indexing and Sorting.
10. Build a python program to perform Handling of missing data.
11. Build a python program to perform usage of Pivot table using Titanic datasets
12. Build a python program to perform use of eval () and query ()
13. Build a python program to perform Scatter Plot
14. Build a python program to perform 3D plotting
15. Implement an application to process a real time data.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. Chirag Shah, “A Hands-On Introduction to Data Science”, Cambridge University Press, 2020.
2. Siddhartha Chatterjee, Michal Krystyanczuk, “Python Social Media Analytics”, Packt Publishing, 2017.
3. Jake VanderPlas, “Python Data Science Handbook - Essential Tools for Working with Data”, O’Reily Media Inc, 2016.
4. Zhang.Y, “An Introduction to Python and Computer Programming”, Springer Publications, 2016.
5. Wesley J Chun, “Core Python Programming”, Pearson Education, 2nd Edition, 2006.

Web References

1. https://nptel.ac.in/courses/106/106/106106212/
2. https://www.geeksforgeeks.org/data-analysis-visualization-python/
3. https://www.coursera.org/learn/python-data-analysis
4. https://www.python.org/
5. https://www.programiz.com/python-programming

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	1	3	-	-	-	-	-	-	-	2	2	2
2	2	3	2	2	3	-	-	-	-	-	-	-	2	3	2
3	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**III**	Course Category: **PC**			End Semester Exam Type: **LE**			
Course Code	**U23MEP302**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MANUFACTURING PROCESSES LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

Prerequisite	Manufacturing Processes	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Know the various basic Manufacturing processes used in industry for converting raw materials into finished products.	**K3**
	CO2 Demonstrate the various operation of the drilling machines	**K2**
	CO3 Acquire knowledge about the various tools and equipment in Tool and Cutter machine	**K3**
	CO4 Perform the various machining operations.	**K3**
	CO5 Analyze the properties of molding sands, prepare pattern and mold cavity using sand casting.	**K4**

List of Experiments

Drilling Machine:

1. Study of drilling machine.
2. Drilling and Tapping.
3. Drilling and Boring.
4. Drilling and Reaming.

Grinding Machine:

5. Study of grinding machine
6. Plain Surface grinding.
7. Cylindrical grinding.

Shaping Machine:

8. Study of shaping machine
9. Square head shaping
10. Hexagonal head shaping

Tool and Cutter machine:

11. Study of Tool and Cutter machine
12. Tool grinding - Single point cutting tool.
13. V tool grinding.

Foundry

14. Preparation of a sand mold using split pattern

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. Hajra Choudhury S.K., Hajra Choudhury A.K., Nirjhar Roy, “Elements of Workshop Technology - Vol. I”, 16th Edition, Media Promoters & Publishers Private Limited, Mumbai, 2023.
2. B.S. Raghuwanshi, “Manufacturing Processes”, Dhanpat Rai & Co. (P) Ltd, January 2020
3. Hajra Choudhury S.K., Nirjhar Roy, “Elements of Workshop Technology - Volume - 2”, 15th Edition, Media Promoters & Publishers Pvt Ltd, Mumbai, 2016.
4. N Khurmi, R.S Khurmi, “Workshop Technology: Manufacturing Processes” S Chand & Company; 16th edition, 2021.
5. R.K. Rajput, Manufacturing Processes, Lakshmi Publications, 2020.

Web References

1. https://nptel.ac.in/courses/112105127
2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=3804
3. https://www.tpctraining.com/collections/machine-shop-practices-training
4. https://www.youtube.com/watch?v=v7IFSKXPmBs
5. https://nptel.ac.in/courses/112/107/112107219/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	3	-	-	-	3	3	-	-	3	1	2
2	2	-	-	-	3	-	-	-	3	3	-	-	3	1	2
3	2	-	-	-	3	-	-	-	3	3	-	-	3	1	2
4	2	-	-	-	3	-	-	-	3	3	-	-	3	1	2
5	2	-	-	-	3	-	-	-	3	3	-	-	3	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**					
Semester	**III**	Course Category: **PC**			End Semester Exam Type: **LE**		
Course Code	**U23MEP303**	Periods/Week			Credit	Maximum Marks	
		L	T	P	C	CAM	ESE	TM
Course Name	**FLUID MECHANICS AND HYDRAULIC MACHINES LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
MECH								
Prerequisite	-							

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Analyse and Interpret fluid flow parameters by conducting experiments on venture and orifice experimental setups.	**K3**
	CO2 Perform the variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.	**K2**
	CO3 Analyse the performance characteristic of various types of turbines.	**K3**
	CO4 Estimate the performance parameters of a given Centrifugal and Reciprocating pump.	**K3**
	CO5 Conduct and analyze an appropriate turbine with reference to given situation in power plants.	**K3**

List of Experiments

1. Determination of the coefficient of discharge of given Orifice meter.
2. Determination of the coefficient of discharge of given Venturi meter.
3. Estimation of major losses in pipe fittings.
4. Estimation of minor losses in pipe fittings.
5. Conducting experiments and drawing the characteristics curves of centrifugal pump.
6. Conducting experiments and drawing the characteristics curves of submersible pump.
7. Conducting experiments and drawing the characteristics curves of jet pump.
8. Conducting experiments and drawing the characteristics curves of Multi Stage Centrifugal Pump.
9. Conducting experiments and drawing the characteristics curves of reciprocating pump.
10. Conducting experiments and drawing the characteristics curves of Gear pump.
11. Conducting experiments and drawing the characteristics curves of Pelton wheel.
12. Conducting experiments and drawing the characteristics curves of Francis turbine.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. CWR, Hydraulics Laboratory Manual,2004
2. N. Kumarasamy, Fluid Mechanics and Machinery laboratory manual, Charotar Publishing House Pvt. Ltd. 2008.
3. White, F.M., “Fluid Mechanics”, Tata McGraw-Hill, New Delhi, 8th Edition, 2016
4. Som S K, Gautam Biswas, Chakraborty S, Introduction to Fluid Mechanics and Fluid Machines, McGraw Hill, 2017.
5. R.K.Bansal, “Fluid Mechanics and Hydraulics Machines”, Laxmi publications (P) Ltd., New Delhi, 11th Edition, 2023

Web References

1. http://fmc-nitk.vlabs.ac.in.
2. https://nptel.ac.in/courses/112/103/112103290/
3. https://apm.iitm.ac.in/fluid_mechanics.html
4. https://virtlabs.tech/fluid mechanics/
5. https://www.iitk.ac.in/me/fluid-mechanics-laboratory.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	1	-	-	-	1	-	-	-	1	1	2	1
2	3	2	-	2	-	-	-	1	-	-	-	1	1	2	2
3	3	1	-	2	-	-	-	1	-	-	-	2	2	2	2
4	3	2	-	2	3	1	-	1	-	-	-	1	2	3	3
5	3	2	-	3	3	2	-	1	-	-	-	2	2	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**III**	Course Category: **AEC**			End Semester Exam Type: **-**			
Course Code	**U23MEC3XX**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**CERTIFICATION COURSE - III**	**0**	**0**	**4**	**-**	**100**	**-**	**100**

MECH

Students shall choose an International / Reputed organization certification course of 40-50 hours duration specified in the curriculum (It is mandatory to do a minimum of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation.

(i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks.

(ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as “pass” on satisfactory completion. A letter grade “P” is awarded to declare pass.

(iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.

Evaluation Methods

Assessment	**Continuous Assessment Marks (CAM)**		**Total Marks**
	Report	**MCQ Test**	
Marks	10	90	100

Department	**Mechanical**	Programme: **B.Tech.**						
Semester	**III**	Course Category: **AEC**				End Semester Exam Type:**-**		
Course Code	**U23MES301**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**SKILL ENHANCEMENT COURSE - I**	**0**	**0**	**2**	**-**	**100**	**-**	**100**

MECH

TWO WHEELER TROUBLESHOOTING

The main objective of this programme is to build students familiar with the Workshop situation and as well as to afford the opportunities to know about the basics of the two wheeler servicing workshop and its environment to make qualified and skilled man power for the two wheeler service sector. And also to create an opportunity for the students to have practical knowledge and to increase their employability. The course has the detailed explanation on the classification of two wheelers, working principles, its components functions. To make the students familiarize with the procedure of troubleshooting of two wheelers with both theoretical and practical approach.

Lecture Periods:30	**Tutorial Periods: -**	**Practical Periods:**	**Total Periods: 30**

Web References

1. https://www.bajajauto.com.np/english/riders/how-to/troubleshooting/
2. https://www.cyclepedia.com/four-stroke-motorcycle-troubleshooting-guide/
3. https://www.tavernermotorsports.com.au/troubleshooting-10-common-moorcycle-problems/

Evaluation Methods

Assessment	**Continuous Assessment Marks (CAM)**			**Total Marks**
	Attendance	**Report**	**Presentation/Demo/ Skill Test**	
Marks	10	40	50	100

Department	**Mechanical**	Programme: **B.Tech.**						
Semester	**III**	Course Category: **MC**				*End Semester Exam Type: **-**		
Course Code	**U23MEM303**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**CLIMATE CHANGE**	**2**	**0**	**0**	**-**	**100**	**-**	**100**

MECH

Prerequisite	-	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Inspect the characteristics and Temperature profile of the atmosphere	**K2**
	CO2 Analyze past climate, human influence on global warming, and predict future climates	**K3**
	CO3 Analyze the impact of climate change and the risk of Irreversible Changes	**K3**
	CO4 Outline the carbon credits and evidences of changes in Environment	**K2**
	CO5 Acquire knowledge on clean development mechanism and mitigation technologies	**K2**

UNIT- I	**Atmosphere and its Components**	**Periods:06**
Importance of Atmosphere-Physical Chemical Characteristics of Atmosphere- Vertical structure of the atmosphere-Composition of the atmosphere-Atmospheric stability-Temperature profile of the atmosphere-Lapse rates-Temperature inversion-effects of inversion on pollution dispersion.		**CO1**
UNIT- II	**Global Climate**	**Periods:06**
Account of past climate- Environmental indicators and instrumental records – Human Footprints on global warming- Predicting future climates- Temperature regime – Extreme climate events.		**CO2**
UNIT- III	**Impacts of Climate Change**	**Periods:06**
Causes of Climate change : Change of Temperature in the environment-Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions- Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.		**CO3**
UNIT- IV	**Observed Changes and its Causes**	**Periods:06**
Climate change and Carbon credits- Initiatives in India-Kyoto Protocol-Intergovernmental Panel on Climate change- Climate Sensitivity and Feedbacks -The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India.		**CO4**
UNIT-V	**Climate Change and Mitigation Measures**	**Periods:06**
Clean Development Mechanism - Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels --- Mitigation Efforts in India and Adaptation funding. Key Mitigation Technologies and Practices- Carbon sequestration – Carbon capture and storage (CCS)- International and Regional cooperation- Remedial measures.		**CO5**

Lecture Periods: 30	**Tutorial Periods:-**	**Practical Periods:-**	**TotalPeriods:30**

Textbooks

1. Joan Fitzgerald, “Greenovation: Urban Leadership on Climate Change”, Oxford University Press, 2020.
2. J. David Neelin, “Climate change and climate modelling”, Cambridge University press, 2011.
3. Robin Moilveen, “Fundamentals of weather and climate”, Oxford University Press, 2nd Edition, 2010.
4. Andrew Dessler and Edward A. Parson, “The Science and Politics of Global Climate Change”, Cambridge University press, 3rd Edition, 2019.
5. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007.

Reference Books

1. Bill McKibben, “The Global Warming Reader: A Century of writing about Climate Change”, Penguin, 2012.
2. Jason Smerdon, “Climate Change: The Science of Global Warming and our Energy Future”, Columbia University, 2009
3. Adaptation and mitigation of climate change-Scientific Technical Analysis, Cambridge University Press, 2006.
4. J.M. Wallace and P.V. Hobbs, “Atmospheric Science”, Elsevier/ Academic Press, 2006.
5. Jan C. van Dam, Impacts of “Climate Change and Climate Variability on Hydrological Regimes”, Cambridge University Press, 2003.

Web References

1. https://nptel.ac.in/courses/105102089/
2. https://www.warmheartworldwide
3. https://nptel.ac.in/content/storage

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	-	3	3	-	-	-	-	2	1	1	1
2	3	3	2	2	-	3	3	-	-	-	-	2	1	1	1
3	3	3	2	2	-	3	3	-	-	-	-	2	1	1	1
4	3	3	2	2	-	3	3	-	-	-	-	2	1	1	1
5	3	3	2	2	-	3	3	-	-	-	-	2	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100

SEMESTER IV

Department	**Mathematics**	Programme : **B.Tech.**						
Semester	**IV**	Course Category: **BS**			End Semester Exam Type: **TE**			
Course Code	**U23MATC04**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**NUMERICAL METHODS AND OPTIMIZATION**	**3**	**1**	**0**	**4**	**25**	**75**	**100**

(Common to EEE, ECE, ICE, BME, MECH, CIVIL & MECHATRONICS)

Prerequisite	Basic Mathematics	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Solve Algebraic and Transcendental equations	**K3**
	CO2 Solve Simultaneous Equations by various Numerical Techniques.	**K3**
	CO3 Apply the Numerical Techniques of interpolation in various Intervals.	**K3**
	CO4 Solve Linear programming problems by using Optimization Techniques.	**K3**
	CO5 Find the solution of Transportation and Assignment Problems.	**K3**

UNIT - I	**Solution of Algebraic and Transcendental Equations and Eigen Value Problems**	**Periods: 12**
Solution of Algebraic and Transcendental equations – Bisection method - Method of False position – Newton Raphson method – Eigen value and Eigen vector by Power method.		**CO1**
UNIT - II	**Linear Simultaneous Equations**	**Periods: 12**
Solutions of Linear simultaneous equations and Matrix Inversion – Gauss Elimination and Gauss - Jordan methods – Iterative methods – Gauss Jacobi – Gauss Seidel.		**CO2**
UNIT - III	**Interpolation and Solution of Ordinary Differential Equations**	**Periods: 12**
Interpolation by Newton's Forward and Backward Difference formula for equal intervals – Lagrange's method for unequal intervals – Integration by Trapezoidal and Simpson's rules (Single integration only) – Fourth order Runge-Kutta method for solving first order Differential Equations.		**CO3**
UNIT - IV	**Linear Programming Problems**	**Periods: 12**
Linear Programming Problems – Graphical Method – Simplex Method – Big M method.		**CO4**
UNIT - V	**Transportation and Assignment Problems**	**Periods: 12**
Transportation Problems – Initial basic feasible solution using North-West Corner rule, Least Cost Method, Vogel's Approximation Method – Optimality in Transportation Problem by Modified Distribution (MODI) Method. Assignment Problems – Solutions of Assignment Problems by Hungarian Method – Unbalanced Assignment Problems.		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Text Books

1. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", S. Chand Limited, 2008.
2. R. Panneerselvam "Operations Research" Prentice Hall of India, 2nd Edition,2004.
3. P.K. Gupta, D.S. Hira, "Operations Research", S. Chand, 5th Edition, 2018.

Reference Books

1. AtulGoyal, Madhuchanda Rakshit Suchet Kumar, "Numerical Methods", New India publishing Agency, 1st Edition, 2019.
2. Rajesh Kumar Gupta, "Numerical Methods - Fundamental and Applications", Cambridge University Press, 1st Edition, 2019.
3. S.Kalavathy, "Operation Research" ,Vikas Publishing house,4th Edition,2012.
4. Kevin J. Hastings, "Introduction to the Mathematics of Operations Research with Mathematica", Taylor and Francis, 2nd Edition, 2019.
5. T. Veerarajan, "Operations Research", McGraw Hill, 1st Edition, 2018.

Web References

1. https://nptel.ac.in/courses/111106101/
2. https://www.geektonight.com/operation-research-notes-pdf/#.XrXzoP8za00
3. https://freecomputerbooks.com/Numerical-Methods-with-Applications.html
4. https://www.pphmj.com/journals/IJNMA.htm
5. https://nptel.ac.in/courses/106/108/106108056/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	1	-	1	-	-	-	-	-	1	1	1	1
2	3	3	3	2	-	1	-	-	-	-	-	1	1	1	1
3	3	3	3	2	-	1	-	-	-	-	-	1	1	1	1
4	3	3	3	2	1	1	1	-	-	-	1	1	1	1	1
5	3	3	3	2	1	1	1	-	-	-	1	1	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Information Technology**	Programme : **B.Tech.**						
Semester	**IV**	Course Category: **ES**			End Semester Exam Type: **TE**			
Course Code	**U23ITTC02**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	CAM	ESE	TM
Course Name	**PROGRAMMING IN JAVA**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

(Common to All Branches)

Prerequisite	Basic knowledge of Object-Oriented Programming Principles	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Articulate the concept of Java fundamentals, OOPs and Strings	**K2**
	CO2 Demonstrate the principles of inheritance, packages and interfaces with real time applications	**K2**
	CO3 Create real time applications using exception handling and thread programming.	**K3**
	CO4 Build distributed applications using Collections and IO streams	**K3**
	CO5 Design and build simple GUI programs using AWT, Swings and build database applications	**K3**

UNIT- I	**Introduction**	**Periods: 09**

Introduction: Java: History – Features – JVM - JRE – JDK – Java Compilation and Execution – Data Types - Variables, Types, Expressions, Assignment Statements, Input/Output Statements: Scanner/System class, Type Casting (Primitives to Primitives), Conditional and Iterative Control Structures - Arrays
OOPs with Java: Introduction to OOPs Concepts - Class – Objects – Methods - Access Modifiers – Creating Class and Objects, Object Life-Cycle - Garbage Collection-Constructors - this – static – Array of Objects – Nested Classes.
String: String Class– Built-in Methods – StringBuilder - StringBuffer — **CO1**

UNIT- II	**Inheritance, Interfaces and Packages**	**Periods: 09**

Inheritance: Types of Inheritance – is-a Relationship, has-a Relationship – super keyword – final keyword – Polymorphism - Method overloading and Method overriding – Abstract Class
Interfaces: Define – Extend – Implement – Access - Interfaces vs Abstract classes, Type Conversions (Primitives to Objects vice-versa): Autoboxing and Auto unboxing
Packages: Define – Create – Access – Import — **CO2**

UNIT - III	**Exception Handling and Multithreading**	**Periods: 09**

Exception Handling: Exception Hierarchy – Checked and Unchecked Exceptions – try, catch, throws, throw and finally – User Defined Exceptions.
Multithreading: Thread – Life cycle – Defining and Running – Implementation Types – Thread Priorities – Thread Synchronization - Inter-Thread Communication — **CO3**

UNIT - IV	**Collections and I/O Streams**	**Periods: 09**

Collections: List: ArrayList and LinkedList. Set: HashSet and TreeSet. Map: HashMap – Stack – Queue. Lambda Expressions.
I/O Streams: Streams – Byte Streams and Character Streams – FileInputStream and FileOutputStream – FileReader and FileWriter. Object Serialization: ObjectInputStream and ObjectOutputStream. — **CO4**

UNIT - V	**GUI and JDBC**	**Periods: 09**

AWT: Components – Controls – Event Handling.
SWING: Swing Components – Layout Management.
JDBC: JDBC Architecture – JDBC Driver Types – Implementation of JDBC. — **CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Allen B. Downey and Chris Mayeld, “Think Java - How to Think Like a Computer Scientist”, 2nd Edition, Green Tea Press, 2020
2. Herbert Schildt, “Java: The Complete Reference”, TMH Publishing Company Ltd, 11th Edition, 2018.
3. H.M.Dietel and P.J.Dietel, “Java How to Program”, 11th Edition, Pearson Education/PHI, 2017
4. Cay S. Horstmann, Gary Cornell, “Core Java Volume - I Fundamentals”, 9th Edition, Prentice Hall, 2013.

Reference Books

1. Sagayaraj, Denis, Karthik, Gajalakshmi, “JAVA Programming for core and advanced learners”, Universities Press Private Limited, 2018.
2. Poaul Deitel, Harvey Deitel, “Java SE 8 for programmers”, 3rd Edition, Pearson, 2015.
3. P.J. Dietel and H.M Dietel, “Java for Programmers”, Pearson Education, 9th Edition, 2011.

4. Steven Holzner, “Java 2 Black book”, Dreamtech Press, 2011.

Web References

1. https://www.javatpoint.com/java-tutorial
2. https://docs.oracle.com/en/java/
3. https://www.studytonight.com/java/
4. https://onlinecourses.nptel.ac.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	-	-	-	-	-	-	2	3	2	1
2	3	3	3	-	3	-	-	-	-	-	-	2	3	2	1
3	3	3	3	1	3	-	-	-	-	-	-	2	3	2	1
4	3	3	3	1	3	-	-	-	-	-	-	2	3	2	1
5	3	3	3	1	3	-	-	-	-	-	-	2	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**IV**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MET406**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	CAM	ESE	TM
Course Name	**HEAT AND MASS TRANSFER**	**2**	**1**	**-**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Applied Thermodynamics							

Course Outcome			BT Mapping (Highest Level)
	On completion of the course, the students will be able to		
	CO1	Understand the mechanisms of heat transfer under steady conditions in composite systems.	**K2**
	CO2	Provide knowledge on unsteady state heat transfer and fin	**K2**
	CO3	Learn the fundamental concept and principle in convection heat transfer	**K2**
	CO4	Determine the radiation properties of a black and grey body Radiation	**K3**
	CO5	Integrate the concepts of phase change heat transfer and compare the thermal performance of heat exchangers using LMTD and NTU approach	**K3**

UNIT- I	**Conduction I**	**Periods: 09**
Introduction of heat transfer – significant modes of heat transfer in practical applications.– Law of heat conduction – heat conduction equations– Cartesian Coordinates- cylindrical Coordinate- One dimensional steady state heat conduction in simple geometries – plane wall - cylinder and sphere – Heat transfer composite walls - composite cylinders		**CO1**
UNIT- II	**Conduction II**	**Periods: 09**
Conduction with Internal Heat Generation in plane wall,cylinder,sphere – Extended Surfaces –Types of fin- Unsteady Heat Conduction – Lumped parameter analysis, Infinite bodies –flate plate ,cylinder and sphere-Semi Infinite bodies–Use of Heisler's charts		**CO2**
UNIT - III	**Convection**	**Periods: 09**
Boundary layer theory – Hydrodynamic and Thermal Boundary Layer- Forced Convection: External Flow – Flow over Plates, Cylinders -Internal flow through pipes– Natural convection in vertical and horizontal surfaces – Cylinders.		**CO3**
UNIT - IV	**Radiation**	**Periods: 09**
Radiation heat transfer –Thermal radiation – Laws of radiation – Black body concept – Grey body radiation -Emissive power – Radiation shape factor-radiation heat exchange between surfaces – Electrical Analogy – Radiation Shields.		**CO4**
UNIT - V	**Phase Change Heat Transfer and Heat Exchangers**	**Periods: 09**
Condensation and Boiling – Film wise and drop wise condensation – Film condensation on a Vertical plate – Regimes of Boiling – Forced convection boiling. Heat Exchangers – Types of heat Exchanger – Analysis of heat exchanger Using LMTD and Effectiveness – NTU method.		**CO5**

Lecture Periods: 30	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. R. C. Sachdeva, Fundamentals of Heat and Mass Transfer, New Age International Publishers, 2017
2. C. P. Kothandaraman and S. Subramanyan, Fundamental of Heat and Mass Transfer, New Age International Publishers, 2012.
3. P. K. Nag, Heat and Mass Transfer, McGraw Hill Education India Pvt. Ltd. 2011.

Reference Books

1. A.Yunus, Cengel, Heat and Mass Transfer: Fundamentals and Applications, McGraw Hill Education, 2020
2. P. S. Ghoshdastidar, Heat Transfer, Oxford University Press. 2012
3. J. P. Holman, Heat Transfer, 10th Edition, McGraw-Hill Publishing Company Limited. 2016
4. P.Frank, Incropera and David P. Dewitt, Incropera's principles of Heat and Mass Transfer, Wiley India Edition, 2018
5. Massoud Kaviany, Principles of Heat Transfer, John Wiley, 2002

Web References

1. https://nptel.ac.in/courses/112108149
2. https://nptel.ac.in/courses/112106170
3. https://nptel.ac.in/courses/112105248
4. http://ceng.tu.edu.iq/ched/images/lectures/chem-lec/st3/c3/Lectures-Mass%20Transfer-1.pdf
5. http://www.ht.energy.lth.se/fileadmin/ht/Kurser/MMV031/Introduction-HEX.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	2	1	1	1	-	-	-	-	1	1	2	2	3
2	2	3	2	1	1	1	-	-	-	-	1	1	2	2	3
3	2	3	2	1	1	1	-	-	-	-	1	1	2	2	3
4	2	3	2	1	1	1	-	-	-	-	1	1	3	3	3
5	2	3	2	1	1	1	-	-	-	-	1	1	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**					
Semester	**IV**	Course Category: **PC**			End Semester Exam Type: **TE**		
Course Code	**U23MET407**	Periods/Week			Credit	Maximum Marks	
		L	**T**	**P**	**C**	CAM	ESE	TM
Course Name	**COMPUTER AIDED DESIGN**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	-							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Explain the fundamentals of CAD and geometric transformation concepts.	**K2**
	CO2	Develop various model using geometric and surface modelling techniques	**K2**
	CO3	Identify the importance of visual realism algorithms	**K3**
	CO4	Identify various factors in computer aided assembly & advanced modeling Techniques	**K3**
	CO5	Apply various standards and Justify importance and need of various components/elements of PLM	**K3**

UNIT- I	**Fundamentals**	**Periods: 09**
Introduction to CAD/CAM/CAE, Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Product cycle, Sequential and Concurrent Engineering, CAD - Architecture, Tools, applications - Coordinate systems - Two and Three dimensional Transformations - Translation - Scaling - Reflection - Rotation, Windowing - clipping and Viewing, Orthographic and perspective projections.		**CO1**

UNIT- II	**Geometric and Surface Modelling**	**Periods: 09**
Geometric Modelling: 2D wire frame modelling, 3D Wire frame modelling, Wireframe models, Entities and their definitions. Concept of Parametric and non-parametric representation of curve, Curve fitting techniques, Definitions of cubic splines. Surface Modelling: Surface modelling and entities, Algebraic and geometric form, Parametric space of Surface, Blending functions, parameterization of surface patch, Subdividing cylindrical surface, Ruled surface, Surface of revolution, Spherical surface, Composite surface..		**CO2**

UNIT - III	**Visual Realism**	**Periods: 09**
Graphics display devices, Cathode Ray Tube, Random & Raster scan display, Color CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters, Coherence types. Hidden line removal algorithm, Priority and Area oriented algorithms. Hidden Surface removal algorithm, Depth buffer and Warnock''s algorithms. Hidden solid removal algorithm, Ray Tracing algorithm, Shading and Coloring, types. Computer Animation..		**CO3**

UNIT - IV	**Assembly Modeling and Advanced Modeling Techniques**	**Periods: 09**
Assembly modeling, Interference of Positions and orientations, CAD Tolerance Analysis, geometrical Mass Properties, degree of freedom, Constraints and Simulation concepts. Introduction to freeform modeling, rendering, generative design, technical drawing.		**CO4**

UNIT - V	**Standards in CAD and PLM Fundamentals**	**Periods: 09**
Standards for computer graphics (GKS) and Data exchange standards – IGES, STEP. PLM Overview, Need, Benefits, Concept of Product Life Cycle, Components / Elements of PLM, Emergence and Significance of PLM, PLM implementation cases in various industry verticals.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. P. Radhakrishnan, S. Subramanyan,V. Raju, "CAD/CAM/CIM", New Age International, 4th Edition, 2020.
2. P.N. Rao, "CAD/CAM: Principles and Applications", Tata McGraw Hill, 3rd Edition, 2017
3. Ibrahim Zeid and R. Sivasubramaniam, CAD/CAM : Theory and Practice, 2nd Edition, Tata McGraw Hill, 2009
4. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006.

Reference Books

1. Mikell P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education, 5th Edition 2019
2. Donald Hearn and M.Pauline Baker “Computer Graphics” with OpenGL Prentice Hall, International, 2011
3. James A. Rehg, Henry W. Kraebber, “Computer Integrated Manufacturing”, Pearson Education. 2007
4. Sareen Kuldeep, Grewal Chandandeep, CAD/CAM: Theory and Concept, 2nd Edition, S Chand & Company, 2007
5. Chris McMahon, Jimmie Browne CADCAM: Principles, Practice and Manufacturing Management, 2nd Edition, Pearson publications 1992.

Web References
1. https://nptel.ac.in/courses/112/102/112102101/
2. http://www.nptelvideos.in/2012/12/computer-aided-design.html
3. https://mech.iitm.ac.in/meiitm/course/cad-in-manufacturing/
4. https://freevideolectures.com/course/2362/computer-aided-design-and-manufacturing
5. https://www.iitk.ac.in/me/me761a
6. https://www.autodesk.com/certification/learn/course/fusion360-generative-design-intro-expert

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	-	-	-	-	-	1	1	3	-	-
2	3	3	2	-	-	-	-	-	-	-	1	1	3	2	1
3	3	3	1	3	1	-	-	-	-	-	1	1	3	2	1
4	3	2	2	2	3	-	-	-	-	-	1	1	3	2	1
5	3	2	2	-	3	-	-	-	-	1	1	1	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**IV**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MEB402**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**KINEMATICS OF MACHINERY**	**2**	**0**	**2**	**3**	**50**	**50**	**100**

MECH

Prerequisite	Engineering Mechanics		
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Familiarize the students to understand the basic concepts of mechanism	**K2**
	CO2	Understand the various types of motion of link interms of displacement, velocity and acceleration.	**K2**
	CO3	Perform synthesis of mechanism by analytical and graphical method	**K2**
	CO4	Demonstration of simple mechanisms and to perform its kinematic ananlysis	**K4**
	CO5	Design a layout of cam for specified motion and to develop a simple gear train for kinematic analysis	**K4**

UNIT- I	**Basics of Mechanisms**	**Periods: 10**
Mechanisms and machines; Elements of kinematic chain, Degrees of Freedom(DOF), planar mechanism -Definition & Concept - inversion of single and double slider chain and four bar chain and its applications Mechanism with lower pairs - Pantograph, Straight line mechanism- exact and approximate Motion-Mini projects.		**CO1**
UNIT- II	**Kinematic Analysis of Mechanisms**	**Periods: 10**
Analysis of displacement, velocity & acceleration diagrams of simple planar mechanisms by graphical (Instantaneous center method and relative velocity method) and analytical method.		**CO2**
UNIT- III	**Kinematic Synthesis of Mechanisms**	**Periods: 10**
Kinematic synthesis, graphical method using relative pole method, Inversion method and overlay 3 point synthesis problems - Motion, path & function generation, Chebyshev's spacing of accuracy points - Freudenstein Method of three point synthesis of four link mechanism and slider crank Mechanism- Coupler curves.		**CO3**
UNIT- IV	**Kinematics of Machinery Practice I**	**Periods:15**
1. Demonstration of mechanism-identification various types links and joints-DOF-various types of inversion 2. To drawa velocity and acceleration diagram for simple planar mechanisms. 3. Four bar mechanism force analysis using ADAMS software 4. Force analysis of slider mechanism using ADAMS software 5. To study about various types CAM and Follower 6. Sketch the radial cam profile for Knif edge follower		**CO4**
UNIT- V	**Kinematics of Machinery Practice II**	**Periods:15**
7. Sketch the radial cam profile for Flat follower 8. Sketch the radial cam profile for roller follower 9. Skecth the offset CAM profile for the mechanical application 10. To study about Gear and gear Train and its classification 11. Analyse the gear speed of simple gear train mechanism under various condition		**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -30**	**Total Periods: 60**

Text Books

1. S S.Rattan - Theory of Machines, McGraw Hill, 5th Edition, 2019
2. J.J. Uicker, Jr., G.R. Pennock, and J.E. Shigley - Theory of Machines and Mechanisms, Oxford University Press, 5th Edition, 2017
3. Amitabh Ghosh, Ashok Kumar Malik - Theory of Mechanisms and Machines, 3rd Edition, CRC Press Publisher, 2021.

Reference Books

1. J.S.Rao and R.V.Dukkipati - Mechanism and Machine Theory, New Age International, 2014
2. Sadhu Singh, Theory of Machines: Kinematics and Dynamics, 3rd Edition, Peasrson Publications, 2011
3. P.L. Ballaney - Mechanics of Machines, Khanna Publishers, 2012
4. Thomas Bevan - Theory of Machines, 3rd Edition, Pearson education, 2009
5. R.S.Khurmi, Gupta,.J.K., "Theory of Machines", S.Chand & Company, 2009

Web References

1. http://mm-nitk.vlabs.ac.in/
2. https://nptel.ac.in/courses/112104114

3. https:/ ocw.mit.edu
4. https://easyengineering.net/me6401-kinematics-of-machinery/
5. https://link.springer.com/book/10.1007/978-94-007-1156-3

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	1	-	-	-	-	-	3	2	2	2	3
2	3	2	2	3	1	-	-	-	-	-	-	2	2	2	3
3	3	2	2	3	1	-	-	-	-	-	-	2	2	2	3
4	3	3	3	3	3	-	-	-	3	-	-	2	2	2	3
5	3	3	3	3	3	-	-	-	3	-	-	2	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment method for theory cum practical courses

Assessment	Continuous Assessment Marks (CAM)									End Semester Examination (ESE) Marks (Practical – Internal Evaluation)	End Semester Examination (ESE) Marks (Theory)	Total Marks
	Continuous ssessment (Theory)					Continuous ssessment (Practical)						
	CAT 1	CAT 2	Model	Attendance	Total	Conduction of Practical	Report	Viva	Total			
Marks	5	5	5	5	20*	15	10	5	30*	30	75**	-
*To be weighted for 10 Marks					10	*To be weighted for 10 Marks			10		*To be weighted for 50 Marks	100

Department	**English**	Programme: **B.Tech.**						
Semester	**IV**	Course Category Code: **HS**			*End Semester Exam Type:**LE**			
Course Code	**U23ENPC02**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**GENERAL PROFICIENCY- II**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

(Common to ALL Branches except CSBS)

Prerequisite	Basics of English Language	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Infer ideas to attend international standardized test by broadening receptive and productive skills	**K2**
	CO2 Interpret the types of writing in different state of affairs	**K3**
	CO3 Acquire meticulous exposure in speaking and get rid of performance anxiety	**K2**
	CO4 Articulate the ideas and opinions effectively and coherently	**K2**
	CO5 Progress the skills to compete in various competitive exams like GATE, GRE, UPSC, etc.	**K4**

UNIT- I	**Career Skills**	**Periods: 06**
Listening: Listening at specific contexts - Speaking: Demonstrative speaking practice using visual aids (charts, graphs, maps) - Reading: Read and Review -Newspaper, Advertisement, Company Handbooks, and Guidelines (IELTS based) - Writing: Integrated Writing Task (TOEFL) - Vocabulary: Synonyms and Antonyms (IELTS)		**CO1**
UNIT- II	**Corporate Skills**	**Periods:06**
Listening: Listening English news and reproducing in own words - Speaking: Team Presentation - Reading: Short texts and Longer Passages (cloze reading) - Writing: Analytical Writing: Analyzing an issue and Argument task (GRE based) - Vocabulary: Prefix and Suffix		**CO2**
UNIT- III	**Functional Skills**	**Periods:06**
Listening: Listening TED Talks - Speaking: Brainstorming & Individual Presentation - Reading: Text Completion (GRE Based) - Writing: Picture Inference - Vocabulary: Word Formation		**CO3**
UNIT- IV	**Transferrable Skills**	**Periods:06**
Listening: Listening Documentaries and making notes - Speaking: Mock Interview - Reading: Read texts on emerging trends - Writing: Agreeing & Disagreeing Essay (IELTS) - Vocabulary: Euphemism, Redundancy, Clichés and Intensifiers		**CO4**
UNIT-V	**Verbal Aptitude - II**	**Periods:06**
Transformational Grammar: Tenses, Change of Voice, Concord **Verbal Ability Enhancement:** Letter Series, Coding &Decoding, Sentence Equivalence (GRE) Analytical Reasoning and Logical Reasoning (GATE), Syllogism, One-word Substitution, Jumbled Sentences		**CO5**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods:30**	**Total Periods:30**

Reference Books

1. Cullen, Pauline, Amanda French, and Vanessa Jakeman. “The official Cambridge guide to IELTS for academic & general training”.Cambridge, 2014.
2. Prasad, Hari Mohan, Sinha, Uma Rani, “Objective English for Competitive Examinations”, Tata Mc Graw Hill: Noida, 2010.
3. Lougheed, Lin. “Barron's Writing for the TOEFL IBT: With Audio CD”. Barron's Educational series, 2008.
4. Grussendorf, Marion, “English for Presentations”, Oxford University Press, Oxford, 2007.
5. Murphy, Raymond English Grammar in Use with answers: Reference and Practice for Intermediate students, Cambridge: CUP,2004.

Web References

1. https://www.englishclub.com/grammar/nouns-compound.htm
2. https://lofoya.com/Verbal-Test-Questions-and-Answers/Sentence-Completion/l3p1
3. https://www.grammarwiz.com/phrases-and-clauses-quiz.html
4. https://www.clarkandmiller.com/25-english-euphemisms-for-delicate-situations/
5. http://www.englishvocabularyexercises.com/general-vocabulary/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	1	-	3	-	2	1	1	1
2	1	-	-	-	-	-	-	1	-	3	-	2	1	1	1
3	1	-	-	-	-	-	-	1	-	3	-	2	1	1	1
4	1	-	-	-	-	-	-	1	-	3	-	2	1	1	1
5	1	-	-	-	-	-	-	1	-	3	-	2	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Practical				
Continuous Assessment Internal Evaluation		**End Semester External Evaluation**		**Total Marks**
50 marks		**50 marks**		
Conduction of Practical (Assignment 1&2 -10 Marks Performance in practical classes - 5 Marks)	15	Listening (L)	20	100
Record	5	Speaking(S)	10	
Viva	5	Reading(R)	10	
Model Practical Examination (Model Exam is conducted for 50 Marks that will be converted to 15 Marks)	15	Writing(W)	10	
Attendance	10			

Department	**Information Technology**	Programme : **B.Tech.**					
Semester	**IV**	Course Category: **ES**			End Semester Exam Type: **LE**		
Course Code	**U23ITPC02**	Periods/Week			Credit	Maximum Marks	
		L	**T**	**P**	**C**	CAM	ESE	TM
Course Name	**PROGRAMMING IN JAVA LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

(Common to All Branches)

Prerequisite	Basic concepts of Object-Oriented Programming Principles	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Apply and practice logical formulations to solve simple problems leading to specific applications.	**K3**
	CO2 Demonstrate the use of inheritance, interface and package in relevant applications	**K3**
	CO3 Implement robust application programs in Java using exception handling and multithreading	**K3**
	CO4 Build java distributed applications using Collections and IO streams.	**K3**
	CO5 Implement Graphical User Interface based application programs by utilizing event handling features and Swing in Java.	**K3**

List of Exercises

1. Develop simple programs using java
2. Develop a java program that implements class and object.
3. Write a java program to find the frequency of a given character in a string
4. Write a java program to demonstrate inheritance and interfaces.
5. Develop a java program that implements the Packages.
6. Create java applications using Exception Handling for error handling.
7. Develop a simple real life application program to illustrate the use of Multi-Threads.
8. Implement simple applications using Collections.
9. Develop application using the concept of I/O Streams
10. Write a Java Program to demonstrate AWT and Swing Components
11. Develop a simple application and use JDBC to connect to a back-end database.

Lecture Periods: -	**Tutorial Periods:**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. Allen B. Downey and Chris Mayeld, “Think Java - How to Think Like a Computer Scientist”, 2nd Edition, Green Tea Press, 2020
2. Sagayaraj, Denis, Karthik, Gajalakshmi, “JAVA Programming for core and advanced learners”, Universities Press Private Limited, 2018
3. Cay.S.Horstmann and Gary Cornell, “Core Java 2”, Vol 2, Advanced Features, Pearson Education, 7th Edition, 2010

Web References

1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/
3. IBM’s tutorials on Swings, AWT controls and JDBC.
4. https://www.edureka.co/blog.
5. https://www.geeksforgeeks.org.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
2	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
3	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
4	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
5	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**IV**	Course Category: **PC**			End Semester Exam Type: **LE**			
Course Code	**U23MEP404**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	CAM	ESE	TM
Course Name	**CAD/CAM LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
MECH								
Prerequisite	Computer Aided Design							

Course Outcome		**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1	Generate 2-D and 3-D drawings using parametric solid software's as per industry templates	**K3**
	CO2	Understand and interpret machine manufacturing drawings and assemble various 3D Components	**K2**
	CO3	Interpret the given drawing as per BIS conventions and exposure in CNC machining	**K3**
	CO4	Understand the CNC control in modern manufacturing system	**K2**
	CO5	Extend CAM software to generate NC code	**K3**

List of Experiments

1. Modeling a component (Isomentric View 1) using Extrude, Hole operations in a 3D CAD Package
2. Modeling a component (Isomentric View 2) using Transformation tools in a 3D CAD Package
3. Detailing and assembly of flange coupling
4. Detailing and assembly of universal coupling
5. Detailing and assembly of Knuckle Joint
6. Programming and machining of given component using CNC turning center.
7. Programming and simulation of given component using CAM software (Lathe).
8. Programming and machining of given component using CNC machining center.
9. Programming and simulation of given component using CAM software (Milling).
10. Programming and machining of given component using Universal Milling Machine.

Lecture Periods: -	**Tutorial Periods:**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. Peter Smid, CNC Programming handbook: a comprehensive guide to practical CNC programming, Industrial press, 2018.
2. Ken Evans, "Programming of CNC Machines", Industrial Press Inc., U.S.; Fourth edition, 2016.
3. P. J. Sha, "Engineering Graphics" S Chand & Company, 2012.
4. R.K. Singal, Mridul Singal, Rishi Singal. "Fundamentals of Machining and Machine Tools" - I.K. International Publishing Home Pvt. Ltd; New Delhi, 2008.
5. M. N. SeshaPraksh& Dr. G. S. Servesh, "Computer Aided Design Laboratory" Laxmi Publications,1st Edition 2016

Web References

1. www.CATIA/Creo/Autodesk Inventor/ Solidworks /ANSYS- Software Tutorials
2. https://sites.ualberta.ca/wmoussa/AnsysTutorial
3. https://www.vlab.co.in/broad-area-mechanical-engineering
4. http://vlabs.iitkgp.ernet.in/tcad/
5. https://www.pdfdrive.com/search?q=Duane+Weidinger

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
4	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
5	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**					
Semester	**IV**	Course Category: **PC**			End Semester Exam Type: **LE**		
Course Code	**U23MEP405**	Periods/Week			Credit	Maximum Marks	
		L	**T**	**P**	**C**	CAM	ESE	TM
Course Name	**HEAT TRANSFER LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
MECH								
Prerequisite	Applied Thermodynamics							

Course Outcome		**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1	Analyse heat transfer parameters by conducting experiments on conduction and Convection experimental set-up.	**K4**
	CO2	Interpret heat transfer parameters by conducting experiments on radiation experimental Set-up.	**K4**
	CO3	Evaluate the performance of tubes in tube heat exchangers	**K4**
	CO4	Analyse the surface emissivity of a test plate and Stefan¬ Boltzmann's constant and compare With theoretical value	**K4**
	CO5	Calculate and compare the thermal conductivity of different materials	**K4**

List of Experiments

1. Heat transfer on cylindrical surface by natural convection
2. Heat transfer on cylindrical surface by forced convection
3. Heat transfer from Pin fin by natural convection.
4. Heat transfer from Pin fin by forced convection.
5. Heat transfer on a composite wall.
6. Experiment to evaluate Stefan Boltzmann constant.
7. Experiment to evaluate the emissivity of a specimen.
8. Experiment on Parallel flow heat exchanger
9. Experiment on Counter flow heat exchanger
10. Study of regimes of pool boiling and determination of critical heat flux

Lecture Periods: -	**Tutorial Periods:**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. C. P. Kothandaraman and S. Subramanyan, Heat and Mass Transfer Data Book, Fifth Edition, New Age International Publishers, 2022.
2. R. C. Sachdeva, Fundamentals of Heat and Mass Transfer, New Age International (P) Ltd, 2017.
3. J. P. Holman, Heat Transfer, 9th Edition, McGraw-Hill Publishing Company Limited, 2011.
4. S.P. Sukhatme, A text book on Heat Transfer, Fourth Edition, Universities Press, 2005.
5. C. A. Sundén, Brebbia, Heat Transfer XIII Simulation and Experiments in Heat and Mass Transfer, WIT Press, 2013.

Web References

1. http://htv-au.vlabs.ac.in/
2. https://nptel.ac.in/courses/103/103/103103032/
3. https://nptel.ac.in/courses/112/101/112101097/
4. https://www.iitk.ac.in/me/heat-transfer-laboratory
5. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Mechanical/Heat%20and%20Mass%20Transfer/TOC.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	1	-	-	-	-	1	-	-	1	2	2	2
2	2	2	2	1	-	-	-	-	1	-	-	1	2	2	2
3	2	2	2	1	-	-	-	-	1	-	-	1	2	2	2
4	2	2	2	2	-	-	-	-	1	-	-	1	2	2	2
5	2	2	2	1	-	-	-	-	1	-	-	1	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**IV**	Course Category: **AEC**			End Semester Exam Type: **-**			
Course Code	**U23MEC4XX**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**CERTIFICATION COURSE - IV**	**0**	**0**	**4**	**-**	**100**	**-**	**100**

MECH

Students shall choose an International / Reputed organization certification course of 40-50 hours duration specified in the curriculum (It is mandatory to do a minimum of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation.

(i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks.

(ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as “pass” on satisfactory completion. A letter grade “P” is awarded to declare pass.

(iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.

Evaluation Methods

Assessment	**Continuous Assessment Marks (CAM)**		**Total Marks**
	Report	**MCQ Test**	
Marks	10	90	100

Department	**Mechanical**	Programme: **B.Tech.**						
Semester	**IV**	Course Category: **AEC**				End Semester Exam Type:**-**		
Course Code	**U23MES301**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**SKILL DEVELOPMENT COURSE II**	**0**	**0**	**2**	**-**	**100**	**-**	**100**

(Choose anyone of the below three courses)

1. Four Wheeler Troubleshooting

The main goal of this programme is to in cultivate students with the broad knowledge on the Workshop situation and as well as to afford the opportunities to know about the basics of the four wheeler servicing workshop and its environment to make qualified and skilled man power for the two wheeler service sector. And also to create an opportunity for the students to have a practical knowledge and to increase their employability. The course has the detailed explanation on the classification of four wheelers, working principles, its components functions such as clutches, shock absorber, chassis, braking systems, battery maintenance etc. To make the students familiarize with the procedure of troubleshooting of four wheelers with both theoretical and practical approach.

2. Demonstration Wood Routing

This course is aimed for mechanical engineering students to provide a Wood Routing operation. It is the process of hollowing out an area in a material (like composites, polymers, and soft metal) to cut various shapes in the material. A router is the power tool that is used in the process. With the birth of computer technology came CNC routers. CNC is short for Computer Numerical Control. The common CNC machine problems, such as improper tool setting, irregular maintenance and poor programming were focused and its remedial measures were provided to the students

3. Demonstration Laser Cutting

This course covers Laser cutting is a versatile and precise method of cutting various materials using a focused laser beam. Here's an overview of laser cutting, Laser cutting is a slitting process with which it is possible to cut metallic and non-metallic raw materials of different material thicknesses. This is based around a laser beam which is guided, formed, and bundled. When it hits the work piece, the material heats up to the extent that it melts or vaporizes. To make the students familiarize with the procedure of demonstration laser cutting with both theoretical and practical approach.

Lecture Periods:30	**Tutorial Periods: -**	**Practical Periods:**	**Total Periods: 30**

Web References

1. https://www.liveoutdoors.com/motorsports/166897-atv-troubleshooting-most-common-issues/
2. https://www.cyclepedia.com/four-stroke-motorcycle-troubleshooting-guide/
3. https://www.typhoontoys.dk/pdf/Adly%2050_service%20manual.pdf
4. https://downloads.intelitek.com/Manuals/CNC/Discontinued%20Machines/Stepper_Router_WIN_Manual.pdf
5. https://www.youtube.com/watch?v=xLxCEBb-74s
6. https://www.youtube.com/watch?v=Zf22FiI1z14
7. https://www.daniels.utoronto.ca/sites/default/files/daniels_digital_fabrication_laser_cutter_manual.pdf

Evaluation Methods

Assessment	**Continuous Assessment Marks (CAM)**			**Total Marks**
	Attendance	**Report**	**Presentation/Demo/ Skill Test**	
Marks	10	40	50	100

Department	**Mechanical**			Programme: **B.Tech.**				
Semester	**IV**			Course Category: **MC**			End Semester Exam Type:-	
Course Code	**U23MEM404**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**RIGHT TO INFORMATION AND GOOD GOVERNANCE**	**2**	**0**	**0**	**-**	**100**	**-**	**100**

(Common to ALL Branches except CSBS)

Prerequisite	-	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Describe and analyze concept and legislative provisions related to RTI	**K2**
	CO2 Develop critical thinking skills to identify instances where public authorities have failed to meet their obligations	**K3**
	CO3 Critically assess the challenges and limitations faced by Central and State Information Commissions	**K2**
	CO4 Analyze the structure and functioning of the judiciary at different levels - local, regional, national.	**K2**
	CO5 Analyze the impact of the RTI Act on promoting transparency, accountability, and citizen empowerment in India	**K2**

UNIT- I	**Introduction**	**Periods:06**
Conceptual background – Right to know – Open Government – Transparency in governance and accountability – Right to information under the Indian Constitution – Article 19(1)(a) and Article 21 of the Constitution – Role of NGOs and movement for right to information – Right to Information Act, 2005- Scope and objectives.		**CO1**
UNIT- II	**Obligation of Public Authorities**	**Periods:06**
Obligations of public authorities: Section 4 - Designation of Public Information Officers: Section 5 - Disposal of request: Section 7 -Exemption from disclosure of information: Section 8 - Grounds for rejection to access in certain cases: Section 9 - Severability: Section 10 - Third party information: Section 11		**CO2**
UNIT- III	**Central and State Information Commission**	**Periods:06**
Constitution of Central and State Information Commissions - Terms of office and conditions of service - Removal of Chief Information Commissioner or Information Commissioner - Powers and functions of Information Commissions.		**CO3**
UNIT- IV	**Judiciary and Right to Information Act**	**Periods:06**
Protection of right to access the information- Role of the Supreme Court and High Courts – Recent attempts of dilution of the right to information Law		**CO4**
UNIT- V	**Right to Information Act, 2005 and its relevance to other laws**	**Periods:06**
Public Records Act, 1993 - Whistle Blowers Protection Act, 2014 - Official Secrets Act, 1923		**CO5**

Lecture Periods:30	**Tutorial Periods: -**	**Practical Periods:**	**Total Periods:30**

Text Books

1. Virender Negi, Monika Negi," Right to Information: Key to Good Governance", Indu Book Services Pvt. Limited, 2019
2. R. M. Pal, Somen Chakraborty "Human Rights Education in India" Indian Social Institute, 2000
3. Sairam Bhat," Right to Information and Good Governance - Volume 3 of NLSIU book series" National Law School of India University, 2016

Reference Books

1. Sairam Bhat [ed], Right to Information and Good Governance, NLSIU Book Series-3, 2016. [ISBN-9789383363452]
2. Sairam Bhat, Right to Information, Eastern Book House, 2012. [ISBN-978838021553]
3. Praveen Dala; Consumer Protection and Right to Information; Central Information Commission, 2007.

Web References

1. https://archive.nptel.ac.in/courses/129/106/129106001/
2. https://onlinecourses.nptel.ac.in/noc20_lw01/preview
3. https://www.classcentral.com/course/swayam-right-to-information-and-good-governance-19988

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
2	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
3	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
4	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
5	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100

SEMESTER V

Department	MBA			Programme : **B.Tech.**			
Semester	V			Course Category: **HS**		End Semester Exam Type: **TE**	
Course Code	U23HSTC02	Periods/Week			Credit	Maximum Marks	
		L	T	P	C	CAM	ESE	TM
Course Name	**RESEARCH METHODOLOGY**	**2**	**0**	**0**	**2**	**25**	**75**	**100**

(Common to All branches)

Prerequisite	-	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Interpret the different types of research and explain how research methods can be used to address engineering problems.	**K2**
	CO2 Discuss the research problems, conduct comprehensive literature reviews, and utilize tools and services for effective information retrieval.	**K2**
	CO3 Apply appropriate methods to design experiments, analyze data, and interpret results using both numerical and graphical techniques.	**K3**
	CO4 Analyze and apply ethical guidelines to structure and write research papers and dissertations, ensuring academic integrity and avoiding plagiarism.	**K4**
	CO5 Examine the fundamentals of intellectual property rights to protect and enforce them, with emphasis on their role in fostering innovation and entrepreneurship in engineering.	**K3**

UNIT - I	**Introduction to Research**	**Periods: 6**
Meaning and Importance of Research, Types of Research: Overview of Basic, Applied, and Developmental Research, Overview of the Research Process, Defining a Research Problem: Key Considerations, Setting Research Objectives and Research Questions, Introduction to Research Design: Basic Concepts, Approaches to Research: Quantitative vs. Qualitative.		**CO1**
UNIT - II	**Problem Formulation and Literature Review**	**Periods: 6**
Identifying and Formulating Research Problems, conducting a Literature Review: Essential Steps, Referencing and Citation Methods: Basic Techniques. Sources of Information: Overview of Libraries and Online Databases.		**CO2**
UNIT - III	**Research Methods and Data Analysis**	**Periods: 6**
Introduction to Experimental Research, Developing Hypotheses: Basic Approach. Data Collection Methods: Sampling and Surveys, Basics of Data Analysis: Numerical and Graphical Analysis, Introduction to Inferential Statistics.		**CO3**
UNIT - IV	**Writing and Presenting Research**	**Periods: 6**
Preparing a Research Report: Key Sections (Abstract, Introduction, Methodology, Results, Discussion, Conclusion). Referencing and Citation: Brief Overview.		**CO4**
UNIT - V	**Ethics and Intellectual Property in Research**	**Periods: 6**
Ethical Considerations in Research: Introduction to Scientific Misconduct. Basics of Intellectual Property Rights - Introduction to Patents, Copyrights, and Trademarks – Case studies on ethical dilemmas in research.		**CO5**

Lecture Periods:30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Text Books

1. Kumar, R. Research Methodology: A Step-by-Step Guide for Beginners, 5th Edition, SAGE Publications, 2019.
2. Ram Ahuja, Research methods, Rawat Publications, 2nd edition, 2022
3. Creswell, J. W., and Creswell, J. D. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 5th Edition, SAGE Publications, 2018.

Reference Books

1. Thiel DV. Research methods for engineers. Cambridge: Cambridge University Press; 2014.
2. Ganesan R. Research methodology for engineers. Chennai: MJP Publishers; 2024.
3. Agarwal C, Sharma V. Research methodology in sociology. New Delhi: Commonwealth Publishers; 2012.
4. Thody A. Writing and presenting research. 2nd edition, London: SAGE Publications; 2006.
5. Kothari CR. Research methodology – methods and techniques. 5th edition, New Delhi: New Age International Publishers; 2023.

Web References

1. https://conjointly.com/kb/
2. https://owl.purdue.edu/owl/research_and_citation/conducting_research/writing_a_literature_review.html
3. https://files.eric.ed.gov/fulltext/ED536788.pdf
4. https://researcheracademy.elsevier.com/
5. https://www.wipo.int/

6.	https://www.scholastic.com /7-steps-to-successful-research-report.html
7.	https://www.futurelearn.com/info/courses/business-research-methods- investigation.
8.	https://articles.manupatra.com/article-details/Patent-Types-Laws-related-to-them-in-India

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	2	-	2	-	-	2	2	3	2	2	3
2	3	1	1	3	1	-	2	-	-	1	2	-	2	3	3
3	1	3	3	1	3	-	2	-	-	2	2	-	2	2	3
4	-	-	1	2	-	-	2	3	2	2	-	2	2	3	3
5	2	2	2	2	2	2	3	3	2	2	3	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Computer Science and Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **ES**			End Semester Exam Type: **TE**			
Course Code	**U23CSTC03**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**DATA STRUCTURES**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

(Common to All Branches except CSBS and FT)

Prerequisite	Basic Programming Knowledge		
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Compute time and space complexity for given problems	**K2**
	CO2	Demonstrate stack, queue and its operation.	**K2**
	CO3	Illustrate the various operations of linked list.	**K3**
	CO4	Use the concepts of tree for various applications.	**K3**
	CO5	Outline the various Tables, Graphs and Sets techniques.	**K3**

UNIT - I	**Basic Terminologies of Data Structures**	**Periods: 9**	
Introduction: Basic Terminologies – Asymptotic Notations: Complexity analysis. Array and its operations - Searching: Linear Search and Binary Search Techniques. Sorting: Bubble Sort – Selection Sort – Insertion Sort – Heap Sort – Shell Sort. Performance and Comparison among the sorting methods.			**CO1**
UNIT - II	**Stack and Queue Operations**	**Periods: 9**	
Stacks and Queues: ADT Stack and its operations. Applications of Stacks: Expression Conversion and evaluation. ADT Queue and its operations. Types of Queue: Simple Queue – Circular Queue – Priority Queue – Deque.			**CO2**
UNIT - III	**Linked List Operations**	**Periods: 9**	
Linked Lists: Singly linked list: Representation in memory. Algorithms of several operations: Traversing – Searching – Insertion – Deletion. Linked representation of Stack and Queue. Doubly linked list: operations. Circular Linked Lists: operations.			**CO3**
UNIT - IV	**Trees**	**Periods: 9**	
Trees: Basic Tree Terminologies. Different types of Trees: Binary Tree – Threaded Binary Tree – Binary Search Tree – Binary Tree Traversals – AVL Tree- Red Black Tree.			**CO4**
UNIT - V	**Graphs, Tables and Sets**	**Periods: 9**	
Graph: Basic Terminologies and Representations – Graph traversal algorithms. Tables: Different types of tables – Hash Table and its operations - Applications. Sets: Representation of Sets- Operations and its applications.			**CO5**
Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Ellis Horowitz, Sartaj Sahni," Fundamentals of Data Structures", Illustrated Edition, Computer Science Press, 2018.
2. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI, Third Edition, 2010.
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, "Data Structures and Algorithms", 4th Edition, 2009.

Reference Books

1. D. Samanta, "Classic Data Structures", Prentice-Hall of India, Second Edition, 2012.
2. Robert Kruse, C.L. Tondo and Bruce Leung, "Data Structures and Program Design in c" Prentice-Hall of India, Second Edition, 2007.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, Second. Edition, 2006.
4. Mark Allen Weiss," Algorithms, Data Structures and Problem Solving with C++", Illustrated Edition, Addison-Wesley Publishing Company, 1995.
5. Mark Allen Weiss," Algorithms, Data Structures and Problem Solving with C++", Addison- Wesley Publishing Company, Illustrated Edition, 1995.

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1. https://www.geeksforgeeks.org/data-structures/
2. https://www.javatpoint.com/data-structure-tutorial/
3. https://www.studytonight.com/data-structures/
4. https://www.tutorialspoint.com/data_structures_algorithms/
5. https://www.w3schools.in/data-structures-tutorial/intro/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	3	2	3
2	3	2	1	1	-	-	-	-	-	-	-	-	3	2	3
3	3	2	1	1	-	-	-	-	-	-	-	-	3	2	3
4	3	2	1	1	-	-	-	-	-	-	-	-	3	2	3
5	3	2	1	1	-	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MET508**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**DYNAMICS OF MACHINERY**	**2**	**1**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Engineering Mechanics							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Carry out static and dynamic force analysis on various parts of reciprocating engine and to determine flywheel parameters by constructing turning moment diagram	**K3**
	CO2	Compute the frequency of free vibration in single degree of freedom systems	**K4**
	CO3	Compute the frequency of forced vibration in damped and undamped systems	**K4**
	CO4	Calculate the speed, lift of the governor, and estimate the gyroscopic effect on automobiles, ships and airplanes.	**K4**
	CO5	Calculate the balancing masses and their locations of reciprocating and rotating masses.	**K3**

UNIT - I	**Dynamic Force Analysis**	**Periods: 9**
Dynamic force analysis – Inertia force and Inertia torque– D'Alembert's principle –Dynamic Analysis in reciprocating engines – Inertia effect of connecting rod – Crank shaft torque – Turning moment diagrams –Fly Wheels.		**CO1**
UNIT - II	**Vibration – Single Degree of Freedom Systems**	**Periods: 9**
Introduction to vibration – Terminology – Classification of vibrations – Undammed and Damped free vibration of single degree of freedom systems – Viscous damping – Forced vibration – harmonic excitation – Magnification factor – Vibration isolation and Transmissibility.		**CO2**
UNIT - III	**Transverse and Torsional Vibration Systems**	**Periods: 9**
Transverse vibrations of shafts and beams – Rayleigh's and Dunkerley's method – Whirling of shafts. Torsional vibrations – Single rotor, two rotors and three rotors systems – Vibration of geared systems		**CO3**
UNIT - IV	**Mechanism for Control**	**Periods: 9**
Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction. Gyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes		**CO4**
UNIT - V	**Balancing**	**Periods: 9**
Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi cylinder-inline and radial engines – Partial balancing in engines		**CO5**

Lecture Periods: 30	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. S.S.Rattan, Theory of Machines,3rd edition, Tata McGraw-Hill Education India, 2019
2. Sadhu Singh, Theory of Machines: Kinematics and Dynamics, 3rdEdition, Publisher: Pearson Education India, 2014
3. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006

Reference Books

1. R.L. Norton, Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines, 6th edition, McGraw-Hill Education, 2019.
2. Thomas Bevan, Theory of Machines: An Introductory Text, 3rd edition, CBS Publishers & Distributors, 2012
3. J.E. Shigley and J.J. Uicker Jr., Theory of Machines and Mechanisms, 4th edition, Oxford University Press, 2010
4. R.S.Khurmi, "Theory of Machines", 14 th Edition, S Chand Publications, 2008.
5. J.S. Rao and R.V. Dukkipati, Mechanism and Machine Theory, 2nd edition, New Age International Publishers, 2007

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1. https://nptel.ac.in/courses/112/105/112105268/
2. https://www.coursera.org/browse/engineering/mechanical-engineering
3. https://www.learnengineering.org/
4. https://www.coursera.org/browse/engineering/mechanical-engineering
5. https://www.khanacademy.org/science/physics/forces-newtons-laws

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	1	-	-	-	-	-	-	-	-	2	2	-
2	3	3	2	1	1	-	-	-	-	-	-	-	2	2	-
3	3	3	2	1	1	-	-	-	-	-	-	-	2	2	-
4	3	2	2	1	1	-	-	-	-	-	-	-	2	2	-
5	3	2	3	1	1	-	-	-	-	-	-	-	2	2	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MET509**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**DESIGN OF MACHINE ELEMENTS**	**2**	**1**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Engineering Mechanics, Strength of Materials							

Course Outcome			BT Mapping (Highest Level)
	On completion of the course, the students will be able to		
	CO1	Demonstrate recalling and applying basics to understand design procedures of various machine elements	**K3**
	CO2	Compute the dimensions of the springs for specific applications	**K4**
	CO3	Comprehend power screws and welded joints and able to apply its knowledge to analyze its strength when different loads.	**K4**
	CO4	Examine and solve design problems involving different couplings and keys	**K4**
	CO5	Compute the dimensions and stress requirements of shafts and knuckle joints based on various load conditions and write simple computer programs to understand solving algorithms.	**K4**

UNIT - I	**Introduction to Machine Design**	**Periods: 9**
Engineering design Process –Standards – form and shape design, embodiment design and design for manufacture. Types of loads –Stresses – Static, varying, thermal, impact and residual. Factors of safety – Theories of failure – Stress concentration factors and Notch sensitivity factor – prevention methods – S-N curves and its applications, Computer-aided design.		**CO1**
UNIT - II	**Design of Springs**	**Periods: 9**
Stresses and deflections of helical springs-extension compression springs - spring for static and fatigue loading- natural frequency of helical springs-energy storage capacity-helical torsion springs-co-axial springs.		**CO2**
UNIT - III	**Design of Powerscrews and Welded Joints**	**Periods: 9**
Design of power screws - Design of bolts with pre-stresses- design of joints under eccentric loading - bolts of uniform strength - Design of fillet welds- axial loads-circular fillet welds-bending and torsion.		**CO3**
UNIT - IV	**Design of Keys and Couplings**	**Periods: 9**
Design of Keys - Stresses in keys. Rigid couplings – Muff, Split muff, and Flange couplings. Flexible couplings – Pin-Bush coupling.		**CO4**
UNIT - V	**Design of Shafts, Knuckle Joints and Simple Programs**	**Periods: 9**
Design of solid and hollow shafts for strength and rigidity – Design of shafts for complex loads– Design of Knuckle joints. Simple programs in any one programming language to design the shafts subjected to simple loading condition.		**CO5**

Lecture Periods: 30	**Tutorial Periods:15**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, 10th Edition, McGraw-Hill, 2022.
2. Bhandari V.B, “Design of Machine Elements”, McGraw-Hill Book Co, 2021..
3. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett “Mechanical Engineering Design”,10th Edition, Tata McGraw-Hill, 2019.

Reference Books

1. R.S. Khurmi and J.K. Gupta, “A Text Book of Machine Design", S.Chand Publications, 2019.
2. William Cawthorne Unwin “The Elements of Machine Design” Norderstedt Hanse books GmbH, 2017.
3. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine component Design”,6th Edition, Wiley, 2017
4. Orthwein W, “Machine Component Design”, 2nd Jaico Publishing Co, 2016
5. Merhyle Franklin Spotts, Terry E. Shoup, and Lee Emrey Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2004.

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1. https://nptel.ac.in/courses/112105124/5
2. https://www.coursera.org/learn/machine-design1
3. https://www.coursera.org/courses?query=machine%20design
4. https://ocw.mit.edu/courses/2-72-elements-of-mechanical-design-spring-2009/
5. https://ocw.mit.edu/courses/mechanical-engineering/2-75-precision-machine-design-fall-2001/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	-	-	-	1	-	-	-
2	3	3	3	3	-	-	-	-	-	-	-	1	2	-	-
3	3	3	3	3	-	-	-	-	-	-	-	1	2	-	-
4	3	3	3	3	-	-	-	-	-	-	-	1	2	-	-
5	3	3	3	3	-	-	-	-	-	-	1	1	2	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Computer Science and Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **ES**			End Semester Exam Type: **LE**			
Course Code	**U23CSPC02**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**DATA STRUCTURES LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

(Common to all Branches Except CSBS and FT)

Prerequisite	Basic Programming Knowledge	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Analyse the algorithm's / program's efficiency in terms of time and space complexity.	**K3**
	CO2 Solve the given problem by identifying the appropriate Data Structure.	**K3**
	CO3 Solve the problems of searching and sorting techniques.	**K3**
	CO4 Solve problems in linear Data Structures.	**K4**
	CO5 Solve problems in non-linear Data Structures.	**K4**

List of Experiments

1. Write a C program to implement recursive and non-recursive i) Linear search ii) Binary Search.
2. Write a C program to implement i) Bubble sort ii) Selection sort iii) Insertion sort iv) Shell sort v) Heap sort.
3. Write a C program to implement the following using an array. a) Stack ADT b) Queue ADT
4. Write a C program to implement list ADT to perform following operations a) Insert an element into a list.
   a) Delete an element from list b) Search for a key element in list c) count number of nodes in list.
5. Write a C program to implement the following using a singly linked list. a) Stack ADT b) Queue ADT.
6. Write a C program to implement the dequeue (double ended queue) ADT using a doubly linked list and an array.
7. Write a C program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.
8. Write a C program that use recursive functions to traverse the given binary tree in
   a) Preorder b) Inorder c) Postorder.
9. Write a C program to perform the AVL tree operations.
10. Write a C program to implement Graph Traversal Techniques.
11. Write a C program to implement the Set operations.
    a) Union b) Intersection c) Difference.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. Yashavant Kanetkar, "Data Structures through C", BPB Publications, 3rd Edition, 2019.
2. Tenebaum Aaron M, "Data Structures using C', Pearson Publisher, 1st Edition, 2019.
3. Manjunath Aradhya M and Srinivas Subramiam, "C Programming and Data Structures", Cengage India 1st Edition, 2017.
4. Reema Thareja, "Data structures using C", Oxford University, 2nd Edition, 2014
5. Gav.pai, "Data Structures and Algorithms", McGraw-Hill India, 1st Edition, 2013.

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1. https://www.tutorialspoint.com/data_structures_algorithms/
2. https://www.w3schools.in/data-structures-tutorial/intro/
3. https://nptel.ac.in/courses/106103069/
4. https://swayam.gov.in/nd1_noc20_cs70/preview
5. https://nptel.ac.in/courses/106103069

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	3	2	3
2	3	2	1	1	-	-	-	-	-	-	-	-	3	2	3
3	3	2	1	1	-	-	-	-	-	-	-	-	3	2	3
4	3	2	1	1	-	-	-	-	-	-	-	-	3	2	3
5	3	2	1	1	-	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **PC**			End Semester Exam Type: **LE**			
Course Code	**U23MEP506**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ANALYSIS AND SIMULATION LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
MECH								
Prerequisite	Strength of Materials, CAD							

Course Outcome		**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1	Calculate the deflection and stress occurring on the mechanical components.	**K3**
	CO2	Perform structural analysis on 2D and 3D elements	**K2**
	CO3	Familiarize on the Structural and Thermal Analysis of 2D and 3D elements using Ansys	**K3**
	CO4	Extend CAM software to generate NC code..	**K2**
	CO5	Find out the vibration effects on mechanical components.	**K3**

List of Experiments

1. Stress analysis of simply supported beam
2. Stress analysis of cantilever beam
3. Stress analysis of fixed beam
4. Stress analysis of a truss
5. Stress analysis of an axi-symmetric component
6. Structural Analysis of a 3D Cantilever Beam and Validating the results with 1D and 2D options in ANSYS
7. Stress analysis of a plate with a circular hole
8. Thermal stress analysis of a 2D component
9. Conductive heat transfer analysis of a 2D component
10. Convective heat transfer analysis of a 2D component
11. Programming and simulation of given component using CAM software (Lathe).
12. Programming and simulation of given component using CAM software (Milling).
13. Programming and machining of given component using Universal Milling Machine.
14. Simulation of Spring-mass system using MAT LAB
15. Simulation of cam and follower mechanism using MATLAB

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. Divya Zindani, Working with ANSYS,IK International Publishing House Pvt. Ltd, 2016.
2. Ken Evans, "Programming of CNC Machines", Industrial Press Inc., U.S.; 4th edition, 2016.
3. R.K. Singal, Mridul Singal, Rishi Singal. “Fundamentals of Machining and Machine Tools” - I.K. International Publishing Home Pvt. Ltd; New Delhi, 2008.
4. Automation, Production Systems, and Computer-Integrated Manufacturing" by Mikell P. Groover, 5th Edition, 2020.
5. "MATLAB: A Practical Introduction to Programming and Problem Solving" by Stormy Attaway, Elsevier, 6th Edition, 2022.

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1. https://sites.ualberta.ca/wmoussa/AnsysTutorial
2. https://www.vlab.co.in/broad-area-mechanical-engineering
3. http://vlabs.iitkgp.ernet.in/tcad/
4. Mastercam Learning Resources- https://www.mastercam.com/learning/
5. Matlab Learning Resources- https://matlabacademy.mathworks.com

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
4	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
5	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **PC**			End Semester Exam Type: **LE**			
Course Code	**U23MEP507**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**DYNAMICS OF MACHINERY LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

MECH

Prerequisite	Basic Knowledge of Science	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Construct and perform analysis on various governor and understand the gyroscopic principles	**K3**
	CO2 Perform different modes of balancing and cam analysis	**K3**
	CO3 Identify and analysis different modes of vibration	**K4**
	CO4 Analyse and understand the critical speed of shafts and whirling phenomena with and without rotors.	**K4**
	CO5 Perform and interpret cam motion analysis and pressure distribution in journal bearings under different conditions.	**K4**

List of Experiments

1. Demonstration of four bar inversion mechanism
2. Natural frequency of single mass, single helical spring system
3. Natural frequency of combination of springs – springs in parallel, springs in series
4. Natural frequency of undamped torsional single rotor, double rotor system Effect of inertia (I) and stiffness(k)
5. Determination of radius of gyration of a given compound pendulum
6. Determination of radius of gyration, moment of inertia – bifilar suspension method – trifilar suspension method
7. Damping coefficient of torsional single rotor system – Effect of depth of immersion in oil and damping ratio
8. Resonance frequency of equivalent spring mass system – undamped and damped condition
   a) To plot amplitude Vs frequency graph for different damping
9. Determination of characteristic curves of Watt, Porter, Proell and spring loaded governors
10. Static and Dynamic balancing
11. Whirling of shafts/ determination of critical speed with and without Rotors
12. Gyroscopic couple verification
13. Journal bearing – pressure distribution of different loads at different Speeds
14. Cam motion analysis

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. R.L. Norton, Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines, 6th edition, McGraw-Hill Education, 2019.
2. S.S.Rattan, Theory of Machines,3rd edition, Tata McGraw-Hill Education India, 2019
3. Sadhu Singh, Theory of Machines: Kinematics and Dynamics, 3rdEdition, Publisher: Pearson Education India, 2014
4. Thomas Bevan, Theory of Machines: An Introductory Text, 3rd edition, CBS Publishers & Distributors, 2012.
5. J.E. Shigley and J.J. Uicker Jr., Theory of Machines and Mechanisms, 4th edition, Oxford University Press, 2010
6. J.S. Rao and R.V. Dukkipati, Mechanism and Machine Theory, 2nd edition, New Age International Publishers, 2007

Web References

1. https://nptel.ac.in/courses/112/105/112105268/
2. https://www.coursera.org/browse/engineering/mechanical-engineering
3. https://www.learnengineering.org/
4. https://www.coursera.org/browse/engineering/mechanical-engineering
5. https://www.khanacademy.org/science/physics/forces-newtons-laws

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	-	-	-	-	3	-	-	-	2	2	3
2	3	2	3	-	-	-	-	-	3	-	-	-	3	2	3
3	3	2	3	-	-	-	-	-	3	-	-	-	3	2	3
4	3	2	3	3	-	-	-	-	3	-	-	-	3	2	3
5	3	2	3	3	-	-	-	-	3	-	-	1	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme: **B. Tech.**						
Semester	**V**	Course Category Code: **PA**			*End Semester Exam Type: **-**			
Course Code	**U23MEW501**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MICRO PROJECT**	**0**	**0**	**2**	**1**	**100**	**0**	**100**
Prerequisite	Mechanical Engineering							

Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Identify the problem statement for the micro project work through the literature survey	**K2**
	CO2 Choose the proper components as per the requirements of the design/ system**.**	**K2**
	CO3 Apply the acquainted skills to develop final model/system	**K3**

There shall be a Micro Project, which the student shall pursue as a team consists of maximum 4 students during the third year, fifth semester. The aim of the micro project is that the student has to understand the real time hardware / software applications. The student should gain a thorough knowledge in the problem he/she has selected and in the hardware / software he/she using in the Project. The Micro-project is an application that should be formally initiated and should be developed and also to be implemented by the respective team.

The Micro Project shall be submitted in a report form along with the hardware model / software developed, duly approved by the department internal evaluation committee. It shall be evaluated for 100 marks as Continuous Assessment. The department internal evaluation committee shall consist of faculty coordinator, supervisor of the project and a senior faculty member of the department. There shall be two reviews that will be considered for assessing a Micro Project work with weightage as indicated evaluation Methods.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

COs/POs/PSOs Mapping

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	2	3	3	3	-	-	-	3	2	2	2	2	2	3
2	3	2	3	3	3	-	-	-	3	2	2	2	2	2	3
3	3	2	3	3	3	-	-	-	3	2	2	2	3	3	3

Correlation Level: 1 – Low, 2 – Medium, 3 – High

Evaluation Methods

Assessment	**Review 1**			**Review 2**				**Total Marks**
	Novelty	**Presentation**	**Viva**	**Presentation**	**Demonstration**	**Viva**	**Report**	
Marks	10	20	10	20	20	10	10	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **AEC**			End Semester Exam Type: **-**			
Course Code	**U23MEC5XX**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**CERTIFICATION COURSE – V**	**0**	**0**	**4**	**0**	**100**	**0**	**100**

Students shall choose an International / Reputed organization certification course of 40-50 hours duration specified in the curriculum (It is mandatory to do a minimum of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation.

(i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks.

(ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as “pass” on satisfactory completion. A letter grade “P” is awarded to declare pass.

(iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.

Evaluation Methods

Assessment	**Continuous Assessment Marks (CAM)**		**Total Marks**
	Attendance	**MCQ Test**	
Marks	10	90	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **AEC**			End Semester Exam Type: **-**			
Course Code	**U23MEM505**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE**	**2**	**0**	**0**	**0**	**100**	**0**	**100**

(Common to ALL Branches)

Prerequisite	-	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Familiarize with the philosophy of Indian culture	**K2**
	CO2 Distinguish the Indian languages and literature	**K2**
	CO3 Describe the philosophy of ancient, medieval and modern India	**K2**
	CO4 Illustrate the information about the fine arts in India	**K2**
	CO5 Describe the contribution of scientists of different eras	**K2**

UNIT - I	**Introduction To Culture**	**Periods:06**
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India		**CO1**
UNIT - II	**Indian Languages, Culture and Literature**	**Periods:06**
Indian Languages and Literature - I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature		**CO2**
UNIT - III	**Religion and Philosophy**	**Periods:06**
Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)		**CO3**
UNIT - IV	**Fine Arts in India (Art, Technology and Engineering)**	**Periods:06**
Indian Painting, Indian handicrafts, Music, divisions of Indian classical music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India		**CO4**
UNIT - V	**Education System in India**	**Periods:06**
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India		**CO5**

Lecture Periods: 30	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”, ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. S. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978 - 8120810990, 2014

Web References

1. https://nptel.ac.in/courses/109/104/109104102/
2. https://nptel.ac.in/courses/101/104/101104065/
3. https://nptel.ac.in/courses/109/108/109108158/
4. https://nptel.ac.in/courses/109/106/109106059/
5. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ae01/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	-	-	-	-	-	3	-	1	1	2	2
2	3	2	-	-	-	-	-	-	-	3	-	1	1	2	2
3	3	2	-	-	-	-	-	-	-	3	-	1	1	3	3
4	3	2	-	-	-	-	-	-	-	3	-	1	1	3	3
5	3	2	-	-	-	-	-	-	-	3	-	1	1	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100

SEMESTER VI

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VI**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MET610**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**METROLOGY AND MEASUREMENT**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Basic Physics							

Course Outcome			BT Mapping (Highest Level)
	On completion of the course, the students will be able to		
	CO1	Explain the measurement concepts that are used with different metrological devices.	**K2**
	CO2	Outline the principles of linear and angular measurement tools used for industrial applications.	**K2**
	CO3	Describe the steps involved in carrying out computer-aided inspection.	**K2**
	CO4	Demonstrate the techniques of form measurement used for industrial components.	**K3**
	CO5	Apply various measuring techniques of mechanical properties in industrial needs.	**K4**

UNIT - I	**Basics of Metrology**	**Periods: 9**	
Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy- Limits, Fits and Tolerances - concepts of interchangeability and selective assembly – Errors in Measurements – Types – Control – Standards of Measurements - Types.			**CO1**
UNIT - II	**Linear and Angular Measurements**	**Periods: 9**	
Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure - Comparators – types – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.			**CO2**
UNIT - III	**Advances in Metrology**	**Periods: 9**	
Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.			**CO3**
UNIT - IV	**Form Measurement**	**Periods: 9**	
Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.			**CO4**
UNIT - V	**Measurement of Power, Flow and Temperature**	**Periods: 9**	
Force, torque, power - mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orificemeter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration – Readability and Reliability.			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. R.K.Rajput, “Measurements & Metrology”, S.K. Kataria and Sons Publishers, 2023.
2. Samir Mekid, “Metrology and Instrumentation”, Wiley Publishers, 25th Edition 2022.
3. J.P.Hadiya, H.G.Kataria,” Mechanical Measurements and Metrology”, Books India Publications, 2018

Reference Books

1. I.C Gupta, “A Textbook of Engineering Metrology” Paperback Dhanpat Rai Publications, 2019.
2. A.Bewoor and Vinay Kulkarni, “Metrology & Measurement” McGraw Hill Education, 2017.
3. Krishnamurthy Raghavendra, “Engineering Metrology and Measurements” Oxford University Press, 2013.
4. Backwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education, 2013.
5. Rega Rajendira,”Principles of Engineering Metrology”, Jaico Publishing House, 2008.

Web References

1. https://nptel.ac.in/courses/112106179/
2. https://nptel.ac.in/courses/112106138/
3. https://www.metrologyparts.com/resources/

4.	https://ndl.iitkgp.ac.in/homestudy/engineering
5.	https://www.nist.gov/dimensional-metrology

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	-	1	-	-	-	-	1	-	1	2	1	2
2	3	1	1	-	1	-	-	-	-	1	-	1	2	1	2
3	3	1	1	-	1	-	-	-	-	1	-	1	2	1	2
4	3	1	1	-	1	-	-	-	-	1	-	1	2	1	2
5	3	1	1	-	1	-	-	-	-	1	-	1	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VI**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MET611**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**THERMAL ENGINEERING**	**2**	**1**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Applied thermodynamics							

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
CO1	Recognize the components and compute the performance of internal combustion engines	**K2**
CO2	Illustrate the working of Brayton and steam power cycles in T-S diagram and formulate its efficiency	**K2**
CO3	Resolve the problems involving steam nozzles and steam turbines	**K3**
CO4	Compare the working and performance of reciprocating and rotary compressors	**K3**
CO5	Estimate the capacity of refrigeration and air conditioning system	**K4**

UNIT - I	**IC Engines Classification**	**Periods: 9**
Classification of IC engines – petrol and diesel engines; two stroke and four stroke engines – scavenging in two stroke engines - port and valve timing diagram - fuel supply system in SI and CI engines - ignition system and its types – cooling system and its types – lubrication system and its types		**CO1**
UNIT - II	**Gas and Steam Power Cycles**	**Periods: 9**
Gas power cycle -Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure and air standard efficiency, Steam power cycles-Rankine cycle, Modifications with reheater and regenerator ((Descriptive treatment only),		**CO2**
UNIT - III	**Steam Nozzles and Turbines**	**Periods: 9**
Types and shapes of nozzles, Flow of steam through nozzles effect of friction – Nozzle efficiency- General relationship between area, velocity and pressure in nozzle flow. Critical pressure ratio – Types of turbine -Impulse and reaction principles, compounding, and velocity diagrams for simple turbines, speed regulations – governors.		**CO3**
UNIT - IV	**Air Compressor**	**Periods: 9**
Classification - Reciprocating Air Compressor - working principle, work of compression with and without clearance. Multistage air compressor and inter cooling (Descriptive treatment only), Rotary Compressors – Centrifugal Compressor and axial flow compressor (Descriptive treatment only), Screw Compressors		**CO4**
UNIT - V	**Refrigeration and Air-Conditioning**	**Periods: 9**
Fundamentals of refrigeration and air conditioning –Types of Air-conditions system Vapour compression refrigeration cycle-super heat, sub cooling-: - Vapour absorption refrigeration system – Types of Air conditioning systems- summer and winter Air conditioning system		**CO5**

Lecture Periods: 30	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Frank Kreith Ed, the CRC Handbook of Thermal Engineering, CRC Press LLC, 2013.
2. Kothandaraman.C.P.,Domkundwar.S, Domkundwar.A.V.,"A course in thermal Engineering",DhanpatRai&sons, 2004.
3. Ganesan. V., "Internal CombustionEngines",TataMcGraw-Hill,2007

Reference Books

1. Rajput R.K, Thermal Engineering, 10th edition, Lakshmi Publications, 2018
2. Yunus A. Cengel, Robert H. Turner, John M. Cimbala,Fundamentals of Thermal-Fluid Sciences,Indian edition, 2016
3. Rudramoorthy R, "Thermal Engineering", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2016.
4. Willard W. Pulkrabek– Internal Combustion Engines, Prentice Hall of India, 2003.
5. J.B. Heywood– Internal Combustion Engines – fundamentals, McGraw Hill, 1988

Web References

1. https://nptel.ac.in/courses/112/103/112103262/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://nptel.ac.in/courses/112/103/112103275/
4. https://nptel.ac.in/courses/112/106/112106133/
5. https://nptel.ac.in/courses/112/105/112105129

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	-	-	-	1	-	-	3	3	3	3
2	3	3	3	3	-	-	-	-	1	-	-	1	3	1	2
3	3	3	3	3	-	-	-	-	1	-	-	1	3	1	2
4	3	3	3	3	-	-	-	-	1	-	-	1	3	1	2
5	3	3	3	3	-	-	-	-	1	-	-	2	3	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical**	Programme : **B.Tech.**						
Semester	**VI**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MET612**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MANUFACTURING TECHNOLOGY AND AUTOMATION**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Engineering Metallurgy, Manufacturing Process							

Course Outcome			BT Mapping (Highest Level)
	On completion of the course, the students will be able to		
	CO1	Understand the principles of unconventional machining process and advantages.	**K2**
	CO2	Gain knowledge about micro machining and simulation of atomic scale level for industrial solutions.	**K3**
	CO3	Illustrate the importance of modern micro fabrication processes and wide range of applications in industries.	**K3**
	CO4	Develop programs related to manufacturing using codes.	**K4**
	CO5	Design, analyse and optimize automated flow lines and AI in manufacturing system.	**K3**

UNIT- I	**Introduction to Non-Traditional Machining**	**Periods: 9**
Introduction to Non-traditional machining, Need for Non-traditional machining process, Comparison between Traditional and non-traditional machining. Selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes. Introduction, equipment and material process of EDM, ECM, ECG, AJM and USM.		**CO1**

UNIT- II	**Micro Machining Process**	**Periods: 9**
Micromachining – definition - principle of mechanical micromachining - Classification of micromachining and Nano finishing processes. Molecular dynamics simulations of machining at atomic scale. Diamond Turn Machining (DTM) - components of DTM – requirements of DTM - material removal mechanism – molecular dynamics - tool geometry.		**CO2**

UNIT- III	**Micro Fabrication**	**Periods: 9**
Materials for Microsystems manufacture - Substrates and Wafers, active substrate materials, silicon and silicon components. Photolithography based micro fabrication processes - Photo resist development. Additive and subtractive techniques – CVD – PVD – etching - chemical, plasma - resists removal. Large aspect ratio micro manufacturing - LIGA, Deep Reactive Ion Etching.		**CO3**

UNIT- IV	**Numerical Control Machines**	**Periods: 9**
N.C. machines – Introduction. Types, Economics advantages and applications, CNC, DNC (Direct and Distributed). Turning and Machining centres– Description and Types of ATC, applications.NC part programming – Types – Introduction to programming languages, APT programming, Examples on CNC Turning, Milling & Drilling operations, Preliminary study on simulation of CAD based NC programming		**CO4**

UNIT- V	**Manufacturing Automation**	**Periods: 9**
Manufacturing Systems- Components & classifications, Automation in manufacturing systems, principles and strategies, mathematical models, costs. Single-station manufacturing cells. Automated flow lines: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration. AI in manufacturing systems.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Education, 5 th Edition, 2024.
2. Mikell P. Groover, ‘‘Fundamentals of Modern Manufacturing-Materials, Processes, and Systems’’, Wiley 8 th Edition 2022.
3. P. Radhakrishnan and S. Subramanian – ‘‘CAD/CAM/CIM’’, Wiley Eastern Ltd., 2000.

Reference Books

1. Eun Sok Kim, ‘‘Fundamentals of Microelectromechanical Systems (MEMS)’’, 1st Edition, McGraw Hill, 2021.
2. Amey Khot Ashok, Advanced Manufacturing Process, 2014
3. V. K. Jain, Introduction to Micromachining, Alpha Science International Ltd, 2010
4. Ramandeep Singh, ‘‘Computer Numerical Control Machines’’, Eagle's 2021.
5. Chua C.K., Leong K.F., And Lim C.S., “Rapid Prototyping: Principles and Applications”, Third Edition, World Scientific Publishers, 2010

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1. https://www.youtube.com/watch?v=cghHDQrdObo&t=7s

2.	https://www.youtube.com/watch?v=PN_tGm5Gip4
3.	https://youtu.be/YjcC_lUtMqw?si=BbSy7Zco9JjFdDpO
4.	https://www.youtube.com/watch?v=-NINgz6KQTA
5.	https://www.youtube.com/watch?v=4ZmdHWGF9pg

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	2	1	-	-	-	-	-	2	2	2	3
2	3	1	1	1	2	2	-	-	-	-	-	2	3	2	3
3	3	2	2	2	3	2	-	-	-	-	-	2	3	3	3
4	3	2	2	1	3	1	-	-	-	-	-	2	3	3	3
5	3	3	2	1	3	2	-	-	-	2	-	3	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VI**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MEB603**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**AUTOMOBILE ENGINEERING**	**2**	**0**	**2**	**3**	**50**	**50**	**100**
MECH								
Prerequisite	Basics of Mechanical Engineering							

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
CO1	Demonstrate the function of chassis, body and frame.	**K3**
CO2	Interrupt the knowledge on the types of transmission systems.	**K3**
CO3	Establish the different suspension and braking systems.	**K3**
CO4	Dismantle and assemble the components of clutch and transmission systems	**K4**
CO5	Dismantle and assemble the components of suspension and transmission systems	**K4**

UNIT- I	**Introduction to Automobiles**	**Periods: 10**
Classification of Automobiles – Types of Drive – Chassis – Frames – Resistances to a moving vehicle – Injection system – Electronic engine management system – Supercharging – Turbo Chargers – EGR – Catalytic converter – Pollution Norms		**CO1**
UNIT- II	**Clutch and Transmission Systems**	**Periods: 10**
Clutches – Types of Clutches – Gear box – Types of Gear Boxes – Fluid Transmission – Fluid Flywheel and Torque Converter – Automatic Transmission – Differential – Drive line system - Tyre - Battery		**CO2**
UNIT- III	**Suspension and Braking Systems**	**Periods: 10**
Suspension System – Springs – Torsion bar – Shock Absorber - Types of Suspension – Air Suspension - Steering Mechanism – Steering System - Wheel Alignment - Braking system – Classification of Brakes		**CO3**
UNIT- IV	**Automobile Engineering Practice I**	**Periods:15**
1. Case study of chassis and body. 2. Dismantle and assemble of Single plate clutch. 3. Dismantle and assemble of Two Wheeler Gearbox. 4. Dismantle and assemble of Differential. 5. Dismantle and assemble of Steering Gearbox.		**CO4**
UNIT- V	**Automobile Engineering Practice II**	**Periods:15**
1. Identify various specifications of Wheels and Tyres in a passenger vehicle. 2. Tyre change and repair (with tube and tubeless). 3. Study on the hydraulic brake system. 4. Dismantle and assemble of a braking system. 5. Two Wheeler Brake and Clutch Play Adjustment.		**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 60**

Text Books

1. R.K.Rajput, “A Textbook of Automobile Engineering”, Laxmi Publications Pvt Ltd”, 3rd Edition, 2023.
2. Kirpal Singh, “Automobile Engineering Volume I and II”, Standard Publishers and Distributors, 14th Edition, 2019.
3. N.K. Giri, “Automotive Technology”, Khanna Publishers, 2nd Edition, 2014.

Reference Books

1. Halderman, “Automotive Engines: Theory and Servicing”, Pearson, 2019
2. D.S.Kumar, “Automobile Engineering”, S.K.Kataria and Sons, 2nd Edition, 2015.
3. P.S.Gill., “A Textbook of Automobile Engineering – Vol. I, II and III”, S.K.Kataria and Sons, 2nd Edition, 2012.
4. K.K.Ramalingam, “Automobile Engineering”, Scitech publications, 2011.
5. Robert Bosch GmbH, “Automotive Handbook”, Robert Bosch, 2004.

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2. https://www.carmagazine.co.uk/
3. https://www.car-engineer.com/
4. https://www.cartalk.com/
5. https://auto.howstuffworks.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	-	-	-	-	-	-	-	-	2	2	2	2
2	2	2	2	-	-	-	-	-	-	-	-	2	2	2	2
3	2	2	2	-	-	-	-	-	-	-	-	2	2	2	2
4	3	3	3	3	-	3	3	-	3	-	3	3	3	3	3
5	3	3	3	3	-	3	3	-	3	-	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment method for theory cum practical courses

Assessment	Continuous Assessment Marks (CAM)									End Semester Examination (ESE) Marks (Practical – Internal Evaluation)	End Semester Examination (ESE) Marks (Theory)	Total Marks
	Continuous ssessment (Theory)					Continuous ssessment (Practical)						
	CAT 1	CAT 2	Model	Attendance	Total	Conduction of Practical	Report	Viva	Total			
Marks	5	5	5	5	20*	15	10	5	30*	30	75**	-
*To be weighted for 10 Marks					10	*To be weighted for 10 Marks			10		*To be weighted for 50 Marks	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VI**	Course Category: **PC**			End Semester Exam Type: **LE**			
Course Code	**U23MEP608**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**THERMAL ENGINEERING LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
MECH								
Prerequisite	Basic Knowledge of Science							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Sketch the valve timing diagram and port timing diagram for single cylinder four stroke diesel engine and two stroke petrol engine.	**K5**
	CO2 Design and conduct experiments, as well as to analyze and interpret data for internal Combustion Engines	**K5**
	CO3 Calculate the mechanical efficiency of four stroke SI engine by Morse test	**K3**
	CO4 Evaluate the performance of four stroke single cylinder CI engine & Predict actual diagram.	**K5**
	CO5 Evaluate the performance of steam generator and steam turbines	**K2**

List of Experiments

1. Valve and port timing diagrams of 4-stroke and 2-stroke IC engines respectively
2. Performance test on Single/multi cylinder 4-stroke petrol engines
3. Performance test on Single/multi cylinder 4-stroke Diesel engines
4. Heat balance test on IC engines
5. Retardation and motoring test on 4-stroke engine
6. Performance test on Vapour compression Refrigeration system
7. Performance test on Air-conditioning system
8. Performance test on cooling system
9. Performance test on Vapour absorption Refrigeration system
10. Engine exhaust gas analysis using Orsat apparatus
11. Performance test on a boiler
12. Performance test on steam turbine
13. Determination of dryness fraction of steam using calorimeter
14. Assembly/Dismantling of Engines to identify the parts and their position in an engine

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. Willard W. Pulkrabek– Internal Combustion Engines, Prentice Hall of India, 2003.
2. J.B. Heywood– Internal Combustion Engines – fundamentals, McGraw Hill, 1988.
3. Rudramoorthy R, “Thermal Engineering”, Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2016.
4. Rajput R.K, Thermal Engineering, 10th edition, Lakshmi Publications, 2018
5. Yunus A. Cengel, Robert H. Turner, John M. Cimbala,Fundamentals of Thermal-Fluid Sciences,Indian edition,2016

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1. https://nptel.ac.in/courses/112/103/112103262/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://nptel.ac.in/courses/112/103/112103275/
4. https://nptel.ac.in/courses/112/106/112106133/
5. https://nptel.ac.in/courses/112/105/112105129/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	-	-	3	-	-	-	3	3	1	3	3	3	1
2	-	-	-	-	3	-	-	-	3	3	1	3	3	3	1
3	-	-	-	-	3	-	-	-	3	3	1	3	3	3	1
4	-	-	-	-	3	-	-	-	3	3	1	3	3	3	1
5	-	-	-	-	3	-	-	-	3	3	1	3	3	3	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme: **B.Tech.**						
Semester	**VI**	Course Category: **PC**			End Semester Exam Type: **LE**			
Course Code	**U23MEP609**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**METROLOGY AND MEASUREMENTS LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
MECH								
Prerequisite	Basic Physics							

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
CO1	Explain the basics knowledge of measurements, metrology and measuring devices.	**K1**
CO2	Recognize the fundamentals of linear and angular measuring devices.	**K1**
CO3	Demonstrate measurements using linear and angular measuring instruments.	**K3**
CO4	Interpret the error and correction factors for different types of measurement devices.	**K4**
CO5	Analyze the findings of measurements obtained using different instruments.	**K4**

List of Experiments

1. Study of Vernier Caliper, Micrometer and Height gauge.
2. Study of Profile projector.
3. Study of Coordinate Measuring Machine (CMM) for various elements.
4. Calibration of Vernier caliper, Micrometer and Height gauge.
5. Measurement of Wedge angle using Sine Bar.
6. Measurement of Thread Parameter Using Tool Maker's Microscope.
7. Measurement of Strain using Strain Gauges.
8. Measurement of Pressure using Strain Gauges.
9. Characteristics of Thermocouple.
10. Characteristics of Load cell.
11. Characteristics of LVDT.
12. Measurement of speed using stroboscope.
13. Inspection of gear tooth using profile projectors.
14. Measurement of straightness of the surface using autocollimator.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. R.K.Rajput, "Measurements & Metrology", S.K. Kataria and Sons Publishers, 2023
2. R.K.Jain, Engineering Metrology, Khanna publications, New Delhi, 2022.
3. Backwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2013
4. R.V.Jalgaonkar, Mechanical measurements and Control, Everest publications, New Delhi, 2010.
5. Rega Rajendira ,"Principles of Engineering Metrology", Jaico Publishing House, 2008

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2. https://www.youtube.com/watch?v=v7NUi88Lxi8&t=19s
3. https://sites.google.com/view/vlab-bnmitmech/home
4. http://mech.sliet.ac.in/laboratories/precision-metrology-measurement-lab/
5. https://www.youtube.com/watch?v=PO-Ab7YfBzY

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	-	-	-	-	-	1	2	3	2	2
2	3	1	2	2	1	-	-	-	-	-	1	2	2	3	2
3	3	1	2	2	3	-	-	-	-	-	1	2	3	2	2
4	3	2	3	2	1	-	-	-	-	-	1	1	3	3	2
5	3	2	2	2	2	-	-	-	-	-	1	2	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VI**	Course Category: **PC**			End Semester Exam Type: **LE**			
Course Code	**U23MEP610**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ADVANCED MANUFACTURING LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
MECH								
Prerequisite	Manufacturing Process							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Demonstrate the various milling operations.	**K2**
	CO2	Demonstrate the gear generation profile.	**K3**
	CO3	Understand the function and applications of tool cutter grinder.	**K3**
	CO4	Distinguish different measuring devices according to the work.	**K3**
	CO5	Apply G-code programs to CNC lathes and milling.	**K4**

List of Experiments

1. Study of milling machines and various cutters.
2. Cube Milling process using milling Machine
3. Step milling process using milling Machine
4. Contour Milling using vertical Milling machine
5. Spur Gear cutting in Milling machine
6. Helical Gear Cutting in Milling machine
7. Demonstrate of Gear hobbing machine
8. Gear generation in Hobbing machine
9. Study of Tool grinding machine.
10. Tool grinding in tool and Cutter Grinder
11. Introduction to CNC Machines
12. Writing and execution of Step turning in CNC Lathe Machine
13. Writing and execution of Facing and plain turning in CNC Lathe Machine
14. Writing and execution of Face milling in CNC Milling Machine
15. Writing and execution of Pocket milling in CNC Milling Machine

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. Yoram Koren, “Computer Control of Manufacturing Systems”, McGraw-Hill, 2005.
2. P.N. Rao, “Manufacturing Technology – Metal Cutting and Machine Tools”-Tata Mc Graw Hill Publishing Company Ltd, 2008.
3. Mohd. Mukhtar Alam, Naresh D.N, Girish Chitoshiya, ‘‘Machining and Machine Tools’’, Genius Publication, 2014.
4. S.Kalpakjain, S.Schimd, “Manufacturing Engineering and Technology”, Pearson Education, 7th edition, 2018.
5. Muammer Koc, Tugrul Ozel, ‘‘Modern Manufacturing Processes’’, Wiley, 2019.

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1. http://mech.sliet.ac.in/advance-machining-lab/
2. https://nptel.ac.in/courses/112/107/112107219/
3. https://nptel.ac.in/content/storage2/courses/112105127/pdf/LM-19.pdf.
4. http://electron.mit.edu/~gsteele/mirrors/www.nmis.org/EducationTraining/machineshop/mill/intro.html.
5. http://web.mit.edu/2.810/www/files/lectures/lec5-machining-2018.pdf.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
4	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1
5	3	2	2	1	1	-	-	-	-	-	-	1	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme: **B. Tech.**						
Semester	**VI**	Course Category: **PA**			End Semester Exam Type: **-**			
Course Code	**U23MEW602**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MINI PROJECT**	**0**	**0**	**2**	**1**	**100**	**0**	**100**
MECH								
Prerequisite	Mechanical Engineering							

Course Outcomes			BT Mapping (Highest Level)
	On completion of the course, the students will be able to		
	CO1	Identify the problem statement for the mini project work through the literature survey	**K2**
	CO2	Choose the proper components as per the requirements of the design/ system**.**	**K2**
	CO3	Apply the acquainted skills to develop final model/system	**K3**

There shall be a Mini Project, which the student shall pursue as a team consists of maximum 4 students during the third year, fifth semester. The aim of the mini project is that the student has to understand the real time hardware / software applications. The student should gain a thorough knowledge in the problem he/she has selected and in the hardware / software he/she using in the Project. The Mini-project is an application that should be formally initiated and should be developed and also to be implemented by the respective team.

The Mini Project shall be submitted in a report form along with the hardware model / software developed, duly approved by the department internal evaluation committee. It shall be evaluated for 100 marks as Continuous Assessment. The department internal evaluation committee shall consist of faculty coordinator, supervisor of the project and a senior faculty member of the department. There shall be two reviews that will be considered for assessing a Mini Project work with weightage as indicated evaluation Methods.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

COs/POs/PSOs Mapping

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	2	3	3	3	-	-	-	3	2	2	2	2	2	3
2	3	2	3	3	3	-	-	-	3	2	2	2	2	2	3
3	3	2	3	3	3	-	-	-	3	2	2	2	3	3	3

Correlation Level: 1 – Low, 2 – Medium, 3 – High

Evaluation Methods

Assessment	**Review 1**			**Review 2**				**Total Marks**
	Novelty	**Presentation**	**Viva**	**Presentation**	**Demonstration**	**Viva**	**Report**	
Marks	10	20	10	20	20	10	10	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VI**	Course Category: **AEC**			End Semester Exam Type: **-**			
Course Code	**U23MEC6XX**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**CERTIFICATION COURSE – VI**	**0**	**0**	**4**	**0**	**100**	**0**	**100**

MECH

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass / Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree

Students shall choose an International / Reputed organization certification course of 40-50 hours duration specified in the curriculum (It is mandatory to do a minimum of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation.

(i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks.

(ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as “pass” on satisfactory completion. A letter grade “P” is awarded to declare pass.

(iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.

Evaluation Methods

Assessment	**Continuous Assessment Marks (CAM)**		**Total Marks**
	Attendance	**MCQ Test**	
Marks	10	90	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VI**	Course Category: **MC**			End Semester Exam Type: **TE**			
Course Code	**U23MEM606**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**GENDER EQUALITY**	**2**	**0**	**0**	**0**	**100**	**0**	**100**
Common to All Branches								
Prerequisite	-							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Describe the general identity, social construction of gender roles.	**K2**
	CO2	Illustrate the causes and issues of gender discrimination in Indian society.	**K2**
	CO3	Describe the workplace discrimination, media influences on gender and culture.	**K2**
	CO4	Familiarize with international and Indian frameworks on gender equality.	**K2**
	CO5	Illustrate the current challenges in gender equality, including the glass ceiling and the role of technology.	**K2**

UNIT- I	**Introduction to Gender Equality**	**Periods:06**
Gender equality – exploring gender identity and expression, Understanding the social construction of general roles and norms, historical perspectives on gender roles, Analyzing key milestones in the fight for gender equality.		**CO1**
UNIT- II	**Gender Inequality and Its Manifestations**	**Periods:06**
Gender discrimination in Indian society – causes of gender inequality – Illiteracy, patriarchal set up, lack of awareness, social beliefs, practice and custom – Issues of gender discrimination – Child marriage, child domestic work, poor education and health, violence and exploitation in workplace.		**CO2**
UNIT- III	**Gender and Culture**	**Periods:06**
Workplace discrimination, Media influences on gender and culture, Gender and power dynamics in society. Strategies for promoting gender equality and cultural understanding.		**CO3**
UNIT- IV	**Promoting Gender Equality**	**Periods:06**
Gender Equality and Human Rights – International frameworks and Conventions on Gender Equality – Equality under the Indian Constitution – Policies and initiatives for gender mainstreaming – Strategies for promoting Gender Equality in various contexts.		**CO4**
UNIT- V	**Contemporary Challenges and Future Directions**	**Periods:06**
Current challenges and emerging issues in gender equality – Glass ceiling – role of technology in continuing or challenging gender inequality – Exploring possibilities for transformative change and envisioning a gender-equal future.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. "Gender and Society" by Raewyn Connell – This book provides a comprehensive overview of gender roles, power dynamics, and the social construction of gender.
2. "The Second Sex" by Simone de Beauvoir – A historical and philosophical examination of women's oppression and gender inequality.
3. "Women and Gender in the Indian Society" by Neera Desai and Usha Thakkar – Focuses on the context of gender roles, inequality, and feminist movements in India.

Reference Books

1. Woman in early Indian societies, New Delhi: Manohar Publications. Sita A. Raman (2009).
2. A social and Cultural history, Volume1. Connecticut: Oxford: Praeger. Sita Raman (2009).
3. A social and Cultural history, Volume2. Connecticut: Oxford: Praeger. Iftikhar R. (2016).
4. Indian Feminism: Class, Gender and Identity in Medieval Ages. Chennai: Notion Press. Iftikhar, R. (2012).

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1. https://www.unwomen.org
2. https://ncw.nic.in
3. https://en.unesco.org/themes/gender-equality
4. https://www.weforum.org/reports
5. https://wcd.nic.in

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	-	-	-	-	-	3	-	3	-	1	1	2	3
2	2	-	-	-	-	-	-	3	-	3	-	1	1	3	3
3	2	-	-	-	-	-	-	3	-	3	-	1	1	3	3
4	2	-	-	-	-	-	-	3	-	3	-	1	1	3	3
5	2	-	-	-	-	-	-	3	-	3	-	1	1	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100

SEMESTER VII

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VII**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MEDC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**PRODUCTION PLANNING AND COST ESTIMATION**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Computer-Aided Design(CAD), Manufacturing Processes							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Differentiate standard/ non-standard working methodologies to enhance productivity.	**K2**
	CO2	Develop operational procedures to perform process planning in industrial set up	**K2**
	CO3	Identify the costing methods and estimation procedures, also capacity to allocate cost elements, distribute over heads and calculate depreciation for a given product	**K3**
	CO4	Ability to estimate cost for various production processes like forging, welding, casting processes for a given product.	**K3**
	CO5	Estimate the machining times and costs for various conventional machining processes.	**K3**

UNIT - I	**Work Study and Ergonomics**	**Periods: 9**
Method study – Definition – Objectives - Motion economy- Principles – Tools and Techniques-Applications – Work measurements- purpose – use – procedure – tools and techniques- Standard time – Ergonomics – principles – applications – case study in Work study and Ergonomics		**CO1**
UNIT - II	**Introduction to Process Planning**	**Periods: 9**
Outline of process planning - Drawing interpretation- material selection process and methods - Selection of Production processes – standardization, simplification - Process planning activities - operating sequences - machine selection – Process parameters Equipment & Tool Selection; Tool material evaluation – Selection of Jigs and fixtures - Set of documents for process planning – Economics of process planning - Computer Aided Process planning – Manual, Retrieval CAPP and Generative CAPP – case study in Process Planning.		**CO2**
UNIT - III	**Introduction to Cost Estimation**	**Periods: 9**
Importance of costing and estimation – methods of costing – elements of cost estimation- Types of estimates – Estimating procedure.– allowances in estimation - Estimation labor cost, material cost – Ladder of cost - allocation of overhead charges – Calculation of depreciation cost.		**CO3**
UNIT - IV	**Production Cost Estimation**	**Periods: 9**
Estimation of cost for various production processes – Estimation of forging Shop – Losses in forging – Forging cost, Estimation of Welding Shop – Electric Welding cost – Gas Welding cost, Estimation of foundry Shop – Pattern cost – Casting cost		**CO4**
UNIT - V	**Estimation of Machining Time and Costs**	**Periods: 9**
Estimation for machining Time – Importance of Machine Time Calculation – Machining time Calculation for the conventional Machining processes – calculation of machining time and Cost for lathe operations, Drilling, boring, Milling and Grinding.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Sinha.B.P., "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co., 1995.
2. Banga.T.R. Sharma.S.C, Mechanical Estimating and Costing, Khanna Publishers, 2006.
3. Panneerselvam, R., Sivasankaran, P.Process Planning and Cost Estimation, Prentice-Hall of India, 2016.

Reference Books

1. Phillip.F Ostwalal and Jairo Munez, “Manufacturing Processes and systems”, John Wiley, 9th Edition, 1998
2. Chitale.A.V and Gupta.R.C. “Product Design and Manufacturing”, PHI, 2nd Edition, 2002.
3. Russell.R.S and Tailor, B.W, “Operations Management”, PHI, 4th Edition, 2003
4. M.Adithan,”Process planning and cost Estimation”, New Age International Publishers,2015
5. R. Kesavan, E.Elanchezhian, B.Vijaya Ramnath, Process planning and cost estimation, New Age International Publications, 2019

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1. https://nptel.ac.in/courses/112107238/
2. https://www.youtube.com/watch?v=yYIVumq6sVM
3. https://onlinecourses.nptel.ac.in/noc20_mg06/preview

4. https://www.youtube.com/watch?v=9qBZyzjoqAo
5. https://www.youtube.com/watch?v=UUZ3EV2Qn70

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	-	-	-	-	1	-	1	2	2	1	1
2	3	3	2	1	1	-	-	-	1	-	1	2	2	1	1
3	3	3	2	2	1	-	-	-	1	-	1	2	2	1	1
4	3	3	2	2	1	-	-	-	1	-	1	2	2	1	1
5	3	3	2	2	1	-	-	-	1	-	1	2	2	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**			Programme : **B.Tech.**			
Semester	**VII**			Course Category: **PC**		End Semester Exam Type: **TE**	
Course Code	**U23MET713**	Periods/Week			Credit	Maximum Marks	
		L	T	P	C	CAM	ESE	TM
Course Name	**INDUSTRIAL AUTOMATION AND ROBOTICS**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Kinematics of Machinery, Fluid Power Automation							

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Understand the concepts industrial automation.	**K2**
	CO2 Understand the concepts of industrial sensors and their applications.	**K2**
	CO3 Analyze and select a suitable PLC system for the given application.	**K4**
	CO4 Understand the development of robotics and future prospects.	**K2**
	CO5 Apply the various applications of robots in material handling and welding.	**K3**

UNIT - I	**Overview of Automation**	**Periods: 9**
Introduction to Industrial Automation and Control, Architecture of Industrial Automation Systems, Types of automation, significance and importance, evaluation of automation, type of Industries and components of automation.		**CO1**
UNIT - II	**Sensors**	**Periods: 9**
Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Optical, Inductive, Capacitive, Encoders, Ultrasonic Need for sensors and vision system in the working and control of a robot.		**CO2**
UNIT - III	**Programmable Logic Controller**	**Periods: 9**
Introduction to PLC, Need of PLC in Designing, Architecture of PLC, Application and Advantage of PLC, Automation Concept and Basic Design, PLC Programming.		**CO3**
UNIT - IV	**Introduction to Robotics**	**Periods: 9**
Industrial revolution, history and need of robotics Definition of a robot, three laws, Degrees of Freedom, Elements of Robotic Systems, Robot anatomy, Types and applications of robot, overview of present status and future trends End effectors, grippers, different types of grippers		**CO4**
UNIT - V	**Robot Applications**	**Periods: 9**
Industrial Applications – Material Transfer, material handling, Loading and unloading, processing, spot and continuous arc welding, spray painting, grinding, Assembly and Inspection and Non-Industrial Applications.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. A. B. Bhattacharya, Debasish Roy, “Foundations of Robotics & Automation” Khanna Publishing House, 2025
2. Jean Riescher Westcott, A.K. Gupta, S.K. Arora, ‘‘Industrial Automation and Robotics, Laxmi Publications Pvt. Limited, 2024
3. R. K.Rajput ,’’Robotics and Industrial Automation’’, S. Chand Limited, 2008

Reference Books

1. S. Mukhopadhyay, S. Sen and A. K. Deb, ‘‘Industrial Instrumentation, Control and Automation’’, Jaico Publishing House, 2013
2. James A Rehg, ‘‘Introduction to Robotics in CIM Systems’’, Prentice Hall of India, 2002
3. Kevin Collins, ‘‘PLC Programming for Industrial Automation’’, Exposure Publishing, 2007
4. Saeed Benjamin Niku, ‘‘Introduction to Robotics: Analysis, Control, Applications’’, Second Edition, Wiley ,2001
5. Rex Miller, ‘‘Robots and Robotics: Principles, Systems, and Industrial Applications’’, Mc Graw Hill,2017

Web References

1. https://onlinecourses.nptel.ac.in/noc21_me67/
2. https://nptel.ac.in/courses/112/101/112101098/
3. https://nptel.ac.in/courses/112/102/112102011/
4. https://rosindustrial.org/
5. https://opensource.com/life/16/4/open-source-robotics-projects

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	1	-	-	-	-	1	-	1	-	1	1	2	1
2	3	-	2	-	-	1	-	1	-	1	-	1	2	1	2
3	3	1	2	-	1	-	-	1	-	1	-	1	2	2	1
4	3	-	2	-	1	1	-	1	-	1	-	2	2	1	2
5	3	-	2	-	-	2	-	1	-	1	-	3	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VII**	Course Category: **PC**			End Semester Exam Type: **TE**			
Course Code	**U23MET714**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**DESIGN OF TRANSMISSION SYSTEM**	**2**	**1**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Engineering Mechanics, Strength of Materials							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Design bearings for various mechanical applications based on load and performance requirements	**K3**
	CO2	Design and analyze belt drive systems like flat and V belts with their pulleys, chain drive systems and wire ropes.	**K3**
	CO3	Evaluate beam strength and effective load on gear teeth for both spur and helical gears	**K3**
	CO4	Evaluate beam strength and effective load on gear teeth for both Bevel and Worm gear	**K3**
	CO5	Understand the concept of speed reducers and gearboxes, including their selection and applications	**K3**

UNIT - I	**Bearings**	**Periods: 9**
Theory of hydrodynamic bearing –design of journal bearing – heat dissipation – elementary ideas of hydrostatic bearings – bearing materials and lubricants. Rolling contact bearings – load capacity and life – selection of rolling contact bearings for radial and axial loads		**CO1**
UNIT - II	**Belt, Chain and Ropes**	**Periods: 9**
Belt Drive: Introduction, types, Material, Design of Belts – Flat Belts and Pulleys – V Belts and Pulleys. Chain and Rope: Design of chain drives – Wire ropes.		**CO2**
UNIT - III	**Gear Drive: Spur and Helical**	**Periods: 9**
Spur gears: Introduction, Types of failure, design requirements, gear terminology, design analysis, stress concentration, dynamic load, surface compressive stress, beam strength, gear materials, design procedure, Gear Lubrication. Helical Gears: Terminology of Helical Gears, Virtual number of teeth, Tooth proportions, Force analysis, Beam strength, Effective Load on gear tooth, design procedure.		**CO3**
UNIT - IV	**Gear Drive: Bevel and Worm Gear**	**Periods: 9**
Bevel gears - nomenclature, design of gears – based on bending and wear criteria– based on Lewis and Buckingham equation, worm and worm wheel – nomenclature – design procedure		**CO4**
UNIT - V	**Gear Box**	**Periods: 9**
Multi-stage speed reducers, Multi-speed Gear boxes, Mechanical speed variation: Maximum and Minimum speed, structural formula, structural diagram (speed diagram), kinematic layout, Ray diagram, design procedure for Multi-speed gear box		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. J.E Shigley and C.R.Mischke, “Mechanical Engineering Design”, McGraw-Hill International; 11th Edition 2019.
2. V Bhandari, “Design of Machine Elements”, Tata McGraw-Hill Book Co, 4th Edition 2016.
3. T.J.Prabhu, Design of Transmission Elements, Madras book house, Chennai, 2018.

Reference Books

1. R.S. Khurmi, J.K.Gupta. “Machine Design”, Schand Publishing House (Pvt.) Ltd. Revised Edition, 2019.
2. Sadhu Singh, “Machine Design”, Khanna Publishing House, 1st Edition 2019.
3. P.C. Gope, “Machine Design – Fundamental and Application”, PHI learning private LTD, New Delhi, 2012.
4. Design Data book– PSG College of Technology, Coimbatore, 2019.
5. A.C Ugural, "Mechanical Design, An Integrated Approach", McGraw Hill Education, 2003.

Web References

1. https://onlinecourses.nptel.ac.in/noc24_me71/preview
2. https://www.classcentral.com/course/swayam-design-of-mechanical-transmission-systems-269693
3. https://www.youtube.com/playlist?list=PLyqSpQzTE6M-7nTyaGekZRTLLUzGfRPMo
4. https://www.youtube.com/watch?v=l709f4xhWPg
5. https://sites.google.com/site/designoftransmissionsystems/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	2	2	2	1	-	-	1	3	2	1
2	3	3	3	2	2	2	2	2	1	-	-	1	3	2	1
3	3	3	3	2	2	2	2	2	1	-	-	1	3	2	1
4	3	3	3	2	2	2	2	2	1	-	-	1	3	2	1
5	3	3	3	2	2	2	2	2	1	-	-	1	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VII**	Course Category: **PC**			End Semester Exam Type: **LE**			
Course Code	**U23MEP711**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**INDUSTRIAL AUTOMATION AND ROBOTICS LABORATORY**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
MECH								
Prerequisite	Kinematics of Machinery							

Course Outcome		**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1	Understand the type of robot and various motions.	**K2**
	CO2	Generate part program for Robots to performing various tasks.	**K3**
	CO3	Understand the robot forward and reverse kinematics.	**K2**
	CO4	Solve direct and inverse kinematics and choose appropriate Robot for given application.	**K3**
	CO5	Perform robot programming for a given application.	**K3**

List of Experiments

1. Study of robot and its major components.
2. Imparting simulation and programming software of robotics.
3. Demonstration of forward and reverse kinematics programming.
4. Programming a robot for performing Point-to-point motion of the manipulator arm.
5. Programming a robot for performing continuous path motion of the manipulator arm.
6. Combining an industrial robot with a conveyor.
7. Programming a robot to perform pick and place operation.
8. Programming a robot for material handling application.
9. Programming a robot for processing application.
10. Programming a robot for a sorting operation using a sensing system.
11. Case Study on advanced industrial applications of robots.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Reference Books

1. Rex Miller, Mark R. Miller “Robots and Robotics: Principles, Systems, and Industrial Applications “McGraw Hill Professional, 2017.
2. Bruno Siciliano, Oussama Khatib “Springer Handbook of Robotics“ Springer, 2016.
3. Kevin M. Lynch, Frank C. Park “Modern Robotics” Cambridge University Press, 2017.
4. Thomas R. Kurfess “Robotics and Automation Handbook” CRC Press, 2018.
5. Mark W. Spong, Seth Hutchinson, M. Vidyasagar “Robot Modeling and Control” John Wiley & Sons, 2020.

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1. https://archive.nptel.ac.in/courses/112/104/112104298/
2. https://opentextbooks.clemson.edu/wangrobotics/chapter/forward-kinematics/
3. https://www.instructables.com/Programmed-Robot-Arm/
4. https://docs.pickit3d.com/en/latest/robots/robot-automation-scenarios/pick_and_place_simple.html
5. https://www.visualcomponents.com/blog/offline-robot-programming-olp-the-complete-guide-with-examples/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	1	2	1	2	-	-	-	1	-	-	2	3	2	2
2	3	1	2	1	2	-	-	-	1	-	-	2	2	3	2
3	3	1	1	1	3	-	-	-	1	-	-	2	3	2	2
4	3	2	3	1	2	-	-	-	1	-	-	1	3	3	2
5	3	2	3	1	3	-	-	-	1	-	-	2	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VII**	Course Category: **PC**			End Semester Exam Type: **LE**			
Course Code	**U23MEP712**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**SEMINAR**	**0**	**0**	**2**	**1**	**100**	**-**	**100**
MECH								
Course Outcome	O1 - Review, prepare and present technological developments.							
	O2 - Face the placement interviews.							

Method of Evaluation:

- During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of about 20 minutes.
- In a session of three periods per week, 8 to 10 students are expected to present the seminar.
- Each student is expected to present atleast twice during the semester and the student is evaluated based on that.
- At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are given based on the report.
- A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
- Evaluation is 100% internal. The marks attained for this course is not considered for CGPA calculation.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Evaluation Methods

Assessment	**Continuous Assessment Marks (CAM)**		**Total Marks**
	Report	**Presentation**	
Marks	50	50	100

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VII**	Course Category: **PA**			End Semester Exam Type: **LE**			
Course Code	**U23MEW703**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**PROJECT PHASE – I**	**0**	**0**	**4**	**2**	**50**	**50**	**100**
MECH								
Prerequisite	Micro and Mini Project							

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
CO1	Identify an innovative or creative idea/concept/solution to a problem.	**K2**
CO2	Work independently to lead the project along with team members.	**K3**
CO3	Interpret the results and document the report.	**K3**
CO4	Communicate effectively through presentation.	**K3**
CO5	Design and Develop the working model.	**K4**

CONTENTS

- The Project is a theoretical study/analysis/prototype design/modeling and simulation or a combination of these.
- Should be done as group (preferably four students) project.
- The progress of the project is evaluated based on a minimum three reviews and final viva-voce examination.
- A project report is required to be submitted in the standard prescribed format.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

COs/POs/PSOs Mapping

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	2	2	2	1	2	2	2	3	2	3	3	3	3	3
2	3	2	2	2	1	2	2	2	3	2	3	3	3	3	3
3	3	2	2	2	1	2	2	2	3	2	3	3	3	3	3
4	3	2	3	3	1	3	3	3	3	3	3	3	3	3	3
5	3	2	3	3	1	3	3	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Sl.No	**Description**			**Weightage**
1	**Continuous Assessment Marks**			
a	Review1	Review Committee	10	15
		Supervisor	5	
b	Review2	Review Committee	10	15
		Supervisor	5	
c	Review3	Review Committee	15	20
		Supervisor	5	
	Total CAM			**50**

2	**End Semester Marks**			
	Evaluation of Phase Report and Viva-voce	Report	15	50
		Presentation and Viva	20	
		Demonstration	15	
			Total ESM	**50**
			Total Marks	**100**

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VII**	Course Category: **PA**			End Semester Exam Type: **LE**			
Course Code	**U23MEW704**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**INTERNSHIP / INPLANT TRAINING**	**-**	**-**	**2**	**1**	**100**	**-**	**100**
MECH								
Prerequisite	**-**							

Course Outcome		**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1	Exposure to the industrial environment and Recognize the requirement of the industry and cope up with the industrial scenario.	**K1**
	CO2	Identify career paths taking into account their individual strengths and aptitude and Prepare a report about the work experience in industry.	**K2**
	CO3	Communicate effectively through technical presentation.	**K2**
	CO4	Enhancing the employability skills and start-up skills to increase his ability to engage in, life-long learning.	**K4**
	CO5	Develop individual confidence to handle various engineering assignments and expose themselves to acquire life skills to meet societal challenges	**K5**

CONTENTS

1. The Guide allotted by the department head have liberty to select nearby organization/industry of local vicinity with prior approval of principal of the institute. Structured training to be arranged by guide and report of the same shall be submitted by the individual student, to full fill their term work.
2. The mechanical engineering students can take in plant training in any one of the following industries.
   a. Public sector enterprises
   b. State government undertaking
   c. Public limited companies
   d. Private limited companies
   e. Individual ownership organisations.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Evaluation Methods

Assessment	**Continuous Assessment Marks (CAM)**		**Total Marks**
	Report	**Presentation**	
Marks	50	50	100

SEMESTER VIII

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VIII**	Course Category: **PA**			End Semester Exam Type: **LE**			
Course Code	**U23MEW805**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**PROJECT PHASE – II**	**0**	**0**	**16**	**8**	**50**	**100**	**150**
MECH								
Prerequisite	Micro and Mini Project							

Course Outcome		**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1	Demonstrate and practice the concepts of basics sciences and mechanical engineering principles in addressing a real time and real life situation.	**K3**
	CO2	Enhance the financial management skills to achieve project goal in a stipulated time by working as a team.	**K3**
	CO3	Familiarize in technical writing skills and create a project proposal and report on completion.	**K4**
	CO4	Develop a model comprising of real time application in the industry.	**K4**
	CO5	**C**hallenge and Achieve the real time solutions for industry and society oriented problems.	**K5**

Guidelines For Carrying Out Project Work

- Create a model/fabricate a model/conduct experiment/simulate mechanical system/implement improved ideas for the project work.
- Analyze data, evaluate the results and conclude the appropriate solution, suggestion for feature work.
- The continuous assessment shall be made as prescribed in the regulations.
- The review committee may be constituted by the Head of the Department.
- The progress of the project is evaluated based on a minimum of three reviews.
- Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.
- This final report shall be typewritten form as specified in the guidelines.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

COs/POs/PSOs Mapping

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	2	2	2	3	2	2	2	3	2	3	3	3	3	3
2	3	2	2	2	3	2	2	2	3	2	3	3	3	3	3
3	3	2	2	2	3	2	2	2	3	2	3	3	3	3	3
4	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3
5	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Sl. No	Description			Weightage
1	**Continuous Assessment Marks**			
a	Review 1	Review Committee#	10	15
		Supervisor	5	
b	Review 2	Review Committee#	10	15
		Supervisor	5	
c	Review 3	Review Committee#	15	20
		Supervisor	5	
	Total CAM			**50**
2	**End Semester Marks**			
a	Evaluation of final report and Viva-voce	Report	20	80
		Presentation and Viva	40	
		Demonstration	20	
b	Expected Outcome from the project ##	Publication / communication of papers / prototypes/ patents etc		20
	Total ESM			**100**
Total Marks				**150****

PROFESSIONAL ELECTIVE – I

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**IV**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE401**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	CAM	ESE	TM
Course Name	**GAS DYNAMICS AND JET PROPULSION**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Fluid Mechanics							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Explain the basic concepts of compressible fluid flows.	**K2**
	CO2 Describe the behaviour of fluid flow in constant area ducts.	**K2**
	CO3 Interpret the equations governing normal shock.	**K3**
	CO4 Define the performance metrics of turbo jet, ram jet and pulse jet engines.	**K3**
	CO5 Explain the basics of rocket propulsion systems.	**K3**

UNIT- I	**Basic Concepts and Isentropic Flows**	**Periods: 09**
Energy and momentum equations for Concept of compressible flow, various regions of flows, reference velocities, stagnation state, velocity of sound, Critical properties, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility- Isentropic flow through variable ducts – Nozzle and Diffusers Use of Gas tables		**CO1**

UNIT- II	**Flow Through Ducts**	**Periods: 09**
Flow in constant area ducts with friction (Fanno flow) - Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length. Flow in constant area ducts with heat transfer (Rayleigh flow), Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer- Applications.		**CO2**

UNIT - III	**Normal Shock**	**Periods: 09**
Governing equations, Rankine Hugonist Relation , Various of flow parameters across the normal and oblique shock normal shock, Prandtl – Meyer equation, impossibility of shock in subsonic flows, flow in convergent and divergent nozzle with shock- Use of tables and charts.		**CO3**

UNIT - IV	**Jet Propulsion**	**Periods: 09**
Theory of jet propulsion – types of jet engines – ram jet, Turbojet, Turbofan, and Turbo prop and pulse jet engine. study of turbojet engine components – diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of jet engines – thrust, thrust power, propulsive and overall efficiencies.		**CO4**

UNIT - V	**Space Propulsion**	**Periods: 09**
Theory of rocket propulsion -types of rocket engines – Propellants-feeding systems – Ignition and combustion – rocket engines thrust equation – effective jet velocity specific impulse – rocket engine performance – Staging – Terminal and characteristic velocity – Applications – space flights.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. H.Cohen, G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Pearson, 2019
2. S.M.Yahya, "Fundamentals of Compressible Flow with aircraft and rocket propulsion", New Age International Publisher, New Delhi, 2018.
3. J.D.Anderson, "Modern Compressible flow: With historical perspective", 3rd Edition, McGraw Hill, 2017.

Reference Books

1. V.Ganesan, "Gas Turbines", Tata McGraw Hill, 2010.
2. P.H. Oosthvizen, William E.Carscallen, “Introduction of Compressible fluid flow”, CRC press, 2013.
3. E. Rathakrishnan, “Gas Dynamics”, Prentice Hall of India, New Delhi, 2014. Academic curriculum and syllabi R-2020 B.Tech. Mechanical Engineering 168
4. V.Babu “Fundamentals of Gas Dynamics”, Wiley, 2015.
5. P.Balachandran, “Fundamentals of compressible fluid dynamics”, PHI Learning Private Ltd, 2009.

Web References

1. https://nptel.ac.in/courses/112106166/
2. https://nptel.ac.in/courses/101101002/
3. https://nptel.ac.in/courses/112103021/
4. http://www.infocobuild.com/education/audio-video-courses/mechanical engineering/GasDynamics Propulsion- IIT-Madras/ lecture-21.html

5. Jet Propulsion https://www.youtube.com/watch?v=cOk4-nKRhr8- nptl

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	-	-	-	-	-	-	1	1	1	2	1
2	3	2	1	1	-	-	-	-	-	-	1	1	1	2	1
3	3	2	1	1	-	-	-	-	-	-	1	1	1	2	1
4	3	2	1	1	-	-	-	-	-	-	1	1	1	2	1
5	3	2	1	1	-	-	-	-	-	-	1	1	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**IV**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE402**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	CAM	ESE	TM
Course Name	**GEOMETRIC TOLERANCE AND DIMENSIONING**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Basic awareness on Engineering Design, Basic knowledge of making 2D drawings.							

Course Outcome		**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1	Explain the geometrical requirements on engineering drawings	**K2**
	CO2	Interpret and specify dimensions and tolerance in professional manner	**K3**
	CO3	Explain geometric symbols and rules	**K3**
	CO4	Specify straightness, circularity and cylindricity tolerance	**K3**
	CO5	Define the orientation and profile of plane surfaces	**K3**

UNIT- I	**Periods: 09**
Geometric product definitions principles , Geometric characteristics symbols, Chart symbols, Rules sheet, introduction to Geometric Tolerance, Coordinate tolerance, Geometric dimensioning, , Allowance and Clearance, GT & D Terms, GT & D rules, Concepts, Value of Tolerance, flat tolerance, straight tolerance, circularity and cylindricity tolerance..	**CO1**
UNIT- II	**Periods: 09**
Fundamental Drawing Rules, Units of Linear Measurement, Specifying Linear Dimensions, Specifying Linear Tolerances, Interpreting Dimensional Limits, Specifying Angular Dimensions, Specifying Angular Tolerances, Dimensioning and Tolerancing for CAD/CAM Database Models.	**CO2**
UNIT - III	**Periods: 09**
Symbols, Geometric Characteristic Symbols, Datum Feature Symbol, Feature Control Frame, Reading the Feature Control Frame, Other Symbols Used with Geometric Tolerancing, Terms, Rules, Limits of Size Prescribe Variations of Form, Applicability of Modifiers in Feature Control Frames, Pitch Diameter Rule.	**CO3**
UNIT - IV	**Periods: 09**
Definition, Specifying Straightness of Surface Tolerance, Specifying Straightness of Median Line, Circularity: Definition, Specifying Circularity Tolerance, Cylindricity: Definition, Specifying Cylindricity Tolerance, Free-State Variation- Problems.	**CO4**
UNIT - V	**Periods: 09**
Definition, Specifying Perpendicularity of a Flat Surface, Tangent Plane, Specifying the Perpendicularity of an Axis to a Plane Surface, Parallelism, Angularity, Floating Fasteners, Fixed Fasteners, Projected Tolerance Zones, Multiple Patterns of Features, Specifying Profile Tolerance, Application of Datum Features, A Radius Refinement with Profile, Combining Profile Tolerances with other Geometric Controls	**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. P.S.Gill, Geometric Dimensioning & Tolerancing, S. K. Kataria and Sons, 2013
2. Alex Krulikowski, Fundamentals of Geometric Dimensioning and Tolerance, Cengage Learning, 2012.
3. Gene R. Cogorno, Geometric Dimensioning and Tolerancing for Mechanical Design, 3E, McGraw Hill Professional, 2020

Reference Books

1. David A. Madsen, Geometric Dimensioning and Tolerancing, Goodheart-Willcox Company, 2010
2. G.Henzold, Handbook of Geometrical Tolerancing: Design, Manufacturing and Inspection, 1995
3. Paul J. Drake, Dimensioning and Tolerancing Handbook, McGraw-Hill Professional, 1999.
4. James D. Meadows, Geometric Dimensioning and Tolerance, Routledge, 2017.
5. N.D.Bhatt, Machine Drawing, Charotar Publishing House Pvt. Ltd.; 51st Edition 2022
6. David A. Madsen, Geometric Dimensioning and Tolerancing, Goodheart-Willcox Company, 2010

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1. https://www.fictiv.com/articles/gdt-101-an-introduction-to-geometric-dimensioning-and-tolerancing
2. https://formlabs.com/blog/gdt-geometric-dimensioning-and-tolerancing/
3. https://www.gdandtbasics.com/

4. https://www.youtube.com/watch?v=aS9OgYadjpY
5. https://www.youtube.com/watch?v=fXoWTHwElvo

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	1	2	2	1	1	3	-	1	3	2	2
2	3	2	3	2	1	2	2	1	1	3	-	1	3	2	2
3	3	2	3	2	1	2	2	1	1	3	-	1	3	2	2
4	3	2	3	2	1	2	2	1	1	3	-	1	3	2	2
5	3	2	3	2	1	2	2	1	1	3	-	1	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**IV**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEDC02**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	CAM	ESE	TM
Course Name	**PRODUCT DESIGN AND DEVELOPMENT**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

Common to MECH and Mechatronics

Prerequisite	Computer Aided Design, Engineering Design	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Explain conceptual product design techniques.	**K2**
	CO2 Identify Customer needs and products design specifications.	**K2**
	CO3 Use different systematic concept generation techniques in product design.	**K3**
	CO4 Use embodiment design principles in latest manufacturing methods.	**K3**
	CO5 Illustrate the concepts relating to simulating product performance and manufacturing processes	**K3**

UNIT- I	**Introduction of Product Design**	**Periods: 09**
Design versus Scientific method, Need for new designs, Considerations of a Good Design, Product Development process cycles, Organizations for Product Design, Technological Innovation and Business Strategies, Modern Product development and design theories, Design morphology- pioneer design phases and flow charting, Reverse engineering and redesign methodology.		**CO1**
UNIT- II	**New Product Idea**	**Periods: 09**
Market research, identifying customer needs, locating ideas for new products, Kano Diagram, Establishing Engineering Characteristics, Quality Function Deployment (QFD), Product Design Specification (PDS) Design information and sources.		**CO2**
UNIT - III	**Concept Generation**	**Periods: 09**
Freud's model, Creative thinking- brain storming, primary design, drawing, Systematic methods: Tear down and experimentation, Function structure, Morphological methods, Theory of Inventive Problem solving (TRIZ), Axiomatic Design (AD) Decision Theory, Evaluation methods, Comparison based on absolute criteria, Pugh's concept, Measurement scales, Weighted decision Matrix, Analytic Hierarchy process (AHP).		**CO3**
UNIT - IV	**Embodiment Design**	**Periods: 09**
Product Portfolios and Architecture, Configuration and Parametric design, detailed design, Design for Environment, Modeling and Simulation, Material selection for Design, Industrial design- Need and process. Robust Design, Optimization of design, quality assessment. Ergonomics and Aesthetics: Break even analysis.		**CO4**
UNIT - V	**Role of Technology in Designing**	**Periods: 09**
Integrating CAE, CAD, CAM tools, Simulating product performance and manufacturing process, Technology driven products, user driven products, assessing the quality of the product.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. George E Dieter, Engineering Design 3rd Edition McGraw Hill, 2001.
2. Karl T. Ulrich, Product Design and Development, Tata McGraw Hill International, 2003.
3. G. Lawrence Sanders, Developing New Products and Services, Publisher: Saylor Foundation 2013.

Reference Books

1. Steven W. Trimble and Abdelrahman N. Shuaib, Product Design and Development Handbook, Cognella Academic Publishing, 2022.
2. Neville Songwe Jr, Carmen Andrisani, An Industrial Design Guide Vol. 01, 2022.
3. Karl Ulrich, Steven Eppinger, Maria C. Yang. Product Design and Development, McGraw Hill-2020.
4. Steven Eppinger, Karl Ulrich, Product Design and Development McGraw-Hill Higher Education, 2015.
5. Sven G. Bilén, Introduction to Engineering Design, McGraw Hill Learning Solutions, 2008.
6. Otto, Product Design, Pearson Education India, 2001.

Web References

1. https://www.digimat.in/nptel/courses/video/112107217/L01.html
2. https://nptel.ac.in/courses/112/104/112104230/
3. http://www.nptelvideos.com/lecture.php?id=15953

4. https://cosmolearning.org/video-lectures/mod-4-lec-14-product-design-development-8953/
5. https://www.udemy.com/course/product-design/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	2	1	-	1	-	1	-	-	-	1	1	2
2	2	2	2	2	2	2	1	-	1	-	-	-	1	3	2
3	3	3	2	1	1	1	-	-	1	-	-	-	2	2	2
4	3	3	1	2	2	-	3	1	1	-	-	2	1	2	2
5	3	3	3	2	2	3	2	1	2	-	-	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**IV**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE403**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	CAM	ESE	TM
Course Name	**INDUSTRIAL CASTING TECHNOLOGY**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Manufacturing Processes							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Identify the basic requirements of the principles of metal casting.	**K2**
	CO2 Acquired knowledge of various melting practices.	**K2**
	CO3 Understand and explain the various special casting techniques.	**K2**
	CO4 Design the gating and riser systems and concepts of solidification.	**K3**
	CO5 Analyze the casting defects and testing of castings.	**K2**

UNIT- I	**Introduction to Casting Process**	**Periods: 09**
Introduction to casting and Foundry industry, Basic principles of casting process - Sequence in foundry operation - Pattern materials, Types, Allowances – Core and its types, Core sand and core making process.		**CO1**

UNIT- II	**Melting Furnaces**	**Periods: 09**
Selection of furnace - Types of Furnaces used in Foundry – Cupola furnace, Electric Arc furnace, Induction furnace, Rotary furnace, Crucible furnace, Open hearth furnace – Refractories for felting units, Safety considerations- Energy conservation and Energy saving in melting and casting.		**CO2**

UNIT - III	**Special Casting Techniques**	**Periods: 09**
Investment casting, Shell mould casting, Pressure Die casting, Squeeze Casting – Centrifugal casting – Types, CO2 mold casting, Continuous casting, Full mould casting, Evaporative pattern castings.		**CO3**

UNIT - IV	**Solidification of Castings**	**Periods: 09**
Solidification of pure metals and alloys – Factors , Nucleation - Rate of solidification - Directional solidification – Gating system – Function and Classification - types of gates - Factors Controlling Gating Design. Riser - Types, Roles and Location of riser - Use of chills and Pads - Design of casting.		**CO4**

UNIT - V	**Defects and Inspection of Casting**	**Periods: 09**
Defects in casting and its remedies - Fettling and Cleaning of Casting – Inspection of casting – Foundry mechanization – equipment's used in foundry - Plant site location layout.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. A.K. Chakrabarti, "Casting Technology and Cast Alloy" PHI Learning Pvt. Ltd., Second edition, 2022.
2. S.Kalpakjian and R.Schmid, "Manufacturing Processes for Engineering Materials", Pearson Education India Edition, 2018.
3. PL Jain, ''Principles of Foundry Technology", Tata McGraw-Hill, First Edition, 2017.

Reference Books

1. S.K. Sharma, Savita Sharma, "Manufacturing Processes", Wiley publisher, 2022.
2. BS. Raghuwanshi, "Manufacturing Processes", Dhanpat Rai & Co. (P) Ltd, January 2020
3. P.N.Rao, "Manufacturing Technology, Volume I & II", Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition, 2018.
4. K.C.John, "Metal Casting and Joining" PHI Learning Pvt. Ltd., Second edition, 2015.
5. Mahi Sahoo, Sam Sahu, Sudhari Sahu, "Principles of Metal Casting", McGraw-Hill Education, Third Edition, 2014.

Web References

1. https://nptel.ac.in/courses/112/107/112107219/#
2. https://www.sciencedirect.com/topics/engineering/manufacturing-process
3. https://www.coursera.org/courses?query=manufacturing%20process
4. https://www.edx.org/course/fundamentals-of-manufacturing-processes
5. https://onlinecourses.nptel.ac.in/noc19_me20/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	1	-	-	2	2	-	-	-	1	2	1	2
2	3	1	1	1	-	-	2	2	-	-	-	1	2	1	2
3	3	1	2	1	-	-	2	2	-	-	-	1	2	1	2
4	3	1	3	3	-	-	2	2	-	-	-	1	2	1	2
5	3	1	1	1	-	-	2	2	-	-	-	1	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**					
Semester	**IV**	Course Category: **PE**			End Semester Exam Type: **TE**		
Course Code	**U23MEE404**	Periods/Week			Credit	Maximum Marks	
		L	**T**	**P**	**C**	CAM	ESE	TM
Course Name	**NON-CONVENTIONAL ENERGY SOURCES**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

MECH

Prerequisite	Basics of Mechanical Engineering	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understands the environmental aspects of renewable energy resources their prospects and limitations.	**K1**
	CO2 Describes the concepts of the solar energy and its conversion systems.	**K2**
	CO3 Describes the conversion principles of wind and biomass energy.	**K2**
	CO4 Understand the conversion principles of tidal and ocean thermal energy conversion	**K1**
	CO5 Acquire the basic knowledge of fuel cell and its utilizations.	**K1**

UNIT- I	**Statistics on Conventional Energy Sources**	**Periods: 09**
Statistics on conventional energy sources and supply world wide and in India, Definition Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. Classification of NCES(brief introduction on Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources		**CO1**

UNIT- II	**Solar Energy**	**Periods: 09**
Solar Energy-Energy available form Sun, Solar radiation data, Solar radiation Measurements- Pyrheliometers, Pyrometer, Sunshine Recorder .Solar Thermal systems: Flat plate collector; Solar distillation; Solar pond electric power plant.Solar electric power generation- Principle of Solar cell, Photovoltaic system for electric power generation, advantages, Disadvantages and applications of solar photovoltaic system.		**CO2**

UNIT - III	**Wind Energy and Biomass Energy**	**Periods: 09**
Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and muliblade system. Vertical axis- Savonius and darrieus types. Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies-fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft) .		**CO3**

UNIT - IV	**Tidal Energy and Ocean Energy**	**Periods: 09**
Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, advantages and limitations. Ocean Thermal Energy Conversion: Principle of working, OTEC power stations in the world, problems associated with OTEC.		**CO4**

UNIT - V	**Green Energy**	**Periods: 09**
Green Energy: Introduction, Fuel cells: Classification of fuel cells – H2; Operating principles, Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. G.D. Rai , “Non-Conventional Energy Sources”, Khanna Publishers, 6th edition, 2017
2. Khan,” Non-Conventional Energy Resources”, McGraw Hill Education India Private Limited; Third edition,2017
3. N.K.Bansal, “Non-Conventional Energy Resources”, Vikas Publishing House, 2014

Reference Books

1. Shobh Nath Singh, “Non-Convention EnergyResources” , Pearson, 2018
2. Ashok Rao, “Sustainable Energy Conversion for Electricity and Coproducts”, Wiley, 2015
3. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 5th edition, 2011.
4. R.Ramesh and K.U.Kumar, Renewable Energy Technologies, Narosa Publishing House, New Delhi, 2004
5. Magal, "Solar Power Engineering", Tata McGraw Hill, 2005.

Web References

1. https://www.pdfdrive.com/non-conventional-energy-sources-e10086374.html
2. https://www.pdfdrive.com/non-conventional-energy-systems-nptel-d17376903.html
3. https://www.pdfdrive.com/renewable-energy-sources-and-their-applications- 33423592.html

4. https://nptel.ac.in/courses/121/106/121106014/
5. https://onlinecourses.nptel.ac.in/noc18_ge09/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	1	-	-	-	2	-	1	1	1	1	1	1	1
2	2	1	1	-	-	-	2	-	1	1	1	1	1	1	1
3	2	1	1	-	-	-	2	-	1	1	1	1	1	1	1
4	2	-	1	-	-	-	2	-	1	1	1	1	1	1	1
5	2	1	1	-	-	-	2	-	1	1	1	1	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

PROFESSIONAL ELECTIVE - II

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE505**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**TURBO MACHINERY**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Applied Thermodynamics, Fluid Mechanics and Hydraulic Machines							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Explain the energy transfer in rotor and stator parts of the turbo machines.	**K2**
	CO2 Explain the function of various elements of centrifugal fans and blowers	**K2**
	CO3 Evaluate the working and performance of centrifugal compressor	**K3**
	CO4 Analyze flow behavior and flow losses in axial flow compressor	**K4**
	CO5 Explain the types and working of axial and radial flow turbines	**K2**

UNIT - I	**Working Principles**	**Periods: 9**
Definition and Classification of Turbomachines. Incompressible and compressible flow, Energy transfer between fluid and rotor - Euler equation and its Interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbomachines.		**CO1**
UNIT - II	**Centrifugal Fans and Blowers**	**Periods: 9**
Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves – various losses. Fan – bearings, drives and noise.		**CO2**
UNIT - III	**Centrifugal Compressor**	**Periods: 9**
Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.		**CO3**
UNIT - IV	**Axial Flow Compressor**	**Periods: 9**
Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forced vortex flow		**CO4**
UNIT - V	**Axial And Radial Flow Turbines**	**Periods: 9**
Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types – Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses		**CO5**

Lecture Periods:45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Maneesh Dubey, BVSSS Prasad, Archana Nema, Turbomachinery, Tata McGraw Hill Co. Ltd., 2018.
2. Ganesan, V., “Gas Turbines”, 3rd Edition, Tata McGraw Hill, 2017.
3. Yahya, S.M., “Turbines, Compressor and Fans”, 4th Edition, Tata McGraw Hill, 2011.

Reference Books

1. R. K. Turton, Principles of Turbomachinery, Springer Netherlands, 2012.
2. B.K.Venkanna, Fundamentals of Turbo machinery, Phi Learning Private Limited, 2009.
3. M. S. Govindegouda and A. M. Nagaraj, Text Book of Turbo machines, M. M. Publications, 4th Edition, 2008
4. S. L. Dixon, Fluid Mechanics and Thermodynamics of Turbo machines, Elsevier, 2005
5. D. G. Shepherd, Principals of Turbo machines, The Macmillan Company, 1964.

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1. https://nptel.ac.in/courses/101/101/101101058/
2. https://nptel.ac.in/courses/112/103/112103249/
3. https://www.youtube.com/watch?v=473XQrJjDZE
4. https://www.youtube.com/watch?v=mLwb4Pk2RZo
5. https://www.sciencedirect.com/science/article/abs/pii/S1359431118361039

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	-	-	-	-	-	-	-	-	1	2	-
2	3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
3	3	3	1	2	-	-	-	-	-	-	-	-	-	2	-
4	3	2	2	3	-	-	-	-	-	-	-	-	-	-	-
5	3	3	2	3	-	-	-	-	-	-	-	-	1	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE506**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**POWDER METALLURGY AND SURFACE COATING**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Engineering Metallurgy							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Acquire the knowledge of Powder Metallurgy History, Applications and its manufacturing methods.	**K1**
	CO2	Gain knowledge about powder characterizing techniques.	**K2**
	CO3	Classify the metal powder compaction methods, adhesives and Surface coatings.	**K3**
	CO4	Exemplify the suitable sintering techniques for powder metallurgy.	**K3**
	CO5	Appraise the suitable material for different applications.	**K4**

UNIT - I	**Characteristics and Testing of Metal Powders**	**Periods: 9**
Sampling, chemical composition purity, surface contamination etc. Particle size and its measurement, Principle and procedure of sieve analysis, microscopic analysis: sedimentation, elutriation, permeability. Adsorption methods and resistivity methods: particle shape, classifications, microstructure, specific surface area, apparent and tap density, green density, green strength, sintered compact density, porosity, shrinkage		**CO1**

UNIT - II	**Production of Powders and Conditioning**	**Periods: 9**
Production of powders- Mechanical methods Machine milling, ball milling, atomization, shotting- Chemical methods, condensation, thermal decomposition, carbonyl Reduction by gas-hydride, dehydride process, electro deposition, precipitation from aqueous solution and fused salts, hydrometallurgical method. Physical methods: Electrolysis and atomisation processes - Water atomization, Gas atomization, Centrifugal atomization, Vacuum atomization. Shotting- factors affecting these processes. powder conditioning, heat treatment, blending and mixing, types of equipment, types of mixing and blending, Self-propagating high-temperature synthesis (SHS), sol-gel synthesis		**CO2**

UNIT - III	**Powder Compaction**	**Periods: 9**
Powder Compaction Methods - Pressure less compaction: slip casting and slurry casting. Pressure compaction- lubrication, single ended and double ended compaction, Vibratory compaction ,isostatic pressing, powder rolling, forging and Powder extrusion - Extrusion of loose powder, Cold pressing and extrusion, Canning followed by extrusion. - Explosive Compaction - Characteristics of Green Compacts.		**CO3**

UNIT - IV	**Sintering**	**Periods: 9**
Stage of sintering, property changes, mechanisms of sintering, liquid phase sintering and infiltration, activated sintering, hot pressing and Hot isostatic Pressing (HIP), vacuum sintering, sintering furnaces-batch and continuous-sintering atmosphere, Finishing operations – sizing, coining, repressing and heat treatment, special sintering processes- microwave sintering, Spark plasma sintering.		**CO4**

UNIT - V	**Applications**	**Periods: 9**
Major applications in Aerospace, Nuclear and Automobile industries- Bearing Materials-types, Self-lubrication and other types, Methods of production, Properties, Applications. Sintered Friction Materials-Clutches, Brake linings, Tool Materials- Cemented carbides, Oxide ceramics, Cermets- Dispersion strengthened materials		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Anish Upadhya and G.S.Upadhaya, “Powder Metallurgy: Science, Technology and Materials, Universities Press, 2018
2. V. Raghavan, “Physical Metallurgy: principles and practice” PHI Learning, 3rd Editions, 2015
3. Cuie Wen “Surface Coating and Modification of Metallic Biomaterial” Woodhead Publishing, 2015.

Reference Books

1. B.K.Datta, “Powder Metallurgy: principles and practice” PHI Learning, 2nd Editions, 2014
2. Isaac Chang YuyuanZhao,”Advances in Powder Metallurgy”, 1st Edition, Woodhead Publishing, 2013.
3. P.C.Angelo and R.Subramanian., “Powder Metallurgy: Science, Technology and Application” Prentice Hall, 2008

4. P. Ramakrishnan," Powder Metallurgy", New Age Publishers, 2007.
5. R.M. German, "Powder Metallurgy and Particulate Materials Processing", Metal Powder Industries Federation, Princeton, NJ, 2005.

Web References

1. https://nptel.ac.in/courses/113/106/113106098/#
2. https://nptel.ac.in/courses/112/105/112105053/
3. https://youtu.be/uRVaLUQUmA8
4. https://youtu.be/7u54Hx9n3LY
5. https://ironpowders.com/iron-powder-for-surface-coating/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	1	2	1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
3	3	2	-	1	-	-	-	-	-	-	-	-	-	2	-
4	3	3	1	2	1	-	-	-	-	-	-	-	-	-	-
5	3	3	2	3	2	-	-	-	-	-	-	-	-	2	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE507**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**GREEN MANUFACTURING**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	-							

Course Outcome		BT Mapping (Highest Level)
	On completion of the course, the students will be able to	
	CO1 Understand the basics of green manufacturing**.**	**K2**
	CO2 Obtain knowledge on the metrics, principles to customize the learned generic concepts to meet the needs of a particular Industry/enterprise.	**K2**
	CO3 Gain knowledge about the Closed-Loop Production Systems for the purpose of satisfying a set of given sustainable green manufacturing requirements.	**K2**
	CO4 Understand the nanotechnologies in real time applications.	**K2**
	CO5 Apply the rules and processes to meet the market need and the green manufacturing requirements by selecting and evaluating suitable technical, managerial / project management and supply chain management scheme.	**K3**

UNIT - I	**Basics of Green Manufacturing**	**Periods: 9**
Introduction to Green Manufacturing: Motivations and Barriers to Green Manufacturing, Environmental Impact of Manufacturing, Strategies for Green Manufacturing, Sustainable green manufacturing.The Social, Business, and Policy Environment for Green Manufacturing		**CO1**
UNIT - II	**Metrics and Principles of Green Manufacturing**	**Periods: 9**
Metrics for Green Manufacturing Introduction, Overview of Currently Used Metrics, LCA Methodologies.Green Supply Chain: Motivation and Introduction, Definition, Issues in Green Supply Chains (GSC), Techniques/Methods of Green Supply Chain. Principles of Green Manufacturing: Introduction, Background.		**CO2**
UNIT - III	**Closed-Loop Production Systems**	**Periods: 9**
Closed-Loop Production Systems: Life Cycle of Production Systems, Economic and Ecological Benefits of Closed Loop Systems, Machine Tools and Energy Consumption, LCA of Machine Tools, Remanufacturing, Reuse, Approaches for Sustainable Factory Design.		**CO3**
UNIT - IV	**Nano-Manufacturing and Clean Energy Technologies**	**Periods: 9**
Environmental Implications of Nano-manufacturing: Introduction, Nano-manufacturing Technologies, Conventional Environmental Impact of Nano-manufacturing, Unconventional Environmental Impacts of Nano-manufacturing. Green Manufacturing Through Clean Energy Supply Introduction, Clean Energy Technologies.		**CO4**
UNIT - V	**Packaging and the Supply Chain**	**Periods: 9**
Packaging and the Supply Chain: A Look at Transportation Introduction, Enabling Technologies for Assuring Green Manufacturing: Motivation, Process Monitoring System.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Ame,Green Manufacturing: Case Studies in Lean and Sustainability, Productivity Press, 2017
2. Mrityunjay Singh, TatsukiOhji, Rajiv Asthana, Green and Sustainable Manufacturing of Advanced Material, Elsevier, 2015
3. Ade Asefeso , Green Manufacturing: (Paradigm Shift to Sustainable Capitalism), AA Global Sourcing ltd.,2013

Reference Books

1. Nand K. Jha , Green Design and Manufacturing for Sustainability, CRC Press,2016
2. A David. Dornfeld Green Manufacturing: Fundamentals and Applications, Springer, 2013
3. T.E Gradel and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
4. Cairncrss and Francis – Costing the earth – Harvard Business School Press – 2009.
5. World commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.

Web References

1. https://nptel.ac.in/courses/112/104/112104225/
2. https://nptel.ac.in/courses/110/104/110104119/

3.	https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mg24/
4.	https://www.youtube.com/watch?v=16vobnhafVw
5.	https://www.youtube.com/watch?v=NSzvttpHdWY

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
2	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-
5	3	-	-	-	-	-	2	-	-	-	-	-	-	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE508**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**FLUID POWER AUTOMATION**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Fluid Mechanics and Hydraulic Machines							

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
CO1	Get exposure to the basics of fluid flow including the physical laws affecting fluid standards and symbols used in industrial applications	**K2**
CO2	Obtain knowledge on fluid power actuators and its components.	**K2**
CO3	Identify hydraulic components and their functions.	**K3**
CO4	Design of hydraulic and pneumatic circuits for industrial automation.	**K4**
CO5	Select and develop electro pneumatics systems for automative applications.	**K4**

UNIT - I	**Introduction to Fluid Power**	**Periods: 9**
Introduction to fluid power controls – Hydraulics and pneumatics – Selection criteria, Application of Fluid power, Application of Pascal's Law, equation, Transmission and multiplication of force – Pressure Losses – Fluids, selection and properties – ISO symbols. Pumps – working principle and construction details of jet, screw and piston pumps.		**CO1**
UNIT - II	**Fluid Power Actuators**	**Periods: 9**
Fluid Power drives – Hydraulic motors, Pneumatic power supply – compressors, air distribution, air motors. Actuators – Selection and specification, cylinders, mounting, cushioning- Hydrostatic transmission drives and characteristics; Accumulators –Intensifiers.		**CO2**
UNIT - III	**Fluid Power Control Elements**	**Periods: 9**
Control valves – pressure, flow, direction – working principle and construction – Special type – valves – Cartridge, modular, proportional, and servo – Selection and actuation method – Hydraulic supply components -pipe fittings – Fluid conditioning elements.		**CO3**
UNIT - IV	**Design of Hydraulic and Pneumatic Circuits**	**Periods: 9**
Regenerative, speed control and synchronizing circuits – Design of Hydraulic and pneumatic circuits for automation, selection and specification of circuit components, sequencing circuits, cascade, and Karnaugh – Veitch map method.		**CO4**
UNIT - V	**Electro Pneumatics and PLC Circuits**	**Periods: 9**
Use of electrical timers, switches, solenoid, relays and proximity sensors electro pneumatic sequencing – PLC – elements, functions and selection – PLC programming – Ladder diagram and different programming methods – Sequencing circuits- Electro pneumatic system for automotive applications.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. James R. Daines and Daniel W. Sielaff, ''Fluid Power-Hydraulics and Pneumatics'', Goodheart-Willcox 3 rd Edition, 2022.
2. S John. Cundiff, Michael F. Kocher, "Fluid Power Circuits and Controls – Fundamental and application", CRC Press LLC, 2nd Edition, 2019.
3. R Srinivasan, "Hydraulic & Pneumatic Controls" Vijay Nicole Imprints Pvt Ltd, 3 rd Edition 2019.

Reference Books

1. Jagadeesha T, ''Automation with Hydraulics and Pneumatics'', I.K. International Publishing House 1 st Edition 2023.
2. Frank H. Simons, ''Fluid Power Automation: Fundamentals and Applications'', McGraw-Hill Education 2 nd Edition 2021.
3. Shanmuga Sundaram, ''Hydraulic and Pneumatic Control-Design, Modelling, and Automation'', S. Chand &Company Pvt. Ltd 2nd Edition 2020.
4. Ilango Sivaraman, "Introduction to Hydraulics and Pneumatics", PHI Learning Pvt. Ltd, 2017.
5. M. Winston, "Essential Hydraulics: Fluid Power: Volume 2", Create Space Independent Publishing Platform, 2014.

Web References

1. https://nptel.ac.in/courses/112/105/112105047
2. https://nptel.ac.in/courses/108/105/108105062
3. https://www.youtube.com/watch?v=jKb-KLVzCtw

4.	https://www.youtube.com/watch?v=S_4anj7GpRo
5.	https://www.youtube.com/watch?v=clVwKynHpB0

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	2	2	2	-	1	-	-	-	1	3	1	2
2	3	2	2	1	1	2	-	-	-	-	-	1	1	2	2
3	3	2	2	2	2	1	-	-	-	-	-	2	2	2	2
4	3	2	3	1	1	3	-	-	-	-	2	1	3	2	2
5	3	2	3	2	2	2	-	-	-	-	2	2	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE509**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**IOT AND SMART MANUFACTURING**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Basics of Electronics, Mechanical Manufacturing Process, and Introduction to Automation.							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Understand the fundamentals and applications of IoT in smart manufacturing	**K2**
	CO2	Analyze various IoT architectures and communication protocols used in industry	**K2**
	CO3	Apply IoT sensors, actuators, and data analytics tools in smart manufacturing.	**K3**
	CO4	Evaluate the impact of cloud computing and big data analytics	**K3**
	CO5	Design and implement basic IoT-enabled systems for real-time monitoring and control	**K3**

UNIT - I	**Introduction to IoT**	**Periods: 9**
IoT Overview: Definition, Characteristics, and Applications. IoT Architecture: Layers and Protocols (Perception, Network, and Application Layers). Role of IoT in Mechanical and Industrial Engineering. Challenges and Opportunities in IoT for Manufacturing.		**CO1**
UNIT - II	**Sensors, Actuators, and IoT Communication**	**Periods: 9**
Sensors and Actuators: Types, Working Principles, and Applications in Manufacturing. Communication Protocols for IoT: RFID, Zigbee, LoRa, Bluetooth, and MQTT. Wireless Sensor Networks (WSN) in Industrial Automation. Real-time Data Acquisition and Transmission.		**CO2**
UNIT - III	**Smart Manufacturing Systems**	**Periods: 9**
Introduction to Smart Manufacturing: Key Concepts and Technologies. Industry 4.0 and the Role of IoT in Enabling Smart Manufacturing. Cyber-Physical Systems (CPS) in Manufacturing: Integration of Physical and Computational Components. Smart Factories: Case Studies of IoT-enabled Manufacturing Plants.		**CO3**
UNIT - IV	**IoT Data Analytics and Cloud Computing**	**Periods: 9**
Introduction to Big Data Analytics: Collection, Processing, and Analysis. Cloud Computing in IoT: Storage, Data Processing, and Management. Edge Computing and Fog Computing in Smart Manufacturing. Predictive Maintenance, Fault Detection, and Process Optimization using IoT Analytics.		**CO4**
UNIT - V	**IoT System Design for Smart Manufacturing**	**Periods: 9**
Design of IoT Systems for Monitoring and Controlling Manufacturing Processes. Interfacing Sensors, Actuators, and Microcontrollers (e.g., Arduino, Raspberry Pi). Security and Privacy Issues in IoT-enabled Manufacturing Systems. Case Study: Implementation of a Smart Manufacturing System using IoT.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Industrial IoT: Challenges, Design Principles, Applications, and Security by Ismail Butun, Springer, 2020.

2. Smart Manufacturing: The Lean Six Sigma Way by Anthony Tarantino, McGraw-Hill, 2019.

3. Internet of Things (IoT): Key Applications and Protocols by Olivier Hersent, David Boswarthick, and Omar Elloumi, Wiley, 2012.

Reference Books

1. Internet of Things: A Hands-on Approach by Arshdeep Bahga and Vijay Madisetti, VPT Publications, 2014.

2. Smart Manufacturing: The Digital Transformation of Manufacturing by Michael Rüßmann, Pearson, 2018.

3. Designing the Internet of Things by Adrian McEwen and Hakim Cassimally, Wiley, 2013.

4. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, Apress, 2016.

5. Sensors and Actuators in Smart Manufacturing by Shankar Srinivasan, Springer, 2019.

Web References

1. https://nptel.ac.in/courses/106/105/106105195
2. https://www.coursera.org/learn/iot
3. https://www.edx.org/course/the-industrial-internet-of-things-iiot

4.	https://ieeexplore.ieee.org/Xplore/home.jsp
5.	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-883-pervasive-human-centric-computing-sensing-io-and-machine-learning-fall-2020/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	1	2	-	2
2	3	2	2	3	-	-	-	-	-	-	-	1	2	-	2
3	3	2	2	3	-	-	-	-	-	-	-	1	2	-	2
4	3	2	2	3	-	-	-	-	-	-	-	1	2	-	2
5	3	2	2	3	-	-	-	-	-	-	-	1	2	-	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

PROFESSIONAL ELECTIVE - III

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VI**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE610**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**FINITE ELEMENT ANALYSIS FOR MECHANICAL ENGINEERS**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Engineering Mathematics							

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
CO1	Discuss the concepts behind various methods and weighted residual methods in FEM.	**K2**
CO2	Describe the discretization concepts.	**K2**
CO3	Identify the application and characteristics of FEA elements such as bars, beams, plane and isoperimetric elements, and 3-D element.	**K4**
CO4	Compare the iso-parametric and iso-perimetric elements.	**K4**
CO5	Identify how the finite element method expands beyond the structural domain, for problems involving in structural dynamics, heat transfer and fluid flow.	**K4**

UNIT - I	**Introduction**	**Periods: 9**
Finite element method, stress and equilibrium, strain – displacement relations, stress – strain relations, plane stress and plane strain conditions, weighted residual methods, concept of potential energy.		**CO1**
UNIT - II	**One Dimensional**	**Periods: 9**
Element shapes, discretization procedures, assembly of stiffness matrix, bandwidth, node numbering, mesh generation, interpolation functions, and local and global coordinates, convergence requirements, and treatment of boundary conditions-one dimensional problems.		**CO2**
UNIT - III	**Analysis of Trusses**	**Periods: 9**
Finite element modeling coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, simple problems on beams. Modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axisymmetric problems.		**CO3**
UNIT - IV	**Higher Order and Isoparametric Elements**	**Periods: 9**
One dimensional quadratic and cubic elements in natural coordinates, two dimensional four nodded isoperimetric elements and numerical integration.		**CO4**
UNIT - V	**Steady State Heat Transfer Analysis**	**Periods: 9**
One-dimensional analysis of a fin and two dimensional analysis of thin plate, analysis of a uniform shaft subjected to torsion. Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of Eigen values and Eigen vectors, free vibration analysis.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Singiresu S Rao,"The Finite Element Methods in Engineering", 6th Edition, Elsevier Butterworth – Heinemann, 2017.
2. Tirupathi R. Chandrupatla, Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", 4th Edition, Prentice Hall, 2012.
3. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005.

Reference Books

1. S.Siddu, Anup Goel, Parmeshwar Patil, N. I. Jamader, "Finite Element Analysis", Technical publications, 2019.
2. G.Ramamurthy, "Applied Finite Element Analysis", 2nd Edition, Wiley Publication, 2010.
3. P.Seshu, "Text Book of Finite Element Analysis", 3rd Edition, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
4. Robert D Cook, David S Malkus, Michael E Plesha, "Concepts and Applications of Finite Element Analysis", 4th edition, John Wiley and Sons, Inc., 2003.
5. C.S.Krishnamurthy, "Finite Element Analysis", Tata McGraw-Hill, 2000.

Web References

1. https://nptel.ac.in/courses/112104193/
2. https://www.coursera.org

3.	https://www.featutorials.com
4.	https://www.sciencedirect.com/topics/engineering/finite-element-analysis
5.	https://www.comsol.co.in/multiphysics/finite-element-method

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	2	1	-	-	-	-	-	1	3	2	1
2	3	2	2	2	2	1	-	-	-	-	-	1	3	2	1
3	3	2	2	2	2	1	-	-	-	-	-	1	3	2	1
4	3	2	3	2	2	1	-	-	-	-	-	1	3	2	1
5	3	2	2	2	2	1	-	-	-	-	-	1	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VI**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE611**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**COMPUTATIONAL FLUID DYNAMICS**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Fluid Mechanics and Machinery							

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
CO1	Solve numerically the governing equations for fluid flow	**K3**
CO2	Analyze the numerical integration the linear algebra methods in various methods	**K4**
CO3	Apply grid generation principles for various problems in CAD interface	**K3**
CO4	Solve numerically a heat transfer and fluid flow problem	**K3**
CO5	Acquire FEM problems in fluid flow and heat transfer by various case studies	**K3**

UNIT- I	**Equations of Fluid Dynamics**	**Periods: 9**
Basic concepts Eulerarian and Lagrangian methods of describing fluid flow motion, acceleration and deformation of fluid particle, vorticity. Laws governing fluid motion, continuity, Navier – stokes & energy equations. Boundary layer equation, Euler equations, potential flow equations, Bernoulli's equation and vorticity transport equation. Initial and boundary conditions. Classification of equation of motions – hyperbolic, parabolic, elliptic.		**CO1**
UNIT- II	**Mathematical Preliminaries**	**Periods: 9**
Numerical integration. Review of linear algebra, solution of simultaneous linear algebraic equations – matrix inversion, solvers – direct methods, elimination methods, ill conditioned systems; Gauss- Sidel method, successive over relaxation method..		**CO2**
UNIT- III	**Grid Generation**	**Periods: 9**
Transformation of coordinates. General principles of grid generation – structured girids in two and three dimensions, algebraic grid generation, differential equations-based grid generation; Elliptic grid generation, algorithm, Grid clustering, Grid refinement, Adaptive grids, Moving grids. Algorithms, CAD interfaces to grid generation. Techniques for complex and large problems: Multi block methods.		**CO3**
UNIT- IV	**Finite Difference Discretization**	**Periods: 9**
Elementary finite difference coefficients, basic aspects of finite difference equations, consistency, explicit and implicit methods, errors and stability analysis. Stability of elliptic and hyperbolic equations. Fundamentals of fluid flow modelling-conservative property, upwind scheme, transporting property, higher order unwinding. Finite difference applications in heat transfer – conduction, convection.		**CO4**
UNIT- V	**Finite Volume Method**	**Periods: 9**
Introduction, Application of FVM in diffusion and convection problems, NS equations – staggered grid, collocated grid, SIMPLE algorithm. Solution of discretized equations using TDMA. Finite volume methods for unsteady problems – explicit schemes, implicit schemes. Finite Element Method: Introduction. Weighted residual and variational formulations. Interpolation in one-dimensional and two-dimensional cases. Application of FEM to ID and 2D problems in fluid flow and heat transfer		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Atul sharma, "Introduction to Computational Fluid Dynamics: Development, Application and Analysis:, Wiley publication, 2016
2. Muralidhar. K and Sundararajan. T, Computational Fluid Flow and Heat Transfer, Narosa Publishing House, 2014.
3. Versteeg. H.K. and Malalasekera. W, "An introduction to computational fluid dynamics", 2nd Edition, Pearson, 2007.

Reference Books

1. Jiyuan Tu Guan Heng Yeoh Chaoqun Liu, "Computational Fluid Dynamics", 3rd Edition, Butterworth-Heinemann, 2018.
2. R.H.Pletcher, J.C.Tannehil and Anderson. D.A, "Computational Fluid Mechanics and Heat Transfer", Taylor and Francis, 3rd Edition, 2013.
3. M.Ramakrishna, "Elements of Computational Fluid Dynamics", A Golden Jubilee Publication, 2011.
4. T.J.Chung, "Computational Fluid Dynamics", Cambridge University Press, 2002.
5. John F.Wendt, "Computational Fluid Dynamics - An Introduction", Springer-Verlag, 1992.

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1. https://nptel.ac.in/courses/101/106/101106045/

2.	https://nptel.ac.in/courses/112/105/112105045/
3.	https://nptel.ac.in/courses/112/104/112104030/
4.	https://nptel.ac.in/courses/112/103/112103289/
5.	https://www.youtube.com/watch?v=E9_kyXjtRHc

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	-	-	-	-	-	-	-	1	3	3	3
2	3	3	3	3	-	-	-	-	-	-	-	1	3	3	3
3	2	2	2	3	2	-	-	-	-	-	-	1	2	1	2
4	2	2	2	2	1	-	-	-	-	-	-	1	2	1	2
5	3	2	2	2	1	-	-	-	-	-	-	1	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VI**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE612**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**QUALITY CONTROL AND IMPROVEMENT**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	-							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Evaluate the basic statistical concepts and quality tools an industrial case.	**K2**
	CO2	Demonstrate the ability to design, use, and interpret control charts for variables and attributes	**K3**
	CO3	Determine the process capability indices for real time processes and demonstrate SixSigma	**K2**
	CO4	Design a sampling plan to construct OC curve and evaluate its effectiveness for a given process.	**K4**
	CO5	Implement the philosophy of Taguchi's DOE and other process improvement method	**K3**

UNIT- I	**Introduction to Statistical Quality Control**	**Periods: 9**
History of Quality Control - Statistical Quality Control and Statistical Process Control – Need for Statistical Concepts – Important Quality Control Tools - Quality costs and Quality loss – Quality Assurance – Taguchi's Quality Loss Function - limitation of SQC - Service Quality		**CO1**
UNIT- II	**Control Charts For Variables**	**Periods: 9**
Control Charts for Variables - Control Charts for $\bar{X}$ and R - process capability – interpretation- Control Charts for $\bar{X}$ and S - Control Chart for Individual Measurements - Applications of Control Charts for Variables		**CO2**
UNIT- III	**Control Charts for Attributes**	**Periods: 9**
Control Chart for Fraction-Nonconforming (OC curve of the control chart, variable sample size, nonmanufacturing application, the OC function and ARL calculation); Control Charts for Nonconformities or Defects; Choices Between Attribute and Variable Control Charts, Guideline for Implementing Control charts.		**CO3**
UNIT- IV	**Process Capability Analysis and six sigma**	**Periods: 9**
Cumulative-Sum (CUSUM) Control Charts - CUSUM Control Chart basic principles for monitoring the shift in process mean, CUSUM design parameters, CUSUM for large shifts - Exponentially Weighted Moving Average (EWMA) control chart (EWMA control chart for monitoring process mean, design of an EWMA control chart.		**CO4**
UNIT- V	**Acceptance Sampling**	**Periods: 9**
The Acceptance-Sampling - Definition of a Single-Sampling - Advantages and Disadvantages of Sampling - Types of Sampling Plan - OC Curve - Designing a SingleSampling Plan - Double, Multiple, and Sequential - The Dodge–Romig Sampling Plans – Producers risk Consumers risk - AOQL LTPD calculation.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Amitava Mitra , "Fundamentals of Quality Control and Improvement", 4th Edition, Wiley publishers, 2021.
2. Eugene L. Grant and Richard S. Leaven Worth, "Statistical Quality Control", 7th edition, TMH. 2017.
3. Charles Ebeling," An Introduction to Reliability and Maintainability Engineering" Mc Graw Hill. 2017.

Reference Books

1. Douglus C. Montgomery, Introduction to Statistical Quality Control, 8th Edition, John Wiley &Sons, 2019
2. M. Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2016.
3. K.Krishnaiah, Applied Statistical Quality Control and Improvement", PHI Learning Private Limited,2014
4. Vinay A. Kulkarni, Anand K. Bewoor, "Quality Control" Wiley India Pvt. Limited, 2009.
5. L.S.Srinath, "Reliability Engineering", Affiliated East west press, 2005.

Web References

1. https://onlinecourses.nptel.ac.in/noc20_mg18/preview
2. https://archive.nptel.ac.in/courses/110/101/110101010/
3. http://digimat.in/nptel/courses/video/110101150/L01.html
4. https://onlinecourses.nptel.ac.in/noc21_mg47/preview
5. https://www.inartifexyou.com/Quality-Control-and-Improvement.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	-	-	-	-	-	-	2	-	1	3	2	1
2	3	3	2	-	-	-	-	-	-	2	-	1	3	2	1
3	2	3	2	-	-	-	-	-	-	2	-	1	2	2	1
4	2	2	2	-	-	-	-	-	-	2	-	1	2	2	1
5	3	2	2	-	-	-	-	-	-	2	-	1	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VI**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE613**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ADDITIVE MANUFACTURING**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Engineering Physics							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Understand the fundamentals and significance of additive manufacturing (AM) technologies.	**K2**
	CO2	Identify and select appropriate AM processes for different applications.	**K3**
	CO3	Analyze material properties and post-processing techniques used in AM.	**K4**
	CO4	Design and evaluate components produced by AM using CAD models and simulation tools.	**K4**
	CO5	Explore the emerging trends and future potential of additive manufacturing in various industries.	**K4**

UNIT- I	**Introduction to Additive Manufacturing**	**Periods: 9**
Overview of additive manufacturing – Comparison with traditional manufacturing – Evolution and development of AM technologies – Benefits, challenges, and applications of AM – General process chain in AM – Introduction to various additive manufacturing technologies.		**CO1**
UNIT- II	**Additive Manufacturing Processes**	**Periods: 9**
Classification of AM processes – Material extrusion processes – Powder bed fusion – Vat polymerization – Material jetting and binder jetting processes – Directed energy deposition.		**CO2**
UNIT- III	**Materials for Additive Manufacturing**	**Periods: 9**
Materials used in AM: polymers, metals, ceramics, and composites – Material properties and selection criteria – Influence of material characteristics on AM process – Recycling and sustainability considerations in AM materials – Post-processing techniques for AM components.		**CO3**
UNIT- IV	**Design for Additive Manufacturing (DFAM)**	**Periods: 9**
Principles of design for additive manufacturing – Design freedom and constraints – Topology optimization – Lightweight structures – Use of CAD tools and software in AM – Simulation and evaluation of AM designs – Case studies in design optimization using AM.		**CO4**
UNIT- V	**Applications and Future Trends in Additive Manufacturing**	**Periods: 9**
Applications of AM in aerospace, automotive, biomedical, and consumer goods industries – Customization and mass production – Digital manufacturing and Industry 4.0 – Future trends in AM technologies: 4D printing, bio-printing, and hybrid manufacturing – Challenges and future research directions.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Ian Gibson, David Rosen, Brent Stucker, "Additive Manufacturing Technologies," 2nd edition, Springer, 2015.
2. Pham, D.T., Dimov, S.S. – Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer, 2001.
3. Richard H. Todd, Dell K. Allen, Leo Alting – Manufacturing Processes Reference Guide, Industrial Press Inc., 1994.

Reference Books

1. L. Ian Campbell – Design for Additive Manufacturing: Advances, Trends, and Technologies, Elsevier, 2020.
2. Ian Gibson, David Rosen, Brent Stucker – Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 2nd edition, Springer, 2015.
3. Amit Bandyopadhyay, Susmita Bose – Additive Manufacturing, CRC Press, 2015.
4. Kalpakjian, Serope, Schmid, Steven R. – Manufacturing Engineering and Technology, 7th edition, Pearson, 2014.
5. Andreas Gebhardt – Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing, Hanser Publishers, 2012.

Web References

1. https://nptel.ac.in/courses/112/105/112105287/
2. https://www.coursera.org/learn/additive-manufacturing

3.	https://additivemanufacturing.mit.edu/
4.	https://www.learnengineering.org/
5.	https://www.khanacademy.org/science/additive-manufacturing

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
2	3	3	2	1	-	-	-	-	-	-	-	-	2	2	-
3	3	3	2	1	1	-	-	-	-	-	-	-	2	2	-
4	3	3	3	2	2	1	-	-	-	-	-	-	2	2	-
5	3	2	3	2	1	1	-	-	-	-	-	-	2	2	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VI**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE614**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ENERGY AND CLIMATE CHANGE**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Climate Change							

Course Outcome			BT Mapping (Highest Level)
	On completion of the course, the students will be able to		
	CO1	An insight into carbon cycle, physical basis of the natural greenhouse effect, including the meaning of the term radioactive forcing, climate change, global warming and measures	**K3**
	CO2	Adapt and mitigate the impacts of climate change.	**K2**
	CO3	Understand the growing scientific consensus established through the IPCC as well as the complexities and uncertainties	**K3**
	CO4	Plan climate change mitigation and adaptation projects	**K2**
	CO5	Use of alternate fuels and renewable energy	**K2**

UNIT- I	**Introduction**	**Periods: 9**	
Atmosphere – weather and Climate – climate parameters – Temperature, Rainfall, Humidity, Wind – Global ocean circulation – El Nino and its effect – Carbon cycle			**CO1**
UNIT- II	**Elements Related to Climate**	**Periods: 9**	
Greenhouse gases – Total carbon dioxide emissions by energy sector – industrial, commercial, transportation, residential – Impacts – air quality, hydrology, green space – Causes of global and regional climate change – Changes in patterns of temperature, precipitation and sea level rise – Greenhouse effect.			**CO2**
UNIT- III	**Impacts of Climate Change**	**Periods: 9**	
Effects of Climate Changes on living things – health effects, malnutrition, human migration, socioeconomic impacts- tourism, industry and business, vulnerability assessment- infrastructure, population and sector – Agriculture, forestry, human health, coastal areas			**CO3**
UNIT- IV	**Mitigating Climate Change**	**Periods: 9**	
IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation -Identifying adaption options – designing and implementing adaption measures – surface albedo environment reflective roofing and reflective paving enhancement of evapotranspiration – tree planting programme – green roofing strategies – energy conservation in buildings – energy efficiencies – carbon sequestration			**CO4**
UNIT- V	**Up-Scaling Renewable Energy: Policy Incentives**	**Periods: 9**	
Energy source - Biofuels – Energy policies for a cool future – Energy Audit - Energy and climate governance, Global Energy - Energy - Geopolitics - Energy Security - Energy Production - Energy Consumption - Energy Markets - Energy Policy			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Twidell and wier" Renewable energy resources", CRC press (Taylor and Francis), 2015.
2. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2014
3. Velma. I. Grover "Global Warming and Climate" Change. Vol. I and II. Science Publishers, 2005

Reference Books

1. Thomas E, Lovejoy and Lee Hannah "Climate Change and Biodiversity", TERI Publishers, 2018.
2. Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2011.
3. David Coley "Energy and Climate Change: Creating a Sustainable Future" Wiley Publishers, 2009
4. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK, 2007.
5. Tiwari and Ghosal" Renewable energy resources" Narosa publications, 2005.

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1. https://nptel.ac.in/courses/119/106/119106008/
2. https://swayam.gov.in/nd2_arp19_ap55/preview
3. https://nptel.ac.in/courses/103/107/103107157/
4. https://olc.worldbank.org/content/climate-change-online-learning
5. https://onlinecourses.nptel.ac.in/noc23_me138/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	-	2	1	1	-	-	-	2	1	2	2
2	3	1	1	2	-	1	2	1	-	-	-	2	2	1	2
3	3	2	2	1	-	2	1	1	-	-	-	1	1	1	2
4	3	2	1	2	-	2	2	1	-	-	-	1	1	2	1
5	3	2	2	1	-	1	2	1	-	-	-	2	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

PROFESSIONAL ELECTIVE – IV

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE715**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**INDUSTRIAL TRIBOLOGY**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								

Prerequisite	Fluid Mechanics and Material Science.		
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Explain the friction characteristics of different surfaces	**K1**
	CO2	Describe the different wear situations	**K1**
	CO3	Discuss on the different types of lubrication.	**K2**
	CO4	Describe the film lubrication with Reynolds equation and Somerfield diagram	**K3**
	CO5	Explain how the surface can be modified with suitable materials to reduce friction	**K3**

UNIT - I	**Surfaces and Friction**	**Periods: 9**
Topography of Engineering surfaces- Contact between surfaces Sources of sliding Friction Adhesion - Ploughing- Energy dissipation mechanisms Friction Characteristics of metals Friction of non-metals. Friction of lamellar solids friction of Ceramic materials and polymers Rolling Friction Source of Rolling Friction Stick slip motion Measurement of Friction		**CO1**
UNIT - II	**Wear**	**Periods: 9**
Types of wear Simple theory of Sliding Wear, Mechanism of sliding wear of metals Abrasive wear Materials for Adhesive and Abrasive wear situations Corrosive wear Surface Fatigue wear situations Brittle Fracture wear Wear of Ceramics and Polymers Wear Measurements.		**CO2**
UNIT - III	**Lubricants and Lubrication Types**	**Periods: 9**
Types and properties of Lubricants Testing methods Hydrodynamic Lubrication Elasto- hydrodynamic lubrication- Boundary Lubrication Solid Lubrication- Hydrostatic Lubrication		**CO3**
UNIT - IV	**Film Lubrication Theory**	**Periods: 9**
Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings – Reaction torque on the bearings - Virtual Co-efficient of friction		**CO4**
UNIT - V	**Applications of Tribology**	**Periods: 9**
Application of tribology in manufacturing processes, Metal machining, Metal cutting, Tool wear, Action of lubricants, Friction welding, Extrusion process.		**CO5**

Lecture Periods: 45	**Tutorial Periods:-**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Ian Hutchings, Philip Shipway, Tribology: Friction and Wear of Engineering Materials, Elsevier, 2017
2. Theo Mang, Kirsten Bobzin, Thorsten Bartels, Industrial Tribology: Tribosystems, Friction, Wear and Surface Engineering, Wiley - VCH Verlag publication, 2011
3. Kirsten Bobzin, Theo Mang, and Thorsten Bartels, Industrial Tribology: Tribosystems, Friction, Wear and Surface Engineering, Lubrication, Wiley-vch Verlag Gmbh, 2010.

Reference Books

1. Shizhu Wen, Ping Huang, Principles of Tribology, Wiley, 2017.
2. Williams John, “Engineering Tribology”, Cambridge University Press, 2005
3. A.Cameron, “Basic Lubrication theory ", Longman, U.K.., 2000.
4. T.A. Stolarski, “Tribology in Machine Design ", Industrial Press Inc., 2000
5. E.P.Bowden and Tabor.D. “Friction and Lubrication ", Heinemann Educational Books Ltd., 2004

Web References

1. https://nptel.ac.in/courses/112/102/112102015/#
2. https://core.ac.uk/search?q=INDUSTRIAL%20TRIBOLOGY
3. https://onlinecourses.nptel.ac.in/noc20_mm12/
4. https://www.classcentral.com/course/swayam-friction-and-wear-of-materials-principle-and-case-studies-
5. https://www.digimat.in/nptel/courses/video/112102014/L19

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	-	1	-	-	-	1	-	1	1	1	1
2	3	1	1	-	-	1	-	-	-	1	-	2	1	1	1
3	3	1	1	-	-	1	-	-	-	1	-	2	1	1	1
4	3	1	1	-	-	1	-	-	-	1	-	2	1	1	1
5	3	1	1	-	-	1	-	-	-	1	-	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE716**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ADVANCED WELDING TECHNOLOGY**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Manufacturing Process							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Demonstrate an understanding of the concepts of welding and its characteristics	**K2**
	CO2	Understand the theory of welding metallurgy	**K2**
	CO3	Explain the various advanced welding techniques and its applications.	**K2**
	CO4	Understand the processes of plasma arc, resistance welding and welding of plastics.	**K2**
	CO5	Apply the knowledge of testing of weld joints and analyses the causes failure	**K3**

UNIT - I	**Introduction to Welding**	**Periods: 9**
Introduction, Classification of welding processes, types of fusion welds, welding symbols, Selection of electrodes, Various weld joint designs, position of welds, applications of welding. Brief review of conventional welding process: Gas welding, Arc welding, MIG, TIG welding, Resistance welding. Electroslag welding, Friction welding, Soldering & Brazing.		**CO1**
UNIT - II	**Welding Metallurgy**	**Periods: 9**
Fundamentals of physical metallurgy: Need, phase diagrams: Fe-C, Al-Cu, Cu-Zn system, Effect of heat in various zones, HAZ, effect of welding parameters on weld structure, grain refinement principle of weld metal, Principle of solidification of weld metal, modes of solidification.		**CO2**
UNIT - III	**Modern Welding Techniques and its Applications**	**Periods: 9**
Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications. Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Under Water welding, Welding automation in aerospace, robotic welding, nuclear and surface transport vehicles.		**CO3**
UNIT - IV	**Arc and Resistance Welding, Welding of Plastics**	**Periods: 9**
Plasma arc welding and their applications, plasma cutting, surfacing and applications. Resistance Welding: Types , Process, Applications. Welding of Plastics: Ultrasonic – Friction – Hot plate – Hot gas – High Frequency Welding of Plastics, Welding of plastic Pipes and other Applications		**CO4**
UNIT - V	**Weld Quality Testing and Inspection**	**Periods: 9**
Weld quality parameters, weldability, weld faults, Destructive testing: Aggressive environment, Corrosion, hardness, hydrogen, residual stress measurement, fatigue, software, fracture and mechanical testing. Non destructive testing: Visual (VT), Ultrasonic (UT), Radiography (RT), Eddy Current (ET), Magnetic Particle (MT), Acoustic Emission (AE) , Dye Penetrant (PT), Leak Testing (LT).		**CO5**

Lecture Periods: 45	**Tutorial Periods:-**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Khanna. O. P, A Textbook of Welding Technology, Dhanpatrai and Sons, 2015.
2. Parmar. R. S. Welding Engineering And Technology, Khanna Publishers, 2nd Edition, 2013.
3. Dr. Yadav. K. S, Advance Welding Technology, Rajson's Publication pvt Ltd, 2006.

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1. Richard Little, Welding and Welding Technology, Mc Grawhill Education, Indian Edition, 2017.
2. ASM Handbook vol.6, welding Brazing & Soldering, 2003
3. P.T.Hould Croft, Welding Process Technology, Cambridge University Press, 1983.
4. L.Carl Love, Welding Procedures and Applications, Prentice Hall Inc., 1993.
5. M.N.Watson, Joining Plastics in Production, Welding Institute, Cambridge, 1990.

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2.	https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-me20/
3.	https://www.classcentral.com/course/swayam-fundamental-of-welding-science-and-technology-13016.
4.	https://www.wileymetal.com/6-advanced-welding-processes-and-their-applications-explained/
5.	https://www.tws.edu/blog/welding/advanced-welding-techniques/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	-	-	-	-	-	-	-	1	1	2	2
2	3	1	1	1	-	-	-	-	-	-	-	1	1	2	2
3	3	1	1	1	-	-	-	-	-	-	-	1	1	2	2
4	3	2	2	2	-	-	-	-	-	-	-	1	1	2	2
5	3	3	3	3	1	-	1	1	1	1	-	1	1	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**		Programme : **B.Tech.**					
Semester	**VII**		Course Category: **PE**			End Semester Exam Type: **TE**		
Course Code	**U23MEE717**		Periods/Week			Credit	Maximum Marks	
			L	T	P	C	CAM	ESE	TM
Course Name	**POWER PLANT ENGINEERING**		**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH									
Prerequisite	Thermodynamics, Heat and Mass Transfer								
Course Outcome	**On completion of the course, the students will be able to**							BT Mapping (Highest Level)	
	CO1	The students will be able to understand the steam cycles and steam generators						**K2**	
	CO2	Compare the functions of different material handling equipment's involved in power production.						**K2**	
	CO3	Students will gain knowledge about the gas turbine plant cycle and nuclear reactor.						**K2**	
	CO4	Illustrate the working of renewable energy based power production systems						**K3**	
	CO5	Apply the knowledge of energy consumption and calculating the tariffs, and analysis on the environmental impact of power plants.						**K3**	

UNIT - I	**Thermal Power Plants**	**Periods: 9**
Introduction - need and selection power plant – types, system and components –.Super Critical Boilers, FBC Boilers, Turbines, Condensers - Steam generators – modern high pressure generators- Accessories: Boiler Feed Pump, feed water heaters - economizer, air-preheaters, Super heaters.		**CO1**
UNIT - II	**Power Plant Handling System and Equipments**	**Periods: 9**
Air handling system: forced draught fans, primary and secondary air system for solid fuels – flue gas path; method of producing draught: natural, induced draughts – induced draught fans – flue gas treatment for pollution: particulate emissions and pollutants - cyclone separator, electro-static precipitator – chimney - Bottom ash handling system. Cooling towers, Feed water treatment (mechanical, chemical processes) – fuel handling and supply system (solid, pulverized, liquid and gaseous fuels).		**CO2**
UNIT - III	**Nuclear and Gas Turbine Power Plant**	**Periods: 9**
Basics of Nuclear Engineering- Layout and subsystems of Nuclear Power Plants- Working of Nuclear Reactors: Boiling Water Reactor (BWR)- Pressurized Water Reactor (PWR)- Deuterium- Uranium reactor (CANDU)- Breeder- Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants. External combustion engines - Gas turbine plant cycle – classification – simple cycle – regenerative cycle – reheat cycle – regenerative – reheat cycle – inter-cooling. Combined cycles - Steam and gas turbine Power plants – cycle analysis		**CO3**
UNIT - IV	**Power from Renewable Energy**	**Periods: 9**
Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Wave, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems		**CO4**
UNIT - V	**Energy, Economic and Environmental Issues of Power Plants**	**Periods: 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.		**CO5**

Lecture Periods: 45	**Tutorial Periods:-**	**Practical Periods: -**	**Total Periods: 45**

Text Books

4. P.K.Nag, Power Plant Engineering, Tata McGraw Hill, 2022
5. R. K. Rajput, A text book on Power Plant Engineering, Laxmi Publictions, 2020
6. P.K Das & A.K Das, An Introduction to Thermal Power Plant Engineering and Operation: For Power Plant Professionals, Notion Press, 2020

Reference Books

1. W. Culp, Principles of Energy Conversion, Tata McGraw Hill, 2000.
2. Domkundwar and Arora Domkundwar, Power Plant Engineering, Dhanpatrai and Son's, 4th edition, 2019.
3. Godfrey Boyle, Renewable energy, Open University, Oxford University Press in association with the Open University, 2004.
4. M.M. El-Wakil, Power Plant Technology, Tata McGraw – Hill Publishing Company Ltd., 2010.
5. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, Standard Handbook of Power Plant Engineering, Second Edition, McGraw – Hill, 1998.

Web References	
1.	https://nptel.ac.in/noc/courses/noc21/SEM2/noc21-me86/
2.	https://npti.gov.in/post-graduate-certificate-course-thermal-power-plant-engineering
3.	https://www.coursera.org/lecture/electricity/power-plants-gAZ4H
4.	https://powermin.gov.in/en/content/national-power-training-institute.
5.	https://www.tpctraining.com/collections/power-plant-operations-training

COs/POs/PSOs Maping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	-	-	-	1	1	2	2
2	3	2	2	2	-	-	-	-	-	-	-	1	1	2	2
3	3	2	2	2	-	-	-	-	-	-	-	1	1	2	2
4	3	3	3	3	-	-	-	-	-	-	-	1	1	2	2
5	3	3	3	3	1	-	1	1	1	1	-	2	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE718**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**NANO TECHNOLOGY IN MATERIALS**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Advanced Manufacturing Technology							

Course Outcome			BT Mapping (Highest Level)
	On completion of the course, the students will be able to		
	CO1	Understand various types of bonding and structure of nanomaterials.	**K2**
	CO2	Apply mechanical, Magnetic, Optical & Thermal properties of different material for potential applications.	**K3**
	CO3	Identify and understand various top-down and bottom-up approaches for nanomaterial synthesis.	**K2**
	CO4	Be familiar with various morphological and spectroscopic techniques.	**K3**
	CO5	Use nanostructured materials for design and developing nano sensors, nano medical applications.	**K4**

UNIT - I	**Introduction to Nano Technology**	**Periods: 9**
Introduction of nanomaterials and nanotechnologies, Features of nanostructures, Background of nanostructures, Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance, nano crystal structure, Nano-particles, Quantum dots, Nano-wires, Ultra-thin films, Challenges in Nanotechnology.		**CO1**
UNIT - II	**Nanoscale Dimensions and Properties**	**Periods: 9**
Effect of Nanoscale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties.		**CO2**
UNIT - III	**Synthesis of Nanomaterials**	**Periods: 9**
Fabrication methods: Top down and bottom up approaches-Top down processes: Milling, Lithographic, machining process, pulsed laser methods, Spray Pyrolysis- Bottom up processes: Vapour phase deposition methods, PVD, CVD, electro deposition, plasma assisted deposition process, MBE, chemical methods, colloidal and solgel methods.		**CO3**
UNIT - IV	**Nanostructured Materials Characterization Techniques**	**Periods: 9**
X-Ray Diffraction (XRD), RAMAN Spectroscope, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunnelling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nano indentation.		**CO4**
UNIT - V	**Applications of Nanomaterials**	**Periods: 9**
Nano-electronics, Nanosensors, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Nano-medical applications, Textiles, Paints, Nanomaterials as electrode materials for batteries, Defence and Space Applications.		**CO5**

Lecture Periods: 45	**Tutorial Periods:-**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Dr. N. Abilash ,Dr. A. Johnny Varghese , Mr. N. Manikandan ,Nanomaterial Synthesis And Characterization Techniques San International Scientific Publications,2024.
2. Zishan Husain Khan, Recent Advances in Nanomaterials, Springer, 2023.
3. Sanjay Mathur and Mrityunjay Singh, Nanostructured Materials and Nanotechnology – 2nd, Edition. Willey, 2008.

Reference Books

1. A.I. Gusev and A. A. Rempel, Nanocrystalline Materials, Viva Books, New Delhi, 2008.
2. Gregory Timp, Nanotechnology, Springer-Verlag, 2009.
3. Guozhong Cao and Ying Wang, Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, World Scientific Series 2011.
4. Rongming Wang, Shuhui Sun, Advanced Nanomaterials for Electrochemical Energy Conversion and Storage, MDPI, 2022.
5. Asim K Das**,** An Introduction to Nanomaterials and Nanoscience, CBS Publishers,2024**.**

Web References

1. https://nptel.ac.in/courses/102/107/102107058/
2. www.azonano.com

3.	https://nptel.ac.in/courses/118/107/118107015/
4.	https://nptel.ac.in/courses/118/102/118102003/
5.	https://nptel.ac.in/courses/118/106/118106021/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	-	1	2	-	1	-	1	2	1	2	1
2	3	1	2	1	-	2	-	-	1	-	2	1	1	2	2
3	3	2	2	-	2	2	2	-	1	-	2	2	1	2	2
4	3	2	2	1	2	2	1	-	2	-	2	2	2	2	2
5	3	2	2	2	2	2	1	-	1	-	2	2	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEDC05**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**SIMULATION MODELING OF MANUFACTURING SYSTEM**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Manufacturing							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Explain discrete, continuous, and hybrid simulation methods.	**K2**
	CO2	Compare legacy simulation tools (FORTRAN, GPSS, SIMAN, SLAM, MODSIM) with modern platforms.	**K2**
	CO3	Apply simulation techniques in manufacturing system case studies, including digital twins.	**K3**
	CO4	Analyze simulation data using advanced analytics.	**K3**
	CO5	Recognize the growing role of simulation in modern engineering.	**K2**

UNIT - I	**Introduction to Modern Simulation**	**Periods: 9**
Overview of simulation in Industry 4.0 – basic concepts of discrete, continuous, and hybrid simulation – digital twin technology – brief comparison of traditional vs. modern simulation software.		**CO1**
UNIT - II	**Mathematical, Statistical & Computational Models**	**Periods: 9**
Review of key mathematical and statistical concepts – introduction to event scheduling and simulation programming (Python/SimPy) – comparison of manual and computational simulation methods.		**CO2**
UNIT - III	**Simulation of Manufacturing Systems**	**Periods: 9**
Study of simulation models for manufacturing systems – inclusion of real-time data and IoT integration – comparison of traditional tools (SIM FACTORY II.5, ProModel) with updated platforms (AnyLogic, Arena) – brief case studies on smart factories.		**CO3**
UNIT - IV	**Analysis and Optimization of Simulation Data**	**Periods: 9**
Fundamentals of data collection, statistical distribution, and parameter estimation – updated techniques for model verification and validation – introduction to machine learning tools for data optimization.		**CO4**
UNIT - V	**Applications and Emerging Trends**	**Periods: 9**
Applications in manufacturing, material handling, and computer systems – emerging trends such as cloud simulation, digital twins, and sustainability – discussion on future innovations in simulation.		**CO5**

Lecture Periods: 45	**Tutorial Periods:-**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Averill M. Law & W. David Kelton – *Simulation Modeling and Analysis*, 5th Edition, McGraw Hill, 2018
2. D.J. Murray-Smith – Testing and Validation of Computer Simulation Models: Principles, Methods and Applications, Springer, 2015
3. L.G. Birta & G. Arbez – *Modeling and Simulation*, Springer, 2013

Reference Books

1. A. Muzy & E. Kofman, *Theory of Modeling and Simulation*, 3rd Edition, Academic Press, 2018.
2. Averill M. Law & W. D. Kelton, *Simulation Modeling and Analysis*, 3rd Edition, McGraw Hill, 2000.
3. W. D. Kelton, R. P. Sadowski & D. A. Sasowski, *Simulation with ARENA*, McGraw Hill, 2002.
4. G. L. Curry & R. M. Feldman, *Manufacturing System Modeling and Analysis*, Springer, 2008.
5. ByoungKyu Choi & Donghun Kang, *Modeling and Simulation of Discrete-Event Systems*, John Wiley & Sons, 2013.

Web References

1. University of Baltimore – Simulation Resources
2. CORE Research on Simulation
3. NPTEL – Simulation Courses
4. NPTEL Video Lectures on Manufacturing
5. NPTEL – Manufacturing Systems Management

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	1	-	-	1	1	1	2	1	1	1
2	3	2	1	-	1	2	-	-	1	1	2	2	1	1	1
3	3	2	2	-	1	2	-	-	1	1	2	2	1	2	1
4	3	2	2	-	1	2	-	-	1	1	2	2	1	2	1
5	3	2	2	-	1	2	-	-	1	1	2	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

PROFESSIONAL ELECTIVE - V

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VIII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE819**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**LEAN MANUFACTURING**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Manufacturing Processes							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Highlighting the lean concepts in modern digital factory.	**K1**
	CO2	Commenting fundamentals of lean manufacturing and thus acquire the capability to work in digital environment.	**K2**
	CO3	Examining the concept of digital twin technology.	**K3**
	CO4	Integrate lean manufacturing with quality management systems	**K3**
	CO5	Apply the knowledge of data driven lean culture in real-time industrial environment.	**K3**

UNIT - I	**Introduction to Lean Manufacturing**	**Periods: 9**
Introduction to Lean and Digital Factory Simulation – Evolution of Lean principles and their relevance in modern manufacturing – Comparison with traditional and contemporary production methods – The 8 Wastes (including underutilized talent) – Causes, effects, and strategies for elimination – Overview of Lean principles, concepts, and tools – Lean beyond stockless production: Integration with Industry 4.0.		**CO1**
UNIT - II	**Lean Manufacturing Methodologies, Tools & Six Sigma**	**Periods: 9**
Core Lean manufacturing tools and techniques – Lean assessments and implementation strategies – Standardized work in digital environments – – Error-proofing (Poka-Yoke) – Define Six Sigma, Features, Goals, ISO Standard, Six Sigma implementation, Operational Excellence, Belts & Roles of Belts		**CO2**
UNIT - III	**Process Mapping**	**Periods: 9**
Advanced Value Stream Mapping (VSM) – Current vs. Future state mapping – Application to smart factory simulations – Process mining and digital twin technology for mapping and optimization – Step-by-step approach to streamlining workflows – Practical guidelines for effective implementation.		**CO3**
UNIT - IV	**Implementation of Lean and Just in Time Manufacturing**	**Periods: 9**
Lean implementation roadmap – Role of senior leadership in sustaining Lean culture – Integration of Lean with Quality Management Systems (ISO 9001:2015, IATF 16949) – Toyota Production System (TPS) in the era of automation – Just-In-Time (JIT) elements and benefits – Pull vs. Push production models – Kanban 2.0 and digital Kanban systems – Continuous improvement strategies – AI and IoT in Lean implementation – Case studies from leading industries.		**CO4**
UNIT - V	**Worker Involvement and Systematic Planning Methodology**	**Periods: 9**
Employee involvement in Lean transformation – Strategies for engagement and empowerment – Quality circles and Kaizen culture – Lean training and skill enhancement programs – Digital suggestion platforms for continuous improvement – Hoshin Kanri (Strategic Policy Deployment) – Phases of systematic planning – Fostering a data-driven Lean culture – Case studies on workforce-led Lean transformations.		**CO5**

Lecture Periods:45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. P. Ramakrishnan – Lean Manufacturing: Principles, Tools & Techniques, Notion Press, 2022
2. R. Panneerselvam & P. Senthilkumar – Production and Operations Management, PHI Learning, 2019
3. T. K. Ramesh & M. Sakthivel – Lean Manufacturing: Concepts, Techniques & Implementation, Laxmi Publications, 2021

Reference Books

1. K. B. Akhilesh – Industrial Engineering and Management, Prentice Hall India, 2008
2. P. N. Mukherjee – Total Quality Management, Prentice Hall India, 2005
3. Vinod Kumar Garg & N. K. Sharma – Production and Operations Management, Excel Books, 2017
4. K. C. Jain & L. N. Aggarwal – Production Planning, Control & Industrial Management, Khanna Publishers, 2017
5. B. Mahadevan – Operations Management: Theory and Practice, Pearson India, 2015

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1. https://onlinecourses.swayam2.ac.in/imb24_mg119/preview?utm_source=chatgpt.com
2. https://www.ascm.org/topics/principles-of-lean-manufacturing
3. https://www.lean.org/lexicon-terms/value-stream-mapping
4. https://leansmarts.com/lean-101/just-in-time-manufacturing

5. https://www.mjvinnovation.com/blog/10-lean-tools-for-continuous-improvement

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	1	-	-	-	-	-	-	-	-	2	3	1	1
2	2	2	3	-	-	-	-	-	-	-	-	1	1	1	2
3	3	3	3	-	-	-	-	-	-	-	-	2	3	2	2
4	2	2	2	-	-	-	-	-	-	-	-	1	2	1	1
5	2	2	2	-	-	-	-	-	-	-	-	2	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VIII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE820**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**CRYOGENIC ENGINEERING**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Thermodynamics, Heat and Mass transfer							

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
CO1	Demonstrate the concept of Cryogenics technology and its working cycles operations.	**K1**
CO2	Describe various properties of cryogenics fluids and its production processes.	**K2**
CO3	Acquire knowledge in various cryogenic liquefaction storage and handling systems.	**K2**
CO4	Identify the various measuring techniques involved to quantify the cryogenic fluids.	**K2**
CO5	Apply the knowledge of cryogenics techniques in various applications.	**K3**

UNIT - I	**Introduction to Cryogenics and Properties**	**Periods: 9**
Definition and history of cryogenics, Low Temperature Properties: Properties of Engineering Materials (Mechanical properties, Thermal properties, Electrical and Magnetic properties), super fluidity, properties of solids at cryogenic temperatures, superconductivity		**CO1**
UNIT - II	**Liquefaction Systems**	**Periods: 9**
Ideal system, Joule Thomson expansion, Adiabatic expansion, Linde Hampson Cycle, Claude & Cascaded System. Principle of air separation, production of gases like oxygen, nitrogen and argon. Gas-Liquefaction and refrigeration systems, thermodynamics of gas liquefaction, liquefaction cycles, cryogenic refrigeration systems down to milli Kelvin range, Dilution Refrigerator and adiabatic demagnetization.		**CO2**
UNIT - III	**Cryogenic Fluids : Storage, Insulation and Transfer**	**Periods: 9**
Cryogenic insulations, storage and transfer of cryogenic liquids, cryostats, introduction to vacuum technology, cool down of cryogenic transfer lines, frost phenomena		**CO3**
UNIT - IV	**Instrumentation in Cryogenics**	**Periods: 9**
Instrumentation in Cryogenics: measurement temperature, thermocouples, platinum resistance and semiconductor thermometry- liquid level, flow rate, quality		**CO4**
UNIT - V	**Cryogenics Applications**	**Periods: 9**
Cryogenics and its applications: applications of cryogenics in engineering, space technology, liquid fuel rockets, space simulation chambers, cryogenic heat pipes, nuclear research, bubble chambers, spectroscopy, cryo pumping, food processing, biology, medicine and LNG technology, Cryo Metallurgy, Medical applications, cryocooler and its applications		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Zhao Z, Cryogenic Engineering and Technologies Principles and Applications of Cryogen Free Systems, Taylor and Francis, 2020.
2. S.S. Thipse, Cryogenics: A Textbook, Narosa, 2013.
3. A.R. Jha, Cryogenic Technology and Applications, Academic Press Inc.(London) Ltd, 2011.

Reference Books

1. Haselden C.J. (Ed) Cryogenic Fundamentals, Academic Press 1975.
2. Baily C.A. Advanced cryogenics. Plenum Press 1971.
3. Bahman Zohuri, Physics of Cryogenics An Ultralow Temperature Phenomenon, Elseivier, 2017.
4. Valery V. Kostionk, A Text Book Of Cryogenics, Discovery Publishing House, 2003
5. G. Perinić, G. Vandoni, T. Niinikoski, Introduction to Cryogenic Engineering, CERN, 2005.

Web References

1. https://www.digimat.in/nptel/courses/video/112101004/L33.html
2. https://trc.nist.gov/cryogenics/aboutCryogenics.html
3. https://home.cern/science/engineering/cryogenics-low-temperatures-high-performance
4. https://www.thoughtco.com/cryogenics-definition-4142815
5. https://www.academia.edu/38257014/_1_1_1_NPTEL_Introduction_to_Cryogenic_Engineering

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	-	-	-	1	1	2	2
2	3	2	2	2	-	-	-	-	-	-	-	1	1	2	2
3	3	2	2	1	-	-	-	-	-	-	-	1	1	2	2
4	3	3	3	3	-	-	-	-	-	-	-	1	1	2	2
5	3	3	3	3	1	-	1	1	1	1	-	1	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VIII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE821**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**AUTOTRONICS**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Automobile Engineering							

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
CO1	Understand the basic knowledge about engine management System.	**K2**
CO2	Acquire knowledge about ignition and injection systems.	**K2**
CO3	Summarize the working of sensors and actuators.	**K2**
CO4	Acquire knowledge about electrical systems in automobiles**.**	**K3**
CO5	Infer the details of chassis and safety systems in automobiles.	**K3**

UNIT - I	**Introduction**	**Periods: 9**
Fundamentals of Automotive Electronics: Microprocessor and micro-Computer applications in automobiles; Concept of CPU and computer memory used in automobiles, components for engine management System; vehicle motion control; electronic panel meters.		**CO1**
UNIT - II	**Ignition and Injection Systems**	**Periods: 9**
Ignition systems: Ignition fundamentals - Electronic ignition systems - CB point controlled magneto ignition system, Electronic battery coil ignition systems, Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.		**CO2**
UNIT - III	**Sensor and Actuators**	**Periods: 9**
Sensors – types, working and positioning. Study of fuel injector, Actuators - types and workings, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated actuator.		**CO3**
UNIT - IV	**Automotive Components and Systems**	**Periods: 9**
Microprocessor control systems. Electronic dashboard instruments and accessories – Onboard diagnosis system, security and warning system – ECU – principle and working of ECU. Batteries; starter motor & drive mechanism; D.C. generator and alternator; regulation for charging; lighting design.		**CO4**
UNIT - V	**Chassis and Safety Systems**	**Periods: 9**
Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – Chassis Domain Controller- working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars - Acoustic Vehicle Alerting System (AVAS)		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. N. R. Khatawale, Automotive Electrical auxiliary systems, 2017.
2. P.L.Kohli, Automotive electrical equipments, Tata McGraw hill publications,2017
3. William B.Ribbens, Understanding Automotive Electronics, 2014

Reference Books

1. Tom Denton, “Automobile Electrical and Electronics Systems”, Edward Arnold Publishers, 2017.
2. Ribbens, "Understanding Automotive Electronics", 7th Edition, Elsevier, Indian Reprint, 2015
3. Ronald. K. Jurgon, “Automotive Electronics Handbook”, McGraw-Hill, 2013.
4. Richard K. Dupuy “Fuel System and Emission controls”, Check Chart Publication, 2000.
5. Barry Hollembeak, “Automotive Electricity, Electronics & Computer Controls”, Delmar Publishers, 2011.

Web References

1. https://www.youtube.com/watch?v=c0zl7449pwE
2. https://www.youtube.com/watch?v=M1klF1_RQqE
3. https://www.youtube.com/watch?v=z4xkPyQn_ZU&list=PLO7bO9QDjtAYV5UcQAQsZPNEiO9FjScVj
4. https://youtu.be/c0zl7449pwE
5. https://onlinecourses.nptel.ac.in/noc21_de02/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	-	-	-	-	-	-	1	2	1	2
2	3	2	1	-	-	-	-	-	-	-	-	1	2	1	2
3	3	2	1	-	-	-	-	-	-	-	-	1	2	1	2
4	3	2	1	-	-	-	-	-	-	-	-	1	2	1	2
5	3	2	1	-	-	-	-	-	-	-	-	1	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VIII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE822**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**OPTIMIZATION TECHNIQUES IN ENGINEERING DESIGN**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

Prerequisite	Numerical Methods and Optimization		
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Finding of optimization.	**K2**
	CO2	Categorizing the various optimum design.	**K2**
	CO3	Choosing ideas on unconstrained optimization.	**K3**
	CO4	Mashing about constrained optimization.	**K4**
	CO5	Grading about Modern methods of optimization like Neural-Network	**K4**

UNIT - I	**Introduction to Optimization**	**Periods: 9**
Engineering application of Optimization – Statement of an Optimization problem - Optimal Problem formulation - Classification of Optimization problem. Optimum design concepts. Definition of Global and Local optima – Optimality criteria - Review of basic calculus concepts – Global optimality		**CO1**
UNIT - II	**Linear Programming Methods for Optimum Design**	**Periods: 9**
Evaluation of Linear programming methods for optimum design – Post optimality analysis - Application of LPP models in design and manufacturing, LLP and stochastic programming.		**CO2**
UNIT - III	**Unconstrained Optimization**	**Periods: 9**
Optimization algorithms for solving unconstrained optimization problems – Gradient based method. Cauchy's steepest descent method, Newton's method, Conjugate gradient method.		**CO3**
UNIT - IV	**Constrained Optimization**	**Periods: 9**
Optimization algorithms for solving constrained optimization problems – direct methods – penalty function methods – steepest descent method - Engineering applications of constrained and unconstrained algorithms.		**CO4**
UNIT - V	**Modern Methods of Optimization**	**Periods: 9**
Modern methods of Optimization, Neural-Network based Optimization, Applications. Use of Matlab to solve optimization problems.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Rao S. S. - 'Engineering Optimization, Theory and Practice' - New Age International Publishers, 4th Edition, 2012.
2. Kalyanmoy Deb, Optimization for Engineering Design: Algorithms and Examples, Eastern Economy edition, PHI Learning Privtae Limited, 2012.
3. Hardley G. -'Linear Programming' - Narosa Book Distributors Private Ltd., 2002.

Reference Books

1. R.VenkataRao, Vimal J. Savsani, Mechanical Design Optimization Using Advanced Optimization Techniques, Springer, 2012.
2. Arora J. - 'Introduction to Optimization Design' - Elsevier Academic Press, New Delhi - 2004
3. Saravanan R. - 'Manufacturing Optimization through Intelligent Techniques', Taylor & Francis (CRC Press), 2006.
4. John Gero, Design Optimization, AP Academic press, 2012.
5. Ashok D. Belegundu, Tirupathi R. Chandrupatla, Optimization Concepts and Applications in Engineering, Cambridge umiversity press, 2011

Web References

1. https://nptel.ac.in/courses/112/101/112101298/
2. https://nptel.ac.in/courses/112/106/112106064/
3. https://www.youtube.com/watch?v=LL20TZGXp3Q
4. https://www.youtube.com/watch?v=3Bh_viwz6_0
5. https://www.youtube.com/watch?v=aJKuM4U-eYg

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	-	-	-	-	-	2	3	2	3	1
2	3	3	2	2	-	-	-	-	-	-	1	3	2	2	3
3	3	3	2	2	-	-	-	-	-	-	2	3	2	1	3
4	3	3	3	2	-	-	-	-	-	-	1	3	1	2	3
5	3	3	3	2	-	-	-	-	-	-	2	3	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VIII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE823**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**TOTAL QUALITY MANAGEMENT**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Metrology and Measurement							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Highlighting the concept of quality	**K1**
	CO2	Commenting fundamentals of total Quality Management	**K2**
	CO3	Examining the concept of Total quality management.	**K3**
	CO4	Distinguishing service based management and Cast of Quality	**K3**
	CO5	Apply the knowledge of quality systems and cost of quality	**K3**

UNIT - I	**Introduction to Concept of Quality**	**Periods: 9**
Definition, Evolution of quality, Concept and Features of TQM, Building blocks of TQM Juran Trilogy, PDSA cycle, 5S, Kaizen, Crosby's theory on Quality Management, Quality Performance Excellence Award- Deming Application Award, European Quality Award, Malcolm Baldrige National Quality Award.		**CO1**
UNIT - II	**Lean and Six Sigma**	**Periods: 9**
Define Lean & Six Sigma, Features, Goals, ISO Standard, Six Sigma implementation, Operational Excellence, Belts & Roles of Belts, Principals of Determinism Pareto, DMAIC and DMADV, Critical Success factors for Six Sigma Project.		**CO2**
UNIT - III	**TQM Tools**	**Periods: 9**
Quality Policy Deployment (QPD), Quality Function Deployment (QFD) House of Quality, QFD Process, Benefits, Taguchi Techniques , Total Productive Maintenance (TPM) Concept and need, Benchmarking, Taguchi Quality Loss Function, Total Productive Maintenance (TPM), FMEA- Failure Modes and Effective Analysis		**CO3**
UNIT - IV	**Service Quality Management and Cost of Quality**	**Periods: 9**
Products and services, Classification of services, Service Quality, Measuring Service Quality, Prevention costs, Appraisal costs, Internal and External failure costs, Cost of quality models, India's quality journey so far, Quality management in India, Quality related priorities of Indian companies, Case studies		**CO4**
UNIT - V	**Cost of Quality and Quality Systems**	**Periods: 9**
Juran's concept of Quality Cost, Quality Cost components, SERVQUAL Model of Customer Satisfaction ISO 9000, ISO 9000:2000, ISO 14000, Quality Management Systems and Quality Assurance		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Jeffry A. Doney, "Total Quality Management: " Nova Science Publishers, 2019
2. D.R Kiran, Total Quality Management: Key Concepts and Case Studies, BSP, 2016.
3. L.Suganthi, Total Quality Management, PHI Learning, 2011

Reference Books

1. Dale H. Besterfield , Hemant Urdhwareshe , Mary Besterfield-Sacre , Carol Besterfield-Michna , Rashmi Urdhwareshe , Glen H. Besterfield, "Total Quality Management" Pearson Publication, 2012.
2. Basterfield , "Total Quality Management", Pearson Education, New Delhi , 2018
3. M. Mahajan, Statistical Quality Control, Dhanpat Rai & Co. Pvt. Limited, 2016
4. R.P.Mohanty and R.R.Lakhe , TQM in Service Sector, Jaico Publishing House, 2013
5. Douglas C. Montgomery, "Introduction of Statistical Quality Control:, John Wiley & Sons, 2009.

Web References

1. https://hello.iitk.ac.in/course/mba663a21
2. https://onlinecourses.nptel.ac.in/noc20_mg34/preview
3. https://onlinecourses.nptel.ac.in/noc21_mg72/preview
4. https://www.careers360.com/university/indian-institute-of-technology-kanpur/total-quality-management-i- certification-course
5. https://edusparkz.com/course_details?course_id=11205

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	1	2	1
2	3	2	2	1	1	-	-	-	-	-	-	1	2	3	2
3	3	1	2	2	1	-	-	-	-	-	-	-	3	2	2
4	3	2	2	2	-	-	-	-		-	-	1	2	3	2
5	3	2	2	2	1	-	-	-		-	-	1	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

PROFESSIONAL ELECTIVE - VI

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VIII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE824**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**COMPOSITES MATERIAL**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Engineering Metallurgy							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Gain knowledge on the need of various types of composites.	**K2**
	CO2	Understand different techniques to process polymer-matrix composites and its limitations.	**K2**
	CO3	Gather different techniques to process metal-matrix composites and its limitations.	**K3**
	CO4	Infer different techniques to process ceramic-matrix composites and its limitations.	**K3**
	CO5	Select appropriate composites for specific applications.	**K4**

UNIT - I	**Introduction to Composites**	**Periods: 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.		**CO1**

UNIT - II	**Polymer Matrix Composites**	**Periods: 9**
Polymer matrix 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 (GRP).		**CO2**

UNIT - III	**Metal Matrix Composites**	**Periods: 9**
Characteristics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC, Limitations of MMC, Metal Matrix, Reinforcements – particles – fibres. Effect of reinforcement - Volume fraction – Rule of mixtures, Aspect Ratio. Processing of MMC – Powder metallurgy process - diffusion bonding – stir casting – squeeze casting.		**CO3**

UNIT - IV	**Ceramic Matrix Composites**	**Periods: 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).		**CO4**

UNIT - V	**Advances in Composites**	**Periods: 9**
Carbon / carbon composites – Advantages of carbon matrix – limitations of carbon matrix Carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol gel technique. Composites for aerospace applications		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Mathews F.L. and Rawlings R.D., Composite materials: Engineering and Science, Chapman and Hall, London, England, 2006.
2. Chawla K.K., Composite materials, Springer – Verlag, 2013.
3. Autar.K.Kaw, “Mechanics of Composite Materials”, CRC Press, 2006.

Reference Books

1. Clyne T.W. and Withers P.J., Introduction to Metal Matrix Composites, Cambridge University Press, 2003.
2. Strong A.B., Fundamentals of Composite Manufacturing, SME, 2008
3. Sharma S.C., “Composite materials”, Narosa Publications, 2004
4. Broutman, L.J. and Krock, R.M., “Modern Composite Materials”, Addison-Wesley, 1967.
5. ASM Hand Book, “Composites”, Vol.21, ASM International, 2001.

Web References

1. https://nptel.ac.in/content/storage2/courses/101106038/mod01lec01
2. https://www.classcentral.com/course/edx-composite-materials-overview-for-10
3. https://www.digimat.in/nptel/courses/video/112104229/L01.html

4.	https://www.youtube.com/watch?v=VMH6qbED7pg
5.	https://www.youtube.com/watch?v=PzdCymgyZ6c

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	-	-	3	3	-	-	-	2	3	3	3	3
2	3	3	-	-	-	-	3	-	-	-	2	3	3	2	3
3	3	3	-	-	-	-	2	3	-	-	3	3	3	3	3
4	3	3	-	-	-	-	2	3	-	-	2	3	3	2	3
5	3	3	-	-	-	-	2	3	-	-	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VIII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE825**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ENGINEERING FAILURE ANALYSIS**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Strength of Materials							

Course Outcome		On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1	Understand various types of failures in engineering materials and components.	**K2**
	CO2	Examine fracture surfaces and material microstructures to assess failure origins and progression.	**K2**
	CO3	Know the general approach to analysis of failure.	**K3**
	CO4	Illustrate the role of environmental factors which influence the material degradation and failure.	**K4**
	CO5	Analysis the failures related to corrosion and wear.	**K4**

UNIT- I	**Introduction to Failure Analysis**	**Periods: 9**
Need and scope of failure analysis. Engineering Disasters and understanding failure analysis. Fundamental sources of failures. Deficient design. Improper Manufacturing & Assembly. Tree diagram and FMEA.		**CO1**
UNIT- II	**Microstructural Aspects**	**Periods: 9**
Critical appraisal of the role of microstructure in failure, application of quantitative metallography, role of grain size and second phase particles, grain boundary and segregation, temper and hydrogen embrittlement, macro and micro examination.		**CO2**
UNIT- III	**Analysis of Failure**	**Periods: 9**
Deformation and general approach to analysis of failure; Fracture aspects: Type of fracture, ductile, brittle and mixed mode fractures, models of nucleation and growth of cracks, fractography. Determination of chemical composition by various analytical techniques; determination of mechanical properties like tensile, hardness, bend tests of failed components, comparison with Bureau of Indian Standards, quality assurance.		**CO3**
UNIT- IV	**Environment Assisted Failures**	**Periods: 9**
Basic principles of aqueous corrosion and high temperature corrosion and oxidation, causes and their remedies. Stress corrosion cracking (SCC)- introduction and history of SCC, material/environment combinations where SCC occurs, characteristics of SCC, introduction to various models of SCC mechanism, evaluating SCC rates using time-to-failure (TTF) tests and the fracture mechanics approach (crack growth rate) tests, significance of the threshold stress intensity factor ($KISCC_{)}$ in SCC evaluation.		**CO4**
UNIT- V	**Failure Analysis of corrosion and wear**	**Periods: 9**
Failures related to corrosion, hot corrosion and stress corrosion cracking; Damages due to hydrogen; Creep of metallic materials, service failures during high temperature service; Failures related to wear.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Gwidon Stachowiak, Andrew W Batchelor, Engineering Tribology , Butterworth-Heinemann, 2025
2. Hock-Chye Qua, Applied Engineering Failure Analysis: Theory and Practice, CRC press, Taylor & Francis, U.K, 2017.
3. Arthur J. McEvily, Metal Failures: Mechanisms, Analysis, Prevention, 2nd edition, John Wiley & Sons Inc. USA, 2013.

Reference Books

1. Callister, W.D. Jr., “Material Science and Engineering – An Introduction”, 5th Ed. John Wiley and Sons 2000.
2. ASTM E647-05, Standard Test Method for Measurement of Fatigue Crack Growth Rates, ASTM International, 2005.
3. T.H. Courtney: Mechanical Behaviour of Materials, 2nd edition, Overseas Press, India; 2006.
4. F.C. Campbell, Fatigue and Fracture: Understanding the basic, 1st edition, ASM International, 2012.
5. Metallurgical Engineering - Metallurgical Failure Analysis, PS Publishing, 2023.

Web References

1. https://archive.nptel.ac.in/courses/112/107/112107241
2. https://youtu.be/5gBfKs5QjSc
3. http://digimat.in/nptel/courses/video/112107241/L25
4. https://www.youtube.com/watch?v=WLOkuk2L8GQ

5. https://www.youtube.com/watch?v=F6Gn1YS0PdY

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	2	2	-	-	-	-	1	2	2	3	3
2	3	2	2	2	3	1	-	1	1	-	1	2	2	3	3
3	3	2	2	2	2	1	-	1	2	-	1	2	3	3	3
4	3	2	2	3	3	1	1	2	2	2	2	3	3	3	3
5	3	2	2	3	3	2	2	2	2	2	2	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VIII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE826**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MAINTENANCE AND SAFETY ENGINEERING**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Manufacturing Technology and Automation							

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
CO1	Identify various types of Maintenance policies used in industries	**K2**
CO2	Identify and apply the various faults finding in machines.	**K3**
CO3	Implement Trouble shooting of machines	**K2**
CO4	Demonstrate different safety methods and protective equipment's	**K4**
CO5	Discuss safety acts and legal provisions	**K3**

UNIT- I	**Introduction to Maintenance Engineering**	**Periods: 9**
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.		**CO1**
UNIT- II	**Fault Tracing**	**Periods: 9**
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, Draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's for various machine components.		**CO2**
UNIT- III	**Periodic and Preventive Maintenance**	**Periods: 9**
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, Preventive maintenance - Definition, need, steps and advantages. Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.		**CO3**
UNIT- IV	**Industrialsafety and Prevention of Accidents**	**Periods: 9**
Introduction to the development of industrial safety and management, Implementation of factories act, Formation of various councils, Safety and productivity, Safety organizations. Safety committees, Roll of management and roll of Govt. in industrial safety, Safety analysis, Accident preventions, protective equipment's and the Acts, First aid, Firefighting equipment. Accident reporting, Investigations, Industrial psychology in accident prevention		**CO4**
UNIT- V	**Safety Acts**	**Periods: 9**
Introduction of Explosive Act, Boiler Act, ESI Act, Workman's compensation Act. Features of Factory Act. Industrial hygiene, Occupational safety, Diseases prevention, Ergonomics, Occupational diseases. Stress, fatigue, health, safety and the physical environment, safety and the physical environment. Control of industrial noise and protection against it, Code and regulations for worker safety and health		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. E Balagurusamy, Reliability Engineering McGraw Hill Education, 2017.
2. A.K. Gupta, Reliability, Maintenance and Safety Engineering, Laxmi Publications, 2015.
3. Venkataraman, K. , Maintenance Engineering and Management, PHI publication, 2010.

Reference Books

1. Iberto Martinetti, Micaela Demichela, and Sarbjeet Singh, Applications and Challenges of Maintenance and Safety Engineering in Industry 4.0, IGI Global, 2020.
2. Verma, Ajit Kumar, Ajit, Srividya, Karanki, Durga Rao Reliability and Safety Engineering, Springer, 2016.
3. Shawn A. Ballee and Gary R. Shearer, Industrial Maintenance and Mechatronics, Goodheart-Willcox; First Edition, 2018.
4. Michael E. Brumbach, Jeffrey A. Clade, Industrial Maintenance, 2nd Edition, Cengage Learning, 2013.
5. MP Poonia and SC Sharma, Industrial safety and Maintenance Management, Khanna Publications, 2019

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2. https://nptel.ac.in/courses/112/107/112107241/
3. https://onlinecourses.swayam2.ac.in/nou21_me10/preview
4. https://freevideolectures.com/course/4411/nptel-industrial-safety-engineering

5. https://www.classcentral.com/course/swayam-industrial-safety-engineering-14124

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	-	-	-	-	-	-	-	2	3	2	3	2
2	3	3	-	-	-	-	-	-	-	-	3	3	3	3	3
3	3	3	-	-	-	-	-	-	-	-	3	3	3	3	3
4	3	3	-	-	-	-	-	-	-	-	3	3	3	3	3
5	3	3	-	-	-	-	-	-	-	-	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VIII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEE827**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**INTEGRATED MATERIALS MANAGEMENT**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Engineering Metallurgy							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Explain the concepts, processes, and strategic importance of integrated materials management in manufacturing and service sectors.	**K2**
	CO2 Analyse and compare various inventory control models (EOQ, JIT, ABC analysis) and their applicability in different operational contexts	**K3**
	CO3 Evaluate procurement strategies, supplier selection, and contract management methods to optimize the supply chain	**K3**
	CO4 Design logistics, warehousing, and materials handling systems that improve the efficiency of the materials flow	**K2**
	CO5 Assess emerging trends and digital technologies (ERP, RFID, IoT) in materials management and their role in sustainable operations.	**K3**

UNIT- I	**Introduction to Integrated Materials Management**	**Periods: 9**
Definitions and scope of materials management - Evolution of materials management - Integration in procurement, production, and distribution - Materials management framework - Role in the supply chain - Interlinkages with production planning and quality control - Industry case studies		**CO1**

UNIT- II	**Inventory Management and Control Techniques**	**Periods: 9**
Fundamental inventory concepts - Economic Order Quantity (EOQ) - Safety Stock and Reorder Point Calculation - Just-in-Time (JIT) practices - Lean inventory management - ABC Analysis - Material Requirement Planning (MRP) - Simulation exercises		**CO2**

UNIT- III	**Procurement and Strategic Sourcing**	**Periods: 9**
Procurement process overview - Supplier evaluation and selection criteria - Strategic sourcing methodologies - Contract negotiation - Vendor Relationship Management (VRM) - Risk mitigation strategies - Global sourcing and supply market dynamics		**CO3**

UNIT- IV	**Logistics, Distribution, and Materials Handling**	**Periods: 9**
Transportation management - Distribution network design - Warehousing and facility layout planning - Materials handling systems - RFID and automated storage systems - Logistics optimization case analyses		**CO4**

UNIT- V	**Emerging Trends and Technologies in Materials Management**	**Periods: 9**
Digital transformation in materials management - ERP systems and cloud-based SCM - IoT applications in logistics - Sustainability and green supply chain practices - Data analytics in materials planning - Future innovations and challenges o3-mini		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Christopher, M. – Logistics & Supply Chain Management, 5th Edition, Pearson, 2016
2. Hugos, M.H. – Essentials of Supply Chain Management, 4th Edition, Wiley, 2018
3. Chopra, S. & Meindl, P. – Supply Chain Management: Strategy, Planning, and Operation, 7th Edition, Pearson, 2016

Reference Books

1. Nigel Slack, Alistair Brandon-Jones & Robert Johnston – Essentials of Operations Management, 2nd Edition, Pearson, 2019
2. William J. Stevenson – Operations Management, 13th Edition, McGraw-Hill, 2018
3. Nada R. Sanders – Global Supply Chain Management, 3rd Edition, Wiley, 2017
4. Stanley E. Fawcett, Lisa M. Ellram & Jeffrey A. Ogden – Supply Chain Management: From Vision to Implementation, Addison-Wesley, 2014
5. Ronald H. Ballou – Business Logistics/Supply Chain Management, 5th Edition, Pearson, 2004

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1. https://www.apics.org
2. https://www.ismworld.org
3. https://www.scmworld.com
4. https://www.supplychaindigital.com
5. https://www.supplychainbrain.com

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	3	1	1	-	1	1	-	-	1	1	1	2	1	1
2	2	3	2	1	-	1	2	-	-	1	1	2	2	1	1
3	3	3	2	2	-	1	2	-	-	1	1	2	2	1	2
4	4	3	2	2	-	1	2	-	-	1	1	2	2	1	2
5	5	3	2	2	-	1	2	-	-	1	1	2	3	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VIII**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**U23MEDC03**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**SUPPLY CHAIN MANAGEMENT**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
MECH								
Prerequisite	Manufacturing Technology and Automation							

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Describe the basics of supply chain management.	**K1**
	CO2 Design network in supply chain**.**	**K3**
	CO3 Explain transportation in supply chain management system.	**K1**
	CO4 Design collaboration, partnership in supply chain.	**K2**
	CO5 Summarize information technology in supply chain system.	**K2**

UNIT- I	**Introduction**	**Periods: 9**
Role and Strategic Importance of Logistics and Supply Chain Management – Scope, significance, and impact in a digital and globalized economy – Evolution from traditional supply chains to digital and AI-driven SCM – Decision Phases in Modern Supply Chains – Competitive and adaptive SCM strategies – Key drivers of Supply Chain Agility and Resilience – Challenges and risks in disruptive global markets.		**CO1**
UNIT- II	**Supply Chain Network Design**	**Periods: 9**
Strategic Role of Distribution in Modern SCM – Factors influencing omnichannel distribution and last-mile delivery – Advanced distribution network design for efficiency and sustainability – AI-driven optimization in network design – Role of network design in enhancing visibility, resilience, and risk management – Framework for data-driven decision-making in supply chain networks.		**CO2**
UNIT- III	**Logistics in Supply Chain**	**Periods: 9**
Digital transformation in transportation logistics – Factors influencing modern transportation strategies – Green logistics and carbon footprint reduction – Design options for autonomous, AI-driven transportation networks – Tailored transportation with predictive analytics – IoT and blockchain for real-time shipment tracking – Advanced routing and scheduling algorithms for cost optimization and efficiency.		**CO3**
UNIT- IV	**Sourcing and Coordination in Supply Chain**	**Periods: 9**
Strategic sourcing and supplier relationship management – AI and big data in supplier selection and performance assessment – Smart contracts and blockchain in procurement – Collaborative planning, forecasting, and replenishment (CPFR) – Supply Chain Coordination – The Bullwhip Effect in digital supply chains – Impact of AI, cloud computing, and automation in reducing inefficiencies – Building resilient and sustainable supply chains through trust and strategic partnerships.		**CO4**
UNIT- V	**Supply Chain and Information Technology**	**Periods: 9**
The role of IT in Smart Supply Chains – AI, IoT, and blockchain in SCM transformation – Digital supply chain frameworks – Customer-centric supply chain models using CRM – End-to-end visibility with cloud-based platforms – Supplier Relationship Management (SRM) & AI-driven analytics – E-Business and E-Commerce supply chains – Future trends: Autonomous supply chains, robotic process automation (RPA), and cybersecurity in SCM.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Sunil Chopra, Peter Meindl, Dharam Vir Kalr “Supply Chain Management” by Pearson Publications, 2024.
2. Dr. R. P. Mohanty & Dr. S. G. Deshmukh – Supply Chain Management: Theories & Practices, Biztantra, 2010.
3. K. Shridhar Bhat – Logistics and Supply Chain Management, Himalaya Publishing House, 2015.

Reference Books

1. Rahul V. Altekar – Supply Chain Management: Concepts and Cases, PHI Learning, 2005.
2. L. Natarajan – Logistics and Supply Chain Management, Margham Publications, 2018.
3. S. Chandrasekaran & G. Sankaranarayanan – Supply Chain Management: A Managerial Approach, Cengage Learning, 2019.
4. S.K. Bhattacharya & A. K. Seth – Logistics and Supply Chain Management, Pearson India, 2011.
5. Dr. K.C. Arora & Dr. R. Kavitha – Introduction to Supply Chain Management, Excel Books, 2017.

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1. https://onlinecourses.nptel.ac.in/noc24_hs128/preview
2. https://onlinecourses.nptel.ac.in/noc23_mg71/preview
3. https://onlinecourses.nptel.ac.in/noc25_mg62/preview
4. https://kpmg.com/xx/en/our-insights/ai-and-technology/supply-chain-trends-2024.html

5. https://www.coursera.org/articles/supply-chain-trends

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	1	2	1
2	3	2	3	1	1	-	-	-	-	-	-	1	2	3	1
3	3	1	2	2	1	-	-	-	-	-	-	-	3	2	2
4	2	2	3	1	-	-	-	-		-	-	1	3	3	2
5	3	2	2	2	1	-	-	-		-	-	1	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

OPEN ELECTIVE - I

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **OE**			End Semester Exam Type: **TE**			
Course Code	**U23MEOC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**RAPID PROTOTYPING**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

(Common to EEE, ECE, ICE, CIVIL, BME)

Prerequisite	Manufacturing Processes, CAD/CAM	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand the fundamentals and processes of rapid prototyping	**K2**
	CO2 Analyze the various rapid prototyping techniques and their suitability for different applications.	**K2**
	CO3 Apply knowledge of materials used in RP to optimize product design.	**K3**
	CO4 Evaluate the limitations and benefits of rapid prototyping technologies in industry	**K3**
	CO5 Implement rapid prototyping in practical case studies for faster product development.	**K3**

UNIT - I	**Introduction to Rapid Prototyping**	**Periods: 9**
Definition, Evolution, and Importance of Rapid Prototyping. Basic Principles and Advantages of RP in Product Development. Overview of the RP process chain.		**CO1**
UNIT - II	**Rapid Prototyping Technologies**	**Periods: 9**
Classification of RP Processes - Subtractive, Additive, and Formative. Detailed Study of Additive Manufacturing Processes: Stereolithography (SLA), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM), Laminated Object Manufacturing (LOM), and 3D Printing.		**CO2**
UNIT - III	**Materials for Rapid Prototyping**	**Periods: 9**
Overview of Materials used in RP: Photopolymers, Thermoplastics, Metals, and Ceramics. Material Properties and Selection Criteria. Impact of Material Properties on RP Processes and Final Product.		**CO3**
UNIT - IV	**Rapid Prototyping Applications**	**Periods: 9**
Applications of RP in Various Industries: Aerospace, Automotive, Biomedical, and Consumer Products. Case Studies on Successful Implementation of RP.		**CO4**
UNIT - V	**Design for Rapid Prototyping**	**Periods: 9**
Design Considerations for RP: CAD Model Preparation, STL File Generation and Checking. Design Optimization for RP. Common Issues and Solutions in RP.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. "Rapid Prototyping: Principles and Applications" by Chua Chee Kai, Leong Kah Fai, Lim Chu-Sing, World Scientific Publishing Company, 2010.
2. "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing" by Ian Gibson, David W. Rosen, Brent Stucker, Springer, 2010.
3. "Rapid Prototyping: Theory and Practice" by Ali K. Kamrani and Emad Abouel Nasr, Springer, 2006.

Reference Books

1. Additive Manufacturing Handbook: Product Development for the Defense Industry" by James P. Wilczynski and David Rosen, CRC Press, 2017.
2. "3D Printing and Additive Manufacturing: Principles and Applications (With Companion Media Pack) - Fourth Edition of Rapid Prototyping" by C.K. Chua, K.F. Leong, C.S. Lim, World Scientific Publishing Company, 2014.
3. "Fundamentals of Digital Manufacturing Science" by Zude Zhou, Shane (Sheng) Xie, Dejun Chen, Springer, 2012.
4. Advances in Rapid Prototyping for Biomedical Applications" by Paulo Bartolo, Springer, 2008.
5. "Rapid Manufacturing: An Industrial Revolution for the Digital Age" by N. Hopkinson, R.J.M. Hague, P.M. Dickens, John Wiley & Sons, 2006.

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1. https://ocw.mit.edu/courses/mechanical-engineering/2-72-elements-of-mechanical-design-fall-2014/lecture-notes/
2. https://www.coursera.org/learn/additive-manufacturing
3. https://nptel.ac.in/courses/112/104/112104236/
4. https://www.edx.org/course/additive-manufacturing
5. https://www.springer.com/journal/10957

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	2	-	-	-	-	-	-	-	3	2	-
2	3	3	3	2	3	-	-	-	-	-	-	-	3	3	-
3	3	2	3	2	3	-	-	-	-	-	-	-	3	3	-
4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-
5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**V**	Course Category: **OE**			End Semester Exam Type: **TE**			
Course Code	**U23MEOC02**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MATERIAL HANDLING SYSTEM**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

(Common to EEE, ICE, CIVIL and Mechatronics Branches)

Prerequisite	Basic Engineering and Mechanical system knowledge		
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Understand various material handling systems.	**K2**
	CO2	Describe about the flexible hosting appliances.	**K2**
	CO3	Explains about the different types of material handling, advantages and disadvantages.	**K3**
	CO4	Identify the selection procedure for the material handling along with its specifications.	**K3**
	CO5	Describe the ergonomics related to material handling equipment and miscellaneous equipment's.	**K3**

UNIT - I	**Material Handling Equipments**	**Periods: 9**
Types of interplants transporting facility, principal groups of material handling equipment's, choice of material handling equipment, hoisting equipment, screw type, hydraulic and pneumatic conveyors, general characteristics of hoisting machines, surface and overhead equipment's, general characteristics of surface and overhead equipment and their applications.		**CO1**
UNIT - II	**Flexible Hosting Appliances**	**Periods: 9**
Flexible hoisting appliances like ropes and chains, welded load chains, roller chains, selection of chains hemp rope and steel wire rope, selection of ropes, fastening of chain sand ropes, different types of load suspension appliances, fixed and movable pulleys, different types of pulley systems, multiple pulley systems . Chain and rope sheaves and sprockets.		**CO2**
UNIT - III	**Material Handling Attachments**	**Periods: 9**
Load handling attachments, standard forged hook, hook weights, hook bearings, cross piece and casing of hook, crane grab for unit and piece loads, carrier beams and clamps, load platforms and side dump buckets, electric lifting magnets, grabbing attachments for loose materials, crane attachments for handling liquid materials.		**CO3**
UNIT - IV	**Material Handling Systems**	**Periods: 9**
Material Handling systems: Selection, Material Handling method- path, Equipment, function oriented systems. Auxiliary Equipment, Feeders – Chutes, Applications and Advancements.		**CO4**
UNIT - V	**Methods to Minimize Cost of Material Handling**	**Periods: 9**
Methods to minimize cost of material handling- Maintenance of Material Handling Equipments, Safety in handling, Ergonomics of Material Handling equipment. Design, Miscellaneous equipment.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Rudenko N , Materials Handling Equipment, Envee Publishers, New Delhi, 2017.
2. White**,** John A., Pence**,** Ira W, Materials handling and logistics, Envee Publishers, New Delhi, 2016.
3. S.C. Sharma, Materials Management and Materials Handling, Khanna Publications, 2000.

Reference Books

1. Siddhartha Ray, Introduction to Material Handling, New Age International, Edition: 2nd edition, 2017.
2. Chowdary RB , G. R. N. Tagore,Plant Layout and Material Handling-, Khanna Publishers; 2nd edition 2016.
3. James A Apple, Plant layout and Material Handlin, Krieger Pub Co, 2016
4. Mahapatra P.B, Operations Management, PHI, 2016
5. Arora K.C, Vikas V. Shinde, Aspects of Material handling, Laxmi Publications; First edition, 2015.

Web References

1. https://nptel.ac.in/courses/112/102/112102011/
2. https://nptel.ac.in/courses/112/107/112107142/
3. https://nptel.ac.in/courses/112/107/112107143/
4. https://www.youtube.com/watch?v=WXmIdbVDJqE
5. https://www.youtube.com/watch?v=BBWPIByOEfI

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	-	-	-	-	-	-	1	2	1	2
2	3	2	1	-	-	-	-	-	-	-	-	1	2	1	2
3	3	2	1	-	-	-	-	-	-	-	-	1	2	1	2
4	3	2	1	-	-	-	-	-	-	-	-	1	2	1	2
5	3	2	1	-	-	-	-	-	-	-	-	1	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

OPEN ELECTIVE - II

Department	MBA	Programme : B.Tech.						
Semester	V/ VI	Course Category: OE			End Semester Exam Type: TE			
Course Code	U23HSOC01	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	INTELLECTUAL PROPERTY RIGHTS	3	0	0	3	25	75	100

(Common to ALL Branches)

Prerequisite	-	
Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Describe the Concept and Importance of Intellectual Property Rights (IPR).	K2
	CO2 Describe the procedures for patent registration, including recognizing legal remedies for infringement.	K3
	CO3 Apply copyright laws to hypothetical scenarios involving academic integrity and plagiarism.	K3
	CO4 Infer the different types of trademarks and understand the registration process and infringement issues.	K4
	CO5 Explain the legalities surrounding industrial designs, geographical indications, and their protection mechanisms.	K2

UNIT - I	Overview of Intellectual Property	Periods: 9
Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Trade Secret – International protection of IPR- Major International conventions and agreements: WTO/TRIPS Agreement, Paris Convention, The Berne Convention, Universal Copyright Convention, WIPO Convention, Madrid Agreement, Nice Agreement and TRIPS Agreement		CO1

UNIT - II	Law of Patents	Periods: 9
Meaning and Nature of Patent - Subject matter of Patent - Registration Procedure, Patentable and Non-patentable Inventions - Process and product Patent, Legal Requirements for Patents – Patent document: Specification and Claims - Granting of Patents - Transfer of Patent rights - Infringement of Patents and Remedies - Evergreening of Patents		CO2

UNIT - III	Law of Copyrights	Periods: 9
Meaning and Nature of Copyright - Subject matter of copyright - Law of Copyrights - Authorship and Ownership of copyright, Registration Procedure, Assignment and Licensing of copyright - Infringement of Copyrights and Remedies - Emerging new trends in Copyrights - Related Rights: Celebrity Rights, Academic Integrity or Plagiarism: An Intellectual Theft - Copyrights with special reference to software.		CO3

UNIT - IV	Law of Trademarks	Periods: 9
Meaning and Nature of Trademarks - Different kinds of Trademarks - Registrable and Non-Registrable Trademarks - Registration of Trademarks - Grounds for refusal of Registration: Absolute Ground and Relative Ground - Assignment and Licensing of trademarks - Infringement, Remedies and Penalties - Offenses relating to Trademarks - Passing off action – Deceptive similarity - Defenses - Emerging New trends in trademarks		CO4

UNIT - V	Other Forms of IPR	Periods: 9
Meaning and nature of Industrial Design - Subject Matter - Procedure for registration - Infringement of Copyrights in designs - Remedies for Infringement - Trade secret Law-Determination of Trade Secret Status - Liability for misappropriations of Trade Secrets- Protection for submission-Trade Secret litigation - Meaning and Nature of Geographical Indication (GI) - Procedure for registration - Infringement of Geographical indication - Remedies for Infringement.		CO5

Lecture Periods: 45	Tutorial Periods: -	Practical Periods: -	Total Periods: 45

Text Books

1. Nithyananda, K. V. Intellectual Property Rights: Protection and Management, 2nd edition, Cengage Learning India Private Limited, 2019.
2. Neeraj, P., and Khusdeep, D. Intellectual Property Rights, 2nd edition, PHI Learning Private Limited, 2018.

Reference Books

1. Ahuja, V. K. Law Relating to Intellectual Property Rights, 2nd edition, Lexis Nexis, 2017.
2. Bouchoux, Deborah E. Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 4th edition, Cengage Learning, 2013.
3. Ganguli P. Intellectual Property Rights: Unleashing the Knowledge Economy. Tata McGraw-Hill Publishing Company; 2022.
4. Jyoti Rattan. Intellectual Property Rights, 2nd edition, Bharat Law House, 2024.
5. Surendra Malik and Sudeep Malik, Supreme Court on Intellectual Property, Eastern Book Company, 2022.

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3.	https://www.wto.org/english/tratop_e/trips_e/trips_e.htm
4.	https://www.epo.org/about-us/annual-reports-statistics/annual-report.html
5.	https://articles.manupatra.com/article-details/Patent-Types-Laws-related-to-them-in-India

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	-	-	-	3	2	2	-	2	1	2	3	2	3
2	1	2	-	2	-	3	2	2	-	2	1	1	3	3	3
3	-	2	-	-	-	2	2	3	-	2	-	1	3	2	3
4	1	1	-	-	-	3	2	2	-	2	1	1	3	2	3
5	1	2	-	-	-	3	3	2	-	2	1	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	MBA	Programme : B.Tech.						
Semester	V/ VI	Course Category: OE			End Semester Exam Type: TE			
Course Code	U23HSOC02	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	NEW PRODUCT DEVELOPMENT	3	0	0	3	25	75	100

(Common to ALL Branches)

Prerequisite	-	
Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Explain the stages and importance of new product development (NPD) in modern business contexts.	K2
	CO2 Apply market research to identify customer needs and translate them into product specifications.	K3
	CO3 Illustrate the product concepts using screening and scoring techniques to select the most viable option.	K3
	CO4 Examine product prototype that incorporates principles of product architecture and design for manufacturing.	K3
	CO5 Analyze a business plan and market strategy for the successful launch of a new product.	K4

UNIT - I	Introduction to New Product Development	Periods: 9
Introduction to New Product Development (NPD) - Product Development vs New Product Development - Stages of NPD - Role of Innovation and Creativity in NPD - Reverse Engineering and its Application in NPD - Business Models for New Products - Risk Management in New Product Development - Sustainability and Ethical Considerations in NPD		CO1
UNIT - II	**Market Research and Customer Needs**	**Periods: 9**
Identifying Market Opportunities for New Products - Conducting Market Research for NPD - Translating Customer Needs into Product Specifications - Establishing and Refining Product Specifications - Competitive Analysis and Benchmarking in NPD - Tools for Understanding Consumer Behaviour: Surveys, Focus Groups, and Ethnography		CO2
UNIT - III	**Concept Generation and Evaluation**	**Periods: 9**
Concept Generation Process: Continuous and External Idea Sources - Clarifying the Problem and Brainstorming Solutions - Design Thinking for New Products - Techniques for Concept Generation - Systematic Exploration of Concepts - Screening and Scoring Product Concepts - Concept Evaluation and Selection Methods - Prototyping Techniques		CO3
UNIT - IV	**Product Design and Development**	**Periods: 9**
Product Architecture and its role in NPD - Modular vs. Integral Product Architecture - Design for Sustainability - Environmental Considerations - Organizing Product Development Teams - Stages of team Development - Collaboration and Cross - Functional Teams in Product Development - Tools for Effective Product Design - Agile Product Development Methodologies		CO4
UNIT - V	**Launch, Strategy and Commercialization**	**Periods: 9**
Developing a New Product Strategy - Building Market Demand and Entry Strategies for New Products - Developing a New Product Business Plan - Preparing for Market Launch - Post - Launch Evaluation - Product Life Cycle - Continuous Improvement and Future Product Enhancements		CO5

Lecture Periods: 45	Tutorial Periods: -	Practical Periods: -	Total Periods: 45

Text Books

1. Ulrich KT, Eppinger SD. Product design and development. 7th edition. McGraw-Hill Education; 2020.
2. Crawford CM, Di Benedetto A. New products management. 11th edition. McGraw-Hill Education; 2014.
3. Cooper RG. Winning at new products: Creating value through innovation. 5th edition. Basic Books; 2017.

Reference Books

1. Trott, P. Innovation management and new product development 6th edition. Pearson Education. 2017
2. Thomke, S. Experimentation works: The surprising power of business experiments. Harvard Business Review Press. 2020
3. Blank, S. G., & Dorf, B. The startup owner's manual: The step-by-step guide for building a great company. Wiley. 2020
4. Brown, T. Change by design: How design thinking transforms organizations and inspires innovation. Harper Business. 2009
5. Kelley, T., & Littman, J. The ten faces of innovation: IDEO's strategies for beating the devil's advocate and driving creativity throughout your organization. Currency/Doubleday. 2006

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1. https://conjointly.com/kb/
2. https://www.entrepreneur.com/article/281999

3.	https://www.mindtools.com/pages/article/newSTR_66.htm
4.	https://www.interaction-design.org/literature/article/design-thinking-getting-started-with-empathy
5.	https://www.productplan.com/glossary/product-architecture/
6.	https://hbr.org/2019/09/why-design-thinking-works
7.	https://www.smartsheet.com/new-product-development.
8.	https://www.ptc.com/en/blogs/cad/best-practices-for-developing-new-products

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	3	-	3	1	1	-	-	1	-	2	3	3	3
2	1	-	2	1	3	-	-	1	-	1	-	3	3	2	3
3	1	1	3	-	2	-	1	-	2	-	1	2	3	3	3
4	3	-	1	1	3	1	-	1	2	-	1	1	3	2	3
5	1	-	3	-	3	-	-	-	2	-	1	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	MBA			Programme : B.Tech.			
Semester	V/ VI			Course Category: OE		End Semester Exam Type: TE	
Course Code	U23HSOC03	Periods/Week			Credit	Maximum Marks	
		L	T	P	C	CAM	ESE	TM
Course Name	FINANCE FOR ENGINEERS	3	0	0	3	25	75	100

(Common to ALL Branches)

Prerequisite	-	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Explain the objectives, scope, and role of financial management in engineering, and differentiate between profit maximization and wealth maximization.	**K2**
	CO2 Apply the concepts of the time value of money to engineering projects and use investment appraisal techniques such as NPV, IRR, and Payback Period for decision-making.	**K3**
	CO3 Demonstrate the steps in the capital budgeting process and apply techniques like cost-benefit and sensitivity analysis for evaluating engineering projects.	**K3**
	CO4 Analyze financial statements, including balance sheets and income statements, from an engineering perspective, and evaluate financial ratios to assess the financial performance of engineering projects.	**K4**
	CO5 Analyze different types of costs, such as fixed, variable, and marginal costs, and evaluate cost-benefit analysis and break-even analysis for engineering decision-making.	**K4**

UNIT - I	**Introduction to Financial Management**	**Periods: 9**
Overview of Financial Management: Objectives, Scope, and Role in Engineering - Financial Planning and Strategy: Short-Term and Long-Term Planning - Basic Concepts: Profit Maximization vs Wealth Maximization - Role of Engineering Managers in Financial Decision - Making, Relationship between Finance and Other Engineering Disciplines.		**CO1**
UNIT - II	**Time Value of Money and Investment Decisions**	**Periods: 9**
Time Value of Money: Concept, Importance and Applications in Engineering Project, Present Value and Future Value Calculations - Investment Appraisal Techniques: Payback Period, Net Present Value (NPV), Internal Rate of Return (IRR) (Theory only) and Profitability Index (PI) - Risk Analysis in Investment Decision Making.		**CO2**
UNIT - III	**Capital Budgeting for Engineering Projects**	**Periods: 9**
Capital Budgeting Process: Steps and Key considerations, Techniques for Evaluating Engineering Project, Cash-Flow Estimation for Project, Cost - Benefit Analysis in Engineering Project, Sensitivity Analysis, and Decision Trees for Project Evaluation.		**CO3**
UNIT - IV	**Financial Statements and Ratio Analysis**	**Periods: 9**
Introduction to Financial Statements: Balance Sheet, Income Statement, and an Engineering Perspective on Financial Statement Interpretation - Financial Ratios: Liquidity, Profitability - Engineering Case Studies on Financial Performance Evaluation - Limitations of Ratio Analysis in Engineering Projects.		**CO4**
UNIT - V	**Cost Estimation and Engineering Economic Analysis**	**Periods: 9**
Introduction to Cost Estimation in Engineering - Types of Costs: Fixed, Variable, Marginal, and Sunk Costs, Cost-Benefit Analysis in Engineering Projects, Break-Even Analysis and Its Application in Engineering Decision Making - Engineering Economic Analysis: Replacement Analysis.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Sullivan WG, Wicks EM, Koelling CP. Engineering Economy. 17th edition. Pearson; 2020.
2. Brealey RA, Myers SC, Allen F. Principles of Corporate Finance. 19th edition. McGraw-Hill Education; 2022.
3. Brigham EF, Houston JF. Fundamentals of Financial Management. 15th edition. Cengage Learning; 2019.

Reference Books

1. Ranganath BJ, Sinha KK. Financial Management for Engineers. 4th edition. Vikas Publishing House; 2018.
2. Crundwell F. Finance for Engineers: Evaluation and Funding of Capital Projects. Springer; 2017.

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1. https://www.netsuite.com/portal/resource/articles/financial-management/financial-management.shtml
2. https://www.investopedia.com/ask/answers/033015/why-time-value-money-tvm-important-concept-investors.asp
3. https://omnicard.in/blogs/capital-budgeting-24042024

4.	https://www.linkedin.com/pulse/role-capital-budgeting-process-engineering-studies-ashraf
5.	https://corporatefinanceinstitute.com/resources/accounting/financial-ratios/
6.	https://www.dau.edu/acquipedia-article/engineering-cost-estimation-method

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	-	-	-	1	1	1	-	2	1	1	3	2	3
2	1	2	1	-	1	2	1	2	-	3	1	-	3	3	3
3	-	3	3	-	1	3	1	2	-	3	1	1	3	2	3
4	1	2	-	2	1	1	2	1	1	2	1	-	3	3	3
5	-	3	-	-	2	3	2	2	1	2	2	3	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	MBA			Programme : **B.Tech.**			
Semester	V/ VI			Course Category: **OE**		End Semester Exam Type: **TE**	
Course Code	U23HSOC04	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**ECONOMICS FOR ENGINEERS**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
(Common to ALL Branches)								
Prerequisite	-							

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Interpret principles of managerial economics to real-world scenarios, utilizing demand analysis and forecasting techniques.	**K2**
	CO2 Discuss production functions and cost structures to **evaluate** their impact on managerial decision-making and market strategies.	**K2**
	CO3 Examine various market structures and pricing strategies, **synthesizing** their effects on market behavior and competitive dynamics.	**K3**
	CO4 Apply macroeconomic policies and their implications on business cycles, investment decisions, and economic stability.	**K3**
	CO5 Analyze recent economic trends, such as technological advancements and income inequality.	**K4**

UNIT - I	**Introduction to Managerial Economics**	**Periods: 9**
Managerial Economics: Meaning, Scope, and Importance - Functions of a Managerial Economist - Demand Analysis: Law of Demand, Elasticity of Demand, Law of Supply, Elasticity of supply and Market Equilibrium - Comparative statistics: Shift of a curve and movement along with the curve - Demand Forecasting: Criteria for Effective Forecasting - Qualitative Methods - Quantitative Methods.		**CO1**
UNIT - II	**Production Function and Cost Concepts**	**Periods: 9**
Production Function: Meaning, Types, Applications in Managerial Decision Making - Law of variable proportion and law of returns to scale - ISO Quants - Producer Surplus: Price ceiling and price floor - Cost concept: Types of Costs - Total, average and marginal cost - Revenue Concepts: Total Revenue (TR) - Marginal Revenue (MR) and Average Revenue (AR).		**CO2**
UNIT - III	**Market Structure**	**Periods: 9**
Market structure: Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly and Duopoly - Pricing policies: Cost-Based Pricing, Demand - Based Pricing, Competition - Based Pricing, Psychological Pricing, Geographical Pricing, Dynamic Pricing, Bundle Pricing, Price Discrimination, Premium Pricing and practices.		**CO3**
UNIT - IV	**Macroeconomics**	**Periods: 9**
Globalization and Economic Policies - National Income Concepts: Methods of measuring national income - circular flow of income - Monetary policy and Fiscal Policy - Business Cycles concepts - Inflation, deflation and its types - Foreign Direct Investment (FDI) - Foreign Institutional Investment (FII).		**CO4**
UNIT - V	**Recent Trends in Economics**	**Periods: 9**
Digital Economy : E-commerce, Fintech, and Online Services - Role of Technology : Big Data, Artificial Intelligence and Automation in Economic Decision-Making - Gig Economy : Growth of Freelance and Contract Work - Impact on Global Economies - Income In - equality : Causes, Effects, and Socio - political Impact		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Samuelson, William F., and Marks, Stephen G. Managerial Economics: Theory, Applications, and Cases, 10th edition, Wiley, 2020.
2. Ahuja, H. L. Principles of Managerial Economics, 7th edition, Tata McGraw-Hill, 2017
3. Mithani, D. M. Managerial Economics, 3rd edition., Himalaya Publishing House,2021.

Reference Books

1. Varian, Hal R. Intermediate Microeconomics: A Modern Approach, 9th edition., W.W. Norton & Company, 2014.
2. Brickley, James A., Smith Jr., Clifford W., and Zimmerman, Jerold L. Managerial Economics and Organizational Architecture, 7th edition., McGraw-Hill Education, 2016.
3. Samuelson, Paul, and Nordhaus, William. Economics, 20th edition., McGraw-Hill Education, 2019.
4. Schiff, Peter, and Schotter, Andrew J. Introduction to Microeconomics, 3rd edition., Cengage Learning, 2012.
5. Moore, James C. Economic Theory and Operations Analysis, 2nd edition., Academic Press, 1970.

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1. https://www.jaroeducation.com/blog/nature-and-types-of-managerial-economics/

2.	https://psu.pb.unizin.org/introductiontomicroeconomics/chapter/chapter-6-costs-and-production/
3.	https://corporatefinanceinstitute.com/resources/economics/market-structure.
4.	https://www.britannica.com/money/macroeconomics
5.	https://www2.deloitte.com/us/en/insights/economy/global-economic-outlook/weekly-update.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	1	-	1	1	-	-	-	2	2	-	2	2	2
2	1	1	1	2	2	2	2	-	-	3	3	3	2	2	3
3	1	1	1	2	-	2	2	-	-	3	-	3	2	2	3
4	1	1	-	2	2	2	2	2	-	3	3	3	2	2	3
5	1	1	1	2	2	-	2	2	-	3	3	3	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**MBA**	Programme : **B.Tech.**						
Semester	**V/ VI**	Course Category: **OE**			End Semester Exam Type: **TE**			
Course Code	**U23HSOC05**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MARKETING MANAGEMENT**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

(Common to ALL Branches)

Prerequisite	-	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Explain the importance of marketing and differentiate between marketing and selling.	**K2**
	CO2 Apply the consumer decision-making process and differentiate between industrial and consumer buying behavior.	**K3**
	CO3 Examine product life cycle management strategies and demonstrate the steps involved in new product development.	**K3**
	CO4 Illustrate the role of distribution channels and design an effective channel distribution strategy for both consumer and industrial goods.	**K3**
	CO5 Analyze emerging trends in marketing, including Customer Relationship Management and experiential marketing strategies.	**K4**

UNIT - I	**Introduction to Marketing**	**Periods: 9**
Marketing - Importance of Marketing - Difference between Marketing and Selling - Marketing Environment: The Macro and Micro Environment factors, Importance of environment analysis – Strategic Marketing planning: Introduction, Need, Framework of Strategic planning process and Steps in strategic planning - Ethical and Social Responsibility of Marketing - 4 Ps of Marketing		**CO1**
UNIT - II	**Consumer Behaviour and Marketing Strategy**	**Periods: 9**
Role of buyer - Types of Buying behavior - Factors influencing buying decisions - Consumer decision making process: Meaning and Steps in Consumer decision making Process – Organizational buying behaviour: Classification of organizational markets, Characteristics, Difference between Industrial and Consumer buying - Market Segmentation - Needs, Classification and Significance – Targeting, Positioning and Competitive Strategies.		**CO2**
UNIT - III	**Product and Pricing Mix**	**Periods: 9**
Product classifications - Product Life cycle - Strategies for managing Product Life cycle – Categories of New product, Importance and Steps in New Product Development – Packaging: Need for packaging, Essential qualities of packaging, kinds of packaging and advantages of packaging – Labelling: Functions, Types of labelling, advantages and disadvantages of labelling – Pricing objectives – Pricing strategies		**CO3**
UNIT - IV	**Place and Promotion Mix**	**Periods: 9**
Distribution Channel and Physical distribution: Meaning and Importance of distribution channel - Channel design decisions – Channels of distribution for consumer and industrial goods – Physical Distribution: Meaning, Objectives and components of physical distribution - Promotion: Objectives, Types of sales promotion: Consumer, Salesperson and Dealer sales promotion – Introduction to Integrated Marketing Communication		**CO4**
UNIT - V	**Trends in Marketing**	**Periods: 9**
Emerging trends in Marketing - Customer Relationship Management: Definition, features, Types and importance - Experiential Marketing: Meaning, strategies and benefits - Mobile Marketing: Definition and types of mobile marketing - Digital Marketing: Meaning, types of digital marketing – Inbound marketing: Meaning, fundamentals and difference between inbound and outbound marketing - Marketing Analytics: Meaning, importance, metrices of marketing analytics – An overview of Sustainable Marketing		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Keller, Philip and Kevin Lane Kotler “Marketing Management” 16th Edition, Pearson Education Limited, 2022.
2. V.S.Ramaswamy, S.Namakumari, 6th Edition, Sage Publications India Pvt Ltd, 2018

Reference Books

1. Prachi Gupta, Ashita Aggarwal, et al. “Marketing Management: Indian Cases” Pearson Education Limited, 2024
2. Arunkumar, Meenakshi.N, “Marketing Management” 3rd Edition, Vikas Publishing House, 2016
3. Rajan Saxena, “Marketing Management” 5th Edition, MacGraw Hill Publications, 2017

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1. https://www.ama.org/
2. https://www.marketingprofs.com/

3.	https://indianjournalofmarketing.com/
4.	http://www.publishingindia.com/ijamm/
5.	https://onlinecourses.swayam2.ac.in/imb20_mg36/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	-	-	-	2	1	1	-	2	1	1	2	2	3
2	1	2	1	-	1	2	1	2	-	2	1	1	2	2	3
3	1	2	3	-	1	2	1	2	-	2	1	1	3	2	3
4	1	1	3	-	2	1	2	1	1	2	2	1	2	2	3
5	1	3	2	2	2	3	2	2	1	2	2	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

OPEN ELECTIVE - III

Department	**Mechanical Engineering**	Programme : **B.Tech.**						
Semester	**VII**	Course Category: **OE**			End Semester Exam Type: **TE**			
Course Code	**U23MEOC03**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**CREATIVITY INNOVATION AND NEW PRODUCT DEVELOPMENT**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

(Common to EEE, ECE, ICE, CIVIL, BME, MCTR)

Prerequisite	Engineering Design & CAD		
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	To understand the need for creativity and innovation	**K2**
	CO2	To learn about the project selection and evaluation	**K3**
	CO3	To learn about the Patent and IPR	**K2**
	CO4	To understand the quality standards and new product planning	**K4**
	CO5	To learn model preparation and evaluation	**K5**

UNIT - I	**Introduction**	**Periods: 9**	
The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving -brainstorming - different techniques- Types of Innovation-Role of AI and Digital Tools in Creativity & Innovation.			**CO1**
UNIT - II	**Project Selection and Evaluation**	**Periods: 9**	
Collection of ideas and purpose of project - Selection criteria - screening ideas for new products evaluation techniques- Feasibility Studies- Risk Analysis in Innovation Projects			**CO2**
UNIT - III	**New Product Development**	**Periods: 9**	
Research and new product development - Patents - Patent search - Patent laws-International code for patents - Intellectual property rights (IPR)- Types of Patents (Utility, Design, Provisional, and PCT Applications)			**CO3**
UNIT - IV	**New Product Planning**	**Periods: 9**	
Design of proto type - testing - quality standards - marketing research introducing new Products - Sustainability and Green Innovation in Product Development - Customer-Centered Design and Lean Startup Methodology			**CO4**
UNIT - V	**Model Preparation and Evaluation**	**Periods: 9**	
Creative design - Model Preparation - Testing - Cost evaluation – Patent application- Rapid Prototyping & 3D Printing in Product Development.			**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Crawford, C. Merle, and C. Anthony Di Benedetto. New Products Management. McGraw-Hill Education, 2019.
2. Watton, Harry B. “New Product Planning”, Prentice Hall Inc., 1992.
3. Bainbridge, David. Intellectual Property: Patents, Copyright, Trade Marks, and Allied Rights. Pearson, 2018.

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1. Nystrom, Harry “Creativity and Innovation”, John Wiley & Sons, 1979.
2. Dr Paul Trott, Innovation Management and New Product Development, 6th Edition, Pearson Publication, 2017
3. Khandwalla, N – “Fourth Eye (Excellence through Creativity) - Wheeler Publishing”, 1992.
4. Bulletins I.P.R, TIFAC, New Delhi, 1997.
5. Jacob Goldenberg, Creativity in Product Innovation, Cambridge University Press, 2002.

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1. https://nptel.ac.in/courses/107/103/107103082/
2. https://nptel.ac.in/courses/107/101/107101086/
3. https://nptel.ac.in/courses/110/107/110107094/
4. https://www.youtube.com/watch?v=H6OlyjLJf6k
5. https://www.youtube.com/watch?v=CnKeVs-_9zs

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	2	-	-	-	-	-	-	-	3	2	-
2	3	3	3	2	3	-	-	-	-	-	-	-	3	3	-
3	3	2	3	2	3	-	-	-	-	-	-	-	3	3	-
4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-
5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus