COIMBATORE INSTITUTE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

B.E MECHANICAL ENGINEERING

Regulation 2023

(Students admitted from 2023 - 2024 onwards)

CHOICE BASED CREDIT SYSTEM

VISION AND MISSION OF THE DEPARTMENT

Vision

The Mechanical Engineering Department strives to be recognized nationally for outstanding education and research leading to well-qualified engineers, who are innovative, entrepreneurial and successful in fields of engineering.

Mission

M1 Imparting quality education to the students and enhancing their skills to make them globally competitive Mechanical Engineers.

M2 Maintaining vital, state-of-the-art laboratory facilities to provide its students with opportunities to create, interpret, apply and disseminate knowledge.

M3 To develop linkages with research organizations and educational institutions in India for excellence in teaching, research and consultancy practices.

M4 To provide the students with academic environment of excellence, leadership, ethical guidelines and lifelong learning needed for a long productive career.

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics, and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behaviour, and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability, etc., with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (POs):

Engineering Graduates will be able to:

PO1: **Engineering Knowledge**: Apply knowledge of mathematics, natural science, computing, engineering fundamentals, and an engineering specialization as specified in WK1 to WK4 respectively to develop solutions for complex engineering problems.

PO2: **Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: **Design/Development of Solutions**: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for public health and safety, whole-life cost, net zero carbon, culture, society, and environment as required. (WK5)

PO4: **Conduct Investigations of Complex Problems**: Conduct investigations of complex engineering problems using research-based knowledge including the design of experiments, modelling, analysis, and interpretation of data to provide valid conclusions. (WK8)

PO5: **Engineering Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering & IT tools, including prediction and modelling, recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: **The Engineer and The World**: Analyse and evaluate societal and environmental aspects while solving complex engineering problems for their impact on sustainability

with reference to economy, health, safety, legal framework, culture, and environment. (WK1, WK5, and WK7)

PO7: **Ethics**: Apply ethical principles and commit to professional ethics, human values, diversity, and inclusion; adhere to national & international laws. (WK9)

PO8: **Individual and Collaborative Teamwork**: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: **Communication**: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: **Project Management and Finance**: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: **Life-Long Learning**: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies iii) critical thinking in the broadest context of technological change. (WK8)

Programme Educational Objectives (PEOs)

The following Programme Educational Objectives are designed based on the department Mission

PE01 The graduates will be able to apply the overall knowledge of Mechanical Engineering along with concepts of Mathematics, Science, Communication and Computing skills to understand specific problem areas and finding the optimal solutions for the same.

PE02 The graduates will be able to implement ideas of Mechanical Engineering for the challenging tasks in the interdisciplinary areas like Electrical, Electronics, Computer Science, Civil and allied branches.

PE03 The graduates will be widely talented in the field of manufacturing, design and service industries which will not only improve their employability but also aid in establishing the above said industries.

PE04 The graduates will develop lifelong learning attitudes, ethics and values that will help their career employability and growth in engineering, academia, defence, state and central government sectors.

Programme Specific Outcomes (PSOs)

PSO1 Identify, specify, and apply the concepts of smart manufacturing techniques and advanced manufacturing tools for fabricating mechanical systems.

PSO2 Analyze, design, and implement thermodynamic concepts for energy-efficient mechanical systems. Adopt alternative energy sources to promote a cleaner environment and ensure sustainability

PSO3 Apply design concepts and use simulation tools to develop innovative products and address industrial and societal challenge

Mapping PEOs, POs & PSOs

PEOs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
PEO1	3	3	3	3	3	3	3	3	3	3	3	3	2	3
PEO2	3	3	3	3	3	2	1	2	-	2	1	2	2	3
PEO3	3	2	2	2	2	2	-	-	-	1	1	3	2	3
PEO4	3	2	2	2	1	3	2	2	1	1	3	2	3	3
3-High 2- Medium 1 – Low - No Correlation														

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SEMESTER I							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
	Theory						
1	U23EGT01	Communicative English	3	0	0	3	HS
2	U23MAT01	Linear Algebra and Calculus	3	1	0	4	BS
3	U23PYT02	Applied Physics	3	0	0	3	BS
4	U23CST01	Problem solving and Programming in C	3	0	0	3	ES
5	U23MET02	Engineering Graphics	2	2	0	4	ES
6	U23TAT01	Heritage of Tamils	1	0	0	1	HS
	Practical						
7	U23PYP01	Physics Laboratory	0	0	2	1	BS
8	U23CSP01	Problem solving and Programming in C Laboratory	0	0	2	1	ES
9	U23EEP01	Engineering Practices Laboratory	0	0	4	2	ES
	Mandatory						
10	U23MTA01	Induction Programme	2	0	0	0	MC
		Total Periods:	**17**	**3**	**8**	**22**	

SEMESTER II							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
	Theory						
1	U23EGT02	Professional English	3	0	0	**3**	HS
2	U23MAT02	Transforms and Boundary value problems	3	1	0	**4**	BS
3	U23CYT02	Applied Chemistry	3	0	0	**3**	BS
4	U23CST02	Python Programming	3	0	0	**3**	ES
5	U23ECT03	Basics of Electrical, Electronics and Information Science	3	0	0	**3**	ES
6	U23TAT02	Tamils and Technology	1	0	0	**1**	HS
	Practical						
7	U23CYP01	Chemistry Laboratory	0	0	2	**1**	BS
8	U23CSP02	Python Programming Laboratory	0	0	2	**1**	ES
9	U23MEP01	Computer Aided Drafting Laboratory	0	0	4	**2**	ES
		Total Periods: 25	**16**	**1**	**8**	**21**	

SEMESTER III							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
	Theory						
1	U23MAT04	Statistics and Numerical Methods	3	1	0	4	BS
2	U23MET03	Engineering Mechanics	2	1	0	3	ES
3	U23MET04	Engineering Thermodynamics	2	1	0	3	PC
4	U23MET05	Engineering Materials and Metallurgy	3	0	0	3	PC
5	U23MCT01	Fluid Mechanics and Machinery	3	0	0	3	PC
6	U23MET06	Manufacturing Technology	3	0	0	3	PC
	Practical						
7	U23MEP03	Computer Aided Machine Drawing Laboratory	0	0	4	2	PC
8	U23MEP04	Manufacturing Technology Laboratory	0	0	4	2	PC
	Mandatory Course						
9		Mandatory Course I	2	0	0	0	MT
	Employability Enhancement Course						
10		Industry Oriented/Linkage Course	0	0	2	1	EEC
		Total Periods:	**18**	**3**	**10**	**24**	

SEMESTER IV							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	CAT
			L	T	P		
	Theory						
1	U23MET07	Fluid Power Systems and Control	3	0	0	3	PC
2	U23MET08	Metrology and Measurements	3	0	0	3	PC
3	U23MET09	Mechanics of Solids	3	0	0	3	PC
4	U23MET10	Thermal Engineering	3	0	0	3	PC
5		Professional Elective -I	3	0	0	3	PE
6		Professional Elective -II	3	0	0	3	PE
	Practical						
7	U23MEP05	Thermal Engineering Laboratory	0	0	4	2	PC
8	U23MEP06	Strength of Materials and Fluid Machinery Laboratory	0	0	4	2	PC
	Mandatory Course						
9		Mandatory Course II	2	0	0	0	MT
	Employability Enhancement Course						
10		Industry Oriented/Linkage Course	0	0	2	1	EEC
		Total Periods:	**20**	**0**	**10**	**23**	

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SEMESTER V							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
	Theory						
1	U23MET11	Heat and Mass Transfer	2	1	0	3	PC
2	U23MET12	Design of Machine Elements	3	1	0	4	PC
3	U23MET13	Mechanics of Machinery	2	1	0	3	PC
4	U23MET14	Industrial Automation	3	0	0	3	PC
5		Professional Elective -III	3	0	0	3	PE
6		Open Elective -I	3	0	0	3	OE
	Practical						
7	U23MEP07	Automation Laboratory	0	0	4	2	PC
8	U23MEP08	Metrology and Dynamics Laboratory	0	0	4	2	PC
	Employability Enhancement Course						
9	U23EGS01	English Expertise and Career Moxie	0	0	2	1	EEC
10	U23MEO03	Internship/In-plant Training	0	0	2	1	EEC
		Total Periods:	**16**	**3**	**12**	**25**	

SEMESTER VI							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	CAT
			L	T	P		
	Theory						
1	U23MGT01	Total Quality Management	3	0	0	3	HS
2	U23MET15	Design of Transmission Systems	3	1	0	4	PC
3	U23MET16	Hybrid and Electric Vehicles Technology	3	0	0	3	PC
4	U23MET17	Finite Element Analysis	2	1	0	3	PC
5		Professional Elective -IV	3	0	0	3	PE
6		Open Elective - II	3	0	0	3	OE
	Practical						
7	U23MEP09	Simulation and Analysis Laboratory	0	0	4	2	PC
	Employability Enhancement Course						
8	U23MEJ01	Design and Fabrication Project	0	0	4	2	EEC
9	U23MEO04	Technical Aptitude	0	0	2	1	EEC
		Total Periods:	**17**	**2**	**10**	**24**	

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SEMESTER VII							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
	Theory						
1	U23MGT02	Principles of Management	3	0	0	3	HS
2	U23MGT03	Entrepreneurship Development	3	0	0	3	HS
3		Universal Human Values	3	0	0	3	HS
4		Professional Elective - V	3	0	0	3	PE
5		Professional Elective - VI	3	0	0	3	PE
		Total Periods: 17	**15**	**0**	**0**	**15**	

SEMESTER VIII							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	CAT
			L	T	P		
	Employability Enhancement Course						
1	U23MEJ02	Project Work	0	0	20	10	EEC
		Total Periods: 20	**0**	**0**	**20**	**10**	

CAT - Category; BS - Basic Science; HS - Humanities and Social Science; ES - Engineering Science; PC - Professional Core; PE - Professional Electives; OE - Open Electives; EEC - Employability Enhancement Course; MT – Mandatory Course

SUMMARY OF CREDIT DISTRIBUTION										
CAT	Credits /Semester								Total Credits	Percentage of total credits
	I	II	III	IV	V	VI	VII	VIII		
HS	4	4	0	0	0	3	9	0	**20**	**12.20**
BS	8	8	4	0	0	0	0	0	**20**	**12.20**
ES	10	9	3	0	0	0	0	0	**22**	**13.41**
PC	0	0	16	16	17	12	0	0	**61**	**37.20**
PE	0	0	0	6	3	3	6	0	**18**	**10.98**
OE	0	0	0	0	3	3	0	0	**06**	**3.65**
EEC	0	0	1	1	2	3	0	10	**17**	**10.36**
MT	0	0	0	0	0	0	0	0	**0**	**0.00**
Total	**22**	**21**	**24**	**23**	**25**	**24**	**15**	**10**	**164**	**100.00**

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PROFESSIONAL ELECTIVE COURSES – VERTICALS

VERTICAL -1	VERTICAL -2	VERTICAL -3	VERTICAL -4	VERTICAL -5	VERTICAL -6
Product and Process Development	**Digital and Green Manufacturing**	**Clean and Green Energy Technologies**	**Thermal Sciences**	**Diversified Courses Group 1**	**Diversified Courses Group 2**
Additive Manufacturing	Digital Manufacturing and IoT	Energy Storage Devices	Heating, Ventilation and Air-Conditioning	Process Planning and Cost Estimation	Smart Mobility and Intelligent Vehicles
Design for X	Lean Manufacturing	Renewable Energy Technologies	Power Generation Systems	Maintenance Engineering	Drone Technologies
Ergonomics in Design	Green Manufacturing Design and Practices	Sensors and Instrumentation	Automobile Engineering	Non-Destructive Testing and Evaluation	Surface Engineering
New Product Development	Environment Sustainability and Impact Assessment	Bioenergy Conversion Technologies	Instrumentation for Thermal Systems	Composite Materials	Operational Research
Product Life Cycle Management	Industrial Robotics	Energy Conservation in Industries	Design of Thermal Systems	Engineering Economics and Financial Management	Industrial Safety
CAD/CAM	Green Supply Chain Management	Equipment for Pollution Control	Design of Heat Exchangers	Design of Jigs, Fixtures and Press tools	Design Concepts in Engineering
Value Engineering	Energy Saving Machinery and Components	Energy Efficient Buildings	Turbo Machines	Precision Manufacturing	Hydrogen and Fuel Cell Technology

PROFESSIONAL ELECTIVE COURSES

VERTICAL -1 PRODUCT AND PROCESS DEVELOPMENT							
S.No.	**Course Code**	**Course Title**	**Contact Periods / week**			**Credits**	**Category**
			L	**T**	**P**		
1	U23MEV01	Additive Manufacturing	3	0	0	3	PE
2	U23MEV02	Design for X	3	0	0	3	PE
3	U23MEV03	Ergonomics in Design	3	0	0	3	PE
4	U23MEV04	New Product Development	3	0	0	3	PE
5	U23MEV05	Product Life Cycle Management	3	0	0	3	PE
6	U23MEV06	CAD/CAM	3	0	0	3	PE
7	U23MEV07	Value Engineering	3	0	0	3	PE

VERTICAL -2 DIGITAL AND GREEN MANUFACTURING							
S.No.	**Course Code**	**Course Title**	**Contact Periods / week**			**Credits**	**Category**
			L	**T**	**P**		
1	U23MEV08	Digital Manufacturing and IoT	3	0	0	3	PE
2	U23MEV09	Lean Manufacturing	3	0	0	3	PE
3	U23MEV10	Green Manufacturing Design and Practices	3	0	0	3	PE
4	U23MEV11	Environment Sustainability and Impact Assessment	3	0	0	3	PE
5	U23MEV12	Industrial Robotics	3	0	0	3	PE
6	U23MEV13	Green Supply Chain Management	3	0	0	3	PE
7	U23MEV14	Energy Saving Machinery and Components	3	0	0	3	PE

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VERTICAL -3 CLEAN AND GREEN ENERGY TECHNOLOGIES							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23MEV15	Energy Storage Devices	3	0	0	3	PE
2	U23MEV16	Renewable Energy Technologies	3	0	0	3	PE
3	U23MEV17	Sensors and Instrumentation	3	0	0	3	PE
4	U23MEV18	Bioenergy Conversion Technologies	3	0	0	3	PE
5	U23MEV19	Energy Conservation in Industries	3	0	0	3	PE
6	U23MEV20	Equipment for Pollution Control	3	0	0	3	PE
7	U23MEV21	Energy Efficient Buildings	3	0	0	3	PE

VERTICAL -4 THERMAL SCIENCES							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23MEV22	Heating, Ventilation and Air-Conditioning	3	0	0	3	PE
2	U23MEV23	Power Generation Systems	3	0	0	3	PE
3	U23MEV24	Automobile Engineering	3	0	0	3	PE
4	U23MEV25	Instrumentation for Thermal Systems	3	0	0	3	PE
5	U23MEV26	Design of Thermal Systems	3	0	0	3	PE
6	U23MEV27	Design of Heat Exchangers	3	0	0	3	PE
7	U23MEV28	Turbo Machines	3	0	0	3	PE

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VERTICAL -5 DIVERSIFIED COURSES GROUP - I							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23MEV29	Process Planning and Cost Estimation	3	0	0	3	PE
2	U23MEV30	Maintenance Engineering	3	0	0	3	PE
3	U23MEV31	Non-Destructive Testing and Evaluation	3	0	0	3	PE
4	U23MEV32	Composite Materials	3	0	0	3	PE
5	U23MEV33	Engineering Economics and Financial Management	3	0	0	3	PE
6	U23MEV34	Design of Jigs, Fixtures and Press tools	3	0	0	3	PE
7	U23MEV35	Precision Manufacturing	3	0	0	3	PE

VERTICAL -6 DIVERSIFIED COURSES GROUP - II							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23MEV36	Smart Mobility and Intelligent Vehicles	3	0	0	3	PE
2	U23MCV15	Drone Technologies	3	0	0	3	PE
3	U23MEV37	Surface Engineering	3	0	0	3	PE
4	U23MEV38	Operational Research	3	0	0	3	PE
5	U23MEV39	Industrial Safety	3	0	0	3	PE
6	U23MEV40	Design Concepts in Engineering	3	0	0	3	PE
7	U23MEV41	Hydrogen and Fuel Cell Technology	3	0	0	3	PE

MANDATORY COURSES							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23MTA02	Essence of Indian Traditional Knowledge	3	0	0	0	IKS
2	U23MTA03	Wellness through Yoga and Ayurveda	3	0	0	0	IKS
3	U23MTA04	Universal human values and Professional Ethics	3	0	0	0	UHV
4	U23MTA05	Gender, Culture and Development	3	0	0	0	Gender Sensitization
5	U23MTA06	Environmental Science	3	0	0	0	EVS
6	U23MTA07	Sustainable Development	3	0	0	0	SDG
7	U23MTA08	Disaster risk reduction and Management	3	0	0	0	SDG
8	U23MTA09	Vision for Humane Society	3	0	0	0	IKS

INDUSTRY ORIENTED/LINKAGE COURSES							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23MEO01	Startup Development Stage - I	1	0	0	1	EEC
2	U23MEO02	Startup Development Stage - II	1	0	0	1	EEC
3	U23MEO05	Basics of Embedded Control Systems	1	0	0	1	EEC
4	U23MEO06	Embedded Control Systems Design and Integration (Automotive Applications)	1	0	0	1	EEC

OPEN ELECTIVE COURSES *(Students are encouraged to choose courses offered by other departments)*							
S.No.	**Course Code**	**Course Title**	**Contact Periods / week**			**Credits**	**Offering Department**
			L	**T**	**P**		
1.	U23OE001	Industrial Waste Management	3	0	0	3	CIVIL
2.	U23OE002	Fundamentals of Nano Science	3	0	0	3	CIVIL
3.	U23OE003	Green Building	3	0	0	3	CIVIL
4.	U23OE004	Corrosion Science	3	0	0	3	CIVIL
5.	U23OE005	Environment and Agriculture	3	0	0	3	CIVIL
6.	U23OE051	Programming in JAVA	3	0	0	3	CSE
7.	U23OE052	Web Frameworks	3	0	0	3	CSE
8.	U23OE053	Fundamentals of Data Structures	3	0	0	3	CSE
9.	U23OE054	Database Technologies	3	0	0	3	CSE
10.	U23OE055	Basics of Software Engineering	3	0	0	3	CSE
11.	U23OE056	Operating System Concepts	3	0	0	3	CSE
12.	U23OE057	Open-Source Software	3	0	0	3	CSE
13.	U23OE057	Virtual Reality	3	0	0	3	CSE
14.	U23OE101	Industry 5.0	3	0	0	3	ECE
15.	U23OE102	Introduction to Internet of everything	3	0	0	3	ECE
16.	U23OE103	Principles of Analog and Digital Communication	3	0	0	3	ECE
17.	U23OE104	Mobile Communication	3	0	0	3	ECE
18.	U23OE105	Introduction to Neural Network	3	0	0	3	ECE
19.	U23OE151	Basics of Electrical Engineering	3	0	0	3	EEE
20.	U23OE152	Fundamentals of Drives and Control	3	0	0	3	EEE
21.	U23OE153	Renewable Energy Systems	3	0	0	3	EEE
22.	U23OE154	Electric Vehicle Technology	3	0	0	3	EEE
23.	U23OE155	Introduction to PLC Programming	3	0	0	3	EEE
24.	U23OE201	Applied Design Thinking	3	0	0	3	MECH
25.	U23OE202	Creativity and Innovation in Entrepreneurship	3	0	0	3	MECH
26.	U23OE203	Basics of Refrigeration and Air Conditioning	3	0	0	3	MECH

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27.	U23OE204	Fundamentals of Mechanical Engineering	3	0	0	3	MECH
28.	U23OE205	Basics of Metrology and Measurements	3	0	0	3	MECH
29.	U23OE206	Testing of Materials	3	0	0	3	MECH
30.	U23OE251	Industrial Automation	3	0	0	3	MCT
31.	U23OE252	Programmable Logic Controllers	3	0	0	3	MCT
32.	U23OE253	Robotics	3	0	0	3	MCT
33.	U23OE254	Sensors and Data Acquisition Systems	3	0	0	3	MCT
34.	U23OE255	3D Printing Technology	3	0	0	3	MCT
35.	U23OE301	Introduction to computer networks	3	0	0	3	IT
36.	U23OE302	Mobile application development	3	0	0	3	IT
37.	U23OE303	Health Informatics	3	0	0	3	IT
38.	U23OE304	Information Technology essentials	3	0	0	3	IT
39.	U23OE305	cloud computing technologies	3	0	0	3	IT
40.	U23OE351	Fundamentals of Data science	3	0	0	3	AI & DS
41.	U23OE352	Fundamentals of AI	3	0	0	3	AI & DS
42.	U23OE353	Data Visualization and its Applications	3	0	0	3	AI & DS
43.	U23OE354	Fundamentals of Data Analytics	3	0	0	3	AI & DS
44.	U23OE355	Introduction to Big data	3	0	0	3	AI & DS
45.	U23OE401	Cryptography Tools and Techniques	3	0	0	3	CSE(CS)
46.	U23OE402	Network Security Essentials	3	0	0	3	CSE(CS)
47.	U23OE403	Cyber Security Fundamentals	3	0	0	3	CSE(CS)
48.	U23OE404	Web Security	3	0	0	3	CSE(CS)
49.	U23OE405	Block chain Essentials	3	0	0	3	CSE(CS)

Mapping of Course Outcome and Programme Outcome

Year	Sem	Course Title	Programme Outcomes (POs)											PSOs		
			1	2	3	4	5	6	7	8	9	10	11	1	2	3
I	I	Communicative English	3	1	2	.	2		-	2	3	-	1.8	1.6	2.2	2.8
		Linear Algebra and Calculus	3	2.1	1.2	1.4	-	-	-	1.2	-	1.2	1.4	2.1	2	1.8
		Applied Physics	3	2.6	1.8	1.4	1.8	1	-	-	-	-	-	2.1	2.2	1.6
		Problem solving and Programming in C	3	2.4	2.1	1.6	1.6	-	-	1.2	-	2	2	2.6	1.4	2
		Engineering Graphics	3	2	2	-	2	-	-	-	3	-	2	2.9	1.4	1.6
		Heritage of Tamils	0.8	0.8	2.1	0.4	0.4	-	-		--	-	-	1.4	2	2
		Physics Laboratory	3	3	1/6	1	1.6	1	-	-	-	-	-	2.3	2	1.6
		Problem solving and Programming in C Laboratory	3	2.3	2.3	1.6	2.6	-	-	1	0.3	0.3	2.3	2.6	1.3	2
		Engineering Practices Laboratory	3	2	-	-	1	1	-	-	-	-	2	2.3	1	2.6
		Induction Program*	-	-	-	-	-	-	-	-	-	-	-	-	-	
	II	Professional English	3	1	3	-	2	-	-	2	3	-	2.4	1.2	1	2.6
		Transforms and Boundary Value Problems	3	3	1	1	-	-	-	2	-	-	3	2.2	3	1
		Applied Chemistry	2.8	2	1.4	1	-	1.4	-	-	-	-	1	2	2.6	1
		Python Programming	2	2	2	2.2	1.8	-	-	0.8	0.4	0.4	2	2	1	3
		Basics of Electrical, Electronics and Information Science	2.4	2.2	1	1.8	0.8	2.2	2.4	-	-	-	0.8	2	1	3
		Tamils and Technology	0.8	0.8	2.2	0.4	0.4	-	-	-	-	-	-	2	2	2
		Chemistry Laboratory	2	2	1.3	0.6	0.3	1.3	1	1	-	-	-	2.3	2.6	1
		Python Programming Laboratory	2.3	2.6	2	2	2	-	-	0.6	0.6	0.6	2	2.6	2.6	2.3
		Computer Aided Drafting Laboratory	2	3	2.3	2	1	1	1	1	1	1	1	3	1	2.3
II	III	Statistics and Numerical Methods	3	2.6	1.4	2	1.2	0.4	-	2	-	0.4	3	2	2.4	2
		Engineering Mechanics	3	2.4	1.8	1.4	1.4	-	-	-	-	-	1	2.6	1.8	2.2
		Engineering Thermodynamics	3	2.6	2.2	1.8	0.2	-	-	-	-	-	1	2	3	2.2
		Engineering Materials and Metallurgy	3	2.2	2	2	1.2	1.1	1	-	1	0.2	2.4	2.6	1.4	2.4
		Fluid Mechanics and Machinery	2.8	1.8	1.4	1.2	2	1	-	-	-	-	1	1.8	2.8	2.6
		Manufacturing Technology	3	2	2	2.6	1.6	1	1	1	1	0.6	2	3	1	2.2
		Computer Aided Machine Drawing Laboratory	2.3	1.3	2.3	0,3	2.3	1.3	0.3	0,7	2.3	0.7	1.7	2.3	0.7	2.7
		Manufacturing Technology Laboratory	3	2	2.6	1.3	3	1		2	2	1	2	3	1	2
		Mandatory Course – I														
	IV	Fluid Power Systems and Control	3	2	2.4	2	3	1		1	2	1	2	2.4	2.4	2.2
		Metrology and Measurements	3	2	2	2	3	-		-	1	-	1	3	1	2.4
		Mechanics of Solids	3	3	1.8	1.8	1.8	1		-	1	1	2	2.8	1	3
		Thermal Engineering	2.6	2.2	1	1	-	-		-	-	-	1	1.4	3	2
		Thermal Engineering Laboratory	2	2	1.3	1.3	1	1	1	1	1	1	0.6	1.6	3	2
		Strength of Materials and Fluid Machinery Laboratory	3	3	2	3	1	`	-	-	1	1	2	2.3	2.3	2
		Mandatory Course - II														

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III	V	Heat and Mass Transfer	3	1	1	1	2	-	-	-	-	-	2	3	2	1
		Design of Machine Elements	3	2.6	2.4	2.4	-	-	-	-	-	-	-	3	2.6	2.4
		Mechanics of Machinery	3	2.8	1.2	2.6	0.4	-	-	-	-	-	-	3	1.2	1.2
		Industrial Automation	2.8	2.6	2.2	1.6	2.4	1.2	0.4	1.4	0.8	0.6	0.6	3.0	1.0	2.2
		Automation Laboratory	2.3	2.7	2.3	1.7	2.7	1.3	2	1.5	2	2.3	2	2.3	1.7	2.7
		Metrology and Dynamics Laboratory	3	2.6	2.1	2.1	2	-	-	-	-	2.3	2	3	2.6	2.3
		English Expertise and Career Moxie	1	1	1	1	1	2	2	2	3	2	2	2	2	2
		Internship/In-plant Training	2.3	2.3	2.7	2.3	2.7	1.3	0.3	2.3	2.3	1.7	3.0	2.7	1.3	2.7
	VI	Total Quality Management	1.6	1.8	2.4	1.2	2.2	2	1.6	0.4	2.2	2.4	1.6	1.6	1.2	2.8
		Design of Transmission Systems	2.8	2.2	1.2	1.2	-	-	-	-	-	-	-	2.8	2.2	2.4
		Mechatronics	3	1.8	1.8	0.2	1	1.8	-	-	-	-	2	0.8	1	1
		Hybrid and Electric Vehicles Technology	3	2	1	3	-	2	-	-	-	-	2	2.8	1.2	2.6
		Finite Element Analysis	3	2	2	2	2	-	-	1	1	-	2	2	2	1
		Simulation and Analysis Laboratory	3	1.7	1	1	3	-	-	-	--		-	2.3	1	2.3
		Design and Fabrication Project	2.7	2.7	2.3	2	1.7	2.3	0.7	0.3	2	2.7	1.7	2.3	2.7	2.3
		Technical Aptitude	3	2	2	2	2	-	-	1	1	-	2	2	2	1
IV	VII	Principles of Management	3.0	2.6	3.0	2.8	1.3	1.0	1.4	1.0	1.4	2.6	1.4	0.6	–	1.2
		Entrepreneurship Development	2.2	1.8	2.2	1.0	1.4	1.4	0.4	1.4	2.0	2.8	2.2	1.2	–	1.4
	VIII	Project Work	2.3	2.3	2.7	2.0	2.7	1.0	0.7	2.3	2.7	2.0	2.3	2.3	1.3	2.3
Year	**Sem**	**Course Title**	**Programme Outcomes (POs)**											**PSOs**		
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
Professional Elective I & II	IV	Additive Manufacturing	3	1.8	1.8	1.8	1	-	-	1	-	-	1	3	1	2
		Design for X	2	2	3	1	1	-	-	1	-	-	1	2.8	1.8	2.8
		Ergonomics in Design	1	1	3	-	2		-	0.8	-	-	1	2.6	1.8	2.6
		Digital Manufacturing and IoT	3	1.2	2.2	0.8	3	3	-	0.8	08.	0.4	1	3	1.6	2.6
		Lean Manufacturing	1	1	2	1	1	-	-	1	-	3	1	3	1.8	2.4
		Green Manufacturing Design and Practices	1	1	3	1	-	3	-	1	-	-	1	2.6	3	2
		Energy Storage Devices	3	2	1.6	1.6	0.6	1.8	-	0.6	0.6	0/6	-	1.6	3	2
		Renewable Energy Technologies	2.6	1.6	2.1	1	1.6	3	1	1	1	1.2	2.6	1.8	3	1.6
		Sensors and Instrumentation	3	2	1	2	1.6	0.8	-	-	0.8	0.2	1	2.8	1	2
		Heating, Ventilation and Air-Conditioning	2	1	0.8	0.8	0.4	2	-	1	0.4	0.6	1	1.6	2.8	1.6
		Power Generation systems	2.6	2.1	1	1	-	-	-	0.2	-	-	1.4	1	2.6	1.8
		Automobile Engineering	1.6	1.4	1	1	-	-	-	1	-	-	1	1	2	3
		Process Planning and Cost Estimation	3	1	1	-	0.6	0.6	-	0.6	0.6	0.6	1	2.4	1	2.4
		Maintenance Engineering	2	1	1	-	-	1	-	1	1	-	1	2.4	1	2.4
		Non-Destructive Testing and Evaluation	2	1.8	0.8	1.6	1.6	-	-	1	0.8	-	1	2.4	1	2.8
		Smart Manufacturing and Intelligent Vehicles	3	2	1	1	1	1	-	0.4	0.6	-	1	2.8	1	3

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		Drone Technologies	1	2	2	-	2	2-	-	-	-	-	1	3	1	2.6
		Surface Engineering	3	2	2	2	-	1	-	1	-	-	2	3	1	2.6
Professional Elective III	**V**	New Product Development	1.6	2.4	2.0	1.6	1.4	0.8	0.6	1.6	1.4	1.4	0.6	1.6	0.6	2.4
		Environment Sustainability and Impact Assessment	1.4	2.0	1.4	2.4	0.6	2.8	1.8	0.6	1.8	1.6	1.4	0.2	2.6	2.2
		Bioenergy Conversion Technologies	2.4	2.8	2.2	2.0	1.6	2.0	0.6	1.2	0.8	1.8	1.2	1.0	3.0	1.8
		Instrumentation for Thermal Systems	3	2.4	1	1	1	0.8	-	-	-	-	1.2	0	1	0.2
		Composite Materials	2.8	2.6	2.4	1.8	1.8	0.2	0.2	0.8	0.6	0.4	0.2	2.4	0.2	2.8
		Operational Research	3	2.8	2	1.4	2	-	-	1	1	1	2	2.2	1.4	1.4
Professional Elective IV	**VI**	Product Life Cycle Management	1.8	2.2	2.6	2.0	2.8	1.8	0.8	2.2	1.6	2.6	1.4	1.6	-	3.0
		Industrial Robotics	3.0	2.6	2.4	1.4	2.4	1.0	0.2	0.6	0.8	0.8	0.6	2.8	-	2.4
		Energy Conservation in Industries	2.4	2.8	1.2	2.6	1.4	2.2	0.8	-	0.6	2.0	1.0	0.6	3.0	1.0
		Design of Thermal Systems	3	0.8	1.8	1.4	-	0.2	-	-	-	-	0.2	-	0.2	-
		Engineering Economics and Financial Management	1.2	2.8	1.4	0	1.2	2.6	1.4	0.4	0.6	3.0	1.0	0.2	1.0	1.4
		Industrial Safety	1.8	2.4	2.0	2.4	0.8	2.8	2.8	1.8	1.4	1.6	1.4	2.0	2.8	1.2
Professional Elective V	**VII**	CAD/CAM	3.0	2.6	2.6	1.4	2.8	–	–	0.2	1.4	–	1.6	2.8	–	2.4
		Green Supply Chain Management	1	1	2	-	-	2	-	1	-	1	3	1	1	1
		Equipment for Pollution Control	2.6	2.4	1.8	1.6	1.6	2.8	1.6	0.2	0.4	0.2	1.4	-	2.2	1.6
		Design of Heat Exchangers	3	1.8	1	1	-	-	-	-	-	-	0.4	3	1.8	1
		Design of Jigs, Fixtures and Press Tools	3.0	2.8	2.8	1.8	2.6	0.6	0.2	1.2	0.6	0.8	0.6	3.0	0.2	2.8
		Design Concepts in Engineering	2.8	2.6	2.8	2.0	1.4	2.0	1.2	1.4	1.4	1.6	2.0	2.0	1.6	2.8
Professional Elective VI	**VIII**	Value Engineering	2.8	2.6	2.8	2.0	1.4	2.0	1.2	1.4	1.4	1.6	2.0	2.0	1.6	2.8
		Energy Saving Machinery and Components	2.6	2.4	1.4	1.0	2.2	3.0	2.4	-	-	-	2.2	2.0	3.0	0.4
		Energy Efficient Buildings	2	2	1	-	-	-	-	-	1	-	1	1	1	1
		Turbo Machines	3	1	1	1	-	-	-	-	-	-	1	3	1	2
		Precision Manufacturing	3.0	2.4	2.0	2.0	2.4	-	-	-	0.2	0.0	1.6	2.4	0.2	3.0
		Hydrogen and Fuel Cell Technology	3.0	2.8	2.8	2.2	2.0	2.6	1.0	0.6	0.4	0.2	1.0	1.8	2.0	2.0

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Semester I

U23EGT01	COMMUNICATIVE ENGLISH (Common to ALL branches)	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To enhance learners' English Language Acquisition skills
- To facilitate learners to acquire effective technical writing skills
- To prepare learners for placement and competitive exams
- To facilitate effective English language skills for academic purposes and real-life situations

Course Outcomes: Upon completion of the course, students shall have ability to		**BT Level (highest level)**
CO1	Demonstrate an understanding of communicative English principles, reading strategies, and basic grammar rules to communicate effectively.	**K2**
CO2	Analyze and use vocabulary, sentence structures, and grammar rules to convey meaning accurately in spoken and written communication.	**K4**
CO3	Apply technical communication skills to read, write, and speak about technical topics, using appropriate vocabulary and grammatical structures.	**K3**
CO4	Develop business communication skills to read, write, and speak effectively in professional contexts, using appropriate formats, vocabulary, and tone.	**K5**
CO5	Bespeak in professional English communication, including reading, writing, speaking, and presenting, using complex vocabulary and grammatical structures.	**K6**

Course Contents

Unit I COMMUNICATIVE ENGLISH **9**

Introduction to Communicative English, **Reading**: Skimming and Scanning; Comprehensive questions (Multiple choice questions/ short questions/open - ended questions) **Speaking:** Self- introduction **Writing**: Formal and informal letters (Requisition, Complaint / Invitation /Accepting/ Declining/ Personal) Grammar: Parts of speech, Present Tense, **Vocabulary**: Synonyms/Antonyms, word formation, Prefixes /suffixes.

Unit II WORDS AND SENTENCES **9**

Reading: Reading biographies on famous scientists and personalities/ newspaper articles/ movie reviews **Speaking:** Travelog with pictorial video /PPT **Writing:** Single line and extended definitions, Data interpretation (Pie chart, Bar chart, Table, Flow chart) **Grammar:** Modal verbs, Voices, Past Tense **Vocabulary**: Compound words, One-word substitutions.

Unit III TECHNICAL COMMUNICATION **9**

Reading: Review on technology/gadgets, reading user manual, **Writing:** Writing Instructions; Recommendations **Speaking:** Pride activity (About hometown) **Grammar:** Cause and Effect, Prepositions, Future Tense **Vocabulary**: Phrasal Verbs, Collocations.

Unit IV BUSINESS COMMUNICATIONS 9

Reading: Reading and understanding general and technical articles **Writing:** Report writing (Industrial visit report, Feasibility report), Checklist **Speaking:** Cultural and heritage of hometown, Dialogue writing and Telephonic conversation **Grammar:** WH questions, If conditionals **Vocabulary**: Abbreviation and Acronyms, Misspelt words.

Unit V PROFESSIONAL ENGLISH 9

Reading: Brochures, Scientific Blogs. **Writing:** Jumbled Sentences, Note-making **Speaking:** team task(role play) **Grammar:** Types of sentences, Possessive case **Vocabulary**: Homonyms/ Homophones.

Total Periods 45

Text Books:

1. "English for Engineers & Technologists", 2020, Department of English, Anna University, Orient Blackswan Private Ltd. Hyderabad.
2. Dr. B. Vinoth & Prof. J. Oormila Heleena, "A workbook of Communicative English",First edition, 2023, Sri Krishna Hitech publishing company Pvt Ltd, Coimbatore,
3. Ramalingam N, "Grammar for all", Second edition, 2013, Himalaya Publishing House, Bengaluru.

Reference Books:

1. Norman Whitby, "Business Benchmark Pre-intermediate to intermediate Personal Study Book", BEC and BULATS Edition, 2006, Cambridge University Press India Pvt Ltd, Delhi.
2. Anne Laws, "Writing Skills", 2011, Summertown Publishing, Oxford, U.K.
3. Sinha DK, "Specimen of English Prose", 2012, Orient Black Swan., Hyderabad.
4. Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", 2009, Cambridge University Press India Pvt Ltd, Delhi.
5. Raymond Murphy. "English Grammar and Use" ,4th edition, 2004, Cambridge University Press India Pvt Ltd, Delhi.

Web URL(s):

1 https://www.science.org/blogs
2 https://www.liveworksheets.com/worksheets/en
3 https://www.upsconline.nic.in/

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	-	-	-	-	-	-	-	2	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO3	2	2	3	3	-	-	-	-	3	-	-	3	-	2
CO4	-	-	-	-	-	-	-	-	3	3	-	2	2	2
CO5	-	-	-	-	-	-	-	-	3	2	3	2	-	3
Av	0.4	0.4	0.6	0.6	-	-	-	0.4	2.8	1.6	0.6	1.4	0.4	1.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MAT01	LINEAR ALGEBRA AND CALCULUS (Common to ALL branches)	L	T	P	C
		3	1	0	4

Pre-Requisites : Concepts of basic matrices, differentiation and integration

Objectives:

To make the students

- Acquaint with the knowledge of vector space and its applications.
- Develop the use of matrix techniques for practical problems.
- Familiarize with functions of several variables.
- Understand the concepts of Gradient, Divergence and Curl through vector differentiation and integration.
- Interpret with mathematical tools needed in evaluating multiple integrals and their applications

Course Outcomes:

	Upon completion of the course, students would be able to	BT Level (highest level)
CO1	Apply the concepts of vectors to find the bases and dimensions.	**K3**
CO2	Apply the knowledge of matrices to solve the problems for respective areas of specialization.	**K3**
CO3	Use Differentiation techniques in solving real time problems.	**K3**
CO4	Compute gradient, curl and divergence using vector differentiation and evaluate line integral, area and volume using vector integration.	**K3**
CO5	Evaluate the function to get the surface area and volume using multiple integrals.	**K3**

Course Contents

Unit I LINEAR ALGEBRA **9+3**

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

Unit II MATRICES **9+3**

Determinant- Cramer's rule-Eigen values and Eigen vectors of a real matrix- Properties-Cayley–Hamilton theorem (statement only)- Application-Elastic Membrane.

Unit III FUNCTIONS OF SEVERAL VARIABLES **9+3**

Limits and Continuity (Geometrical interpretations) – Properties of continuous function – Partial derivatives-Total derivatives- Jacobians - Taylor's series for two variables.

Unit IV VECTOR CALCULUS **9+3**

Gradient and directional derivative – Divergence and curl - Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Volume integral - Green's and Stoke's theorems.

Unit V MULTIPLE INTEGRALS **9+3**

Double integration (Cartesian coordinates)-Region of integration-Triple integration in Cartesian coordinates- application of triple integrals.

Total Periods **60**

Text Books:

1. James Stewart., "Calculus: Early transcendentals", 7th Edition, 2015, Cengage Learning, New Delhi.
2. Kreyszig. E, "Advanced EngineeringMathematics", 10th Edition ,2016, John Wiley and Sons (Asia) Ltd, Delhi.

Reference Books:

1. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", 5th Edition,2017, Narosa Publications, New Delhi.
2. Srimantha Pal and Bhunia. S.C., "Engineering Mathematics", 2015, Oxford University Press, India
3. Lay.D.C.,"Linear Algebra and Its Applications", 5th Edition,2015, Pearson Education, New Delhi

Web URL(s):

1. https://archive.nptel.ac.in/courses/111/104/111104137/
2. https://archive.nptel.ac.in/courses/111/105/111105122/
3. https://archive.nptel.ac.in/courses/111/104/111104137/

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	-	-	-	-	-	-	2	-	2	1	2	1
CO2	3	3	-	-	-	-	-	-	2	-	2	2	2	1
CO3	3	3	1	1	-	-	-	-	2	-	2	2	2	1
CO4	3	3	1	1	-	-	-	-	2	-	2	1	2	-
CO5	3	3	1	1	-	-	-	-	2	-	2	2	2	1
Av	3	3	1	1	-	-	-	-	2	-	2	1.6	2	1
3 – High; 2 – Medium; 1– Low; - No correlation														

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U23PYT02	APPLIED PHYSICS (Common to CIVIL, MECH and MCT)	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves.
- Gain the knowledge on magnetic and super conducting properties of materials.
- The students will have knowledge on the various phase diagrams and their applications.
- Understand the concept of ceramics, composites, metallic glasses and shape memory alloys.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply the important concepts of mechanics in engineering field.	**K3**
CO2	Use their knowledge of electromagnetic waves in various engineering fields.	**K3**
CO3	Interpret the knowledge of magnetic and superconducting properties of materials, as well as their applications.	**K3**
CO4	Apply the principle to determine the different phases present in alloy materials.	**K3**
CO5	Develop knowledge on advanced engineering materials.	**K3**

Course Contents

Unit I MECHANICS **9**

Basic definitions – Multi–particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of the system of particles. Types of motion– Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy – moment of inertia– torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule – torsional pendulum.

Unit II ELECTROMAGNETIC WAVES **9**

Basic definitions: Gauss law for electric field, Faraday's law and Ampere's circuit law – Maxwell's equations – Derivation of Maxwell's Equations – wave equation: Plane electromagnetic waves in vacuum – properties of electromagnetic waves in vacuum: speed, amplitude, phase, orientation and waves in matter – Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure.

Unit III MAGNETIC MATERIALS AND SUPERCONDUCTIVITY **9**

Introduction – Types of magnetic materials: Dia, Para and Ferromagnetism–domain theory of Ferromagnetism –hysteresis – Ferrites and application of Ferrites.
Superconductivity: Properties of Superconductor – Type I& Type II Superconductor. Application of Superconductor: Josephson junction – SQUID – Magnetic levitated Train.

Unit IV PHASE DIAGRAMS **9**

Solid solutions – Hume Rothery's rules – the phase rule – single component system – one component system of iron – binary phase diagrams – isomorphous systems – the tie–line rule – the lever rule –

isomorphous system – eutectic phase diagram – free energy composition curve for binary systems – microstructural change during cooling.

Unit V ADVANCED MATERIALS **9**

Ceramics – types and applications – Composites – classification, role of matrix and reinforcement, processing of fiber reinforced plastics– Metallic glasses: types , glass forming ability of alloys, melt spinning process, applications –shape memory alloys: phases, shape memory effect, pseudoelastic effect, NiTi alloy, applications.

Total Periods 45

Text Books:

1. Kleppner D and Kolenkow R, "An Introduction to Mechanics",2017, McGraw Hill Education (Indian Edition),New Delhi.
2. Purcell E M and Morin D J, "Electricity and Magnetism",2013, Cambridge Univ.Press. United Kingdom.
3. Raghavan V, "Materials Science and Engineering: A First Course", 2015, Prentice Hall India Learning Private Limited, New Delhi.

Reference Books:

1. Wolfson R, "Essential University Physics". Volume 1 & 2, 2009, Pearson Education (Indian Edition), New Delhi.
2. William D. Callister J "Materials Science and Engineering", 9th edition, 2014, John Wiley and sons,Inc, New Delhi.
3. Smith, W.F., Hashemi, J. & Prakash, R, "Materials Science and Engineering" 2014, Tata McGraw Hill Education Pvt. Ltd, New Delhi.

Web URL(s):

1. http://nitttrc.edu.in/nptel/courses/video/115104094/115104094.html
2. http://nitttrc.edu.in/nptel/courses/video/115101005/115101005.html
3. https://archive.nptel.ac.in/courses/113/104/113104068/
4. https://nptel.ac.in/courses/113105081

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	1	1	1	-	-	-	-	-	3	1	2
CO2	3	3	2	1	2	1	-	-	-	-	-	2	2	1
CO3	3	3	1	1	2	1	-	-	-	-	-	2	2	2
CO4	3	2	2	2	2	1	-	-	-	-	-	3	2	1
CO5	3	2	2	2	2	1	-	-	-	-	-	2	1	2
Av	3	2.6	1.8	1.4	1.8	1	-	-	-	-	-	2.2	1.6	1.6
3 – High; 2 – Medium; 1– Low; - No correlation														

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U23CST01	PROBLEM SOLVING AND PROGRAMMING IN C	L	T	P	C
		3	0	0	3

Pre-requisites : None

Objectives:

- To understand problem solving methodologies.
- To provide an overview of concepts in C language.
- To develop C programs using Arrays and Strings
- To develop modular applications in C using Functions.
- To develop skills in using Pointers. Structures, Unions and File handling.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
C01	Understand and apply problem solving techniques and basic C programming constructs.	**K3**
C02	Identify the appropriate conditional and looping statements for developing applications.	**K3**
C03	Apply Arrays and Strings concepts to store and manipulate data efficiently in programming applications.	**K3**
C04	Make use of Functions and Pointers to solve computational problems.	**K3**
C05	Develop applications in C using Structures, Unions and File processing.	**K3**

Course Contents

UNIT-I PROBLEM SOLVING FUNDAMENTALS **9**

Fundamentals of Computing – Identification of Computational Problems -Problem solving- Flow Chart, Algorithm, Pseudo code – Introduction to C – Structure of a C program- Keyword- Identifiers - Data Types – Variables - Constants – Input/output statements Operators – Type Conversion and Type casting

UNIT-II CONDITIONAL STATEMENTS AND LOOPING CONSTRUCTS **9**

Conditional Branching Statements: if, if-else, else-if ladder, nested-if, switch constructs - Looping constructs: for, while, do-while constructs – Nested loops - Usage of break continue, return and go to statements

UNIT-III ARRAYS AND STRINGS **9**

1D Array –Declaration, Initialization, 2D Array - Declaration, Initialization – Operations on Arrays- Multi-dimensional Arrays, Strings: Declaration and Initialization - String operations: length, compare, concatenate, copy

UNIT-IV FUNCTIONS AND POINTERS **9**

Functions: Built-in Functions, User defined functions – Function Prototypes–Command Line Arguments -Arrays and Functions – Strings and Functions- Scope of Variables – Storage classes – Recursion- Pointers: Declaration – Pointer operators – Pointer expressions -Passing Pointers to a Function – Pointers and one-dimensional arrays – Pointers and Strings - Dynamic Memory Allocation.

UNIT-V STRUCTURES, UNIONS AND FILE HANDLING **9**

Structure: Creating a Structure-Member initialization - Accessing Structure Members - Nested structures – Pointer and Structures – Array of structures - Self Referential Structures – typedef –Unions – Bit fields – Enumerated data types - Files- Opening and Closing a Data File, Reading and writing a data file- Pre-processor Directives

Total Periods **45**

Text Books:

1. David Riley and Kenny hunt, "Computational Thinking for the Modern problem solver", 2014, Chapman & Hall, CRC, USA.
2. SparnkleM, "Problem solving and programming concepts", 9th edition, 2011, Pearson Education, New Delhi.
3. ReemaThareja, "Programming in C", Second Edition, 2016, Oxford University Press, New Delhi.
4. Herbert Schildt, "C – The Complete Reference", 2017, Tata McGraw Hill Publishing Company, New Delhi.
5. Kernighan B. W. and Ritchie D. M., "C Programming Language (ANSI C)", 2015, Prentice Hall of India Private Limited, New Delhi.

Reference Books:

1. Deitel and Deitel, "C How to Program", 2011, Pearson Education, New Delhi.
2. Byron S. Gottfried and Jitendar Kumar Chhabra, "Programming with C", 2011, Tata McGraw Hill Publishing Company, New Delhi.
3. PradipDey and ManasGhosh, "Programming in C", 2009, Oxford University Press, New Delhi.

Web URL(s):

1. https://onlinecourses.nptel.ac.in/noc22_cs40/preview
2. https://www.udemy.com/topic/c-programming/
3. https://www.coursera.org/courses?query=c%20programming
4. https://alison.com/tag/c-programming
5. https://nptel.ac.in/courses/106105171

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	-	1	-	-	-	-	1	2	2	1	3
CO2	3	3	2	1	1	-	-	-	-	3	2	3	1	2
CO3	3	2	3	1	2	-	-	-	-	2	2	2	1	3
CO4	3	2	2	3	1	-	-	2	-	2	2	3	2	1
CO5	3	3	3	3	3	-	-	3	-	2	2	3	2	1
Av	3	2.4	2.1	1.6	1.6	-	-	1.2	-	2	2	2.6	1.4	2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MET02	ENGINEERING GRAPHICS (Common to MECH, MCT and CIVIL)	L	T	P	C
		2	2	0	4

Pre-Requisites : None

Objectives:

- To develop graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national BIS standards related to technical drawings.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Construct the basic engineering curves,	**K3**
CO2	Construct the projecting of lines and plane surfaces using rotating line and object methods respectively.	**K3**
CO3	Show orthographic projections of a simple solids with its axis inclined to one of the principal planes.	**K3**
CO4	Construct the true shape of the sectioned simple solids in simple vertical positions and develop its lateral surface.	**K3**
CO5	Develop freehand sketch and isometric projection of simple three dimensional objects.	**K3**

Course Contents

Unit I ENGINEERING CURVES **12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Unit II PROJECTION OF LINES AND PLANE SURFACES **12**

Orthographic projection- principles-Principal planes -First angle projection of straight lines inclined to both the principal plane - Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both principal plane by rotating object method.

Unit III PROJECTION OF SOLIDS **12**

Projection of simple solids like prisms, pyramids, cylinder, cube and cone when the axis is inclined to one of the principal planes by rotating object method.

Unit IV SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple solids – Prisms, pyramids, cylinders and cones.

Unit V FREE HAND SKETCHING AND ISOMETRIC PROJECTIONS **12**

Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects. Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids,

cylinders, cones- combination of two solid objects in simple vertical positions and conversion of orthographic views to isometric.

Total Periods 60

Text Books:

1. Venugopal K. and Prabhu Raja V, "Engineering Graphics", 17th Edition, 2024, New Age International (P) Limited, New Delhi.
2. Natarajan K.V., "A text book of Engineering Graphics", 33rd Edition, 2023, Dhanalakshmi Publishers, Chennai.

Reference Books:

1 Bhatt N.D. and Panchal V.M, "Engineering Drawing", 55th Edition, 2025, Charotar Publishing House, Anand, Gujarat.

2 Gopalakrishna K. R., "Engineering Drawing", (Vol. I&II combined), 30th Edition, 2017, Subhas Stores, Bangalore.

3 Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", 2015, Oxford University, Press, New Delhi.

Web URL(s):

1 https://nptel.ac.in/courses/112103019

2 https://archive.nptel.ac.in/courses/112/105/112105294/

3 https://archive.nptel.ac.in/courses/112/102/112102304/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	1	-	-	-	-	-	-	1	-	-
CO2	3	-	-	-	1	-	-	-	-	-	-	1	-	-
CO3	3	-	-	-	1	-	-	-	-	-	-	2	-	1
CO4	3	-	-	-	1	-	-	-	-	-	-	2	-	1
CO5	3	-	-	-	1	-	-	-	-	-	-	3	-	1
Av	3	-	-	-	1	-	-	-	-	-	-	1.8	-	1
3 – High; 2 – Medium; 1– Low; - No correlation														

U23TAT01	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

Pre-Requisites : None

Objectives:

To make the students to:

- Understand and appreciate the secular nature and ethical concepts of Sangam literature and the evolution of Tamil literature through different periods.
- Explore and analyze the traditional and modern art forms, including sculpture and folk arts, and their significance in Tamil culture and society.
- Evaluate the historical and cultural impact of Tamil heritage, including traditional sports, Agam and Puram theories, and the role of Tamil contributions in the Indian national movement and knowledge dissemination.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Understand the secular nature of Sangam literature and its ethical concepts.	**K2**
CO2	Apply knowledge of ancient and modern sculpture techniques to analyse various art forms.	**K3**
CO3	Evaluate the role of traditional sports in Tamil society and their impact on community life.	**K3**
CO4	Recognize the Agam and Puram theories from ancient Tamil texts.	**K2**
CO5	Assess the historical significance of Tamil printing and its role in the dissemination of knowledge.	**K3**

Course Contents

Unit I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

Unit II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

Unit III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

Unit IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

Unit V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

Total Periods 15

Text-cum-Reference Books:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	2	-	-	-	-	-	-	-	-	1	2	3
CO2	-	-	3	2	-	-	-	-	-	-	-	3	2	1
CO3	-	-	3	-	-	-	-	-	-	-	-	2	3	1
CO4	2	2	-	-	-	-	-	-	-	-	-	1	2	3
CO5	-	-	3	-	2	-	-	-	-	-	-	2	1	2
Av	0.8	0.8	2.1	0.4	0.4	-	-		--	-	-	1.4	2	2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23PYP01	PHYSICS LABORATORY (Common to ALL branches)	L	T	P	C
		0	0	2	1

Pre-Requisites : None

Objectives:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Use the different components and equipment in physics practical.	**K3**
CO2	Solve problems individually and summarize the experimental results effectively.	**K3**
CO3	Use graphical models to analyze laboratory data and develop skills to impart practical knowledge in real time solution.	**K3**

List of Experiments

1. Determination of Wavelength of Laser.
2. Determination of Particle Size and Acceptance angle of the fiber using laser.
3. Determination of young's modulus by Uniform bending.
4. Determination of thickness of a thin wire by Air wedge method.
5. Determination of thermal conductivity of bad conductor.
6. Determination of Rigidity modulus by Torsion pendulum.
7. Determination of wavelength of mercury spectrum – Spectrometer grating.
8. Determination of bandgap of a semiconductor.
9. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.

Total Periods 30

Bloom's Taxonomy Level
K1- Remember, K2 – Understand, K3 - Apply, K4 - Analyse, K5 - Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	1	1	1	-	-	-	-	-	3	1	1
CO2	3	3	2	1	2	1	-	-	-	-	-	2	2	1
CO3	3	3	1	1	2	1	-	-	-	-	-	2	1	3
Av	3	3	1/6	1	1.6	1	-	-	-	-	-	2.3	1.7	1.7
3 – High; 2 – Medium; 1– Low; - No correlation														

		L	T	P	C
U23CSP01	**PROBLEM SOLVING AND PROGRAMMING IN C LABORATORY (Common to ALL branches)**	**0**	**0**	**2**	**1**

Pre-Requisites : None

Objectives:

This Course aims to develop comprehensive competence in C programming by practising problem solving skills.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Utilize C programming constructs to develop efficient programs.	**K3**
CO2	Develop robust programs incorporating arrays, strings, functions and pointers.	**K3**
CO3	Design and implement structured, efficient and error-free C programs.	**K6**

LIST OF EXPERIMENTS

1. I/O statements, operators, expressions
2. Decision-making constructs: if-else, go to, switch-case, break-continue
3. Loops: for, while, do-while
4. Arrays: 1D and 2D, multi-dimensional arrays
5. Strings: Operations
6. Functions: call, return, passing arrays to function, Passing string to functions, Recursion
7. Pointers: Pointers to Functions, Arrays and Strings, Passing parameters to functions
8. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions
9. Files: reading and writing, File pointers, File operations, Preprocessor directives
10. Mini project

Total Periods 30

Reference Books:

1. ReemaThareja, “Programming in C”, Second Edition, 2016, Oxford University Press.
2. Herbert Schildt, “C – The Complete Reference”, 2017, Tata McGraw Hill Publishing Company, New Delhi.
3. Kernighan B. W. and Ritchie D. M., “C Programming Language (ANSI C)”, 2015, Prentice Hall of India Private Limited, New Delhi.
4. Deitel and Deitel, “C How to Program”, 2011, Pearson Education, New Delhi.
5. Byron S. Gottfried and Jitendar Kumar Chhabra, “Programming with C”, 2011, Tata McGraw Hill Publishing Company, New Delhi.
6. PradipDey and ManasGhosh, “Programming in C”, 2009, Oxford University Press, New Delhi.

Web URL(s):

1. https://cse02-iiith.vlabs.ac.in/List%20of%20experiments.html

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3	2	1	1	2	-	-	-	-	-	2	3	2	1
CO2	3	2	3	2	3	-	-	1	0	0	2	2	1	3
CO3	3	3	3	2	3	-	-	2	1	1	3	3	1	2
Av	3	2.3	2.3	1.6	2.6	-	-	1	0.3	0.3	2.3	2.6	1.3	2
3 – High; 2 – Medium; 1– Low; - No correlation														

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Narasipuram (Post), Coimbatore-641 109.

U23EEP01	ENGINEERING PRACTICES LABORATORY (Common to CIVIL, EEE, MECH and MCT)	L	T	P	C
		0	0	4	2

Pre-Requisites : None

Objectives:

- To gain the basic knowledge of measuring the components.
- To know about the usage of appropriate tools and equipment used in welding, plumbing and carpentry
- To impart knowledge about different types joints in welding, carpentry and plumbing.
- To understand working methodologies of lathe machine and sheet metal processes.
- To impart knowledge in electrical wiring concepts for house hold and calculations of power and energy.
- To familiarize with various electronic components and equipment.
- To learn the basic skills of soldering electronic components and wires.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Measure basic dimensions of mechanical components, Join metals using arc welding	**K3**
CO2	Create models in sheet metal and perform basic machining operations in lathe, Use proper tools for plumbing and carpentry.	**K3**
CO3	Make joints related to carpentry and plumbing work.	**K3**
CO4	Carry out basic home electrical works and measure electrical quantities	**K2**
CO5	Apply the knowledge on various electronics components and equipment	**K3**
CO6	Elaborate on soldering practices	**K2**

LIST OF EXPERIMENTS

MECHANICAL AND CIVIL ENGINEERING PRACTICES

1. Measurement of mechanical components using Vernier Caliper and Vernier Height Gauge.
2. Measurement of diameter of mechanical components using Micrometer.
3. Sheet Metal Works: Model making – like Rectangular Tray.
4. Hands-on-exercise on Lathe machine: Facing, Simple Turning and Step Turning
5. Hands-on-exercise on Drilling Machine: Drilling of holes in a component.
6. Preparation of butt joint, lap joint and T- joint by metal arc welding.
7. Study of plumbing tools and equipment
8. Hands-on-exercises in Plumbing: Basic pipe connection using different types of joints and components required for residential and industrial buildings.
9. Hands-on-exercises in Carpentry: Wood work joints using conventional/power tools.
10. Assembling and dismantling of simple mechanical products.

ELECTRICAL AND ELECTRONICS ENGINEERING PRACTICES

1. Basic switch board wiring with switch to connect three pin socket, Two Lights and Indicator Lamp.
2. Staircase wiring.
3. Measurement of Voltage, Current, Power and calibration of Single-phase Energy meter.
4. Fluorescent Lamp wiring with introduction to CFL and LED types.
5. Measurement of AC Signal parameters using CRO and Function Generator.
6. (i) Measurement of DC & AC Voltage, Continuity using Digital Multimeter.
   (ii) Measurement of Inductor and Capacitor using LCR Meter.
7. Soldering of Electronic components in PCB.
8. Study of Megger, Circuit Breakers, DC Regulated power supply and DSO.

Total Periods 60

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	1	2	-	-	-	-	2	3	1	2
CO2	3	2	-	-	1	2	-	-	-	-	2	3	1	2
CO3	3	2	-	-	1	2	-	-	-	-	2	2	1	3
CO4	3	2	-	-	1	2	-	-	-	-	2	2	1	3
CO5	3	2	-	-	1	2	-	-	-	-	2	2	1	3
CO6	3	2	-	-	1	2	-	-	-	-	2	2	1	3
Av	3	2	-	-	1	2	-	-	-	-	2	2.3	1	2.6
3 – High; 2 – Medium; 1– Low; - No correlation														

Semester II

U23EGT02	PROFESSIONAL ENGLISH (Common to ALL branches)	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To enhance learners' English language acquisition skills
- To facilitate learners to acquire effective technical writing skills
- To prepare learners for placement and competitive exams
- To facilitate effective English language skills for academic purposes and real-life situations

Course Outcomes:
Upon completion of the course, students shall have ability to

		BT Level (highest level)
CO1	Cultivate critical thinking skills to analyze and evaluate information effectively.	**K4**
CO2	Acquire and apply specialized English language skills in professional contexts.	**K6**
CO3	Develop technical communication competencies to articulate complex ideas with precision and clarity.	**K3**
CO4	Demonstrate expertise in professional communication, encompassing written, verbal, and interpersonal skills.	**K6**
CO5	Enhance language proficiency and strategic competencies to excel in competitive examinations and professional pursuits.	**K5**

Course Contents

Unit I CREATIVE THINKING **9**

Articles – Conjunctions – subject verb agreement - Sentence completions- online worksheets on matching, paragraph writing on Comparison and contrast.

Unit II PROFESSIONAL VOCABULARY **9**

Compound nouns-Process description, product description, Job application and resume writing-Online worksheets for hints development

Unit III TECHNICAL SKILL **9**

Discourse Markers -Gerunds and infinitive– Relative Pronouns – Definitions of Technical Terms – Digital Transcoding – Group discussion (Do's and Don't)-online worksheet on transcoding

Unit IV PROFESSIONAL COMMUNICATIONS **9**

Concord – Clauses – Phrases – Numerical Adjectives – Complaint letter-Filling up forms(Opening bank a/c and ticket booking) – Virtual Communication: E-Mail Writing – Essay Writing: Types of essays Opinion Essay, Discussion Essay, Direct Questions Essay, Advantage/Disadvantage Essay, Problem/Solution Essay.

Unit V ENGLISH FOR COMPETITIVE EXAMS **9**

TOFEL / IELTS- (LSRW) Synonyms; Vocabulary; reading comprehension of IELTS; writing-verbal: Verbal Ability- Commonly misspelt words, travel itinerary.

Total Periods **45**

Text Books:

1. "English for Engineers & Technologists", 202, Department of English, Anna University, Orient Blackswan Private Ltd., Hydeabad.
2. Dr. B. Vinoth & Prof.J. Oormila Heleena, "A workbook of Communicative English", First edition, 2023, Sri Krishna Hitech publishing company pvt Ltd, Coimbatore,
3. Ramalingam N, "Grammar for all", Second edition, 2013, Himalaya Publishing House, Bengaluru.

Reference Books:

1. Norman Whitby, "Business Benchmark Pre-intermediate to intermediate Personal Study Book", BEC and BULATS Edition, 2006, Cambridge University Press India Ltd, New Delhi.
2. Anne Laws, "Writing Skills", 2011, Summertown Publishing Oxford - U.K.
3. Sinha DK, "Specimen of English Prose", 2012, Orient Black Swan., Hyderabad.
4. Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", 20009, Oxford University Press India Ltd, New Delhi.
5. Raymond Murphy. "English Grammar and Use" - 4th edition, 2004, Cambridge University Press, UK.

Web URL(s):

1 https://www.liveworksheets.com/worksheets/en
2 https://www.ets.org/toefl.html (TOEFL Test Takers (ets.org))
3 https://englishonline.britishcouncil.org/ielts-coach/

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	3	1	2	-	-	-	-	2	-	-	1	1	1
CO2	1	1	1	1	-	-	-	-	-	-	-	1	1	2
CO3	2	2	2	-	-	-	-	-	3	-	-	2	2	3
CO4	1	2	2	-	-	-	-	-	-	-	-	2	2	3
CO5	1	1	1	-	-	-	-	-	-	-	-	2	1	2
Av	1.4	1.9	1.4	0.6	-	-	-	-	1	-	-	1.6	1.4	2.2
3 – High; 2 – Medium; 1– Low; - No correlation														

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U23MAT02	TRANSFORMS AND BOUNDARY VALUE PROBLEMS (Common to CIVIL, ECE, EEE, MECH and MCT)	L	T	P	C
		3	1	0	4

Pre-Requisites : Linear Algebra and Calculus

Objectives:

To make the students

- Introduce the basic concepts of partial differential equations for solving standard types.
- Introduce Fourier series in engineering problems.
- Acquaint with Fourier transform techniques used in wide variety of situations.
- Interpret with Fourier series techniques in solving heat flow problems.
- Introduce the effective mathematical tools for the solutions of partial differential equations to model several physical processes and to develop Z transform techniques for discrete time systems.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Solve the standard partial differential equations.	**K3**
CO2	Solve differential equations using Fourier series analysis in engineering applications	**K3**
CO3	Apply the mathematical principles of transforms and partial differential equations to formulate and solve the physical problems of engineering.	**K3**
CO4	Apply the physical significance of Fourier series techniques in solving one- and two-dimensional heat flow Problems and one-dimensional wave equations.	**K3**
CO5	Apply the mathematical tools for the solutions of partial differential equations using the Z transform techniques for discrete time systems	**K3**

Course Contents

Unit I PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Solution of standard types of first order equations- Lagrange's equation- linear partial Differential equation of second and higher order with constant coefficients.

Unit II FOURIER SERIES **9+3**

Dirichlet's conditions- General Fourier series- Half Range Sine and Cosine series- Parseval's Identity- Harmonic Analysis.

Unit III FOURIER TRANSFORM **9+3**

The infinite Fourier transform pair - sine and cosine transform - properties- Parseval's identity and convolution theorem (statement only)

Unit IV BOUNDARY VALUE PROBLEMS **9+3**

Classification of Second order linear partial differential equations- solutions of one-dimensional wave equation-One-dimensional heat equation, steady state solution of two-dimensional heat equation, Fourier series solution in cartesian coordinates

Unit V Z – TRANSFORMS **9+3**

Definition and properties- Elementary Problems- Inverse Z transforms (partial fraction method) -convolution theorem (statement only)- Application of Z – Transforms in solving difference equations.

Total Periods **60**

Text Books:

1. Grewal.B.S. and Grewal.J. S, "Higher Engineering Mathematics", 44th Edition, 2018, Khanna Publishers, New Delhi.
2. Kreyszig.E, "Advanced EngineeringMathematics", 10th Edition ,2018, John Wiley and Sons (Asia) Ltd, Delhi.

Reference Books:

1. Bali.N. P and Manish Goyal., "A Textbook of Engineering Mathematics", 10th Edition ,2015, Laxmi Publications, Pvt Ltd.
2. Ramana. B.V., "Higher Engineering Mathematics",6th edition, 2018, McGraw Hill Education Pvt Ltd, New Delhi
3. James. G., "Advanced Modern Engineering Mathematics", 4th Edition, 2016, Pearson Education, New Delhi.

Web URL(s):

1 https://archive.nptel.ac.in/courses/111/105/111105123/
2 https://archive.nptel.ac.in/courses/111/106/111106111/
3 https://archive.nptel.ac.in/courses/111/102/111102129/

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	-	3	2	-	-	-	-	-	1	2	2	2
CO2	3	3	-	3	2	-	-	-	-	-	1	2	-	1
CO3	3	3	-	3	2	-	-	-	-	-	1	2	-	2
CO4	3	3	-	3	2	-	-	-	-	-	2	3	2	2
CO5	3	3	-	2	3	-	-	-	-	-	2	2	-	-
Av	3	3	-	2.8	2.2	-	-	-	-	-	1.4	2.2	2	1.8
3 – High; 2 – Medium; 1– Low; - No correlation														

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U23CYT02	APPLIED CHEMISTRY (Common to CIVIL, MECHANICAL and MCT)	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- Understand the requirements of Boiler feed water, its problems and water treatment methods
- Learn the principles and generation of energy in solar cells, fuel cells and batteries.
- Familiar with the nature of fuels its combustion.
- Understand the basic concepts of Phase Rule and its application to one component systems and appreciate the purpose of significance of alloys.
- Develop an understanding about engineering materials, synthesis of nanomaterials and its applications.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Adapt various water treatment process, which make it fit for industrial and domestic purpose.	**K3**
CO2	Examine various sources of energy and its storage in different batteries, which find its application in society including engineering fields.	**K3**
CO3	Choose various fuels, its characteristics and combustion.	**K3**
CO4	Identifying components of a system and selection of heat treatment for alloys	**K3**
CO5	Infer methods involved in the synthesis of different materials and its properties.	**K2**

Course Contents

Unit I WATER TECHNOLOGY **9**

Hardness of water-types -expression-units-estimation of hardness of water by EDTA-numerical problems-boiler feed water-disadvantages of hard water in boilers-boiler troubles (scale & sludge, boiler corrosion)-water treatment-zeolite process, Ion exchange process-desalination-reverse osmosis-instrumental methods for water analysis-AAS, flame emission spectroscopy and photocolorimetry.

Unit II ENERGY SOURCES AND STORAGE DEVICES **9**

Energy sources-types-nuclear energy-nuclear fission-controlled nuclear fission-nuclear fusion-nuclear reactor power generator-breeder reactor-solar energy-solar energy conversion-wind energy-Batteries - primary (alkaline battery) - Secondary (lead storage battery, NICAD battery and lithium ion battery) - Electric vehicles – working principles -Fuel cells (H_2-O_2 , direct methanol and solid oxide)-super capacitors.

Unit III FUELS AND COMBUSTION **9**

Fuels: Introduction-Gross Calorific value- Net Calorific value- classification of fuels - coal- analysis of coal (proximate and ultimate)- carbonization- manufacture of metallurgical coke (Otto Hoffmann method) - octane number - diesel oil- cetane number - natural gas- compressed natural gas (CNG)- liquefied petroleum gases (LPG)- Power alcohol and bio diesel. flue gas analysis (gas chromatography).

Unit IV PHASE RULE AND ALLOYS **9**

Phase Rule: Introduction-definition of terms with examples-one component system-water system-reduced phase rule – thermal analysis and cooling curves-two component system-lead-silver system-pattinson

process. Alloys: Introduction-definition-properties of alloys-significance of alloying, functions and effect of alloying elements-ferrous alloys (Nichrome and Stainless steel)-Heat treatment of steel-nonferrous alloys (Brass and Bronze).

Unit V CHEMISTRY OF ENGINEERING MATERIALS 9

Abrasives-classification-properties-Mho scale-Applications of Abrasives -Portland Cement-manufacture (wet process)-properties-setting and hardening of cement-special cement-alumina cement and water proof cement. -Nano Chemistry: Basics-distinction between molecules, nano particles and bulk materials-preparation of nano particles by sol-gel-preparation of nano wires by electro spinning-preparation of carbon nano tube by chemical vapour deposition-quantum dots-synthesis by colloidal process-Applications of nano materials.

Total Periods 45

Text Books:

1. Jain P.C. and Monica Jain, "Engineering Chemistry", 17th Edition, 2018, Dhanpat Rai Publishing Company (P) Ltd, New Delhi.
2. Palanna O.G, "Engineering Chemistry", 2nd edition, 2017, McGraw Hill Education (India) Pvt. Ltd., Chennai.
3. Dara S.S, and Umare S.S, "Engineering Chemistry", 2013, S. Chand & Company Ltd., New Delhi

Reference Books:

1. Murty B. S, Shankar P, Baldev Raj, Rath B.B and James Murday, "Text book of nanoscience and nanotechnology", 2018, Universities Press-IIM Series in Metallurgy and Materials Science., Springer Publications, US
2. Sivasankar B, "Engineering Chemistry-Fundamentals and Applications", 2008, Tata McGraw-Hill Publishing Company, Ltd., New Delhi.
3. Shikha Agarwal, "Engineering Chemistry" Second Edition, 2019, Cambridge University Press, New Delhi.

Web URL(s):

1. https://archive.nptel.ac.in/courses /118/104/118104008/
2. https://archive.nptel.ac.in/courses /118/102/118102003/
3. https://archive.nptel.ac.in/courses /105/106/105106206/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	1	-	2	-	-	-	-	1	2	3	1
CO2	3	1	2	1	-	2	-	-	-	-	1	2	3	1
CO3	3	1	2	1	-	2	-	-	-	-	2	2	3	1
CO4	3	2	1	1	-	1	-	-	-	-	1	3	2	1
CO5	2	-	-	1	-	2	-	-	-	-	-	2	2	1
Av	2.8	2	1.4	1	-	1.4	-	-	-	-	1	2	2.6	1
3 – High; 2 – Medium; 1– Low; - No correlation														

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U23CST02	PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

Pre-requisites : None

Objectives:

- To understand and apply fundamental Python programming concepts
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To know the basics of object-oriented programming concepts.
- To do input/output with files in Python.

Course Outcomes:

	Upon completion of the course, students would be able to	BT Level (highest level)
C01	Develop python programs using appropriate data types.	**K3**
C02	Utilize and manipulate Python data structures like lists, tuples, sets, and dictionaries.	**K3**
C03	Design and implement functions, modules, and packages for structured Python programming.	**K3**
C04	Articulate the Object oriented programming concepts used in Python.	**K3**
C05	Develop Python applications with file handling, command-line programming, and exception handling.	**K3**

Course Contents

Unit I BASICS OF PYTHON PROGRAMMING **9**

Introduction to Python - Python Interpreter – Data types - variables - expressions -statements- Operators and Expressions – Strings – Decision control statements

Unit II PYTHON DATA STRUCTURES **9**

Sequence - Lists - Functional Programming – Tuples – Sets- Dictionaries

Unit III FUNCTIONS, MODULES AND PACKAGES **9**

Functions – Definition – Call - Variable scope and Life time – Return- Lamda Functions- Recursive functions- Modules – Packages

Unit IV OBJECT ORIENTED PROGRAMMING **9**

Object-Oriented Concepts and Terminology - Classes and objects - Attributes and Methods - Inheritance – Method overriding – Data encapsulation – Data hiding

Unit V FILES AND EXCEPTION HANDLING **9**

File Handling - Read - Write – Command Line Programming – Exception Handling

Total Periods 45

Text Books:

1. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Second Edition, 2016, Updated for Python 3, Shroff O’Reilly Publishers.
2. ReemaThareja, “Problem solving and Programming with Python”, 2018, Oxford University.
3. Liang Y. Daniel, “Programming Using Python”, 1st Edition, 2017, Pearson Education.
4. Guido van Rossum and Fred L. Drake Jr, “An Introduction to Python”, 2011, Revised and updated for Python 3.2, Network Theory Ltd.

Reference Books:

1. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, 2012,CENGAGE Learning.
2. Charles Dierbach, “Introduction to Computer Science using Python: A Computational Problem-Solving Focus”, 2013, Wiley India Edition.

3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-Disciplinary Approach", 2016, Pearson India Education Services Pvt. Ltd.
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, 2019, No Starch Press.

Web URL(s):

1. https://nptel.ac.in/courses/106106145
2. https://onlinecourses.swayam2.ac.in/cec22_cs20/preview
4. https://nptel.ac.in/courses/106106182
5. https://www.udemy.com/course/python-for-complete-beginners-1/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	2	1	-	-	1	1	-	2	2	1	3
CO2	2	3	2	2	2	-	-	1	-	-	2	2	1	3
CO3	2	2	3	2	2	-	-	1	1	-	2	2	1	3
CO4	1	1	2	3	1	-	-	0	0	1	2	2	1	3
CO5	2	2	2	2	3	-	-	1	1	1	2	2	1	3
Av	2	2	2	2.2	1.8	-	-	0.8	0.4	0.4	2	2	1	3
3 – High; 2 – Medium; 1– Low; - No correlation														

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		L	T	P	C
U23ECT03	**BASICS OF ELECTRICAL, ELECTRONICS AND INFORMATION SCIENCE (Common to MECH, CIVIL and MCT)**	**3**	**0**	**0**	**3**

Pre-Requisites : Mathematics and Physics

Objectives:

- To introduce the basics of electric circuits and analysis.
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics To know about the various types of communication systems.
- To Familiar with the concepts in Emerging fields of Information science.

Course Outcome Upon completion of the course, students would be able to		**BT Level (highest level)**
C01	Compute the electric circuit parameters for simple problems.	**K4**
C02	Analyze the characteristics of analog electronic devices.	**K4**
C03	Explain the basic concepts of digital electronics.	**K2**
C04	Relate the Concept of Modulation, Demodulation and learn the amplitude modulation techniques.	**K3**
C05	Investigate the characteristics of different network technology.	**K3**

Course Contents

Unit I ELECTRIC CIRCUITS **9**

Introduction to DC Circuits: Conductor, Resistor, Inductor, Capacitor- Ohm's Law, Kirchhoff's Laws, simple problems. Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor.

Unit II ANALOG ELECTRONICS **9**

Semiconductor Materials: Silicon & Germanium – PN Junction Diodes, Zener Diode –Characteristics and Applications – Bipolar Junction Transistor- Types, I-V Characteristics and Applications.

Unit III DIGITAL ELECTRONICS **9**

Basic logic gates, Universal gates, Combinational circuit, Half- Adder, Full-Adder, Decoder, Sequential Circuit, Latches, RS Flip-flop, JK Flip-flop, D Flip-flop, T Flip-flop.

Unit IV COMMUNICATION FUNDAMENTALS **9**

Analog and Digital Communication: Need for Modulation, Amplitude Modulation and Frequency modulation, Basic of Pulse Amplitude Modulation, Pulse Code Modulation, Digital Modulation Techniques.

Unit V COMPUTER AND INFORMATION TECHNOLOGY **9**

Computer Networks: TCP/IP Model- Introduction to Microcontroller (Quantitative treatment only), Introduction to Embedded Technology- Real Time Application- Washing machine controller, Advanced Technologies- Artificial Intelligence.

Total Periods: 45

Text Books

1. Sudhakar A, Shyammohan S Pilla, "Circuits and Networks Analysis and Synthesis", 2013, Tata McGraw Hill India Pvt Limited, New Delhi.

2. Robert L Boylestad and Louis Nasheresky,"Electronic Devices and Circuit Theory", 2013, Pearson Education, New Delhi. .

Reference Books

1. Morris Mano M and Michael D Ciletti, "Digital Design, With an Introduction to the Verilog HDL", 2013, Pearson Education, New Delhi.

2. Wayne Tomasi, "Electronic Communication Systems", 2004, Pearson Education, New Delhi.
.

Web url(s)

1 https://nptel.ac.in/courses/105103023
2 https://www.allaboutcircuits.com/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	3	2	-	2	2	2	-	-	-	-	2	1	3
CO2	3	3	-	2	-	2	2	-	-	-	2	2	1	3
CO3	2	2	3	1	-	3	3	-	-	-	-	2	1	3
CO4	3	2	-	3	-	2	3	-	-	-	-	2	1	3
CO5	2	1	-	3	2	2	2	-	-	-	2	2	1	3
Av	2.4	2.2	1	1.8	0.8	2.2	2.4	-	-	-	0.8	2	1	3
3 – High; 2 – Medium; 1– Low; - No correlation														

U23TAT02	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

Pre-Requisites : None

Objectives:

To make the students to:

- Understand the key technologies and techniques in weaving and ceramics during the Sangam Age, including pottery styles and decorations.
- Explore ancient design and construction methods by studying buildings and architectural styles from different historical periods in Tamil Nadu.
- Learn about manufacturing technologies like shipbuilding and metalworking, and their importance in ancient Tamil society through archaeological findings.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Understand the significance of weaving and ceramic technology during the Sangam Age, including Black and Red Ware Potteries and graffiti on potteries.	**K2**
CO2	Apply knowledge of ancient design and construction techniques to analyze structural elements and materials used during the Sangam Age.	**K3**
CO3	Evaluate the technological advancements in manufacturing, including shipbuilding, metallurgy, and bead making during ancient Tamil periods.	**K3**
CO4	Recognize the agricultural and irrigation practices, including dam and pond construction, and animal husbandry methods used during the Chola period.	**K2**
CO5	Assess the development of scientific Tamil and Tamil computing, including digitalization efforts and the establishment of Tamil virtual resources.	**K3**

Course Contents

Unit I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

Unit II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

Unit III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

Unit IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

Unit V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

Total Periods: 15

Text-cum-Reference Books:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	2	-	-	-	-	-	-	-	-	2	1	3
CO2	-	-	3	2	-	-	-	-	-	-	-	2	1	3
CO3	-	-	3	-	-	-	-	-	-	-	-	3	2	1
CO4	2	2	-	-	-	-	-	-	-	-	-	2	3	1
CO5	-	-	3	-	2	-	-	-	-	-	-	1	3	2
Av	0.8	0.8	2.2	0.4	0.4	-	-	-	-	-	-	2	2	2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23CYP01	CHEMISTRY LABORATORY (Common to ALL branches)	L	T	P	C
		0	0	2	1

Pre-Requisites : None

Objectives:

- To make the student to acquire practical skills in the determination of water quality parameters through Volumetric and instrumental analysis.
- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, hardness, DO.
- To acquaint the students with the determination of molecular weight of a polymer by viscometry.
- To induce the students to familiarize with electro analytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Examine the water quality parameters for domestic and industrial purposes.	**K3**
CO2	Quantitatively analyse the amount of metal ions by spectroscopic techniques.	**K3**
CO3	Practice electroanalytical technique to determine the ions in solution.	**K3**

List of Experiments

1. Estimation of Total, Temporary and Permanent Hardness of Water Sample by EDTA method.
2. Determination of DO content in Water by Winkler's method.
3. Determination of strength of acids in a mixture using conductivity meter.
4. Determination of strength of acid in a base using conductivity meter.
5. Determination of strength of an acid using pH meter.
6. Estimation of iron content of the given solution using potentiometer.
7. Determination of molecular weight and degree of polymerisation of a polymer (PVA) by viscometric method
8. Estimation of Iron in a given sample by photo colorimetry

Total Periods: 30

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	1	1	-	2	1	1	-	-	-	2	3	1
CO2	2	2	2	1	-	2	1	1	-	-	-	3	2	1
CO3	2	2	1	-	1	1	1	1	-	-	-	2	3	1
Av	2	2	1.3	0.6	0.3	1.6	1	1	-	-	-	2.3	2.6	1
3 – High; 2 – Medium; 1– Low; - No correlation														

U23CSP02	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	2	1

Pre-requisites : None

Objectives:

This course helps to develop and implement Python programs using fundamental constructs, data structures, and advanced features like OOP and file handling.

Course Outcomes:

	Upon completion of the course, students would be able to	**BT Level (highest level)**
C01	Apply Python programming fundamentals to create programs with simple statements, expressions and control structures.	**K3**
C02	Design and implement complex programs integrating data structures, modules and exception handling for technical solutions.	**K4**
C03	Develop real-time applications using advanced Python features such as functions, OOP, and file handling.	**K6**

List of Experiments

1.Python programming using simple statements and expressions
2. Conditionals and Iterative loops
3. Implementing programs using Functions.
4. Implementing programs using Strings
5. Implementing real-time/technical applications using Lists, Tuples, and Dictionaries.
6. Implementing programs using written modules and Python Standard Libraries.
7. Implementing real-time/technical applications using File handling.
8. Implementing real-time/technical applications using Exception handling.
9. Python programming using OOPs concepts.
10. Mini project.

Total Periods: 30

Reference Books

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition, 2016, Updated for Python 3, Shroff O'Reilly Publishers.
2. ReemaThareja, "Problem solving and programming with python", 2018, Oxford University.
3. Liang Y. Daniel, "Programming Using Python",1st Edition, 2017, Pearson Education.
4. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python ", 2011, Revised and updated for Python 3.2, Network Theory Ltd.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs",2012, CENGAGE Learning.
6. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", 2013,Wiley India Edition.
7. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-Disciplinary Approach"., 2016, Pearson India Education Services Pvt. Ltd.
8. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction toProgramming", 2nd Edition,2019, No Starch Press.

Web URL(s):

1. https://python-iitk.vlabs.ac.in/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	2	1	-	-	-	-	-	2	2	1	3
CO2	2	3	2	2	2	-	-	1	1	1	2	3	2	3
CO3	2	2	2	2	3	-	-	1	1	1	2	3	2	3
Av	2.3	2.6	2	2	2	-	-	0.6	0.6	0.6	2	2.6	2.6	3
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEP01	COMPUTER AIDED DRAFTING LABORATORY (Common to MECH, MCT and CIVIL)	L	T	P	C
		0	0	4	2

Pre-Requisites : None

Objectives:

- To draw simple figures with title block using CAD software commands.
- To sketch curves like parabola, spiral and involute of square & circle and draw the orthographic projection of simple solids.
- To prepare orthographic projection of simple machine parts and draw a plan of residential building
- To develop skill in sketching simple steel truss and sectional views of simple solids.
- To develop skill to use software to create 2D and 3D models.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Exhibit proficiency in creating and editing a title block that includes essential text elements and projection symbols using CAD software.	**K3**
CO2	Construct front, top, and side views of simple objects from a given pictorial view, including basic dimensions and sectional details using cad software.	**K3**
CO3	Develop a detailed plan of a residential building featuring designated rooms and produce an accurate drawing of a simple steel structures using CAD software.	**K3**

List of Exercises:

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 of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using B-spline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder and cone including dimensioning.
5. Drawing sectional views of prism, pyramid, cylinder and cone.
6. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
7. Drawing isometric projection of simple objects.
8. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.
9. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
10. Drawing of a simple steel truss.

Total Periods: 60

Bloom's Taxonomy Level
K1- Remember, K2 – Understand, K3- Apply , K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	1	-	-	-	3	-	-	-	1	-	-	1	-	1
CO2	2	1	2	-	3	-	-	-	1	-	-	1	-	2
CO3	2	1	3	-	3	1	-	-	2	1	-	2	-	3
Av	1.7	0.7	1.7	-	3	0.3	-	-	1.3	0.3	-	1.3	-	2
3 – High; 2 – Medium; 1– Low; - No correlation														

Semester III

U23MAT04	STATISTICS AND NUMERICAL METHODS (Common to CIVIL, MECH, MCT)	L	T	P	C
		3	1	0	4

Pre-Requisites : Basic concepts of Integration, Differentiation, Probability and Standard Distributions

Objectives:

To provide the necessary basic concepts and procedures for solving numerically in engineering and technology.

- Acquaint the knowledge in testing the hypothesis for small and large samples in real life problems.
- Provide the necessary basic concepts of a design of experiments in statistics.
- Introduce the basic concepts of solving algebraic and transcendental equations using numerical techniques.
- Introduce the numerical systems of interpolation, differentiation and integration.
- Acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Apply the concept of testing of hypothesis for small and large samples in real life problems.	**K3**
CO2	Apply the basic concepts of classifications of design of experiments in the field of agriculture.	**K3**
CO3	Solve the algebraic and transcendental equations using numerical techniques for engineering applications.	**K3**
CO4	Apply the numerical techniques of interpolation in various intervals, differentiation and integration for engineering problems.	**K3**
CO5	Use the knowledge of various techniques and methods for solving first and second order ordinary differential equations.	**K3**

Course Contents

Unit I TESTING OF HYPOTHESIS **9+3**

Tests for single and difference of means (Large and small samples) – Tests based on t, chi-square and F distribution for testing mean and variance – Contingency table (test for independence)- Goodness of fit.

Unit II DESIGN OF EXPERIMENTS **9+3**

One way and two-way classifications-Completely randomized design – Randomized block design – Latin square design.

Unit III NUMERICAL SOLUTION OF LINEAR EQUATIONS **9+3**

Solution of algebraic and transcendental equations - Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel.

Unit IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION **9+3**

Lagrange's and Newton's forward and backward difference interpolation –Approximation of derivates using interpolation polynomials – Numerical single and double integration using Trapezoidal and Simpson's 1/3 rules.

Unit V NUMERICAL SOLUTION OF ODE GIVEN INITIAL VALUES 9+3

Single step methods: Taylor's series method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's predictor corrector methods for solving first order differential equations.

Total Periods: 60

Text Books:

1. Grewal. B. S and Grewal. J. S, "Numerical Methods in Engineering and Science", 11th Edition 2013, Khanna Publishers, New Delhi.
2. Johnson. R.A, Miller.I and Freund. J, "Miller and Freund's Probability and Statistics for Engineers", 8th Edition, 2015, Pearson Education, Asia, Delhi.

Reference Books:

1. Gupta.S.C. and Kapoor. V. K, "Fundamentals of Mathematical Statistics", 12th Edition ,2020, Sultan Chand & Sons, New Delhi.
2. Burden.R.L. and Faires. J. D, "Numerical Analysis", 9th Edition ,2016, Cengage Learning, New Delhi.
3. Devore.J.L., "Probability and Statistics for Engineering and the Sciences", 8th Edition, 2014, Cengage Learning , New Delhi

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Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	3	1	3	2	1	-	-	-	1	1	2	1	1
CO2	1	3	1	3	2	1	-	-	-	1	-	2	1	1
CO3	2	3	-	1	2	-	-	-	-	-	1	2	1	1
CO4	3	3	-	2	3	-	-	-	-	-	-	1	1	2
CO5	3	3	-	3	3	-	-	-	-	-	-	1	2	2
Av	2.2	2.6	1	2.4	2.4	1	-	-	-	1	1	1.6	1.2	1.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MET03	ENGINEERING MECHANICS (Common to MECH, MCT and CIVIL)	L	T	P	C
		2	1	0	3

Pre-Requisites : None

Objectives:

- To make the students understand the vector and scalar representation of forces and Moments and the static equilibrium of particles and rigid bodies.
- To understand the effect of friction on equilibrium, laws of motion, kinematics of motion and the interrelationship.
- To make the students understand the properties of surfaces and solids, prediction of behaviour of particles and rigid bodies under motion.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply the basic concepts and laws of mechanics for solving force system in 2D and 3D.	**K3**
CO2	Calculate the reaction forces and moments of 2D rigid bodies by applying equilibrium concept.	**K3**
CO3	Calculate the centroid and centre of gravity of surfaces and objects.	**K3**
CO4	Calculate the displacement, velocity and acceleration of particles and objects in rectilinear and curvilinear motion.	**K3**
CO5	Apply the friction laws and concepts to solve the motion of rigid bodies in translational and rotation.	**K3**

Course Contents

Unit I BASICS AND EQUILIBRIUM OF PARTICLES 9

Introduction-Units and Dimensions-Laws of Mechanics– Parallelogram Law of forces - principle of transmissibility Resolution and Resultant of Coplanar concurrent Forces- Equilibrium of a particle in two dimensions– Free Body Diagram- Lamis Theorem - Forces In Space-Resultant and Equilibrium of particles in space (vector approach).

Unit II EQUILIBRIUM OF RIGID BODIES 9

Moment of a force -Varignon's theorem - Equivalent system of forces – Reduction of system of forces into single force and couple - Type of supports and reaction - Equilibrium of rigid bodies in two dimensions

Unit III PROPERTIES OF SURFACES AND SOLIDS 9

Centroid of Common Shapes of Area-Centroid and Area Moment of Inertia of Composite Areas (Rectangle, triangle, circle, quarter and semicircle) by using Standard formula. Papus - Guldinus Theorem only - Centre of gravity of 3D composite bodies by using standard formula - Parallel axis theorem and perpendicular axis theorem - Polar moment of inertia.

Unit IV DYNAMICS OF PARTICLES 9

Displacements, Velocity and acceleration - Rectilinear motion of particles - Motion of particles under Gravity - Curvilinear motion - Motion of projectile - Newton's laws of motion- D'Alembert's Principle - Work Energy Equation– Impulse and Momentum Equation - Impact of elastic bodies- Direct central impact.

Unit V FRICTION AND DYNAMICS OF RIGID BODIES 9

Types of Friction- Coulombs Law of Dry Friction - Impending motion, Angle of repose - Simple contact friction - Ladder friction. Kinematics of rigid bodies – Translation and Rotation of Rigid Bodies – General Plane motion.

Total Periods: 45

Text Books:

1. Ferdinand P. Beer, Russell Johnston E., "Vector Mechanics for Engineers: Statics and Dynamics". 12th Edition, 2016, Tata McGraw-Hill International Edition, Bangalore
2. Irving H. Shames, G. Krishna Mohan Rao., "Engineering Mechanics - Statics and Dynamics", 4th Edition, 1996, Pearson Education Asia Pvt. Ltd, New Delhi.

Reference Books:

1. Vela Murali, "Engineering Mechanics", 2nd Edition, 2018, Oxford University Press. New Delhi.
2. Kottiswaran N, "Engineering Mechanics - Statics and Dynamics", 8th Edition, 2017, Sri Balaji Publications, Chennai.
3. Rajasekaran S and Sankara subramanian G., "Engineering Mechanics", 1st Edition, 2018, Vikas Publishing House Pvt. Ltd. New Delhi.
4. Kumar D.S., "Engineering Mechanics", 5nd Edition, 2022, S.K. Kataria & Sons Publications, New Delhi.

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	-	-	-	-	-	-	1	3	1	2
CO2	3	3	2	-	-	-	-	-	-	-	1	3	1	2
CO3	3	2	2	-	-	-	-	-	-	-	1	3	2	2
CO4	3	2	2	-	2	-	-	-	-	-	1	2	2	3
CO5	3	3	3	2	-	-	-	-	-	-	1	2	3	2
Av	3	2.4	2.3	2	2	-	-	-	-	-	1	2.6	1.8	2.2
3 – High; 2 – Medium; 1– Low; - No correlation														

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U23MET04	ENGINEERING THERMODYNAMICS	L	T	P	C
		2	1	0	3

Pre-Requisites : Engineering Physics

Objectives:

- To familiarize the students to understand the fundamentals of thermodynamics
- To understand second law and entropy
- To Derive simple thermodynamic relations of ideal gases
- To study the properties of pure substance and its use
- To understand the working of steam power plant

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Determine the property changes in thermodynamic system using the zeroth and first law of thermodynamics.	**K3**
CO2	Apply the second law of thermodynamics for studying the performance of thermal systems through energy and entropy concepts.	**K3**
CO3	Apply the thermodynamic relations to study the ideal and real gases	**K3**
CO4	Discuss the properties of pure substance using steam tables and Mollier charts	**K3**
CO5	Calculate the performance of simple steam power plants.	**K3**

Course Contents

Unit I BASICS, ZEROTH AND FIRST LAW 6+3

Basic concepts – Thermodynamic systems, Properties and process, Thermodynamic equilibrium, Displacement work, P – V Diagram, Zeroth law of Thermodynamics, Concept of Temperature, First law – application to closed and open systems – Steady and Unsteady flow process

Unit II SECOND LAW AND ENTROPY 6+3

Heat Engine, Refrigerator and Heat pump. Statements of second law and its corollaries. Carnot cycle, Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations - entropy change for pure substance

Unit III IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS 6+3

Properties of Ideal gas – Ideal and real gas comparison, Equations of state for ideal and real gases-Reduced Properties-Compressibility factor - Generalised Compressibility Chart - Maxwell relations, Tds Equations – heat capacity relations - Joule-Thomson Coefficient, Clausius Clapeyron equation.

Unit IV PROPERTIES OF PURE SUBSTANCE 6+3

Formation of steam and its thermodynamic properties, P-v, T-v, P-T T-s, h-s diagrams-Determination of dryness fraction. Calculation of work done and Heat transfer in non-flow and flow process processes using steam table and mollier chart.

Unit V STEAM BOILERS AND VAPOUR POWER CYCLES 6+3

Steam Boilers – Nozzle - Turbine – Condenser – Pumps – Ideal and actual Rankine cycle – Cycle improvement methods - Reheat cycle and Regenerative cycle (Theory only) using steam table and mollier chart

Total Periods 45

Text Books:

1. Nag P.K, "Engineering Thermodynamics", 6th Edition, 2017, Tata McGraw – Hill Publishing Company Limited, Bangalore.
2. Yunus A Cengel , Michael A Boles " Thermodynamics" , 10th Edition, 2022 McGraw – Hill Publishing Company Limited, Bangalore.

Reference Books:

1. Holman J P "Thermodynamics", 4th Edition, 1998, McGraw – Hill Publishing Company Limited, Bangalore.
2. Natarajan E "Engineering Thermodynamics – Fundaments and Applications",2nd Edition, 2014, Anuragam Publications, Chennai.
3. Arora C.P "Thermodynamics", 3rd Edition, 2017, McGraw – Hill Publishing Company Limited, Bangalore.
4. Ganesan V "Internal Combustion Engines", 4th Edition, 2012, McGraw – Hill Publishing Company Limited, Bangalore.

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	2	-	-	-	-	-	-	1	2	3	3
CO2	3	3	2	2	-	-	-	-	-	-	1	2	3	2
CO3	3	2	2	-	1	-	-	-	-	-	1	2	3	1
CO4	3	2	2	2	-	-	-	-	-	-	1	2	3	2
CO5	3	3	3	3	-	-	-	-	-	-	1	2	3	3
Av	3	2.6	2.2	2.3	12	-	-	-	-	-	1	2	3	2.2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MET05	ENGINEERING MATERIALS AND METALLURGY	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To impart knowledge on the crystal and phase structures of metals/alloys
- To study the heat treatment process employed for various materials
- To learn about metallic and non-metallic materials with their applications
- To impart knowledge on testing and characterizing engineering materials
- To gain knowledge about composite and Nano materials

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the crystal structure and phase diagrams related to materials.	**K3**
CO2	Apply appropriate heat treatment processes to improve mechanical properties of the materials.	**K3**
CO3	Identify suitable metallic material for engineering applications.	**K3**
CO4	Demonstrate the procedure for conducting standard mechanical testing methods	**K3**
CO5	Explain the characteristics of the composite and non-metallic materials.	**K3**

Course Contents

Unit I INTRODUCTION **9**

Introduction to material science – Selection of materials, Gibbs phase rule, Constitution of alloys — Solid solutions, substitutional and interstitial — phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron — carbon equilibrium diagram, Microstructures. Classification of steel and cast Iron - microstructure, properties and application.

Unit II HEAT TREATMENT PROCESSES **9**

Introduction - Annealing - Full, Process, Stress relief, Recrystallisation and Spheroidizing – normalising, hardening and tempering - Isothermal transformation (TTT) diagrams – Cooling curves - CCR – CCT diagram - Hardenability, Jominy end quench test - Austempering, Martempering – Case hardening - Carburising, Nitriding, Cyaniding, Carbonitriding, Flame and Induction hardening.

Unit III METALLIC MATERIALS **9**

Classification, properties and applications of plain carbon steels and cast iron – effect of alloying elements on steel (Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels - HSLA and maraging steels - Copper and its alloys - Brass, Bronze and Cupronickel – Aluminium and its alloys – Bearing alloys – Nickel and Nickel alloys, Monel metal, Super alloys, Titanium and Titanium alloys,

Unit IV MECHANICAL TESTING METHODS **9**

Mechanical properties - stress strain curve for ferrous and non-ferrous alloys - Mechanism of plastic deformation, slip and twinning – types of fracture – Griffith theory - testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Rockwell and Vickers) - Impact test (Izod and Charpy) - Fatigue and creep tests.

Unit V COMPOSITES AND NON-METALLIC MATERIALS 9

Definition - classification - types of composite materials - Fabrication of metal and ceramic matrix composites – properties and uses. Polymers – types - Properties and applications of various polymers (PP, PS, PVC, PMMA, PET, ABS, PPO, PPS, PEEK, PTFE, Urea and Phenol formaldehydes)- Engineering Ceramics - Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON.

Total Periods: 45

Text Books:

1. Donald R. Askeland, Pradeep P. Fulay and Wendelin J.Wright, "Science and Engineering of Materials", 8th Edition, 2020, Cengage Learning India Pvt. Ltd, New Delhi.
2. William D. Callister, Jr. "Material Science and Engineering", Seventh Edition, 10th Edition, 2018, John Wiley & Sons Inc. New Delhi.
3. Raghavan V. "Materials Science and Engineering: A First course", 6th Edition, 2015, PHI Learning, Delhi.

Reference Books:

1. Van Vlack, "Elements of Material Science and Engineering", 6th Edition, 1989, Pearson Education India, New Delhi.
2. Askeland, Fulay, Wright, and Balani, "The Science of Engineering and Materials", 8th Edition, 2020, Cengage learning India Pvt Ltd, New Delhi.
3. Kenneth G Budinski and Michael K Budinski, "Engineering Materials: Properties and Selection", 9th Edition, 2010, PHI learning private limited, Delhi.

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1	1	-	-	1	-	-	1	-	1	2	1	2
CO2	3	1	2	2	2	-	-	-	-	1	-	3	1	3
CO3	3	1	2	2	2	1	1	-	-	1	-	3	2	3
CO4	3	1	3	3	3	-	-	1	-	1	-	2	1	3
CO5	3	1	3	2	2	2	1	1	1	1	1	3	2	3
Av	3	1	2	2	1.2	1.2	1	1	1	1	1	2.6	1.4	2.4
3 – High; 2 – Medium; 1– Low; - No correlation														

		L	T	P	C
U23MCT01	**FLUID MECHANICS AND MACHINERY**	**3**	**0**	**0**	**3**

Pre-Requisites : None

Objectives:

- To understand the properties of fluids and principles of fluid statics.
- To learn the behavior of fluids under rest and motion using fundamental equations.
- To explore the concepts of dimensional and model analysis for real-world applications.
- To study the principles and performance of hydraulic turbines and pumps for engineering applications.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Describe fluid properties and explain pressure measurement methods used in static fluid systems.	**K3**
CO2	Analyze fluid motion using kinematic and dynamic equations and apply Bernoulli's principle in real time pipe flow problems.	**K3**
CO3	Apply dimensional analysis techniques to derive empirical relationships and develop models using similitude principles.	**K3**
CO4	Construct velocity triangles and analyze the performance characteristics of hydraulic turbines for power generation.	**K3**
CO5	Determine discharge, efficiency and work done of pumps and analyze the performance of centrifugal and reciprocating pumps in fluid systems.	**K3**

Course Contents

Unit I FLUID PROPERTIES AND PRESSURE MEASUREMENT 9

Units and Dimensions – Fluid properties – Density, Specific gravity, Viscosity, Surface tension, Capillarity, Compressibility and Bulk modulus –Newton's law of viscosity- Pascal's Law – pressure measurements – Buoyancy and meta-centre - Fluid statics - Total pressure and centre of pressure on submerged surfaces

Unit II FLUID KINEMATICS AND DYNAMICS 9

Types of fluid flow and flow lines – concept of continuum and control volume – continuity equation in one-dimension and three dimension – velocity potential and stream function -Energy equation – Euler and Bernoulli's equations – Laminar and Turbulent flow through pipes – Hagen Poiseuille's equation- Major and Minor Energy Losses- Darcy Weisbach formula- applications

Unit III DIMENSIONAL AND MODEL ANALYSIS 8

Need for dimensional analysis – Dimensional Homogeneity – Rayleigh's and Buckingham methods of dimensional analysis –Problems. Model and Prototype- Model study and Similitude – scale effects and distorted model.

Unit IV HYDRAULIC TURBINES 10

Impact of Jets- Euler's equation- Theory of rotodynamic machines- General layout of a hydro electric power plant-Velocity components at the entry and exit of the rotor- Classification of turbines-Axial, Radial and mixed flow turbines- – construction, working principles, Velocity triangles and design of Pelton wheel,

Francis and Kaplan Turbines - head, losses, work done and efficiency - specific speed – operating characteristics - Governing of Turbines – Problems.

Unit V PUMPS 9

Classification of pumps - Centrifugal pump - working principle and Velocity triangle - discharge, work done and efficiencies – Gear oil and Multistage pumps - Reciprocating pumps - work done and efficiencies –Problems- working principle of Gear-oil pump and Vane pump-Applications.

Total Periods: 45

Text Books:

1. Bansal R.K, "A textbook of Fluid Mechanics and Hydraulic Machines", 9th Edition, 2015, Laxmi Publications, New Delhi.
2. Rajput. R. K, "A text Book of Fluid Mechanics and Machinery", Revised Edition, 2019, S. Chand and Company, New Delhi.

Reference Books:

1. Yunus A Cengel and John M Cimbala, "Fluid Mechanics", 4th Edition, 2018, McGraw Hill Education (India) Pvt Ltd, Bangalore.
2. Kumar. K.L, "Engineering Fluid Mechanics", Revised Edition, 2009, S. Chand and Company, New Delhi
3. Streeter, Victor L. and Wylie, E. Benjamin, "Fluid Mechanics", 9th Edition, 1998, McGraw Hill, Bangalore.
4. Hibbler R.C, "Fluid Mechanics", 3rd Edition, 2022, Pearson India Pvt Ltd., Delhi.

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	-	-	-	-	-	-	-	1	1	2	1
CO2	3	2	-	1	1	-	-	-	-	-	1	1	3	2
CO3	3	3	2	3	2	-	-	-	-	-	1	2	2	3
CO4	2	1	-	-	1	-	-	-	-	-	1	1	3	2
CO5	2	1	-	-	1	-	-	-	-	-	1	1	3	2
Av	2.4	1.6	2	2	1.25	-	-	-	-	-	1	1.2	2.6	2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MET06	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To illustrate the working principles of various metal casting and metal joining processes.
- To analyse the working principles of bulk deformation and sheet metal forming processes.
- To study the concepts and basic mechanics of metal cutting and the factors affecting machinability
- To learn working of basic and advanced conventional machine tools.
- To study the basic concepts of CNC machine tools construction and its programming.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the principle of metal casting processes and metal joining processes including their defects and remedies.	**K2**
CO2	Compare the bulk deformation and sheet metal processes based on working conditions and material behaviour.	**K2**
CO3	Apply the mechanism of metal removal process to identify the factors involved in improving machinability.	**K3**
CO4	Demonstrate the operations of conventional machine tools and surface finishing processes through suitable applications	**K3**
CO5	Apply basic CNC programming concepts to generate part programs for simple turning and milling operations using G and M codes.	**K3**

Course Contents

Unit I METAL CASTING AND JOINING PROCESSS 9

Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Moulding sand Properties - Moulding machines – Types and applications - Shell moulding – Investment casting - Pressure die casting – Centrifugal Casting – Defects in Sand casting process-remedies. Fusion welding processes – Arc welding– TIG and MIG Welding- Submerged arc welding – Electro slag welding– Spot welding Process -Laser beam Welding – Thermit Welding - Weld defects and remedies – Brazing - soldering – Adhesive bonding.

Unit II BULK DEFORMATION AND SHEET METAL PROCESSES 9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – Rolling of metals – Rolling Mill stands– shape rolling operations – Defects in rolled parts – Wire drawing – Hot and Cold extrusion. Sheet metal characteristics – Typical shearing, bending and drawing operations – Formability of sheet metal – Hydro forming – Rubber pad forming – Metal spinning – Explosive forming- Super plastic forming.

Unit III MECHANICS OF METAL CUTTING- 9

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

Unit IV MACHINE TOOL OPERATIONS AND FINISHING PROCESSES 9

Turning Machine operations - Drilling Machine operations - Shaper machine operations – Planar machine operations – Milling Machine operations- Gear cutting operations: Gear shaping and Gear hobbing - Grinding processes: cylindrical grinding, surface grinding, centreless grinding - Grinding wheel specifications – Honing- Lapping – Super Finishing- Polishing - Buffing.

Unit V CNC MACHINE TOOLS AND PROGRAMMING 9

Computer Numerical Control (CNC) machine tools, constructional details, special features – Drives, Recirculating ball screws, tool changers; CNC Control systems – Open/closed, point-to point/continuous - Turning and machining centres. Coordinates: Absolute vs Incremental, Interpolators, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers.

Total Periods: 45

Text Books:

1. Rao P.N. “Manufacturing Technology: Volume 1 & 2”, 5th edition,2018, Mc Graw Hill Education India Ltd., Bangalore.
2. Michael Fitzpatrick, “Machining and CNC Technology”, 3rd edition, 2013, McGraw-Hill Education India Ltd, Bangalore.

Reference Books:

1. Kalpakjian. S, “Manufacturing Engineering and Technology”, 8th Edition, 2020, Pearson Education India Edition, New Delhi.
2. Hajra Chouldhary S.K and Hajra Choudhury. A.K., “Elements of workshop Technology, volume I and II”, 16th Edition, 2023, Media promoters and Publishers Private Limited, Mumbai.
3. Sharma, P.C., “A Text book of Production Technology”, Revised Edition, 2014, S. Chand and Co. Ltd, New Delhi.
4. Chattopadhyay A.B. “Machining and Machine Tools”, 2nd edition 2017, Wiley India Pvt Ltd, New Delhi.

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Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	1	-	-	-	-	-	-	1	-	-
CO2	3	-	-	-	1	-	-	-	-	-	-	2	-	-
CO3	3	-	-	-	3	-	-	-	-	-	-	2	-	-
CO4	3	-	-	-	2	-	-	1	-	-	-	3	-	-
CO5	3	-	-	-	3	-	-	1	-	-	1	3	-	1
Av	3	-	-	-	2	-	-	1	-	-	1.0	2.2	-	1.0-
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEP03	COMPUTER AIDED MACHINE DRAWING LABORATORY	L	T	P	C
		0	0	4	2

Pre-Requisites : None

Objectives:

- To understand and apply the principles and standards of machine drawing, concepts of limits, fits, geometric dimensioning, and tolerances while preparing drawings.
- To prepare 2D drawings and 3D modelling of various mechanical components and assemblies using CAD software packages.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Apply BIS standards and code of practice in preparing machine drawings, including limits, fits, tolerances, and geometric dimensioning.	**K3**
CO2	Construct 2D part and assembly drawings of simple machine components using cad software.	**K3**
CO3	Create 3D models of simple machine components and generate orthographic/isometric views with proper sectioning and Bill of Materials	**K3**

Course Contents

1.	**Basics of Machine Drawing** Code of practice for Engineering Drawing, BIS specifications, Classification of Machine Drawings	**3**
2.	**Limits, Fits and Tolerances** Fundamentals of Limits & Fits, Geometric Dimensioning & Tolerances.	**3**
3.	**Symbols** Welding symbols, riveted joints, keys, fasteners. Machining symbols - surface finish indication - Functional and manufacturing datum.	**4**
4.	**Detailed part drawings (2D Drafting)** Preparation of detailed parts drawings of the following *Flange coupling, Universal and Oldham couplings, Plummer Block, Footstep bearing, etc*	**16**
5.	**Creation of machine assembly drawings (2D Drafting)** Preparation of part and assembly drawings *Safety valve, Knuckle joint, screw jack.*	**16**
6.	**Part Modeling of machine components (3D Modeling)** Creating standard machine components *Shaft, Pulleys for flat and V- rope, Bracket.*	**8**
7.	**Detailed Drawing of Assembly** Creation of Orthographic, Isometric and Section views. Applying Bill of Material concept. *Stuffing box, Steam engine crosshead, machine vice, etc*	**10**
	Total Periods:	**60**

Text Books:

1. Gopalakrishna K.R., "Machine Drawing", 18th Edition, 2004, Subhas Stores Books Corner, Bangalore.
2. Bhatt N. D and Panchal V.M, "Machine Drawing", 51st Edition, 2022, Charator Publishers, Anand, Gujarat.
3. Siddeshwar N, Kanniah P, Sastri V.V. S, "Machine Drawing", 2017, Tata McGraw Hill India Pvt Ltd, Bangalore.
4. Trymbaka Murthy S. "A Text Book of Computer Aided Machine Drawing", 2nd Edition, 2019, Medtech Publishers, New Delhi.

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	3	-	2	1	1	-	1	-	-	1	-	2
CO2	2	1	3	-	3	1	-	-	1	-	-	2	-	3
CO3	2	1	3	-	3	-	-	-	2	-	-	2	-	3
Av	2	1	3	-	2.7	0.7	0.3	-	1.3	-	-	1.7	-	2.7
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEP04	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	2

Pre-Requisites : None

Objectives:

- Demonstration and study of the various manufacturing processes.
- Study of various General-Purpose Machine Tools.
- Study of various Special Purpose Machine Tools.
- Understanding of machine tool capabilities.
- Complete understanding of various grinding and abrasive processes.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Select appropriate tools, equipment and machines to complete a given job.	**K3**
CO2	Apply various machining operations using different machine tools.	**K3**
CO3	Perform a machining operation using a CNC Turning Centre.	**K3**

LIST OF EXPERIMENTS:

1. Fabricating simple structural shapes using Gas / Metal Arc Welding machine.
2. Preparing green sand moulds with wooden patterns.
3. Taper Turning /Eccentric Turning on circular parts using lathe machine.
4. Knurling /external / internal thread cutting on circular parts using lathe machine.
5. Shaping – Square /Hexagonal Heads on circular parts using shaper machine.
6. Drilling and Reaming using vertical drilling machine.
7. Milling contours on plates using vertical milling machine.
8. Cutting spur gear using milling machine.
9. Generating gears using gear hobbing machine.
10. Grinding components using surface / cylindrical / centreless grinding machines.
11. Cutting force calculation using dynamometer in lathe machine
12. Machining of a component using CNC Turning Centre.

Total Periods: 60

EXPERIMENTS THAT MAY BE PERFORMED THROUGH VIRTUAL LABS:

S.No	Experiment Name	Experiment Link(s)
1	Welding Shop (Arc/Gas Welding)	http://mmcoep.vlabs.ac.in/LaserSpotWelding/Theory.html?domain=Mechanical%20Engineering&lab=Welcome%20to%20Micromachining%20laboratory
2	Foundry and Casting	https://mp-dei.vlabs.ac.in/List%20of%20experiments.html
3	Machining Operations	https://fab-coep.vlabs.ac.in/exp/computer-controlled-cutting/theory.html

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	-	-	1	-	1	-	2	-	-
CO2	3	-	-	-	-	-	-	1	-	1	-	2	-	-
CO3	3	-	-	-	1	-	-	1	-	1	1	3	-	-
Av	2.7	-	-	-	1.0	-	-	1.0	-	1.0	1.0	2.3	-	-
3 – High; 2 – Medium; 1– Low; - No correlation														

Semester IV

U23MET07	FLUID POWER SYSTEMS AND CONTROL	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

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

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the basic concepts, properties, and principles of fluid power systems and the construction and working of hydraulic pumps.	**K2**
CO2	Illustrate the construction, types, and applications of hydraulic actuators, control valves, and system accessories.	**K2**
CO3	Apply hydraulic components and circuits to operate industrial systems using accumulators, intensifiers, servo, and proportional valves..	**K3**
CO4	Develop pneumatic and electro-pneumatic circuits using appropriate air preparation methods and control components for industrial applications.	**K3**
CO5	Implement the selection, maintenance, and troubleshooting of hydraulic and pneumatic systems for industrial automation with IoT integration.	**K3**

Course Contents

Unit I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 9

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

Unit II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

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

Unit III HYDRAULIC CIRCUITS AND SYSTEMS 9

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

Unit IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

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

Unit V TROUBLE SHOOTING AND APPLICATIONS 9

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

Total Periods: 45

Text Books:

1. Anthony Esposito, "Fluid Power with Applications", 7th Edition, 2013, Pearson Education Limited, London, UK.
2. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, 1998, Prentice Hall , USA.

Reference Books:

1. Shanmuga sundaram.K., "Hydraulic and Pneumatic Controls". 2006, S. Chand & Co, New Delhi.
2. Srinivasan R. "Hydraulic and Pneumatic Controls", 3rd edition, 2019, Vijay Nicole Imprints, Chennai.
3. Majumdar, S.R., "Oil Hydraulics Systems – Principles and Maintenance", First Edition, 2017, McGraw Hill, Bangalore.
4. Joshi. P., "Pneumatic Control", 2017, Wiley India Pvt Ltd, New Delhi.

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	-	2	1	-	-	-	-	-	-	2	1
CO2	3	2	2	-	2	1	-	-	-	-	-	-	2	1
CO3	3	2	3	-	3	1	-	1	-	1	-	1	2	2
CO4	3	2	2	-	2	1	-	-	-	-	-	-	2	1
CO5	3	3	2	1	2	2	-	-	-	-	1	1	2	1
Av	3.0	2.2	2.2	0.2	2.2	1.2	-	0.2	-	0.2	0.2	0.4	2.0	1.2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MET08	METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

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

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the need for measurement, sources of errors, uncertainty estimation, and calibration procedures in accordance with ISO standards.	**K2**
CO2	Describe the construction, working, and applications of linear and angular measuring instruments used in precision measurement.	**K2**
CO3	Apply appropriate methods to measure screw thread elements and gear parameters for functional and analytical evaluation.	**K3**
CO4	Apply the principles of GD&T and surface measurement techniques to evaluate form deviations, fits, and functional tolerances in mechanical components.	**K3**
CO5	Implement latest metrology techniques for precision inspection and process monitoring in manufacturing.	**K3**

Course Contents

Unit I BASICS OF METROLOGY 9

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

Unit II MEASUREMENT OF LINEAR AND ANGULAR DIMENSIONS 9

Linear Measuring Instruments – Vernier calliper, Micrometer, Vernier height gauge, Depth Micrometer, bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector – Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor.

Unit III MEASUREMENT OF TRANSMISSION ELEMENTS 9

Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.

Unit IV METROLOGY OF SURFACES AND TOLERANCING 9

Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations- Measurement of Surface finish – Functionality

of surfaces, Comparative, Stylus based and Optical Measurement techniques. Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits.

Unit V ADVANCES IN METROLOGY 9

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

Total Periods: 45

Text Books:

1. Raghavendra N.V. and Krishnamurthy. L., "Engineering Metrology and Measurements", 2013, Oxford University Press India Ltd, Noida.
2. Dotson Connie, "Dimensional Metrology", 6th edition, 2016. Cengage Learning India Pvt Ltd, Delhi.
3. Venkateshan, S. P., "Mechanical Measurements", Second edition, 2021, Springer Nature India Pvt. Ltd. New Delhi.

Reference Books:

1. Ammar Grous, J "Applied Metrology for Manufacturing Engineering", 2011, Wiley India Ltd, New Delhi.
2. Galyer, J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", 5th revised edition 1990, Cengage Learning, uK.
3. Mark Curtis, Francis T. Farago, "Handbook of Dimensional Measurement", Fifth edition, 2013, Industrial Press, USA.

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	-	-	-	-	-	-	3	1	2
CO2	3	-	-	-	-	-	-	-	-	-	-	3	1	2
CO3	3	-	-	-	-	-	-	-	-	-	-	3	1	3
CO4	3	2	-	1	-	-	-	-	-	-	-	3	1	3
CO5	3	2	-	1	-	-	-	1	-	-	1	3	1	2
Av	2.7	2	-	1	-	-	-	1	-	-	1	3	1	2.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MET09	MECHANICS OF SOLIDS	L	T	P	C
		2	1	0	3

Pre-Requisites : Engineering Mechanics

Objectives:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply the concepts of stress, strain, and material properties to calculate deformation and principal stresses in structural elements.	**K3**
CO2	Apply the principles of shear force, bending moment, and bending theory to calculate stresses and load-carrying capacity in various types of beams	**K3**
CO3	Determine the stresses, deformations, and power transmission in shafts and helical springs using torsion and spring theories.	**K3**
CO4	Determine slope and deflection of beams using appropriate methods.	**K3**
CO5	Calculate stresses and deformations in thin and thick cylinders and spherical shells subjected to internal pressure using appropriate theories.	**K3**

Course Contents

Unit I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses - Deformation of simple and compound bars – Thermal stresses – Elastic constants - Volumetric strains – Stresses on inclined planes – Principal stresses and principal planes – Mohr's circle of stress.

Unit II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beams – Types - Transverse loading on beams – Shear force and Bending moment in beams – Cantilever, simply supported and over hanging beams. Theory of simple bending – Bending stress distribution – Load carrying capacity – Shear stress distribution

Unit III TORSION 9

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

Unit IV DEFLECTION OF BEAMS 9

Elastic curve – Governing differential equation - Double integration method - Macaulay's method – Area moment method - Conjugate beam method for computation of slope and deflection of determinant beams.

Unit V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses - Deformation in thin cylinders – Spherical shells subjected to internal pressure – Deformation in spherical shells – Thick cylinders - Lame's theory.

Total Periods: 45

Text Books:

1. Beer. F.P. and Johnston. E.R. “Mechanics of Materials”, 8th Edition, 2020, McGraw Hill India Pvt Ltd, Noida, UP.
2. Rajput R.K. “Strength of Materials (Mechanics of Solids)", 7th Edition, 2018, S.Chand & company Ltd., New Delhi.
3. Rattan S.S., “Strength of Materials", 2017, McGraw Hill India Pvt Ltd, Noida, UP.

Reference Books:

1. Singh. D.K., “Strength of Materials”, 2014, Ane Books Pvt Ltd., New Delhi.
2. Egor P Popov, “Engineering Mechanics of Solids”, 2nd edition, 2010, PHI Learning Pvt. Ltd., New Delhi.
3. Vazirani. V.N, Ratwani. M.M, Duggal. S.K “Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1”, 1999, Khanna Publishers, New Delhi.

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3. https://nptel.ac.in/courses/112107146

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	1
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	1
CO3	3	2	3	-	1	-	-	-	-	-	-	1	-	2
CO4	3	2	2	-	1	-	-	-	-	-	-	-	-	1
CO5	3	3	2	1	-	-	-	-	-	-	-	-	1	1
Av	3.0	2.2	2.0	1	1	-	-	-	-	-	-	1	1	1.2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MET10	THERMAL ENGINEERING	L	T	P	C
		3	0	0	3

Pre-Requisites : Engineering Thermodynamics

Objectives:

- To learn the concepts of air standard cycles and working and performance parameters of IC engines.
- To study the fundamentals of compressible flow concepts and the use of gas tables.
- To study the types of jet engines and their performance parameters.
- To impart knowledge on working principles and performance of air compressors, fans and blowers.
- To study the working principle of refrigeration and air conditioning systems

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Calculate the performance parameters of air standard cycles and working principle and performance parameters of IC Engines.	**K3**
CO2	Apply flow equations and gas tables to evaluate isentropic flow in nozzles, diffusers, and ducts.	**K3**
CO3	Explain the types of jet engines and their performance parameters.	**K2**
CO4	Explain the working principles, classifications, and applications of reciprocating and rotary air compressors, fans, and blowers.	**K2**
CO5	Apply the concepts of thermodynamics in refrigeration and air conditioning system.	**K3**

Course Contents

Unit I AIR STANDARD CYCLES AND INTERNAL COMBUSTION ENGINES 10

Air standard assumptions, cycles - Otto, Diesel and Dual cycles, Calculation air standard efficiency. Classification - working principle of four stroke and two stroke engines. Fuel Injection systems – MPFI - Ignition systems – Battery- Lubrication and Cooling systems. Performance parameters and calculations and Heat Balance test.

Unit II GAS DYNAMICS 9

Isentropic flow through variable area ducts – Nozzle and Diffusers –area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles. Use of Gas tables. Fanno flow equation and Raleigh flow equation.

Unit III PROPULSION 8

Jet propulsion -Turbo propeller, turbo jet engine, ramjet and scramjet. Performance calculation of ram jet and turbojet engines. Rocket propulsion - solid and liquid propellants (Description only).

Unit IV AIR COMPRESSOR, FANS AND BLOWERS 9

Classification - reciprocating air compressor - working principle, work of compression with and without clearance, various efficiencies of reciprocating air compressors. Multistage air compressor and inter cooling (Description only), Rotary compressors and centrifugal compressor (Description only). Fans & blowers - Types and its industrial applications.

Unit V REFRIGERATION AND AIR-CONDITIONING 9

Vapour compression refrigeration cycle - superheat, sub cooling, performance calculations. Working Principle of Vapour Absorption System – NH3-H2O (Description only) - Steam jet refrigeration. Psychrometry – Psychrometric properties, processes and chart – heating and cooling load calculations (Simple Problems). Types of air conditioning systems - Summer and winter air conditioning systems.

Total Periods: 45

Text Books:

1. Rajput R.K. "Thermal Engineering". 10th Edition, 2015, Laxmi Publications, New Delhi.
2. Kothandaraman. C.P., Domkundwar. S, Domkundwar. A.V., "A course in Thermal Engineering", Revised Edition, 2016, Dhanpat Rai & sons, New Delhi.

Reference Books:

1. Rudramoorthy, R, "Thermal Engineering ",2003, McGraw-Hill, New Delhi.
2. Ganesan V. "Internal Combustion Engines", Fourth Edition, 2012, McGraw-Hill, New Delhi.
3. Ballaney. P, "Thermal Engineering", 25th Edition, 2017, Khanna Publishers, New Delhi.
4. Sadhu Singh. "Thermal Engineering". 1st Edition, 2018, Pearson Education, Noida.
5. Yahya, S. M., "Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion", Sixth edition, 2018, New Age International Publishers, New Delhi.
6. Arora C P , "Refrigeration and Air-conditioning", 2017, McGraw Hill India, New Delhi.

Web URL(s):

1. https://nptel.ac.in/courses/112103316
2. https://onlinecourses.swayam2.ac.in/nou23_es04/preview
3. https://archive.nptel.ac.in/courses/112/103/112103307/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	1	-	-	-	-	-	-	1	2	3	2
CO2	3	3	1	1	-	-	-	-	-	-	1	1	3	2
CO3	2	3	1	1	-	-	-	-	-	-	1	1	3	2
CO4	2	2	1	1	-	-	-	-	-	-	1	1	3	2
CO5	3	1	1	1	-	-	-	1	-	-	1	2	3	2
Av	2.6	2.2	1	1	-	-	-	-	-	-	1	1.4	3	2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEP05	THERMAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

Pre-Requisites : None

Objectives:

- To study the valve timing and port timing diagram.
- To understand the basic concepts and working of IC engines.
- To study the characteristics of fuels/Lubricants used in IC engines.
- To study the principle of air compressor.
- To study the Performance of refrigeration and Air-conditioning systems.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply the various performance parameters of Internal Combustion Engines.	**K3**
CO2	Determine the properties of fuels and lubricating oils.	**K3**
CO3	Analyze the performance of air compressors, Refrigeration and Air-conditioning systems. .	**K4**

List of Exercises:

1. Draw the Valve and Port Timing diagrams.
2. Experimental study on performance test of 4-Stroke diesel engine.
3. Experimental study on heat balance test of 4-Stroke diesel engine.
4. Morse Test on Multi-Cylinder Petrol Engine.
5. Retardation Test on a Diesel Engine.
6. Determination of Flash Point and Fire Point of various fuels / lubricants.
7. Determination of Viscosity of lubricants using Redwood viscometer.
8. Performance test on a two stage Reciprocating Air compressor.
9. Experimental study on determination of Coefficient of Performance of refrigeration.
10. Experimental study on determination of Coefficient of Performance of Air-conditioning system.
11. Study of data acquisition system for engine experiments.

Total Periods: 60

EXPERIMENTS THAT MAY BE PERFORMED THROUGH VIRTUAL LABS:

S.No	Experiment Name	Experiment Link(s)
1	Heat Transfer Lab	https://ht-nitk.vlabs.ac.in/List%20of%20experiments.html

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	-	1	2	-	-	-	-	-	1	3	1
CO2	3	2	1	-	-	2	-	-	-	-	-	-	3	-
CO3	3	3	2	1	1	2	-	-	-	-	1	1	3	1
Av	3.0	2.3	1.7	0.3	0.7	2.0	-	-	-	-	0.3	0.7	3.0	0.7
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEP06	STRENGTH OF MATERIALS AND FLUID MACHINERY LABORATORY	L	T	P	C
		0	0	4	2

Pre-Requisites : None.

Objectives:

- To study the mechanical properties of metals and springs.
- To study the characteristics of fluids, pumps and turbines.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Determine the mechanical properties of various metals by testing	**K4**
CO2	Apply the conservation laws to determine the coefficient of discharge of a venturi meter and finding the friction factor of given pipe	**K4**
CO3	Determine the performance characteristics of turbine and positive displacement pump.	**K4**

LIST OF EXPERIMENTS

STRENGTH OF MATERIALS LABORATORY

1. Hardness test on metal (Rockwell and Brinell Hardness)
2. Torsion test on mild steel rod
3. Deflection test on a metal beam.
4. Compression test on helical spring
5. Impact Test on a mild steel rod (Izod / Charpy)
6. Tension test on mild steel rod

FLUID MECHANICS AND MACHINES LABORATORY

1. Determination of the Coefficient of discharge of given Venturi meter.
2. Determination of Friction factor for a given set of pipes.
3. Drawing the characteristic curves of Centrifugal pump
4. Drawing the characteristic curves of Submersible pump
5. Drawing the characteristic curves of Pelton wheel turbine
6. Determination of the Coefficient of discharge of given Orifice meter.

Total Periods: 60

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	3	2	1	-	-	1	1	2	3	1	2
CO2	3	3	2	3	2	1	-	-	1	1	2	2	3	2
CO3	3	3	2	3	2	1	-	-	1	1	2	2	3	2
Av	3	3	2	3	1	`	-	-	1	1	2	2.3	2.3	2
3 – High; 2 – Medium; 1– Low; - No correlation														

Semester V

U23MET11	HEAT AND MASS TRANSFER	L	T	P	C
		2	1	0	3

Pre-Requisites : Engineering Thermodynamics

Note : Use of Heat and Mass Transfer Data Book is permitted

Objectives:

- To study the various modes of heat transfer and its applications.
- To enable the students to understand the free and forced convection concepts.
- To acquire knowledge about radiation laws and its applications.
- To learn the theory of phase change heat transfer and heat exchangers.
- To develop the basic concept and diffusion, convective mass transfer.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Apply the heat conduction equation to compute the rate of heat transfer composite systems and extended surfaces	**K3**
CO2	Examine the fundamental concept and principles in convective heat transfer.	**K3**
CO3	Apply the basic laws for radiation and its principles to radiative heat transfer between different types of surfaces to solve problems.	**K3**
CO4	Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems.	**K3**
CO5	Apply diffusive and convective mass transfer equations and correlations to solve mass transfer related problems.	**K3**

Course Contents

Unit I CONDUCTION **9**

Basic modes of heat transfer - One Dimensional steady state conduction in simple geometries - plane wall and cylindrical. Composite systems – Composite cylinder and Wall. Extended surfaces – Fin effectiveness and efficiency.

Unit II CONVECTION **9**

Basic concepts - Heat transfer coefficients, Boundary layers. Forced convection – External flow – Plates and Cylinders, Internal flow – Cylinders, Natural convection – Flow over vertical and horizontal Plates.

Unit III RADIATION **9**

Basic Concepts - laws of radiation – Planck, Stefan-Boltzmann, Wein's displacement, Kirchhoff's law - Black and Grey body radiation - Radiation heat transfer between surfaces, shape factor -Electrical analogy - radiation shields.

Unit IV PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS **9**

Boiling: Modes - correlations. Condensation: Nusselt theory, correlations. Types of heat exchangers - heat exchanger analysis, LMTD and Effectiveness - NTU Method. Introduction of heat pipe and compact heat exchanger.

Unit V MASS TRANSFER **9**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

Total Periods 45

Text Books:

1 Yunus A. Cengel, "Heat and Mass Transfer: Fundamentals and Application", 6th edition, 2020, McGraw Hill publishing Company I*ndia* private limited, New Delhi.
2 S.P. Venkateshan, "Heat Transfer", 3rd Edition, 2021, Ane Books Ltd, New Delhi.

Reference Books:

1. J. P. Holman, "Heat Transfer", 10th Edition,2010, McGraw Hill publishing Company India private limited, New Delhi.
2 Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", 7th edition, 2011, John Wiley & Sons, USA
3 R. K. Rajput, "Heat and Mass Transfer", 7TH Edition, 2018, S Chand and Company, New Delhi.
4 Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", 3rd Edition, 2006, New Age International, New Delhi.
5 R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", 4th Edition, 2009, New Age International Publishers, New Delhi.
6 John H Lienhardd, John H Lienhard , "Heat Transfer Text Book", 6th Edition, 2024, Phlogiston Press, USA.

Web URL(s):

1. https://nptel.ac.in/courses/112101097
2. https://nptel.ac.in/courses/112108149

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1	1	1	2	-	-	-	-	-	2	3	2	1
CO2	3	1	1	1	2	-	-	-	-	-	2	3	2	1
CO3	3	1	1	1	2	-	-	-	-	-	2	3	2	1
CO4	3	1	1	1	2	-	-	-	-	-	2	3	2	1
CO5	3	1	1	1	2	-	-	-	-	-	2	3	2	1
Av	3	1	1	1	2	-	-	-	-	-	2	3	2	1
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MET12	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	1	0	4

Pre-Requisites : Engineering Mechanics and Mechanics of solids

Note ; Use of Standard and Approved Design data book is permitted

Objectives:

- To understand the design process and analyze stresses in machine elements under various loading conditions.
- To design shafts and couplings based on strength, rigidity, and critical speed.
- To design threaded, welded, riveted, and bonded joints for mechanical applications.
- To design springs, flywheels, connecting rods, and crankshafts considering energy storage and stress factors.
- To analyze and select suitable sliding and rolling contact bearings for machine components.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Apply the concepts of principal stresses, theories of failure, stress concentration and fatigue loading for engineering problems.	**K3**
CO2	Apply design methods to find the size and stress of shafts and couplings for given loads.	**K4**
CO3	Determine suitable joints for machine elements for specific applications.	**K3**
CO4	Select the dimensions of the energy storing devices for specific applications.	**K3**
CO5	Explain different type of bearing and select them for the required design.	**K3**

Course Contents

Unit I STEADY AND VARIABLE STRESSES IN MACHINE MEMBERS 9

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – curved beams – crane hook and „C" frame- Factor of safety - theories of failure – Design based on strength and stiffness – stress concentration – Design for variable loading.

Unit II SHAFTS AND COUPLINGS 9

Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys, key ways and splines - Rigid and flexible couplings.

Unit III TEMPORARY AND PERMANENT JOINTS 9

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints, riveted joints for structures - theory of bonded joints.

Unit IV ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9

Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods and crank shafts.

UNIT V BEARINGS 9

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi and Boyd graphs, -- Selection of Rolling Contact bearings.

Total Periods 45

Text Books:

1. Bhandari V, "Design of Machine Elements", 5th Edition, 2021, McGraw-Hill Education India Pvt Ltd, New Delhi..
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 9th Edition, 2011, McGraw-Hill Education India Pvt Ltd, New Delhi.

Reference Books:

1. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", 2010, McGraw-Hill Education India Pvt Ltd, New Delhi..
2. Bernard Hamrock, Steven Schmid,Bo Jacobson, "Fundamentals of Machine Elements",3rd Edition, 2014, CRC Press (Taylor & Francis Group, UK.
3. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 9th Edition, 2013, Pearson Education India, New Delhi.

Web URL(s):

1. https://youtu.be/3QzWuhSmO5Q?si=GNkh6VfJEQF_Zzyr
2. https://archive.nptel.ac.in/courses/112/105/112105125/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	-	-	1	-	-	-	-	-	-	-	2
CO2	3	3	3	-	2	1	-	-	-	1	-	1	-	3
CO3	3	2	3	-	1	-	-	-	-	-	-	1	-	3
CO4	3	2	3	-	1	-	-	-	-	-	-	1	-	3
CO5	3	2	3	-	1	-	-	-	-	-	-	1	-	3
Av	3.0	2.4	2.8	-	1.3	**1**	-	-	-	1	-	1	-	2.8
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MET13	MECHANICS OF MACHINERY	L	T	P	C
		2	1	0	3

Pre-Requisites : Engineering Mechanics

Objectives:

- To understand the basic principles of kinematics of mechanisms and perform velocity and acceleration analysis.
- To study the types of gears and gear trains and apply methods for analyzing their motion and torque transmission.
- To analyze force systems in machines using static and dynamic force analysis techniques.
- To understand the principles of balancing rotating and reciprocating masses and analyze various types of vibrations in mechanical systems.
- To explore the working, characteristics and applications of governors and gyroscopes in control mechanisms.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Understand the fundamentals of mechanisms and perform velocity and acceleration analysis.	**K2**
CO2	Apply gear terminology and gear train concepts to calculate velocity ratios and torque for various gear arrangements.	**K3**
CO3	Perform force analysis using static and dynamic force analysis in mechanisms.	**K3**
CO4	Solve problems related to static and dynamic balancing, and vibrations in mechanical systems to ensure smooth and stable operation.	**K3**
CO5	Determine the effects of governors and gyroscopic forces on speed regulation and stability in mechanical and automotive systems.	**K3**

Course Contents

Unit I BASICS OF MECHANISMS AND KINEMATICS 9

Mechanism - classification of mechanisms – Kinematic links – Kinematic pairs – Degrees of freedom – Grashof's law – Kinematic chains – Inversions – Four bar chain, single slider crank chain, double slider crank chain – Velocity analysis – Relative velocity method – Acceleration analysis – Coriolis component – Four bar mechanism - slider crank mechanism – Analytical and graphical methods.

Unit II GEARS AND GEAR TRAINS 9

Spur Gear terminology – Law of gearing – Types of gears – Gear tooth action — contact ratio — Interference and undercutting - Helical, Bevel, Worm, Rack and Pinion gears [Basics only] - Gear trains – Simple, compound, reverted and epicyclic gear trains – Gear train applications – Velocity ratio and torque calculations.

Unit III FORCE ANALYSIS 9

Applied Forces and Constrained Forces – Free body diagrams – Equilibrium Conditions-Statics and Dynamics – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – Dynamic Force Analysis in simple machine members

Unit IV BALANCING AND VIBRATION 9

Static and dynamic balancing – Balancing of rotating masses – Balancing of reciprocating masses – Single and multi-cylinder engines – Types of vibrations – Free and forced vibration – Damped vibration – Vibration isolation and transmissibility.

Unit V MECHANISM FOR CONTROL 9

Governors - Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction. Gyroscopes –Gyroscopic forces and torques – Gyroscopic effects in Automobiles, ships and airplanes.

Total Periods 45

Text Books:

1. R.S. Khurmi, "Theory of Machines", Revised Edition, 2005, S. Chand Publishing, New Delhi.
2. Rattan, S.S., "Theory of Machines", 5th Edition, 2019, McGraw Hill Education (India) Pvt. Ltd, New Delhi.

Reference Books:

1. Thomas Bevan, "Theory of Machines", 3rd Edition, 2005, CBS Publishers and Distributors, New delhi.
2. Shigley J.E and Uicker J.J., "Theory of Machines and Mechanisms", 5th Edition, 2017, Oxford University Press India Ltd, New Delhi.
3. Dr.R.K.Bansal and Dr.J. S. Brar, "A Text book of Theory of Machines", 5th Edition, 2020, Laxmi publications, New Delhi.

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1. https://archive.nptel.ac.in/courses/112/105/112105268/
2. https://archive.nptel.ac.in/courses/112/104/112104114/
3. https://onlinecourses.nptel.ac.in/noc20_me21/preview

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	2	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	2	-	-	-	-	-	-	-	3	-	-
CO3	3	3	2	3	-	-	-	-	-	-	-	3	2	2
CO4	3	3	2	3	-	-	-	-	-	-	-	3	2	2
CO5	3	3	2	3	2	-	-	-	-	-	-	3	2	2
Av	3	2.8	1.2	2.6	0.4	-	-	-	-	-	-	3	1.2	1.2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MET14	INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

Pre-Requisites : Basic Electrical and Electronics Engineering

Objectives:

- To understand the fundamentals and scope of industrial automation, smart sensors, and mechatronic systems.
- To explore the application of microcontrollers and embedded systems in automation.
- To learn industrial communication protocols and visualize control data using SCADA and HMI.
- To develop proficiency in programming and implementing Programmable Logic Controllers (PLCs).
- To integrate sensors, actuators, and controllers for real-time industrial applications using case-based learning.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Interpret the evolution, scope, and hierarchy of industrial automation along with the functionalities of smart sensors.	**K2**
CO2	Demonstrate the use of microcontrollers and embedded programming for automation tasks.	**K3**
CO3	Apply industrial communication protocols and develop interfaces using SCADA and HMI.	**K3**
CO4	Develop and troubleshoot ladder logic programs for PLC-controlled system	**K3**
CO5	Integrate components to build a functional automation system and analyze case studies of real-world applications.	**K3**

Course Contents

Unit I INTRODUCTION TO INDUSTRIAL AUTOMATION AND SMART SENSORS 9

Evolution and scope of Industrial Automation - Mechatronics and Automation: Key concepts and differences - Automation hierarchy (field level to enterprise level) - Types and characteristics of sensors - Smart sensors and IoT-enabled sensors (with examples: temperature, proximity, vision sensors) - Sensor calibration, signal conditioning, and interfacing basics

Unit II MICROCONTROLLER AND EMBEDDED SYSTEMS FOR AUTOMATION 9

Overview of modern microcontrollers (e.g., ARM Cortex, Arduino, ESP32) -Architecture and interfacing basics - Role of microcontrollers in automation systems - Interfacing sensors and actuators with microcontrollers - Introduction to Embedded C / Python for industrial automation

Unit III INDUSTRIAL COMMUNICATION AND HUMAN MACHINE INTERFACES (HMI) 9

Industrial communication protocols: MODBUS, PROFIBUS, CAN, OPC-UA - Basics of SCADA (Supervisory Control and Data Acquisition) - HMI: Architecture and usage - Integration of PLC, HMI, SCADA - Remote monitoring and data logging.

Unit IV PROGRAMMABLE LOGIC CONTROLLERS (PLC) 9

PLC architecture and working - Input/output modules and wiring - PLC Programming languages: Ladder Logic, Function Block Diagram - Programming elements: Timers, Counters, Data Handling - Interfacing

with field devices: Sensors, Motors, Valves - Case study using a standard PLC software (e.g., Siemens/TIA Portal or Allen Bradley)

Unit V ACTUATORS, SYSTEM INTEGRATION AND CASE STUDIES 9

Pneumatic, hydraulic, and electric actuators - Stepper and servo motors in automation - System integration: Combining sensors, controllers, HMIs, and actuators - Mechatronic and automated system design principles - Case studies: Smart conveyor systems, Industrial robotic arm. Automated warehouse system, Energy-efficient building automation

Total Periods 45

Text Books:

1. Mikell P. Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", 4th Edition, 202, Pearson Education India, New Delhi.
2. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, 2022, McGraw Hill, Bangalore.

Reference Books:

1. Stuart A. Boyer, "SCADA: Supervisory Control and Data Acquisition", 4th Edition, 2021, ISA, USA.
2. R. K. Rajput, "Industrial Automation and Robotics", 2019, S. Chand Publishing, New Delhi.
3. Tariq Samad and Thomas Parisini, "Automation for the Future: Toward a Smart and Sustainable Industry", 2020, Springer Nature India, New Delhi.
4. K. S. Fu, R. C. Gonzalez, and C. S. G. Lee, "Robotics: Control, Sensing, Vision, and Intelligence", 2020, McGraw Hill India, Bangalore.

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2. https://nptel.ac.in/courses/112103174
3. https://www.classcentral.com/course/swayam-design-of-mechatronic-systems-43582

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	1	-	2	2	-	-	-	-	1	3	1	2
CO2	2	2	2	-	3	1	-	1	-	-	2	3	-	2
CO3	2	2	2	-	3	1	-	1	1	1	1	3	-	3
CO4	2	3	2	1	3	-	-	1	-	-	1	3	-	2
CO5	3	3	3	2	3	2	-	2	1	2	2	3	1	3
Av	2.2	2.4	2.0	0.6	2.8	1.2	-	1.0	0.4	0.6	1.4	3.0	0.4	2.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEP07	AUTOMATION LABORATORY	L	T	P	C
		0	0	4	2

Pre-Requisites : None

Objectives:

- To understand the working principles and applications of actuators, transducers, and various sensors.
- To develop and analyze hydraulic, pneumatic, electro-pneumatic, and electrical circuits using hardware and simulation tools.
- To apply PLC, microprocessor programming, and interfacing techniques for automation and control, including image processing applications..

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply the working principles of sensors, actuators, and transducers to develop basic mechatronic system functions.	**K3**
CO2	Develop hydraulic, pneumatic, and electro-pneumatic circuits using conventional and software-based tools for automation tasks.	**K3**
CO3	Implement programmable logic controllers and microprocessor-based systems for motor control and basic industrial applications.	**K3**

List of Exercises:

1. Study of various types of actuators and transducers
2. Study of various types of sensors
3. Study of hydraulic, pneumatic and electro-pneumatic circuits
4. Study of PLC and its applications
5. Assembly language programming of 8085 – Addition – Subtraction – Multiplication Division – Sorting – Code Conversion.
6. Stepper motor interface
7. Speed control of AC & DC motor
8. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software

Total Periods: 60

EXPERIMENTS THAT MAY BE PERFORMED THROUGH VIRTUAL LABS:

S.No	Experiment Name	Experiment Link(s)
1	Sensors and Instrumentation Lab	https://sil-coep.vlabs.ac.in/List%20of%20experiments.html

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1	3	1	3	-	-	-	3	-	-	3	1	1
CO2	3	1	3	1	3	-	-	-	3	-	-	3	1	1
CO3	3	1	3	1	3	-	-	-	3	-	-	3	1	1
Av	3	1	3	1	3	-	-	-	3	-	-	3	1	1
3 – High; 2 – Medium; 1– Low; - No correlation														

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U23MEP08	METROLOGY AND DYNAMICS LABORATORY	L	T	P	C
		0	0	4	2

Pre-Requisites : None.

Objectives:

- To calibrate and measure linear, angular, and gear parameters using precision metrology instruments.
- To analyze and determine mechanical properties like torque, angles, and depth through standard measurement techniques.
- To study and evaluate dynamic behaviour of mechanical systems including vibrations, gyroscopic effects, and governor performance.
- To experimentally determine natural frequencies, damping characteristics, and critical speeds in mechanical systems.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Apply appropriate measuring instruments to accurately determine the dimensions of various engineering components.	**K3**
CO2	Analyze the performance of mechanical systems involved in speed regulation and vibration control.	**K4**
CO3	Evaluate the dynamic behavior of mechanical systems and validate the results through experimental data.	**K5**

LIST OF EXPERIMENTS

METROLOGY LABORATORY

1. Calibration of vernier calliper/micrometre using gauge blocks.
2. Measurement of given sample using vernier depth gauge.
3. Measurement using mechanical comparator.
4. Measurement of angles using sine bar.
5. Measurement of gear parameters using gear tooth vernier.
6. Measurement of torque.

DYNAMICS LABORATORY

1. Determine the radius of gyration of given compound pendulum.
2. Study of gyroscopic effect and couple using Motorized gyroscope.
3. Determination of range of speed and effort for Watts/ Porter/Proell/Hartnell Governors.
4. Determination of natural frequency and damping co-efficient of single degree of freedom spring-mass system.
5. Determine the natural frequency of simply supported beam having span lengths
6. Determination of critical speeds of shafts with concentrated loads.

Total Periods: 60

EXPERIMENTS THAT MAY BE PERFORMED THROUGH VIRTUAL LABS:

S.No	Experiment Name	Experiment Link(s)
1	Types of Governors	https://dom-nitk.vlabs.ac.in/List%20of%20experiments.html
2	Measurement of shaft torque	https://ic-coep.vlabs.ac.in/exp/shaft-torque/
3	Free Vibrations of Simply Supported Beam	https://mdmv-nitk.vlabs.ac.in/exp/exp-simply-supported-beam-nitk/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	2	-	-	-	-	-	1	3	-	2
CO2	3	1	1	1	2	-	-	-	-	-	-	3	-	2
CO3	3	1	3	1	2	-	-	-	-	-	-	3	-	3
Av	3	1	1	1	2	-	-	-	-	-	-	3	-	2.3
3 – High; 2 – Medium; 1– Low; - No correlation														

		L	T	P	C
U23EGS01	**ENGLISH EXPERTISE AND CAREER MOXIE LABORATORY (Common to ALL)**	**0**	**0**	**2**	**1**

Pre-Requisites :

Objectives:

- To enable learners to develop their Professional communicative competence
- To enhance the practical understanding of the placement activity with employability skills
- To facilitate learners' soft skills

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Develop effective communication skills for corporate settings, including listening, speaking, and writing.	**K4**
CO2	Demonstrate the ability to manage business meetings and presentations effectively, with attention to time management and documentation.	**K3**
CO3	Develop critical thinking, creative problem-solving skills, and self-reflection for career advancement.	**K6**

Course Contents

1. **Corporate Communication Skills**
   1. Listening to the latest corporate meetings
   2. Speaking excerpts from formal corporate meetings
   3. Interview skills and biography of Founder/CEO
2. **Business Meeting and Presentation**
   1. Preparing agenda and minutes of meeting
   2. Oral presentations using the latest audio-visual aids
   3. Observing time restrictions
3. **Time Management and Responsibility**
   1. Working in pairs or groups to manage time
   2. Accepting responsibility and undertaking small projects
   3. Organizing and maintaining a portfolio of one's work
4. **Business Writing and Documentation**
   1. Preparing digital brochures
   2. Creating term planners and schedules
   3. Noting key dates and events
5. **Technical Conversation and Listening**
   1. Listening and completing technical conversations
   2. Addressing questions on specific companies from the audience
6. **Travel and International Business**
   1. Preparation for domestic and international business travel
   2. Essential communication skills for global business interactions
7. **Creative Thinking and Problem-Solving**
   1. Hands-on training in latest AI tools
   2. Developing creative thinking skills for innovative solutions

8. Self-Assessment and SWOT Analysis

1. Filling up self-assessment forms
2. Conducting SWOT analyses

9. Corporate History and Research

1. Researching the history of reputed companies
2. Preparing biographies of founders/CEOs

10. Portfolio Development and Career Moxie

1. Developing a professional portfolio
2. Demonstrating career moxie for successful careers in business and communication

Total Periods: 30

Reference Books:

1 On Writing Well, William Zinsser, Harper Resource Book, 2001
2 Study Writing, Liz Hamp-Lyons and Ben Heasly, Cambridge University Press, 2006
3 Communication Skills, Sanjay kumar and pushpalata, Oxford Unversity Press. 2011

Web URL(s) / Websites:

1 Best Academic Course Programs in Business English 2023 (academiccourses.com)
2 Cambridge English
3 TED Talks
4. Company Websites
5. AI Apps
6. YouTube - Documentaries

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	-	-	-	-	-	-	1	1	3	-	1	-	-	-
CO2	-	-	-	-	-	-	1	2	3	2	1	-	-	-
CO3	-	1	-	-	-	-	2	1	2	1	3	-	-	-
Av	-	0.3	-	-	-	-	1.3	1.3	2.7	1.0	1.7	-	-	-
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEO03	INTERNSHIP/IN-PLANT TRAINING	L	T	P	C
		0	0	2	1

Pre-Requisites : None

Objectives:

- To provide hands-on experience by engaging students in industries, project sites, design offices, or service sectors related to Mechanical Engineering.
- To expose students to real-world industrial environments covering areas such as Production, Planning, Quality Assurance, Maintenance, Service, and allied domains.
- To enable students to apply theoretical knowledge to solve practical problems encountered in industry.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Understand and relate practical industrial practices to the theoretical concepts learned in the classroom.	**K2**
CO2	Identify, formulate, and solve real-life industrial problems by applying appropriate engineering methodologies.	**K3**
CO3	Demonstrate practical skills and professional competence by working in industries, service centers, project sites, or design offices.	**K3**

Guidelines for Internship / In-plant Training:

- Students must undergo two weeks of practical training in an industry, project site, service center, or design/planning office, relevant to Mechanical Engineering, with prior approval from the Head of the Department
- Upon completion of the training, students must submit a detailed report following the format prescribed by the department.
- Students are required to make a presentation based on their training experience before a departmental staff appointed by the Head of the Department.
- The evaluation will be based on:
  - Quality and completeness of the Internship Report.
  - Effectiveness and clarity of the Presentation.
- This course is conducted in Internal Mode only.

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Assessment Pattern:
Training Report: 50%
Presentation and Viva Voce: 50%

Total Periods: 30

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	1	-	-	-	-	-	1	2	1	2
CO2	3	3	-	-	2	-	-	-	-	1	2	3	-	3
CO3	2	2	-	-	3	-	-	-	-	2	2	3	1	3
Av	2.7	2.3	-	-	2.0	-	-	-	-	1.0	1.7	2.7	1.0	2.7
3 – High; 2 – Medium; 1– Low; - No correlation														

Semester VI

		L	T	P	C
U23MGT01	**TOTAL QUALITY MANAGEMENT**	**3**	**0**	**0**	**3**

Pre-Requisites :

Objectives:

- To understand the fundamental principles and concepts of Total Quality Management.
- To familiarize with various tools and techniques used in quality control and improvement.
- To understand the role of leadership and employee involvement in quality improvement.
- To study various quality management systems and certifications.
- To apply quality management principles in real-life industry applications.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the principles and philosophies of Total Quality Management.	**K2**
CO2	Apply TQM tools and techniques for quality improvement in industries.	**K3**
CO3	Explain the role of leadership and employee involvement in quality enhancement.	**K2**
CO4	Describe the structure and implementation aspects of various quality standards and certification processes.	**K2**
CO5	Apply quality improvement plans and identify the appropriate TQM practices for effective execution	**K3**

Course Contents

Unit I INTRODUCTION TO TQM 10

Definition of Quality – Dimensions of Quality - TQM – Basic concepts, principles and pillars of TQM- Historical background: Contributions of Deming, Juran, Crosby Quality Planning and Quality Cost - Barriers to TQM Implementation

Unit II TQM TOOLS AND TECHNIQUES – I 9

Seven Basic Quality Tools: Check Sheet, Histogram, Pareto Chart, Cause & Effect Diagram, Control Chart, Scatter Diagram, Flow Chart - Statistical Process Control (SPC) - Process Capability Analysis - Failure Mode and Effect Analysis (FMEA) - Quality Function Deployment (QFD)

Unit III TQM TOOLS AND TECHNIQUES – II 8

Benchmarking: Types, Process and Benefits - 5S Concepts and Implementation - Kaizen Principles and Applications - Poka-Yoke – Error-proofing Methods - Total Productive Maintenance (TPM): Pillars, Metrics

Unit IV QUALITY MANAGEMENT SYSTEMS AND STANDARDS 9

ISO 9000:2015 Standards: Clauses and Implementation - ISO 14000: Environmental Management Systems - Six Sigma: Concepts, DMAIC Process - Certifications and Accreditation: NABL, NABH - Documentation and Auditing

Unit V STRATEGIC TQM AND CASE STUDIES 9

Strategic Quality Management: Vision, Mission, Policies - Leadership and Change Management in TQM - Customer Focus and Satisfaction - Employee Involvement and Teamwork - Case Studies of TQM Implementation in Manufacturing and Service Sectors

Total Periods 45

Text Books:

1. Dale H. Besterfield, "Total Quality Management", 4th Edition, 2021, Pearson Education, New Delhi.
2. Shridhar Bhat K, "Total Quality Management – Text and Cases", Revised edition, 2nd Edition, 2020, Himalaya Publishing House, Mumbai.

Reference Books:

1. J.M. Juran and Frank M. Gryna, "Quality Planning and Analysis", 6th Edition, 2018, McGraw-Hill Publishing India Ltd, New Delhi.
2. Gregory H. Watson, "Strategic Benchmarking Reloaded with Six Sigma: Improving Your Company's Performance Using Global Best Practice", First Edition, 2021, Wiley India Pvt. Ltd., New Delhi.
3. Subburaj Ramasamy, "Total Quality Management", 2nd Edition, 2018, McGraw-Hill Publishing India Ltd, New Delhi
4. James R. Evans and William M. Lindsay, "Managing for Quality and Performance Excellence", 11th Edition, 2020, Cengage Learning India Pvt. Ltd., New Delhi.

Web URL(s):

1. https://archive.nptel.ac.in/courses/110/104/110104080/
2. https://onlinecourses.swayam2.ac.in/nou21_me04/preview
3. https://onlinecourses.nptel.ac.in/noc21_mg72/preview

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	-	2	1	-	1	-	1	-	1
CO2	2	-	-	-	2	-	1	2	-	2	1	2	-	2
CO3	1	-	-	-	-	-	3	2	-	1	-	1	-	1
CO4	2	-	-	-	1	-	2	1	-	2	-	2	-	1
CO5	2	-	-	-	1	-	2	2	-	2	1	2	-	2
Av	1.8	-	-	-	0.8	-	2.0	1.6	-	1.6	0.4	1.6	-	1.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MET15	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	1	0	4

Pre-Requisites : Engineering Mechanics and Mechanics of Solids

Note : Use of Standard and Approved Design data book is permitted

Objectives:

- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements.
- To satisfy functional and strength requirements to learn to use standard practices and standard data.
- To Identify various bevel, worm &cross helical gears and analyze their terminologies.
- To learn to use catalogues and standard machine components.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Choose flexible components using basic principles and procedure.	**K3**
CO2	Develop gear transmission systems with the available standard procedure.	**K3**
CO3	Identify the mechanical properties and thermal capacity of the gear transmission systems.	**K3**
CO4	Select the working principles of mechanical components employed in mechanical transmission systems.	**K3**
CO5	Select the basic engineering principles and procedures to design the transmission elements.	**K3**

Course Contents

Unit I DESIGN OF FLEXIBLE ELEMENTS 9

Selection of V belts and pulleys – selection of Flat belts and pulleys -Wire ropes and pulleys - Selection of Transmission chains and Sprockets. Design of pulleys and sprockets.

Unit II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9

Gear Terminology - Speed ratios and number of teeth - Force analysis - Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Module and Face width - power rating calculations based on strength and wear considerations - Parallel axis Helical Gears – Pressure angle in the normal and transverse plane - Equivalent number of teeth - forces and stresses. Estimating the size of the helical gears.

Unit III BEVEL, WORM AND CROSS HELICAL GEARS 9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits - terminology. Thermal capacity, materials - forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology - helix angles - Estimating the size of the pair of cross helical gears.

Unit IV DESIGN OF GEAR BOXES 9

Geometric progression - Standard step ratio - Ray diagram, kinematics layout - Design of sliding mesh gear box - Constant mesh gear box. Design of multi speed gear box.

Unit V DESIGN OF CAM, CLUTCHES AND BRAKES 9

Cam Design: Types - pressure angle and under cutting base circle determination – forces and surface stresses. Design of plate clutches – axial clutches - cone clutches – internal expanding rim clutches - internal and external shoe brakes.

Total Periods 45

Text Books:

1. R.S. Khurmi and J.K. Gupta, "A Textbook of Machine Design", Revised Edition, 2020, S. Chand & Company Ltd., Ram Nagar, New Delhi.
2. T. Jagadeesh and M.A. Varma, "Design of Machine Elements", 1st Edition, 2010, I.K. International Publishing House Pvt. Ltd., Daryaganj, New Delhi.

Reference Books:

1. Maitra G.M., Prasad L.V., "Hand book of Mechanical Design", 2nd Edition, 2014, Tata McGraw-Hill, New Delhi.
2. Bhandari, V.B., "Design of Machine Elements", 4th Edition, 2020, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
3. Prabhu. T.J., "Design of Transmission Elements", 2nd Edition, 2020, Mani Offset, Chennai,
4. Hamrock B.J., Jacobson B., Schmid S.R., "Fundamentals of Machine Elements", 4th Edition, 2020, McGraw-Hill Book Co., New Delhi.

Web URL(s):

1. https://youtu.be/SRmtLKUB8nc?si=7W5W_p3nXwb94K2a
2. https://youtu.be/1k-WtZKvfD4?si=yeGuFW2fEV5tQvk2
3. https://archive.nptel.ac.in/courses/112/106/112106137/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	-	-	-	-	-	-	-	-	2	1	2
CO2	3	2	1	1	-	-	-	-	-	-	-	3	2	2
CO3	3	2	1	1	-	-	-	-	-	-	-	3	2	2
CO4	3	3	2	2	-	-	-	-	-	-	-	3	3	3
CO5	3	3	2	2	-	-	-	-	-	-	-	3	3	3
Av	2.8	2.2	1.2	1.2	-	-	-	-	-	-	-	2.8	2.2	2.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MET16	HYBRID AND ELECTRICAL VEHICLES TECHNOLOGY	L	T	P	C
		3	0	0	3

Pre-Requisites : Automobile Engineering

Objectives:

- To introduce the concept of hybrid and electric drive trains and its modelling.
- To elaborate on the types and utilisation of hybrid and electric drive trains
- To expose on different types of AC and DC drives for electric vehicles.
- To understand and utilise different types of energy storage systems
- To introduce concept of energy management strategies and drive sizing

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Characterise and configure hybrid drivetrains requirement for a vehicle	**K3**
CO2	Design and apply appropriate hybrid and electric drive trains in a vehicle	**K3**
CO3	Design and install suitable AC and DC drives for electric vehicles.	**K3**
CO4	Arrive at a suitable energy storage system for a hybrid / electric vehicle	**K3**
CO5	Apply energy management strategies to ensure better economy and efficiency.	**K3**

Course Contents

Unit I DESIGN CONCEPTS **9**

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, social and environmental importance of hybrid and electric vehicles, impact of modern drivetrains on energy supplies. Modelling Vehicle Acceleration - Acceleration performance parameters

Unit II HYBRID ELECTRIC DRIVE TRAINS **9**

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.
Electric Drivetrains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Unit III CONTROL OF AC & DC DRIVES **9**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control - DC Motor drives, Induction Motor drives, Permanent Magnet Motor drive, and Switch Reluctance Motor drives, drive system efficiency.

Unit IV ENERGY STORAGE **9**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Energy storage and its analysis - Battery based, Fuel Cell based, and Super Capacitor based, Hybridization of different energy storage devices.

Unit V DRIVE SIZING AND ENERGY MANAGEMENT STRATEGIES **9**

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selection of appropriate energy storage technology, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification and comparison of energy management strategies, implementation issues.

Total Periods 45

Text Books:

1 Mi, Chris, and Masrur, M. Abul. "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", 2nd Edition, 2018, John Wiley & Sons, United Kingdom.

2 Husain and Iqbal. "Electric and Hybrid Vehicles: Design Fundamentals", 3rd Edition, 2021, CRC Press, United States.

Reference Books:

1. Larminie, James, and Lowry, John. "Electric Vehicle Technology Explained", 2nd Edition, 2012, John Wiley & Sons, Germany.
2. Muneer, Tariq., Kolhe, Mohan., Doyle, Aisling. "Electric Vehicles: Prospects and Challenges". 1st Edition, 2017, Elsevier, Netherlands.
3. Graham, John D.. "The Global Rise of the Modern Plug-in Electric Vehicle: Public Policy, Innovation and Strategy", 1st Edition, 2021, Edward Elgar Publishing. United Kingdom,
4. Liu, Wei. "Hybrid Electric Vehicle System Modelling and Control". 3rd Edition, 2023, Wiley, Germany.

Web URL(s):

1. https://onlinecourses.nptel.ac.in/noc20_ee18/preview
2. https://myigetit.com/business/best-ev-courses-online-with-certificate/
3. https://www.nielit.gov.in/content/online-course-ev-technology-public-charging-station-0

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1	1	1	1	1	-	-	-	-	2	-	1	1
CO2	3	2	2	-	1	2	-	-	-	-	2	1	1	1
CO3	3	2	2	-	1	2	-	-	-	-	2	1	1	1
CO4	3	2	2	-	1	2	-	-	-	-	2	1	1	1
CO5	3	2	2	-	1	2	-	-	-	-	2	1	1	1
Av	3	1.8	1.8	0.2	1	1.8	-	-	-	-	2	0.8	1	1
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MET17	FINITE ELEMENT ANALYSIS	L	T	P	C
		2	1	0	3

Pre-Requisites : None

Objectives:

- To introduce the fundamentals and mathematical background of the finite element method.
- To enable students to solve one-dimensional engineering problems using FEM.
- To provide knowledge on two-dimensional scalar field analysis using finite elements.
- To develop the ability to analyze vector field problems such as elasticity and stress analysis.
- To familiarize students with iso-parametric elements and numerical integration techniques.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Understand the fundamentals and mathematical formulation of finite element methods.	**K2**
CO2	Solve 1D solid mechanics and heat transfer problems using finite element analysis	**K3**
CO3	Apply FEM to 2D scalar problems such as heat conduction and torsion.	**K3**
CO4	Solve 2D vector problems and axisymmetric elasticity using FEM.	**K3**
CO5	Develop iso-parametric models and use numerical integration and software tools for FEM-based stress and dynamic analysis.	**K3**

Course Contents

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

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems–Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

Unit II **ONE-DIMENSIONAL PROBLEMS** 9

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.

Unit III **TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS** **9**

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

Unit IV **TWO-DIMENSIONAL VECTOR VARIABLE PROBLEMS** **9**

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

Unit V ISOPARAMETRIC FORMULATION 9

Natural co-ordinate systems – Iso-parametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

Total Periods 45

Text Books:

1. Reddy, J.N., "An Introduction to the Finite Element Method", 4th Edition, 2019, Tata McGraw-Hill, New Delhi, India.
2. Seshu, P., "Text Book of Finite Element Analysis", 1st Edition, 2007, Prentice-Hall of India Pvt. Ltd., New Delhi, India.

Reference Books:

1. Bhatti, Asghar M., "Fundamental Finite Element Analysis and Applications", 1st Edition, 2013, John Wiley & Sons, Hoboken, NJ, USA.
2. Logan, D.L., "A First Course in Finite Element Method", 6th Edition, 2017, Cengage Learning, USA.
3. Rao, S.S., "The Finite Element Method in Engineering", 6TH Edition, 2017, Butterworth Heinemann, Oxford, UK.
4. Cook, Robert D., Malkus, David S., Plesha, Michael E., Witt, Robert J., "Concepts and Applications of Finite Element Analysis", 4th Edition, 2002, Wiley Student Edition, New York, NY, USA.

Web URL(s):

1. https://nptel.ac.in/courses/112/104/112104115/
2. https://archive.nptel.ac.in/courses/112/104/112104193/
3. https://nptel.ac.in/courses/112106130

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO2	3	3	2	-	2	-	-	-	-	-	-	2	1	2
CO3	3	3	2	-	2	-	-	-	-	-	-	2	1	3
CO4	3	3	3	1	3	-	-	-	-	-	1	2	-	3
CO5	3	3	3	2	3	-	-	-	-	-	2	3	-	3
Av	3.0	2.8	2.2	1.5	2.2	-	-	-	-	-	1.5	2.0	1.0	2.6
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEP09	SIMULATION AND ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

Pre-Requisites : Strength of Materials, Fine Element Analysis

Objectives:

- To introduce students to computational tools such as MATLAB or SCILAB, and finite element analysis (FEA) software for solving engineering problems.
- To enable students to perform structural, thermal, and vibration analysis of mechanical components using numerical simulations.
- To develop students' ability to simulate real-world engineering problems related to stress analysis, heat transfer, and dynamic behavior of structures.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply computational tools to perform basic matrix operations and function plotting for engineering analysis.	**K3**
CO2	Simulate and analyze structural, thermal, and vibration responses of mechanical components under different loading conditions.	**K3**
CO3	Conduct stress, deflection, and modal analysis for beams, trusses, axisymmetric components, and 3D structures using numerical methods and FEA software.	**K3**

List of Exercises:

1. Perform basic matrix operations (addition, multiplication, inversion) and plot functions of one and two variables using MATLAB or SCILAB.
2. Simulation of the free vibration response of a spring-mass system under different damping conditions and analysis of displacement over time.
3. Simulation of mechanical mechanisms using any multibody dynamics software to analyze motion, forces, and kinematic behaviour.
4. Force and Stress analysis using link elements in Trusses, cables and bars.
5. Stress and deflection analysis in beams with different support conditions.
6. Stress analysis of flat plates and simple shells.
7. Stress analysis of axisymmetric components such as pressure vessels and circular discs to evaluate stress distribution and deformation.
8. Thermal stress and heat transfer analysis of fins, plates and cylinders.
9. Modal analysis of beams and 2D components to evaluate natural frequencies and mode shapes.
10. Stress analysis of a 3D component under various loading conditions to determine stress distribution and deformation.

Total Periods: 60

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3	–	–	–	3	–	–	–	–	–	–	1	-	1
CO2	3	2	–	3	3	–	–	–	–	–	–	3	2	3
CO3	3	3	3	3	3	–	–	–	–	–	–	3	1	3
Av	3	1.7	1	1	3	-	-	-	--		-	2.3	1	2.3
3 – High; 2 – Medium; 1– Low; - No correlation														

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		L	T	P	C
U23MEJ01	**DESIGN AND FABRICATION PROJECT**	**0**	**0**	**4**	**2**

Pre-Requisites : None

Objectives:

- To develop practical competence in designing and fabricating mechanical systems using engineering principles, design tools, standards, and safety practices.
- To enhance professional skills such as teamwork, communication, and project management through collaborative execution of design and fabrication tasks.
- To foster innovation and problem-solving skills by engaging students in real-world engineering challenges and guiding them through the complete product development cycle.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply engineering design principles and software tools to develop a functional solution for a real-world mechanical problem.	**K3**
CO2	Develop a working prototype by selecting appropriate materials, processes, and adhering to engineering standards and safety practices.	**K3**
CO3	Demonstrate effective teamwork, documentation, and presentation skills through systematic project planning, execution, and review.	**K3**

Guidelines for the Conduct of the Course:

- Students shall form convenient teams of not more than four members and select a new product, process, process enhancement, or working model for design and fabrication.
- Each project team shall be guided by a faculty member from the department. If required, an industry expert may serve as a co-guide to provide additional technical or practical insights.
- The project title must clearly reflect the design and fabrication aspect of the work undertaken.
- The Head of the Department shall appoint a Project Coordinator to oversee the process and conduct three internal review meetings to assess the progress of the project.
- Students are expected to design and fabricate the selected item within the college premises and demonstrate its functionality. A detailed project report must be submitted, including assembly drawings, part drawings, and fabrication process charts.
- At the end of the semester, the project will be evaluated through an oral presentation, review of the project report, and demonstration of the working model, conducted jointly by internal and external examiners appointed by the Head of the Department.

Total Periods: 60

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3	3	3	2	3	1	2	–	2	2	2	3	2	3
CO2	2	3	2	1	3	2	2	1	1	2	2	3	2	2
CO3	2	2	2	2	2	1	2	2	3	3	2	2	1	3
Av	2.3	2.7	2.3	1.7	2.7	1.3	2	1.5	2	2.3	2	2.3	1.7	2.7
3 – High; 2 – Medium; 1– Low; - No correlation														

		L	T	P	C
U23MEO04	**TECHNICAL APTITUDE**	**0**	**0**	**2**	**1**

Pre-Requisites : None

Objectives:

- To refresh core concepts from mathematics, science, and basic engineering subjects.
- To practice and solve MCQs from major Mechanical Engineering subjects.
- To improve speed and accuracy in answering technical questions.
- To prepare students for competitive exams and placement tests.
- To promote self-study and regular practice using curated question banks.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Recall and apply fundamental engineering concepts across engineering sciences and professional core subjects covered in semesters 3 to 6.	**K2**
CO2	Apply core Mechanical Engineering concepts to solve technical questions effectively.	**K3**
CO3	Demonstrate readiness for competitive exams and technical interviews through consistent performance in MCQ-based assessments.	**K3**

Guidelines for the Course:

- This is a non-theory, practical-oriented course focusing on technical Multiple-Choice Questions for self-assessment and enhancement of core subject knowledge.
- Topics will be drawn from all major Mechanical Engineering subjects taught from Semester I to Semester VI.
- At the end of Semester, a single Multiple-Choice Question based assessment will be conducted for 100 marks.
- Marks will be awarded based on the number of correct responses. There may be no negative marking.
- Evaluation is purely internal, aimed at improving technical aptitude and preparing students for placement, internships, and competitive exams like GATE, UPSC, etc.
- Students may be encouraged to prepare using a question bank curated by subject faculty.
- Periodic mock tests or quizzes may be organized to support continuous preparation.
- All students must attend the final aptitude test for successful course completion.

Total Periods: 30

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3	-	-	-	1	-	-	-	1	-	-	-	-	-
CO2	3	-	-	-	1	-	-	-	1	-	-	1	1	1
CO3	**3**	-	-	-	1	-	-	-	1	-	-	1	1	1
Av	3	-	-	-	1	-	-	-	1	-	-	1	1	1
3 – High; 2 – Medium; 1– Low; - No correlation														

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Semester VII

U23MGT02	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To introduce the fundamental concepts and principles of management.
- To explore the fundamental roles and functions of management, including planning, organizing, leading, and controlling.
- To develop the ability to apply management principles to organizational scenarios.
- To build decision-making and problem-solving skills in management contexts.
- To understand ethical and social considerations in management practices.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Recall and explain the basic principles and concepts of management	**K1**
CO2	Describe and understand the core functions of management: planning, organizing, leading, and controlling	**K2**
CO3	Apply management principles to practical organizational scenarios	**K3**
CO4	Develop strategies to improve organizational efficiency and effectiveness	**K3**
CO5	Identify and address ethical challenges in management practices	**K3**

Course Contents

Unit I INTRODUCTION TO MANAGEMENT **9**

Definition, Nature, and Importance of Management - Evolution of Management Thought - Classical Approach: Scientific Management, Administrative Theory, Bureaucratic Management -Human Relations and Behavioural Approach - Contemporary Approaches: Systems Theory, Contingency Theory - Roles and Skills of a Manager - Ethical and Social Responsibilities of Management

Unit II PLANNING **9**

Nature and Purpose of Planning - Types of Plans: Strategic, Tactical, Operational - Planning Process - Goal Setting: SMART Goals - Decision Making: Types, Process, and TechniquesStrategic Management and Planning Tools: SWOT Analysis, PEST Analysis, BCG Matrix

Unit III ORGANIZING **9**

Organizational Structure and Design - Functional, Divisional, Matrix Structures - Authority and Responsibility - Delegation: Process, Barriers, and Principles - Decentralization vs. Centralization - Organizational Culture and Change - Coordination and Communication

Unit IV LEADING **9**

Leadership vs. Management - Leadership Theories and Styles - Trait Theory, Behavioural Theories, Contingency Theories - Motivation Theories: Maslow's Hierarchy of Needs, Herzberg's Two-Factor Theory - Communication: Process, Types, Barriers, and Effective Communication - Team Building and Group Dynamics.

Unit V CONTROLLING **9**

Nature and Importance of Control - Control Process - Types of Control: Feedforward, Concurrent, Feedback - Financial Controls: Budgets, Audits, Financial Statements - Non-Financial Controls: Balanced Scorecard, Benchmarking - Performance Measurement: KPIs and Metrics - Managing Information and Technology in Control

Total Periods 45

Text Books:

1. Tripathy P. C and Reddy P. N, "Principles of Management", 3rd Edition, 2021, McGraw Hill India Pvt Ltd, New Delhi.
2. Harold Koontz and Heinz Weihrich, "Essentials of Management", 10th Edition, 2020, McGraw Hill India Pvt Ltd, New Delhi.

Reference Books:

1. Gail Freeman - Bell and Janes Balkwill, "Management in Engineering – Principles and Practice", First Edition, 2008, Prentice Hall of India Pvt Ltd, India.
2. Stephen A. Robbins, David A. Decenzo and Mary Coulter, "Fundamentals of Management", 11th Edition, 2022, Prentice Hall, India.
3. Gupta and Meenakshi, "Principles of Management", 3rd Edition, 2021, PHI Learning Pvt. Ltd., New Delhi.

Web URL(s):

1. https://nptel.ac.in/courses/110/105/110105146/
2. https://onlinecourses.nptel.ac.in/noc20_mg58/preview
3. https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-mg58/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	-	-	-	-	-	2	-	-	-	1
CO2	3	3	-	2	-	-	2	-	1	2	-	1	-	1
CO3	3	3	3	3	2	-	-	-	2	3	2	1	-	1
CO4	3	2	3	3	2	-	2	2	2	3	2	-	-	1
CO5	3	3	3	3	-	2	3	3	2	3	3	1	-	2
Av	3.0	2.6	3.0	2.8	1.3	1.0	1.4	1.0	1.4	2.6	1.4	0.6	–	1.2
3 – High; 2 – Medium; 1– Low; - No correlation														

		L	T	P	C
U23MGT03	**ENTREPRENUERSHIP DEVELOPMENT**	**3**	**0**	**0**	**3**

Pre-Requisites : None

Objectives:

- To understand the concept and importance of entrepreneurship and entrepreneurial mindset.
- To identify various types of entrepreneurs and recognize business opportunities.
- To learn how to prepare business plans and feasibility reports.
- To gain insights into sources of finance, funding agencies, and support institutions.
- To acquire basic knowledge of managing small businesses and sustaining growth.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the fundamentals of entrepreneurship, its role in economic development, and characteristics of entrepreneurs.	**K2**
CO2	Analyze the factors influencing the identification and evaluation of business opportunities.	**K3**
CO3	Develop a structured business plan and assess its feasibility.	**K3**
CO4	Apply knowledge of various sources of finance and institutional support systems for entrepreneurial ventures.	**K3**
CO5	Develop strategies for launching, managing, and sustaining small enterprises.	**K3**

Course Contents

Unit I INTRODUCTION TO ENTREPRENEURSHIP 9

Definition, Characteristics, and Functions of Entrepreneurs - Role of Entrepreneurship in Economic Development - Difference between Entrepreneur and Intrapreneur- Types of Entrepreneurs - Factors Affecting Entrepreneurial Growth.

Unit II ENTREPRENEURIAL MOTIVATION AND OPPORTUNITY IDENTIFICATION 9

Motivating Factors - Entrepreneurial Competencies - Creativity and Innovation in Entrepreneurship - Identifying and Evaluating Business Opportunities - Entrepreneurship Development Programs

Unit III BUSINESS PLAN PREPARATION 9

Meaning and Importance of Business Plan - Components of a Business Plan - Project Formulation and Feasibility Analysis - Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information.

Unit IV INSTITUTIONAL SUPPORT AND SOURCES OF FINANCE 9

Institutional Support to Entrepreneurs (DIC, NSIC, SIDBI, NABARD, TCOs, etc.) - Various Sources of Finance – Angel Investors, Venture Capitalists, Banks, and Financial Institutions - Government Schemes for Startups and MSMEs

Unit V SMALL BUSINESS MANAGEMENT 9

Growth Strategies for Small Enterprises - Managing Finance, Marketing, and Operations in Small Business - Problems and Challenges faced by Entrepreneurs - Case Studies on Successful Entrepreneurs

Total Periods 45

Text Books:

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, "Entrepreneurship", 11th Edition, 2022, McGraw Hill Education (India) Private Limited, New Delhi.
2. S.S. Khanka, "Entrepreneurial Development", 5th Edition, 2022, S. Chand and Company Private Limited, New Delhi.

Reference Books:

1. David H. Holt, "Entrepreneurship: New Venture Creation", 1st edition, 2000, Prentice Hall of India Private Limited, New Delhi.
2. Donald F. Kuratko, "Entrepreneurship: Theory, Process and Practice", 11th Edition, 2022, Cengage Learning India Private Limited, New Delhi.
3. P. Saravanavel, "Entrepreneurship Development", 3rd edition, 2022, Ess Pee Kay Publishing House, Chennai.
4. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", 7yh edition, 2022, Himalaya Publishing House, Mumbai.

Web URL(s):

1. https://archive.nptel.ac.in/courses/110/106/110106141/
2. https://archive.nptel.ac.in/courses/127/105/127105007/
3. https://nptel.ac.in/courses/110107094

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	2	-	-	-	1	-	-	1	1	-	-	1	-	1
CO3	3	-	-	-	1	-	-	1	1	-	-	2	-	2
CO4	2	-	-	-	1	-	-	1	1	-	-	1	-	1
CO5	2	-	-	-	1	-	-	1	1	-	-	2	-	2
Av	2.2	-	-	-	1	-	-	1	1	-	-	1.2	–	1.4
3 – High; 2 – Medium; 1– Low; - No correlation														

Semester VIII

U23MEJ02	PROJECT WORK	L	T	P	C
		0	0	20	10

Pre-Requisites : None

Objectives:

- To apply engineering principles to solve practical problems through modeling, design, experimentation, fabrication, or analysis in Mechanical or interdisciplinary domains.
- To develop project planning, execution, teamwork, and communication skills by working on real-world or industry-based assignments.
- To enhance innovative thinking by proposing improvements to existing systems or creating new designs, supported by systematic investigation and documentation.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply engineering knowledge and skills to design, develop, or improve mechanical systems or interdisciplinary projects.	**K3**
CO2	Demonstrate ability to plan, organize, execute, and report project work effectively within a team environment.	**K6**
CO3	Execute structured project methodology and communicate technical findings clearly through comprehensive project documentation and viva-voce.	**K3**

Guidelines for Project Work:

- **Scope**:
  The project work shall focus on innovative improvement of existing systems or development of new systems in Mechanical Engineering or interdisciplinary areas. It shall involve modeling, design, experimentation, fabrication, evaluation, or analysis.
- **Team Formation:**
  Each project shall be carried out by a team of maximum four students.
- **Approval Process**:
  The project topic must be approved by the Head of the Department under the guidance of a faculty member familiar with the area of work.
- **Industrial Projects:**
  For projects carried out in industry, an industry supervisor shall act as a co-guide along with the faculty guide.
- **Execution:**
  Students are expected to utilize the project period effectively through library research, laboratory work, computer analysis, field work, experimentation, or fabrication as assigned by the guide.
- **Reviews:**
  - The project progress will be monitored through a minimum of three formal reviews.
  - A Review Committee constituted by the Head of the Department will assess the project work during reviews.
  - Students must demonstrate project progress, methodology, results, and plan for completion during each review.
- **Report Submission:**
  At the end of the semester, each team shall submit a comprehensive project report in the prescribed format.

Total Periods: 120

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3	2	3	-	2	1	-	1	1	1	1	2	1	3
CO2	1	1	2	-	1	-	1	3	2	3	-	1	-	2
CO3	1	1	1	1	-	-	1	2	3	2	-	-	-	1
Av	1.7	1.3	2.0	0.3	1.0	0.3	0.7	2.0	2.0	2.0	0.3	1.0	0.3	2.0
3 – High; 2 – Medium; 1– Low; - No correlation														

Mandatory Courses

U23MTA02	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Objectives:

- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the scope and characteristics of traditional knowledge and differentiate it from indigenous and Western knowledge.	**K2**
CO2	Assess the importance of protecting traditional knowledge and analyze the role of governments in this process.	**K3**
CO3	Summarize key laws related to traditional knowledge and evaluate their impact on its protection.	**K3**
CO4	Describe protection systems for traditional knowledge and evaluate patents and non-IPR mechanisms.	**K3**
CO5	Examine the role of traditional knowledge in various sectors and discuss its significance for sustainability and food security.	**K3**

Course Contents

Unit I INTRODUCTION TO TRADITIONAL KNOWLEDGE 8

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

Unit II PROTECTION OF TRADITIONAL KNOWLEDGE 4

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Unit III LEGAL FRAMEWORK AND TRADITIONAL KNOWLEDGE 7

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

Unit IV TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY 5

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge.

Unit V TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS 6

Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Food security of the country and protection of TK.

Total Periods 30

Text Books:

1. Jha, Amit, "Traditional Knowledge System in India", 2009.
2. Mohanta, Basanta Kumar and Singh, Vipin Kumar, "Traditional Knowledge System and Technology in India", 2012, Pratibha Prakashan.

Reference Books:

1. Jha, Amit, "Traditional Knowledge System in India", 2002, Atlantic Publishers.
2. Kapoor, Kapil and Danino, Michel, "Knowledge Traditions and Practices of India".
3. Tempelman, Erik, Shercliff, Hugh, and Ninaber van Eyben, Bruno, "Manufacturing and Design: Understanding the Principles of How Things Are Made", 2014, Elsevier.

Web URL(s):

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	-	-	-	-	-	-	3	1	1	2
CO2	-	2	-	-	-	3	-	-	-	-	2	1	2	2
CO3	-	2	-	-	-	3	2	-	-	-	-	1	2	2
CO4	-	2	-	-	-	3	2	-	-	-	-	1	2	2
CO5	-	2	-	-	-	3	2	-	-	-	3	1	3	2
Av	0.6	2	-	-	-	2.4	1.2	-	-	-	1.6	1	2	2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MTA03	WELLNESS THROUGH YOGA AND AYURVEDA	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Objectives:

- To enjoy life happily with fun filled new style activities that help to maintain health
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Define health and describe its various dimensions, emphasizing the importance of maintaining overall health.	**K2**
CO2	Explain the role of diet in health maintenance, including the components of a balanced diet and their benefits.	**K2**
CO3	Summarize the preventive aspects of AYUSH systems and evaluate their role in maintaining health through different prevention levels.	**K3**
CO4	Describe the importance of emotional health, analyze stress management techniques, and explain the impact of sleep and immunity on mental wellness.	**K3**
CO5	Analyze the benefits of different types of yoga and evaluate how to choose appropriate yogasanas based on individual needs and health conditions.	**K3**

Course Contents

Unit I HEALTH AND ITS IMPORTANCE 6

Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health,

Unit II DIET 6

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight. **Balanced Diet and its 7 Components** - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Unit III ROLE OF AYURVEDA IN MAINTAINING HEALTH 6

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy. **Prevention of illness with our traditional system of medicine**-Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

Unit IV MENTAL WELLNESS 8

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion. Immunity - Types and importance - Ways to develop immunity.

Unit V YOGA **4**

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders.

Total Periods 30

Text Books:

1. Martin, Ashley, "Nutrition and Dietetics", White Word Publications, New York, NY 10001, USA.
2. Elliott, Jennifer, "An Introduction to Sustainable Development", 4th Ed., 2012, Routledge, London.

Reference Books:

1. Zeidner, Moshe, Matthews, Gerald, and Roberts, Richard D., "What We Know About Emotional Intelligence: How It Affects Learning, Work, Relationships, and Our Mental Health".
2. Neff, Kristin., and Germer, Christopher, "The Mindful Self-Compassion Workbook", The Guilford Press, A Division of Guilford Publications, New York.

Web URL(s):

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
2. Simple lifestyle modifications to maintain health https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.
3. Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
4. https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926
5. Benefits of healthy eating https://www.cdc.gov/nutrition/resources-publications/benefits-ofhealthy-eating.html
6. https://yogamedicine.com/guide-types-yoga-styles/
7. Ayurveda: https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	-	3	-	-	-	-	-	1	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	1	3	1
CO3	3	2	3	-	-	3	-	-	-	-	-	1	3	1
CO4	3	2	-	-	-	3	-	-	-	-	-	1	2	2
CO5	3	2	-	-	-	3	-	-	-	-	3	1	2	3
Av	3	2	0.6	-	-	2.4	-	-	-	-	0.6	1	2.4	1.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MTA04	UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Objectives:

- To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
- To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
- To help students understand the meaning of happiness and prosperity for a human being.
- To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Define value education and describe its importance and basic guidelines, including self-exploration as a method for value development.	**K2**
CO2	Explain the concept of harmony between the Self and the Body, and analyze the needs of both to achieve personal balance.	**K3**
CO3	Analyze the role of family in human values and relationships, and evaluate the principles for achieving harmony in family, society, and nature.	**K3**
CO4	Explain the basics of ethical human conduct, analyze defects in ethical behavior, and evaluate holistic and universal approaches to ethical conduct.	**K3**
CO5	Apply ethical frameworks and principles to create sustainable and ethically sound engineering practices and solutions.	**K3**

Course Contents

Unit I INTRODUCTION TO VALUE EDUCATION 6

Value Education- Definition, Concept and Need, The Content and Process of Value Education, Basic Guidelines for Value Education. Self exploration as a means of Value Education.

Unit II HARMONY IN THE HUMAN BEING 6

Human Being is more than just the Body. Harmony of the Self ('I') with the Body. Understanding Myself as Co-existence of the Self and the Body. Understanding Needs of the Self and the needs of the Body.

Unit III HARMONY IN THE FAMILY AND SOCIETY AND HARMONY IN THE NATURE 7

Family as a basic unit of Human Interaction and Values in Relationships. The Basics for Respect and today's Crisis: Affection, Guidance, Reverence, Glory, Gratitude and Love. Comprehensive Human Goal: The Five Dimensions of Human Endeavour.

Unit IV SOCIAL ETHICS 5

The Basics for Ethical Human Conduct. Defects in Ethical Human Conduct. Holistic Alternative and Universal Order. Universal Human Order and Ethical Conduct.

Unit V PROFESSIONAL ETHICS 6

Value based Life and Profession. Professional Ethics and Right Understanding. Competence in Professional Ethics. Issues in Professional Ethics – The Current Scenario.

Total Periods 30

Text Books:

1. Tripathi, A.N., "Human Values", 2004, New Age Intl. Publishers, New Delhi.
2. Bajpai, B. L., "Indian Ethos and Modern Management", 2004, New Royal Book Co., Lucknow. Reprinted 2008.
3. Gaur, R.R., Sangal, R., and Bagaria, G.P., "A Foundation Course in Value Education", 2009, Excel Books.

Reference Books:

1 Gaur, R.R., Sangal, R., and Bagaria, G.P., "Teachers Manual", 2009, Excel Books.
2 Sharma, I.C., "Ethical Philosophy of India", Nagin & Co., Julundhar.
3 Govindrajran, M., Natrajan, S., and Senthil Kumar, V.S., "Engineering Ethics (including Human Values)", Eastern Economy Edition, Prentice Hall of India Ltd.

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	-	-	-	-	-	3	3	-	-	-	3	1	2	2
CO2	-	2	-	-	-	3	3	-	-	-	3	1	3	2
CO3	-	-	2	-	-	3	3	-	-	-	3	1	3	2
CO4	-	2	3	-	-	3	3	-	-	-	3	1	2	3
CO5	2	3	3	3	3	3	3	-	3	3	3	2	2	3
Av	0.4	1.4	1.6	0.6	0.6	3	3	-	0.6	0.6	3	1.2	2.4	2.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MTA05	GENDER, CULTURE AND DEVELOPMENT	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Objectives:

- To build an understanding and initiate and strengthen programmes combating gender-based violence and discrimination
- To analyze current events aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with race, class, caste, nationality and other social identities.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply core concepts, historical evolution, and key theories of gender studies to analyze societal structures and practices.	**K3**
CO2	Apply principles of gender equality and employment laws to address gender dynamics, issues, and violence in the workplace.	**K3**
CO3	Understand basic concepts and approaches to studying culture from gender perspectives, including the role of media and performance.	**K2**
CO4	Understand the relationship of gender with development, including key indices and measures such as the Gender Development Index and Gender Empowerment Measure.	**K2**
CO5	Apply government policies, initiatives, and emerging strategies to enhance gender equality and reduce disparities in economic opportunities in India.	**K3**

Course Contents

Unit I FOUNDATIONS OF GENDER STUDIES 8

Gender : Core Concepts of Gender/Evolution in Gender Studies, Patriarchy: Power, Structure and Practices, Masculinity/Femininity: An Overview, Understanding Sexuality: Conceptual Underpinnings, Inclusion, Exclusion, Discrimination: Caste, Class, Ethnicity, Waves of Feminism and Gender Theories.

Unit II GENDER DYNAMICS IN THE WORKPLACE 5

Gendering Work, Gender and Employment, Gender Issues in Work and Labour Market, Gender- Based Violence, Gender Equality and Women's Protection: Law and Legislation in India

Unit III GENDER AND CULTURAL PERSPECTIVES 5

Culture: Gender Perspectives, Basic concepts and approaches to the study of culture: Gender perspectives, Interrogating Culture: Gender, caste and class.

Unit IV GENDER AND DEVELOPMENT 6

Introduction, Relationship of Gender with Development, Role of Gender in Development, Gender Empowerment and Development, Gender Development Index, Gender Empowerment Measure.

Unit V GENDER AND DEVELOPMENT IN INDIA 6

Government Policies and Initiatives for promoting gender equality, Role of women in the Indian economy, Gender disparities in economic opportunities, Women in Indian politics.

Total Periods 30

Text Books:

1. Seth, M., "Women and Development: The Indian Experience", 2001, Sage Publications, New Delhi.
2. Uberoi, P., "Freedom and Destiny: Gender, Family, and Popular Culture in India", 2006, Oxford University Press, New Delhi.
3. Nathan, Hippu Salk Kristle, "Gender-Based Indicators in Human Development: Correcting for 'Missing Women'", 2008, Indira Gandhi Institute of Development Research, Mumbai.

Reference Books:

1. Seth, Mira, "Women and Development: The Indian Experience", 2001, Sage Publications, New Delhi.
2. Mathu, A., "Gender and Development in India: The Indian Scenario", 2008, Gyan Publishing House.
3. Spary, C., "Gender, Development, and the State in India", 2019, Routledge.

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	-	-	3	-	-	3	3	-	-	-	3	1	2	3
CO2	-	3	3	-	-	3	3	-	-	-	3	2	3	3
CO3	-	-	-	-	-	3	3	-	-	-	3	1	2	3
CO4	-	-	3	-	-	3	3	-	-	-	3	1	3	2
CO5	-	3	3	-	-	3	3	-	-	-	3	2	3	2
Av	-	1.2	2.4	-	-	3	3	-	-	-	3	1.4	2.6	2.6
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MTA06	ENVIRONMENTAL SCIENCE	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Objectives:

- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Study the Environment, Ecosystem and Biodiversity by learning the structures and functions.	**K2**
CO2	Apply the case studies with present scenario on the effects of resource use on forests, water, minerals, and food by preparing a report that identifies the specific impacts and proposes practical solutions.	**K3**
CO3	Measure water and air quality parameters and assess pollution levels by conducting field tests and interpreting the results in a written analysis.	**K2**
CO4	Evaluate the role of NGOs and community initiatives in solving environmental issues by participating in a local environmental project and documenting the process and outcomes in a presentation.	**K5**
CO5	Identify and describe the different types and limitations of EIA by reviewing and summarizing an actual EIA report for a local development project, highlighting its strengths and weaknesses.	**K3**

Course Contents

Unit I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY **6**

Definition – scope of environment – concept of an ecosystem - structure and function of an ecosystem – ecological succession processes – Types. Biodiversity – definition: genetic, species and ecosystem diversity – threats to biodiversity – endangered and endemic species of India – conservation of biodiversity.

Unit II NATURAL RESOURCES **6**

Forest resources: Use and benefits – Causes and effects. Water resources: Purpose and benefits, Socio economic impacts – Case studies. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Food resources: Food security, effects of modern agriculture on soil and water resources, Problems with Fertilizers and pesticides. Energy resources - Case studies.

Unit III ENVIRONMENTAL POLLUTION **6**

Water pollution: Forms and sources of water pollution – water quality parameters – physical, chemical and biological parameters. Air pollution: Sources and classification, effects of air pollution – case study. Marine pollution: Causes and effects - Thermal pollution: Nuclear hazards – Case study.

Unit IV SOCIAL ISSUES AND THE ENVIRONMENTAL LEGISLATION **6**

Sustainability – Ecological foot print – Urban energy crisis – Renewable energy. Water conservation – Rainwater harvesting. Role of non-governmental organization. Greenhouse effect - Global warming and climate change. Pollution control boards and acts in India.

Unit V ENVIRONMENT IMPACT ASSESSMENT 6

Environmental impact analysis (EIA) – Legal and Regulatory aspects in India – Types and limitations of EIA – Issues in EIA – Case studies of EIA of developmental projects.

Total Periods 30

Text Books:

1. Joseph, Benny, "Environmental Science and Engineering", 2006, Tata McGraw Hill Publishing Company, New Delhi.
2. Masters, Gilbert M. and Ela, Wendell P., "Introduction to Environmental Engineering and Science", 3rd Ed., 2015, Pearson Education India, Noida, Uttar Pradesh.
3. Peavy, Howard S., Rowe, Donald R., and Tchobanoglous, George, "Environmental Engineering", 2017, McGraw Hill Education, New Delhi.
4. Cunningham, W.P., Cooper, T.H., Gorhani, E., and Hepworth, M.T., "Environmental Encyclopedia", 2001, Jaico Publishing House, Mumbai.

Reference Books:

1. Kaul, S.N. and Ashutosh Gautam, "Principles of Environmental Studies", 2002, Daya Publishing house, New Delhi.
2. Anjaneyalu. Y, "Introduction to Environmental Science", 2004, BS Publications, Hyderabad, Andhra Pradesh.
3. Swarajya Lakshmi, G, Prabhu Prasadini, P, Ramesh Thatikunta and VNLV Tayaru, "Environmental Science a Practical Manual", 2010, BS publications, Hyderabad.

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2. https://onlinecourses.nptel.ac.in/noc23_hs155/preview
3. https://nptel.ac.in/courses/103107084

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	-	3	-	-	-	-	2	1	3	2
CO2	2	3	3	-	-	3	-	-	2	-	-	2	3	2
CO3	3	3	-	3	-	3	-	-	-	-	-	1	3	2
CO4	-	-	-	-	-	3	-	3	3	-	-	1	3	3
CO5	-	3	-	-	-	3	-	-	-	-	-	1	3	2
Av	1.6	2.2	0.6	0.6	-	3	-	-0.6	1	-	-	1.2	3	2.1
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MTA07	SUSTAINABLE DEVELOPMENT	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Objectives:

- To introduce students to the concept and principles of sustainable development.
- To analyze the environmental, social, and economic challenges facing sustainable development.
- To explore strategies for promoting sustainability in various sectors.
- To encourage critical thinking and problem-solving skills in addressing sustainability issues.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Define sustainable development and describe the differences between economic growth and sustainable development, including the transition from MDGs to SDGs.	**K2**
CO2	Explain the economic, socio-political, and ecological aspects of sustainability and analyze strategies for achieving sustainability in each aspect	**K2**
CO3	Analyze the roles of society, environment, culture, and economy in sustainable development and evaluate various initiatives and policies.	**K3**
CO4	Explain major challenges like climate change and resource management, and analyze adaptation and mitigation strategies.	**K3**
CO5	Describe the SDGs, analyze implementation challenges, and evaluate strategies for development, financing, and governance.	**K3**

Course Contents

Unit I INTRODUCTION TO SUSTAINABLE DEVELOPMENT 6

Introduction to Sustainable Development - Economic Growth and Progress - Environmental Threats. Business as Usual Versus Sustainable Development, From the MDGs to the SDGs: Agenda 2030.

Unit II ASPECTS OF SUSTAINABILITY DEVELOPMENT 6

Introduction to Sustainability Development, Economic Aspects- Meaning, Ways of Achieving Economic Sustainability. Socio Political Aspects – Meaning, Ways of Achieving Socio Political Sustainability. Ecological (Environmental) Aspects – Meaning, Ways of Achieving Ecological Sustainability.

Unit III DIMENSIONS TO SUSTAINABLE DEVELOPMENT 6

Society, environment, culture and economy; current challenges – natural, political, socio-economic imbalance. Sustainable development initiatives and policies of various countries: global, regional, national, local; needs of present and future generation – political, economic, environmental.

Unit IV CHALLENGES TO SUSTAINABLE DEVELOPMENT 6

Agriculture, Population & Food Security, Public Health and Nutrition, Education, Natural Resources (Forests, Energy, Water), Climate Change, Introduction to the science of climate change, Climate change and natural resources system, Human dimensions of climate change, Adaptation and Mitigation

Unit V PROPOSAL FOR SUSTAINABLE DEVELOPMENT GOALS 6

The Sustainable Development Goals, Structure and Content of the SDGs, Challenges in Implementing the SDGs, Goal-Based Development, Financing for Sustainable Development, Principles of Good Governance – Green Technology.

Total Periods 30

Text Books:

1. Franco, I.B. and Tracey, J., "Community capacity-building for sustainable development: Effectively striving towards achieving local community sustainability targets", 2019, International Journal of Sustainability in Higher Education.
2. Elliott, Jennifer, “An Introduction to Sustainable Development”, 4th Edition, 2012, Routledge, London.
3. Rogers, Peter P., Kazi F. Jalal, and John A. Boyd. "An introduction to sustainable development", 2012.
4. Sachs, J. D, “The Age of Sustainable Development”, 2015, Columbia University Press, New York.

Reference Books:

1 Soubbotina, Tatyana P., "Beyond Economic Growth: An Introduction to Sustainable Development", 2004, WBI Learning Resources Series, Washington DC, World Bank.
2 Kerr, Julie, "Introduction to Energy and Climate: Developing a Sustainable Environment", 2017, CRC Press.
3 Nhamo, Godwell, and Mjimba, Vuyo, "Sustainable Development Goals and Institutions of Higher Education", 2020, Springer.

Web URL(s):

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Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	-	-	-	-	-	3	-	-	-	-	2	1	3	2
CO2	-	3	-	-	-	3	-	-	-	-	-	1	3	2
CO3	-	3	3	-	-	3	-	-	-	-	-	1	3	2
CO4	-	-	3	-	-	3	-	-	-	-	3	1	3	2
CO5	-	2	3	-	-	3	-	-	3	-	-	1	3	2
Av	-	1.6	1.8	-	-	3	-	-	0.6	-	1	1	3	2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MTA08	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Objectives:

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the concepts of Disaster, Vulnerability and Disaster Risk reduction.	**K2**
CO2	Identify the Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction.	**K3**
CO3	Develop disaster response skills by adopting relevant tools and technology	**K3**
CO4	Build awareness of institutional processes for Disaster response in the country.	**K3**
CO5	Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity.	**K3**

Course Contents

Unit I HAZARDS, VULNERABILITY AND DISASTER RISKS 6

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks. Natural, Human induced, Climate change induced. Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters – Structural collapse, Industrial accidents, oil spills – Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.

Unit II DISASTER RISK REDUCTION (DRR) 6

Sendai Framework for Disaster Risk Reduction, Disaster cycle – Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR. Structural – non-structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders.

Unit III DISASTER MANAGEMENT 6

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction – Disaster Risk Management and post disaster management – Compensation and Insurance. Disaster Management Act (2005) and Policy.

Unit IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 6

Early warning systems - Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness – Role of GIS and Information Technology Components in Preparedness.

Unit V DISASTER MANAGEMENT: CASE STUDIES 6

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters – Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies. Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies

Total Periods 30

Text Books:

1. Taimpo, "Disaster Management and Preparedness", 2016, CRC Publications, Florida, USA.
2. Singh R, "Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami", 2017, Horizon Press Publications, Norfolk, United Kingdom.
3. Singhal J.P. "Disaster Management", 2010, Laxmi Publications, Chennai.
4. Tushar Bhattacharya, "Disaster Science and Management", 2012, McGraw Hill India Education Pvt. Ltd, New Delhi.

Reference Books:

1. Govt. of India: Disaster Management Act, 2005, Government of India, New Delhi.
2. Government of India, "National Disaster Management Policy", 2009.
3. Shaw R, "Community based Disaster risk reduction", 2016, Oxford University Press, England, United Kingdom.

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2. https://ssp.nidm.gov.in/enrol/index.php?id=147

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	-	-	-	3	-	3	-	-	-	-	-	1	2	3
CO2	-	-	-	3	-	3	-	-	-	-	-	1	2	3
CO3	3	-	-	3	3	3	-	-	-	-	2	1	2	3
CO4	-	-	-	-	-	3	-	-	-	-	-	1	2	3
CO5	3	-	-	3	-	3	-	-	-	-	2	1	2	3
Av	1.2	-	-	2.4	0.6	3	-	-	-	-	0.4	1	2	3
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MTA09	VISION FOR HUMANE SOCIETY	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Objectives:

- To help the students to understand the importance and types of relationship with expressions.
- To develop the competence to think about the conceptual framework of undivided society as well as universal human order.
- To help the students to develop the exposure for transition from current state to the undivided society and universal human order.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Analyze the significance of feelings in ensuring justice in human-human relationships	**K3**
CO2	Formulate a conceptual framework of humane society based on relationship and harmony	**K2**
CO3	Evaluate the fulfilment in relationships in their personal and professional life with the understanding of established and expressed values.	**K3**
CO4	Develop the competence to work as a team based on relationship in different dimensions of life and society.	**K3**
CO5	Formulate the steps of transition from current state to humane society (the undivided society and universal human order).	**K4**

Course Contents

Unit I INTRODUCTION TO THE COURSE **7**

Basic aspiration of a Human Being and program for its fulfilment, Need for family and relationship for a Human Being, Human-Human relationship and role of work in its fulfilment, Comprehensive Human Goal, Need for Undivided Society, Need for Universal Human Order.

Unit II UNDERSTANDING HUMAN-HUMAN RELATIONSHIP & ITS FULFILMENT **6**

Recognition of Human-Human Relationship, Recognition of feelings in relationship, Established Values and Expressed Values in Relationship, interrelatedness of feelings and their fulfilment, Expression of feelings.

Unit III JUSTICE FROM FAMILY TO WORLD FAMILY ORDER **6**

Undivided Society as continuity and expanse of Justice in behaviour – family to world family order, continuity of culture and civilization, Universal Order on the basis of Undivided Society, Conceptual Framework for Universal human order.

Unit IV PROGRAM FOR ENSURING UNDIVIDED SOCIETY AND UNIVERSAL HUMAN ORDER **4**

Education –Sanskar, Health –Sanyam, Production-work, Exchange – storage, Justice-preservation.

Unit V HUMAN TRADITION **7**

Scope and Steps of Universal Human Order, Human Tradition (Ex. Family order to world family order), Steps for transition from the current state, Possibilities of participation of students in this direction, Present efforts in this direction, Sum up.

Total Periods **30**

Text Books:

1. Gaur, R. R., Sangal, R., and Bagaria, G. P., "A Foundation Course in Human Values and Professional Ethics", 2010, Excel Books India.
2. Gandhi, M. K., "Hind Swaraj: Indian Home Rule", 2014, Sarva Seva Sangh Prakashan.
3. Holborn, Martin, and Langley, Peter, "Sociology: Themes and Perspectives", 8th Ed., 2014, HarperCollins; originally published 1980.

Reference Books:

1. Dhar, P. L., and Gaur, R. R., "Science & Humanism – Towards a Unified Worldview", 1990, Commonwealth Publishers, New Delhi.
2. Nagraj, A., "Manav Vyavahar Darshan", Divya Path Sansthan, Amarkantak, India.
3. Kumarappa, J. C., "Economy of Permanence – A Quest for Social Order Based on Non-Violence", 2010, Sarva-Seva-Sangh-Prakashan, Varanasi, India.

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3. https://www.youtube.com/watch?v=AK3mTb_-1BQ
4. https://www.youtube.com/playlist?list=PLBvTTYUOHEmc2jUJh4gPaoqm_kKup1aqX

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	-	-	-	-	-	3	2	-	-	-	-	1	1	3
CO2	-	-	-	-	-	3	2	-	-	-	-	1	1	3
CO3	-	-	-	-	-	3	-	3	-	-	-	1	1	3
CO4	-	-	-	-	-	3	-	3	3	-	-	1	1	3
CO5	-	-	-	-	-	3	2	-	-	-	-	1	1	3
Av	-	-	-	-	-	3	1.2	1.2		-	-	1	1	3
3 – High; 2 – Medium; 1– Low; - No correlation														

Industry Oriented/ Linkage Courses

U23MEO01	STARTUP DEVELOPMENT - STAGE I (Problem Identification and Idea generation)	L	T	P	C
		1	0	0	1

Pre-Requisites : None

Objectives:

- Understand the importance of problem identification in the innovation process.
- Learn various methods and tools for identifying problems.
- Develop skills in creative thinking and idea generation.
- Evaluate and refine ideas for potential solutions.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Apply the design thinking process to engineering problems.	**K3**
CO2	Identify and articulate problems through research and analysis.	**K3**
CO3	Develop innovative solutions using design thinking techniques.	**K3**
CO4	Work effectively in teams to brainstorm and refine ideas.	**K3**
CO5	Present and defend their solutions clearly and persuasively.	**K3**

Course Contents:

MODULE 1 Introduction to Problem Identification **3**

Course Overview and Objectives - problem identification in innovation - Understanding Problems, Problem Identification Techniques

MODULE 2 Research and Data Collection **3**

Methods of Data Collection - Surveys and Questionnaires - Interviews and Focus Groups - Analysing Data - Qualitative vs. Quantitative data - Tools for data analysis

MODULE 3 Creative Thinking and Idea Generation **3**

Introduction to Creative Thinking - The importance of creativity in problem-solving Barriers to creativity - Brainstorming Techniques

MODULE 4 Idea Evaluation and Selection **3**

Criteria for Evaluating Ideas: Feasibility, Impact, Novelty - Techniques for Evaluating Ideas: Pros and Cons Analysis, Decision Matrix, Refining Ideas

MODULE 5 Application and Case Studies **3**

Applying Techniques to Real-World Problems: Case studies of successful problem identification and idea generation - Group activity

Total Periods **15**

Evaluation Method:

- Regular attendance and active participation in class discussions and activities.
- Assignments on design thinking techniques and problem-solving exercises.
- Presentation in problem identification and case studies.
- Final report on case studies and viva voce.

Reference Books:

1. Tim Brown, "Change by Design", 1st edition, 2009, HarperCollins e-books,US.
2. Don Norman, “The Design of Everyday Things", 2019, Basic Books, US.
3. Tom Kelley and David Kelley,"Creative Confidence", 2014, William Collins, US

Web Url(s):

1. https://nptel.ac.in/courses/110106124
2. https://nptel.ac.in/courses/112101005
3. https://onlinecourses.nptel.ac.in/noc21_de01/preview

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply , K4- Analyse K5- Evaluate, K6 – Create.

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	1	1	1	1	-	1	1	1	-	3
CO2	1	-	-	-	-	1	-	1	-	-	1	1	-	2
CO3	2	-	-	-	1	2	-	2	-	1	2	2	-	3
CO4	-	-	-	-	-	-	1	3	-	1	-	-	-	1
CO5	-	-	-	-	-	-	-	1	-	-	-	-	-	1
Av	2.7	-	-	-	1	1.3	1	1.6	-	1	1.3	1.3	-	2.0
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEO02	STARTUP DEVELOPMENT – STAGE II (Proof of Concept and Prototype)	L	T	P	C
		1	0	0	1

Pre-Requisites : None

Objectives:

- Understand the role and importance of proof of concept in the innovation process.
- Learn the methodologies and tools for creating effective proofs of concept.
- Develop skills in designing and building prototypes.
- Evaluate and refine prototypes based on feedback and testing.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Conceptualize and articulate the value of a Proof of Concept.	**K3**
CO2	Gain hands-on experience in developing and presenting a PoC.	**K3**
CO3	Understand the steps and considerations in prototype development.	**K3**
CO4	Evaluate and improve prototypes through iterative testing.	**K3**
CO5	Understand the process of bringing an idea from concept to prototype.	**K3**

Course Contents:

MODULE 1 Introduction to Proof of Concept **3**

Course Overview and Objectives - Proof of Concept in innovation -Definition and purpose of PoC - Planning a PoC - Resource allocation and timeline

MODULE 2 Developing a Proof of Concept **3**

Techniques - Rapid prototyping, Simulation and modelling - Tools and Technologies for PoC - Software tools - Presenting and Validating a PoC -Pitching techniques

MODULE 3 Introduction to Prototyping **3**

Fundamentals of Prototyping - Designing a Prototype - User-cantered design principles, Wire framing and mock ups Prototyping Tools and Materials

MODULE 4 Building and Testing Prototypes **3**

Steps in building a prototype - Developing a simple prototype - Testing and Evaluation, Usability testing - Performance and functionality testing

MODULE 5 Case Studies and Application **3**

Success stories of PoC and prototyping in industry - Group discussion and Final presentation of group activity

Total Periods: 15

Evaluation Method:

1. Regular attendance and active participation in class
2. Assignments in Proof of Concept and Prototyping
3. Presentation in Proof of concept and study projects
4. Group discussion and Presentation

Reference Books:

1. Eric Ries, "The Lean Start-up: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses", 2011, Oxford Press, UK
2. Jake Knapp, John Zeratsky, and Braden Kowitz, "Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days", 2016, Oxford Press, UK
3. Kathryn McElroy, "Prototyping for Designers: Developing the Best Digital and Physical Products", 2016, McGraw Publications, US.
4. Dan Saffer,"Designing for Interaction: Creating Innovative Applications and Devices", 2009, McGraw Publications, US.

Web Url(s):

1. https://onlinecourses.nptel.ac.in/noc21_me83/preview
2. https://onlinecourses.nptel.ac.in/noc23_me52/preview

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply , K4- Analyse K5- Evaluate, K6 – Create .

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	1	1	1	1	-	1	1	1	-	3
CO2	1	-	-	-	-	1	-	1	-	-	1	1	-	2
CO3	2	-	-	-	1	2	-	2	-	1	2	2	-	3
CO4	-	-	-	-	-	-	1	3	-	1	-	-	-	1
CO5	-	-	-	-	-	-	-	1	-	-	-	-	-	1
Av	2.7	-	-	-	1	1.3	1	1.6	-	1	1.3	1.3	-	2.0
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEO05	BASICS OF EMBEDDED CONTROL SYSTEMS	L	T	P	C
		1	0	0	1

Pre-Requisites : C Programming

Objectives:

- To understand the basics of C programming needed for control system applications.
- To learn how to write Embedded C programs for microcontroller-based systems.
- To practice using GPIOs for reading inputs and controlling outputs.
- To apply bitwise operations and bit fields for register-level programming.
- To understand interrupts and memory layout in embedded systems.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply fundamental C programming concepts such as control structures, arrays, pointers, and structures to develop basic I/O-based control applications	**K3**
CO2	Construct modular programs using data structures like stacks and queues and apply logical reasoning to solve control system problems.	**K3**
CO3	Demonstrate the setup of Embedded C development environments and develop programs for basic GPIO operations such as LED blinking and digital input reading.	**K3**
CO4	Implement register-level programming techniques using bitwise operations, structures, bit fields, and preprocessor directives for hardware-level control.	**K3**
CO5	Analyze the use of interrupts and memory organization in embedded systems and develop interrupt-based programs for real-time control applications.	**K4**

Course Contents:

MODULE 1 Essentials of C Programming for Embedded Contro **3**

Overview of C language syntax and structure - Looping and conditional statements - Arrays and pointers - Introduction to structures in C - Basic I/O programs for control applications

MODULE 2 Data Structures and C for Control Logic **3**

Recap of arrays, pointers, and structures - Introduction to data structures (e.g., stacks and queues) Logic building for control systems - Menu-driven programs and modular coding practices - Practice tasks using decision-making and loops

MODULE 3 Introduction to Embedded C and GPIO **3**

Installation and setup of Embedded C IDE (e.g., Keil, MPLAB) - Writing basic Embedded C programs (e.g., LED blink) - Bitwise operators and bit manipulation techniques - Reading from and writing to GPIO pins - Coding exercises using digital I/O

MODULE 4 Register Access and Bit Fields **3**

Use of structures and bit fields in Embedded C - Register-level programming and hardware control Practical use of bit fields for GPIO access - Preprocessor directives and macros in Embedded C - Hands-on tasks with register and bit-level control

MODULE 5 Interrupts and Embedded Memory Concepts **3**

Introduction to interrupts and ISRs (Interrupt Service Routines) - Writing interrupt-based Embedded C programs - Memory layout in embedded systems (code, data, stack segments) - Handling external inputs using interrupts - Practice exercise: LED control with external interrupt

Total Periods **15**

Assessment & Evaluation:

1. Hands-on Assignment: Mini-task based on GPIO and bit manipulation.
2. Quiz/Test: MCQs and code snippets based on C and Embedded C fundamentals.

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply , K4- Analyse K5- Evaluate, K6 – Create .

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	1	1	1	1	-	1	1	1	-	3
CO2	1	-	-	-	-	1	-	1	-	-	1	1	-	2
CO3	2	-	-	-	1	2	-	2	-	1	2	2	-	3
CO4	-	-	-	-	-	-	1	3	-	1	-	-	-	1
CO5	-	-	-	-	-	-	-	1	-	-	-	-	-	1
Av	2.7	-	-	-	1	1.3	1	1.6	-	1	1.3	1.3	-	2.0
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEO06	EMBEDDED CONTROL SYSTEMS DESIGN AND INTEGRATION	L	T	P	C
		1	0	0	1

Pre-Requisites : C Programming

Objectives:

- To introduce the basic architecture and functioning of microcontrollers and their hardware interfaces.
- To develop foundational skills in sensor and actuator interfacing with embedded systems.
- To enable students to design signal conditioning circuits and implement ADC-based data acquisition.
- To impart knowledge on microcontroller communication protocols and actuator control mechanisms.
- To provide hands-on experience in integrating embedded control systems for real-time applications.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the architecture and basic interfacing principles of microcontrollers used in embedded system	**K2**
CO2	Apply concepts of analog signal conditioning to design ADC interfaces and acquire sensor data	**K3**
CO3	Interface and interpret data from various physical sensors such as temperature, pressure, and speed sensors.	**K3**
CO4	Design actuator control systems and implement communication protocols for real-time applications.	**K4**
CO5	Integrate sensors, actuators, and control logic to build and validate embedded control systems through practical tasks.	**K4**

Course Contents:

MODULE 1 Introduction to Microcontroller Basics **3**

Microcontroller Basics - Electrical and Electronic Fundamentals - Practical Hardware Skills - Sensor and Actuator Fundamentals - Handling Microcontroller Inputs/Outputs Properly

MODULE 2 Signal Conditioning and Sensor Interfacing **3**

Analog Signal Conditioning and ADC Interface Design - Interfacing and Reading Position Sensors - Interfacing and Reading Temperature Sensors

MODULE 3 Microcontroller Communication **3**

Interfacing and Reading Pressure Sensors - Interfacing and Reading Speed Sensors - Microcontroller Communications

MODULE 4 Actuator Interfacing and Control **3**

Actuator Driver Circuit Design and Implementation - Actuator Control: Injectors and Ignition Systems

MODULE 5 Integration and Practical Applications **3**

Problem Statements & Practical Tasks

Total Periods: 15

Assessment & Evaluation:

1. Students will complete and demonstrate practical tasks at the end of each module/unit.
2. Students will design, implement, and present a mini embedded control system (e.g., sensor-actuator integration with feedback control).
3. Individual viva sessions will be conducted after each unit.

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply , K4- Analyse K5- Evaluate, K6 – Create .

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	1	1	1	1	-	1	1	1	-	3
CO2	1	-	-	-	-	1	-	1	-	-	1	1	-	2
CO3	2	-	-	-	1	2	-	2	-	1	2	2	-	3
CO4	-	-	-	-	-	-	1	3	-	1	-	-	-	1
CO5	-	-	-	-	-	-	-	1	-	-	-	-	-	1
Av	2.7	-	-	-	1	1.3	1	1.6	-	1	1.3	1.3	-	2.0
3 – High; 2 – Medium; 1– Low; - No correlation														

Professional Electives I & II

U23MEV01	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To introduce the development of Additive Manufacturing (AM) and its applications
- To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
- To be acquainted with vat polymerization and direct energy deposition processes
- To be familiar with powder bed fusion and material extrusion processes.
- To gain knowledge on applications of binder jetting, material jetting and sheet lamination processes

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the development of Additive Manufacturing technology and its various business opportunities. .	**K2**
CO2	Describe the process of transforming a concept into the final product in AM technology.	**K2**
CO3	Illustrate the vat polymerization and direct energy deposition processes and its applications	**K3**
CO4	Explain the process and applications of powder bed fusion and material extrusion	**K3**
CO5	Describe the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes	**K3**

Course Contents

Unit I INTRODUCTION TO ADDITIVE MANUFACTURING 9

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing Process Chain- Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing- Electronics Printing. – Automobile, Aerospace, Healthcare. Business Opportunities and Future Directions

Unit II VAT POLYMERIZATION 9

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process – top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP)Technology.

Unit III DIRECTED ENERGY DEPOSITION AND POWDER BED FUSION 9

Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery - Materials -Benefits -Applications. Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications.

Unit IV MATERIAL EXTRUSION, 3D PRINTING AND LOM 9

Material Extrusion: Fused Deposition Modelling (FDM)- Process-Materials -Applications and Limitations. Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multi jet Modelling- Materials - Process - Benefits - Applications. Laminated Object

Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation.

Unit V DESIGN FOR ADDITIVE MANUFACTURING 9

oncepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization- Generative design - Lattice Structures - Multi-Material Parts and Graded Materials – Data Processing: CAD Model Preparation - AM File formats: STL-Problems with STL- Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation – Design rules for Extrusion based AM.

Total Periods 45

Text Books:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani “Additive manufacturing Technologies”, 3rd edition,2021, Springer Cham, ISBN: 978-3-030-561260, Switzerland.
2. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, 2015, Hanser publications, ISBN: 978-1-56990-582-1, USA.

Reference Books:

1. Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1st Edition, 2015, CRC Press. ISBN-13: 978-1482223590. United States.
2. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, 2006, Springer., , ISBN: 978-1-4614-9842-1, United States.
3. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, 2011, CRC Press., , ISBN: 9780849334092, United States.
4. Milan Brandt, “Laser Additive Manufacturing: Materials, Design, Technologies, and Applications”, 2016, Woodhead Publishing., , ISBN: 9780081004333, United Kingdom.

Web URL(s):

1. https://nptel.ac.in/courses/112/104/112104265/
2. https://nptel.ac.in/courses/110/106/110106146/
3. https://archive.nptel.ac.in/courses/112/103/112103306/

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1	1	1	1	-	-	1	-	-	1	3	1	2
CO2	3	2	2	2	1	-	-	1	-	-	1	3	1	2
CO3	3	2	2	2	1	-	-	-	-	-	1	3	1	2
CO4	3	2	2	2	1	-	-	1	-	-	1	3	1	2
CO5	3	2	2	2	1	-	-	1	-	-	1	3	1	2
Av	3	1.8	1.8	1.8	1	-	-	1	-	-	1	3	1	2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV02	DESIGN FOR X	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To understand the general design principles for manufacturability, including strength, mechanical factors, and process capability.
- To learn about the factors influencing form design, including material choices and manufacturing methods.
- To apply component design considerations for casting and machining processes to optimize manufacturability.
- To learn the design principles specific to additive manufacturing (AM).
- To understand the sustainable design practices that incorporate principles such as dematerialization, modularization, and recyclability.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain how assembly limits, datum features, and tolerance stacks impact the manufacturability of a design.	**K3**
CO2	Identify and list the factors influencing form design, including material choices and manufacturing methods.	**K3**
CO3	Apply component design considerations for casting and machining processes to optimize manufacturability.	**K3**
CO4	Illustrate design optimization for additive manufacturing of parts that includes interlocking features and reduced part count.	**K3**
CO5	Apply product design concepts for its environmental impact, focusing on material usage, energy efficiency, and recyclability.	**K3**

Course Contents

Unit I INTRODCUTION 9

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric Tolerances - Assembly limits -Datum features - Tolerance stacks. Design to minimize material usage – Design for disassembly – Design for recyclability – Design for manufacture – Design for energy efficiency – Design to regulations and standards.

Unit II FACTORS INFLUENCING FORM DESIGN 9

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice –Influence of materials on form design - form design of welded members, forgings and castings.

Unit III COMPONENT DESIGN – CASTING AND MACHINING CONSIDERATON 9

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Design features to facilitate machining - drills - milling cutters - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability.

Unit IV DESIGN CONSIDERATIONS 9

Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts

and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers.

Unit V SUSTAINABLE DESIGN 9

The Natural Step, biomimicry, design for reuse, dematerialization, modularization, Design to minimize material usage – Design for disassembly – Design for recyclability – design for flexibility, design for disassembly, design for inverse manufacturing, design for the environment, – Design for energy efficiency – Design to regulations and standards etc.

Total Periods 45

Text Books:

1. James G. Bralla, "Design for Manufacturability Handbook", 2nd Edition, 1999, McGraw Hill Professional, USA.
2. Boothroyd, G., Dewhurst, P., and Knight, W.A., "Product Design for Manufacture and Assembly", 3rd Edition, 2010, CRC Press (Taylor & Francis Group), USA.
3. Graedel, T. E., and Allenby, B. R., "Design for the Environment", 1st Edition, 1998, Prentice Hall, NJ, USA.

Reference Books:

1. Corrado Poli, "Design for Manufacturing: A Structured Approach", First Edition, 2001, Elsevier, USA.
2. David M. Anderson, "Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production", 2nd Edition, 2020, Taylor & Francis Group, USA.
3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, first Edition, 2014, Elsevier, USA.

Web URL(s):

3. https://nptel.ac.in/courses/112107217
4. https://onlinecourses.nptel.ac.in/noc19_me48/preview
5. https://nptel.ac.in/courses/107103012
6. https://www.udemy.com/course/manufacturing-process-selection-and-design-for-manufacturing/?couponCode=LEADERSALE24B

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	3	1	1	-	-	1	-	-	1	3	2	3
CO2	2	2	3	1	1	-	-	1	-	-	1	3	2	2
CO3	2	2	3	1	1	-	-	1	-	-	1	3	1	3
CO4	2	2	3	1	1	-	-	1	-	-	1	3	1	3
CO5	2	2	3	1	1	-	-	1	-	-	1	2	3	3
Av	2	2	3	1	1	-	-	1	-	-	1	2.8	1.8	2.8
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV03	ERGONOMICS IN DESIGN	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To introduce to industrial design based on ergonomics.
- To consider ergonomics concept in manufacturing
- To apply ergonomics in design of controls and display.
- To apply environmental factors in ergonomics design.
- To develop aesthetics applicable to manufacturing and product

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Discuss ergonomics need in the industrial design.	**K3**
CO2	Apply ergonomics in creation of manufacturing system	**K3**
CO3	Illustrate design of controls and display	**K3**
CO4	State environmental factors in ergonomics design	**K3**
CO5	Infer importance of aesthetics to manufacturing system and product	**K3**

Course Contents

Unit I INTRODUCTION **9**

An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems- Ergonomics and Industrial Design: Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment-light, Heat, Sound.

Unit II ERGONOMICS AND PRODUCTION **9**

Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt's perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form.

Unit III DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS **9**

Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls: Design considerations, Controls with little efforts – Push button, Switches, rotating Knobs. Controls with muscular effort – Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles, Machine Tools

Unit IV ENVIRONMENTAL FACTORS **9**

Colour: Colour and light, Colour and objects, Colour and the eye – after Image, Colour blindness, Colour constancy, Colour terms – Colour circles, Munsel colour notation, reactions to colour and colour combination – colour on engineering equipments, Colour coding, Psychological effects, colour and machine form, colour and style.

Unit V AESTHETIC CONCEPTS **9**

Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout software's, total layout design.

Total Periods 45

Text Books:

1. Marcelo M. Soares, Francisco Rebelo, "Ergonomics in Design: Methods and Techniques (Human Factors and Ergonomics)", First Edition, 2016, CRC Press; USA.
2. "Ergonomics in Product Design". First Edition, 2018, Sendpoints Publishing Co. Ltd, China.

Reference Books:

1. Martin Helander, "A Guide to human factors and Ergonomics",2nd Edition, 2005, CRC Press, USA.
2. Bridger, R.C., "Introduction to Ergonomics", 3rd Edition, 2008, McGraw Hill India Pvt Ltd, Noida.
3. Benjamin W. Niebel, "Motion and Time Study", 7th Edition, 2002, Richard, D. Irwin Inc, USA.
4. Mayall W.H. "Industrial design for Engineers", 1988, London Hiffee books Ltd. UK.

Web URL(s):

1. https://archive.nptel.ac.in/courses/107/103/107103004/
2. https://onlinecourses.nptel.ac.in/noc23_de21/preview
3. https://archive.nptel.ac.in/courses/112/104/112104222/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	-	-	-	2	-	-	-	-	-	1	3	-	2
CO2	1	-	-	-	2	-	-	1	-	-	1	3	-	3
CO3	1	-	-	-	2	-	-	1	-	-	1	3	-	2
CO4	1	-	-	-	2	-	-	1	-	-	1	2	-	3
CO5	1	-	-	-	2	-	-	1	-	-	1	2	-	3
Av	1	-	-	-	2	-	-	0.8	-	-	1	2.6	-	2.6
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV08	DIGITAL MANUFACTURING AND IOT	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To study the various aspects of digital manufacturing.
- To inculcate the importance of DM in Product Lifecycle Management and Supply chain Management.
- To formulate of smart manufacturing systems in the digital work environment.
- To interpret IoT to support the digital manufacturing.
- To elaborate the significance of digital twin.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the various elements in the digital manufacturing.	**K3**
CO2	Describe the digital product development life cycle process and supply chain management in digital environment.	**K3**
CO3	Examine the procedure of validating practical work through digital validation in Factories.	**K3**
CO4	Demonstrate the concepts of IoT and its role in digital manufacturing.	**K3**
CO5	Analyse various practical manufacturing process through digital twin.	**K3**

Course Contents

Unit I INTRODUCTION **9**

Introduction – Need – Overview of Digital Manufacturing and the Past – Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management – Practical Benefits of Digital Manufacturing – The Future of Digital Manufacturing

Unit II DIGITAL LIFE CYCLE AND SUPPLY CHAIN MANAGEMENT **9**

Collaborative Product Development, Mapping Requirements to specifications – Part Numbering, Engineering Vaulting, and Product reuse – Engineering Change Management, Bill of Material and Process Consistency – Digital Mock up and Prototype development – Virtual testing and collateral. Overview of Digital Supply Chain - Scope& Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM

Unit III SMART FACTORY AND INDUSTRY 4.0 **9**

Smart Factory – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT- Key Principles of a Smart Factory – Creating a Smart Factory – Smart Factories and Cybersecurity

Unit IV INTERNET OF THINGS **9**

Introduction – Industry 4.0 –Internet of Things – Industrial Internet of Things – Framework: Connectivity devices and services – Intelligent networks of manufacturing – Cloud computing – Data analytics –Cyber physical systems –Machine to Machine communication – Case Studies.

Unit V DIGITAL TWIN TECHNOLOGY 9

Basic Concepts – Features and Implementation – Digital Twin: Digital Thread and Digital Shadow- Building Blocks – Types – Characteristics of a Good Digital Twin Platform – Benefits, Impact & Challenges – Future of Digital Twins

Total Periods 45

Text Books:

1. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, "Fundamentals of Digital Manufacturing Science", First Edition, 2011, Springer-Verlag London Limited, UK.
2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", First Edition, 2016, Apress, USA

Reference Books:

1. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", first Edition, 2019, Elsevier Science. United States.
2. Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", First Edition, 2018, Springer., Switzerland.
3. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing the Digital Transformation", First Edition, 2017, Springer Series in Advanced Manufacturing., Switzerland.
4. Lihui Wang and Andrew YehChing Nee, "Collaborative Design and Planning for Digital Manufacturing", first Edition, 2009, Springer-Verlag London Limited, UK.

Web URL(s):

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Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	1	-	3	3	-	-	-	-	1	3	1	2
CO2	3	2	3	1	3	3	-	1	1	-	1	3	2	2
CO3	3	2	3	1	3	3	-	1	1	-	1	3	1	3
CO4	3	2	2	1	3	3	-	1	1	2	1	3	2	3
CO5	3	-	2	1	3	3	-	1	1	-	1	3	2	3
Av	3	1.2	2.2	0.8	3	3	-	0.8	08.	0.4	1	3	1.6	2.6
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV09	LEAN MANUFACTURING	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To introduce the basics of 6 SIGMA
- To learning about the lean manufacturing tools.
- To study about the deeper understanding methodologies of Lean manufacturing.
- To study the lean concepts and its elements.
- To learn implementation and challenges of lean manufacturing

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Discuss the basics of SIX SIGMA	**K3**
CO2	Apply the lean manufacturing tools	**K3**
CO3	Describe about the deeper understanding methodologies of Lean manufacturing	**K3**
CO4	Explain the lean concepts and its elements	**K3**
CO5	Illustrate the implementation and challenges of lean manufacturing	**K3**

Course Contents

Unit I BASICS OF SIX SIGMA 9

Introduction to Six Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources of variation, Mean and moving the mean, Various quality costs, cost of poor quality.

Unit II LEAN MANUFACTURING TOOLS 9

Process Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP, PPAP. 3 foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and PDCA for sustaining improvements

Unit III PROCESS MANAGEMENT METHODOLOGIES 9

What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, PDCA, DMAIC and continuous improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System, Six Sigma and Production System integration

Unit IV LEAN ELEMENTS 9

Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost. Building Zero defect capabilities, Cultural and Organizational aspects

Unit V IMPLEMENTATION AND CHALLENGES 9

Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.

Total Periods 45

Text Books:

1. Akhilesh N. Singh, "Lean Manufacturing: Principles to Practice", First edition, 2011, Bibliophile South Asia, Infotech Standards India Pvt Ltd, New Delhi.
2. Juran J M, Gryna F M, "Quality Planning and Analysis". 5th Edition, 2007, Mc Graw Hill, USA..

Reference Books:

1. Erick C Jones, "Quality Management for Organizations Using Lean Six Sigma Techniques", First Edition, 2014, CRC Press, USA.
2. Masaki Imai, "Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy", 2nd edition, 2012, McGraw-Hill Education , USA.

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1. https://nptel.ac.in/courses/110105123
2. https://qcin.org/nbqp/knowledge_bank
3. https://archive.nptel.ac.in/courses/110/107/110107130/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	-	-	-	1	-	-	1	-	3	1	3	-	-
CO2	1	-	-	-	1	-	-	1	-	3	1	3	-	-
CO3	1	-	-	-	1	-	-	1	-	3	1	3	-	-
CO4	1	-	-	-	1	-	-	1	-	3	1	3	-	-
CO5	1	-	-	-	1	-	-	1	-	3	1	3	-	-
Av	1	-	-	-	1	-	-	1	-	3	1	3	-	-
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV10	GREEN MANUFACTURING DESIGN AND PRACTICES	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To introduce the concept of environmental design and industrial ecology.
- To impart knowledge about air pollution and its effects on the environment.
- To enlighten the students with knowledge about noise and its effects on the environment.
- To enlighten the students with knowledge about water pollution and its effects on the environment.
- To introduce the concept of green co-rating and its need

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the environmental design and selection of eco-friendly materials.	**K3**
CO2	Analyse manufacturing processes towards minimization or prevention of air pollution	**K3**
CO3	Analyse manufacturing processes towards minimization or prevention of noise pollution	**K3**
CO4	Analyse manufacturing processes towards minimization or prevention of water pollution.	**K3**
CO5	Calculate green co-rating and its benefits	**K3**

Course Contents

Unit I DESIGN FOR ENVIRONMENT AND LIFE CYCLE ASSESSMENT 9

Environmental effects of design -selection of natural friendly material - Eco design – Environmental damage Material flow and cycles – Material recycling – Emission less manufacturing- Industrial Ecology – Pollution prevention – Reduction of toxic emission – design for recycle.

Unit II AIR POLLUTION SAMPLING AND MEASUREMENT 9

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants-solution to the atmosphere dispersion equationthe Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dixide, carbon monoxide, oxidants and ozone.

Unit III NOISE POLLUTION AND CONTROL 9

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise-Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects.

Unit IV WATER DEMAND AND WATER QUALITY 9

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non-portable

use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.

Unit V GREEN CO-RATING 9

Ecological Footprint - Need For Green Co-Rating – Green Co-Rating System – Intent – System Approach – Weightage- Assessment Process – Types Of Rating – Green Co-Benefits – Case Studies Of Green Co- Rating

Total Periods 45

Text Books:

1. Rao M.N. and Dutta A.K. "Wastewater treatment", 3rd Edition, 2007, Oxford & IBH publishing Co. Pvt. Ltd., New Delhi.
2. Gradel.T.E. and Allenby B.R, "Industrial Ecology", 2nd Edition, 2010, Prentice Hall of India Ltd, New Delhi.

Reference Books:

1. Rao CS, "Environmental Pollution Control Engineering", 4th Edition, 2022, New Age International (P) Ltd, New Delhi.
2. Lewis H Bell and Douglas H Bell, "Industrial noise control, Fundamentals and applications", 2nd Edition, 1994, CRC Press, USA.
3. World Commission on Environment and Development (WCED): Our Common Future, 4th Edition, 2005, Oxford University Press, UK.

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1. https://nptel.ac.in/courses/110104119
2. https://archive.nptel.ac.in/courses/112/104/112104225/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	1	3	1	-	3	-	1	-	-	1	2	-	2
CO2	1	1	3	1	-	3	-	1	-	-	1	3	-	2
CO3	1	1	3	1	-	3	-	1	-	-	1	3	-	2
CO4	1	1	3	1	-	3	-	1	-	-	1	3	-	2
CO5	1	1	3	1	-	3	-	1	-	-	1	2	-	2
Av	1	1	3	1	-	3	-	1	-	-	1	2.6	-	2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV15	ENERGY STORAGE DEVICES	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To study the various types of energy storage devices and technologies and them comparison.
- To learn the techniques of various energy storage devices and their performances.
- To learn the basics of batteries and hybrid systems for EVs and other mobile applications.
- To learn about the renewable energy storage systems and management systems.
- To have an insight into other energy storage devices, hydrogen, and fuel cells.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the need and identify the suitable energy storage devices for applications	**K3**
CO2	Describe the working of various energy storage devices and their importance.	**K3**
CO3	Illustrate the basic characteristics of batteries for mobile and hybrid systems.	**K3**
CO4	Illustrate the storage of renewable energies and management systems	**K3**
CO5	Explore the need for other energy devices and their scope for applications.	**K3**

Course Contents

Unit I INTRODUCTION TO ENERGY STORAGE **9**

Need for Energy Storage – Types of Energy Storage – Various forms of Energy Storage – Mechanical– Thermal - Chemical– Electrochemical – Electrical - Other alternative energy storage technologies – Efficiency and Comparison

Unit II ENERGY STORAGE SYSTEMS **9**

Pumped Air Energy Storage – Compressed Air Energy Storage – Flywheel – Sensible and Latent Heat Storage – Storage Materials – Performance Evaluation - Thermochemical systems – Batteries – Types- Charging and Discharging – Battery testing and performance

Unit III HYBRID ENERGY STORAGE SYSTEMS **9**

Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby supplies – V2G and G2V technologies – HESS.

Unit IV RENEWABLE ENERGY STORAGE AND ENERGY MANAGEMENT **9**

Storage of Renewable Energy Systems –Solar Energy – Wind Energy – Energy Storage in Micro grid– Smart Grid – Energy Conversion Efficiency - Battery Management Systems – EVBMS – Energy Audit and Management

Unit V OTHER ENERGY DEVICES **9**

Superconducting Magnetic Energy Storage (SMES), Supercapacitors – MHD Power generation – Hydrogen Storage - Fuel Cells – Basic principle and classifications – PEMFC, AMFC, DMFC, SOFC, MCFC and Biofuel Cells – Biogas Storage.

Total Periods **45**

Text Books:

1. Rober Huggins, "Energy Storage: Fundamentals, Materials and Applications", 2nd Edition, 2016, Springer India Pvt Ltd, New Delhi.
2. Dell, Ronald M R and, David A J, "Understanding Batteries", 1st Edition, 2001, Royal Society of Chemistry, UK.

Reference Books:

1. Francisco Díaz-González, Andreas Sumper, Oriol Gomis Bellmunt, "Energy Storage in Power Systems", 1st Edition, 2016, Wiley, USA.
2. Ibrahim Dincer and Mark A Rosen, "Thermal Energy Storage Systems and Applications", 3rd Edition, 2021, Wiley & Sons, USA.
3. Aulice Scibioh M. and Viswanathan B, "Fuel Cells – principles and applications', First Edition, 2006, University Press (India)Pvt Ltd, Hyderabad.
4. Ru-Shiliu, Leizhang, Sueliang Sun, "Electrochemical Technologies for Energy Storage and Conversion", First edition, 2012, Wiley , Weinheim, Germany.

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1. https://nptel.ac.in/courses/113105102
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3. https://en.wikipedia.org/wiki/Energy_storage
4. https://www.sciencedirect.com/topics/computer-science/energy-storage-device

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	-	1	-	-	-	-	-	-	3	2
CO2	3	-	-	-	1	2	-	1	1	1	-	-	3	2
CO3	3	-	-	-	1	2	-	1	1	1	-	-	3	2
CO4	3	-	-	-	1	2	-	1	1	1	-	-	3	2
CO5	3	-	-	-	-	2	-	-	-	-	-	-	3	2
Av	3	-	-	-	0.6	1.8	-	0.6	0.6	0/6	-	-	3	2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV16	RENEWABLE ENERGY TECHNOLOGIES	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To learn about solar radiation, solar thermal system application and fundamentals of solar photovoltaic.
- To study about the potential and energy conversion process of wind Energy.
- To explore the various bio-energy, Ocean Thermal Energy and Geothermal Energy technologies.
- To study the other energy sources.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the solar radiation, and its conversion into heat using solar collector and working concept of solar photovoltaic system.	**K3**
CO2	Describe the energy conversion process of wind energy.	**K3**
CO3	Illustrate the various bio-energy technologies.	**K3**
CO4	Illustrate the fundamentals concepts of ocean thermal energy systems and geothermal thermal energy systems.	**K3**
CO5	Explain the other energy sources.	**K3**

Course Contents

Unit I SOLAR ENERGY **9**

Basic concepts on solar radiation, potential of solar energy; Solar collectors: Flat plate collectors, evacuated tubes, concentrators; Solar plant configurations, Fundamentals of solar photo voltaic conversion - series and parallel connections - Solar PV applications.

Unit II WIND ENERGY **9**

Basic principles of wind energy conversion - classification of wind turbines - Horizontal axis wind turbine - Vertical axis wind turbine – wind power generation curves, wind data and energy estimation. Site selection considerations.

Unit III BIO-ENERGY **9**

Bio mass resources, Energy from Bio mass, Biofuels classification, Biomass gasification- Technologies for utilisation of biomass, Biogas - Production, factors affecting biogas production, biogas plants, Bio mass Cogeneration.

Unit IV OCEAN AND GEOTHERMAL ENERGY **9**

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

Unit V OTHER ENERGY SOURCES **9**

Magneto hydrodynamic system (MHD), thermionic and thermos- electric generator, micro-hydel systems, hybrid systems and applications; Fuel cells: Classification, advantages and
Applications - Hydrogen production and storage methods.

Total Periods **45**

Text Books:

1. Rai G D, "Non-Conventional Sources of Energy", 6th Edition, 2017, Khanna Publishers, New Delhi.
2. Aldo Vieira da Rosa, "Fundamentals of Renewable Energy Processes", 3rd Edition, 2012, Elsevier Academic Press, USA .

Reference Books:

1. Kothari P, Singal K C, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", 2nd Edition, 2011, PHI Learning Ltd, Delhi.
2. Twidell, J.W. & Weir A., "Renewable Energy Resources", 2015, EFNSpon Ltd., UK.
3. Bent Sorensen, "Renewable Energy", 5th Edition, 2017, Academic Press, UK.
4. Sukhatme, Suhas P., and J. K. Nayak. "Solar Energy". First Edition, 2017, McGraw-Hill Education Pvt Ltd, Noida.
5. Cengel, Yunus A., "Fundamentals and Applications of Renewable Energy", 2019, McGraw Hill LLC, USA.
6. Bhatia, S. C., and Gupta, R. K., "Textbook of Renewable Energy", First Edition, 2018, Woodhead Publishing India PVT. Limited, New Delhi.

Web URL(s):

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2. https://onlinecourses.nptel.ac.in/noc23_me138/preview
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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	-	1	3	-	-	-	-	1	-	3	1
CO2	3	2	1	-	1	3	-	-	-	-	1	-	3	1
CO3	3	2	1	-	1	3	-	-	-	-	1	-	3	1
CO4	3	2	1	-	1	3	-	-	-	-	1	-	3	1
CO5	3	2	1	-	1	3	-	-	-	-	1	-	3	1
Av	3.0	2.0	1.0	-	1.0	3.0	-	-	-	-	1.0	-	3.0	1.0
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV17	SENSORS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development
- To learn about the optical, pressure and temperature sensor
- To understand the signal conditioning and DAQ systems

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Interpret various calibration techniques and signal types for sensors.	**K3**
CO2	Explain the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducers.	**K3**
CO3	Apply the various sensors and transducers in various applications	**K3**
CO4	Analyse the appropriate sensor for different applications	**K3**
CO5	Analyse the signals from different sensors using Data acquisition systems.	**K3**

Course Contents

Unit I INTRODUCTION **9**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

Unit II MOTION, PROXIMITY AND RANGING SENSORS **9**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

Unit III FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

Unit IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS **9**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

Unit V SIGNAL CONDITIONING AND DAQ SYSTEMS **9**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multichannel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

Total Periods **45**

Text Books:

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", 6th Edition, 2019, McGraw-Hill Education, New York, USA.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th Edition, 2013, Dhanat Rai & Co, New Delhi.

Reference Books:

1. Hans Kurt Tönshoff (Editor), Ichiro, "Sensors in Manufacturing- Volume 1", First edition, 2001, Wiley-VCH, USA.
2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", First Edition, 1999, Oxford Science Publications, UK.
3. Patranabis D, "Sensors and Transducers", 2nd Edition, 2011, PHI, New Delhi.
4. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, 2015, CRC Press, USA.

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2. https://onlinecourses.nptel.ac.in/noc23_ee105/preview

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	1	-	-	-	-	-	-	1	3	1	2
CO2	3	2	1	2	2	1	-	-	1	-	1	3	1	2
CO3	3	2	1	2	2	1	-	-	1	-	1	3	1	3
CO4	3	2	1	2	2	1	-	-	1	-	1	3	1	3
CO5	3	2	1	2	2	1	-	-	1	1	1	2	1	3
Av	3	2	1	2	1.6	0.8	-	-	0.8	0.2	1	2.8	1	2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV22	HEATING, VENTILATION AND AIR-CONDITIONING	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To emphasize the importance of heating, ventilation and air-conditioning systems.
- To provide the skills necessary to obtain an entry-level HVAC Technician position.
- To understand se HVAC practices and how important they are *in* the HVAC environment.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Assist in the installations of Heating, Air Conditioning and Refrigeration equipment.	**K3**
CO2	Perform preventive maintenance on heating and air-conditioning systems	**K3**
CO3	Identify the suitability of the site and its related hazards.	**K3**
CO4	Understand the principles and working HVAC systems	**K4**
CO5	Analyse psychrometric chart in refrigeration systems. Develop problem solving skills through the application of thermodynamics	**K4**

Course Contents

Unit I INTRODUCTION TO HVAC **9**

Fundamentals-Modes of Heat Transfer-Sensible Heat and Latent Heat-Basic Components of Air-Conditioning and Refrigeration machines-Basic Refrigeration System or Vapor Compression Cycle-Pressure –Enthalpy Chart- Function and Types of Compressor- Function and Types of Condenser-Function & Types of Expansion Valves, Function & Types of Evaporator-Accessories used in the System-Refrigerant and Brines

Unit II CLASSIFICATION OF AIR-CONDITIONING SYSTEM **9**

Window A/C-Working of Window A/C with Line Diagrams-Split A/C-Types - Working of Split A/C with Line Diagrams-Ductable Split A/C Working of Ductable Split A/C with Line Diagrams-Variable Refrigerant Volume (VRV)/ Variable Refrigerant Flow (VRF)-Ductable Package A/C-Working of Ductable Package A/C with Line Diagrams

Unit III STUDY OF PSYCHROMETRIC CHARTS **9**

Dry Bulb Temperature-Wet Bulb Temperature-Dew Point Temperature-Relative Humidity-Humidity Ratio-Processes, Heating, Cooling, Cooling and Dehumidification, Heating and Humidification

Unit IV LOAD CALCULATION **9**

Survey of Building-Cooling Load Steps-Finding Temperature difference(ΔT)- Wall, Glass, Roof, partition-Finding 'U' Factor-Wall, Glass, Roof, Partition-Finding Ventilation requirement for IAQ-Load Calculations (Manually using E-20 form)- ESHF, ADP & Air Flow Rate (CFM)Calculation.

Unit V STATIC PRESSURE CALCULATION **9**

Selection of Motor HP-Selection Fan/Blower RPM-Hydronic System-ClassificationofWaterPiping-Pipesizingforchillwatersystem-FittingsusedintheHVAC Piping System-Valves used in the HVAC Piping System-Function of Valves-Openings for CHW Pipes passing through Wall-Sectional drawing @ CHW Pipe supports-Pump Head Calculation- Selection of Pump.

Total Periods **45**

Text Books:

1. Samuel C. Sugarman, "HVAC Fundamentals", 2nd Edition, 2016, Fairmont Press,USA.
2. Robert Mcdowall, "Fundamentals of HVAC Systems", First Edition, 2007, Academic Press, USA.

Reference Books:

1. Hazim B. Awbi, "Ventilation Systems: Design and Performance", First Edition, 2007, Rout ledge, UK.
2. Neil McManus, "Portable Ventilation Systems Hand Book", First Edition, 2000, CRC Press, USA.
3. John L Alden, "Design of Industrial Ventilation Systems", 5th Edition, 2009, Industrial Press, USA.

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Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	-	-	2	-	1	-	-	1	2	3	2
CO2	2	1	1	1	-	2	--	1	1	1	1	2	3	1
CO3	2	1	1	1	1	2	-	1	1	1	1	2	2	1
CO4	2	1	1	1	1	2	-	1	-	1	1	1	3	2
CO5	2	1	1	1	-	2	-	1	-	-	1	1	3	2
Av	2	1	0.8	0.8	0.4	2	-	1	0.4	0.6	1	1.6	2.8	1.6
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV23	POWER GENERATION SYSTEMS	L	T	P	C
		3	0	0	3

Pre-Requisites **:** Engineering Thermodynamics and Thermal Engineering.

Objectives:

- To understand the concept of sources of electrical power system.
- To improvise knowledge on working of the components inside hydro and thermal power generation systems.
- To study about the construction and working of the components of nuclear and gas turbine power generation systems.
- To comprehend about the working of the components of diesel and combine cycle Power generation systems.
- To learn the power from non-conventional energy sources.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Illustrate the concept of sources of electrical power	**K3**
CO2	Explain the layout, construction and working of the components inside a hydro and thermal power generation	**K3**
CO3	Demonstrate the layout, construction and working of the components inside a nuclear and gas turbine power generation systems	**K3**
CO4	Clarify the layout, construction and working of the components inside Diesel and Combine cycle Power generation systems	**K3**
CO5	Summarize the concepts, working principles of non-conventional power generation systems.	**K3**

Course Contents

Unit I SOURCES OF ELECTRICAL POWER **9**

Classification of Energy Resources; Conventional Energy Resources – Types, Availability and their limitations; Non-Conventional Energy Resources –Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario, Environmental Issues of Present Day Power Generation.

Unit II HYDRO AND THERMAL POWER GENERATION **9**

Hydroelectric Power Generation- Selection of site – Classification - Runoff river plants, pumped storage plants, underground stations. Thermal Power Generation - Site selection -
Components and Layout - Fuel and Ash Handling system.

Unit III NUCLEAR AND GAS TURBINE POWER GENERATION **9**

Nuclear power plants - Schematic arrangement - Principle of power generation- Types of reactor – BWR, PWR and CANDU Reactor - Reactor safety waste disposal. Gas turbine power generation - components and layouts. Open and closed cycle plants.

Unit IV DIESEL AND COMBINE CYCLE POWER GENERATION **9**

Components of diesel power generation – components - layout, selection of engine type, Selection of Site. Combined cycle power generation. Cogeneration systems.

Unit V NON-CONVENTIONAL POWER GENERATION 9

Basic concepts, principles of working and layout of Solar thermal, horizontal and vertical types of wind turbines, Tidal and Ocean thermal energy conversion, Geothermal power generation.

Total Periods 45

Text Books:

1. Nag. P.K., "Power Plant Engineering", 4th Edition, 2017, Tata McGraw-Hill Education India Pvt Ltd, Hyderabad.
2. El-Wakil M M , "Power Plant Technology", First Edition, 2017, McGraw Hill Book Company Inc, USA

Reference Books:

1. Rajput R K, "Power Plant Engineering", First Edition, 2016, Laxmi Publications (p) Ltd, New Delhi.
2. Arora S C and Domkundwar S, "Power Plant Engineering", First Edition, 2013, Dhanpat Rai and Sons, Delhi.
3. Ashok V Desai, "Non-Conventional Energy", First Edition, 2011, Wiley India Pvt Led, New Delhi.
4. Godfrey Boyle, "Renewable Energy", 3rd Edition, 2012, Oxford University Press in association with the Open University, UK.
5. Hegde R.K, "Power Plant Engineering", 1st Edition, 2015, Pearson India Education Services Pvt. Ltd, Delhi.

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Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	1	-	-	-	-		-	1	1	3	1
CO2	3	3	1	1	-	-	--	--	-	-	1	1	3	2
CO3	2	3	1	1	-	-	-	-	-	-	2	1	2	2
CO4	2	2	1	1	-	-	-	-	-	-	2	1	2	2
CO5	3	1	1	1	-	-	-	1	-	-	1	1	3	2
Av	2.6	2.1	1	1	-	-	-	0.2	-	-	1.4	1	2.6	1.8
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV24	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

Pre-Requisites **:** Thermal Engineering

Objectives:

- To learn the concepts various types of automobiles, their power packs and types of vehicle bodies.
- To study the various fuel supply and management systems.
- To study the various types of transmission systems for a vehicle.
- To impart knowledge on working parameters of various braking and suspension system in a vehicle.
- To study the working parameters of various electrical and electronic devices in a vehicle.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the types of automobiles, their power packs and types of vehicle bodies.	**K2**
CO2	Apply the various types of power train and fuel supply and management systems in real time automotive.	**K3**
CO3	Explain the types of transmission systems for a vehicle.	**K2**
CO4	Compute the working parameters of various braking and suspension system in a vehicle.	**K3**
CO5	Describe the working parameters of various electrical and electronic devices in a vehicle.	**K3**

Course Contents

Unit I VEHICLE STRUCTURE AND ENGINES 9

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

Unit II ENGINE AUXILIARY SYSTEMS 9

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

Unit III TRANSMISSION SYSTEMS 9

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

Unit IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

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

Unit V ELECTRICAL AND ELECTRONIC SYSTEMS 9

Introduction to Battery, Alternator, and Starter Motor systems, working principle, and circuitry, Safety systems - seat belts, air-bag, ABS, Modern electronic features in vehicles like tyre pressure monitoring, ESP, EBD, Automatic headlamp ON, Rain sensing wipers, speed sensing auto locking, OBD. HVAC system.

Total Periods 45

Text Books:

1. Kirpal Singh, "Automobile Engineering", Vol I & II, 14th Edition, 2018, Standard Publishers Distributor, New Delhi.
2. Gupta R B, "Automobile Engineering", 1st Edition, 2016, Satya Prakashan Publishers, New Delhi.

Reference Books:

1. William Crouse, Donald Anglin , "Automotive Mechanics", 10th Edition, 2017, McGraw Hill Education, US.
2. Kumar D.S., “Automobile Engineering”, , 2nd Edition, 2017, S.K. Kataria and Sons, Delhi.
3. Anil Chhikara, "Automobile Engineering”, Vol-1 & 2, 1st Edition, 2017, Tech India Publications, New Delhi.
4. Rajput R.K., "A Text book of Automobile Engineering", 2nd Edition, 2017, Laxmi Publication, New Delhi.
5. Crouse and Anglin, “Automotive Mechanics”, 9th Edition, 2016, McGraw Hill Education, US.

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Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	2	1	1	-	-	-	1	-	-	1	1	2	3
CO2	2	1	1	1	-	-	-	1	-	-	1	1	2	3
CO3	1	1	1	1	-	-	-	1	-	-	1	1	2	3
CO4	2	1	1	1	-	-	-	1	-	-	1	1	2	3
CO5	2	2	1	1	-	-	-	1	-	-	1	1	1	3
Av	1.6	1.4	1	1	-	-	-	1	-	-	1	1	2	3
3 – High; 2 – Medium; 1– Low; - No correlation														

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U23MEV29	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

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

Course Outcomes:
At the end of the course the students would be able to

		BT Level (highest level)
CO1	Discuss and select the process, equipment and tools for various industrial products.	**K3**
CO2	Explain and prepare process planning activity chart.	**K3**
CO3	Explain the concept of cost estimation.	**K4**
CO4	Compute the job order cost for different type of shop floor.	**K4**
CO5	Calculate the machining time for various machining operations.	**K4**

Course Contents

Unit I INTRODUCTION TO PROCESS PLANNING 9

Introduction- methods of process planning- Place of process planning in Manufacturing cycle -Drawing Interpretation-Material evaluation – steps in process selection-. Production equipment and tooling selection

Unit II PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning-Computer-Aided Process Planning (CAPP) – Benefits and approaches

Unit III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation –methods of costing-elements of cost estimation – Classification of costs, Cost elements, Ladder of cost - Types of estimates – Estimating procedure- Estimation of labour cost, material cost- allocation of overhead charges- Calculation of depreciation cost

Unit IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs - Estimation in forging shop – Losses in forging – forging cost – Estimation of Welding Shop, Estimation in foundry shop – Estimation of metal forming–Forging –Forging losses

Unit V MACHINING TIME CALCULATION 9

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

Total Periods 45

Text Books:

1. Peter scalon, "Process planning, Design/Manufacture Interface", 1st Edition, 2002, Elsevier science technology Books, US.
2. Sinha B.P, "Mechanical Estimating and Costing", 1st Edition, 1995, McGraw Hill Education (India), Noida.

Reference Books:

1. Jain K. C & Aggarwal L.N, "Production Planning Control and Industrial Management", 1st Edition, 1990, Khanna Publishers, New Delhi.
2. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", 4th Edition, 2015, Pearson Education India Pvt Ltd, New Delhi.
3. Narang G.B.S., Kumar V, "Production and Costing", 7th edition, 2013, Khanna Publishers, New Delhi.

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Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	-	-	-	-	-	-	1	3	-	2
CO2	3	-	-	-	1	1	-	1	1	1	1	3	-	2
CO3	3	-	-	-	-	-	-	-	-	-	1	2	-	2
CO4	3	-	-	-	1	1	-	1	1	1	1	2	-	3
CO5	3	-	-	-	1	1	-	1	1	1	1	2	-	3
Av	3	-	-	-	1	1	-	1	1	1	1	2.4	-	2.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV30	MAINTENANCE ENGINEERING	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To understand the principles, objectives and importance of maintenance adopted in industry for successful progress.
- To introduce different maintenance categories, its merits and types of lubrication.
- To expose the idea of condition monitoring, methods and instruments used for allied measurements.
- To learn about failure analysis and repair methods for CNC machines, Agricultural and earth moving machines.
- To promote computerization in maintenance and inventory management.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the principles, objectives and importance of maintenance adopted in industry	**K3**
CO2	Select the suitable maintenance category and lubrication type.	**K3**
CO3	Apply the appropriate methods and instruments for condition monitoring and maintenance of agricultural and earth moving machinery	**K3**
CO4	Describe the failures of mechanical systems and select suitable repair methods and maintenance of CNC machines	**K3**
CO5	Utilize computers in maintenance and inventory management.	**K3**

Course Contents

Unit I PRINCIPLES OF MAINTENANCE PLANNING 9

Basic principles of maintenance planning - Objectives and principles of planned maintenance activity- Importance and benefits of sound maintenance systems - Maintenance organization - Maintenance economics.

Unit II MAINTENANCE CATEGORIES AND LUBRICATION 9

Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules, Repair cycle - Total Productive Maintenance - Principles and methods of lubrication.

Unit III CONDITION MONITORING & MAINTENANCE OF AGRICULTURAL AND EARTH MOVING MACHINERY 9

Condition based maintenance - Methods and instruments for condition monitoring - Wear and temperature measurement. Fault diagnosis, rectification servicing and repairs of various components/systems of agricultural equipment's and earth moving machinery.

Unit IV FAILURE ANALYSIS & MAINTENANCE OF CNC MACHINES 9

Failure analysis - Role of Non-Destructive Testing in failure analysis- Repair methods for bearings, cylinder block. Introduction to DNC, FMS, CNC systems, failure in CNC systems, causes diagnosis and remedies

Unit V COMPUTER AIDED MAINTENANCE MANAGEMENT 9

Approach towards Computerization in maintenance- computer-aided maintenance management system (CAMMS) - Advantages of CAMMS - spare parts and inventory centre performance reporting.

Total Periods 45

Text Books:

1. Srivastava S.K, "Maintenance Engineering", 1st Edition, 2010, S Chand and Company, New Delhi.
2. Mishra R.C, Pathak K, "Maintenance Engineering and Management", 2nd Edition, 2012, Prentice Hall India Learning Pvt. Ltd. New Delhi.

Reference Books:

1. Keith Mobley R, Lindley R. Higgins and Darrin J. Wikoff, "Maintenance Engineering Handbook", 8th edition, 2014, McGraw-Hill Professional, USA.
2. Davies A, "Handbook of Condition Monitoring: Techniques and Methodology", 1st Edition, 2012, Springer Publications, USA.
3. Otegui Jose Luis, "Failure Analysis: Fundamentals and Applications in Mechanical Components", 1st Edition, 2014, Springer Publications, USA.

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Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	1	-	-	-	-	1	2	-	2
CO2	2	-	-	-	-	1	-	-	-	-	1	2	-	2
CO3	2	-	-	-	-	1	-	-	-	-	1	3	-	2
CO4	2	-	-	-	-	1	-	-	-	-	1	3	-	3
CO5	2	-	-	-	-	1	-	-	-	-	1	2	-	3
Av	2	-	-	-	-	1	-	-	-	-	1	2.4	-	2.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV31	NON-DESTRUCTIVE TESTING AND EVALUATION	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To introduce need and scope of failure analysis and fundamental sources of failures.
- To learn about non-destructive testing and basic principles of visual inspection.
- To study about magnetic testing and principles, techniques.
- To learn the principle of radiography testing and its inspection techniques and methods.
- To study the acoustic testing principle and technique and instrumentation

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the need and scope of failure analysis including fundamental sources of failures	**K3**
CO2	Describe about non-destructive testing and basic principles of visual inspection	**K3**
CO3	Explain about the principles of magnetic testing and techniques.	**K3**
CO4	Explain the principle of radiography and thermographic testing and its inspection techniques.	**K3**
CO5	Explain about the principle of ultrasonic and acoustic emission testing, its technique and instrumentation.	**K3**

Course Contents

Unit I INTRODUCTION ABOUT FAILURES 9

Introduction and scope of failure analysis. Engineering Disasters and understanding failure analysis. Fundamental sources of failures. Deficient design. Improper Manufacturing and Assembly. Tree diagram and FMEA.

Unit II VISUAL INSPECTION 9

Introduction to Non-Destructive Testing: An Introduction, Visual examination, Basic Principle, The Eye, Optical aids used for visual inspection, Applications. Liquid Penetrant Testing: Physical principles, Procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods, Applications and Limitations.

Unit III MAGNETIC TESTING 9

Magnetic Particle Testing: Magnetism-basic definitions and principle of. magnetic particle testing, Magnetizing techniques, induced current flow, Procedure used for testing a component, Equipment Used for magnetic particle testing, Sensitivity, Limitations. Eddy Current Testing: Principles, Instrumentation for eddy current testing Techniques. Case studies, Applications and Limitations

Unit IV RADIOGRAPHY AND THERMOGRAPHY TESTING 9

Radiography: Basic principle, Electromagnetic radiation, Sources, Radiation attenuation in the specimen. Effect of radiation in film, Radiographic imaging, Inspection techniques, Applications of radiographic inspection, Limitations, Safety in Industrial Radiography, Standards, Neutron radiography. Thermograph: Basic Principles, Detectors and Equipment, Techniques, Applications, Case studies.

Unit V ULTRASONIC AND ACOUSTIC EMISSION TESTING 9

Ultrasonic Testing: Basic properties of sound beam, Ultrasonic transducers, Inspection methods, Techniques for Normal Beam Inspection, Techniques for Angle Beam Inspection, Flaw characterization techniques, Ultrasonic flaw detection equipment, Modes of Display, Immersion Testing, Applications of Ultrasonic Testing, Advantages, Limitations, Case studies. Acoustic Emission Testing: Principle of Acoustic Emission Testing, Technique, Instrumentation, Sensitivity, Applications and Standards.

Total Periods 45

Text Books:

1. Baldev Raj, T. Jayakumar, M.Thavasimuthu, "Practical Non-Destructive Testing", 3rd Edition, 2017, Narosa Publishing House, Delhi.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 2nd Revised edition, 2017, New Age International Publishers, Delhi.

Reference Books:

1. Prasad J and Nair .C.G.K, "Non-Destructive Test and Evaluation of Materials", 2nd edition, 2011, Tata McGraw-Hill Education, Hyderabad.
2. Paul E Mix, "Introduction to Non-destructive testing: a training guide", 2nd Edition,2005, Wiley publications, New Jersey.USA.
3. American Society of Metals, "Handbook, Non-Destructive Evaluation and Quality Control", Volume-17., 9th Edition, 2018, Metals Park, Ohio, USA.
4 Charles, J. Hellier, "Handbook of Non-destructive evaluation", 3rd Edition, 2020, McGraw Hill, New York, USA.

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Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	-	-	2	1	-	-	-	-	2	1	1
CO2	2	2	1	-	2	1	-	-	-	-	-	3	-	1
CO3	3	2	1	-	3	-	-	-	-	-	-	3	-	1
CO4	3	2	1	-	3	-	-	-	-	-	-	3	-	1
CO5	3	2	1	-	3	-	-	-	-	-	-	3	-	1
Av	2.8	2.0	1.0	0.0	2.2	1.5	1	0.0	0.0	0.0	0.0	2.8	1.0	1.0
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV36	SMART MOBILITY AND INTELLIGENT VEHICLES	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To introduce students to the various technologies and systems used to implement smart mobility and intelligent vehicles.
- To learn Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems and other sensors for automobile vision system.
- To learn Basic Control System Theory applied to Autonomous Automobiles.
- To produce overall impact of automating like various driving functions, connecting the automobile to sources of information that assist with a task
- To allow the automobile to make autonomous intelligent decisions concerning future actions of the vehicle that potentially impact the safety of the occupants through connected car & autonomous vehicle technology.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Recognize the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles	**K3**
CO2	Select the concept of remote sensing and the types of sensor technology needed to implement remote sensing	**K3**
CO3	Familiar with the concept of fully autonomous vehicles	**K3**
CO4	Apply the basic concepts of wireless communications and wireless data networks	**K3**
CO5	Analyse the concept of the connected vehicle and its role in automated vehicles	**K3**

Course Contents

Unit I INTRODUCTION TO INTELLIGENT VEHICLES 9

Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles

Unit II SENSOR TECHNOLOGY FOR SMART MOBILITY 9

Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems

Unit III CONNECTED AUTONOMOUS VEHICLE 9

Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy

Unit IV VEHICLE WIRELESS TECHNOLOGY AND3 NETWORKING 9

Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts– Demodulation/Decoding, Wireless Networking and

Applications to Vehicle Autonomy, Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks

Unit V CONNECTED CAR AND AUTONOMOUS VEHICLE TECHNOLOGY 9

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles - Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues

Total Periods 45

Text Books:

1. "Intelligent Transportation Systems and Connected and Automated Vehicles", 1st Edition, 2016, Transportation Research Board, US.
2. Radovan Miucic, "Connected Vehicles: Intelligent Transportation Systems", 1st Edition, 2019, Springer Publications, US.

Reference Book:

1 Tom Denton, "Automobile Electrical and Electronic systems", 5th Edition, 2018, Roultedge, Taylor & Francis Group,US.

Web URL(s):

1. https://sahyadri.edu.in/home/icims2024
2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/e-mobility-and-electric-vehicle-engineering/?v=c86ee0d9d7ed

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	-	3	2	1	1	1	1	2	2	1	3
CO2	3	2	1	-	3	1	-	-	-	-	1	3	-	2
CO3	3	2	2	-	2	2	1	-	1	-	2	2	1	3
CO4	2	2	1	-	3	-	-	-	-	-	1	2	-	2
CO5	3	3	2	1	2	2	1	1	1	1	2	3	1	3
Av	2.8	2.2	1.6	0.2	2.6	1.4	0.6	0.4	0.6	0.4	1.6	2.4	0.6	2.6
3 – High; 2 – Medium; 1– Low; - No correlation														

		L	T	P	C
U23MCV15	**DRONE TECHNOLOGIES**	**3**	**0**	**0**	**3**

Pre-Requisites : None

Objectives:

- To understand the basics of drone concepts.
- To learn and understand the fundaments of design, fabrication and programming of Drone.
- To impart the knowledge of a flying and operation of drone
- To know about the various applications of drone
- To understand the safety risks and guidelines of fly safely

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain about a various type of drone technology, drone fabrication and programming.	**K3**
CO2	Execute the suitable operating procedures for functioning a drone.	**K3**
CO3	Select appropriate sensors and actuators for Drones.	**K3**
CO4	Develop a drone mechanism for specific applications.	**K3**
CO5	Create the programs for various drones.	**K3**

Course Contents

Unit I INTRODUCTION TO DRONE TECHNOLOGY **9**

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.

Unit II DRONE DESIGN, FABRICATION AND PROGRAMMING **9**

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts - Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program -Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

Unit III DRONE FLYING AND OPERATION **9**

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations management tool Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications

Unit IV DRONE COMMERCIAL APPLICATIONS **9**

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

Unit V FUTURE DRONES AND SAFETY **9**

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

Total Periods **45**

Text Books:

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and implementation", 1st Edition, 2021, John Wiley & Sons, US..
2. Terry Kilby and Belinda Kilby, "Make: Getting started with Drones", 1st Edition, 2018, Makers Media Inc, US.

Reference Books:

1. John Baichtal, "Building your Own Drones: A beginners guide to Drones, UAVs and ROVs", 1st Edition, 2016, Que Publishing, UK.
2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and social Implications for Security and Surveillance", 1st Edition, 2018, Springer Publications, USA..

Web URL(s):

1. https://nptel.ac.in/courses/101104073
2. https://nptel.ac.in/courses/101104083

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	2	2	-	2	2	-	-	-	-	1	3	1	2
CO2	1	2	2	-	2	2	-	-	-	-	1	3	1	2
CO3	1	2	2	-	2	2	-	-	-	-	1	3	1	3
CO4	1	2	2	-	2	2	-	-	-	-	1	3	1	3
CO5	1	2	2	-	2	2	-	-	-	-	1	3	1	3
Av	1	2	2	-	2	2	-	-	-	-	1	3	1	2.6
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV37	SURFACE ENGINEERING	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To study the fundamentals of surface features and different types of friction associated with metals and non-metals
- To study the different types of wear mechanism and its standard measurement.
- To study the different types of corrosion and its preventive measures
- To study the different types of surface properties and surface modification techniques
- To study the various types of materials used in the friction and wear applications

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Describe the fundamentals of surface features and different types of friction associated with metals and non-metals	**K3**
CO2	Analyse the different types of wear mechanism and its standard measurement	**K3**
CO3	Analyse the different types of corrosion and its preventive measures	**K3**
CO4	Analyse the different types of surface properties and surface modification techniques	**K3**
CO5	Analyse the various types of materials used in the friction and wear applications	**K3**

Course Contents

Unit I SURFACES AND FRICTION **9**

Basics of surfaces features – Roughness parameters – surface measurement - Cause of friction- Laws of friction – Static friction – Rolling Friction – Stick-slip Phenomenon - Friction properties of metal and non-metals – Friction in extreme conditions – Thermal considerations in sliding contact

Unit II WEAR **9**

Laws of Wear - Types of Wear mechanism – wear debris analysis - Theoretical wear models - Wear of metals and non-metals – International standards in friction and wear measurements

Unit III CORROSION **9**

Introduction – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors

Unit IV SURFACE TREATMENTS **9**

Surface properties – Hydrophobic – Super hydrophobic – Hydrophilic - surface metallurgy –Surface coating Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying - New trends in coating technology – DLC – CNC – Thick coatings – Nanoengineered coatings – Other coatings, Corrosion resistant coatings

Unit V MATERIALS FOR SURFACE ENGINEERING **9**

Introduction – High and low friction materials - Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Bio Tribology - Nano Tribology

Total Periods **45**

Text Books:

1. Stachowiak G.W. and Batchelor A.W. "Engineering Tribology", 4th Edition, 2013, Butterworth-Heinemann, UK.
2. Basu S.K, Sengupta S.N and Ahuja B.B, "Fundamentals of Tribology", 1st Edition, 2005, Prentice Hall of India Ltd, New Delhi.

Reference Books:

1. Joseph R. Davis, "Corrosion: Understanding the Basics", 1st Edition, 2000, ASM International, USA.
2. Rabinowicz. E., "Friction and Wear of materials", 2nd Edition, 1998, John Willey &Sons, USA.
3. Williams J.A., "Engineering Tribology", 1st Edition, 1998, Oxford University Press, UK.
4. Fontana G., "Corrosion Engineering", 3rd Edition, 1986, McGraw Hill, USA.

Web URL(s):

1. https://archive.nptel.ac.in/courses/112/107/112107248/
2. https://archive.nptel.ac.in/courses/113/105/113105086/
3. https://onlinecourses.nptel.ac.in/noc20_mm10/preview

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	-	1	2	-	-	-	-	-	2	1	1
CO2	3	3	2	1	2	2	-	-	-	-	1	3	1	2
CO3	3	3	2	1	2	3	-	-	-	-	1	2	2	1
CO4	3	3	3	1	2	2	-	-	-	-	1	3	1	3
CO5	3	3	2	-	2	1	-	-	-	-	-	3	1	2
Av	3.0	2.8	2.0	0.6	1.8	2.0	0.0	0.0	0.0	0.0	0.6	2.6	1.2	1.8
3 – High; 2 – Medium; 1– Low; - No correlation														

Professional Electives III

U23MEV04	NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To introduce the fundamental concepts of the new product development
- To develop material specifications, analysis and process.
- To Learn the Feasibility Studies & reporting of new product development.
- To study the new product qualification and Market Survey on similar products of new product development
- To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply engineering drawings, specifications, and customer requirements for new product development.	**K3**
CO2	Apply manufacturing processes, standards and testing for product validation.	**K3**
CO3	Prepare feasibility studies and reports for new product development.	**K3**
CO4	Conduct product qualification analysis and market surveys for new products.	**K3**
CO5	Develop innovative product strategies using prototyping, reverse engineering, and concurrent engineering.	**K3**

Course Contents

Unit I FUNDAMENTALS OF NPD **9**

Basics of drawing interpretation, Engineering Change Note, material specifications, and customer requirements. Introduction to NPD tracking tools like Gantt charts and critical path analysis. Overview of Bill of Material types, MIS software applications, and Quality Function Deployment.

Unit II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS **9**

Overview of global material standards (ISO, DIN, JIS, ASTM, EN, etc.) and key manufacturing processes. Basics of material property testing and report preparation. Introduction to DFMEA, PFMEA, FEA, and analysis of bending, distortion, and material flow.

Unit III ESSENTIALS OF NPD **9**

RFQ (Request of Quotation) Processing – Feasibility Studies and reporting – Concept design, and process planning – Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods – Manual measuring, CMM – GOM (Geometric Optical Measuring), CAM programming-Tool assembly and shop floor trials. Initial sample submission with PPAP documents.

Unit IV CRITERIONS OF NPD **9**

New product qualification for Dimensions, Mechanical and Physical Properties, NDT methods (X-Ray, Radiography, Ultrasonic Testing, MPT, etc.) customer agreement on testing, market survey, and risk analysis. Emphasizes simulation validation, lessons learned, and horizontal deployment.

Unit V REPORTING & FORWARD-THINKING OF NPD **9**

Overview of PPAP, APQP, and the role of SOPs in production. Prototyping, 3D printing, and Reverse Engineering techniques. Concurrent Engineering and its benefits in product development.

Total Periods 45

Text Books:

1. Karl T. Ulrich, Steven D. Eppinger, Maria C. Yang, "Product Design and Development", 7th Edition, 2019, McGraw-Hill Education, New York.
2. Steven C. Wheelwright, Kim B. Clark, "Revolutionizing Product Development: Quantum Leaps in Speed, Efficiency, and Quality", First Edition, 1992, The Free Press, New York.

Reference Books:

1. Tim Brown, Change, "Design: How Design Thinking Transforms Organizations and Inspires Innovation", Revised Edition, 2019, Harper Business, New York..
2. James M. Morgan, Jeffrey K. Liker, 'The Toyota Product Development System: Integrating People, Process, and Technology', First Edition, 2006, Productivity Press, New York.
3. Robert G. Cooper, "Winning at New Products: Creating Value Through Innovation", 5th Edition, 2017, Basic Books, New York.

Web URL(s):

1. Robert G. Cooper, *Winning at New Products: Creating Value Through Innovation* (3rd Edition), 2001, Basic Books, New York.
2. https://onlinecourses.nptel.ac.in/noc20_mg03/preview
3. https://onlinecourses.nptel.ac.in/noc21_me66/preview

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	-	1	-	-	1	1	-	-	2	-	2
CO2	2	3	2	1	2	-	-	1	-	-	-	3	1	2
CO3	1	2	3	2	1	1	1	2	2	2	1	1	1	3
CO4	-	2	1	3	-	2	1	1	2	2	-	-	-	2
CO5	2	3	3	2	3	1	1	3	2	3	2	2	1	3
Av	1.6	2.4	2.0	1.6	1.4	0.8	0.6	1.6	1.4	1.4	0.6	1.6	0.6	2.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV11	ENVIRONMENT SUSTAINABILITY AND IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To make the students to understand the concepts of Environmental Sustainability & Impact Assessment
- To familiarize the students in environmental decision-making procedure.
- Make the students to identify, predict and evaluate the economic, environmental, and social impact of development activities
- To provide information on the environmental consequences for decision making
- To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the objectives, evolution, and legislative frameworks of Environmental Impact Assessment (EIA), including international directives and conceptual models.	**K3**
CO2	Analyze strategic environmental assessments, sustainability appraisals, and evaluate the socio-economic and environmental implications for informed decision-making.	**K4**
CO3	Interpret environmental policy frameworks and regional planning tools, including assessment of cumulative impacts, climate change, and associated risks.	**K3**
CO4	Apply life cycle assessment (LCA) principles and tools, including ecological foot printing, DfE, and industrial ecology, to assess product sustainability and reporting methods.	**K3**
CO5	Apply the concepts of spatial economics and knowledge economies to analyze sustainable development strategies in urban and regional planning contexts.	**K3**

Course Contents

Unit I ENVIRONMENTAL IMPACT ASSESMENT 9

Environmental impact assessment objectives – rationale and historical development of EIA - Conceptual frameworks for EIA Legislative development – European community directive – Hungarian directive.

Unit II ENVIRONMENTAL DECISION MAKING 9

Strategic environmental assessment and sustainability appraisal – Mitigation, monitoring and management of environmental impacts- Socio economic impact assessment..

Unit III ENVIRONMENTAL POLICY, PLANNING AND LEGISLATION 9

Regional spatial planning and policy – Cumulative effects assessment – Planning for climate change, uncertainty and risk.

Unit IV LIFE CYCLE ASSESSMENT 9

Life cycle assessment; Triple bottom line approach; Industrial Ecology. Ecological foot printing, Design for Environment, Future role of LCA, Product stewardship, design, durability and justifiability, measurement techniques and reporting

Unit V SUSTAINABLE URBAN ECONOMIC DEVELOPMENT 9

Spatial economics – Knowledge economy and urban regions

Total Periods 45

Text Books:

1. Aaron J. MacKinnon, Peter N. Duinker, Tony R. Walker, Routledge, "The Application of Science in Environmental Impact Assessment", 1st edition, 2019, Routledge (Taylor & Francis Group), UK, ISBN-10: 0367340194
2. Kevin Hanna, Routledge Routledge, "Handbook of Environmental Impact Assessment", 1st edition, 2022, Routledge (Taylor & Francis Group), ISBN-10: 0367244470

Reference Books:

1. Clive George, C. Collin, H. Kirkpolarice, "Impact Assessment and sustainable development", First Edition, 2007, Edward Elgar Publishing, UK
2. Shukla, S.K. And Srivastava, P.R., "Concepts In Environmental Impact Analysis", First Edition, 1992, Common, Wealth Publishers, New Delhi.
3. Canter, R.L., "Environmental Impact Assessment", 2nd Edition, 2015, McGraw Hill Inc., New Delhi.
4. Simon Dresner, "The principle of sustainability", 2nd Edition, 2008, Earth Scan publishers, UK.

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	2	-	3	3	-	2	-	1	-	2	1
CO2	1	3	1	3	1	3	2	1	2	2	1	-	3	2
CO3	1	2	1	3	-	3	2	-	2	1	2	-	3	2
CO4	2	2	3	2	2	2	1	1	1	2	1	1	3	3
CO5	1	2	2	2	-	3	1	1	2	3	2	-	2	3
Av	1.4	2.0	1.4	2.4	0.6	2.8	1.8	0.6	1.8	1.6	1.4	0.2	2.6	2.2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV18	BIO MASS CONVERSION TECHNOLOGY	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To elucidate on biomass, types, availability, and characteristics
- To study the bio-methanation process.
- To impart knowledge on combustion of biofuels
- To describe on the significance of equivalence ratio on thermochemical conversion of biomass
- To provide insight to the possibilities of producing liquid fuels from biomass

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Estimate the surplus biomass availability of any given area	**K3**
CO2	Design a biogas plant for a variety of biofuels.	**K3**
CO3	Determine and compare the cost of steam generation from biofuels with that of coal and petroleum fuels	**K3**
CO4	Analyse the influence of process governing parameters in thermochemical conversion of biomass	**K3**
CO5	Synthesize liquid biofuels for power generation from biomass	**K3**

Course Contents

UNIT I INTRODUCTION **9**

Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies – typical conversion mechanisms - densification technologies

UNIT II BIOMETHANATION **9**

Bio methenation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent based biogas plants.

UNIT III COMBUSTION **9**

Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion

UNIT IV GASIFICATION, PYROLYSIS AND CARBONISATION **9**

Chemistry of gasification - types – comparison – typical application – performance evaluation – economics. Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonisation

UNIT V LIQUIFIED BIOFUELS **9**

Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications

Total Periods **45**

Text Books:

1. Nidhi Adlakha, Rakesh Bhatnagar and Syed Shams Yazdani, "Biomass for Bioenergy and Biomaterials", First Edition, 2021, CRC Press, USA.
2. Augustine O. Ayeni, Samuel Eshorame Sanni and Solomon U. Oranusi, "Bioenergy and Biochemical Processing Technologies", First Edition, 2022, Springer Campus, USA.

Reference Books:

1. David Boyles, " Bio Energy Technology Thermodynamics and Costs," First Edition, 1984 Ellis Honwood, Chichester, USA.
2. Khandelwal KC, Mahdi SS, "Biogas Technology – A Practical Handbook," 3rd Edition, 2010, The Energy and Resources Institute (TERI) Press, New delhi.
3. Mahaeswari, R.C. "Bio Energy for Rural Energisation", First Edition, 1997, Concept Publication House, New Delhi.
4. Tom B Reed, "Biomass Gasification – Principles and Technology," First Edition, 1981 Noyce Data Corporation, USA.

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2. https://archive.nptel.ac.in/courses/103/103/103103207/
3. https://set.ksu.edu.sa/sites/set.ksu.edu.sa/files/imce_images/third_series_by_dr-_salim.pdf

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	3	1	1	1	3	-	1	-	2	-	1	3	1
CO2	3	2	3	-	2	2	1	2	-	3	1	2	3	2
CO3	2	3	2	1	2	3	-	1	-	3	-	1	3	1
CO4	3	3	2	2	2	2	-	1	-	1	1	1	3	1
CO5	3	3	3	2	2	3	-	2	-	2	2	2	3	2
Av	2.6	2.8	2.2	1.2	1.8	2.6	0.2	1.4	0.0	2.2	0.8	1.4	3.0	1.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV25	INSTRUMENTATION FOR THERMAL SYSTEMS	L	T	P	C
		3	0	0	3

Pre-Requisites : Metrology and Measurements

Objectives:

- To classify various measuring instruments.
- To categorise temperature sensors and their applications in measurement.
- To outline the advancements in pressure and volume measurements.
- To explore the various measurement techniques for thermos physical properties.
- To compare the different data acquisition systems.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Infer the role of uncertainty analysis in measuring instruments.	**K3**
CO2	Select the appropriate temperature sensors based on specific applications.	**K3**
CO3	Identify the suitable sensors for pressure and volume measurements.	**K3**
CO4	Evaluate thermos physical properties of media.	**K3**
CO5	Appraise the advantages of data acquisition systems	**K3**

Course Contents

Unit I MEASUREMENT CHARACTERISTICS 9

Instrument Classification, Characteristics of Instruments – Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments

Unit II TEMPERATURE MEASUREMENT 9

Temperature, Types, materials, Accuracy - Selection of Temperature sensors - Effect of length of sensor on temperature measurements- calibration of thermocouple, RTD's & Thermistors- Standards for temperature measurement - Cryogenic & High Temperature measurement techniques.

Unit III PRESSURE FLOW & VOLUME MEASUREMENTS 9

Pressure Sensors: Types & materials - piezoelectric transducers- calibration of pressure sensors- selection of pipes & fittings for pressure sensors. Volume sensors: Standard volumetric flask- Types, Density measurement instruments for liquids & gases. Flow Sensors: Caroli's mass flow measurements - flow measurements for water, gases, other oils & other chemicals.

Unit IV MEASUREMENT OF THERMO PHYSICAL PROPERTIES 9

Thermal Conductivity measurement of solids - liquids & gases- Sensors & calibration methods- Thermal conductivity of microbar nano composites - Specific heat of liquids, solids through DSC Analysis - viscosity measurement of Newtonian & non-Newtonian fluids through rheological analysis

Unit V DATA ACQUISITION SYSTEM 9

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selection of appropriate energy storage technology, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification and comparison of energy management strategies, implementation issues.

Total Periods 45

Text Books:

1 "Fundamentals of Instrumentation and Measurement". First Edition, 2013, Wiley, Germany.
2 Bhuyan, Manabendra. "Intelligent Instrumentation: Principles and Applications", frst Edition, 2017, CRC Press, United Kingdom.

Reference Books:

1. Mukhopadhyay, Subhas Chandra. "Intelligent Sensing, Instrumentation and Measurements". First Edition, 2015, , Springer Berlin Heidelberg, Germany.
2. Holman, Jack Philip. "Experimental Methods for Engineers". 8th Edition, 2012, McGraw-Hill/Connect Learn Succeed, USA.
3. Raju, N. V. S. "Instrumentation: Operation, Measurement, Scope and Application of Instruments", First Edition, 2016, Taylor & Francis Group, India.

Web URL(s):

1. https://www.classcentral.com/tag/instrumentation
2. https://instrumentationtools.com/instrumentation-and-control-course/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	1	1	1	-	-	-	-	-	1	-	1	-
CO2	3	3	1	1	1	1	-	-	-	-	1	-	1	-
CO3	3	3	1	1	1	1	-	-	-	-	1	-	1	-
CO4	3	3	1	1	1	1	-	-	-	-	1	-	1	-
CO5	3	3	1	1	1	1	-	-	-	-	2	-	1	1
Av	3	2.4	1	1	1	0.8	-	-	-	-	1.2	0	1	0.2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV32	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To provide an understanding of composite materials, their classifications, reinforcements, matrices, and applications.
- To introduce various manufacturing techniques used in fabricating composite materials and their interface characteristics.
- To develop knowledge on the mechanical behavior of composites, including stiffness and strength for different fibre systems.
- To explain the structural behaviour and stress analysis of various types of laminated composite plates.
- To impart knowledge on different joining techniques and standard test procedures for composite materials.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Classify composite materials by identifying the types of reinforcements & matrices and comparing their fundamental properties with conventional engineering materials	**K2**
CO2	Explain manufacturing methods of composite materials and describe fibre-matric interface characteristics using standard procedures.	**K2**
CO3	Utilize mechanical testing methods to identify stiffness and strength characteristics of composite materials.	**K3**
CO4	Solve structural problems by selecting appropriate laminate types amd applying analytical model to laminated composite materials.	**K3**
CO5	Develop procedures for evaluating composite joining techniques and interpret bond strength data using standard testing methods.	**K3**

Course Contents

Unit I INTRODUCTION TO COMPOSITE MATERIALS 9

Definition – Composites –Reinforcements and matrices, Types of reinforcements – Types of Matrices – Types of Composites, Carbon Fibre composites - Properties of composites in comparison with standard materials. Applications of metals, ceramics and polymer matrices composites

Unit II MANUFACTURING METHODS 9

Hand and Spray Lay –Up, Injection moulding, Resin injections, filament windings , Pultrusion , Castings and Prepregs, Fibre / Matrix Interface , Mechanical measurements of interface strength, Characterization of system; Carbon Fibre / epoxy , Glass Fibre / Polyster etc

Unit III MECHANICAL PROPERTIES - STIFFNESS AND STRENGTH 9

Geometrical aspects – Volume and Weight fraction, Unidirectional continuous fibre – discontinuous fiber, Short fibre system, Woven reinforcements – Mechanical testing; determinations of Stiffness and strength of unidirectional composite, tension , compression , flexure and shear

Unit IV LAMINATES 9

Plate stiffness and Compliance, Assumptions, Strains, Stress Resultants, Computation of stresses , Types of Laminates – Symmetric, Anti symmetric laminates, Balanced laminates, Quasi isotropic laminates,

Cross – Ply laminates, Angle ply laminates, Orthotropic laminates, Laminate Moduli, Hydrothermal stresses

Unit V JOINING TECHNIQUES AND APPLICATIONS OF COMPOSITE MATERIALS 9

Joining – Advantages and Disadvantages of adhesives and mechanically fastened joints, Typical bond strengths- Test Procedures – Applications of Composite Materials: Aerospace, Automotive bodies, Marine, Wind Turbine Blades, Civil Infrastructures.

Total Periods 45

Text Books:

1. Mathews F. L. and Rawlings R. D, "Composite Materials: Engineering and Science", 2nd Edition, 1999, CRC Press, UK.
2. Sharma, S. C "Composite Materials", First Edition, 2000, Narosa Publications, New Delhi

Reference Books:

1. Clyne, T. W. and Withers, P. J, *"Introduction to Metal Matrix Composites"*, First Edition, 1993, Cambridge University Press, Cambridge, UK
2. Strong, A. B, *"Fundamentals of Composite Manufacturing"*, 2nd Edition, 2008, SME, Dearborn, Michigan, USA
3. Broutman, L. J. and Krock, R. M, "Modern Composite Materials", First Edition, 1967, Addison-Wesley, Reading, Massachusetts, USA
4. Agarwal, B. D. and Broutman, L. J, "Analysis and Performance of Fiber Composites", 3rd Edition, 2006, John Wiley & Sons, New York, USA

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	-	1	-	-	1	-	1	2	-	2
CO2	3	2	3	2	2	-	-	1	1	1	-	3	1	3
CO3	3	3	2	3	2	-	-	1	-	-	-	3	-	3
CO4	3	3	3	2	2	-	-	-	-	-	-	2	-	3
CO5	2	3	3	2	3	-	1	2	1	1	-	2	-	3
Av	2.8	2.6	2.4	1.8	1.8	0.2	0.2	0.8	0.6	0.4	0.2	2.4	0.2	2.8
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV38	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To understand and apply various optimization techniques in operations research for solving real-world engineering problems.
- To analyze and evaluate decision-making problems using models such as linear programming, transportation, inventory, queuing, and replacement

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Formulate and solve linear programming problems using graphical and simplex-based methods including Big M and Two-Phase techniques.	**K3**
CO2	Analyze transportation, assignment, and network scheduling problems using models such as CPM, PERT, and shortest route algorithms.	**K4**
CO3	Apply deterministic and stochastic inventory models to determine optimal inventory policies under various business scenarios.	**K3**
CO4	Develop and analyze queuing models to evaluate service system performance under different arrival and service patterns.	**K4**
CO5	Evaluate sequencing and replacement strategies for machines and components considering cost and time-based deterioration.	**K4**

Course Contents

Unit I LINEAR PROGRAMMING **10**

Operations Research-Definition, Phases, models, LP problem formulation – Graphical solution, LP Methods- simplex methods- Big M, Dual Simplex, Two phase methods, Duality in LP.

Unit II TRANSPORTATION AND NETWORK **8**

Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.

Unit III INVENTORY CONTROL **8**

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models

Unit IV QUEUING MODEL **9**

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

Unit V SEQUENCING AND REPLACEMENT MODEL **10**

Sequencing Problem - Introduction, Types - n jobs with 2 machines and n jobs with 3 machines. Replacement Models - Introduction, Types, Replacement of items that deteriorate with time, Value of money changing with time and not changing with time, Optimum replacement policy - Individual and Group replacement policy.

Total Periods **45**

Text Books:

1. Sharma J.K., "Operations Research: Theory and Applications", 6th Edition, 2021, Macmillan India, New Delhi.
2. Panneerselvam R., "Operations Research", 3rd Edition, 2022, Prentice Hall of India, New Delhi.

Reference Books:

1 Srinivasan G., "Operations Research: Principles and Applications", 3rd Edition, 2017, EEE PHI Learning Private Limited, New Delhi.
2 Hiller F.S. and Liberman G.J., "Introduction to Operations Research: Concepts and Cases", 11th Edition, 2021, Tata McGraw-Hill Publishing Company Private Limited, New Delhi.
3 Taha H.A., "Operation Research – An Introduction", 11th Edition, 2022, Pearson Publications, New Delhi.
4 Wagner H.M., "Operations Research", Reprint, 2000, Prentice Hall of India, New Delhi.

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3 https://www.coursera.org/learn/operations-research-modeling
4 https://www.coursera.org/learn/operations-research-algorithms#modules

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	2	2	-	-	1	1	1	2	1	2	1
CO2	3	3	2	2	2	-	-	1	1	1	2	2	1	2
CO3	3	3	2	1	2	-	-	1	1	1	2	3	1	1
CO4	3	3	2	1	2	-	-	1	1	1	2	2	-	1
CO5	3	2	2	1	2	-	-	1	1	1	2	3	3	2
Av	3	2.8	2	1.4	2	-	-	1	1	1	2	2.2	1.4	1.4
3 – High; 2 – Medium; 1– Low; - No correlation														

Professional Electives IV

U23MEV05	PRODUCT LIFE CYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To explore the history, fundamental concepts, and key terminology related to Product Lifecycle Management (PLM).
- To understand the core functions and features of PLM and Product Data Management (PDM) systems.
- To design and develop various modules available in commercial PLM/PDM software tools.
- To demonstrate the application of PLM/PDM methodologies in industrial environments.
- To integrate PLM/PDM systems with legacy databases, COAX, and ERP systems.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Apply the fundamental concepts and terminology of PLM to understand its infrastructure and data management systems.	**K3**
CO2	Apply the user and utility functions of PLM/PDM tools to manage engineering data and workflow processes effectively.	**K3**
CO3	Select appropriate PLM/PDM software modules based on their architecture and application requirements in an industrial context.	**K3**
CO4	Apply PLM implementation strategies through case studies to analyze its impact on business processes and organizational performance.	**K3**
CO5	Apply PLM customization and integration techniques using middleware and legacy system connectivity for efficient enterprise-wide deployment.	**K3**

Course Contents

Unit I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM **9**

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications

Unit II PLM/PDM FUNCTIONS AND FEATURES **9**

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration

Unit III DETAILS OF MODULES IN A PDM/PLM SOFTWARE **9**

Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.-Architecture of PLM software- selection criterion of software for particular application - Brand name to be removed

Unit IV ROLE OF PLM IN INDUSTRIES 9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance- process compliance and process automation

Unit V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP.

Total Periods 45

Text Books:

1. "Product Lifecycle Management for a Global Market", First Edition, 2014, Springer, ISBN-10 : 3662516330
2. "Product Life Cycles and Product Management", First Edition, 1989, Praeger Publishers Inc ,)ISBN-10 : 0899303196

Reference Books:

1. AnttiSaaksvuori and AnselmiImmonen, "Product Lifecycle Management", 3rd Edition, 2008, Springer Publisher, USA.
2. John Stark, "Product Lifecycle Management", 4th Edition, 2020, 21st Century Paradigm for Product Realisation, Springer Publisher,
3. Michael Grieves, "Product Life Cycle Management", First Edition, 2016, McGraw Hill, USA.

Web URL(s):

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	2	1	-	-	-	-	1	2	-	3
CO2	2	-	-	-	3	1	-	-	-	-	1	3	-	3
CO3	2	-	-	-	3	1	-	-	-	-	1	3	-	3
CO4	2	-	-	-	2	2	-	-	-	-	1	2	-	3
CO5	3	-	-	-	3	1	-	-	-	-	2	3	-	3
Av	2.2	-	-	-	2.6	1.2	-	-	-	-	1.2	2.6	-	3.0
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV12	INDUSTRIAL ROBOTICS	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To introduce the basic concepts, anatomy, classifications, and applications of industrial robots.
- To enable students to understand and solve forward and inverse kinematics of robotic manipulators.
- To familiarize students with various robot drive systems and the design and selection of end effectors.
- To provide knowledge on the types and functions of sensors and machine vision systems in robotics.
- To train students in robot programming methods and explore industrial and specialized robotic applications.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the fundamental components and classification of robots along with their specifications and applications.	**K2**
CO2	Solve forward and inverse kinematics problems for robotic manipulators using transformation matrices.	**K3**
CO3	Compare and select appropriate drive systems and end effectors based on the requirements of industrial applications.	**K2**
CO4	Explain the working principles of various sensors and machine vision systems used in robotics.	**K2**
CO5	Develop simple robot programs and apply robotic systems in tasks like material handling, inspection, and surgery.	**K3**

Course Contents

Unit I FUNDAMENTALS OF ROBOT **9**

Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.

Unit II ROBOT KINEMATICS **9**

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

Unit III ROBOT DRIVE SYSTEMS AND END EFFECTORS **9**

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper

Unit IV SENSORS IN ROBOTICS 9

Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications Inspection, identification, visual serving and navigation.

Unit V PROGRAMMING AND APPLICATIONS OF ROBOT 9

Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

Total Periods 45

Text Books:

1. Ganesh.S.Hedge, "A textbook of Industrial Robotics", First Edition, 2006, Lakshmi Publications, New Delhi.
2. Mikell.P.Groover , "Industrial Robotics – Technology, Programming and applications", 2nd edition, 2012, McGraw Hill Education India, New Delhi.

Reference Books:

1. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", 3rd Edition, 2020, Springer India Pvt Ltd, New Delhi.
2. Fu K.S. Gonalz R.C. and ice C.S.G."Robotics Control, Sensing, Vision and Intelligence", First Edition, 2007, McGraw Hill Education India, New Delhi.
3. Janakiraman P.A., "Robotics and Image Processing", First Edition, 2005, McGraw Hill Education India, New Delhi.
4. John. J.Craig, "Introduction to Robotics: Mechanics and Control" 4th Edition, 2017, Pearson Education., New Delhi

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2. https://nptel.ac.in/courses/107106090
3. https://nptel.ac.in/courses/112107289

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	2	-	1	-	-	-	-	-	-	3	-	2
CO2	3	-	2	-	2	-	-	-	-	-	-	2	-	2
CO3	3	-	3	-	3	-	-	-	-	2	-	3	-	3
CO4	3	-	2	-	3	-	-	-	-	-	-	3	-	2
CO5	3	-	3	-	3	-	-	-	-	2	-	3	-	3
Av	3.0	-	2.4	-	2.4	-	-	-	-	2	-	2.8	-	2.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV19	ENERGY CONSERVATION IN INDUSTRIES	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To understand the national energy scenario and the importance of energy auditing for sustainable development.
- To analyze energy billing and apply demand side management techniques to reduce energy costs.
- To compute air-fuel ratios and evaluate energy losses in industrial thermal utilities.
- To identify performance issues in electrical utilities and recommend efficiency improvement measures.
- To apply CUSUM and financial evaluation methods to assess savings from energy efficiency projects.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain national energy demand-supply scenarios while appreciating energy auditing's role in environmental sustainability.	**K3**
CO2	Apply demand-side management concepts to reduce energy costs.	**K3**
CO3	Compute stoichiometric air requirements for fuels and quantify energy losses in industrial thermal utilities.	**K3**
CO4	Diagnose underperformance causes in electrical utilities and suggest efficiency improvement remedies	**K3**
CO5	Apply CUSUM and financial techniques to estimate energy savings/monetary benefits of efficiency projects	**K3**

Course Contents

UNIT I INTRODUCTION **9**

Energy scenario of World, India and TN - Environmental aspects of Energy Generation – Material and Energy balancing - Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Basic instruments for Energy Auditing.

UNIT II ELECTRICAL SUPPLY SYSTEMS **9**

Electricity Tariff structures – Typical Billing - Demand Side Management - HT and LT supply - Power Factor – Energy conservation in Transformers – Harmonics

UNIT III ENERGY CONSERVATION IN MAJOR THERMAL UTILITIES **9**

Stoichiometry - Combustion principles. Energy conservation in: Boilers - Steam Distribution Systems - Furnaces - Thermic Fluid Heaters – Cooling Towers – D.G. sets. Insulation and Refractories - Waste Heat Recovery Devices.

UNIT IV ENERGY CONSERVATION IN MAJOR ELECTRICAL UTILITIES **9**

Energy conservation in: Motors - Pumps – Fans – Blowers - Compressed Air Systems - Refrigeration and Air Conditioning Systems - Illumination systems

UNIT V ENERGY MONITORING, TARGETING, LABELLING AND ECONOMICS 9

Elements of Monitoring & Targeting System – CUSUM - Energy / Cost index diagram – Energy Labelling - Energy Economics – Cost of production and Life Cycle Costing - Economic evaluation techniques – Discounting and Non-Discounting - ESCO concept – PAT scheme

Total Periods 45

Text Books:

1. Guide book for National Certification Examination for "Energy Managers and Energy Auditors" (4 Volumes). Available at http://www.em-ea.org/gbook1.asp. This website is administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.
2. K. Nagabhushan Raju, "Industrial Energy Conservation Techniques: (Concepts, Applications and Case Studies)," first Edition, 2007, Atlantic Publishers & Dist., New Delhi.

Reference Books:

1. Abbi Y P, Shashank Jain., "Handbook on Energy Audit and Environment Management", First Editiom, 2006, TERI Press, New Delhi.
2. Albert Thumann and Paul Mehta D, "Handbook of Energy Engineering", 8th Edition, 2020, The Fairmont Press, USA.
3. Paul W.O'Callaghan, "Design and management for energy conservation: A handbook for energy managers, plant engineers, and designers",First Edition, 1981, Pergamon Press, USA.
4. Steve Doty, Wayne Turner C, Energy Management Handbook 9th Edition, 2018, The Fairmont Press, USA.

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3. https://www.beeindia.gov.in/sites/default/files/Energy%20conservation%20guidelines%20for%20industries.pdf?utm_source=chatgpt.com

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	-	3	-	3	2	-	1	1	2	-	3	1
CO2	2	3	1	2	1	3	1	-	1	3	1	-	3	1
CO3	3	3	2	3	2	2	-	-	-	1	-	1	3	1
CO4	3	3	2	3	2	1	-	-	-	2	-	2	3	1
CO5	2	3	1	2	2	2	1	-	1	3	2	-	3	1
Av	2.4	2.8	1.2	2.6	1.4	2.2	0.8	-	0.6	2.0	1.0	0.6	3.0	1.0
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV26	DESIGN OF THERMAL SYSTEMS	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To familiarize the working principles of various components of thermal systems.
- To understand the design procedures of Pumps, Heat Exchangers, Condensers and Evaporators

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Construct and explain the working principle of thermal systems and thermal equipment.	**K3**
CO2	Design and select the thermal components of various thermal systems.	**K3**
CO3	Develop model and design thermal equipment for better performance	**K3**
CO4	Apply various optimization techniques for improving system performance	**K3**
CO5	Study dynamic behaviour of thermal systems under different loading conditions.	**K3**

Course Contents

Unit I DESIGN CONCEPTS **9**

Design Principles, Workable Systems, Optimal Systems, Matching of System Components, Economic Analysis, Depreciation, Gradient Present Worth factor, modelling overview – levels and steps in model development - Examples of models – curve fitting and regression analysis

Unit II MODELLING AND SYSTEMS SIMULATION **10**

Modelling of thermal energy systems – heat exchanger - solar collectors – distillation - - information flow diagram - solution of set of nonlinear algebraic equations - successive substitution - Newton Raphson method- examples of thermal systems simulation

Unit III OPTIMIZATION **10**

Objectives - constraints, problem formulation - unconstrained problems - necessary and sufficiency conditions. Constrained optimization - Lagrange multipliers, constrained variations, - New generation optimization techniques – examples

Unit IV DYNAMIC BEHAVIOUR **9**

Steady state Simulation, Laplace Transformation, Feedback Control Loops, Stability Analysis, Non-Linearities

Unit V APPLICATIONS AND CASE STUDIES **9**

Case studies of optimization in thermal systems problems- Dealing with uncertainty- probabilistic techniques – Trade-offs between capital and energy using Pinch analysis

Total Periods **45**

Text Books:

1. Dhar, P.L,. “Thermal System Design and Simulation”., First Edition, 2016, Elsevier Science, Netherlands.
2. Majumdar, Pradip. “Design of Thermal Energy Systems”. First Edition, 2021, Wiley, United Kingdom.

Reference Books:

1. "Developments in the Design of Thermal Systems". First Edition, 2005, , Cambridge University Press, United Kingdom.
2. Jaluria, Yogesh. "Design and Optimization of Thermal Systems: With MATLAB Applications". 3rd Edition, 2019, CRC Press, United Kingdom.
3. Sekulic, Dusan P., and Shah, Ramesh K. "Fundamentals of Heat Exchanger Design". 2nd Edition, 2023, Wiley, United Kingdom.
4. Sarbu, Ioan, and Sebarchievici, Calin. "Solar Heating and Cooling Systems: Fundamentals, Experiments and Applications". First Edition, 2016, , Academic Press, Germany.

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1. https://archive.nptel.ac.in/courses/112/106/112106064/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	1	1	-	-	-	-	-	-	-	-	-	-
CO2	3	1	2	1	-	1	-	-	-	-	-	-	1	-
CO3	3	1	2	2	-	-	-	-	-	-	-	-	-	-
CO4	3	1	2	2	-	-	-	-	-	-	-	-	-	-
CO5	3	1	2	1	-	-	-	-	-	-	1	-	-	-
Av	3	0.8	1.8	1.4	-	0.2	-	-	-	-	0.2	-	0.2	-
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV33	ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To learn the fundamental of Economics.
- To understand different methods of depreciation, use for calculation
- To know the various method of comparison used in economic
- To understand how funds are managed in an organization.
- To know the different methods of production and marketing adopted in an industry

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply economic principles, cost structures, and national income for supporting technical and financial decision-making.	**K4**
CO2	Apply various depreciation methods to evaluate asset valuation and financial planning in an engineering context.	**K3**
CO3	Compare economic alternatives using interest formulas and investment evaluation methods to determine cost-effective decisions.	**K3**
CO4	Interpret financial statements and accounting principles to assess the financial health of an organization.	**K3**
CO5	Demonstrate production planning, scheduling, and marketing strategies to enhance business efficiency and customer satisfaction.	**K3**

Course Contents

Unit I MICRO AND MACRO ECONOMICS AND ITS APPLICATIONS 9

Introduction – Micro Economics – Macro Economics – Economic decisions and Technical Decisions – Demand and Supply Concepts – Elasticity of Demand – Price of products – Break-Even Analysis – Nature of Functioning of Money –Notional Income – GNP and Savings – Inflation and Deflation Concepts

Unit II METHODS OF DEPRECIATION 9

Straight line method of Depreciation- Declining Balance Method of Depreciation-Sum of the Years Digits Method of Depreciation-Sinking Fund Method of Depreciation- Service-output Method of Depreciation.

Unit III METHODS OF COMPARISON OF ALTERNATIVES 9

Introduction – Elementary Economic Analysis – Interest Formulas and their Applications Comparisons – Present Worth Method – Future Worth Method – Annual Equivalent Method – Rate of Return Method.

Unit IV FINANCIAL MANAGEMENT 9

Sources of finance, internal and external-preparation of balance sheet and profit and loss statements, Types of accounting and significance of each type.

Unit V PRODUCTION & MARKETING MANAGEMENT 9

Types of Production; process of planning, scheduling, Routing, material control; productivity concept, Core concepts of Marketing- Needs, Wants, Demand- Marketing Vs Selling- Pricing and its related factors- Channels of Distribution- Promotion- Advertising- Market Research- Sales Forecasting

Total Periods 45

Text Books:

1. O.P. Khanna, "Industrial Engineering and Management", 18th Edition, 2018, Dhanpat Rai & Co. (P) Ltd., New Delhi
2. R. Pannerselvam, "Engineering Economics", 2nd Edition, 2014, PHI Learning Private Limited, Rimjhim House, Delhi

Reference Books:

1. S.K. Jain, "Applied Economics for Engineers and Managers", 1st Edition, 2008, Vikas Publishing House Pvt. Ltd., New Delhi.
2. Mote Paul and Gupta, "Managerial Economics", 1st Edition, 1999, McGraw Hill Education (India) Pvt. Ltd., Noida.
3. Joseph L. Massie, "Essentials of Management", 1st Edition, 1999, PHI Learning Private Limited, Rimjhim House, Delhi.

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3. https://nptel.ac.in/courses/110101005
4. https://www.coursera.org/lecture/faecalsludge/4-7-engineering-economics-KoVa9

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	-	-	-	-	3	1	1	-	-
CO2	1	-	-	-	2	-	-	-	-	3	1	1	1	1
CO3	1	-	-	-	2	-	-	-	-	3	1	1	1	2
CO4	1	-	-	-	1	-	-	-	-	3	1	1	1	1
CO5	1	-	-	-	1	-	-	-	-	3	1	1	1	2
Av	1.2	-	-	-	1.2	-	-	-	-	3.0	1.0	0.2	1.0	1.5
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV39	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To create awareness about health hazards and promote adherence to safety measures in industrial environments.
- Explain industrial legislations such as the Factories Act, Workmen's Compensation Act, and other relevant laws aimed at safeguarding employees' health in the workplace.
- Outline strategies for the prevention and control of occupational diseases, workplace accidents, emergencies, and other potential hazards."

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply knowledge of workplace safety systems, relevant legislations, and international safety initiatives including ergonomics to improve industrial safety practices.	**K3**
CO2	Apply control measures and personal protective strategies to mitigate occupational health hazards based on exposure pathways and environmental monitoring.	**K3**
CO3	Implement workplace safety practices through safe design, proper housekeeping, and system safety techniques including fire and electrical safety.	**K3**
CO4	Apply hazard identification, accident investigation, and risk management techniques for ensuring plant safety and effective emergency planning.	**K3**
CO5	Apply environmental health and safety management principles for policy implementation, employee participation, and training in industrial settings.	**K3**

Course Contents

Unit I INTRODUCTION **9**

Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

Unit II OCCUPATIONAL HEALTH AND HYGIENE **9**

Definition of the term occupational health and hygiene - Categories of health hazards - Exposure pathways and human responses to hazardous and toxic substances - Advantages and limitations of environmental monitoring and occupational exposure limits - Hierarchy of control measures for occupational health risks - Role of personal protective equipment and the selection criteria - Effects on humans - control methods and reduction strategies for noise, radiation and excessive stress.

Unit III WORKPLACE SAFETY AND SAFETY SYSTEMS **9**

Features of Satisfactory and Safe design of work premises – good housekeeping - lighting and colour, Ventilation and Heat Control – Electrical Safety – Fire Safety – Safe Systems of work for manual handling operations – Machine guarding – Working at different levels – Process and System Safety.

Unit IV HAZARDS AND RISK MANAGEMENT **9**

Safety appraisal - analysis and control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques – major accident hazard control – Onsite and Offsite emergency P

Unit V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT 9

Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and methods of its effective implementation and review – Elements of Management Principles – Education and Training – Employee Participation.

Total Periods 45

Text Books:

1. Krishna Nand P., "Industrial Safety and Hazard Management", 1st Edition, 2018, Laxmi Publications Pvt. Ltd., New Delhi.
2. R.K. Jain and Sunil S. Rao, "Industrial Safety, Health and Environment Management Systems", 1st Edition, 2015, Khanna Publishers, Delhi

Reference Books:

1. L. M. Deshmukh, "Industrial Safety Management", 2nd Edition, 2016, McGraw Hill Education (India) Pvt. Ltd., P-25-26, 1st Floor, Knowledge Boulevard, Noida.
2. K. U. Mistry, "Fundamentals of Industrial Safety and Health", 1st Edition, 2020, Siddharth Prakashan, Vadodara, Gujarat.
3. C. Ray Asfahl and David W. Rieske, "Industrial Safety and Health Management", 7th Edition, 2010, Pearson Education, NJ, USA

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2. https://onlinecourses.swayam2.ac.in/nou23_ge81/preview
3. https://onlinecourses.swayam2.ac.in/nou23_ce09/preview

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	1	3	-	-	-	1	1	1	2	1
CO2	2	-	-	-	2	3	-	-	-	1	1	1	2	1
CO3	2	-	-	-	2	3	-	-	-	1	1	1	1	2
CO4	2	-	-	-	2	3	-	-	-	2	1	1	1	2
CO5	2	-	-	-	1	3	-	-	-	3	1	1	2	1
Av	2.0	-	-	-	1.6	3.0	-	-	-	1.6	1.0	1	1.6	1.4
3 – High; 2 – Medium; 1– Low; - No correlation														

Professional Electives V

U23MEV06	CAD/CAM	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To understand the fundamentals of design standards, 2D drafting, and 3D modeling relevant to mechanical systems.
- To learn the principles and practices of assembly modeling, motion analysis, and tolerance stack-up in product design.
- To gain knowledge in CNC programming, CAM software tools, and process simulation for efficient manufacturing.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the basics of engineering drawing, projections, GD&T symbols, and their application in industrial design.	**K2**
CO2	Create 2D draftings and technical drawings using standard drawing conventions including BOM, title blocks, and inspection features.	**K3**
CO3	Develop 3D models using parametric and non-parametric modeling techniques with solid and surface features.	**K3**
CO4	Perform assembly modeling using different approaches and analyze interferences, tolerances, and motion.	**K3**
CO5	Generate and simulate CNC part programs using CAM tools for 2D and 3D operations including post-processing and setup.	**K3**

Course Contents

Unit I ENGINEERING DRAWING STANDARDS AND INTERPRETATION 9

Projections and scales – Units – GD&T symbols and applications (14 symbols, special characteristics) – Title block and revision control – Engineering Change Notes (ECN) – Customer-specific requirements – Drawing grid interpretation.

Unit II 2D DRAFTING AND TECHNICAL DOCUMENTATION 9

Orthographic views – Auxiliary, Full, Half, Broken, and Offset Section views – Title block and Bill of Materials (BOM) creation – Notes and annotations – Ballooning techniques – Drawing features for inspection reports.

Unit III 3D MODELING TECHNIQUES 9

2D to 3D and 3D to 2D conversion – Parametric vs. Non-Parametric modeling – Feature trees and design intent – Solid modeling, surface modeling – Boolean operations (Union, Subtract, Intersect) – Introduction to Body-in-White (BIW) modeling.

Unit IV ASSEMBLY MODELING AND MOTION ANALYSIS 9

Assembly modeling basics – Top-down and Bottom-up approaches – Clearance and interference checking – Undercut detection – Tolerance stack-up and cumulative effects – Basics of motion analysis and kinematic checks.

Unit V COMPUTER AIDED MANUFACTURING (CAM) 9

CNC basics – 3, 4 & 5-axis machining – CAM software interface – Tool path planning for 2D/3D – Roughing, semi-finishing, finishing – Boundary creation and cutter compensation – Post-processing and NC code – Setup sheet and cycle time estimation.

Total Periods 45

Text Books:

1. brahim Zeid, "Mastering CAD/CAM", 1st Edition, 2005, McGraw Hill Education (India) Pvt. Ltd., Noida.
2. Mikell P. Groover and Emory W. Zimmers, Jr., "CAD/CAM: Computer-Aided Design and Manufacturing", 2nd Edition, 2010, PHI Learning Private Limited, Delhi.

Reference Books:

1. P. Radhakrishnan, S. Subramanyan, V. Raju, "CAD/CAM/CIM", 3rd Edition, 2008, New Age International Publishers, New Delhi.
2. Rao P.N., "CAD/CAM: Principles and Applications", 4th Edition, 2018, McGraw Hill Education (India) Pvt. Ltd., Noida.
3. Chris McMahon and Jimmie Browne, "CAD/CAM: Principles, Practice and Manufacturing Management", 2nd Edition, 2000, Pearson Education India, Noida.
4. David F. Rogers and J. Alan Adams, "Mathematical Elements for Computer Graphics", 2nd Edition, 2002, McGraw Hill Education (India) Pvt. Ltd., Noida.

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2. https://nptel.ac.in/courses/112104031
3. https://archive.nptel.ac.in/courses/112/102/112102103/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	-	2	-	-	-	1	-	1	2	-	2
CO2	3	3	3	-	3	-	-	-	2	-	1	3	-	2
CO3	3	2	3	2	3	-	-	-	1	-	2	3	-	3
CO4	3	3	3	2	3	-	-	1	1	-	2	3	-	3
CO5	3	3	2	3	3	-	-	-	2	-	2	3	-	2
Av	3.0	2.6	2.6	1.4	2.8	–	–	0.2	1.4	–	1.6	2.8	–	2.4
3 – High; 2 – Medium; 1– Low; - No correlation														

		L	T	P	C
U23MEV13	**GREEN SUPPLY CHAIN MANAGEMENT**	**3**	**0**	**0**	**3**

Pre-Requisites : None

Objectives:

- To introduce the environmental challenges in the electronics industry and associated global regulations.
- To explore green materials, manufacturing processes, and eco-friendly design principles for sustainable electronics.
- To analyze green supply chain models and case studies related to end-of-life product recovery and reuse.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain environmental regulations and green initiatives governing global electronics production.	**K2**
CO2	Identify eco-friendly materials, processes, and their environmental benefits in electronics manufacturing.	**K3**
CO3	Apply concepts of green assembly and e-waste recycling in the design of sustainable electronics.	**K3**
CO4	Analyze green product design approaches using life cycle assessment (LCA) and eco-design tools.	**K4**
CO5	Evaluate green supply chain models and assess real-world case studies related to EOL product recycling.	**K5**

Course Contents

Unit I GLOBAL ENVIRONMENTAL REGULATIONS FOR ELECTRONICS 9

Environmental issues in electronics – Overview of global regulations (RoHS, WEEE, EuP, REACH) – Country-specific strategies: China, EU – Global sustainability policies.

Unit II GREEN MATERIALS AND COMPONENTS 9

Lead-free soldering and adhesives – Halogen-free components – Green substrates – Recyclable polymers – XRF analysis for hazardous substance detection.

Unit III ASSEMBLY AND E-WASTE RECYCLING 9

Sustainable electronics assembly – Life-cycle impact of materials – Substrate interconnects – E-waste management systems – Disassembly technologies – Global recycling collaborations.

Unit IV SUSTAINABLE DESIGN AND LCA TOOLS 9

Green product development – Design for recycling – LCA methodology – Eco-design tools – Environmental management standards (ISO 14001) – Green design in industry

Unit V GREEN SUPPLY CHAIN AND CASE STUDIES 9

Green supply chain modelling – End-of-life electronics reuse and recycling – CRT recycling LCA – Practical case studies of green initiatives in supply chains.

Total Periods 45

Text Books:

1. Bhuvan Unhelkar, "Green IT Strategies and Applications: Using Environmental Intelligence", 1st edition, 2011, CRC Press, USA.
2. Anita Raghavan, "Green Manufacturing: Fundamentals and Applications", 1st edition, 2015, Cengage Learning India, New Delhi.

Reference Books:

1. Ramzy Kahhat, Daniel C. Richter, "E-Waste Management: From Waste to Resource", 1st edition, 2012, Routledge, UK.
2. R. K. Jain, "Environmental Impact Assessment", 2nd edition, 2014, Khanna Publishers, New Delhi.
3. Surendra M. Gupta, "Reverse Supply Chains: Issues and Analysis", 1st edition, 2013, CRC Press, USA.
4. Narayan V., "Environmental Management: A Business Approach", 1st edition, 2009, Prentice Hall India, New Delhi.

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3. https://archive.nptel.ac.in/courses/110/106/110106045/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	1	2	-	-	2	-	1	-	1	3	1	1	1
CO2	1	1	2	-	-	2	-	1	-	1	3	1	1	1
CO3	1	1	2	-	-	2	-	1	-	1	3	1	1	1
CO4	1	1	2	-	-	2	-	1	-	1	3	1	1	1
CO5	1	1	2		-	2		1		1	3	1	1	1
Av	1	1	2	-	-	2	-	1	-	1	3	1	1	1
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV20	EQUIPMENT FOR POLLUTION CONTROL	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To introduce environmental regulations, pollution types, and the need for pollution control equipment.
- To provide knowledge of design and operational principles of equipment used for controlling water, air, and solid waste pollution.
- To familiarize students with environmental monitoring instruments and their industrial applications.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain pollution control laws, regulatory frameworks, and criteria for equipment selection	**K2**
CO2	Identify and describe the design and operational principles of water pollution control equipment.	**K2**
CO3	Analyze the working of air pollution control systems used in industries.	**K4**
CO4	Evaluate solid waste processing equipment based on treatment type and end-use application.	**K5**
CO5	Apply knowledge of pollution monitoring equipment to assess air, water, and solid pollution levels.	**K3**

Course Contents

Unit I POLLUTION CONTROL REGULATIONS AND STANDARDS (9

Overview of water, wastewater, solid and hazardous waste pollutants – Sources and environmental impacts. Key Environmental Laws in India: Constitutional provisions, Water Act (1974), Air Act (1981), and Environmental Protection Act (1986). Overview of major rules and notifications: Municipal Solid Waste, Biomedical Waste, Hazardous Waste Management, and Environment Impact Assessment (EIA). Basics of pollution control: Unit operations and processes – Criteria for selecting pollution control equipment.

Unit II EQUIPMENT FOR WATER POLLUTION CONTROL 9

Operational principles and Design criteria of Flash mixers, Flocculators, Clarifiers, Sand Filters, Adsorption Columns, Aerators, Air blowers, Distillation units, Centrifugal and Reciprocating Pumps, Chemical dosing systems, Motors, Pipes, valves and Fittings.- Filed visit to a wastewater treatment plant

Unit III EQUIPMENT FOR AIR POLLUTION CONTROL 9

Operational principles and Design criteria of Cyclone separators, gravity settlers, Wet Scrubbers, Air strippers, Bag Filters, Electrostatic precipitators, Biofilters - Filed visit to an industry with air pollution control systems

Unit IV EQUIPMENT FOR SOLID WASTE PROCESSING 9

Operational principles and Design criteria of Dewatering equipment – centrifuge, Vaccum Filter, Filter Press- Size Reduction equipment – shredders, grinders – Trommel and Disc Screens – Air Classifiers - bailing and briquetting – incinerators –Pyrolysis – field visit to a solid waste processing facility

Unit V POLLUTION MONITORING EQUIPMENT 9

Equipment's for sampling of water, solids and air- Sample preservation Equipment – incubators – Cold Storage systems- equipment for analysis of water and air samples- Ambient air and flue gas sampling and monitoring equipment

Total Periods 45

Text Books:

1. George Tchobanoglous, Hilary Theisen, and Samuel A. Vigil, "Integrated Solid Waste Management", 2nd edition, 1993, McGraw Hill Education, New Delhi.
2. Rao M.N. and Rao H.V.N., "Air Pollution", 1st edition, 2001, Tata McGraw Hill Publishing Company Ltd., New Delhi.

Reference Books:

1. Garg S.K., "Environmental Engineering Vol. I & II", 33rd edition, 2020, Khanna Publishers, New Delhi
2. Mahajan S.P., "Pollution Control in Process Industries", 1st edition, 1991, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. Peavy H.S., Rowe D.R., and Tchobanoglous G., "Environmental Engineering", 1st edition, 1985, McGraw Hill International, New York
4. Metcalf & Eddy, "Wastewater Engineering: Treatment and Resource Recovery", 5th edition, 2014, McGraw Hill Education, New Delhi.

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	-	-	3	3	-	1	-	2	-	-	-
CO2	3	2	2	1	2	2	-	-	-	-	1	-	2	1
CO3	3	3	2	2	2	3	1	-	-	-	1	-	3	2
CO4	2	3	2	2	1	3	2	-	-	-	1	-	3	2
CO5	3	3	3	3	3	3	2	1	1	1	2	-	3	3
Av	2.6	2.4	1.8	1.6	1.6	2.8	1.6	0.2	0.4	0.2	1.4	-	2.2	1.6
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV27	DESIGN OF HEAT EXCHANGERS	L	T	P	C
		3	0	0	3

Pre-Requisites : Engineering Thermodynamics, Fluid Mechanics, Heat and Mass Transfer

Objectives:

- To learn the fundamentals of heat exchanger.
- To understand the methods available to design the double pipe heat exchanger.
- To inculcate the thermal design aspects of shell and tube heat exchangers.
- To provide the details of design aspects of compact heat exchangers.
- To explain the function and design aspects condensers and evaporators.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Describe the basic methodologies of different types of heat exchangers.	**K2**
CO2	Design and analyse the thermal performance of double pipe heat exchangers	**K3**
CO3	Design and analyse the thermal performance of shell and tube heat exchangers	**K3**
CO4	Design and analyse the thermal performance of compact heat exchangers.	**K3**
CO5	Design and analyse the thermal performance of condensers and evaporators.	**K3**

Course Contents

Unit – I FUNDAMENTALS OF HEAT EXCHANGERS 9

Introduction - Types - Application - Overall Heat Transfer Coefficient –Fouling - Effect of Fouling on Heat Transfer - Fouling Factor - Techniques to Control Fouling - Logarithmic Mean Temperature Difference (LMTD) Method - Effectiveness-Number of Transfer Units (NTU) Method of Heat Exchanger Analysis - Selection of Heat Exchangers.

Unit – II DESIGN OF DOUBLE PIPE HEAT EXCHANGERS 9

Introduction - Thermal and Hydraulic Design of Inner Tube and Annulus - Hairpin Heat Exchanger with Bare and Multi Tube Finned Inner Tube - Parallel-Series Arrangements of Hairpins - Total Pressure Drop.

Unit – III DESIGN OF SHELL AND TUBE HEAT EXCHANGERS 9

Introduction - Basic Components - Classification - Basic Design Procedure - Tubular Exchanger Manufacturers Association (TEMA) Code - Heat Transfer and Pressure Drop Analysis on Shell Side and Tube Side - Bell Delaware Method.

Unit – IV DESIGN OF COMPACT HEAT EXCHANGERS 9

Introduction - Heat Transfer Enhancement - Plate Fin Heat Exchangers - Tube Fin Heat Exchangers - Heat Transfer and Pressure Drop Analysis of Finned Tube and Plate Fin Heat Exchangers.

Unit – V DESIGN OF CONDENSERS AND EVAPORATORS 9

Introduction - Classification - Thermal Design of Shell and Tube Condensers - Thermal Analysis of Evaporators - Condensers and Evaporators for Refrigeration and Air Conditioning - Standards for Condensers and Evaporators.

Total Periods 45

Text Books:

1. Kakac, Sadik; Liu, Hongtan; Pramuanjaroenkij, Anchasa, "Heat Exchangers: Selection, Rating, and Thermal Design", 4th Edition, 2020, CRC Press, Boca Raton, FL, USA.
2. Sekulic, Dusan P.; Shah, Ramesh K., "Fundamentals of Heat Exchanger Design", 1st Edition, 2023, John Wiley & Sons, Hoboken, NJ, USA.

Reference Books:

1. Thulukkanam, Kuppan, "Heat Exchanger Design Handbook, Three-Volume Set", 1st Edition, 2024, CRC Press, Boca Raton, FL, USA.
2. Zohuri, Bahman, "Compact Heat Exchangers: Selection, Application, Design and Evaluation", 1st Edition, 2018, Springer International Publishing, Cham, Switzerland.
3. Smith, Eric M., "Advances in Thermal Design of Heat Exchangers: A Numerical Approach: Direct-Sizing, Step-Wise Rating, and Transients", 1st Edition, 2005, John Wiley & Sons, Hoboken, NJ, USA.
4. "Heat Exchangers: Design, Experiment and Simulation", 1st Edition, 2017, IntechOpen, London, United Kingdom.

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1	1	1	-	-	-	-	-	-	1	3	1	1
CO2	3	2	1	1	-	-	-	-	-	-	-	3	2	1
CO3	3	2	1	1	-	-	-	-	-	-	-	3	2	1
CO4	3	2	1	1	-	-	-	-	-	-	-	3	2	1
CO5	3	2	1	1	-	-	-	-	-	-	1	3	2	1
Av	3	1.8	1	1	-	-	-	-	-	-	0.4	3	1.8	1
3 – High; 2 – Medium; 1– Low; - No correlation														

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		L	T	P	C
U23MEV34	**DESIGN OF JIGS, FIXTURES AND PRESS TOOLS**	**3**	**0**	**0**	**3**

Pre-Requisites : None

Note : Use of Approved Design Data Book is permitted

Objectives:

- To understand fundamental principles of locating, clamping, and standard components in jig-fixture design.
- To design and analyze jigs/fixtures for machining, assembly, and inspection operations.
- To master press working terminologies, strip layouts, and design elements of cutting dies
- To develop bending, forming, and drawing dies with blank development strategies for complex geometries.
- To explore special dies (bulging, coining, fine blanking) and modern trends like single minute exchange of dies, Poka-Yoke, and CAD/CAM integration.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply locating/clamping principles to design jig-fixture elements, minimizing redundant location.	**K3**
CO2	Develop functional jigs/fixtures for milling, lathe, and welding, optimizing modular/quick-change systems.	**K3**
CO3	Design cutting dies (blanking, piercing) with standardized components, computing press capacity and strip layout.	**K4**
CO4	Develop bending/drawing dies, addressing spring back and metal flow variables for axisymmetric parts.	**K3**
CO5	Implement special dies (fine blanking, shaving) and modern techniques (SMED, Poka-Yoke) for Numerical /C machines.	**K3**

Course Contents

Unit I LOCATING AND CLAMPING PRINCIPLES 9

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

Unit II JIGS AND FIXTURES 9

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

Unit III ELEMENTS OF CUTTING DIES 9

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

Unit IV BENDING, FORMING AND DRAWING DIES 9

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

Unit V SPECIAL DIES 9

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

Total Periods 45

Text Books:

1. Venkataraman, K., "Design of Jigs Fixtures & Press Tools", 2nd Edition, 2015, Tata McGraw Hill Education Private Limited, New Delhi.
2. Donaldson, C., Lecain, G.H., and Goold, V.C., "Tool Design", 3rd Edition, 2012, Tata McGraw Hill Education Private Limited, New Delhi.

Reference Books:

1. Kempster, M.H.A., "Jigs and Fixtures: Design Manual", 3rd Edition, 2020, Industrial Press Inc., New York, USA.
2. Hoffman, Edward G., "Jig and Fixture Design", 6th Edition, 2018, Cengage Learning, Boston, USA.
3. Joshi, P.H., "Jigs and Fixtures", 2nd Edition, 2010, Tata McGraw Hill Education Private Limited, New Delhi.

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2. https://nptel.ac.in/content/storage2/courses/112105127/pdf/LM-34.pdf
3. http://www.nitc.ac.in/dept/me/jagadeesha/mev303/CHAPT_INTRODUCTION_TO_JIGS_AND%20FIXTURES.pdf

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	1	2	-	-	1	1	-	1	3	-	2
CO2	3	3	3	2	3	1	-	2	1	1	1	3	-	3
CO3	3	3	3	2	3	-	-	1	-	1	-	3	-	3
CO4	3	3	3	2	2	-	-	-	-	-	-	3	-	3
CO5	3	3	3	2	3	2	1	2	1	2	1	3	1	3
Av	3.0	2.8	2.8	1.8	2.6	0.6	0.2	1.2	0.6	0.8	0.6	3.0	0.2	2.8
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV40	DESIGN CONCEPTS IN ENGINEERING	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To understand fundamental concepts of engineering design and their application in product development.
- To gain insight into systematic design processes and creative approaches to solving design problems.
- To learn to consider material selection, ergonomics, sustainability, and manufacturability in developing innovative and user-centric products.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain various design methodologies, terminology, and concurrent engineering principles.	**K2**
CO2	Apply systematic design processes including problem identification, conceptualization, and prototyping.	**K3**
CO3	Apply creativity tools and TRIZ methodology to generate innovative design solutions.	**K3**
CO4	Evaluate product designs based on human factors, aesthetics, legal, and environmental considerations.	**K5**
CO5	Select appropriate materials and manufacturing processes using DFM and DFA principles	**K4**

Course Contents

Unit I DESIGN TERMINOLOGY **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.

Unit II INTRODUCTION TO DESIGN PROCESSES **9**

Basic modules in design process-scientific method and design method-Need identification, importance of problem definition-structured problem, real life problem- information gathering -customer requirements-Quality Function Deployment (QFD)- product design specifications-generation of alternative solutions-Analysis and selection-Detail design and drawings-Prototype, modelling, simulation, testing and evaluation

Unit III CREATIVITY IN DESIGN **9**

Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks Creativity methods-brainstorming, Synectic's, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition creating design concepts.

Unit IV HUMAN AND SOCIETAL ASPECTS IN PRODUCT DEVELOPMENT **9**

Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects environmental aspects-marketing aspects-team aspects-legal aspects-presentation aspects.

Unit V MATERIAL AND PROCESSES IN DESIGN 9

Material selection for performance characteristics of materials-selection for new design substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process, process systems- Design for Manufacturability (DFM) - Design for Assembly (DFA).

Total Periods 45

Text Books:

1. Dieter, G.E. & Schmidt, L.C., "Engineering Design", 5th Edition, 2013, McGraw-Hill Education, New York, USA
2. Horenstein, M.N., "Design Concepts for Engineers", 5th Edition, 2018, Pearson Education, NJ, USA

Reference Books:

1. Budynas, Richard G. & Nisbett, J. Keith, "Shigley's Mechanical Engineering Design", 11th Edition, 2020, McGraw-Hill Education, New York, USA
2. Krishnan, Sumesh and Sukla, Mukul, "Concepts in Engineering Design", 1st Edition, 2016, Notion Press, Chennai.
3. Magrab, Edward B., et al., "Integrated Product and Process Design and Development", 2nd Edition, 2009, CRC Press, USA
4. Ulrich, K.T. & Eppinger, S.D., "Product Design and Development", 7th Edition, 2020, McGraw-Hill Education, New York, USA

Web URL(s):

1. https://archive.nptel.ac.in/courses/107/101/107101087/
2. https://archive.nptel.ac.in/courses/107/103/107103002/
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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	2	-	-	1	-	-	1	-	1	1	-	2
CO2	3	3	3	2	2	1	-	2	1	2	2	2	1	3
CO3	3	3	3	2	1	1	-	1	1	1	2	2	-	3
CO4	3	3	3	2	1	3	2	1	2	1	2	1	2	3
CO5	3	3	3	2	3	2	-	1	1	2	2	3	1	3
Av	2.8	2.6	2.8	1.6	1.4	1.6	0.4	1.0	1.2	1.2	1.8	1.8	0.8	2.8
3 – High; 2 – Medium; 1– Low; - No correlation														

Professional Electives VI

U23MEV07	VALUE ENGINEERING	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To introduce the fundamental concepts and philosophy of value engineering and its role in improving product value and cost-effectiveness.
- To enable students to understand and apply the job plan, FAST diagram, and creative techniques in value analysis.
- To equip students with tools and methodologies to analyze costs, perform life cycle costing, and prepare value engineering proposals effectively.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the basics, principles, and advantages of value engineering and its application in industries.	**K2**
CO2	Apply the Value Engineering Job Plan and create FAST diagrams to identify and analyze functions.	**K3**
CO3	Discuss and select appropriate methods, standards and apply them on value engineering project and propose appropriate training	**K4**
CO4	Apply querying theory and FAST to prefect a value engineering project implementation.	**K3**
CO5	Develop various case studies related to value engineering project implementation.	**K3**

Course Contents

Unit I VALUE ENGINEERING BASICS 9

Origin of value engineering - Meaning of value engineering - Definition of value engineering and Value analysis- Value Management - Value Analysis Versus Value Engineering - Value Analysis versus Traditional cost reduction techniques - Types of Value function – Basic and Secondary functions - concept of cost and worth - creativity In Value Engineering - uses, applications, advantages and limitations of Value analysis.

Unit II VALUE ENGINEERING JOB PLAN AND PROCESS 9

Seven phases of job plan - FAST Diagramming as Value Engineering Tool - Behavioral and organizational aspects of Value Engineering - Ten principles of Value analysis - Benefits of Value Engineering

Unit III VALUE ENGINEERING TECHNIQUES 9

Creativity - Brain storming - Gordon technique - Morphological Analysis - ABC Analysis- Probabilistic approach - Make or Buy decisions – Function cost worth analysis (FCWA) - Function Analysis System technique (FAST) - Break Even Analysis - Life cycle cost(LCC)

Unit IV WORKSHEETS AND GUIDELINES 9

Preparation of worksheets - general and information phase - Function Classification, relationship and summary - Meaningful costs - Cost analysis - idea listing and comparison - Feasibility ranking Investigator phase, study summary - guidelines for writing value engineering proposal - Financial aspects - List cycle cost analysis - Oral presentation - Audit - Case studies and Discussion.

Unit V VERSATILITY OF VALUE ENGINEERING 9

Value engineering operation in maintenance and repair activities - value engineering in non-hardware projects - Initiating a value engineering programme Introduction - training plan - career development for value engineering specialties.

Total Periods 45

Text Books:

1. Iyer, S.S., "Value Engineering", 9th Edition, 2009, New Age International (P) Limited, New Delhi.
2. Anil Kumar & Mukhopadhyaya, "Value Engineering: Concepts Techniques and Applications", 1st Edition, 2003, SAGE Publications, New Delhi.

Reference Books:

1. Del L. Younker, "Value Engineering: Analysis and Methodology", 1st Edition, 2003, CRC Press, Boca Raton, FL.
2. Lawrence D. Miles, "Techniques of Value Analysis and Engineering", 3rd Edition, 2015, Lawrence D. Miles Value Foundation, Washington, D.C.
3. Miles, Lawrence D., "Techniques of Value Analysis and Engineering", 2015, 3rd edition, McGraw Hill, New York.
4. Mudge, Arthur E., "Value Engineering: A Systematic Approach", 3rd Edition, 2000, McGraw Hill Professional, 2 Penn Plaza, New York, USA

Web URL(s):

1. https://archive.nptel.ac.in/courses/112/107/112107282/
2. https://en.wikipedia.org/wiki/Value_engineering
3. https://en.wikipedia.org/wiki/Value_engineering/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	3	-	1	2	1	1	1	2	1	2	1	3
CO2	2	3	3	-	2	2	1	2	1	3	1	2	1	3
CO3	2	2	3	-	2	2	2	2	2	3	1	2	1	3
CO4	2	3	3	1	2	2	1	2	1	3	1	3	1	3
CO5	2	3	3	2	2	2	1	2	2	3	2	3	1	3
Av	2.0	2.6	3.0	0.6	1.8	2.0	1.2	1.8	1.4	2.8	1.2	2.4	1.0	3.0
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV14	ENERGY SAVING MACHINERY AND COMPONENTS	L	T	P	C
		3	0	0	3

Pre-Requisites : Basic Electrical Engineering

Objectives:

- To introduce the various energy saving machineries and components to the students for the purpose of conserving energy.
- To study the basics and principles of transforms, Pumps and motors.
- To impart the knowledge about the methods of energy conservation.
- To introduce the energy efficiency devices and concepts of ENCON.
- To impart the knowledge about CO2 mitigation

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the various energy saving machinery and components.	**K2**
CO2	Analyze the various methods of conservation of energy.	**K4**
CO3	Analyze the performance and energy conservation of fans, pumps and compressors.	**K4**
CO4	Discuss the various energy efficiency devices.	**K3**
CO5	Explain the CO_2 mitigation and cost factor.	**K2**

Course Contents

Unit I BASICS OF ELECTRICAL ENERGY USAGE 9

Fuel to Power : Cascade Efficiency – Electricity Billing : Components and Costs – kVA – Need and Control – Determination of kVA demand and Consumption – Time of Day Tariff – Power Factor Basics – Penalty Concept for PF – PF Correction – Demand Side Management (a brief) - energy monitoring, measurement and analysis.

Unit II TRANSFORMERS AND MOTORS 9

Transformer – Basics and Types – AVR and OLTC Concepts – Selection of Transformers – Performance Prediction - Energy Efficient Transformers - Motors: Specification and Selection – Efficiency / Load Curve – Load Estimation – Assessment of Motor Efficiency under operating conditions – Factors affecting performance – ill effects of Rewinding and Over sizing - Energy Efficient Motors – ENCON Scope.

Unit III FANS, PUMPS AND COMPRESSORS 9

Basics – Selection – Performance Evaluation – Cause for inefficient operation – scope for energy conservation – methods adopted for effecting ENCON – Economics of ENCON adoption.

Unit IV STUDY OF ILLUMINATION AND ENERGY EFFICIENT DEVICES 9

Specification of luminaries - Types - Efficacy - Selection and Application - ENCON Avenues and Economic Proposition - New Generation Luminaries (LED - Induction Lighting) - Soft Starters- Auto Star - Delta - Star Starters- APFC - Variable Speed and Frequency Drives - Time Sensors - Occupancy Sensors.

Unit V CO_2 MITIGATION AND CASE STUDIES 9

Evaluation for 3 / 4 Typical Sectors – PAT Scheme (an introduction) – CO_2 Mitigation – Energy Conservation - Cost Factor. Case Studies on Industrial Energy Audit.

Total Periods 45

Text Books:

1. Ehsan Pakbaznia, "Energy-Efficient Shutdown of Circuit Components and Computing Systems", 2011, 1st Edition, ProQuest UMI Dissertation Publishing, USA
2. TERI, "Handbook on Energy Efficiency", 2001, 1st Edition, TERI Publications, New Delhi.

Reference Books:

1. Hamies, "Energy Auditing and Conservation: Methods, Measurements, Management and Case Study", 1980, 1st Edition, Hemisphere Publishing, Washington.
2. Trivedi, P.R., and Jolka, K.R., "Energy Management", 1997, 1st Edition, Commonwealth Publications, New Delhi
3. Nagrath, I.J., and Kothari, D.P., "Power System Engineering", 2007, 2nd Edition, Tata McGraw-Hill, New Delhi.
4. Bureau of Energy Efficiency, "Guide Book for National Certification Examination for Energy Managers and Energy Auditors", Latest Edition, Available at: www.energymanagertraining.com

Web URL(s):

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2. https://archive.nptel.ac.in/courses/112/105/112105221/
3. https://nptel.ac.in/courses/103103206

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	2	3	2	-	-	-	2	2	3	-
CO2	3	3	2	2	3	3	3	-	-	-	2	2	3	-
CO3	3	3	3	2	3	3	2	-	-	-	2	3	3	2
CO4	2	2	2	-	3	3	2	-	-	-	2	3	3	-
CO5	2	2	-	-	-	3	3	-	-	-	3	-	3	-
Av	2.6	2.4	1.4	1.0	2.2	3.0	2.4	-	-	-	2.2	2.0	3.0	0.4
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV21	ENERGY EFFICIENT BUILDINGS	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To learn the climate and buildings, building efficiency rating and standards
- To Develop energy efficient building envelopes through alternate methods
- To study the thermal comfort, passive heating and cooling techniques
- To apply various energy saving concepts in buildings.
- To incorporate Renewable energy systems in buildings.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Develop climate responsive building design and basic concepts	**K3**
CO2	Explain the basic terminologies related to buildings	**K3**
CO3	Discuss the energy efficient air conditioning techniques	**K3**
CO4	Analyze the performance of buildings	**K4**
CO5	Apply the renewable energy systems in buildings	**K3**

Course Contents

Unit I INTRODUCTION **9**

Climate and Building, Historical perspective, Aspects of Net Zero building design – Sustainable Site, Water, Energy, Materials and IGBC, LEED, GRIHA, IEQ and ECBC Standards

Unit II LANDSCAPE AND BUILDING ENVELOPES **9**

Energy efficient landscape design – Micro climates – various methods – Shading, water bodies – Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, insulation, Design methods and tools

Unit III THERMAL COMFORT, PASSIVE HEATING AND COOLING **9**

Thermal comfort, Psychrometry, Comfort indices – ASHRAE / ISHRAE Standards on thermal Comfort – Passive heating and cooling systems - HVAC Systems for build environment – Heat Pumps, Evaporative Cooling and Radiant Cooling.

Unit IV ENERGY CONSERVATION IN BUILDING UTILITIES **9**

Energy conservation in Hot water generator – Boiler, Heat Pumps, DG Sets, Motors, Pumps, Illumination Systems, Electrical distribution systems, Cooling Towers, Refrigeration and Air Conditioning Systems, Water and Waste Management systems

Unit V RENEWABLE ENERGY IN BUILDINGS **9**

Introduction of Renewable sources in buildings, , Stand-alone PV systems, BIPV, Solar water heating, Solar Air Conditioning in Buildings, Small wind turbines, Poly-generation systems in Buildings

Total Periods **45**

Text Books:

1. Khazaii, Javad, "Advanced Decision Making for HVAC Engineers", 1st Edition, 2018, Springer Nature Switzerland.
2. Kalz, Doreen E. and Pfafferott, Jens, "Thermal Comfort and Energy-Efficient Cooling of Non-residential Buildings", 1st Edition, 2014, Springer-Verlag GmbH, Germany

Reference Books:

1. Givoni, Baruch, "Climate Considerations in Building and Urban Design", 1st Edition, 1998, John Wiley & Sons Ltd, United Kingdom
2. Givoni, Baruch, "Passive Low Energy Cooling of Buildings", 1st Edition, 1994, John Wiley & Sons Ltd, United Kingdom
3. Duffie, John A. and Beckman, William A., "Solar Engineering of Thermal Processes", 4th Edition, 2013, John Wiley & Sons Inc., NJ, USA
4. Kreider, Jan F., Curtiss, Peter S. and Rabl, Ari, "Heating and Cooling of Buildings: Design for Efficiency", Revised 2nd Edition, 2009, CRC Press, USA

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1. https://nptel.ac.in/courses/105102175
2. https://nptel.ac.in/courses/124105552

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	1	-	-	-	-	-	1	-	1	1	1	1
CO2	2	2	1	-	-	-	-	-	1	-	1	1	1	1
CO3	2	2	1	-	-	-	-	-	1	-	1	1	1	1
CO4	2	2	1	-	-	-	-	-	1	-	1	1	1	1
CO5	2	2	1	-	-	-	-	-	1	-	1	1	1	1
Av	2	2	1	-	-	-	-	-	1	-	1	1	1	1
3 – High; 2 – Medium; 1– Low; - No correlation														

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U23MEV28	TURBO MACHINES	L	T	P	C
		3	0	0	3

Pre-Requisites : Thermal Engineering

Objectives:

- To study the energy transfer in rotor and stator parts of the turbo machines.
- To study the function of various elements of centrifugal fans and blowers.
- To evaluating the working and performance of centrifugal compressor.
- To analyse the flow behaviour and flow losses in axial flow compressor.
- To study the types and working of axial and radial flow turbines.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the basic principles and classification of turbo machinery	**K2**
CO2	Illustrate the principles and applications of the centrifugal Fans and Blowers.	**K3**
CO3	Illustrate the construction details of centrifugal compressor.	**K3**
CO4	Illustrate the construction details of centrifugal compressor.	**K3**
CO5	Explain the principles and applications of the axial and radial flow turbines.	**K3**

Course Contents

Unit I PRINCIPLES **9**

Energy Transfer between Fluid and Rotor-Classification of Fluid Machinery-Dimensionless Parameters-Specific Speed – Applications-Stage Velocity Triangles-Work and Efficiency.

Unit II CENTRIFUGAL FANS AND BLOWERS **9**

Types- Stage and Design Parameters-Flow Analysis in Impeller Blades-Volute and Diffusers – Losses - Characteristic Curves and Selection - Fan Drives and Fan Noise.

Unit III CENTRIFUGAL COMPRESSOR **9**

Construction Details - Impeller Flow Losses - Slip Factor - Diffuser Analysis - Losses and Performance Curves.

Unit IV AXIAL FLOW COMPRESSOR **9**

Stage Velocity Diagrams – Enthalpy - Entropy Diagrams - Stage Losses and Efficiency –Work done - Simple Stage - Design - Problems and Performance Characteristics.

Unit V AXIAL AND RADIAL FLOW TURBINES **9**

Stage Velocity Diagrams - Reaction Stages - Losses and Coefficients - Blade Design Principles - Testing and Performance Characteristics.

Total Periods 45

Text Books:

1. Yahya, S.M., "Turbines, Compressors and Fans", 4th Edition, 2017, Tata McGraw-Hill Education, New Delhi, India.
2. Dick, Erik, "Fundamentals of Turbomachines", 1st Edition, 2022, Springer International Publishing, Cham, Switzerland.

Reference Books:

1. Korpela, Seppo A., "Principles of Turbomachinery", 2nd Edition, 2019, John Wiley & Sons, Hoboken, NJ, USA.
2. Gambini, Marco; Vellini, Michela, "Turbomachinery: Fundamentals, Selection and Preliminary Design", 1st Edition, 2020, Springer International Publishing, Berlin, Germany.
3. Zhao, Dan; et al., "Fluid Mechanics and Thermodynamics of Turbomachinery", 1st Edition, 2025, Elsevier Science, Oxford, United Kingdom.
4. Rogers, G.F.C.; Straznicky, P.V.; Saravanamuttoo, H.I.H.; Cohen, H.; Nix, A.C., "Gas Turbine Theory", 7th Edition, 2017, Pearson Education, Harlow, United Kingdom.
5, Brun, Klaus; Kurz, Rainer, "Introduction to Gas Turbine Theory", 1st Edition, 2019, Solar Turbines Incorporated, San Diego, CA, USA.

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Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1	1	1	-	-	-	-	-	-	1	3	1	2
CO2	3	1	1	1	-	-	-	-	-	-	1	3	1	2
CO3	3	1	1	1	-	-	-	-	-	-	1	3	1	2
CO4	3	1	1	1	-	-	-	-	-	-	1	3	1	2
CO5	3	1	1	1	-	-	-	-	-	-	1	3	1	2
Av	3	1	1	1	-	-	-	-	-	-	1	3	1	2
3 – High; 2 – Medium; 1– Low; - No correlation														

U23MEV35	PRECISION MANUFACTURING	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To introduce the fundamentals and scope of precision engineering in the context of advanced manufacturing.
- To familiarize students with precision machining processes, machine design elements, and error control in precision systems.
- To enable students to understand modern measurement and characterization techniques used in precision engineering.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the need and classification of precision and ultra-precision machining processes.	**K2**
CO2	Explain and compare various micro- and nano-machining techniques.	**K2**
CO3	Analyze the design features and functionality of machine elements used in ultra-precision systems.	**K4**
CO4	Evaluate the influence of mechanical and thermal errors and recommend control measures in precision machines.	**K5**
CO5	Apply optical and surface metrology techniques for measuring and characterizing precision components	**K3**

Course Contents

Unit I PRECISION ENGINEERING 9

Introduction to Precision Engineering, Need for precision manufacturing, Taniguchi diagram, Four Classes of Achievable Machining Accuracy – Normal, Precision, High-precision, Ultra-precision Processes and Nanotechnology

Unit II PRECISION MACHINING 9

Overview of Micro- and Nano-machining, Conventional micro machining techniques - micro-turning, micro milling, micro-grinding, Ultra-precision diamond turning, non-conventional micromachining techniques – abrasive jet and water jet micromachining, Ultrasonic micromachining, micro electrical discharge machining, photochemical machining, electro chemical micromachining, laser beam micromachining, Electron beam micromachining, Focused Ion Beam micromachining, etc.

Unit III MACHINE DESIGN FOR PRECISION MANUFACTURING 9

Philosophy of precision machine design, Ultra-Precision Machine Elements: Guide- ways, Drive Systems, Friction Drive, Linear Motor Drive, Spindle Drive. Bearings: Principle, construction and application of Rolling, Hydrodynamic and Hydrostatic Bearings, Aerostatic Bearings, Magnetic bearings.

Unit IV MECHANICAL AND THERMAL ERRORS 9

Sources of error, Principles of measurement, Errors due to machine elements, bearings, spindles, Kinematic design, Structural compliance. Vibration, Thermal errors – background, thermal effects, Environmental control of precision machinery. Error mapping and error budgets.

Unit V MEASUREMENT AND CHARACTERISATION 9

Optical metrology of precision features – Machine vision and multi-sensor coordinate metrology – Laser tracking and scanning systems – White-light interference microscopes – Basics of fringe projection and focus-based optical metrology.

Surface metrology – Introduction to 3D surface topography – Overview of chromatic confocal microscopy and interferometry – Basics of scanning electron and scanning probe microscopy – Key parameters for 3D surface characterization.

Total Periods 45

Text Books:

1. Hiromu Nakazawa, "Principles of Precision Engineering", 1st Edition, 1994, Oxford University Press, Oxford. UK.
2. Murthy R. L., "Precision Engineering in Manufacturing", 1st Edition, 2002, New Age International Publishers, New Delhi.

Reference Books:

1. Yin Zhongwei, "Ultra-Precision Machining Technology", 1st Edition, 2021, Springer, Singapore.
2. Patel D. K., "Precision Engineering: Design and Measurement", 1st Edition, 2013, Nirali Prakashan, Pune
3. Madhusudan Lal, "Micro and Precision Manufacturing", 1st Edition, 2016, Narosa Publishing House, New Delhi.
4. David Whitehouse, "Handbook of Surface Metrology", 1st Edition, 1994, Institute of Physics Publishing, Bristol. UK.

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2. https://archive.nptel.ac.in/courses/112/103/112103202/
3. https://archive.nptel.ac.in/courses/112/107/112107219/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	-	2	-	-	-	-	-	1	2	-	3
CO2	3	3	2	-	2	-	-	-	-	-	1	2	-	3
CO3	3	2	3	2	3	-	-	-	-	-	2	3	-	3
CO4	3	3	2	3	2	-	-	-	-	-	2	3	1	3
CO5	3	2	2	3	3	-	-	-	1	-	2	2	-	3
Av	3.0	2.4	2.0	2.0	2.4	-	-	-	0.2	0.0	1.6	2.4	0.2	3.0
3 – High; 2 – Medium; 1– Low; - No correlation														

		L	T	P	C
U23MEV41	**HYDROGEN AND FUEL CELL TECHNOLOGY**	**3**	**0**	**0**	**3**

Pre-Requisites : None

Objectives:

- To introduce the fundamentals of hydrogen production methods, including conventional and advanced techniques.
- To explain various hydrogen storage and transportation technologies, and evaluate their feasibility.
- To familiarize students with the principles, classifications, and operations of different types of fuel cells.
- To enable students to understand the design and performance parameters involved in fuel cell operation and integration.
- To analyze the practical applications, economic viability, and environmental benefits of hydrogen and fuel cell systems in modern energy solutions

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain various hydrogen production and storage technologies including conventional and emerging methods.	**K2**
CO2	Analyze the applications of hydrogen in transportation, power, and industrial sectors, including techno-economic aspects.	**K4**
CO3	Apply the operating principles of various fuel cell types to select appropriate fuel cell technologies for specific applications.	**K3**
CO4	Apply fuel cell design principles to calculate performance parameters such as mass flow rate, voltage, current, and polarization effects in single cells and fuel cell stacks.	**K3**
CO5	Apply economic and environmental analysis methods to evaluate the feasibility of hydrogen and fuel cell technologies for power, transport, and domestic applications.	**K3**

Course Contents

Unit I **HYDROGEN- PRODUCTION AND STORAGE** **9**

Fossil fuels, electrolysis, thermal decomposition, nuclear, photochemical, photo catalytic, hybrid-Hydrogen Storage - Metal hydrides, chemical hydrides, carbon nano-tubes- sea as the source of Deuterium, methane hydrate etc.,

Unit II **HYDROGEN APPLICATIONS AND ECONOMY** 9

Hydrogen transmission systems. Applications of Hydrogen. Hydrogen as an alternative fuel in IC engines-Suitability of Hydrogen as a fuel, and techno-economic aspects of fuel cell as energy conversion device-Hydrogen fuel for transport

Unit III **FUEL CELLS** **9**

Introduction and overview, operating principle, polarization curves, components, types of fuel cell-AFC, PAFC, DMFC, PEMFC, low and high temperature fuel cells, fuel cell stacks.

Unit IV **FUEL CELL DESIGN AND PERFORMANCE** **9**

Stoichiometric coefficients and utilization percentages of fuels and oxygen, mass flow rate calculation for fuel and oxygen in single cell and fuel cell stack, total voltage and current for fuel cells in parallel and

serial connection, over-potential and polarizations, DMFC operation scheme, general issues-water flooding and water management, polarization in PEMFC.

Unit V APPLICATION OF FUEL CELL AND ECONOMICS 9

Fuel cell usage for domestic power systems, large scale power generation, Automobile, Space. Economic and environmental analysis on usage of Hydrogen and Fuel cell. Future trends in fuel cells

Total Periods 45

Text Books:

1. Rebecca L. Busby, "Hydrogen and Fuel Cells: A Comprehensive Guide", 1st Edition, 2005, PennWell Corporation, Tulsa, Oklahoma, USA.
2. Sørensen, Bent, "Hydrogen and Fuel Cells: Emerging Technologies and Applications", 2nd Edition, 2011, Academic Press (Elsevier), USA.

Reference Books:

1. Kordesch, K. and G. Simader, "Fuel Cells and Their Applications", 1st Edition, 1996, Wiley-VCH, Weinheim, Germany.
2. Hart, A.B. and G.J. Womack, "Fuel Cells: Theory and Application", 1st Edition, 1989, Prentice Hall, Englewood Cliffs, NJ, USA.
3. O'Hayre, R., Cha, S.W., Colella, W., and Prinz, F.B., "Fuel Cell Fundamentals", 3rd Edition, 2016, John Wiley & Sons, Inc., NJ, USA.

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3. https://nptel.ac.in/content/storage2/courses/121106014/Week11/lecture35.pdf

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	1	1	3	1	-	-	-	1	1	2	2
CO2	3	3	3	2	2	3	1	1	1	1	1	2	2	2
CO3	3	3	3	2	2	2	1	-	-	-	1	2	2	2
CO4	3	3	3	3	3	2	1	-	-	-	1	2	2	2
CO5	3	3	3	3	2	3	2	2	1	1	1	2	2	2
Av	3.0	2.8	2.8	2.2	2.0	2.6	1.0	0.6	0.4	0.2	1.0	1.8	2.0	2.0
3 – High; 2 – Medium; 1– Low; - No correlation														

Open Electives

U23OE201	APPLIED DESIGN THINKING	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To understand design thinking principles
- To develop human centric approach
- To enhance problem solving skills
- To encourage Innovative thinking
- To apply design thinking to real world problem

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the core principles and processes of design thinking to solve complex problems	**K3**
CO2	Discuss empathy for users and frame well-defined problem statements	**K3**
CO3	Illustrate innovative ideas using diverse creativity techniques	**K3**
CO4	Demonstrate prototypes to validate solutions and iteratively improve them	**K3**
CO5	Apply an entrepreneurial mindset and foundational knowledge to build and pitch	**K3**

Course Contents

Unit I BASICS OF DESIGN THINKING 9

Introduction to design thinking: Origin, Evolution and Key thinkers – core principles of design thinking – Design process: Five phase – Methods and Tools. Thinking: Critical thinking, Creative thinking, Analytical thinking, Vertical Thinking, Lateral Thinking, Analysis and Synthesis.

Unit II PROBLEM IDENTIFICATION AND USER UNDERSTANDING 9

User needs and contexts, Empathy Techniques – Interviews, Shadowing, observation, User persona Journey Mapping, Developing maps. Problem statements: Defining POV, Framing a problem statement, Convergent and Divergent

Unit III IDEA GENERATION TECHNIQUES 9

Techniques for generating ideas – Brain storming, Scammer, Mind mapping, Brain writing, Role storming, Analogy and metaphors, the worse possible idea, Random word association, Dot Voting, Reverse brainstorming, six thinking Hats, Design Charrette

Unit IV PROTOTYPING AND TESTING 9

Innovation and Invention, Proof of Concept, Types of Prototyping: From low – fidelity to High fidelity, Tools for Prototyping: wire frame, Story board, User testing, Types of user testing, Steps in conducting user testing, Tools, Key metrics and best practices

Unit V STARTUP AND MINDSET 9

Introduction to startup – Business Models and Validation, Funding, Growth and Pitching, Entrepreneurial mindset, Traits, Leadership and collaboration, Tools and Practices

Total Periods 45

Text Books:

1. Mootee, Idris, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", 1st Edition, 2014, Adams Media (Simon & Schuster), USA
2. Kelley, Tom, "The Art of Innovation", Revised Edition, 2016, Profile Books Ltd, UK.
3 Liedtka, Jeanne and Ogilvie, Tim, "Designing for Growth: A Design Thinking Tool Kit for Managers", 2nd Edition, 2019, Columbia University Press, New York, USA.

Reference Books:

1. Brown, Tim, "Change by Design: How Design Thinking Creates New Alternatives for Business and Society", Revised and Updated Edition, 2019, Harper Business (HarperCollins), New York, USA.
2. Lewrick, Michael, Link, Patrick, and Leifer, Larry, "The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses, and Ecosystems", 1st Edition, 2018, John Wiley & Sons, Inc., NJ, USA
3. Gray, Dave, Brown, Sunni, and Macanufo, James, "Gamestorming: A Playbook for Innovators, Rulebreakers, and Changemakers", 2nd Edition, 2021, O'Reilly Media, Inc., USA.

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5. https://www.quicksprout.com/.../how-to-reverse-engineer-your-competit
6. www.vertabelo.com/blog/documentation/reverse-engineering

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	-	-	-	-	-	-	-	-	-			
CO2	3	3	3	-	-	-	-	-	-	-	-			
CO3	-	3	3	-	-	-	-	-	-	-	-			
CO4	-	3	3	3	-	-	-	-	-	-	-			
CO5	-	-	-	-	-	3								
Av	1.2	2.4	1.8	0.6	-	0.6	-	-	-	-	-			
3 – High; 2 – Medium; 1– Low; - No correlation														

U23OE202	CREATIVITY AND INNOVATION IN ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To develop the creativity skills among the learners
- To impart the knowledge of creative intelligence essential for entrepreneurs
- To disseminate the knowledge of innovation
- To know the applications of innovation in entrepreneurship.
- To develop innovative business models for business.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Apply creativity theories and models to examine factors shaping the creative process and environment with an entrepreneurial focus.	**K3**
CO2	Apply analytical reasoning and innovation tools to assess and enhance innovative thinking, overcome barriers, and create environments that foster innovation."	**K3**
CO3	Use innovation frameworks and theories to classify types, stages, and attributes of innovation, and examine design thinking for collaborative and systemic approaches."	**K3**
CO4	Implement entrepreneurial strategies to investigate opportunities, analyze industry dynamics, and align technology demand with market needs.	**K3**
CO5	Explain the components and principles of innovative business models and their role in creating value propositions and fostering responsible innovation	**K3**

Course Contents

Unit I FUNDAMENTALS OF CREATIVITY **9**

Introduction to Creativity: Overview of creativity, key theories, and conceptual models – creative process – quality of creativity –Factors influencing creativity – Entrepreneurial and empowerment-driven creativity – Creative environment – Creative technologies – Characteristics of the creative personality and the role of motivation in fostering creativity

Unit II CREATIVE INTELLIGENCE **9**

Innovative Thinking: Analytical reasoning skills – Characteristics linked to innovation – Training for innovative thinking – Standards for assessing innovation – Reliable assessment methods – Enhancing the depth and quality of innovation – Tools and methodologies for fostering innovation – Barriers to innovative thinking – Fears and limitations – Techniques for overcoming obstacles – Crafting environments that nurture innovation.

Unit III BASIC OF INNOVATION **9**

Innovation: Meaning and scope – Stages and degrees of innovation – Comparison between incremental and radical innovation – Distinction between product and process innovation – Technological and organizational advancements – Key indicators of innovation – Sector-specific attributes of innovation – Frameworks and theories in innovation and creativity – Role of design thinking in driving innovation – Innovation as a collaborative transformation – Viewing innovation as a systemic approach.

Unit IV INNOVATION AND ENTREPRENEURSHIP 9

Innovation and Entrepreneurship: Developing an entrepreneurial mindset – Motivations and behavioural traits of entrepreneurs – Identifying and evaluating opportunities – Strategic decision-making processes – Gaining insights into industry dynamics – Recognizing and leveraging entrepreneurial opportunities – Crafting effective entrepreneurial strategies – Balancing technology-driven demand and market-driven supply – Achieving product-market alignment.

Unit V BUSINESS MODELS 9

Innovative Business Models: Understanding customer discovery and identifying customer segments – Applying prospect theory to create compelling value propositions – Building business models: Key components and structure – Exploring innovative business models: Core elements and design principles – Crafting and implementing innovative business models – Emphasizing responsible innovation and fostering creativity throughout the process.

Total Periods 45

Text Books:

1. Kankha, “Creativity and Innovation in Entrepreneurship”, First Edition, 2018, Sultan Chand, New Delhi.
2. Trott, Paul, "Innovation Management and New Product Development", 7th Edition, 2021, Pearson Education, New York, USA.

Reference Books:

1. Krishnamacharyulu, C.S.G. and Lalitha, R., "Innovation Management", 1st Edition, 2010, Himalaya Publishing House, Mumbai.
2. Echambadi, Raj, "Strategic Innovation: Building and Sustaining Innovative Organizations", Online Edition, 2023, Coursera Inc., USA
3. Krishna macharyulu C.S.G., Lalitha R “Innovation Management”, First Edition, 2010, Himalaya Publishing House, New Delhi.
4. Timpe, Dale, "Creativity", 1st Edition, 2003, Jaico Publishing House, Mumbai.

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3. https://onlinecourses.nptel.ac.in/noc22_de08/preview

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	1	1	-	1	1	1	1			
CO2	1	-	-	-	1	1	-	1	2	1	1			
CO3	1	-	-	-	2	1	-	2	1	2	2			
CO4	2	-	-	-	2	1	-	2	2	2	2			
CO5	1	-	-	-	3	1	1	3	2	3	3			
Av	1.4	-	-	-	1.8	1	1	1.8	1.6	1.8	1.8			
3 – High; 2 – Medium; 1– Low; - No correlation														

U23OE203	BASICS OF REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components
- To provide knowledge on design aspects of Refrigeration & Air conditioning systems.
- To study the Vapour absorption and air refrigeration systems
- To learn the psychrometric properties and processes
- To study the air conditioning systems and load estimation.

Course Outcomes: Upon completion of the course, students would be able to		**BT Level (highest level)**
CO1	Explain the basic concepts of Refrigeration	**K3**
CO2	Explain the Vapor compression Refrigeration systems	**K3**
CO3	Discuss the various types of Refrigeration systems	**K3**
CO4	Discuss the psychrometric properties and processes	**K3**
CO5	Explain the concepts of Air conditioning	**K3**

Course Contents

Unit I INTRODUCTION **9**

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

Unit II VAPOUR COMPRESSION REFRIGERATION SYSTEM **9**

Vapor compression cycle : p-h and T-s diagrams - subcooling and super heating- effects of condenser and evaporator pressure on COP- multi pressure system - low temperature refrigeration - Cascade systems - Equipment: Type of Compressors, Condensers, Expansion devices, Evaporators.

Unit III OTHER REFRIGERATION SYSTEMS **9**

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

Unit IV PSYCHROMETRIC PROPERTIES AND PROCESSES **9**

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

Unit V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION **9**

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

Total Periods **45**

Text Books:

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd Edition, 2019, McGraw Hill, New Delhi.
2. R S Khurmi “Textbook of Refrigeration And Air-Conditioning”, First Edition, 2019, S.Chand and Co, New Delhi.

Reference Books:

1. Jones, W.P., "Air Conditioning Engineering", 5th Edition, 2001, Elsevier Butterworth-Heinemann (Elsevier Ltd.), UK.
2. Stoecker, W.F. and Jones, J.W., "Refrigeration and Air Conditioning", 2nd Edition, 1982, McGraw Hill Education (India) Pvt. Ltd., Noida.
3. Roy J. Dossat, "Principles of Refrigeration", 4th edition, , 2009, Pearson Education Asia, New Delhi.
4. R K Rajput “A Textbook of Refrigeration and Air-Conditioning”, First Edition, 2013, Pearson Education Asia, New Delhi.

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Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	1	1	-	-	-	-	1			
CO2	3	-	-	-	2	1	-	-	-	-	-			
CO3	3	-	-	-	2	1	-	-	-	-	-			
CO4	3	-	-	-	1	1	-	-	-	-	-			
CO5	3	-	-	-	1	2	-	-	-	-	1			
Av	3.0	-	-	-	1.4	1.2	-	-	-	-	1			
3 – High; 2 – Medium; 1– Low; - No correlation														

		L	T	P	C
U23OE204	**FUNDAMENTALS OF MECHANICAL ENGINEERING**	**3**	**0**	**0**	**3**

Pre-Requisites : None

Objectives:

- To gain knowledge on manufacturing processes including casting, forming, machining, welding, and additive manufacturing, enabling practical application in industry scenarios.
- To develop the ability to apply mechanical engineering principles to analyze and operate IC engines, power plants, pumps, and turbines effectively.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Apply the basic principles of casting, forming, and machining operations to select appropriate processes for manufacturing a given component.	**K3**
CO2	Classify different types of welding and additive manufacturing processes and explain their working principles.	**K2**
CO3	Illustrate the functional differences between IC engines and electric vehicles through real-world examples.	**K3**
CO4	Summarize the working principles and distinguish between conventional and renewable power plants.	**K2**
CO5	Select suitable pumps and turbines for fluid transport and energy conversion systems.	**K2**

Course Contents

Unit I CASTING, FORMING, AND WELDING PROCESSES 10

Sand casting, lathe machine and its parts, lathe machine operations (turning, taper turning, facing, chamfering, etc.), Drilling, forming process – Bulk Deformation (Forging, Rolling), Sheet metal operation (Blanking, punching)

Unit II WELDING AND ADDITIVE MANUFACTURING 8

Welding – types, Shielded Metal Arc Welding, gas welding, MIG and TIG welding, Additive manufacturing: Types and its applications - Demonstration of relevant experiments

Unit III IC ENGINES AND RECENT DEVELOPMENTS 9

Introduction to IC Engine, 2 stroke Engine, 4 Stroke Engine, Petrol Engine, Diesel Engine –Demonstration Electric Vehicles - Introduction & Challenges –Demonstration of relevant experiments.

Unit IV POWER PLANT ENGINEERING 10

Coal based power plants- working, advantages & disadvantages, Hydro Electric power plants- working, advantages & disadvantages, nuclear power plants- Types, working, advantages & disadvantages, solar power plant- working, advantages & disadvantages, wind-based power generation- working, advantages & disadvantages.

Unit V PUMPS AND TURBINES 8

Pumps: Basic concepts of centrifugal and reciprocating pumps - constructional details and working principle; Turbines: Principle and working of Pelton wheel, Francis and Kaplan turbine.

Total Periods 45

Text Books:

1. Rajput, R.K., "A Textbook of Manufacturing Technology", 3rd Edition, 2023, Laxmi Publications Pvt. Ltd., New Delhi.
2. Venugopal, K., Prabhu Raja, V., and Sreekanjana, G., "Basic Mechanical Engineering", 7th Edition, 2007, Anuradha Agencies, Chennai.

Reference Books:

1 Khanna, O.P., "A Textbook of Production Technology, Volume I", 19th Edition, 1976, Dhanpat Rai Publications, New Delhi.
2 Gibson, I., Rosen, D., Stucker, B., and Khorasani, M., "Additive Manufacturing Technologies", 3rd Edition, 2021, Springer, New York, USA.
3 Hajra Choudhury S.K. and Hajra Choudhury A.K., "Elements of Workshop Technology, Volume I and II", 13th Edition, 2009, Media Promoters and Publishers, Mumbai.
4 Bansal, R.K., "Engineering Mechanics", 7th Revised Edition, 2016, Laxmi Publications Pvt. Ltd., New Delhi

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3 https://archive.nptel.ac.in/courses/108/106/108106170/

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	–	–	–	2	–	–	–	–	–	-			
CO2	3	–	–	–	2	–	–	–	–	–	–			
CO3	3	–	–	–	1	2	–	–	–	–	–			
CO4	3	–	–	–	1	3	–	–	–	–	–			
CO5	3	–	–	–	2	2	–	–	–	–	–			
Av	3	–	–	-	1.6	1.4	-	-	-	-	--		-	-
3 – High; 2 – Medium; 1– Low; - No correlation														

U23OE205	BASICS OF METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To learn basic concepts of the metrology and importance of measurements.
- To teach measurement of linear and angular dimensions assembly and transmission elements.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the basics of metrology, its need, elements, factors affecting accuracy, errors, and standards.	**K3**
CO2	Apply linear measuring instruments to perform precise measurements and assess their accuracy in practical scenarios.	**K3**
CO3	Apply angular measuring instruments to measure and evaluate angles accurately in various applications	**K3**
CO4	Explain the methods for measuring screw threads and gears, including pitch diameter, lead, pitch, and gear parameters like runout and tooth profile	**K3**
CO5	Apply various instruments to measure force, torque, power, flow, and temperature in practical scenarios.	**K3**

Course Contents

Unit I BASICS OF METROLOGY **9**

Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment –their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control –Types of standards.

Unit II MEASUREMENT OF LINEAR DIMENSIONS **9**

Linear Measuring Instruments – Vernier calliper, Micrometer, Vernier height gauge, Depth Micrometer, bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Profile projector.

Unit III MEASUREMENT OF ANGULAR DIMENSIONS **9**

Angular measuring instruments – Types – Bevel protractor- clinometers- angle gauges, spirit levels -sine bar – Angle dekkor- Autocollimator – Applications.

Unit IV METROLOGY OF TRANSMISSION ELEMENTS **9**

Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Runout, Pitch variation, Tooth profile, Tooth thickness.

Unit V MEASUREMENT OF POWER, FLOW AND TEMPERATURE **9**

Force, torque, power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturi meter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer.

Total Periods **45**

Text Books:

1. Raghavendra N.V. and Krishnamurthy. L., "Engineering Metrology and Measurements", First Edition, 2013, Oxford University Press India Ltd, Noida.
2. Dotson Connie, "Dimensional Metrology", 6th edition, 2016. Cengage Learning India Pvt Ltd, Delhi.
3. Venkateshan, S. P., "Mechanical Measurements", Second edition, 2021, springer Nature, Switzerland..

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1. Ammar Grous, J "Applied Metrology for Manufacturing Engineering", First Edition, 2011, Wiley, USA.
2. Galyer, J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", 5th revised edition 1990, Cengage Learning, UK.
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Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	-	-	1	-	1	-	1			
CO2	3	-	-	-	1	-	-	-	-	-	-			
CO3	3	-	-	-	2	-	-	-	-	-	-			
CO4	3	-	-	-	3	-	-	-	-	-	-			
CO5	3	-	-	-	2	1	-	-	-	-	-			
Av	3.0	-	-	-	2.0	1.0	1.0	-	1.0	-	1.0			
3 – High; 2 – Medium; 1– Low; - No correlation														

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Coimbatore Institute of Engineering and Technology
Narasipuram (Post), Coimbatore-641 109.

U23OE206	TESTING OF MATERIALS	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Objectives:

- To understand the various destructive and non-destructive testing methods of materials and its industrial applications.

Course Outcomes:
Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Understand the purpose and scope of materials testing and its role in material selection and analysis.	**K2**
CO2	Explain the principles and procedures of various mechanical testing methods.	**K2**
CO3	Apply appropriate non-destructive testing techniques based on material type and defect characteristics.	**K3**
CO4	Analyze microstructural features and properties using material characterization tools like SEM, XRD.	**K4**
CO5	Evaluate the thermal and chemical behaviour of materials using relevant testing techniques.	**K4**

Course Contents

Unit I INTRODUCTION TO MATERIALS TESTING 9

Overview of materials - Classification of material testing - Purpose of testing - Selection of material - Development of testing - Testing organizations and its committee - Testing standards - Result Analysis - Advantages of testing

Unit II MECHANICAL TESTING 9

Introduction to mechanical testing - Hardness test (Vickers, Brinell, Rockwell) - Tensile test, Impact test (Izod, Charpy) - Principles, Techniques – Methods - Advantages and Limitations - Applications. Bend test - Shear test - Creep and Fatigue test – Principles – Techniques – Methods - Advantages and limitations - Applications

Unit III NON-DESTRUCTIVE TESTING 9

Visual inspection, Thermography test –Principles, Techniques - Advantages and Limitations - Applications. Radiographic test - Eddy current test - Ultrasonic test - Acoustic emission- Principles – Techniques – Methods - Advantages and Limitations - Applications.

Unit IV MATERIAL CHARACTERIZATION TESTING 9

Macroscopic and Microscopic observations - Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations - Applications. Diffraction techniques - Spectroscopic Techniques - Electrical and Magnetic Techniques- Principles – Types - Advantages and Limitations - Applications

Unit V OTHER TESTING 9

Thermal Testing: Differential scanning calorimetry - Differential thermal analysis. Thermo mechanical and Dynamic mechanical analysis: Principles – Advantages - Applications - Chemical Testing: X-Ray Fluorescence - Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

Total Periods 45

Text Books:

1. Baldev Raj, T. Jayakumar, M. Thavasimuthu, "Practical Non-Destructive Testing", 2nd Edition, 2009, Narosa Publishing House, New Delhi.
2. B. D. Cullity, "Elements of X-ray Diffraction", 3rd Edition, 2000, Addison-Wesley, New York.
3. P. Field Foster, "The Mechanical Testing of Metals and Alloys", 7th Edition, 2007, Cousens Press, London.

Reference Books:

1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9thEdition, American Society for Metals, 1978.
2. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA.
3. Brandon D.G., “Modern Techniques in Metallography”, Von Nostrand Inc. NJ, USA,1986.

Web URL(s):

1. https://www.thermofisher.com/blog/materials/dsc-vs-dta-know-the-difference/
2. https://www.sciencedirect.com/topics/engineering/material-characterization

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	2	2	2	1	-	1	-	2			
CO2	3	3	2	2	3	-	1	-	-	-	2			
CO3	3	3	2	3	3	2	-	-	1	1	2			
CO4	3	3	2	3	3	-	-	-	-	-	2			
CO5	3	3	2	3	3	2	-	-	-	-	3			
Av	3	3	2	2.6	2.8	2	1	-	1	1	2.2			
3 – High; 2 – Medium; 1– Low; - No correlation														