NANDHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Anna University Chennai and approved by AICTE, New Delhi)
Erode-638 052, Tamil Nadu, India, Phone: 04294 – 225585

Curriculum and Syllabi

for

B.E. – Mechanical Engineering [R22]

[CHOICE BASED CREDIT SYSTEM]

(This Curriculum and Syllabi are applicable to Students admitted from 2022-26 onwards)

APRIL 2025

INSTITUTE VISION AND MISSION	
VISION	• To be an Institute of excellence providing quality Engineering, Technology and Management education to meet the ever changing needs of the society.
MISSION	• To provide quality education to produce ethical and competent professionals with social Responsibility • To excel in the thrust areas of Engineering, Technology and Entrepreneurship by solving real- world problems. • To create a learner centric environment and improve continually to meet the changing global needs.

B.E – MECHANICAL ENGINEERING	
VISION	• To be recognised as a centre of excellence in the field of Mechanical Engineering and to produce competent engineers with multi-disciplinary exposure to meet the changing needs of the society.
MISSION	• To enrich technical knowledge and skills by imparting quality education with ethics and social responsibility. • To empower the students in the thrust areas of Mechanical, Allied Engineering and Entrepreneurship in the continually changing global market. • To provide a conducive learning environment for improving continually to cater the needs of the society.
PROGRAMME EDUCATIONAL OBJECTIVES (PEO)	**The graduates of Mechanical Engineering will be** **PEO1: Core Competency:** A Successful professional with core competency and inter-disciplinary skills to satisfy the Industrial needs. **PEO2: Research, Innovation and Entrepreneurship:** Capable of identifying technological requirements for the society and providing innovative solutions to real time problems. **PEO3: Ethics, Human values and Life-long learning:** able to apply professional and ethical practices in their career through continuous learning.
PROGRAMME SPECIFIC OUTCOMES (PSO)	**The students of Mechanical Engineering will be able to** • Identify, formulate and analyze the problems of Mechanical, Allied Engineering systems and product development. • Apply appropriate computer aided engineering tools for modeling, simulation, analysis, and manufacturing techniques to solve engineering problems.

PROGRAM OUTCOMES:

At the end of this programme the students will be able to

a-l	GRADUATE ATTRIBUTES	PO No.	PROGRAMME OUTCOMES
a	**Engineering Knowledge**	PO1	Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
b	**Problem analysis**	PO2	Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
c	**Design / development of solutions**	PO3	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal and environmental considerations.
d	**Conduct investigations of complex problems**	PO4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
e	**Modern Tool Usage**	PO5	Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f	**The Engineer and Society**	PO6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g	**Environment and Sustainability**	PO7	Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge and need for the sustainable development.
h	**Ethics**	PO8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i	**Individual and Team Work**	PO9	Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
j	**Communication**	PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large such as being able to comprehend and write effective reports and design documentation and make effective presentations and give and receive clear instructions.
k	**Project Management and Finance**	PO11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, manage projects and in multidisciplinary environments.
l	**Lifelong Learning**	PO12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Programme Educational Objectives and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	3	3	2	3	2	1	1	2	1	2	2	3
2	3	3	3	3	3	1	1	2	1	2	2	3
3	3	3	3	3	3	1	1	2	1	2	2	3

Contribution 1: Reasonable 2: Significant 3: Strong

MAPPING OF PROGRAM SPECIFIC OUTCOMES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table

PROGRAM SPECIFIC OUTCOMES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	3	3	2	3	2	1	1	1	1	1	1	2
2	3	3	3	3	3	2	2	3	1	3	3	3

Contribution 1: Reasonable 2: Significant 3: Strong

SEMESTER: I									
S. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
1	22MAN01	Induction Programme	MC	-	-	-	-	-	-
THEORY									
2	22EYA01	Professional Communication - I	HSMC		4	2	0	2	3
3	22MYB01	Calculus and linear algebra*	BSC		4	3	1	0	4
4	22CYB02	Chemistry for Engineers	BSC		3	3	0	0	3
5	22EEC02	Basic Electrical Engineering	ESC		3	3	0	0	3
6	22MEC02	Engineering Graphics and drafting (Theory + Lab)	ESC		5	3	0	2	4
7	22GYA01	தமிழர் மரபு /Heritage of Tamils	HSMC	-	1	1	0	0	1
PRACTICAL									
8	22GEP01	Engineering Practices Laboratory	ESC		4	0	0	4	2
9	22CYP01	Chemistry Laboratory*	BSC		2	0	0	2	1
Mandatory Non Credit Courses									
10	22MAN02	Soft/Analytical Skills - I	**MC**		3	1	0	2	0
11	22MAN03	Yoga – I*	**MC**		1	0	0	1	0
TOTAL					**30**	**16**	**1**	**13**	**21**

* **Ratified by Eleventh Academic Council**

SEMESTER: II									
S. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22EYA02	Professional Communication - II	HSMC	22EYA01	4	2	0	2	3
2	22MYB02	Partial Differential Equations and Transform Techniques*	BSC		4	3	1	0	4
3	22PYB04	Physics for Mechanical Engineering	BSC		3	3	0	0	3
4	22CSC01	Problem Solving and C Programming*	ESC		3	3	0	0	3
5	22ECC03	Basic Electronics and instrumentation Engineering	ESC		3	3	0	0	3
6	22MEC03	Engineering Mechanics	ESC		3	2	1	0	3
7	22GYA02	தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	HSMC	22GYA01	1	1	0	0	1
PRACTICAL									
8	22CSP01	Problem Solving and C Programming Laboratory*	ESC		4	0	0	4	2
9	22PYP01	Physics Laboratory*	BSC		2	0	0	2	1
Mandatory Non Credit Courses									
10	22MAN04	Soft / Analytical Skills - II	MC	22MAN02	3	1	0	2	0
11	22MAN05	Yoga – II*	MC		1	0	0	1	0
TOTAL					**31**	**18**	**2**	**11**	**23**

* **Ratified by Eleventh Board of studies**

SEMESTER: III									
S. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22MYB03	Statistics And Numerical Methods	BSC		4	3	1	0	4
2	22MEC04	Engineering Thermodynamics	PCC		3	2	1	0	3
3	22MEC05	Fluid Mechanics and Machinery (Theory + Lab)	ESC		5	3	0	2	4
4	22MEC06	Manufacturing Processes	PCC		3	3	0	0	3
5	22MEC07	Engineering materials and metallurgy	PCC		3	3	0	0	3
PRACTICAL									
6	22MEP02	Computer Aided Machine Drawing	BSC		4	0	0	4	2
Mandatory Non Credit Courses									
7	22MAN07	Soft / Analytical Skills - III#	MC	-	3	1	0	2	0
8	22MAN07R	Soft / Analytical Skills - III##	MC	-	3	1	0	2	0
9	22MAN09	Indian Constitution	MC		1	1	0	0	0
TOTAL					**26**	**16**	**2**	**8**	**19**

Applicable for 2022-26 Batch only
Applicable for 2023-27 Batch only

SEMESTER: IV									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22MEC09	Thermal Engineering Systems	PCC	22MEC04	4	3	1	0	4
2	22MEC10	Subtractive Manufacturing Processes	PCC	2MEC06	3	3	0	0	3
3	22MEC11	Strength of Materials (Theory + Lab)	PCC		5	3	0	2	4
4	22MEC12	Theory of Machines (Theory + Lab)	PCC		4	3	0	2	4
5	E1	Elective(OEC/PEC)	OEC / PEC		3	3	0	0	3
PRACTICAL									
6	22MEP03	Thermal Engineering Systems Laboratory	PCC		4	0	0	4	2
7	22MEP04	Subtractive Manufacturing Processes Laboratory	PCC		4	0	0	4	2
Mandatory Non Credit Courses									
8	22MAN08	Soft/Analytical Skills - IV#	MC	-	3	1	0	2	0
9	22MAN08R	Soft/Analytical Skills - IV##	MC	-	3	1	0	2	0
10	22MAN06	Environmental Science	MC		2	0	0	2	0
11	22GED01	Personality and Character Development	MC		2	0	0	2	0
TOTAL					**34**	**16**	**1**	**18**	**22**

* **Ratified by Twelfth Academic Council**

\# **Applicable for 2022-26 Batch only**

\## **Applicable for 2023-27 Batch only**

SEMESTER: V									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22MEC14	Machine Design	PCC		**4**	**3**	**1**	**0**	**4**
2	22MEC15	Metrology and Measurements	PCC		**3**	**3**	**0**	**0**	**3**
3	22MEC16	Heat and Mass Transfer	PCC		**3**	**3**	**0**	**0**	**3**
4	22MEC17	Hydraulics and Pneumatics	PCC		**3**	**3**	**0**	**0**	**3**
5	E2	Elective(PEC)	PEC		**3**	**3**	**0**	**0**	**3**
6	E3	Elective(OEC/PEC)	PEC		**3**	**3**	**0**	**0**	**3**
PRACTICAL									
7	22MEP05	Heat and Mass Transfer Laboratory	PCC		4	0	0	4	2
8	22MEP06	Metrology and Measurements Laboratory	PCC		4	0	0	4	2
Mandatory Non Credit Courses									
9	22MAN10R	Communication and Quantitative Reasoning	MC	-	3	1	0	2	0
TOTAL					**30**	**19**	**1**	**10**	**23**

SEMESTER: VI									
S. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22MEC18	Finite Element Analysis	PCC		3	3	0	0	3
2	22MEC19	Mechatronics & IOT	PCC		3	3	0	0	3
3	22GEZ01	Entrepreneurship Development	HSMC		3	3	0	0	3
4	E4	Elective(PEC)	PEC		3	3	0	0	3
5	E5	Elective(PEC)	PEC		3	3	0	0	3
6	E6	Elective(OEC)	OEC		3	3	0	0	3
PRACTICAL									
7	22MEP07	Computer Aided Analysis Laboratory	PCC		4	0	0	4	2
8	22MEP08	Mechatronics & IOT Laboratory	PCC		4	0	0	4	2
TOTAL					**26**	**18**	**0**	**08**	**22**

SEMESTER: VII									
S. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22MEC20	CAD / CAM / CIM	PCC		3	3	0	0	3
2	22GEA01	Universal Human Values	HSMC		2	2	0	0	2
3	E7	Elective (PEC)	PEC		3	3	0	0	3
4	E8	Elective (PEC)	PEC		3	3	0	0	3
5	E9	Elective (PEC)	PEC		3	3	0	0	3
6	E10	Elective (OEC)	OEC		3	3	0	0	3
PRACTICAL									
7	22MEP09	CAD / CAD Laboratory	PCC		4	0	0	4	2
8	22GED02	Internship / Industrial Training*	EEC		0	0	0	0	2
TOTAL					**21**	**17**	**0**	**4**	**21**

SEMESTER: VIII									
S.NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
PRACTICAL									
1	22MED01	Project Work	EEC		20	0	0	20	10
TOTAL					**20**	**0**	**0**	**20**	**10**

(A) HSC, BSC AND ESC COURSES

(a) Humanities and Social Sciences (HS)

S. NO	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1	22EYA01	Professional Communication - I	HSMC		4	2	0	2	3	I
2	22GYA01	தமிழர்மரபு / Heritage of Tamils	HSMC	-	1	1	0	0	1	I
3	22EYA02	Professional Communication - II	HSMC	22EYA01	4	2	0	2	3	II
4	22GYA02	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	HSMC	22GYA01	1	1	0	0	1	II
5	22GEA02	Principles of Management	MEC	-	3	3	0	0	3	VI
6	22GEA03	Total Quality Management	MEC	-	3	3	0	0	3	VI
7	22GEA04	Professional Ethics and Human Values	MEC	-	3	3	0	0	3	VI
8	22GEA01	Universal Human Values	HSMC		2	2	0	0	2	VII

(b) Basic Sciences (BSC)

S. NO	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1	22MYB01	Calculus and linear algebra	BSC		4	3	1	0	4	I
2	22CYB02	Chemistry for Engineers	BSC		3	3	0	0	3	I
3	22CYP01	Chemistry Laboratory	BSC		2	0	0	2	1	I
4	22PYB04	Physics for Mechanical Engineering	BSC		3	3	0	0	3	II
5	22PYP01	Physics Laboratory	BSC		2	0	0	2	1	II
6	22MYB03	Statistics And Numerical Methods	BSC		4	3	1	0	4	III
7	22MEP02	Computer Aided Machine Drawing	BSC		4	0	0	4	2	III

(c) Engineering Sciences (ESC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1	22EEC02	Basic Electrical Engineering	ESC		3	3	0	0	3	I
2	22MEC02	Engineering Graphics and drafting (Theory + Lab)	ESC		5	3	0	2	4	I
3	22GEP01	Engineering Practices Laboratory	ESC		4	0	0	4	2	I
4	22ECC03	Basic Electronics and instrumentation Engineering	ESC		3	3	0	0	3	II
5	22MEC03	Engineering Mechanics	ESC		3	2	1	0	3	II
6	22CSP01	Problem Solving and C Programming Laboratory	ESC		4	0	0	4	2	II

Mandatory Courses (MC)										
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**	**P.S**
1.	22MAN01	Induction Programme	MC	-	0	0	0	0	0	I
2.	22MAN02	Soft /Analytical Skills - I	MC	-	3	I	0	2	0	I
3.	22MAN03	Yoga - I	MC	-	I	0	0	I	0	I
4.	22MAN04	Soft /Analytical Skills - II	MC	22MAN02	3	I	0	2	0	II
5.	22MAN05	Yoga - II	MC	-	I	0	0	I	0	II
6.	22MAN07	Soft / Analytical Skills - III	MC	-	3	I	0	2	0	III
7.	22MAN09	Indian Constitution	MC	-	I	I	0	0	0	III
8.	22MAN08	Soft/Analytical Skills - IV	MC	-	3	I	0	2	0	IV
9.	22MAN06	Environmental Science	MC		2	0	0	2	0	IV
10.	22GED01	Personality and Character Development	MC	-	I	0	0	I	0	IV
11.	22MAN10R	Communication and Quantitative Reasoning	MC	-	3	I	0	2	0	V

(B) PROFESSIONAL CORE COURSES (PCC)										
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**	**P.S**
I	22MEC04	Engineering Thermodynamics	PCC		3	2	I	0	3	III
2	22MEC06	Manufacturing Processes	PCC		3	3	0	0	3	III
3	22MEC07	Engineering materials and metallurgy	PCC		3	3	0	0	3	III
4	22MEC09	Thermal Engineering Systems	PCC		4	3	I	0	4	IV
5	22MEC10	Subtractive Manufacturing Processes	PCC		3	3	0	0	3	IV
6	22MEC11	Strength of Materials (Theory + Lab)	PCC		5	3	0	2	4	IV
7	22MEC12	Theory of Machines (Theory + Lab)	PCC		4	3	0	2	4	IV
8	22MEP03	Thermal Engineering Systems Laboratory	PCC		4	0	0	4	2	IV

9	22MEP04	Subtractive Manufacturing Processes Laboratory	PCC		4	0	0	4	2	IV
10	22MEC14	Machine Design	PCC		4	3	1	0	4	V
11	22MEC15	Metrology and Measurements	PCC		3	3	0	0	3	V
12	22MEC16	Heat and Mass Transfer	PCC		3	3	0	0	3	V
13	22MEC17	Hydraulics and Pneumatics	PCC		3	3	0	0	3	V
14	22MEP05	Heat and Mass Transfer Laboratory	PCC		4	0	0	4	2	V
15	22MEP06	Metrology and Measurements Laboratory	PCC		4	0	0	4	2	V
16	22MEC17	Finite Element Analysis	PCC		3	3	0	0	3	VI
17	22MEC18	Mechatronics & IOT	PCC		3	3	0	0	3	VI
18	22MEP07	Computer Aided Analysis Laboratory	PCC		4	0	0	4	2	VI
19	22MEP08	Mechatronics & IOT Laboratory	PCC		4	0	0	4	2	VI
20	22MEC19	CAD / CAM / CIM	PCC		3	3	0	0	3	VII
21	22MEP07	CAD/CAD Laboratory	PCC		4	0	0	4	2	VII

(C) Employability Enhancement Courses (EEC)										
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**	**P.S**
1.	22GED02	Internship / Industrial Training *	EEC		0	0	0	0	2	VII
2.	22MED01	Project Work	EEC		20	0	0	20	10	VIII

VERTICAL 1 DESIGN ENGINEERING										
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**	**P.S**
1.	22MEX01	Composite Materials	PEC	-	3	3	0	0	3	V - VII
2.	22MEX02	Tool Design	PEC	-	3	3	0	0	3	V - VII
3.	22MEX03	Non-traditional Machining Processes	PEC	-	3	3	0	0	3	V - VII
4.	22MEX04	Design Concepts in Engineering	PEC	-	3	3	0	0	3	V - VII
5.	22MEX05	Design of Transmission System	PEC	**22MEC14**	3	3	0	0	3	V - VII
6.	22MEX06	Automobile Engineering	PEC	-	3	3	0	0	3	V - VII
7.	22MEX07	Industrial Layout Design and Safety	PEC	-	3	3	0	0	3	V - VII
8.	22MEX08	Modern Robotics	PEC	-	3	3	0	0	3	V - VII
VERTICAL 2 MODERN MOBILITY SYSTEMS										
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**	**P.S**
1.	22MEX11	Automotive Materials, Components, Design & Testing	PEC	-	3	3	0	0	3	V - VII
2.	22MEX12	Conventional and Futuristic Vehicle Technology	PEC	-	3	3	0	0	3	V - VII
3.	22MEX13	Renewable Powered Off Highway Vehicles and Emission Control Technology	PEC	-	3	3	0	0	3	V - VII
4.	22MEX14	Vehicle Health Monitoring, Maintenance and Safety	PEC	-	3	3	0	0	3	V - VII
5.	22MEX15	CAE and CFD Approach in Future Mobility	PEC	-	3	3	0	0	3	V - VII
6.	22MEX16	Hybrid and Electric Vehicle Technology	PEC	-	3	3	0	0	3	V - VII
7.	22MEX17	Thermal Management of Batteries and Fuel Cells	PEC	-	3	3	0	0	3	V - VII
8.	22MEX18	Smart Mobility and Intelligent Vehicles	PEC	-	3	3	0	0	3	V – VII

VERTICAL 3 THERMAL ENGINEERING										
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**	**P.S**
1.	22MEX21	Turbo Machines	PEC	-	3	3	0	0	3	V - VII
2.	22MEX22	Advanced Internal Combustion Engineering	PEC	-	3	3	0	0	3	V - VII
3.	22MEX23	Gas Dynamics and Jet Propulsion	PEC	-	3	3	0	0	3	V - VII
4.	22MEX24	Refrigeration and Air Conditioning	PEC	-	3	3	0	0	3	V - VII
5.	22MEX25	Thermal Power Engineering	PEC	-	3	3	0	0	3	V - VII
6.	22MEX26	Renewable Energy Technologies	PEC	-	3	3	0	0	3	V - VII
7.	22MEX27	Advanced Vehicle Engineering	PEC	-	3	3	0	0	3	V - VII
8.	22MEX28	Power Plant Engineering	PEC	-	3	3	0	0	3	V - VII
VERTICAL 4 COMPUTATIONAL ENGINEERING										
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**	**P.S**
1.	22MEX31	Computational Solid Mechanics	PEC	-	3	3	0	0	3	V - VII
2.	22MEX32	Computational Fluid Dynamics and Heat transfer	PEC	-	3	3	0	0	3	V - VII
3.	22MEX33	Theory on Computation and Visualization	PEC	-	3	3	0	0	3	V - VII
4.	22MEX34	Computational Bio-Mechanics	PEC	-	3	3	0	0	3	V - VII
5.	22MEX35	Design of Pressure Vessels	PEC	-	3	3	0	0	3	V - VII
6.	22MEX36	CAD and CAE	PEC	-	3	3	0	0	3	V - VII
7.	22MEX37	Failure Analysis and NDT Techniques	PEC	-	3	3	0	0	3	V - VII
8.	22MEX38	Machine Learning for Intelligent Systems	PEC	-	3	3	0	0	3	V - VII

VERTICAL 5 DIGITAL AND GREEN MANUFACTURING										
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**	**P.S**
1.	22MEX41	Digital Manufacturing and IoT	PEC	-	3	3	0	0	3	V - VII
2.	22MEX42	Additive Manufacturing	PEC	-	3	3	0	0	3	V - VII
3.	22MEX43	Green Manufacturing Design and Practices	PEC	-	3	3	0	0	3	V - VII
4.	22MEX44	Casting and Welding Processes	PEC	-	3	3	0	0	3	V - VII
5.	22MEX45	Environment Sustainability and Impact Assessment	PEC	-	3	3	0	0	3	V - VII
6.	22MEX46	Surface Engineering	PEC	-	3	3	0	0	3	V - VII
7.	22MEX47	Green Supply Chain Management	PEC	-	3	3	0	0	3	V - VII
8.	22MEX48	Product Life Cycle Management	PEC	-	3	3	0	0	3	V - VII
(E) MINOR DEGREE										
MINOR I ELECTRIC VEHICLE TECHNOLOGIES										
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**	**P.S**
1.	22MEM01	Basics of Electric Vehicles	OEC	-	3	3	0	0	3	V - VII
2.	22MEM02	Electric Vehicle Architecture and Control System	OEC	-	3	3	0	0	3	V - VII
3.	22MEM03	Materials for Electric Vehicles	OEC	-	3	3	0	0	3	V - VII
4.	22MEM04	Powertrain Design for Electric Vehicles	OEC	-	3	3	0	0	3	V - VII
5.	22MEM05	Battery Management	OEC	-	3	3	0	0	3	V - VII
6.	22MEM06	AI and IoT for Electric Vehicles	OEC	-	3	3	0	0	3	V - VII
7.	22MEM07	Autonomous Vehicles	OEC	-	3	3	0	0	3	V - VII
8.	22MEM08	Fuel Cell Technology & Safety Regulations	OEC	-	3	3	0	0	3	V - VII
(F) MANAGEMENT ELECTIVES										
1.	22GEA02	Principles of Management	HSMC	-	3	3	0	0	3	VI
2.	22GEA03	Total Quality Management	HSMC	-	3	3	0	0	3	VI
3.	22GEA04	Professional Ethics	HSMC	-	3	3	0	0	3	Vi

(G) OPEN ELECTIVES										
1.	22MEZ01	Value Engineering	OEC	-	3	3	0	0	3	V-VII
2.	22MEZ02	Ergonomics in Design	OEC	-	3	3	0	0	3	V-VII
3.	22MEZ03	Industrial safety	OEC	-	3	3	0	0	3	V-VII
4.	22MEZ04	Process Planning and Cost Estimation	OEC	-	3	3	0	0	3	V-VII

Summary of Credit Distribution

Semester / Category	HSMC	BSC	PCC	ESC	EEC	PEC	OEC	Total
1	4	8		9				21
2	4	8		11				23
3		4	9	6				19
4			19				3	22
5			17			6		23
6	3		10			6	3	22
7	2		5		2	9	3	21
8					10			10
Total Credits	13	20	60	26	12	21	9	161
%	8.07%	12.42%	37.27%	16.15%	7.45%	13.04	5.59%	100.00%
AICTE Credits	12	29	58	27	16	9	9	160
%	7%	18%	36%	17%	10%	6%	6%	

22MAN01 INDUCTION PROGRAMME
(For Common To All Branches)

	L	T	P	C
	-	-	-	-

PRE REQUISITE : NIL

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:
"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. "

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration

of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

REFERENCES:

1.Guide to Induction program from AICTE

22EYA01 - PROFESSIONAL COMMUNICATION I (Common to All Branches)					
		L	**T**	**P**	**C**
		2	**0**	**2**	**3**
PREREQUISITE : NIL					
Course Objective:	• To build essential English skills to address the challenges of communication • To enhance communication employing LSRW skills				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Communicate effectively in various work environments.	R	20%
CO2	Involve indiverse discourse forms utilizing LSRW Skills.	U	20%
CO3	Participate actively in communication activities that enhance the creative skill.	U	20%
CO4	Associate with the target audience and contexts using varied types of communication.	Ap	20%
CO5	Convey the ideas distinctly both in verbal and non-verbal communication in work culture.	U	20%

UNIT I –INTRODUCTORY SKILLS	(6+6)
Grammar – Parts of Speech – Verb (Auxiliaries – Primary & Modal, Main Verb) -**Listening** – Listening toShort Conversations or Monologues - Listening to Experiences – Listening to Descriptions- **Speaking** – Introducing Oneself – Exchanging Personal information - Talking about food and culture - **Reading**– Reading for Interrogation – Reading Newspaper, Advertisements and Interpreting - **Writing** - Seeking Permission for Industrial Visit & In-plant Training	
UNIT II – LANGUAGE ACUMEN	(6+6)
Grammar – Word Formation – Tenses (Present Tense) – Synonyms & Antonyms - **Listening** – Listeningto Announcements – Listening to Interviews - Listening and Note-taking - **Speaking** – Talking aboutHolidays & Vacations – Narrating Unforgettable Anecdotes - **Reading** – Skimming – Scanning (Short Textsand Longer Passages) – Critical Reading - **Writing** – Instruction – Process Description	
UNIT III – COMMUNICATION ROOTERS	(6+6)
Grammar– Cause and Effect – Tenses (Past Tense) – Discourse Markers - **Listening** – Listening to Telephonic Conversations – Listening to Podcasts - **Speaking** – Talking about neoteric Technologies – Eliciting information to fill a form - **Reading** –Book Reading(Motivational) - Practicing Speed Reading (reading newspaper reports & biographies) - **Writing** – Checklist – Circular, Agenda & Minutes of the Meeting	

UNIT IV - DISCOURSE FORTE	(6+6)
Grammar – Tenses (Future Tense) –Yes/No & WH type questions – Negatives - **Listening** – Listening toTED/ Ink talks -**Speaking** – Participating in Short Conversations - **Reading** – Reading Comprehension (Multiple Choice / Short / Open Ended Questions) - **Writing** - E-Mail Writing	
UNIT V - LINGUISTIC COMPETENCIES	(6+6)
Grammar – Articles – Homophones & Homonyms – Single line Definition – Phrasal Verb - **Listening** – Intensive listening to fill in the gapped text - **Speaking** –Expressing opinions through Situations & Role play - **Reading** – Cloze Texts - **Writing** – Paragraph Writing	
LIST OF SKILLS ASSESSED IN THE LABORATORY **1. Grammar** **2. Listening Skills** **3. Speaking Skills** **4. Reading Skills** **5. Writing Skills**	
TOTAL (L:30 , P:30) = 60 PERIODS	

TEXT BOOKS:

1. Shoba K N., Deepa Mary Francis. *English for Engineers and Technologists.* Volume 1, 3rd Edition, Orient BlackSwanPvt.Ltd, Telangana, 2022.

REFERENCES:

1. Koneru, Aruna. *English Language Skills.* Tata McGraw Hill Education (India) Private Limited, Chennai, 2006.
2. Hewings, M. *Advanced English Grammar.* Cambridge University Press, Chennai, 2000.
3. Jack C Richards, Jonathan Hull and Susan Proctor. *Interchange.* Cambridge University Press, New Delhi, 2015 (Reprint 2021).

WEB REFERENCE:

1. https://youtu.be/f0uqUzEf3A8?si=vyzu5KGIfbu35_IQ

Mapping of COs with POs / PSOs

	POs												PSOs	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				
CO (W.A)									**2**	**3**				

22MYB01-CALCULUS AND LINEAR ALGEBRA *(Common to All Branches)*				
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**

PREREQUISITE : NIL

Course Objective:	• To understand the mathematical concepts of matrices and analytical geometry in real time problems. • To formulate differential and integral equations to model physical, biological, and engineering systems

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts of matrix theory for find solutions to complex problems efficiently.	Ap	20%
CO2	Analyze the geometric configurations and relationships by using Analytical geometry.	An	20%
CO3	Interpret the partial derivatives which involve heat conduction problems modeled by the heat equation.	Ap	20%
CO4	Apply the differential and integral techniques to solve the differential equations and multiple integrals in heat conduction, fluid mechanics and potential theory.	Ap	40%
CO5	Demonstrate the importance of matrix theory, analytical geometry and integral methods using programming tools.	Ap	Internal Assessment

UNITI–MATRICES	**(9+3)**
Characteristic Equation-Eigen values and Eigen vectors of a matrix- Cayley Hamilton Theorem(excluding proof)and its applications-Quadratic Form-Reduction of a Quadratic form to canonical form by orthogonal transformation.	
UNITII–ANALYTICAL GEOMETRY OF THREE DIMENSIONS	**(9+3)**
Equation of plane–Angle between two planes–Equation of straight lines-Coplanar lines–Equation of sphere –Orthogonal spheres.	
UNITIII-GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS	**(9+3)**
Curvature–Curvature in Cartesian co-ordinates-Centre and Radius of curvature-Circle of curvature-Evolutes and Involutes.	
UNITIV-FUNCTIONS OF SEVERAL VARIABLES	**(9+3)**
Partial derivatives-Euler's theorem on homogeneous function-Jacobian-Maxima and Minima of functions of Two variables-Constrained Maxima and Minima by Lagrange's multiplier method.	
UNITV-MULTIPLE INTEGRALS	**(9+3)**
Double integration in Cartesian Co-ordinates-Change of order of integration-Area as double integral-Triple Integration in Cartesian Co-ordinates-Volume as triple integrals.	
TOTAL(L:45+T:15) :60PERIODS	

LIST OF PROGRAMS USING MATLAB (Assignment/Online Test**)**:

1. Introduction to MATLAB
2. Matrix operations–Addition, Multiplication, Transpose and Inverse
3. Characteristic equation of a Matrix
4. Eigen values and Eigen vectors of Higher order Matrices.
5. Curve Tracing
6. Determining Maxima and Minima of a function of one variable.
7. Determining Maxima and Minima of a function of two variables.
8. Evaluating double integrals
9. Evaluating triple integrals
10. Finding area between two curves.

TEXT BOOKS:

1. Grewal,B.S., "Higher Engineering Mathematics", Khanna publications,42nd Edition,2012.
2. ErwinKreyszig, "Advanced Engineering mathematics",JohnWiley&sons,9th Edition,2013.
3. Veerarajan,T., "Engineering Mathematics of semesterI&II",TataMcGrawHill,3rd Edition,2016.

REFERENCES:

1. Bali,N.P.,ManishGoyal,"A Textbook of Engineering Mathematics-Sem-II", Laxmi Publications,6th Edition,2014.
2. Kandasamy,P.,Thilagavathy,K.,Gunavathy,K., "Engineering Mathematics for first year",Scand & Co Ltd,9th Revised Edition,2013.
3. GlynJames,"Advanced Engineering Mathematics",Wiley India,7th Edition,2007.

Mapping of COs with POs / PSOs

	POs												PSOs	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													
2		2												
3		2												
4	3													
5	3				2				3			2		
CO (W.A)	**3**	**2**			**2**				**3**			**2**		

22CYB02 - CHEMISTRY FOR ENGINEERS (Common to CIVIL and MECH Branches)				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE : NIL

Course Objective:	• To make the students conversant with water treatment, boiler feed water techniques, energy storage devices and corrosive nature of metals. • To impart knowledge on the basic principles, preparatory methods of nanomaterials and combustion nature of fuels.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Predict the nature, oxidation and reduction potential of an electrode.	An	20%
CO2	Investigate on renewable energy sources like nuclear, solar, wind energy and also on storage devices.	E	20%
CO3	Identify the types of hardness in water and its removal by various water treatment techniques.	Ap	20%
CO4	Explore the type of corrosion and its control measures.	An	20%
CO5	Recommend suitable fuels for engineering processes and applications.	E	20%

UNIT I – ELECTROCHEMISTRY	(9)
Electrode potential - Nernst equation - derivation and problems - reference electrodes - standard hydrogen electrode - calomel electrode - electrochemical series - significance - Types of cell - electrolytic and electrochemical cells - reversible and irreversible cells - potentiometric titrations (redox) - conductometric titrations (acid-base).	
UNIT II - ENERGY SOURCES AND STORAGE DEVICES	(9)
Nuclear energy - nuclear fission - nuclear fusion - light water nuclear power plants - breeder reactor – solar energy conversion - solar cells - solar water heater - Recent developments in solar cell materials - wind energy - batteries - types of batteries - lead acid storage battery - lithium-ion battery, Electric vehicles - working principles.	
UNIT III - WATER TECHNOLOGY AND NANO MATERIALS	(9)
Municipal water treatment - disinfection methods (uv, ozonation, chlorination) - desalination of brackish water - reverse osmosis - boiler troubles (scale, sludge , priming, foaming and caustic embrittlement) - treatment of boiler feed water - internal treatment (carbonate, phosphate and calgon conditioning) - external treatment - demineralization process. Nanomaterials - synthesis (laser ablation, and chemical vapour deposition method) and applications of nanomaterials.	

UNIT IV - CORROSION AND ITS CONTROL	(9)
Corrosion - types - chemical corrosion - pilling bedworth rule - electrochemical corrosion - mechanism- galvanic corrosion - differential aeration corrosion - factors influencing corrosion - corrosion control - sacrificial anode and impressed cathodic current methods - corrosion inhibitors - protective coatings - paints - constituents and their functions	
UNIT V - FUELS AND COMBUSTION	(9)
Fuels: Introduction: Classification of fuels: Coal and coke: Analysis of coal (Proximate) - Carbonization - Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process) - Knocking - octane number - diesel oil - cetane number: Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Flue gas analysis - ORSAT method. CO2 emission and carbon foot print.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

1. Dr.Ravikrishnan, A,"Engineering Chemistry I & Engineering Chemistry II", Sri Krishna Hitech Publishing chem., Co. Pvt Ltd., 13th Edition, Chennai, 2020.
2. S.S. Dara," A Text book of Engineering Chemistry", S.Chand & Co.Ltd. New Delhi, 2019.

REFERENCES:

1. P.C.Jain and Monica Jain, "Engineering Chemistry", Vol I &II, DhanpatRai Pub, Co,New Delhi 15th ed.,2018.
2. B.Sivasankar, "Engineering Chemistry" , Tata McGraw- Hill Pub.Co.Ltd.,New Delhi,2018

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3								2					
2		2												
3														
4			2				2							
5		2				2						2		
CO (W.A)	3	2	2			2	2		2			2		

22EEC02- BASIC ELECTRICAL ENGINEERING *(For MECH Branch only)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE : NIL

Course Objective:	• To impart knowledge on the concepts of electrical circuit laws, AC and DC machines. • To Gain information on the basic principles of transformers, electric drives with applications.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the basic electric laws for AC and DC circuits and investigates the behavior of basic electrical machines.	Ap	25%
CO2	Illustrate the operation and types of electrical circuits, transformers and machines including the speed control of Electric vehicle and paper mills.	Ap	25%
CO3	Analyze the Characteristics of AC machines and DC machines and predict the selection of electric drives.	An	25%
CO4	Apply the various categories of AC and DC electric circuits, machines and drives for various applications.	Ap	25%
CO5	Achieve as an independent learner in a team to build an authentic application of electrical engineering and make an effective oral presentation.	C	Internal Assessment (Seminar)

UNIT I - ELECTRIC CIRCUITS	**(9)**
Introduction to DC circuits-Ohm's Law – Kirchhoff's Laws – Resistive circuits-Series and parallel reduction-Introduction to AC circuits– Alternating current and Voltage-RMS and average values of sinusoidal waveforms-Power-real power, reactive power and Power factor.	
UNIT II - DC MACHINES	**(9)**
DC Generator: Construction, Types, Principle of operation, EMF equation, Characteristics. DC Motor: Principle of operation, Types, Torque equation, Characteristics and Applications.	
UNIT III - AC MACHINES	**(9)**
Single phase induction motor: Construction, Types, working principle- Three phase induction motor: Construction, Types, Torque – Slip Characteristics- Synchronous motor : Construction, working principle.	
UNIT IV - TRANSFORMERS	**(9)**
Construction, Types, Principle of operation, EMF Equation and applications.	
UNIT V -ELECTRICAL DRIVES AND ITS APPLICATIONS	**(9)**
Introduction - Selection of electric drive – types of DC and AC drives, Case study: Speed control in Electric vehicle and paper mills.	
	TOTAL (L:45) : 45 PERIODS

TEXT BOOK:

1. D P Kothari and I.J Nagarath, "Basic Electrical Engineering", McGraw Hill Education (India) Private Limited, 4th Edition, 2019.
2. Dubey G.K., "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2nd edition, Reprint 2020

REFERENCES:

1. Mittle and V. N. Mittle, "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 2005
2. Krishnan R, Electric Motor Drives: Modeling, Analysis and Controlll, Pearson India,2015

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2	3												2	
3		3											2	
4	3												2	
5									3	3	3	3		
CO (W.A)	**3**	**3**							**3**	**3**	**3**	**3**	**2**	

22MEC02 - ENGINEERING GRAPHICS AND DRAFTING				
	L	T	P	C
	3	0	2	4
PREREQUISITE : Nil				

Course Objective:	• To Create the projection of points, lines and planes • To Develop the projection of Solid • To Solve problems in sectioning of solids and developing the surfaces • To Apply the concepts of orthographic and isometric • To Draw engineering drawing by Modeling software with dimensions

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of engineering drawing standards to drawn 2D Engineering drawings with drafting software	Ap	40%
CO2	Apply the knowledge of engineering drawing standards to solve the given 2D problem using first angle of projection with drafting software	Ap	20%
CO3	Apply the knowledge of engineering drawing standards solve the 3D problem using first angle of projection with drafting software	Ap	20%
CO4	Analyze the given problem to create 3D drawing with drafting software	An	20%
CO5	Engage independent study as a member of team and make effective oral presentation on engineering graphics	U	Internal Assessment

CONCEPTS AND CONVENTIONS (Not for Examination)	
Importance of graphics in engineering applications - use of drafting instruments - BIS conventions and specifications - size, layout and folding of drawing sheets - lettering and dimensioning - scales.	
UNIT I- PROJECTION OF POINTS AND LINES	**(9)**
Principal planes - first angle projection - projection of points - projection of straight lines (only first angle projections) inclined to both the principal planes - determination of true lengths and true inclinations by rotating line method.	
UNIT II - FIRST ANGLE PROJECTION OF PLANE	**(9)**
Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.	
UNIT III - PROJECTION OF SOLIDS	**(9)**
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to anyone of the principal plane and Parallel to another by rotating object method.	
UNIT IV - DEVELOPMENT OF SURFACES	**(9)**
Development of lateral surfaces of simple and sectioned solids - prisms, pyramids cylinder and cone.	
UNIT V – ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS	**(9)**
Principles of isometric projection - isometric scale - isometric projections of lines, plane figures, simple solids and truncated solids - prisms, pyramids, cylinders, cones – free hand sketching of orthographic views from isometric views of objects.	

LIST OF THE EXPERIMENTS

1. Computer aided drafting of front and top views of the given isometric view.
2. Computer aided drafting of front and top views of cylinder and cone.
3. Computer aided drafting of sectional views of prism and pyramid.
4. Draw the isometric projection from given front and top views of the solid model.
5. 3D modeling of prism and pyramid
6. 3D modeling of spur gear.

TOTAL (L:45+P30) : 75 PERIODS

TEXT BOOKS:

1. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International (P) Limited, 2022.
2. N.S Parthasarathy and Vela Murali, "Engineering Drawing", Oxford University Press, 2015.

REFERENCES:

1. N.D.Bhatt and V.M.Panchal, "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2014.
2. K.R.Gopalakrishna., "Computer Aided Engineering Drawing" (Vol I and II combined) Subhas Stores, Bangalore, 2017.
3. K. V.Natarajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
4. Luzzader, Warren.J., and Duff, John M, "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production", Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005.
5. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson, 2nd Edition, 2009.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3			3									3	2
2	3			3									3	2
3	3			3									3	2
4	3			3									3	2
5	3			3					2				3	2
CO (W.A)	**3**			**3**					**2**				**3**	**2**

22GEP01 - ENGINEERING PRACTICES LABORATORY *(Common to AGRI, BME, CHEM, CIVIL, ECE, EEE and MECH Branches)*				
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

PREREQUISITE : NIL

Course Objective:	• To provide hands on training on various basic engineering practices in civil engineering • To provide hands on training on welding in mechanical engineering • To provide hands on training on various basic engineering practices in mechanical engineering • To understand the basic working principle of electric components • To understand the basic working principle of electronic components

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Design new layouts of civil work for residential and industrial buildings.	Ap
CO2	Apply the concepts of welding in repairing works and making various components	Ap
CO3	Design new components using machining processes in real life and industries	Ap
CO4	Apply the skills of basic electrical engineering for wiring in different areas and Measure various electrical quantities	Ap
CO5	Apply electronic principles to measure various parameters of a signal.	Ap

GROUP-A (MECHANICAL AND CIVIL ENGINEERING)	
I - CIVIL ENGINEERING PRACTICE	**(15)**
Buildings: a. Study of plumbing and carpentry components of residential and industrial buildings, Safety aspects	
Plumbing: a. Study of tools and operations b. Hands-on-exercise: External thread cutting and joining of pipes	
Carpentry: a. Study of tools and operations b. Hands-on-exercise: "L" joint and "T" joint	
II - MECHANICAL ENGINEERING PRACTICE	**(15)**
Welding: a. Study of arc welding, gas welding tools and equipments b. Arc welding- Butt joints, Lap joints and Tee joints c. Practicing gas welding	

Basic Machining: a. Study of lathe and drilling machine b. Facing and turning c. Drilling and Tapping
Sheet Metal Work: a. Study of tools and operations b. Rectangular tray c. Cone
GROUP - B (ELECTRICAL AND ELECTRONICS)
I - ELECTRICAL ENGINEERING PRACTICE **(15)**
a. Residential house wiring using Switches ,fuse, indicator, lamp b. Fluorescent lamp wiring c. Stair Case Wiring d. Measurement of electrical quantities – Voltage, current ,power in R Circuit e. Study of Electrical apparatus-Iron box & water heater f. Study of Electrical Measuring instruments- Megger
II - ELECTRONICS ENGINEERING PRACTICE **(15)**
a. Study of Electronic components and various use of multi meter. b. Measurement of AC signal parameter (peak-peak, RMS period, frequency) using CRO. c. Study of logic gates AND, OR, XOR and NOT. d. Study of Clock Signal. e. Soldering practice -Components Devices and Circuits - Using general purpose PCB. f. Study of Half Wave Rectifier (HWR) and Full Wave Rectifier (FWR). g. Study of Telephone, FM Radio and Cell Phone.
TOTAL (P: 60) = 60 PERIODS

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3												
3			2											
4	3												1	
5	3												1	
CO (W.A)	**3**	**3**	**2**										1	

22CYP01 CHEMISTRY LABORATORY (Common to AGRI, BME, CHEM, CIVIL, ECE, EEE and MECH Branches)				
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

PREREQUISITE : NIL

Course Objective:	• To determine the copper in brass in the given solution and explain the origin of hardness, alkalinity, chloride and dissolved oxygen in water. • To perform a potentiometric, conductometric titration and pH of an acidic solution of known Normality.

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Predict the various water quality parameters by volumetric analysis.	An
CO2	Evaluate the amount of copper in the given solution by titration method.	E
CO3	Analyze the conductance and emf of the different solutions.	An
CO4	Analyze and gain experimental skill about potential of hydrogen ion.	An
CO5	Examine the pH of various acidic, basic and neutral solutions.	An

LIST OF EXPERIMENTS :

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of alkalinity in water sample.
3. Determination of chloride content of water sample by Argentometric method.
4. Determination of DO content of water sample by Winkler's method.
5. Estimation of copper in brass by EDTA.
6. Conductometric titration of strong acid vs strong base.
7. Estimation of iron content of the given solution using potentiometer.
8. Determination of strength of given hydrochloric acid using pH meter.

Total (30 P) = 30 periods

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1					3									
2							2							
3							2							
4					3									
5							2							
CO (W.A)					**3**		**2**							

* **Ratified by Eleventh Academic Council**

22MAN02 - SOFT/ANALYTICAL SKILLS – I (Common to All Branches)				
	L	**T**	**P**	**C**
	1	**0**	**2**	**0**
PREREQUISITE : NIL				

Course Objective:	• To understand the basic concepts of grammar and apply them in a structured Manner • To solve mathematical problems and thereby reducing the time taken for performing job functions

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of Continuous Assessment Test**
CO1	Recognize and apply fundamental grammatical rules in both written and spoken contexts.	U	40%
CO2	Solve real-time problems for performing job functions easily.	Ap	30%
CO3	Enhance their aptitude round clearing ability in interview process.	An	30%

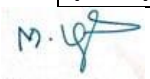
UNIT I – VERBAL ABILITY	(5+10)
Tenses - One Word Substitution- Articles - Preposition - Conjunction	
UNIT II – BASIC APTITUDE	(5+10)
Percentage - Ratio and Proportion - Blood Relations - Analogy	
UNIT III – LOGICAL REASONING	(5+10)
Probability - Profit and Loss - Syllogism - Statement Assumptions.	
TOTAL (L:45) = 45 PERIODS	

REFERENCES:

1. Murphy, Raymond. *English Grammar in Use*. Fourth Edition, Cambridge University, 2012.
2. Dr. R.S. Aggarwal. *A Modern Approach to Verbal & Non-Verbal Reasoning*. S Chand and Company Limited, New Delhi, 2014.
3. Aggarwal, Ashish. *Quick Arithmetic*. S Chand and Company Limited, New Delhi, 2014.

Mapping of COs with POs / PSOs

	POs												**PSOs**	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1									2	3				
2		2		2										
3		2		2										
CO (W.A)		**1**		**1**					**1**	**1**				



22MAN03 - YOGA – I (For Common To All Branches)				
	L	**T**	**P**	**C**
	0	**0**	**I**	**0**

PREREQUISITE : NIL

Course Objective:	• To make students in understanding the importance of yoga in shaping mental and physical wellness. • To provide awareness about the significance of leading a peaceful life by following yoga exercises and principles. • To develop mental wellbeing through meditation and breathing exercises. • To strengthen the body through physical exercises. • To inculcate the knowledge about different types of Asanas and their benefits

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Understand the importance of yoga for physical and mental goodness.	U	Internal Assessment
CO2	Perform the yoga exercises for hand, leg, eye and sun salutation etc.	Ap	
CO3	Learn and practice meditation techniques for keeping good mental health	Ap	
CO4	Develop their body by performing yoga exercises.	Ap	
CO5	Demonstrate different types of yoga Asanas for improving their personal fitness.	Ap	

UNIT I – INTRODUCTION TO YOGA	(3)
Meaning and Importance of Yoga - Elements of Yoga - Introduction - Asanas, Pranayama, Meditation and Yogic Kriyas - Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana and Shashankasana) - Relaxation Techniques for improving concentration - Yog-nidra.	
UNIT II - YOGA AND LIFE STYLE	(3)
Asanas as Preventive measures – Hypertension:Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana – Obesity: Procedure, Beneits and contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana – Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana - Diabetes: Procedure, Benefits and contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana – Asthema: Procedure, Benfits and contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.	
UNIT III – MIND EXERCISES	(3)
Naadi sudhi – Thanduvada sudhi – Breathing meditation – Silent meditation – Relax meditation.	
UNIT IV – PHYSICAL EXERCISES (PART– I)	(3)
Hand Exercises – Leg Exercises – Eye Exercises – Sun Salutation.	

UNIT V – ASANAS (PART-I)	(3)
Asanas –Tadasana – Yegapadhasana – Chakrasana – Udkaddasana – Thirikosana – Thandasana – Paschimottanasana.	
TOTAL (P:15) : 15 PERIODS	

TEXT BOOKS/REFERENCES:
1. Light On Yoga by B.K.S. Iyengar.

Mapping of COs with POs / PSOs														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1								3	2			3		
2								3	2			3		
3								3	2			3		
4								3	2			3		
5								3	2			3		
CO (W.A)								3	2			3		

*Ratified by Eleventh Academic Council

22EYA02- PROFESSIONAL COMMUNICATION- II (Common to All Branches)					
		L	**T**	**P**	**C**
		2	**0**	**2**	**3**
PREREQUISITE : 22EYA01					
Course Objective:	• To enhance the students with necessary English language skills • To enable students to communicate effectively in an academic setting				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Frame sentences both in written and spoken forms with accuracy and fluency.	R	20%
CO2	Use linguistic structures to read and understand well-structured texts encountered in academic or social contexts.	U	20%
CO3	Gain essential competency to express one's thoughts orally and in writing in a meaningful way.	U	20%
CO4	Attain and enhance competence in the four modes of literacy: Listening, Speaking, Reading and Writing.	Ap	20%
CO5	Perform various tasks, such as role plays, debates, group discussions apart from the use of correct spelling and punctuation.	U	20%

UNIT I - LANGUAGE RUDIMENTS	(6+6)
Grammar – Active and Passive Voice – Impersonal Passive Voice – Numerical Expressions - Listening – Listening for Specific Information and Match / Choose / Fill in the texts - Speaking – Describing a Person - Making Plans -Reading – Intensive Reading -Writing – Job Application with Resume	
UNIT II - RHETORIC ENHANCERS	(6+6)
Grammar – Reported Speech – Infinitive and Gerund - Listening – Listening to Iconic Speeches and making notes - Listening news / documentaries - Speaking –Talking over Phone – Narrating Incidents - Reading – Extensive Reading (Motivational Books) - Writing – Recommendation	
UNIT III - TECHNICAL CORRESPONDENCE	(6+6)
Grammar – If Conditionals – Blended Words - Listening – Listening to business conversation on audio and video of Short Films, News, Biographies - Speaking – Synchronous communication and Asynchronous communication - Opportunities and threats in using digital platform- Reading - Finding key information in a given text - Writing –Netiquettes- Inviting Dignitaries - Accepting & Declining Invitation	
UNIT IV - CORPORATE COMMUNICATION	(6+6)
Grammar – Concord – Compound Words - Listening – Listening to Roles and Responsibilities in Corporate - Listening to technical videos - Speaking – Introduction to Technical Presentation - Story Telling - Reading – Reading and Understanding Technical Articles - Writing – Report Writing (Accident, Survey and feasibility)	

UNIT V - LANGUAGE BOOSTERS	(6+6)
Grammar - Idiomatic Expressions – Relative Clauses – Confusable words - Listening – Listening to different kinds of Interviews - Listening to Group Discussion - Speaking – Group Discussion - Reading – Reading and Interpreting Visual Materials - Writing – Analytical Paragraph Writing	
LIST OF SKILLS ASSESSED IN THE LABORATORY **1. Grammar** **2. Listening Skills** **3. Speaking Skills** **4. Reading Skills** **5. Writing Skills**	
TOTAL (L:30 , P:30) = 60 PERIODS	

TEXT BOOKS:

1. Sudharshana, N.P and Saveetha.C. *English for Technical Communication*. Cambridge University Press, New Delhi, 2016 (Reprint 2017).

REFERENCES:

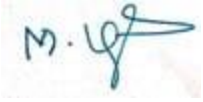
1. Rizvi, M Ashraf. *Effective Technical Communication.* Second Edition, McGraw Hill Education India PvtLtd, 2017.
2. Rodney Huddleston, Geoffrey K. Pullum and Brett Reynolds. *A Student's Introduction to English Grammar.* Second Edition, Cambridge University Press, New Delhi, 2022.

WEB REFERENCE:

1. http://youtu.be/URtdGiutVew

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				
CO (W.A)									2	3				



22MYB02 – PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORM TECHNIQUES *(Common to AGRI,CIVIL,CHEMICAL, MECH Branches)*				
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**
PREREQUISITE : NIL				

Course Objective:	• To make the conversant with concepts of Laplace transforms, Fourier series, Fourier Transforms to represent periodical physical problems in engineering analysis. • To provide adequate knowledge in partial differential equation and to analyze the boundary value problems.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the various techniques of Fourier series to obtain solution for different functions.	Ap	20%
CO2	Interpret the methods of partial differential equations in fluid mechanics and water resource management.	Ap	20%
CO3	Solve the initial and boundary value problems by using Fourier series.	Ap	20%
CO4	Analyze the concepts of Transform Techniques to solve the problems in stability analysis, Structural Analysis, control system design and analysis.	An	40%
CO5	Demonstrate the importance of Transform Techniques and partial differential equations in engineering using modern tools.	Ap	Internal Assessment

UNIT I – FOURIER SERIES	**(9+3)**
Dirichlet's condition – Fourier series: Half range sine series – Half range cosine series – Parseval's identity for half range series – Root mean square value of a function – Harmonic analysis.	
UNIT II –PARTIAL DIFFERENTIAL EQUATIONS	**(9+3)**
Formulation of partial differential equations by eliminating arbitrary constants and functions – Solution of standard types first order partial differential equations of the type f(p,q)=0,Clairaut's form – Lagrange's linear equations –Linear partial differential equation of second and higher order with constant coefficient of homogeneous types.	
UNIT III –APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	**(9+3)**
Classification of second order quasi linear partial differential equations – Solution of one dimensional wave equation (Zero and non-zero velocity) – One dimensional heat equation (Temperature reduced to zero and non zero boundary conditions) – Steady state solution of two dimensional heat equation(Finite and infinite plate).	

UNIT IV –-FOURIER TRANSFORM	(9+3)
Fourier integral theorem(Statement only) – Fourier transform pair - Sine and Cosine transforms – Properties -Transforms of simple functions – Convolution theorem – Parseval's identity(Excluding proof).	
UNIT V –LAPLACE TRANSFORM	**(9+3)**
Condition for existence - Transforms of Elementary functions –Basic Properties- First & Second Shifting Theorems(Statement only) - Initial and Final value Theorems. Inverse Laplace transforms -Convolution theorem (Excluding proof)- Solution of linear second order ordinary differential equations with constant coefficients using Laplace transform.	
TOTAL (L:45+T:15) : 60 PERIODS	

TEXT BOOKS:

1. Veerarajan.T,"Engineering Mathematics (for semester III), 3rd ed., Tata McGraw Hill, New Delhi.
2. Kandasamy.P, Thilagavathy.K, and Gunavathy.K., "Engineering Mathematics; Volume III", S.Chand&Coltd., 2008.
2. GrewalB.S,"Higher Engineering Mathematics", 42nd ed., Khanna publishers, New Delhi, 2012.

REFERENCES:

1. Goyal Manish and Bali.N.P,"A Text book of Engineering mathematics", 6th ed.,Laxmi Publication (P) Ltd,New Delhi, 2012.
2. Kreyszig, Erwin,"Advanced Engineering Mathematics", 9th ed., Wiley Publications, New Delhi, 2006.

Singaravelu.A,"Transforms and Partial Differential Equations", Reprint Edition 2013, Meenakshi Publications, Tamilnadu.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		2												
2	3													
3	3													
4	3													
5	3				2				3			3		
CO (W.A)	3	2			2				3			3		

22PYB04 - PHYSICS FOR MECHANICAL ENGIINEERING (Mechanical Engineering)					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To expose the concepts of properties of matter.	1.1	Predict the importance of properties of matter in the field of mechanical engineering.		
2.0	To identity knowledge of fundamental concepts of thermal physics.	2.1	Gain the importance of fundamental concepts of thermal physics.		
3.0	To update the knowledge about the elements of thermodynamics.	3.1	Understand the basics of elements of thermodynamics.		
4.0	To identify knowledge in the field of electromagnetic theory.	4.1	Recognize the importance of electromagnetic theory.		
5.0	To obtain the knowledge of optics and laser.	5.1	Acquire knowledge about optics, laser and their applications.		

UNIT I – PROPERTIES OF MATTER	**(9)**
Elasticity – Hooke's law Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.	
UNIT II – THERMAL PHYSICS	**(9)**
Mode of heat transfer-thermal conductivity - Newton's law of cooling - thermal conduction through compound media (bodies in series and parallel) - thermal conductivity of a good conductor – Forbe's method-thermal conductivity of bad conductor - Lee's disc - radial flow of heat-expression for thermal conductivity of rubber - experimental determination - practical applications of conduction.	
UNIT III – ELEMENTS OF THERMODYNAMICS	**(9)**
Concept of temperature – Heat - Thermodynamics - work – Heat in Thermodynamics – Comparison of heat and work – internal energy - first law of thermodynamics – applications of first law - second law of thermodynamics – the Carnot engine – heat engine – heat pump refrigerator -Third law of thermodynamics.	
UNIT IV – ELECTRO MAGNETIC THEORY	**(9)**
Force on a moving Charge - Force on a differential Current Element - Force & Torque Magnetisation & Permeability - Magnetic Boundary Conditions -Inductance & Mutual Inductance - Time Varying Fields: Faraday's Law - Displacement Current - Maxwell's Equation.	
UNIT V – OPTICS AND LASERS	**(9)**
Interference: Air wedge – theory – uses – testing of flat surfaces – determination of thickness of a thin wire – Introduction of laser - Properties of laser beams : mono - chromaticity, coherence, directionality and Intensity - Einstein's A and B coefficients derivation - Resonant cavity - Types of lasers – solid state laser (Neodymium) – Gas laser (CO_2) – Materials processing – Laser Cutting – Drilling – Welding – Soldering – Industrial Applications.	

TOTAL (L: 45) = 45 PERIODS

TEXT BOOKS

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2019.
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2017.
3. A. Marikani, "Materials Science", PHI Learning Private Limited, Eastern Economy Edition, 2019.

REFERENCES

1. Dattuprasad and Ramanlal Joshi, "Engineering Physics" Tata McGraw hill education, 2016.
2. Subrahmanyam N, Brijlal, "A Text Book of Optics" S.Chand & Co. Ltd, New Delhi, 2017.
3. M.N.Avathanalu, P.G.Kshirsagar "A text book of engineering physics" S.Chand &company Ltd, 2015.

WEB LINKS

1. https://bayanbox.ir/view/7764531208313247331/Kleppner-D.-Kolenkow-R.J.-Introduction-to-Mechanics-2014.pdf.
2. https://physicaeducator.files.wordpress.com/2017/11/electricity_and_magnetism-by-purcell-3ed-ed.pdf.
3. https://rajeshvcet.home.blog/regulation-2021/ph3151-engineering-physics-study-materials/
4. https://zenodo.org/record/243407#.ZEgPZXZBzIU
5. https://farside.ph.utexas.edu/teaching/qmech/qmech.pdf.
6. https://web.pdx.edu/~pmoeck/phy381/workbook%20nanoscience.pdf.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) / Programme Specific Outcomes (PSOs)

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	-	-	-	-	-	1	1	-	2	-	-
2	3	2	3	-	-	-	-	-	1	1	-	1	-	-
3	3	2	3	-	-	-	-	-	1	1	-	2	-	-
4	2	2	2	-	-	-	-	-	-	-	-	1	-	-
5	2	1	2	-	-	-	-	-	1	1	-	2	-	-
CO (W.A)	**3.0**	**2.0**	**3.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.0**	**1.0**	**0.0**	**2.0**	**0.0**	**0.0**

22CSC01 - PROBLEM SOLVING AND C PROGRAMMING *(Common to All Branches)*					
			L	**T**	**P**	**C**
			3	**0**	**0**	**3**
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand problem solving, problem solving aspects, programming and to know about various program design tools.	**1.1**	The student will be able to identify the appropriate problem solving techniques to drive the solution for the given problem.		
2.0	To learn basic structure and Control Statements in C programming.	**2.1**	The student will be able to implement the appropriate looping and control statements in C for developing applications.		
3.0	To learn the manipulation of arrays and strings	**3.1**	The student will be able to develop programs on arrays of different dimensions of arrays and strings concepts.		
4.0	To understand the concept of modular programming using user defined functions.	**4.1**	The student will be able to implement programs using user defined functions.		
5.0	To acquaint with the use and benefits of Memory Allocation and file handling.	**5.1**	The student will be able to use dynamic memory allocation functions for assigning memory space during execution.		

UNIT I -PROBLEM SOLVING AND C PROGRAMMING BASICS	**(9)**
General Problem Solving: Algorithms, Flowcharts and Pseudo-codes, implementation of algorithms **Basics of C Programming** : Introduction to C - Structure of C program - Programming Rules – Compilation – Errors - C Declarations: Tokens - keywords - identifiers - constants - data types - variable declaration and initialization - type conversion - constant and volatile variables - operators and expressions.	
UNIT II - DECISION CONTROL STATEMENTS	**(9)**
Managing Input and Output operations, Decision Control Statements: Decision control statements, Selection/conditional branching Statements: if, if-else, nested if, if-elif-else statements. Basic loop Structures/Iterative statements: while loop, for loop, selecting appropriate loop. Nested loops break and continue statements.	
UNIT III - ARRAYS AND STRINGS	**(9)**
Introduction to Array - Definition - Array initialization - Characteristics - One Dimensional Array - Array operations -Two dimensional arrays -Strings and String handling functions.	
UNIT IV - FUNCTIONS	**(9)**
Functions: Basics - definition - Elements of User defined Functions - return statement, Function types, Parameter Passing Techniques, Function returning more values - Passing Array to Functions - Recursion - Storage classes.	
UNIT V - POINTERS AND FILE MANAGEMENT	**(9)**
Pointer concepts - Pointers & Arrays, Structure concepts - Defining, Declaring, Accessing Member Variables, Structure within Structure - Union - File Management in C- Dynamic Memory Allocation	
TOTAL (L:45) :45 PERIODS	

TEXT BOOKS:

1. Ashok N. Kamthane, "Programming in C", 2nd Edition, Pearson Education, 2013.
2. Sumitabha Das, "Computer Fundamentals and C Programming", 1st Edition, McGraw Hill, 2018.

REFERENCES:

1. R. G. Dromey, "How to Solve it by Computer", Pearson Education India; 1st Edition, ISBN10: 8131705625, ISBN-13: 978-8131705629
2. Maureen Spankle, "Problem Solving and Programming Concepts", Pearson; 9th Edition, India, ISBN-10: 9780132492645, ISBN-13: 978- 0132492645
3. Yashavant Kanetkar, "Let us C", 16th Edition, BPB Publications, 2018.
4. ReemaThareja., "Programming in C ", 2nd Edition, Oxford University Press, New Delhi, 2018.
5. Balagurusamy E., "Programming in ANSI C", 7th Edition, Mc Graw Hill Education, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	-	-	-	-	-	-	-	-	3	3	3
2	3	2	3	-	-	-	-	-	-	-	-	3	3	3
3	3	2	3	-	-	-	-	-	-	-	3	3	3	3
4	3	2	3	-	-	-	-	-	3	-	3	3	3	3
5	3	2	3	-	-	-	-	-	-	-	3	3	3	3
CO (W.A)	3	2	3	-	-	-	-	-	3	-	3	3	3	3

* **Ratified by Eleventh Academic Council**

22ECC03 BASICS OF ELECTRONICS AND INSTRUMENTATION ENGINEERING *(For MECH Branch only)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To learn the basic knowledge on basic electric laws and basic of electronics.	**1.1**	The students will be able to explain the basic knowledge on basic electric laws and basic of electronics.		
2.0	To impart knowledge on the principles of working of semi-conductor circuits and its characteristics.	**2.1**	The students will be able to understand the principles of working of the semiconductor circuits and its characteristics.		
3.0	To introduce the fundamentals of digital electronics.	**3.1**	The students will be able to expose the concept of digital electronics.		
4.0	To expound the working principles of measuring instruments.	**4.1**	The students will be able to explain different measuring instruments.		
5.0	To expound the working principles of indicating instruments.	**5.1**	The students will be able to choose appropriate instruments for indicating different measurements for a specific application.		

UNIT I - BASICS OF ELECTRONICS	**(9)**
Ohm's law - Kirchhoff's law - Power: real, reactive and apparent - Power factor - Electrical circuit elements(R, L, C) series and parallel circuits - Voltage and current sources - Representation of sinusoidal waveforms- Peak and RMS values- semiconductors-intrinsic, extrinsic, energy band diagram.	
UNIT II - SEMICONDUCOR CIRCUITS	**(9)**
PN junction Diode - forward bias, reverse bias, drift and diffusion current - Rectifier: Half wave, full wave and bridge rectifier - Transistor: PNP, NPN transistor – Operational amplifier: inverting and non-inverting amplifier.	
UNIT III - DIGITAL ELECTRONICS	**(9)**
Number system: binary, octal, decimal and hexadecimal – Boolean algebra theorems – Logic gates - Flip-flops and types (diagram and truth table) – register and counter (types).	
UNIT IV - MEASURING INSTRUMENTS	**(9)**
Sensors: static and dynamic characteristics – Transducer – Piezo electric, resistive, inductive, capacitive, thermo electric, photo electric and LVDT.	
UNIT V - INDICATING INSTRUMENTS	**(9)**
Types of indicating instruments: moving coil and moving iron - Error analysis: electrical, mechanical, thermal, optical, biological and chemical classification of errors – Oscilloscopes - Multimeters and Voltmeters.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

1. S.Salivahanan, N.Suresh kumar and A.Vallavanraj, "Electronic Devices and Circuits", Tata McGraw Hill, 3rd Edition(2013).
2. Morris Mano M and Michael D.Clletti, "Digital Design", IV Edition, Pearson Education, 2008
3. Patranabis.D, "Sensor and Transducer", Prentice Hall of India(Pvt)Ltd., 2013.
4. R.Muthusubramanian, S.Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw Hill, Nineteenth reprint(2015).

REFERENCES:

1. J.B.Gupta, "Electronic Devices and Circuits", S.K.Kataria and Sons, 2009.
2. D.P.Leach, A.P.Malvino, "Digital Principles and Applications",TMH,2010

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	-	-	-	-	1	-	-	-	1	-	-	-
2	1	-	-	-	-	-	-	-	-	1	2	-	-	-
3	2	2	1	2	-	-	-	-	-	1	2	-	-	-
4	-	1	-	-	-	-	-	-	-	2	2	1	-	2
5	2	-	2	-	2	2	1	-	-	-	1	-	-	-
CO (W.A)	**1.4**	**1**	**0.6**	**0.4**	**0.4**	**0.4**	**0.2**	**0**	**0**	**0.8**	**1.6**	**0.2**	**-**	**0.4**

22MEC03 ENGINEERING MECHANICS (Mechanical Engineering Branch only)				
	L	**T**	**P**	**C**
	2	**1**	**0**	**3**
PREREQUISITE :				

Course Objective:	• To acquire knowledge on the behaviour of a particle under the action of forces To analyze the behaviour of the rigid body under the action of forces • To gain knowledge related to friction and simple contact friction • To introduce the geometric properties of the different surfaces. • To acquire knowledge work, energy and momentum related to dynamics of particles

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply principles of units, laws of mechanics to solve problems in particles and rigid bodies.	Ap	20%
CO2	Analyze the statics of rigid bodies in two dimensions and reaction forces of various supports.	An	20%
CO3	Analyze centroid, center of gravity, moment of inertia using theorems of Pappus and Guldinus, parallel and perpendicular axis theorem.	An	20%
CO4	Evaluate frictional forces, limiting friction, Coulomb's law, and various frictional scenarios such as sliding, ladder, and belt friction.	E	20%
CO5	Evaluate kinematic and kinetic principles, displacement, velocity, acceleration, Newton's laws, and the impact of elastic bodies.	E	20%

UNIT I - STATICS OF PARTICLE	**(6+3)**
Units and dimensions - fundamental principles - laws of mechanics, lami's theorem, parallelogram and triangular law of forces, principle of transmissibility – system forces - statics of particles in two dimensions - resultant force - coplanar concurrent forces - Free body diagram - equilibrium of particles in two dimensions.	
UNIT II - STATICS OF RIGID BODY	**(6+3)**
Statics of rigid body in two dimensions - rigid body - moment of a force about a point - varignon's theorem - resultant force for coplanar parallel and nonconcurrent forces - moments and couples - equilibrium of rigid bodies in two dimensions - requirements of stable equilibrium - types of supports and their reactions.	
UNIT III - FRICTION	**(6+3)**
Frictional force – limiting friction - angle of repose - coulomb's law of dry friction - cone of friction - problems involving the equilibrium analysis of simple systems with sliding friction - simple contact friction - ladder friction - belt friction.	
UNIT IV - PROPERTIES OF SECTIONS	**(6+3)**
Centroid – centre of gravity- Theorems of Pappus and Guldinus – moment of inertia of plane areas - transfer theorems - parallel axis and perpendicular axis theorem- radius of gyration- product of inertia - polar moment of inertia - principal axes and principal moment of inertia of plane areas.	

UNIT V - DYNAMICS OF PARTICLES	(6+3)
Kinematics - Displacements, velocity and acceleration, their relationship -rectilinear motion - curvilinear motion - projectile motion. Kinetics - Newton's law – D'Alembert's principle - impact of elastic bodies.	
TOTAL (L:30+T:15): 45 PERIODS	

TEXT BOOKS :

1. 1. Ferdinand P. Beer and E. Russell Johnson, "Vector Mechanics for Engineers: Statics and Dynamics", 12th ed., Tata McGraw Hill International Edition, 2019

REFERENCES:

1. Irving H. Shames, "Engineering Mechanics : Statics and Dynamics", Prentice Hall of India Private limited, 2006
2. Russell C Hibbeler, "Engineering Mechanics: Statics and Dynamics", 14th ed., Prentice Hall, 2016
3. Anthony M. Bedford and Wallace Fowler, "Engineering Mechanics: Statics and Dynamics", 5th ed., Prentice Hall, 2008
4. Palanichamy, M.S and Nagan,S, "Engineering Mechanics - Statics and Dynamics", 3rd ed., Tata McGraw-Hill, New Delhi, 2005
5. Meriam.J.L , Kraige.L.G, and Boltan, J.N "Engineering Mechanics: Statics and Dynamics", 9th ed., Wiley Publishers, 2020
6. Rajasekaran.S and Sankarasubramanian.G, "Fundamentals of Engineering Mechanics", 3rd ed., vikas Publishing House Pvt.Ltd. New Delhi, 2005.

Mapping of COs with POs / PSOs

Cos	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2		3											3	
3		3											3	
4			3										3	
5			3											
CO (W.A)	3	3	3										3	

22CSP01 - PROBLEM SOLVING AND C PROGRAMMING LABORATORY *(Common to All Branches)*					
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To study, analyze and understand logical structure of a computer program, and different construct to develop a program in 'C' language.	**1.1**	The student will be able to identify the appropriate programming construct to develop programs for all types of problems.		
2.0	To study, analyze and implement the concepts of arrays and strings in C programming.	**2.1**	The student will be able to implement programs on arrays of different dimensions and string concepts.		
3.0	To learn the importance user defined functions and pointers.	**3.1**	The student will be able to develop programs using user defined functions and pointers.		
4.0	To gain knowledge in user defined data types and file handling functions in C programming	**4.1**	The student will be able to design programs using user defined data types and various file handling functions.		
5.0	To acquire skill in dynamic memory allocation	**5.1**	The student will be able to use dynamic memory allocation functions for assigning memory space during execution.		

C-Programming:

1. Draw the flowchart for the following using Raptor tool.
    a) Simple interest calculation
    b) Greatest among three numbers
    c) Find the sum of digits of a number
2. Programs for demonstrating the use of different types of operators like arithmetic, logical, relational and ternary operators (Sequential and Selection structures)
3. Programs for demonstrating repetitive control statements like 'for', 'while' and 'do-while' (Iterative structures)
4. Programs for demonstrating one-dimensional and two-dimensional numeric array
5. Programs to demonstrate modular programming concepts using functions
6. Programs to implement various character and string operations with and without built-in library functions.
7. Programs to demonstrate the use of pointers
8. Programs to illustrate the use of user-defined data types
9. Programs to implement various file management.
10. Program Using Dynamic memory allocation functions

HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS:
Hardware: • LAN System with 33 nodes (OR) Standalone PCs – 33 Nos. • Printers – 3 Nos. **Software:** • RAPTOR Tool • Compiler – C
TOTAL (P:60) : 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	-	-	-	-	-	-	-	-	3	3	3
2	3	2	3	-	-	-	-	-	-	-	-	3	3	3
3	3	2	3	-	-	-	-	-	-	-	3	3	3	3
4	3	2	3	-	-	-	-	-	3	-	3	3	3	3
5	3	2	3	-	-	-	-	-	-	-	3	3	3	3
CO (W.A)	3	2	2	-	-	-	-	-	3	-	3	3	3	3

* **Ratified by Eleventh Academic Council**

22PYP01 - PHYSICS LABORATORY (Common to All Branches)					
			L	**T**	**P**	**C**
			0	**0**	**2**	**1**
PREREQUISITES: NIL					
Course Objectives		**Course Outcomes**			
1.0	To provide the basic practical exposure to all the engineering and technological streams in the field of physics.	1.1	The students will be able to apply the concept of stress, strain and elastic limit for a given sample to find their properties.		
2.0	To infer the practical knowledge by applying the experimental methods to correlate with the Physics theory.	2.1	The students will be able to gain the basic knowledge about handling the laser light and Identify the basic parameters of an optical fibre.		
3.0	To enable the students to correlate the theoretical principles with application oriented studies.	3.1	The students will be able to analyze the properties of matter with sound waves.		
4.0	To introduce different experiments to test basic understanding of physics concepts applied in optics and electronics	4.1	The students will be able to recall the knowledge of properties of light through spectrometer grating and fiber optic cable.		
5.0	To analyze the behavior and characteristics of solar cells and LED	5.1	The students will be able to acquire the knowledge in semiconducting devices such as solar cells and LED.		

PHYSICS LABORATORY (Any Five)

1. Determination of Young's modulus by non-uniform bending method
2. Determination of (a) wavelength and (b) particle size using Laser.
3. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
4. Determination of wavelength of mercury spectrum – spectrometer grating
5. Determination of band gap of a semiconductor.
6. Determination of thickness of a thin wire – Air wedge method.
7. Determination of V-I characteristics of solar cell.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	-	-	-	-	-	-	1	-	3	3	3
2	3	3	2	-	-	-	-	-	-	-	-	2	3	2
3	3	3	2	-	-	-	-	-	1	-	-	2	3	3
4	3	2	3	-	-	-	-	-	-	-	-	3	2	3
5	3	2	2	-	-	-	-	-	-	1	-	3	2	2
CO (W.A)	**3.0**	**2.0**	**2.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.0**	**1.0**	**0.0**	**2.6**	**2.6**	**2.6**

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22MAN04- SOFT/ANALYTICAL SKILLS – II *(Common to All Branches)*					
		L	**T**	**P**	**C**
PREREQUISITE : 22MAN02		**1**	**0**	**2**	**0**
Course Objectives		**Course Outcomes**			
1.0	To acquire satisfactory competency in use of verbal reasoning	**1.1**	The students will be able to enhance their vocabulary which in turn will be helpful in developing their speaking skills.		
2.0	To develop skill to meet the competitive examinations for better job opportunity.	**2.1**	The students will be able to solve the problems easily by using Short-cut method with time management.		
3.0	To enrich their knowledge and to develop their logical reasoning thinking ability.	**3.1**	The students will be able to analyze the problems logically and approach the problems in a different manner.		

UNIT I – VERBAL COMPETENCY	**(5+10)**
Voice - Modal Verbs – Synonyms & Antonyms - Confusable Words	
UNIT II – NUMERICAL REPRESENTATION	**(5+10)**
Average – Data Interpretation – Simple Interest and Compound Interest – Venn Diagram.	
UNIT III - RESOLUTION TENDENCY	**(5+10)**
Time and Work – Pipes and Cistern – Number Series and Odd man Out – Cube Problems.	
TOTAL(L :15,P:30) : 45 PERIODS	

REFERENCES:

1. Ashish Aggarwal, "Quick Arithmetic", S Chand and Company Limited, New Delhi, 2014.
2. Dr. R.S. Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", S Chand and Company Limited, New Delhi, 2014.
3. Raymond Murphy, "English grammar in use", Fourth Edition, Cambridge University 2012.

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	-	-	-	-	-	-	-	-	3	3	-	2	1	-
2	-	3	2	2	-	-	-	-	2	-	-	3	1	-
3	-	3	2	2	-	-	-	-	2	-	-	3	1	-
CO	**-**	**2**	**1.3**	**1.3**	**-**	**-**	**-**	**-**	**2.3**	**1**	**-**	**2.6**	**1**	**-**

22MAN05 YOGA - II *(For Common To All Branches)*					
		L	**T**	**P**	**C**
		0	**0**	**I**	**0**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To contribute to building a peaceful and better world by educating youth through sport practiced in accordance with Olympism and its values.	**1.1**	Students will be able to Learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.		
2.0	To learn different postures associated with physical games.	**2.1**	Students will be able to Assess current personal fitness levels.		
3.0	To learn how to make basic plan for any activity or task.	**3.1**	Students will be able to Improve personal fitness through participation in sports activities.		
4.0	To have an understanding about the basics of sport psychology	**4.1**	Students will be able to Develop understanding of psychological problems associated with the age and lifestyle.		
5.0	To Utilize a thorough knowledge and understanding of Sports Medicine and relevant applied sciences to maintain standards of best practice in prevention and treatment of sports related injuries.	**5.1**	Students will be able to Demonstrate an understanding of sound nutritional practices as related to health and physical performance.		

UNIT I – OLYMPIC MOVEMENT	**(3)**
Ancient & Modern Olympics (Summer & Winter) - Olympic Symbols, Ideals, Objectives & Values - Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.).	
UNIT II – POSTURES	**(3)**
Meaning and Concept of Postures - Causes of Bad Posture - Advantages & disadvantages of weight training - Concept & advantages of Correct Posture - Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis - Corrective Measures for Postural Deformities	
UNIT III – TRAINING AND PLANNING IN SPORTS	**(3)**
Meaning of Training - Warming up and limbering down - Skill, Technique & Style - Meaning and Objectives of Planning - Tournament – Knock-Out, League/Round Robin & Combination.	
UNIT IV – PSYCHOLOGY AND SPORTS	**(3)**
Definition & Importance of Psychology in Physical Edu. & Sports - Define & Differentiate Between Growth & Development - Adolescent Problems & Their Management - Emotion: Concept, Type & Controlling of emotions - Meaning, Concept & Types of Aggressions in Sports - Psychological benefits of exercise - Anxiety & Fear and its effects on Sports Performance - Motivation, its type & techniques - Understanding Stress & Coping Strategies.	

UNIT V – SPORTS MEDICINE	(3)
Following subtopics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc. History of the Game/Sport – Latest General Rules of the Game/Sport – Specifications of Play Fields and Related Sports Equipment – Important Tournaments and Venues – Sports Personalities – Proper Sports Gear and its Importance.	
TOTAL (L:15) : 15 PERIODS	

TEXT BOOKS/REFERENCES:

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga by B.K.S. Iyengar.
3. Health and Physical Education – NCERT (11th and 12th Classes).

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1						1	2	3	3	2	1	3		
2						1	2	3	3	2	1	3		
3						1	2	3	3	2	1	3		
4						1	2	3	3	2	1	3		
5						1	2	3	3	2	1	3		
CO (W.A)						**1**	**2**	**3**	**3**	**2**	**1**	**3**		

* **Ratified by Eleventh Academic Council**

22MYB03 – STATISTICS AND NUMERICAL METHODS *(Common to Mech, Civil, Agri, Chemical Branches)*				
L	**T**	**P**	**C**
3	**1**	**0**	**4**

PRE REQUISITE :

Course Objectives		Course Outcomes	
1.0	To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.	**1.1**	The students will be able to select a hypothesis testing method for the given numerical set of data to analyze the significance.
2.0	To understand the knowledge of design of experiments	**2.1**	The students will be able to apply analysis of Variance for the data set of selected number factors for analyzing the significance.
3.0	To introduce the basic concepts of solving algebraic and transcendental equations.	**3.1**	The students will be able to solve an algebraic or transcendental equation using an appropriate numerical method.
4.0	To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in Engineering and technology disciplines.	**4.1**	The students will be able to appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for Engineering problems.
5.0	To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.	**5.1**	The students will be able to solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with Engineering applications.

UNIT I - TESTING OF HYPOTHESIS	**(9+3)**
Sampling Distributions-Tests for single mean, difference of means (Large and Small samples) Using z, t -distribution, F – distribution- Chi-square - Test for independence of attributes and Goodness of fit.	
UNIT II - DESIGN OF EXPERIMENTS	**(9+3)**
Analysis of variance- Completely randomized design - Randomized block design - Latin square design.	
UNIT III - SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS	**(9+3)**
Solution of algebraic and transcendental equations - Fixed point iteration method - Newton Raphson method- Solution of linear system of equations Gauss elimination method – Iterative methods of Gauss Jacobi and Gauss Seidel Methods- Eigen values of a matrix by Power method.	
UNIT IV - INTERPOLATION AND APPROXIMATION	**(9+3)**
Lagrange's and Newton's divided difference interpolations - Newton's forward and backward difference interpolation - Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules - Romberg's Methods.	
UNITV - NUMERICAL DIFFERENTIATION AND INTEGRATION	**(9+3)**
Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.	
TOTAL (L:45+T:15) : 60 PERIODS	

TEXT BOOK:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
3. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.

WEB REFERENCES:

1. https://youtu.be/zmyh7nCjmsg
2. https://youtu.be/NmgbFJ4UwPs
3. https://youtu.be/RgKy7URFx1c
4. https://archive.nptel.ac.in/courses/111/107/111107105/

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	1	1	1				1	1		2		
2	3	3	1	1	1				1	1		2		
3	3	2	1	1	1				1	1		2		
4	3	3	1	1	1				1	1		2		
5	3	2	1	1	1				1	1		2		
CO (W.A)	**3**	**3**	**1**	**1**	**1**				**1**	**1**		**2**		

22MEC04 - ENGINEERING THERMODYNAMICS (Use of Steam Tables and Psychrometric Chart permitted)				
	L	**T**	**P**	**C**
	2	**1**	**0**	**3**
PREREQUISITE : NIL				

Course Objective:	• To teach the basic concept of thermodynamics and applications of firstlaw of thermodynamics • To introduce the concept of second law of thermodynamics and entropy • To teach steps involved in analysis of gas power cycles • To provide knowledge on the process of steam formation at various conditions • To impart the knowledge in Psychrometry and Psychrometricprocesses

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concept of Zeroth, first law in thermodynamic closed and open system.	Ap	30%
CO2	Apply the concept of second law to analyze the performance of thermal equipments.	Ap	20%
CO3	Analyze the performance characteristics of various air power cycles in internal combustion engines.	An	20%
CO4	Analyze the various psychrometric processes and select suitable process for industrial applications.	An	30%
CO5	Implement the concept of psychrometric process for environmental aspects.	U	Internal Assessment

UNIT I - BASIC CONCEPT, ZEROTH AND FIRST LAW OF THERMODYNAMICS	**(6+3)**
Definitions - Thermodynamic systems - thermodynamic equilibrium - properties, state, process and cycle - point and path function - Zeroth law - reversible and Irreversible processes - energy, work and heat - internal energy - First Law - energy as a property of a system - PMM 1 - application of first law to closed system and steady Flow processes - applications of steady flow energy equation - steam turbine, centrifugal compressor, nozzle - limitations of first law.	
UNIT II - SECOND LAW OF THERMODYNAMICS AND ENTROPY	**(6+3)**
Second Law - performance of heat engines and reversed heat engines - reversible processes - statements of Second Law - PMM 2 - Clausius inequality - Carnot cycle - Carnot's theorem and corollary - entropy as a property of a system - entropy and irreversibility - entropy changes for a closed system and open system - Third Law of Thermodynamics.	
UNIT III - GAS POWER CYCLES	**(6+3)**
Air standard efficiency - Otto cycle - Diesel cycle - dual combustion cycle - Brayton cycle - work ratio - pressure ratio for maximum work - calculation of air standard efficiency.	
UNIT IV - PROPERTIES OF PURE SUBSTANCES AND THERMODYNAMIC RELATIONS	**(6+3)**
Pure substances - definition - phase change - p-T diagram - P-V-T surface - phase change terminologies - formation of steam - thermodynamic properties of steam - external work done during evaporation -	

internal latent heat - internal energy of steam - Entropy of water, evaporation, wet steam, superheated steam - Mollier diagram – Thermodynamic relations – Maxwell equations – TDS equations- heat capacities relations – energy equation – joule Thomson coefficient.	
UNIT V - PSYCHROMETRY	**(6+3)**
Concept of psychrometry and psychrometrices - psychrometric Relations - pressure, specific humidity, degree of saturation, relative humidity, enthalpy of moist air - Sling psychrometer - psychrometric charts - Psychrometric processes	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Rajput.R.K, "A Textbook of Engineering Thermodynamics", 5th ed., Laxmi Publications, 2017
2. MichaelA.Boles,YunusA.Cengel,"Thermodynamics:AnEngineeringApproach",8thed.,TataMcGraw-HillEducation,2017

REFERENCES:

1. Nag.P.K,"EngineeringThermodynamics",5th ed.,McGrawHillEducation,2013
2. Arora.C.P,Thermodynamics,TataMcGraw-HillEducation,2003
3. Moran,Shapiro,BoettnerandBailey"PrinciplesofEngineeringThermodynamics",8thed.,WileyIndiaPvtLtd-2015
4. Holman.J.P,"Thermodynamics",10thed.,McGrawHillEducation,2011
5. Rao.Y.V.C," An Introduction to Thermodynamics",RevisedEdition,OrientLongman,2009

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2													
2	2												1	
3		2	1										1	
4		2	1										1	
5							1							
CO (W.A)	2	2	1				1						1	

22MEC05 FLUID MECHANICS AND MACHINERY				
	L	T	P	C
	3	0	2	4

PREREQUISITE : Nil

Course Objective:	• To introduce the fundamentals of fluid mechanics and its properties • To impart basic knowledge to determine major and minor losses in flow through pipes and boundary layer concept. • To give the fundamental knowledge on physical quantities and to predict the behavior of the prototype/model by applying model laws. • To introduce the types and working principles of hydraulic turbines and evaluate the performance of hydraulic turbines • To understand the functioning and characteristic curves of pumps

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyse fluid flow behaviour within control volumes by applying the concepts of fluid properties and principle of continuity equation.	An	20 %
CO2	Calculate energy losses and pressure variations of flowing fluid in pipe systems	Ap	20 %
CO3	Analyse the nature of physical quantities and behaviour of the prototype/model by applying model laws.	An	20 %
CO4	Calculate the performance of hydraulic turbines and Pumps	Ap	40 %
CO5	Demonstrate the fundamental concepts of fluid mechanics and explain the performance of turbines and pumps while working in a team and communicate the same through effective presentations	U	Internal Assessment

UNIT I - FLUID PROPERTIES AND FLOW CHARACTERISTICS	**(9)+(3)**

Units and dimensions – Definition of fluids - Properties of fluids - mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension and capillarity. Flow characteristics -concept of control volume - application of continuity equation, energy equation and momentum equation.

Lab Experiments:

- Verification of Bernoulli's equation
- Determination of the coefficient of discharge of given Orifice meter/ Venturimeter.

UNIT II - FLOW THROUGH CIRCULAR CONDUITS	**(9)+(3)**

Laminar flow through circular conduits – Hagen Poiseuille equation - Boundary layer concepts -types of boundary layer thickness -Darcy Weisbach equation –friction factor - Moody diagram - minor losses - Flow through pipes in series and parallel - Hydraulic and energy gradient lines.

Lab Experiments:

- Determination of friction factor for a given set of pipes
- Determination of minor losses in pipes

UNIT III - DIMENSIONAL ANALYSIS AND SIMILITUDE	**(9)**

Fundamental dimensions - Dimensional homogeneity – dimensional analysis by using Buckingham's π theorem method - Similitude – types of similitude - Dimensionless parameters - application of dimensionless Parameters-Model analysis.

UNIT IV - TURBINES **(9)+(5)**

Classification of turbines -heads and efficiencies -velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines - working principles - work done by water on the runner - unit quantities - Specific speed.

Lab Experiments:

- Performance studies on Pelton wheel
- Performance studies on Francis turbine
- Performance studies on of Kaplan turbine

UNIT V - PUMPS **(9)+(4)**

Classification of Pumps - Centrifugal pumps-working principle - work done by the impeller - various efficiencies-velocity components at entry and exit of the rotor - velocity triangles - Reciprocating pump - working principle - work done.

Lab Experiments:

- Performance studies on centrifugal pump
- Performance studies on reciprocating pump

TOTAL (L:45 + P:15) = 60 PERIODS

TEXT BOOKS:

3. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi. 2019. Reviced 9th Edition (Unit I, II, III, IV, V)

REFERENCES:

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House, New Delhi 2019. 22nd Editon (Unit I, II, III, IV, V)
2. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, "Fluid Mechanics and Machinery", John Wiley & Sons; 9th Edition SI Version 2015. (UNIT - I, II, III, IV, V)
3. Kumar. K.L., Engineering Fluid Mechanics, S Chand., New Delhi, 2016. 8th Edison (Unit I, II, III)
4. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 2017. 9th Edition (Unit I, II, III)
5. Rajput. R. K, "A text book of Fluid Mechanics and Hydraulic Machines", S. Chand & Company Ltd., New Delhi, sixth edition, 2010 (Unit I, II, III, IV, V).

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3							3				3	
2	3								3				3	
3	3	3							3				3	
4	3								3				3	
5									3	3			3	
CO (W.A)	3	3							3	3			3	

22MEC06 – MANUFACTURING PROCESSES				
	L	T	P	C
	3	0	0	3

PREREQUISITE : Nil

Course Objective:	• To acquire knowledge on basic concepts of foundry and casting processes • To learn various metal joining processes and gain welding skills. • To provide the knowledge on various bulk deformation processes and its applications. • To expose knowledge on sheet metal forming processes and special forming processes and to make small sheet metal parts. • To learn about the various plastics moulding and forming processes and to make simple plastic part.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the metal casting components and joining process	Ap	20%
CO2	Analyze the metal joining processes in different methods.	An	20%
CO3	Identify the various kinds of deformation process in manufacturing.	Ap	40%
CO4	Evaluate the forming process under various operations.	An	20%
CO5	Develop a project based learning by identifying the suitable materials and manufacturing processes as a member/ team.	An/ Cr	Internal Assessment

UNIT I - METAL CASTING PROCESSES	(9)
Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Molding sand Properties and testing – Cores –Types and applications – Molding machines – Types and applications– Melting furnaces – Principle of special casting processes- Shell, investment – Ceramic mould – Pressure die casting – low pressure, gravity- Tilt pouring, high pressure die casting- Centrifugal Casting – CO2 casting – - Defects in Sand casting process-remedies.	
UNIT II - METAL JOINING PROCESSES	(9)
Fusion welding processes – Oxy fuel welding – Filler and Flux materials-–Arc welding, Electrodes, Coating and specifications – Gas Tungsten arc welding –Gas metal arc welding - Submerged arc welding – Electro slag welding– Plasma arc welding — Resistance welding Processes -Electron beam welding –Laser beam Welding Friction welding – Friction stir welding – Diffusion welding – Thermit Welding, Weld defects – Inspection & remedies – Brazing - soldering – Adhesive bonding.	
UNIT III - BULK DEFORMATION PROCESSES	(9)
Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – cold forging- Characteristics of the processes – Typical forging operations – rolling of metals – Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts – Principle of rod and wire Drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion. Introduction to shaping operations.	
UNIT IV - SHEET METAL FORMING AND SPECIAL FORMING PROCESSES	(9)
Sheet metal characteristics – Typical shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes - Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning – Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming – Incremental forming.	
UNIT V - MANUFACTURE OF PLASTIC COMPONENTS	(9)

Types and characteristics of plastics – Molding of thermoplastics & Thermosetting polymers– working principles and typical applications – injection molding – Plunger and screw machines – Compression molding, Transfer Molding – Typical industrial applications – introduction to blow molding – Rotational molding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics- duff moulding.
TOTAL (L:45) = 45 PERIODS

TEXT BOOKS:
1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India,4th Edition, 2013 2. P.N .Rao Manufacturing Technology Volume 1 McGrawhill Education 5th edition, 2018.
REFERENCES:
1. HajraChoudhury S.K, HajraChoundhury A.K and Nirjhar Roy, "Elements of Workshop Technology", Vol. 1, 2017 2. HMT, "Production Technology", "McGraw Hill Education", 2017 3. Sharma.P.C, "A Textbook of Production Technology", S. Chand Publications, 2014 4. S. Gowri P. Hariharan, A.SureshBabu, Manufacturing Technology I, Pearson Education, 2008. 5. Ro y. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006. 6. Rajput.R.K, "A Textbook of Manufacturing Technology", 2nd ed., Laxmi Publications (P) Ltd, 2016

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2			2				3							
3										2				
4		3												
5												3		
CO (W.A)	**3**	**3**	**2**				**3**			**2**		**3**	**3**	

22MEC07 ENGINEERING MATERIALS AND METALLURGY				
	L	T	P	C
	3	0	0	3

PREREQUISITE : Nil

Course Objective:	• To develop the knowledge on structure of materials including crystallography, microstructure, defect • To understand the importance of various ferrous materials and phase diagram. • To apply the suitable heat treatment process to Enhance the property of a material. • To know mechanical properties of materials. • To give insight into advanced materials such as polymers, ceramics and composite and their applications.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply knowledge of fundamental engineering principles		
CO2	Apply principles phase transformations and material equilibrium		
CO3	Apply heat treatment processes to modify material properties		
CO4	Implement preventive measures for material failure in engineering applications		
CO5	Assess the suitability of various advanced materials for specific applications		

UNIT I - STRUCTURES OF MATERIALS	**(9)**
Materials Science - Simple Crystal Structures - BCC, FCC, HCP Structures - Unit Cell - Defects - Point, Line, Surface, Volume - Slip planes and slip systems - Schmid's rule - Polymorphism and allotropy.	
UNIT II - PHASE DIAGRAMS AND PHASE TRANSFORMATION	**(9)**
Gibbs's Phase rule - Solidification and Solid Solutions - Equilibrium Diagrams - Classification of Equilibrium Diagrams - Isomorphous System - Eutectic systems, Eutectoid, Peritectic and Peritectoid system - Iron-Iron carbide phase diagram - Phase, Time - Temperature - Transformation (TTT), Continuous Cooling Transformation (CCT) and Martensitic Transformation - Types and applications of Steels and Cast Irons.	
UNIT IV - HEAT TREATMENT PROCESS	**(9)**
Heat treatment – Overview – Objectives – Annealing and types, normalizing, quenching, austempering and martempering – microstructure changes – Surface hardening processes - Carburizing – nitriding – cyaniding and carbonitriding, induction and flame hardening, Laser and Electron beam hardening.	
UNIT IV - MECHANICAL PROPERTIES OF MATERIALS	**(9)**
Testing of Materials - Classification of tests, Tensile test, Impact test, Hardness test Tension and Torsion test - Stress-strain Curve - Fractures in metals - Ductile Fracture, Brittle Fracture - Methods of protection against fracture - Creep test - stages of creep - Prevention of Creep Fracture	
UNIT V –ADVANCED MATERIALS	**(9)**
Non Ferrous Metals - Aluminium, Copper, Nickel, Magnesium, Zinc, Lead, Non Ferrous Alloys - Copper alloys, Aluminium alloys - precipitation of hardening, Magnesium alloys and Nickel alloys. Non Metallic Materials - Polymers, Ceramics and Composites - Overview of Nanomaterials.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOK:
1. Balasubramaniam R. "Callister's Materials Science and Engineering". 2nd Edition, Wiley India Pvt. Ltd., 2017
REFERENCES:
1. Kenneth G.Budinski and Michael K.Budinski, Engineering Materials Prentice-Hall of India 2. Raghavan.V. Materials Science and Engineering, Prentice Hall of India 3. PremamoyGhosh., "Polymer Science and Technology: Plastics, Rubbers, Blends and Composites". 3rd Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2011. 4. SinaEbnesajjad. "Handbook of Biopolymers and Biodegradable Plastics: Properties, Processing and Applications", 1st Edition, Elsevier, Amsterdam, Netherlands, 2012. 5. Bolton, W., Engineering materials technology: Butterworth-Heinemann.

Mapping of COs with POs / PSOs														
Cos	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												2	
2		3												
3	2		3											2
4				2									2	2
5		2				2							2	
CO (W.A)	2.5	2.5	3	2		2							2	2

22MEP02 -COMPUTER AIDED MACHINE DRAWING					
		L	T	P	C
		0	0	4	2
PREREQUISITE : 22MEC02					
Course Objective:	• To familiarize the engineering drawing standards and develop proficiency in dimensioning and tolerance techniques. • To develop skills in creation of 3D models and assembly.				
Course Outcomes The Student will be able to		**Cognitive Level**			
CO1	Understand the significance of limits and fits in mechanical components assemblies.	Un			
CO2	Recognize the principles and symbols of GD&T and their applications in Design.	Ap			
CO3	Evaluate the level of accuracy and precision of engineering drawings according to industry standards.	Ev			
CO4	Generate detailed 3D model of automobile components for manufacturing.	Ap			
CO5	Assemble individual 3D models into complete functional units.	Ap			

PART I DRAWING STANDARDS & FITS AND TOLERANCES 12

Code of practice for Engineering Drawing, Welding symbols, riveted joints, keys, and fasteners Limits, Fits– Tolerancing of individual dimensions - basic principles of Geometric Dimensioning &Tolerancing

PART II MODELING AND ASSEMBLY 48

LIST OF EXPERIMENTS :

Creation of 3D modeling, assembly and drafting of Plummer Block

Creation of 3D modeling, assembly and drafting of Connecting Rod

Creation of 3D modeling, assembly and drafting of Universal Coupling

Creation of 3D modeling, assembly and drafting of Knuckle Joint

Creation of 3D modeling, assembly and drafting of Screw Jack

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													
2	3													
3						3		3					3	3
4			3							3			3	3
5			3							3				3
CO (W.A)	**3**		**3**			**3**		**3**		**3**			**3**	**3**

22MAN07 – SOFT / ANALYTICAL SKILLS - III *(Common to all Branches)*				
	L	**T**	**P**	**C**
	1	**0**	**2**	**0**

PRE REQUISITE : NIL

Course Objectives		**Course Outcomes**	
1.0	Improving overall language proficiency for personal or professional reasons	**1.1**	The students will be able to enhance their writing skills
2.0	To develop problem solving skills across all levels	**2.1**	The students will be able to develop problem solving skills across all levels
3.0	To develop students to workout solutions for problems that involving general reasoning.	**3.1**	The students will be able to solve reasoning problems with ease.

UNIT I – Verbal Competency	**(5+10)**
Sentence Selection-Paragraph Formation- Sentence Correction- Spellings.	
UNIT II - Aptitude	**(5+10)**
Clocks, Calendar, Age Problems-Problem on Trains- Problems on Numbers - Partnerships.	
UNIT III – Logical & Reasoning	**(5+10)**
Coding and Decoding - Logical Equivalent- Venn Diagram Problem.	
TOTAL (L:15, P:30) : 45 PERIODS	

REFERENCES:

1. Dr. R.S. Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", S Chand and Company Limited, New Delhi, 2014.
2. Ashish Aggarwal, "Quick Arithmetic", S Chand and Company Limited, New Delhi, 2014.
3. Raymond Murphy, "English grammar in use", Fourth Edition, Cambridge University, 2012.

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	-	-	-	-	-	-	-	-	3	3	-	2	-	1
2	-	3	2	2	-	-	1	-	2	-	-	3	2	-
3	-	3	2	2	-	-	1	-	2	-	-	3	2	-
CO (W.A)	-	2	1.3	1.3	-	-	0.6	-	2.3	1	-	2.6	1.3	0.3

22MAN09 INDIAN CONSTITUTION (Common to All Branches)					
		L	**T**	**P**	**C**
		1	**0**	**0**	**0**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To educate students to learn about the Constitutional Law of India.	**1.1**	The students will be able to Gain Knowledge about the Constitutional Law of India.		
2.0	To motivate students to Understand the role of Union Government.	**2.1**	The students will be able to know the Union Government and role of President and Prime Minister.		
3.0	To make students to understand about State Government.	**3.1**	The students will be able to acquire knowledge about State Government and role of Governor, Chief Minister.		
4.0	To understand about District Administration, Municipal Coporation and Zila Panchayat.	**4.1**	The students will be able to understand the District Administration, Municipal Coporation and Zila Panchayat.		
5.0	To encourage students to Understand about the election commission.	**5.1**	The students will be able to understand the role and function of election commission.		

UNIT I - The Constitution - Introduction	**(9)**
The History of the Making of the Indian Constitution - Preamble and the Basic Structure, and its interpretation - Fundamental Rights and Duties and their interpretation - State Policy Principles.	
UNIT II – Union Government	**(9)**
Structure of the Indian Union - President – Role and Power - Prime Minister and Council of Ministers - Lok Sabha and Rajya Sabha	
UNIT III – State Government	**(9)**
Governor – Role and Power - Chief Minister and Council of Ministers - State Secretariat	
UNIT IV – Local Administration	**(9)**
District Administration - Municipal Corporation - Zila Panchayat	
UNIT V – Election Commission	**(9)**
Role and Functioning - Chief Election Commissioner - State Election Commission	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOK:

1. Rajeev Bhargava, Ethics and Politics of the Indian Constitution, Oxford University Press, New Delhi, 2008.
2. B.L. Fadia, The Constitution of India, Sahitya Bhawan; New edition (2017).
3. DD Basu, Introduction to the Constitution of India, Lexis Nexis; Twenty-Third 2018 edition.

REFERENCES:

1. Steve Blank and Bob Dorf, The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company", K & S Ranch ISBN – 978-0984999392
2. Eric Ries, The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" , Penguin UK ISBN – 978-0670921607
3. Adrian J. Slywotzky with Karl Weber, Demand: Creating What People Love Before They Know They Want It, Headline Book Publishing ISBN – 978-0755388974
4. Clayton M. Christensen, The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business, Harvard business ISBN: 978-142219602.

REFERENCES: Web link

1. https://www.fundable.com/learn/resources/guides/startup
2. https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate- structure/
3. https://www.finder.com/small-business-finance-tips
4. https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1						3		3		2		3		
2						3		3		2		3		
3						3		3		2		3		
4						3		3		2		3		
5						3		3		2		3		
CO (W.A)						**3**		**3**		**2**		**3**		

22MEC09 THERMAL ENGINEERING SYSTEM				
	L	T	P	C
	3	I	0	4

PREREQUISITE : 22MEC04

Course Objective:	• To determine the number of stages/plates required. • To provide a in the basic principles of thermodynamics and heat transfer, enabling students to understand and analyze thermal systems.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Understand the working principles of internal combustion engines and steam boilers.	U	20%
CO2	Comprehend the concepts of Fuel Injection and ignition systems	U	20%
CO3	Analysis the efficiency enhancement of various steam power cycles.	An	20%
CO4	Determine the condition of steam flow though nozzle and efficiency of nozzle.	Ap	20%
CO5	Compute performance of steam turbine and Refrigeration systems	An	20%

UNIT I - INTERNAL COMBUSTION ENGINES – FUNDAMENTALS AND COMBUSTIONS	**(9+3)**
IC engine – Classification, working, components and their functions. Ideal and actual : Valve and port timing diagrams, p-v diagrams- two stroke & four stroke, and SI & CI engines – comparison. Geometric, operating, and performance comparison of SI and CI engines. Desirable properties and qualities of fuels. Air-fuel ratio calculation – lean and rich mixtures. Combustion in SI & CI Engines – Knocking – phenomena and control	
UNIT II - INTERNAL COMBUSTION ENGINES - PERFORMANCES AND AUXILIARY SYSTEMS	**(9+3)**
Performance and Emission Testing, Performance parameters and calculations. Morse and Heat Balance tests. Multipoint Fuel Injection system and Common rail direct injection systems. Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbo charging – Emission Norms	
UNIT III - STEAM BOILERS AND NOZZLES	**(9+3)**
Classifications – comparison - Fire tube boiler and water tube boiler – simple vertical, Cochran boiler, Locomotive, Babcock and Wilcox boilers – High pressure boiler – Lamont boiler and Loeffler boiler – Steam nozzle – convergent and divergent nozzle - steam flow through nozzles – nozzle efficiency – Metastable expansion of steam in a nozzle	

UNIT IV - STEAM POWER CYCLES AND STEAM TURBINE	(9+3)
Steam Power Cycles - Carnot Cycle - Rankine Cycle - Modified Rankine Cycle - Regenerative Cycle - Steam Turbine - Classifications – working - Impulse and reaction turbine – Compounding – velocity diagram of impulse turbine	
UNIT V - REFRIGERATION AND AIR CONDITIONING	**(9+3)**
Fundamentals of refrigeration - COP - simple vapour compression system – Effect of super heating, Effect of sub cooling - working principle of vapour absorption system - refrigerants, classification, properties - air conditioning systems- summer, winter, year round air conditioning - central system	
TOTAL (L:45+T:15) : 60 PERIODS	

TEXT BOOKS:

1. Rajput.R.K, "Thermal Engineering", 11thEdition., Laxmi Publications Ltd, 2020
2. Ganesan V, Internal Combustion Engines, 4th Edition, McGraw-Hill companies, 2017

REFERENCES:

1. Ba llaney. P.L "Thermal Engineering", 25th Edition, Khanna Publishers, 2017.
2. Manohar Prasad, "Refrigeration and Air Conditioning", 3rd ed., New Age International publications, 2021
3. Arora C P, "Refrigeration and Air Conditioning",4th Edition., Tata McGraw - Hill Education, 2021
4. Rudramoorthy.R, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2017

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1							3							
2														
3	3	3	3				3						3	
4	3	3		3									3	
5	3	3				3	3						3	
CO (W.A)	3	3	3	3		3	3						3	

22MEC10 – SUBTRACTIVE MANUFACTURING PROCESSES				
	L	T	P	C
	3	0	0	3

PREREQUISITE : 22MEC06

Course Objective:	• To study the concepts and basic mechanics of metal cutting and the factors affecting machinability • To learn working of basic and advanced turning machines. • To apply the working of machine namely shaping, planning, slotting and different drilling machines. • To study the basic concepts of CNC of machine tools and constructional features of CNC. • To learn the basics of CNC programming concepts to develop the part Programme for Machine centre and turning centre.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the mechanism of metal removal process.	Ap	20%
CO2	Identify the operational features in different types of lathe.	An	20%
CO3	Evaluating the different types of operating in reciprocating machines/ revolving machines.	An	40%
CO4	Demonstrate the Program for CNC machine tools through planning, writing codes and setting up CNC machine tools to manufacture a given component.	An	20%
CO5	Develop a project based learning by identifying the suitable materials and subtractive manufacturing process as a member/ team.	An/ Cr	Internal Assessment

UNIT I - THEORY OF METAL CUTTING	**(9)**
Mechanics of chip formation, forces in machining, Types of chip, cutting tools – 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 II - TURNING MACHINES	**(9)**
Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface roughness in turning, machining time and power estimation. Special lathes - Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle	
UNIT III - RECIPROCATING MACHINE TOOLS	**(9)**
Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments- types of milling cutters– machining time calculation- Gear cutting, gear hobbing and gear shaping – gear finishing methods Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centerless grinding, internal grinding - micro finishing methods.	
UNIT IV - CNC MACHINES	**(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 – Work holding methods in Turning and machining centres, Coolant systems, Safety features.	

UNIT V - PROGRAMMING OF CNC MACHINE TOOLS	(9)
Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers – Fixed cycles, Loops and subroutines, Setting up a CNC machine for machining.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India,4th Edition, 2013
2. P.N .Rao Manufacturing Technology Volume I McGrawhill Education 5th edition, 2018.

REFERENCES:

1. HajraChoudhury S.K, HajraChoundhury A.K and Nirjhar Roy, "Elements of Workshop Technology", Vol. 1, 2017
2. HMT, "Production Technology", "McGraw Hill Education", 2017
3. Sharma.P.C, "A Textbook of Production Technology", S. Chand Publications, 2014
4. S. Gowri P. Hariharan, A.SureshBabu, Manufacturing Technology I, Pearson Education, 2008.
5. Ro y. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
6. Rajput.R.K, "A Textbook of Manufacturing Technology", 2nd ed., Laxmi Publications (P) Ltd, 2016

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3									3			3	
2											2			
3		3												
4						3								
5			3									3		
CO (W.A)	3	3	3			3				3	2	3	3	

22MEC11 STRENGTH OF MATERIALS				
	L	T	P	C
	3	0	2	4
PREREQUISITE : NIL				

Course Objective:	• To provide knowledge about stress distribution and strain in regular and composite structures subjected to axial loads • To familiarize about bi-axial stress systems and stresses in thin cylinders • To give input on shear force, bending moment diagrams and evaluate the bending stress in different beams under transverse loading • To impart knowledge on finding slope and deflection of beams and buckling of columns for different boundary conditions • To provide awareness on stresses on shafts and helical springs based on theory of torsion

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concept of the material properties and derive expressions used in static analysis of structural members.	Ap	20%
CO2	Evaluate various physical quantities / properties by doing static analysis on structural members.	Ap	40%
CO3	Compare and/or interpret the strength of components / structural members of various materials and geometries.	An	20%
CO4	Construct and analyse Mohr's circle, stress-strain distributions, shear force and bending moment diagrams for given / derived data.	An	20%
CO5	Conduct investigation on engineering materials based on the principles of solid mechanics while working as a member of a team/individual	An	Internal Assessment

UNIT I: STRESSES AND STRAIN	**(9)**
Introduction to material properties, Stress-strain curve for ductile and brittle materials, Hooke's law, Stresses and strain due to axial force in Stepped and Composite bars, Stresses due to thermal effect in composite bars, Factor of safety, Poisson-ratio, Volumetric strain, Elastic constants and their relationship	
UNIT II: BI-AXIAL STRESS SYSTEM	**(9)**
State of stresses at a point, Normal and shear stresses on inclined planes, Principal planes and Principal stresses, Plane of maximum shear stress, Mohr's circle for bi-axial stress with shear stress. Hoop and longitudinal stresses in thin cylindrical vessels, Maximum Shear stress, Changes in dimensions and volume.	
UNIT III: SHEAR FORCE, BENDING MOMENT AND STRESSES IN BEAMS	**(9)**
Types of beams, supports and Loads, Shear force and Bending Moment diagram of Cantilever, simply supported and overhanging beams, Point of contra flexure. Theory of Simple Bending, Bending stress.	
UNIT IV: DEFLECTION OF BEAMS AND COLUMNS	**(9)**
Slope and Deflection of cantilever and simply supported beams by Double integration method and Macaulay's method. Types of Columns, Equivalent length, Euler and Rankine's formulae, Slenderness ratio	

UNIT V: TORSION IN SHAFT AND HELICAL SPRING	(9)
Torsion equation - stresses and deformations in circular solid, circular hollow and stepped shafts - Closed coil helical spring-stresses and deflection under axial load.	

LIST OF EXPERIMENTS

1. Study of Stress / Strain curves for various materials
2. Tension test on steel rod
3. Double shear test in UTM
4. Rockwell Hardness test
5. Brinell Hardness Test
6. Izod impact test
7. Deflection test on Steel beam
8. Deflection test on Wooden beam
9. Compression test on Bricks
10. Compression test on helical spring

TOTAL (L:45 + P:30): 75 PERIODS

TEXT BOOKS:

1. Bansal.R.K, "A textbook of Strength of Materials: (Mechanics of Solids) SI Units", 6thEdition, Laxmi Publications, 2017
2. Ferdinand Beer Jr., E. Russell Johnston Jr., John T. DeWolf and David F. Mazurek, "Mechanics of Materials", 7thEdition, McGraw Hill, 2011

REFERENCES:

1. S.S. Rattan, Strength of Materials, McGraw Hill Education (India) Private Limited, Chennai, 3rdEdition, 2017
2. S.S. Bhavikatti, Strength of Materials, Vikas Publishing House, New Delhi, 4th Edition, 2013
3. Egor P. Popov, Engineering Mechanics of Solids, Pearson India Education Services Pvt. Ltd., New Delhi, 2015
4. Ramamrutham.S and Narayanan.R, "Strength of Materials", DhanpatRai Publications, 2017
5. Rajput R.K, "Strength of Materials", 6thEdition, S.Chand and Company Ltd., 2015

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2		3											3	
3	3												3	
4		3											3	
5				2					1	1			3	
CO (W.A)	3	3		2					1	1			3	

22MEC12 - THEORY OF MACHINES				
	L	T	P	C
	3	0	2	4

PRE REQUISITE : 22MEC03-Engineering Mechanics

Course Objectives		Course Outcomes	
		At the end of the course, the students would be able to	
1.0	To know the basic components and velocity / acceleration analysis of mechanisms.	1.1	Demonstrate the working of various mechanisms and determine the velocity and acceleration of mechanisms.
2.0	To understand the basic concepts of toothed gearing and kinematics of gear trains.	2.1	Describe the concepts and applications of kinematics of gears and gear trains.
3.0	To acquire knowledge on cam mechanisms for specified output motions and the effects of friction in machine elements.	3.1	Explain the concepts of cam follower system and examine the friction concepts in various engineering applications.
4.0	To introduce the concepts of static and dynamic force analysis in mechanisms and reciprocating engines.	4.1	Analyze the static and dynamic forces in mechanisms and reciprocating engines.
5.0	To learn the balancing concepts of rotating and reciprocating masses and the various types of vibrations	5.1	Apply the balancing concepts in reciprocating and rotating masses to solve problems; and Compute the frequency of various types of vibrations.

UNIT - I KINEMATICS OF MECHANISMS AND ANALYSIS	**(9)**
Mechanisms – Terminology and definitions – Degree freedom of simple mechanism – Grashof"s Law - Kinematic Inversions of Four bar chain, Single slider and Double slider crank chains –kinematics Analysis in slider crank mechanism - Velocity and Acceleration- Analytical method.	
UNIT – II GEARS AND GEAR TRAINS	**(9)**
Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains	
UNIT- III KINEMATICS OF CAMS AND FRICTION DRIVES	**(9)**
Classifications of Cams and Followers - Displacement diagrams for uniform velocity, simple harmonic motion, constant acceleration and deceleration, cycloidal motions - Graphical layout of radial cam profile with in-line knife edge follower- tangent cam and circular arc cam. Friction- Surface contacts – Sliding and Rolling friction- Friction drives – Plate clutches and belt drive.	
UNIT – IV FORCE ANALYSIS	**(9)**
Static force analysis - static equilibrium conditions - free body diagrams - static Equilibrium conditions – Two, Three and four members - graphical force analysis without friction for four bar mechanism and slider crank mechanism - Dynamic force analysis in Reciprocating Engines –D'Alembert's principle - analytical method of engine force analysis without inertia.	
UNIT – V BALANCING AND VIBRATION	**(9)**
Static and Dynamic balancing - Balancing of rotating masses – balancing of reciprocating masses - tractive force, swaying couple, hammer blow – vibration- Free longitudinal and transverse vibrations – natural Frequency – Damped Vibration – critical speed of simple shaft –torsional vibrations on single and two rotor systems.	

LIST OF EXPERIMENTS

1. Determination of transmission angle and toggle position of four bar mechanisms.
2. Determination of ratio of time of cutting stroke to return stroke and length of stroke of quick return mechanism.
3. Experimental study of Gears, Gear trains and Differential unit.
4. Determination of moment of inertia of an object by oscillation method.
5. Determination of jump speed of the cam.
6. Balancing of rotating mass of the shaft.
7. Deflection of fixed –free cantilever beam.
8. Determination of natural frequency of vibration of the spring mass system.
9. Determination of whirling speed of shaft.
10. Determination of natural frequency of the free torsional vibration of the single rotor system.

TOTAL (L:45 + P:30): 75 PERIODS

TEXT BOOK:

1. John J. Uicker, Jr., Gordon R. Pennock and Joseph E. Shigley, "Theory of Machines and Mechanisms - SI Edition", 4th ed., Oxford University Press, 2017
2. Khurmi.R.S and Gupta.J.K, "Theory of Machines", 15th ed., S.Chand & Company Pvt. Ltd., 2017

REFERENCES:

1. Rattan.S.S, "Theory of Machines", 5th ed., McGraw Hill Education India Private Limited, 2019
2. Ambekar A.G, "Mechanism and Machine Theory",1st ed., Prentice Hall of India, 2013
3. Bansal.R.K and Brar.J.S, "Theory of Machines", 5th ed., Laxmi Publications, Revised 2016
4. Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", East-West Publications, 2008
5. Kenneth J Waldron and Gary L Kinzel, "Kinematics, Dynamics, and Design of Machinery", 3rd ed., Wiley India Pvt Ltd, 2016

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3	2	-	-	-	-	2	2	-	3	2	-
2	3	3	3	3	-	-	-	-	2	2	-	3	2	-
3	3	3	3	3	-	-	-	-	2	2	-	3	2	-
4	3	3	3	2	-	-	-	-	2	2	-	3	2	-
5	3	3	3	2	-	-	-	-	2	2	-	3	2	-
CO (WA)	**3**	**3**	**3**	**2.4**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**3**	**2**	**-**

22MEP02 THERMAL ENGINEERING LABORATORY				
	L	T	P	C
	0	0	4	2

PRE REQUISITE :

Course Objectives		Course Outcomes	
1.0	To know the method to conduct performance measurement in thermal systems	1.1	Conduct the experiments on various thermal engineering systems and analyze the performance
2.0	To understand the properties of fuels in thermal applications	2.1	Analyze the performance of blowers, fan and internal combustion engines
3.0	To acquire knowledge on operating Characteristics of Internal Combustion engines	**3.1**	Know how to balance the heat energy available in engine cylinder after the combustion process
4.0	To conduct the performance test on air compressors	**4.1**	Estimate the performance of air compressors
5.0	To conduct the performance test on boiler and steam turbine	**5.1**	Determine performance of boiler and steam turbine

PART I IC ENGINES LABORATORY

List of Experiments

CYCLE - I

1. Valve timing and Port Timing Diagrams
2. Determination of flash point, fire point and viscosity of fuels
3. Performance test on C.I engines
4. Morse test on multi cylinder engine
5. Determination of Frictional power using retardation test
6. Heat balance test on C.I engines with Data Acquisition system

CYCLE - II

7. Performance test on air blower
8. Performance test on reciprocating air compressor
9. Measurement of lift and drag force of an aero foil model
10. Performance test on air conditioning system.
11. Performance test on Refrigeration system.
12. Study of Steam Generators and Turbines.

TOTAL:60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2						2	3		3	2	
2	3	3	2				2		2	3		3	2	
3	3	3	2				2		2	3		3	2	
4	3	3	2						2	3		3	2	
5	3	3	2						2	3		3	2	
CO (W.A)	**3**	**3**	**2**				**2**		**2**	**3**		**3**	**2**	

22MEP04 - SUBTRACTIVE MANUFACTURING PROCESSES LABORATORY				
	L	T	P	C
	3	0	0	3
PREREQUISITE : Nil				

Course Objective:	• To carry out machining operations in lathe machines. • To understand the methods of calculating cutting forces. • To gain skills in performing shaping, slotting, milling, grinding machine, gear hobbing. • To acquire knowledge on the cutting forces, average chip-temperature and surface finish during metal removal processes. • To understand the effect of process parameters on material removal processes.

	Course Outcomes The Student will be able to	**Cognitive Level**
CO1	Apply the machining of cylindrical and prismatic parts using metal removal processes.	Ap
CO2	Estimate the cutting forces in machining operations of different materials.	An
CO3	Develop gear model by using gear generation and gear hobbing processes.	An/Cr
CO4	Identify the process parameters for machining various materials.	An
CO5	Design and develop a given components into finished components in subtractive manufacturing processes as a member of a team/ individual.	Cr

LIST OF EXPERIMENTS :

1. Fabricating simple structural shapes using Gas and Arc Welding machine
2. Preparing green sand moulds with cast patterns.
3. Conversion of round rod into square/hexagonal rod using forging.
4. Taper Turning, External Thread Cutting & Knurling on circular parts using lathe machine.
5. Eccentric Turning on circular parts using lathe machine.
6. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
7. Drilling and Reaming using vertical drilling machine.
8. Milling contours on plates using vertical milling machine.
9. Cutting spur and helical gear using horizontal milling machine.
10. Generating gears using gear hobbing machine.
11. Grinding components using cylindrical and centerless grinding machine.
12. Grinding components using surface grinding machine.
13. Cutting force calculation using dynamometer in milling machine.
14. Cutting force calculation using dynamometer in lathe machine.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3								3				3	
2			3											
3		3												
4														
5							3							
CO (W.A)	**3**	**3**	**3**				**3**		**3**				**3**	

22MAN08 – SOFT / ANALYTICAL SKILLS - IV *(Common to all Branches)*				
	L	**T**	**P**	**C**
	1	**0**	**2**	**0**

PRE REQUISITE :

Course Objectives		**Course Outcomes**	
1.0	To recollect the functional understanding of basic grammar and its structure	**1.1**	The students will be able to apply the knowledge of basic grammar to construct the sentences.
2.0	To develop students to workout solution for problems that involves mathematics aptitude.	**2.1**	The students will be able to solve aptitude problems with ease
3.0	To enrich their knowledge and to develop their logical reasoning ability	**3.1**	The students will be able to solve reasoning problems with ease.

UNIT I - Verbal	**(5+10)**
Articles - Fill in the blanks - Grammatical Error - Sentence improvement	
UNIT II – Aptitude	**(5+10)**
Speed and Distance- Time and Work- Mixture And Alligations- Permutation and Combinations	
UNIT III - Logical and Reasoning	**(5+10)**
Seating Arrangement- Directions and Distance- Non verbal Reasoning	
TOTAL (L:15, P:30) : 45 PERIODS	

REFERENCES:

1. Dr. R.S. Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", S Chand and Company Limited, New Delhi, 2014.
2. Ashish Aggarwal, "Quick Arithmetic", S Chand and Company Limited, New Delhi, 2014.
3. Raymond Murphy, "English grammar in use", Fourth Edition, Cambridge University, 2012.

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	-	-	-	-	-	-	-	-	3	3	-	2	-	1
2	-	3	2	2	-	-	1	-	2	-	-	3	2	-
3	-	3	2	2	-	-	1	-	2	-	-	3	2	-
CO (W.A)	-	2	1.3	1.3	-	-	0.6	-	2.3	1	-	2.6	1.3	0.3

22MAN06 ENVIRONMENTAL SCIENCE *(Common to Agri-2nd AND Mech-4thSEM)*					
		L	**T**	**P**	**C**
		2	**0**	**0**	**0**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To recognize the basic concepts of environment, ecosystems and biodiversity.	**1.1**	The students will be able to know the importance of environment and functions ecosystems and biodiversity		
2.0	To impart knowledge on the causes, effects and control measures of environmental pollution.	**2.1**	The students will be able to identify the causes, effects of environmental pollution and contribute the preventive measures to the society.		
3.0	To make the students conversant with the global and Indian scenario of renewable resources, causes of their degradation and measures to preserve them.	**3.1**	The students will be able to identify and understand the renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.		
4.0	To familiarize the concept of sustainable development goals, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.	**4.1**	The students will be able to recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.		
5.0	To impart knowledge on the e-waste and its recycling methods of cell phone, battery, laptop and PCB.	**5.1**	The students will be able to demonstrate the recycling of battery, cell phone , laptop and PCB		

UNIT I - ENVIRONMENT AND BIODIVERSITY	**(6)**
Environment - scope and importance - Eco-system: Structure and function of an ecosystem- types of biodiversity - genetic - species and ecosystem diversity – values of biodiversity - hot-spots of biodiversity — conservation of biodiversity: In-situ and ex-situ.	
UNIT II - ENVIRONMENTAL POLLUTION	**(6)**
Pollution – Causes - Effects and Preventive measures of Water, Air and noise pollution - Solid waste management: methods of disposal of solid waste - Environmental protection act: Air act – Water act.	
UNIT III - RENEWABLE SOURCES OF ENERGY	**(6)**
Energy management and conservation - New Energy Sources: Different types of new energy sources – Solar energy – wind energy - Applications of Hydrogen energy, Ocean energy resources, Tidal energy conversion.	
UNIT IV – SUSTAINABILITY AND MANAGEMENT	**(6)**
Development – Factors affecting development – advantages – disadvantages – GDP - Sustainability- needs – concept - concept of carbon credit – carbon footprint – Environmental management.	

UNIT V – BATTERIES AND RECYCLING OF E-WASTE	**(6)**
Battery lifecycle - Mobile battery life cycle – Laptop battery life cycle – battery maintenance – benefits of recycling battery – E-waste – sources of e-waste - recycling of computing devices - mobile phones - PCB .	
TOTAL (L:30) : 30 PERIODS	

TEXT BOOKS:

1. Dr. A.Ravikrishan, Envrionmental Science and Engineering., Sri Krishna Hitech Publishing co. Pvt.Ltd., Chennai,15thEdition, 2023.
2. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers , 2018.

REFERENCES:

1. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
2. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

WEBLINK:

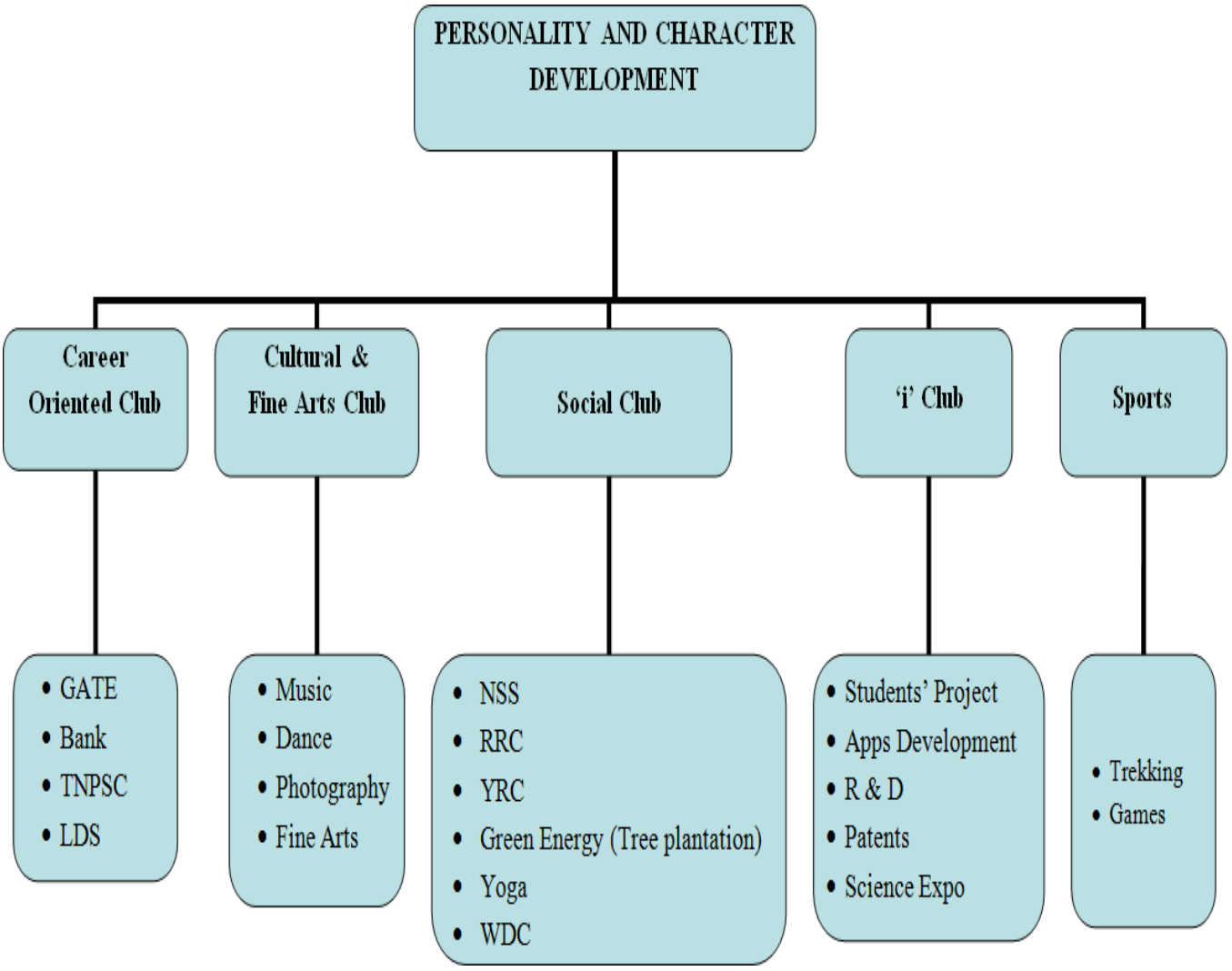
1. http://www.jnkvv.org/PDF/08042020215128Amit1.pdf
2. https://www.conserve-energy-future.com/types-of-renewable-sources-of-energy.php
3. https://ugreen.io/sustainability-engineering-addressing-environmental-social-and-economic-issues/
4. https://www.researchgate.net/publication/326090368_E-_Waste_and_Its_Management
5. https://www.ewaste1.com/how-to-reduce-e-waste/

Mapping of COs with POs / PSOs

COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	2			3	3	2	1			2		
2	2	2	2			3	3	2	1			2		
3	2	2	2			3	3	2	1			2		
4	2	2	2			3	3	2	1			2		
5	2	2	2			3	3	2	1			2		
CO (W.A)	**2**	**2**	**2**			**3**	**3**	**2**	**1**			**2**		

22GED01 PERSONALITY AND CHARACTER DEVELOPMENT

L	T	P	C
0	0	2	0



*LDS - Leadership Development Skills

OBJECTIVES :				
Career Oriented Club	**Cultural & Fine Arts Club**	**Social Club**	**'i' club**	**Sports**
• To provide support for identifying specific career field of interests and career path • To provide support for preparing for competitive exams	• To bring out the hidden talent of students in music, dance and other fine arts. • To promote photography skill among the students • To develop and enhance the performance of students by participating in various events • To inculcate managerial capabilities such asevent managementand stage organization	• To create social awareness anddevelop a sense of social and civic responsibility • To inculcate socially and environmentally sound practices and be aware of the benefits • To encourage the students to workalong with the people in rural areas, thereby developing their character, social consciousness, commitment, discipline and beinghelpful towards thecommunity.	• To inculcate the basic concepts of innovation • To foster the networking between students, build teams, exchange ideas, do projects and discuss entrepreneurial opportunities • To enrich the academic experience, build competencies and relationships beyond the classroom	• To provide opportunities to excel at sports • To promote an understanding of physical and mental well-beingthrough an appreciation ofstress, rest and relaxation. • To develop an ability to observe, analyze and judge the performance of self and peers in sporting activities. • To develop leadership skills and nurture the team building qualities. **Trekking:** • To provide opportunities to explore nature and educating about the purity of nature • To improve physical and mental health.

OUTCOMES : At the end of this course, the students will be able to				
• Find a better career of their interest. • Make use of their knowledge during competitive exams and interviews.	• Take part in various events • Develop team spirit, leadership and managerial qualities	• Develop socially responsive qualities by applying acquired knowledge • Build character, social consciousness, commitment and discipline	• Apply the acquired knowledge in creating better solutions that meet new requirements and market needs • Develop skills on transforming new knowledge or new technology into viable products and services on commercial markets as a team	• Demonstrate positive leadership skills that contribute to the organizational effectiveness • Take part an active role in their personal wellness (emotional, physical, and spiritual) that supports a healthy lifestyle • Create inclination towards outdoor activity like nature study and Adventure.

TOTAL [2 x (P: 15)]: 30 PERIODS

(Cumulatively for Two Semesters)

22ITZ01 PYTHON PROGRAMMING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To acquaint with data types, input output statements, decision making, looping in Python	**1.1**	The students will be able to develop understanding of basics of Python Programming constructs.		
2.0	To acquire knowledge about manipulation of strings.	**2.1**	The students will be able to impart basic knowledge of all strings functions.		
3.0	To be familiarized with programming concepts like list and tuples.	**3.1**	The students will be able to choose most appropriate programming constructs and features to solve the problems with list, tuples and dictionaries.		
4.0	To understand the concepts of dictionaries, function and modules.	**4.1**	The students will be able to exhibit the programming skills for the use of the logical constructs of language using function and files.		
5.0	To develop the skill of designing Graphical user Interfaces in Python	**5.1**	The students will be able to demonstrate significant experience with the Python program development environment.		

UNIT I - INTRODUCTION TO PYTHON	**(9)**
Introduction to python: Features - Execution of python program – Flavors of Python – Comments - Data Types: Built-in data types– Sequences – Set - Literals– Operators – Input and Output Statements - Control Statements if – if-else –if-else-if – while-For –Nested loops – the else suite - Break – Continue - pass - assert – return.	
UNIT II - STRINGS	**(9)**
Arrays: One Dimensional arrays - Multi Dimensional arrays - Strings and Characters: Creating - Length - Indexing - Slicing - Repeating - Concatenation - Comparing - Removing Spaces - Finding Sub Strings - Counting Substrings in a String - Strings are Immutable - Replacing - Splitting and Joining Strings - Changing Case - Checking Starting and Ending of a String – String Formatting - Working with Characters – Sorting - Searching Strings - Finding Number- Inserting sub string into a string.	
UNIT III - LISTS , TUPLES AND DICTIONARIES	**(9)**
Lists: Creating Lists – Updating - Concatenation - Repetition - Methods – Sorting. Tuples: Creating - Accessing – Operations – Functions - Nested Tuples - Inserting Elements, Modifying Elements, Deleting Elements from a tuples. Dictionaries: Operations – Methods - Using for Loop with Dictionaries – Sorting the Elements of a Dictionary using Lambdas - Converting Lists and Strings into Dictionary - Passing Dictionaries to Functions - Ordered Dictionaries.	
UNIT IV - FUNCTIONS AND FILES	**(9)**
Functions: Defining – Calling – Returning - Pass by Object Reference – Formal, Actual, Positional, Keyword, Default & Variable Length Arguments - Local and Global Variables - Recursive Functions - Lambdas - Function Decorators. Files - Types of Files - Opening & Closing a File - Working with Text Files Containing Strings - Working with Binary Files - The with Statement - The seek() and tell() Methods - Random Accessing of Binary Files - Random Accessing of Binary Files using mmap - Zipping and Unzipping Files - Working with Directories.	

UNIT V - MODULES AND FRAMEWORKS	(9)
Modules: Importing module –Features – Built in functions. - Python Environment and Frameworks: NumPy: NumPy Arrays – Computation on NumPy Arrays – Aggregation – Sorting Arrays – Structured Arrays.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

1. Dr. R. Nageswara Rao, "Core Python Programming", Dream tech Press, 2021 Edition.
2. Jake Vander Plas, "Python Data Science Handbook Essential Tools for Working with Data", 1st Edition O'Reilly Publishers, 2016.

REFERENCES:

1. Kenneth A. Lambert, "Fundamentals of Python: First Programs", Cengage Learning, 2018.
2. Wesley J. Chun, "Core Python Programming", Pearson Education, 2013.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	3	3	3	3	-	-	-	-	3	3	3
2	3	2	3	3	3	3	3	-	-	-	-	3	3	3
3	3	2	3	3	3	3	3	3	-	-	3	3	3	3
4	3	2	3	3	3	3	3	3	-	-	3	3	3	3
5	3	2	3	3	3	3	3	3	-	-	3	3	3	3
CO (W.A)	3	2	2.8	3	3	3	3	3	-	-	3	3	3	3

2MEC14 MACHINE DESIGN				
	L	T	P	C
	3	I	0	4

PREREQUISITE :

Course Objective:	• To introduce the design methodology of machine elements • To acquire knowledge on analysis of forces acting on the machine elements and appropriate design methodology • To analyse the stresses acting on the temporary and permanent joints • To gain knowledge about the design of couplings and/or springs • To teach various standards, and selection procedures of machine elements

Course Outcomes The Student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Apply concepts of strength of materials to estimate the stresses in a machine element and predict failure of components.	Ap	20%
CO2	Analyse the effect of fatigue load on machine elements and factors affecting it to predict failure.	An	20%
CO3	Design the machine elements such as Shafts, Keys, springs and bearings	An/E	40%
CO4	Design the various joints such as temporary joints, permanent joints and couplings	E	20%
CO5	Implement standards, codes, and regulations in machine design	U/Ap	Internal Assessment

UNIT I : STRESSES IN MACHINE ELEMENTS	**(9+3)**
Procedure in design process - factors influencing machine design - selection of materials based on mechanical properties preferred numbers, fits and tolerance - direct, bending and torsional stress equation - Modes of failure- bending stress incurved beams - crane hook and 'C' frame - factor of safety - theories of failures	
UNIT II :VARIABLE STRESSES AND DESIGN OF SHAFTS	**(9+3)**
Variable stresses in machine parts - stress concentration factor - cyclic stresses - fatigue and endurance limit - Goodman and Soderberg methods - combined normal stress and variable stress - design of solid and hollow shafts based on strength and rigidity	
UNIT III : PERMANENT AND TEMPORARY JOINTS	**(9+3)**
Welded joints - types - basic weld symbols - strength of transverse and parallel fillet welded joints - eccentrically loaded welded joints. Threaded joints - terms - forms - design of bolted joints under eccentric loading - introduction to riveted joints	
UNIT IV : DESIGN OF COUPLINGS AND SPRINGS	**(9+3)**
Couplings - types - design of muff coupling, unprotected type flange coupling, bushed pin flexible coupling - Introduction to ELBO flexible pin-type coupling, springs- types, helical springs, materials, end connections, terms used in compression springs - stresses and deflection in helical springs of circular wire - surge in springs - design of leaf springs - stress and deflection equation, nipping	
UNIT V : BEARINGS	**(9+3)**
Sliding contact bearings – theory of lubrication, hydrodynamic bearings, Sommerfield number – design of hydrodynamic bearings – rolling contact bearings, static and dynamic load capacity, cubic mean load, variable load, probability of survival, selection of deep groove ball bearing, Introduction to Magnetic bearings and its applications.	

S. No.	Practice Titles	Unit
1	Fits and Tolerances	1
2	Welded joints	3
3	Helical Springs	4
		TOTAL : 60 Hours (45 L +15 T)

TEXT BOOKS

2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 10th ed., McGraw-Hill Education, 2015
3. Bhandari V.B, "Design of Machine Elements", 4th ed., McGraw Hill Education India Private Limited, 2017

REFERENCES:

1. Khurmi. R.S and Gupta. J. K, "A Textbook of Machine Design", S. Chand and Company Ltd., New Delhi, 2014
2. Jalaludeen S.Md, "Machine Design (Volume-1)", 4th ed., Anuradha Publications, Chennai, 2011
3. Sundararajamoorthy T. V. Shanmugam. N, "Machine Design", Anuradha Publications, Chennai, 2003
4. Robert C. Juvinall, Kurt M. Marshek, "Machine Component Design", Wiley India Pvt Ltd., 2016
5. Ganesh Babu.K, Srithar.K, "Design of Machine Elements", 2nd ed., McGraw Hill Education (India) Private Limited, 2009

Mapping of COs with POs / PSOs

Cos	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												3	
2		3											3	
3			3										3	
4				2									3	
5								2						
CO (W.A)	**3**	**3**	**3**	**2**				**2**					**3**	

22MEC15 METROLOGY AND MEASUREMENTS				
	L	T	P	C
	3	I	0	4
PREREQUISITE :				

Course Objective:	• To introduce the principles of metrology and measurements • To acquire knowledge on measurement parameters and its applications • To acquire knowledge on the concept of various measurements like linear and angular measurements • To impart knowledge on statistical measurements and surface finish • To gain knowledge on laser and advances in metrology system

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concept of measurement system for industrial components	Ap	30
CO2	Apply the various measuring methods in mechanical applications	Ap	30
CO3	Design the various components using measuring instruments	Ap	20
CO4	Develop competence in form measurement and optical measurement methods, including 3D surface metrology	An	20
CO5	Engage in independent study as a member of a team or individual and make effective oral presentation on measurement systems	U	Internal Evaluation

UNIT I : MEASUREMENT SYSTEMS	**(9)**
General concept - units and standards - characteristics of measuring instruments - sensitivity, stability, range, accuracy and precision - static and dynamic response - repeatability, hysteresis - systematic and random errors - correction, calibration - interchangeability	
UNIT II : PARAMETER MEASUREMENTS	**(9)**
Measurement of force, torque, power using mechanical, pneumatic, hydraulic, electrical instruments - flow measurement - rotameter, pitot tube - Temperature measurement - bimetallic strip, thermocouple, electrical resistance thermometer	
UNIT III : LINEAR AND ANGULAR MEASUREMENTS	**(9)**
Linear measuring instruments - vernier, micrometer, slip gauges, limit gauges, tool maker's microscope - interferometry, optical flats, comparators - mechanical, pneumatic, electrical applications - angular measurements - sine bar, sine center, bevel protractor, autocollimator, Angle Dekkor.	
UNIT IV : FORM MEASUREMENT	**(9)**
Fundamentals of GD & T - Measurement of Screw Thread - Measurement of Gears - Measurement of straightness, flatness and roundness - measurement of surface finish - stylus based - Tomlinson surface meter and Taylor-Hobson Talysurf - optical measurement - light cross section method - Introduction to 3D surface metrology	
UNIT V : ADVANCED METROLOGY	**(9)**
Precision instruments based on laser principles - interferometer - application in linear, angular measurements - Coordinate Measuring Machine (CMM) - constructional features - types, applications - computer aided inspection - Introduction to machine vision system - Demonstration of Modern Measurement System for Industrial Applications.	

TEXT BOOKS:

1. Thomas G. Beckwith, Roy D, Marangoni, John H.Lienhard V., "Mechanical Measurements", 6th ed., Pearson Education India, 2014
2. Jain R.K., "Engineering Metrology", 20th ed, Khanna Publishers, 2009

REFERENCES:

1. Raghavendra N.V, Krishnamurthy L, "Engineering Metrology and Measurements", 1st ed., Oxford University Press, 2013
2. R.K.Rajput A textbook of measurement and metrology ,S.K. Kataria & Sons,2013.
3. Gupta.I.C., "Engineering Metrology", 10th ed., Dhanpat Rai Publications, 2013
4. Anand K Bewoor, Vinay A Kulkarni, "Metrology & Measurement", McGraw Hill Education, 2009
5. Mahajan.M, "Engineering Metrology", Dhanapat Rai publications, 2014
6. Tayal A.K, "Instrumentation and Mechanical Measurements", 4th ed., Galgotia Publications, 2000

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	2
2		2											2	
3			2										1	
4					2									1
5					2									2
CO (W.A)	**3**	**2**	**2**		**2**								**1.67**	**1.67**

22MEC16 HEAT AND MASS TRANSFER				
	L	T	P	C
	3	0	0	3

PREREQUISITE :

Course Objective:	• To introduce the concept of heat conduction in various systems. • To analyze about the internal heat generation and transient heat conduction. • To acquire knowledge on convection in various systems. • To acquire knowledge on Boiling and Condensation, radiation heat transfer. • To learn the basic of heat exchangers, develop the basic concept, diffusion and convective mass transfer.

	Course Outcomes The Student will be able to	**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concept of heat transfer to calculate the rate of heat transferred through conduction and convection in various thermal systems.	Ap	40%
CO2	Numerically determine and compare the emissivity of grey bodies with that of a black body.	Ap	20%
CO3	Compare the modes of heat transfer by solving numerical problems relevant to real-time applications.	Ap	20%
CO4	Analyze the transfer of matter on a microscopic level as a result of diffusion from a region of higher concentration to lower concentration region.	An	20%
CO5	Engage in an independent study to deliver a compelling oral presentation on heat transfer modes in diverse thermal applications.	U	Internal Assessment

UNIT I : STEADY STATE HEAT CONDUCTION	**(9)**
Mechanisms of heat transfer - General heat conduction equation in Cartesian coordinates –One dimensional steady state heat conduction in composite and plane walls with constant thermal conductivity - critical radius of insulation - Rectangular plate fins and pin fins with uniform cross section - Efficiency and effectiveness - circumferential fins.	
UNIT II - CONDUCTION WITH HEAT GENERATION	**(9)**
Solid cylinder with internal heat generation - Transient heat conduction - plane wall with negligible internal resistance - heat flow in an infinitely thick plate - chart solutions of transient heat conduction problems in plane wall.	
UNIT III - CONVECTION	**(9)**
Thermal and velocity boundary layer in flow over flat plate and flow through circular pipe - forced convection - correlations for flow over flat plate - flow across tube banks - correlations for flow through circular tubes - Natural convection in vertical and horizontal plates	
UNIT IV - RADIATION, BOILING AND CONDENSATION	**(9)**
Thermal radiation - emissive power - absorption, reflection and transmission - Plank's, Wien's displacement, Stefan- Boltzmann, Kirchhoff's laws - emissivity - grey body - Radiation shields - pool boiling curve for water - boiling correlations -Nusselt's theory - condensation on vertical surfaces and horizontal tubes	
UNIT V – HEAT EXCHANGERS AND MASS TRANSFER	**(9)**
Types of heat exchangers - overall heat transfer coefficient - fouling factors - LMTD and NTU methods - Diffusion mass transfer - Fick's law of diffusion - diffusion coefficient - equimolar counter diffusion - concentration boundary layer - governing equations - convective mass transfer correlations	

TEXT BOOKS

1. Sachdeva.R.C, "Fundamentals of Engineering Heat and Mass transfer", 6th ed., New age international publishers, 2022.
2. Yunus A Cengel, "Heat and Mass Transfer", 6th ed., McGraw Hill Education (India) Pvt Ltd, 2020

REFERENCES:

1. Kothandaraman.C.P, "Fundamentals of Heat and Mass transfer", 4th ed., New age international publishers, 2012
2. Nag.P.K, "Heat and Mass Transfer", 3rd ed., McGraw Hill Education, 2011
3. Holman.J.P, "Heat Transfer", McGraw Hill Education (India) Pvt Ltd, 2017
4. Incropera and Dewitt, "Fundamentals of Heat and Mass Transfer", 7th ed., Wiley India Pvt Ltd, 2013

Mapping of COs with POs / PSOs

COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2	3												2	
3	3												2	
4		3											2	
5										2				
CO (W.A)	**3**	**3**								**2**			**2**	

22MEC17 HYDRAULICS AND PNEUMATICS				
	L	T	P	C
	3	0	0	3
PREREQUISITE :				

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

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts of fluid power in controlling actuators/components.	AP	20
CO2	Apply the concepts of hydraulics and pneumatics to obtain automation industrial applications.	AP	40
CO3	Analyze various fluid power circuits and select suitable actuators and control components.	AN	20
CO4	Design hydraulic and pneumatic circuits to meet the given specifications.	AN / C	20
CO5	Formulate, Design, Implement, Demonstrate, Analyze a mini project relate to the course.	AN / C	Internal Assessment

UNIT I - FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS	**(9)**
Fluid power systems – Introduction to Fluid power – Advantages and Applications –Types of fluids - Properties of fluids – Basics of Hydraulics – Pascal's Law – Problems, Sources of Hydraulic power: Pumping Theory – Pump Classification – Construction, Operation, Advantages, Disadvantages and Applications	
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, Operation and Applications – Fluid Power ANSI Symbols	
UNIT III - HYDRAULIC CIRCUITS AND SYSTEMS	**(9)**
Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits – 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, Compressors and types, Pneumatic actuators, Design of Pneumatic circuit – classification – single cylinder and multi cylinder circuits – Cascade method – Electro Pneumatic System – Elements – timer circuits	
UNIT V – TROUBLE SHOOTING AND APPLICATIONS	**(9)**
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Surface grinding, Press and Forklift applications – Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits – IoT in Hydraulics and pneumatics	

TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997

REFERENCES:

1. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.
2. Joshi.P., Pneumatic Control", Wiley India, 2008.
3. Majumdar, S.R., "Oil Hydraulics Systems – Principles and Maintenance",TataMcGraw Hill, 2001.
4. Shanmugasundaram.K., "Hydraulic and Pneumatic Controls". Chand & Co, 2006.
5. Srinivasan.R., "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 3rd edition,2019.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2	3												3	
3		3											3	
4			3										3	
5			2						2	1	1	1	3	2
CO (W.A)	**3**	**3**	**2.5**						**2**	**1**	**1**	**1**	**3**	**2**

22MEP05 HEAT AND MASS TRANSFER LABORATORY				
	L	T	P	C
	0	0	4	2

PREREQUISITE :

Course Objective:	• To calculate the thermal conductivity of different materials. • To analyze the efficiency of fin. • To acquire knowledge on natural convection from a vertical cylinder and forced convection inside tube. • To identify the value of Stefan - Boltzmann constant and emissivity of a grey body. • To learn the basics of parallel and counter flow heat exchangers and to acquire knowledge on Boiling and Condensation.

	Course Outcomes The Student will be able to	**Cognitive Level**
CO1	Apply the concept of heat transfer to calculate the thermal conductivity of different insulating materials and heat transfer through natural and forced convection.	40%
CO2	Analyze the efficiency of fin using pin-fin apparatus and its effect on heat transfer.	20%
CO3	Analyze the radiation heat transfer in a grey body and experimentally calculate the value of Stefan - Boltzmann constant	20%
CO4	Evaluate the effectiveness of parallel and counter flow heat exchangers as well as the mechanisms of heat transfer through boiling and condensation.	20%
CO5	Engage in an independent study focusing on analyzing various heat transfer mechanisms within thermal systems.	Internal Assessment

LIST OF EXPERIMENTS

1. Thermal conductivity measurement using guarded plate apparatus
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus
3. Efficiency calculation of a pin-fin apparatus
4. Determination of heat transfer coefficient under natural convection from a vertical cylinder
5. Determination of heat transfer coefficient by forced convection inside tube
6. Determination of Stefan - Boltzmann constant
7. Determination of emissivity of a given grey surface
8. Determine the effectiveness of parallel / counter flow heat exchanger
9. Determination of heat flux in boiling and condensation heat transfer
10. Determination of thermal conductivity of insulating powder

TOTAL (P:60) = 60 PERIODS

REFERENCES:

1. Sachdeva.R.C, "Fundamentals of Engineering Heat and Mass transfer", 6th ed., New age international publishers, 2024.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		3											2	
3		3											2	
4		3											2	
5									2					
CO (W.A)	**3**	**3**							**2**				**2**	

22MEP06 METROLOGY AND MEASUREMENTS LABORATORY				
	L	T	P	C
	0	0	4	2

PREREQUISITE :

Course Objective:	• To measure the linear dimensions of the components. • To identify the various gear teeth parameters. • To measure the angular dimensions of the components • To measure the straightness, flatness of the surface • To acquire knowledge on measurement parameters and its applications

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Calibrate the measuring instruments and measure the dimension of the components	40%
CO2	Select proper instruments for measurement	20%
CO3	Calculate least count of instrument, take reading using the instrument.	20%
CO4	Determine the characteristics of instruments.	20%
CO5	Identify the surface finish of a component.	Internal Assessment

List of Experiments

1. Determination of Linear dimensions of a part using Vernier Caliper / Micrometer.
2. Determination of Linear dimensions of a part using Vernier Height Gauge and Vernier depth gauge.
3. Measurement of Internal Bore diameter using Digital Bore Gauge.
4. Measurement of Gear Tooth Dimensions using Gear Tooth vernier.
5. Measurement of Taper Angle using Bevel Protractor / Sine bar / Slip Gauges.
6. Measurement of given Component using Profile Projector.
7. Measurement of screw thread parameters using Tool Makers Microscope.
8. Measurement of straightness and flatness of surface plate using Autocollimator.
9. Measurement Surface Finish using surface roughness tester.
10. Measurement of Force /torque.
11. Measurement of Temperature using thermo couples.
12. Measurement of displacement using LVDT.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
Cos	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												2	2
2		2											2	1
3			2										1	
4					2								1	2
5										2				
CO (W.A)	**3**	**2**	**2**		**2**					**2**			**1.5**	**1.67**

22MEC17 – FINITE ELEMENT ANALYSIS				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives:	• To introduce the concepts of Mathematical Modeling and numerical solution of engineering problems • To appreciate the use of Finite Element Method to a range of engineering problems • To gain knowledge related to two dimensional scalar variable problems with heat transfer • To introduce the vector variable of the axisymmetric problems and fluid mechanics • To teach Isoparametric formulation and advanced topics in FEM

	Course Outcomes The Student will be able to	Cognitive level	Weightage in End Semester exams
CO1	Apply the finite element theory and procedures to various structural and non-structural applications	Ap	20%
CO2	Calculate the stiffness matrices and stress values in 1D and 2D elements using finite element concepts	Ap	20%
CO3	Analyze the three dimensional elements using axisymmetric concepts	An	20%
CO4	Estimate the stiffness matrices of isoparametric elements using FEM methods	An	20%
CO5	Perform the dynamic analysis of elements using FEM method	AN / C	Internal Assessment

UNIT I - BASIC CONCEPTS AND 1D ELEMENTS	**(9)**
Basic concepts - types of analysis - general procedure for FEA - introduction to meshing - discretization - weak form - governing equations – discrete and continuous models - boundary, initial and eigen value problems - weighted residual method - Ritz method- applications - finite element modeling - coordinates - shape functions - stiffness matrix and assembly - boundary conditions - solution of equations - mechanical loads, stresses and thermal effects - bar and beam elements - one-dimensional heat transfer problems	
UNIT II - 2D ELEMENTS	**(9)**
Finite element modeling - Poisson equation - Laplace equation - plane stress, plane strain - CST element - element equations, load vectors and boundary conditions - truss - deflection - stresses - Pascal's triangles - assembly - application in two dimensional heat transfer problems	
UNIT III - AXISYMMETRIC PROBLEMS	**(9)**
Vector variable problems - elasticity equations - axisymmetric problems - formulation - element matrices - assembly - boundary conditions and solutions - introduction to plates and shells	
UNIT IV - ISOPARAMETRIC ELEMENTS	**(9)**
Isoparametric elements - four node quadrilateral element - shape functions - Jacobian matrix - element stiffness matrix and force vector - serendipity elements - numerical integration - stiffness integration - displacement and stress calculations	
UNIT V – DYNAMIC ANALYSIS	**(9)**
Types of dynamic analysis - general dynamic equation of motion, point and distributed mass - lumped and consistent mass - mass matrices formulation of bar and beam element - undamped - free vibration - eigen value and eigen vectors problems	

TEXT BOOKS

1. S.S. Rao, "The Finite Element Method in Engineering", 6th Edition, Butterworth-Heinemann,2018.
2. J.N. Reddy, "Introduction to the Finite Element Method", 4th Edition, Tata McGrawHill,2018.

REFERENCES:

1. K. Tirupathi, Chandrupatla and D. Ashok Belegundu, "Introduction to Finite Elements in Engineering",

International Edition, Pearson Education Limited, 2014.
2. David Hutton, "Fundamentals of Finite Element Analysis", Tata McGrawHill, 2005
3. R. Dhanaraj and K. Prabhakaran Nair, "Finite Element Analysis", Oxford Publications, 2015.
4. D. Robert Cook, S. David Malkus, E. Michael Plesha, J. Robert Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2004.
5. P. Seshu, "Text Book of Finite Element Analysis", PHI Learning Pvt. Ltd., NewDelhi, 2012.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2	3												3	
3		3											3	
4		3											3	
5												2	3	
CO (W.A)	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**

22MEC19 MECHATRONICS AND INTERNET OF THINGS					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes At the end of the course the students will be able to**			
1.0	To make students get acquainted with the sensors and the actuators in mechatronics systems	**1.1**	Identify the suitable sensors and type of actuators to achieve the desired output motion		
2.0	To provide insight into the control systems in Mechatronics	**2.1**	Identify the elements of Mechatronics control system.		
3.0	To understand the concepts and programming in PLC	**3.1**	Apply the operations of PLC for mechatronics applications		
4.0	To make students familiarize with the fundamentals of IoT systems	**4.1**	Elucidate the basics of IoT systems		
5.0	To inculcate skills in the design and development of mechatronics and IoT based systems	**5.1**	Design the suitable Mechatronics/ IoT based system for the real-time applications		

UNIT I - SENSORS AND ACTUATORS	**(9)**
Introduction to Mechatronics - Emerging areas of Mechatronics Sensors and Transducers - Static and Dynamic Characteristics, Transducers - Resistive, Capacitive, Inductive and Resonant, Optical Sensors - Photodetectors - Vision Systems – Laser - Fibre optic - Non-fibre Optic, Solid State Sensors, Piezoelectric and Ultrasonic Sensors - Humidity sensor - Temperature sensors Actuators – Brushless Permanent Magnet DC Motor – PM, VR and Hybrid Stepper motors – DC and AC Servo Motors	
UNIT II - CONTROL SYSTEMS AND MICROPROCESSOR	**(9)**
Control systems - open and closed loop systems - automatic control of water level - analogue and digital control systems - control modes - two step, proportional, derivative, integral and PID controllers Microprocessor - architecture of 8085 microprocessor - Pin Configuration - Addressing Modes - Instruction set, Timing diagram of 8085	
UNIT III - MICROCONTROLLERS AND PROGRAMMABLE LOGIC CONTROLLER	**(9)**
Architecture of 8051 microcontroller - Single-Chip Microcontroller Systems - Single-Board Microcontroller Systems - Single-Board Computer Systems - Embedded Systems: Peripherals - typical architecture of a CAN based system- Programmable logic controller - Architecture – Input / Output Processing – Ladder diagrams - Latching, Sequencing, Timers, Counters and Internal relays – Data Handling – Selection of PLC - Application of PLCs for control	
UNIT IV - FUNDAMENTALS OF IoT AND CONTROLLERS	**(9)**
The Internet of Things (IoT) - Introduction to the IoT Framework – IoT Enabling Technologies- The Effective Implementation of IoT - Foundation topics: Programming Languages: C++ and Python - Arduino: The Arduino Boards - Arduino Peripherals- Arduino IDE – ESP8266 Wi-Fi module - (typical peripherals) Interfacing and Controlling I/O devices by Arduino and Raspberry Pi: LEDs - Sensor and Actuator interactions	
UNIT V – MECHATRONICS AND IoT CASE STUDIES	**(9)**
Mechatronics systems: Drone actuation and Control -Autonomous Robot with Vision System, Automotive Mechatronics: Electronic Ignition System - ABS - EBD - Adaptive Cruise Control. IoT case studies: Remote Monitoring Systems- Remotely Operated Autonomous Systems - Centralized Water Management System - IoT Enabled Robotic Camera Dolly - Portable, Wireless, Interactive IoT Sensors for Agriculture - IoT Vehicle Management System with Network Selection	

TEXT BOOKS

1. D.A. Bradley, N.C. Burd, D. Dawson, A.J. Loader, "Mechatronics: Electronics in Products and Processes", Routledge, 2017.

2. S.H. Sami and G. Kisheen Rao, "The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers", CRC Press, 2022.

REFERENCES:

1. John Billingsley, "Essentials of Mechatronics", Wiley, 2006.
2. David H., Gonzalo S., Patrick G.,Rob B. and Jerome H.,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education, 2018
3. Nitin G and Sharad S, "Internet of Things: Robotic and Drone Technology", CRC Press, 2022
4. Newton C. Braga, "Mechatronics for The Evil Genius", McGrawHill, 2005.
5. Bell C., "Beginning Sensor Networks with Arduino and Raspberry Pi", Apress, 2013

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	-	3	-	1	-	-	-	-	1	3	2
2	3	3	2	-	3	-	1	-	-	-	-	1	3	2
3	3	3	2	-	3	-	1	-	-	-	-	1	3	2
4	3	3	2	-	3	-	1	-	-	2	-	1	3	2
5	3	3	2	-	3	-	1	-	-	2	-	1	3	2
CO (W. A)	**3**	**3**	**2**	**-**	**3**	**-**	**1**	**-**	**-**	**2**	**-**	**1**	**3**	**2**

22GEZ01-ENTREPRENEURSHIP DEVELOPMENT			
	L	**T**	**P**
	2	**0**	**2**

PRE REQUISITE : Nil

Course Objective:	• Learn basic concepts in entrepreneurship, develop mind-set and skills necessary to explore entrepreneurship • Apply process of problem –opportunity identification and validation through human centred approach to design thinking in building solutions as part of engineering projects. • Analyze market types, conduct market estimation, identify customers, create customer persona, develop the skills to create a compelling value proposition and build a Minimum Viable Product. • Explore business models, create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture ideas & solutions built with domain expertise. • Prepare and present an investible pitch deck of their practice venture to attract stakeholders.

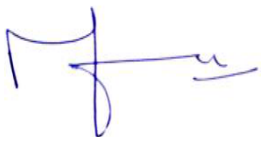
Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze different types of entrepreneurs and their impact on emerging economies through case studies of successful and failed engineering entrepreneurs	An	20%
CO2	Apply concepts related to societal problems, generate and validate ideas, and assess business opportunities by studying emerging markets and their potential	Ap	20%
CO3	Develop prototypes using various methods and tools, understand their importance in the entrepreneurial process, and iterate based on feedback to enhance their designs	C	20%
CO4	Apply the Lean Canvas to develop business models and craft effective pitches that engage investors and customers	Ap	20%
CO5	Analyze the entrepreneurial ecosystem, including its components, financing models, and stakeholder networks through interactive activities such as visits and interactions with startup founders	Ap	20%

MODULE–I: ENTREPRENEURIAL MINDSET	(6+6)
Introduction to Entrepreneurship: Definition – Types of Entrepreneurs – Emerging Economics–Developing and Understanding an Entrepreneurial Mindset– Importance of Technology Entrepreneurship – Benefits to the Society. Case Analysis: Study cases of successful & failed engineering entrepreneurs - Foster Creative Thinking: Engage in a series of Problem-Identification and Problem-Solving tasks.	
MODULE– II: OPPORTUNITIES	(6+6)
ProblemsandOpportunities–IdeasandOpportunities–Identifyingproblemsinsociety– Creation of opportunities – Exploring Market Types – Estimating the Market Size, - Knowing the Customer and Consumer - Customer Segmentation - Identifying niche markets – Customer discovery and validation; Market research techniques, tools for validation of ideas and opportunities. Activity Session: Identify emerging sectors / potential opportunities in existing markets - Customer Interviews:	

Conduct preliminary interviews with potential customers for Opportunity Validation – Analyse feedback to refine the opportunity.
MODULE–III: PROTOTYPING &ITERATION (6+6)
Prototyping – Importance in entrepreneurial process – Types of Prototypes - Different methods – Tools & Techniques.Hands-on sessions on prototyping tools (3D printing, electronics, software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the prototypes.
MODULE– IV: BUSINESS MODELS &PITCHING (6+6)
Business Model and Types - Lean Approach - 9 block Lean Canvas Model - Riskiest assumptions to Business Models – Using Business Model Canvas as a Tool – Pitching Techniques:Importanceofpitching-Typesofpitches-craftingacompellingpitch –pitch presentation skills - using storytelling to gain investor/customer attention. ActivitySession:Developabusinessmodelcanvasfortheprototype;presentandreceive feedback from peers and mentors - Prepare and practice pitching the business ideas- Participate in a Pitching Competition and present to a panel of judges - receive & reflect feedback.
MODULE–V:ENTREPRENEURIAL ECOSYSTEM (6+6)
Understanding the Entrepreneurial Ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors. Financing models–equity, debt, crowd funding, etc, Support from the government and corporate. Navigating Ecosystem Support: Searching & Identifying the Right Ecosystem Partner – Leveraging the Ecosystem - Building the right stakeholder network. Activity Session: Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers; angels; etc), Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or maker space or interact with startup founders).
TOTAL(L:30,P:30) = 60 PERIODS

TEXT BOOKS:
1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, SabyasachiSinha (2020). Entrepreneurship, McGraw Hill, 11th Edition. 2. Ries,E.(2011).The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business.
REFERENCES:
1.Blank, S.G.,&Dorf,B.(2012).The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch. 2. Roy, R.(2017).Indian Entrepreneurship: Theory and Practice New Delhi: Oxford University Press. 3. Osterwalder,A.,&Pigneur, Y.(2010).Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)														
COs / POs & PSOs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1		3							3	3		3		
CO2		3	3				2		3	3		3		
CO3			3		3				3	3		3		
CO4									3	3	3	3		
CO5									3	3	3	3		
CO Weighted average	-	3	3	-	3	-	2	-	3	3	3	3	-	-
1 – Slight, 2 – Moderate, 3 – Substantial														



22MEP07 COMPUTER AIDED ANALYSIS LABORATORY				
	L	T	P	C
	0	0	4	2

PREREQUISITE :

Course Objective:	• To calculate the thermal conductivity of different materials. • To analyze the efficiency of fin. • To acquire knowledge on natural convection from a vertical cylinder and forced convection inside tube. • To identify the value of Stefan - Boltzmann constant and emissivity of a grey body. • To learn the basics of parallel and counter flow heat exchangers and to acquire knowledge on Boiling and Condensation.

	Course Outcomes The Student will be able to	**Cognitive Level**
CO1	Apply FEM methods for solving structural analysis problems using software	Ap
CO2	Analyze static and axi-symmetric elements under given boundary conditions using FEA software	An
CO3	Design a structural component and perform (simulate) modal analysis using FEA software	C/An
CO4	Conduct experiments to evaluate the Harmonic response of a structural system using simulation	An
CO5	Use the tool ANSYS to interpret the simulation results for engineering heat transfer applications	An

LIST OF EXPERIMENTS

1. Analysis of a plate with a circular hole.
2. Analysis of bar (Straight, Stepped, Taper bar).
3. Analysis of beams (Cantilever, Simply supported, Fixed ends).
4. Analysis of truss component.
5. Analysis of an Axi-symmetric component.
6. Modal analysis of a component.
7. Harmonic analysis of a component.
8. Thermal analysis of the components (Fin and Wall).
9. Thermal mixed boundary conditions (Conduction and Convection).
10. Contact analysis experiment of beam
11. Application of plane stress and plane strain conditions
12. Modelling and analysis of tapered structures

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	-	-	-	-	-	-	-	-	-	-	-	1	3
2	-	3	-	-	-	-	-	-	-	-	-	-	1	3
3	-	-	3	-	-	-	-	-	-	-	-	-	1	3
4	-	-	-	3	-	-	-	-	-	-	-	-	1	3
5	-	-	-	-	3	-	-	-	-	-	-	-	1	3
CO (W.A)	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**

22MEP08 MECHATRONICS AND INTERNET OF THINGS LABORATORY					
		L	T	P	C
		0	0	4	2
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes At the end of the course the students will be able to**			
1.0	To introduce the integrated approach of Mechatronics systems	**1.1**	Simulate the electrical, hydraulic and pneumatic system using simulation software		
2.0	To design, model and analyze the electrical, hydraulic and pneumatic systems with mechatronics perspective	**2.1**	Design mechatronics system with Microprocessor, PLC and other Electrical and Electronics control		
3.0	To understand the concepts of computerized data logging system	**3.1**	Build interface between stepper motor and 8051 microcontroller		
4.0	To stimulate interfacing techniques between electromechanical and microcontrollers	**4.1**	Apply the concepts of computerized data logging in mechatronics system		
5.0	To know the design stages of mechatronics system	**5.1**	Analyze the velocity and direction in fluid power circuits with the help of simulation software		

LIST OF EXPERIMENTS

1. Manual Control of single and double acting cylinders with direction control valves using pneumatic trainer kit
2. Simulation of cylinder sequencing using hydraulic control by Cascade method
3. Pneumatic cylinder sequencing using electrical control with Internal Relay
4. Process control using PID controller
5. Control of double acting cylinder using Timer, DPDT relay with solenoid operated valves
6. Speed - Torque characteristics of AC Servo motor
7. Stepper motor interfacing using 8051 microcontroller
8. Process control of Automatic bottle filling system using PLC
9. Computerized data logging system for process control variables like level and temperature
10. Design and testing of fluid power circuits to control direction, velocity and force in double acting cylinder using hydraulic trainer kit
11. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
12. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	3	3	-	3	-	-	2	-	1	3	3
2	3	3	2	3	3	-	3	-	-	2	-	1	3	3
3	3	3	2	3	3	-	3	-	-	2	-	1	3	3
4	3	3	2	3	3	-	3	-	-	2	-	1	3	3
5	3	3	2	3	3	-	3	-	-	2	-	1	3	3
CO (W. A)	**3**	**3**	**2**	**3**	**3**	**-**	**3**	**-**	**-**	**2**	**-**	**1**	**3**	**3**

22MEC20 CAD / CAM / CIM				
	L	T	P	C
	3	0	0	3
PREREQUISITE : Engineering drawing, Material removal process				
Course Objective:	• To understand the CAD implementation, design process models, benefits of CAD, hardware components, and fundamental geometric modeling techniques including wireframe, surface, and solid modeling. • To understand the standards and principles of computer graphics, including various graphic exchange formats, communication standards, coordinate systems, transformations, and clipping techniques. • To explore the functions, benefits, and techniques of Computer-Aided Manufacturing (CAM), including process planning, part classification, coding systems, and engineering approaches like sequential and concurrent engineering. • To understand the principles, components, and programming of CNC machine tools, including various types of machine tools, functions, and part programming techniques. • To learn the components and systems of Computer-Integrated Manufacturing (CIM), including Flexible Manufacturing Systems (FMS), production planning techniques, and shop floor control.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply geometric modeling techniques and CAD implementation concepts to design processes using various modeling approaches and hardware interfaces.	Ap	20 %
CO2	Apply CAD standards and computer graphics principles for effective data exchange, transformations, and visualization in engineering design.	Ap	20 %
CO3	Analyze and apply computer-aided manufacturing and computer-integrated manufacturing techniques, including process planning, coding systems, and production planning, to optimize product development, resource utilization, and shop floor control.	An	40 %
CO4	Utilize CNC machine tools and programming techniques to enhance precision manufacturing and automation in engineering applications.	Ap	20 %
CO5	Engage in independent study as a member of a team or individual and make effective oral presentation on CAM & CIM systems.	Ap	Internal Assessment

UNIT I : GEOMETRIC MODELLING TECHNIQUES	**(9)**
CAD implementation - design Process - Shigley, Pahl and Beitz, Ohsuga, Earle model - benefits of CAD - hardware - input and output devices - display devices - LCD, LED - geometric modeling - basics of wire frame, surface, solid modeling	
UNIT II : CAD STNADARDS & PRINCIPLES OF COMPUTER GRAPHICS	**(9)**
Types of standards-Graphics and Exchange standards-IGES-DXF-Standard for exchange of product model data Communication standards LAN, WAN - transformation in graphics - coordinate system used in graphics	

and windowing - viewport - 2D Transformation - homogeneous transformation - combination transformation - clipping - 3D transformation	
UNIT III : COMPUTED AIDED MANUFACTURING	**(9)**
Function of CAM - benefits of CAM - Group Technology - Part families - Production flow analysis - Parts classification and coding - OPITZ, MI CLASS and DCLASS coding systems - computed aided process planning - retrieval type CAPP, generative CAPP - product development cycle - sequential engineering - concurrent engineering	
UNIT IV : CNC MACHINE TOOLS	**(9)**
Principle of numerical control - component of NC system - NC procedure - types of CNC machine tools - programming of CNC machine tools - preparatory functions - miscellaneous functions - part programming - types - turning and machining center	
UNIT V : COMPUTER INTEGRATED MANUFACTURING AND PRODUCTION PLANNING	**(9)**
Flexible Manufacturing System (FMS)-Components - Manufacturing systems-Material handling systems - Tool handling - Layouts of FMS - development of CIM - material requirement planning - capacity requirement planning - manufacturing resource planning - just in time - shop floor control.	
TOTAL (L:45): 45 PERIODS	
TEXT BOOKS : 1. Ibrahim Zeid and Sivasubramanian, R, "CAD/CAM Theory and Practice", Tata McGraw Hill Publications, New Delhi, 2009 2. Radhakrishan.P, Subramanyan.S, Raju.V, "CAD/CAM/CIM", 4th ed., New Age International Publishers Ltd., 2018	
REFERENCES: 1. Chris McMohon and Jimmie Browne, "CAD/CAM Principles, Practice and Manufacturing Management", 2nd ed., Pearson Education (Singapore) Pvt. Ltd., 2000 2. David F. Rogers, J. A. Adams, "Mathematical Elements for Computer Graphics", Tata McGraw Hill Publications, 2017 3. Donald Hearn and M. Pauline Baker, "Computer Graphics" Eastern Economy Edition, 2007 4. Groover, M. P. and Zimmers, E. W., "CAD/ CAM", Dorling Kingsley, 2008 5. Mikell P. Groover and Zimmers.W, "CAD/CAM - Computer Aided and Manufacturing", Pearson India, 2008	

Mapping of COs with POs / PSOs														
Cos	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												3	
2	3												3	
3		3											3	
4					3								3	
5	3								3	3			3	
CO (W.A)	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**

22GEA01- UNIVERSAL HUMAN VALUES (Common To All Branches)				
	L	T	P	C
	2	0	0	2
PREREQUISITE : NIL				

Course Objective:	• To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity. • To facilitate the development of a holistic perspective among students towards life and profession. • To highlight plausible implications of holistic understanding in terms of ethical human conduct. • To understand the nature and existence. • To understand human contact and holistic way of living

Course Outcomes The Student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Evaluate the significance of value inputs in formal education and start applying them in their life and profession.	E	Internal Assessment
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual.	Ap	
CO3	Analyze the value of harmonious relationship based on trust and respect in their life and profession.	An	
CO4	Examine the role of a human being in ensuring harmony in society and nature.	Ap	
CO5	Apply the understanding of ethical conduct to formulate the strategy for ethicallife and profession.	Ap	

UNIT I - INTRODUCTION-BASIC HUMAN ASPIRATION, ITS FULFILLMENT THROUGH ALL- ENCOMPASSING RESOLUTION	**(6)**
The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution as the activities of the Self, Self being central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution	
UNIT II - RIGHT UNDERSTANDING (KNOWING)- KNOWER, KNOWN & THE PROCESS	**(6)**
The domain of right understanding starting from understanding the human being (the knower, the experiencer and the doer) and extending up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).	
UNIT III - UNDERSTANDING HUMAN BEING	**(6)**
Understanding the human being comprehensively as the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Basis for harmony/contradiction in the self	

UNIT IV - UNDERSTANDING NATURE AND EXISTENCE	(6)
A comprehensive understanding (knowledge) about the existence, Nature being included; the need and process of inner evolution (through self-exploration, self- awareness and self-evaluation), particularly	
awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).	
UNIT V - UNDERSTANDING HUMAN CONDUCT, ALL-ENCOMPASSING RESOLUTION AND HOLISTIC WAY OF LIVING	**(6)**
Understanding Human Conduct, different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All- encompassing Resolution covering all four dimensions of human endeavor viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from Self to Nature and entire Existence	
TOTAL (L:30) : 30 PERIODS	

TEXT BOOK:

1. R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi

REFERENCES:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins,USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers
8. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists &Engineers, Oxford University Press
9. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
10. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co.,Lucknow. Reprinted 2008.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1						2	2	3	2	2		3		
2						2	2	3	2	2		3		
3						2	2	3	2	2		3		
4						2	2	3	2	2		3		
5						2	2	3	2	2		3		
CO (W.A)						**2**	**2**	**3**	**2**	**2**		**3**		

22MEP09 CAD / CAM LABORATORY

L	T	P	C
0	0	4	2

PREREQUISITE: Nil

Course Objectives:

- To gain practical experience in handling 2D drafting and 3D modeling software
- To gain practical knowledge on assembly of 3D components in a modeling software
- To know the application of various machine tools like CNC lathe, CNC Vertical Machining Centre
- To study the features of CNC Machine Tool and modern control systems
- Learn and apply relevant G-codes and M-codes for threading operations

Course Outcomes The student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Construct Three Dimensional CAD model of the machine component with given specifications	Ap	20 %
CO2	Develop Three Dimensional assembly model from the generated part models	Ap	20 %
CO3	Make use of Manual Part Programming to create the prismatic component using CNC Machining Centre	An	20 %
CO4	Apply manual part programming techniques to perform cylindrical turning, thread cutting, and milling operations using canned cycles on CNC turning and milling centre	Ap	40 %
CO5	Engage in an independent study focusing on modeling various Mechanical components	C	Internal Assessment

LIST OF EXPERIMENTS

1. 3D Modelling

Creation of 3D assembly model of following machine elements using 3D Modeling software

1. Flange Coupling
2. Universal Joint
3. Stuffing box
4. Crosshead
5. Lathe Tailstock
6.Machine Vice

2. Manual Part Programming.

(i) Part Programming - CNC Machining Centre

7. Manual part programming for CNC Milling machine using linear interpolation.
8. Manual part programming for CNC Milling machine using Circular interpolation.
9. Manual part programming for CNC Milling machine using Canned Cycle Operations

(ii) Part Programming - CNC Turning Centre

10. Manual part programming for CNC turning centre for step turning using linear interpolation
11. Manual part programming for CNC turning centre for step turning using circular interpolation
12. Manual part programming for CNC turning centre for Thread cutting

TOTAL (P:60): 60 PERIODS

Mapping of COs with POs / PSOs														
Cos	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3		3		3					3			3	
2			3		3					3			3	
3			3		3					3			3	
4				3	3					3			3	
5				3	3				3	3		3		
CO (W.A)	**3**	**-**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**3**	**-**

22GED02 INTERNSHIP / INDUSTRIAL TRAINING				
	L	T	P	C
	0	0	0	2

PREREQUISITE: Nil

Course Objective:	• Integrate theoretical knowledge acquired in academic coursework into practical applications within industrial or professional environments. • Develop a comprehensive understanding of emerging technologies and advancements in the industry.

Course Outcomes The student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Critically analyze industrial challenges by applying theoretical concepts to real-world problems, demonstrating an ability to diagnose and address technical issues.	An	20%
CO2	Evaluate and assess workplace dynamics, industry trends, and process efficiencies to make data-driven and strategic decisions for improvement.	E	20%
CO3	Develop and propose innovative engineering solutions by integrating advanced technologies and best industry practices to enhance productivity and sustainability.	C	20%
CO4	Design and execute research-based projects and technical solutions by collaborating in multidisciplinary teams, ensuring effective problem-solving and implementation.	C	20%
CO5	Synthesize and communicate key learnings from industry exposure to enhance leadership, professional ethics, technical writing, and project management skills.	C	20%

DESCRIPTION

Every student is required to complete 4 weeks of internship (with about 28days), during the Summer/Winter semester breaks. The Internships are evaluated through Internship Reports. The internships can be taken up in an industry, a government organization, a research organization or an academic institution, either in the country or outside the country, that include activities like:

- Successful completion of Internships/ Value Added Programs / Training
- Programs/ workshops organized by academic Institutions and Industries
- Soft skill training by the Placement Cell of the college
- Active association with incubation/ innovation /entrepreneurship cell of the institute;
- Participation in Inter-Institute innovation related competitions like Hackathons
- Working for consultancy/ research project within the institutes
- Participation in activities of Institute's Innovation Council, IPR cell, Leadership
- Talks, Idea/ Design/ Innovation contests
- Internship with industry/ NGO"s/ Government organizations/ Micro/ Small/ Medium enterprises
- Development of a new product/ business plan/ registration of a start-up

Mapping of COs with POs / PSOs														
Cos	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1									2		2		3	3
2	3								2	3	3	3	3	3
3	3									2		2	3	3
4			2			3						3	3	3
5	2												3	3
CO (W.A)	**2.7**		**2**			**3**			**2**	**2.5**	**2.3**	**2.7**	**3**	**3**

22MED01 PROJECT WORK				
	L	T	P	C
	0	0	20	10
PREREQUISITE: Nil				

Course Objective:	• Utilize basic science and engineering principles to address real-world challenges, either individually or as part of a team. • Develop teamwork, project management, and technical writing abilities to effectively achieve project goals • Gain expertise in experimental and numerical data collection, along with the use of analytical tools for interpretation and decision-making. • Conduct literature reviews to identify specific problems and devise systematic methodologies for successful resolution. • Foster creativity and innovation in solving theoretical and experimental engineering problems, particularly in mechanical engineering applications.

Course Outcomes The student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze real-world engineering challenges by integrating fundamental scientific and mechanical engineering principles and propose optimal solutions through individual and team-based approaches.	An	20%
CO2	Evaluate project goals by effectively collaborating in teams, managing resources, and demonstrating proficiency in technical writing to communicate engineering solutions professionally.	E	20%
CO3	Interpret and synthesize experimental and numerical data using advanced analytical tools, drawing meaningful conclusions to support engineering decision-making.	E	20%
CO4	Formulate systematic methodologies through critical literature review to identify engineering problems and design structured solutions based on empirical and theoretical insights.	C	20%
CO5	Design and develop innovate mechanical engineering solutions by applying creativity, experimental techniques, and problem-solving strategies to tackle theoretical and practical challenges.	C	20%

DESCRIPTION

Project work may be allotted to a single student or to a group of students not exceeding 3 per group. The title of project work is approved by head of the department under the guidance of a faculty member and student(s) shall prepare a comprehensive project report after completing the work to the satisfaction of the guide.

The Head of the department shall constitute a review committee for project work. There shall be three reviews during the semester by the committee to review the progress. Student(s) shall make presentation on the progress made by him / her / them before the committee and evaluation is done as per Rules and Regulations.

TOTAL (P: 300) = 300 PERIODS

Mapping of COs with POs / PSOs														
Cos	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3			3					3			3		2
2		3		3					3			3		3
3		2					3	3	3					
4	3	3	3	3		3	2		3					
5									3	3	3	3	3	3
CO (W.A)	**3**	**2.7**	**3**	**3**		**3**	**2.5**	**3**	**3**	**3**	**3**	**3**	**3**	**2.7**

22MEX01 COMPOSITE MATERIALS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To introduce the fundamentals and manufacturing aspects of composite materials • To acquire knowledge on Lamina Constitutive Equations and analysis of laminated flat plates • To introduce the thermal analysis of various laminates • To understand various failure criterions related to laminated plates • To gain knowledge about thermal analysis of composites

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the rule of mixtures to predict the properties of composite materials.	Ap	20%
CO2	Analyze the mechanical properties and applications of various composites.	An	20%
CO3	Develop the role of interfaces in composite manufacturing.	Ap	20%
CO4	Make use of strength analysis techniques to predict the failure of laminated plates	Ap	20%
CO5	Evaluate the Coefficient of Thermal Expansion of composites by selecting a thermal analysis	An	20%

UNIT I- INTRODUCTION TO COMPOSITE MATERIALS	**(9)**
Definition - matrix materials - polymers - metals - ceramics - reinforcements - particles, whiskers, inorganic fibers, metal filaments - ceramic fibers - fiber fabrication - natural composite wood, jute - advantages and drawbacks of composites over monolithic materials - mechanical properties and applications of composites, particulate reinforced composite materials, dispersion strengthened composite, fiber reinforced composites - rule of mixtures - characteristics of fiber reinforced composites, manufacturing fiber and composite .	
UNIT II - MANUFACTURING OF COMPOSITES	**(9)**
Manufacturing of Polymer Matrix Composites (PMCs) - handlay up, spray technique, filament winding, pultrusion, Resin Transfer Moulding (RTM) - bag moulding, injection moulding, Sandwich Mould Composites (SMC) - manufacturing of Metal Matrix Composites (MMCs) - solid state, liquid state, vapour state processing, manufacturing of Ceramic Matrix Composites (CMCs) - hot pressing - reaction bonding process - infiltration technique, direct oxidation – interfaces.	
UNIT III - INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS	**(9)**
Lamina Constitutive Equations: Lamina Assumptions - macroscopic viewpoint - generalized Hooke's Law - reduction to Homogeneous Orthotropic Lamina - Isotropic limit case, Orthotropic Stiffness matrix (Qij), definition of stress and moment resultants - strain displacement relations - basic assumptions of laminated anisotropic plates - laminate constitutive equations - coupling - Interactions, balanced laminates, symmetric laminates, angle ply laminates, cross ply laminates - laminate structural moduli - evaluation of lamina properties from laminate tests - quasi Isotropic laminates - determination of lamina stresses within Laminates.	

UNIT IV - LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES	(9)
Introduction - maximum stress and strain criteria - Von-Misses yield criterion for isotropic materials - generalized Hill'scriterion for anisotropic materials - Tsai-Hill's failure criterion for composites - tensor polynomial (Tsai-Wu) - failure criterion - prediction of laminate failure equilibrium equations of motion - energy formulations - static bending analysis -buckling analysis - free vibrations - natural frequencies .	
UNIT V – THERMAL ANALYSIS	**(9)**
Assumption of constant Coefficient of Thermal Expansion (C.T.E.) - modification of Hooke's law - modification of laminate constitutive equations - orthotropic lamina C.T.E's - C.T.E's for special laminate configurations - unidirectional, off-axis,symmetric balanced laminates, zero C.T.E laminates, thermally quasi-isotropic laminates	

TEXT BOOKS

1.Malik, P.K., "Fiber Reinforced Composite: Materials, Manufacturing and Design", 3rd ed., CRC Press, 2007

2. Ronald F. Gibson, "Principles of Composite Material Mechanics ", 2nd ed., CRC Press, 2007

REFERENCES:

1.Michael Hyer and Scott R White, " Stress Analysis of Fibre Reinforced Composite Materials", International edition, McGraw-Hill Education, 1998

2.Issac M. Daniel and Oril Shai, "Engineering Mechanics of Composite Materials", 2nd ed., Oxford UniversityPress, 2005

3.Bhagwan D. Agarwal, Lawrence J. Broutman and K. Chandrashekhara, "Analysis and Performance of Fiber Composites", 3rd ed., Wiley Publications, 2012

4.Mallick.P.K and Newman.S, "Composite Materials Technology: Processes and Properties", Hanser Gardner Publications,1991

5.Deborah D. L. Chung, " Composite Materials: Science and Applications", 2nd ed., Springer, 2012

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	2					2		1		2	1	2
2	2	2	2	1		2	1	2		1		2	1	2
3	2	2	2	1	1	2	1	2	1	1		2	1	2
4	2	2	2	1				2		1		2	1	2
5	2	2	2	1	1		1	2	1	1		2	1	2
CO (W.A)	2	2	2	1	1	2	1	2	1	1		2	1	2

22MEX02 TOOL DESIGN				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To teach students the fundamentals of work holding devices. • To enable the students design tools, dies, jigs and fixtures. • To teach students to analyze and optimize an existing jigs. • To gain knowledge about the design of various fixtures. • To expose students to design of dies for press work and forging

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply general considerations in the design of jigs and fixtures and their methods of construction.	Ap	20%
CO2	Apply principles of mechanical, pneumatic, and hydraulic clamping.	Ap	20%
CO3	Comprehend the metal cutting process and selection of appropriate tool materials	Ap	20%
CO4	Analyze the required specifications of a press for required operations	An	20%
CO5	Identify the importance of forging die design, including flow lines, parting lines, and materials for die blocks.	An	20%

UNIT I- DESIGN OF CUTTING TOOLS	**(9)**
Metal cutting process - selection of tool materials - design of single point and multipoint cutting tool - form tools, drills, milling cutters, broaches and chip breakers - problems on design of single point cutting tools only .	
UNIT II - LOCATING AND CLAMPING METHODS	**(9)**
Basic principles of location - locating methods and devices - principles of clamping - mechanical, pneumatic and hydraulic actuation - clamping force analysis - design problems.	
UNIT III - DESIGN OF JIGS	**(9)**
Types of drill jigs - general considerations in the design of drill jigs - drill bushings - types, methods of construction- simple designs of plate, channel, boxes, post, angle plate, turnovers and pot jigs.	
UNIT IV - DESIGN OF FIXTURES	**(9)**
Design principles - types of fixtures - fixtures for machine tools: lathe, milling, boring, broaching and grinding - assembly fixtures - inspection and welding fixtures.	
UNIT V – DESIGN OF DIES	**(9)**
Press tools - Fundamentals of die-cutting operations - Cutting action in punch and die operations - Die clearance - Blanking and Piercing Die construction - Pilots - Strippers and Pressure Pads - Press work materials - Strip layout - Design of simple progressive and compound die sets - Forging Die - Flow lines, parting lines, open and close die forging; Materials for die block.	

TEXT BOOKS

1. Donaldson, Lecain and Goold, "Tool Design", 3rd ed., Tata McGraw Hill, 2012
2. John G. Nee, "Tool Design", 6th ed., Society of Manufacturing Engineers, 2010

REFERENCES:

1. Venkataraman. K, "Design of Jigs Fixtures and Press Tools", Tata McGraw Hill, New Delhi, 2005
2. Joshi. P.H, "Jigs and Fixtures", 2nd ed., Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2004
3. Elanchezhian. C, "Design of Jigs Fixtures and Press Tools", EswarPress,Chennai, 2004
4. Hoffman, "Jigs and Fixture Design", Thomson Delmar Learning, Singapore, 2004
5. VukotaBoljanovicPaquin .J. R, "Die Design Fundamentals", 3rd ed., Industrial Press, 2005

Mapping of COs with POs / PSOs														
Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	2	2	2	1		1	1	1		2	2	
2	2	2	2	2	2	1		1	1	1		2	2	
3	2	2	2	2	2	1		1	1	1		2	2	
4	2	2	2	2	2								2	
5	2	2	2	2	2		2						2	
CO (W.A)	2	2	2	2	2	1	2	1	1	1		2	2	

22MEX03 NON TRADITIONAL MACHINING PROCESSES					
		L	T	P	C
		3	0	0	3
PREREQUISITE :					
Course Objective:	• To classify non-traditional machining processes and describe mechanical energy based non-traditional machining processes. • To differentiate chemical and electro chemical energy-based processes. • To describe thermo-electric energy-based processes • To explain nano finishing processes. • To introduce hybrid non-traditional machining processes and differentiate hybrid non-traditional machining processes.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Formulate different types of non-traditional machining processes and evaluate mechanical energy based non-traditional machining processes.	AP	30
CO2	Investigate the mechanisms and characteristics of mechanical energy-based processes, such as Ultrasonic Machining and Water Jet Machining.	AN	30
CO3	Compare the advantages and limitations of USM and WJM against other non-traditional methods, such as EDM or Laser Machining, with respect to specific manufacturing scenarios.	E	20
CO4	Develop criteria for selecting nano finishing processes by integrating knowledge of material properties, desired surface finish, and production volume.	AN / C	20
CO5	Analyse hybrid non-traditional machining processes and differentiate non- traditional machining processes.	AN / C	Internal Assessment

UNIT I - INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES	**(9)**
Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.	
UNIT II - CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES	**(9)**
Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring.	
UNIT III - THERMO-ELECTRIC ENERGY BASED PROCESSES	**(9)**
Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining.	
UNIT IV - NANO FINISHING PROCESSES	**(9)**
Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magneto rheological finishing, Magneto rheological abrasive flow finishing.	
UNIT V – HYBRID NON-TRADITIONAL MACHINING PROCESSES	**(9)**
Introduction - Various hybrid non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different non-traditional machining processes.	

TEXT BOOKS:

3. Adit han. M., "Unconventional Machining Processes", Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458
4. Ana nd Pandey, "Modern Machining Processes", Ane Books Pvt. Ltd., New Delhi, India, 2019.

REFERENCES:

6. Benedict, G.F., "Non-traditional Manufacturing Processes", Marcel Dekker Inc., New York 1987. ISBN-13: 978-0824773526.
7. Carl Sommer, "Non-Traditional Machining Handbook", Advance Publishing., United States, 2000, ISBN-13: 978-1575373256.
8. Golam Kibria, Bhattacharyya B. and Paulo Davim J., "Non-traditional Micromachining Processes: Fundamentals and Applications", Springer International Publishing., Switzerland, 2017, ISBN:978-3-319-52008-7.
9. Jagadeesha T., "Non-Traditional Machining Processes", I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017, ISBN-13: 978-9385909122.
10. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., "Hybrid Machining Processes: Perspectives on Machining and Finishing", 1st edition, Springer International Publishing., Switzerland, 2016, ISBN- 13: 978-3319259208.

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3		1		1		1		1	1		1	2	2
2	3		1		1		1		1	1		1	2	2
3	3		1		1		1		1	1		1	2	2
4	3		2		1		1		1	1		1	2	2
5	3		3		3		1		1	1		1	2	2
CO (W.A)	**3**		**1.6**		**1.4**		**1**		**1**	**1**		**1**	**2**	**2**

22MEX04 - DESIGN CONCEPTS IN ENGINEERING				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To study the various design requirements and get acquainted with the processes involved in product development. • To study the design processes to develop a successful product. • To learn scientific approaches to provide design solutions. • Designing solution through relate the human needs and provide a solution. • To study the principles of material selection, costing and manufacturing in design.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze the various design requirements and get acquainted with the processes involved in product development.	An	20%
CO2	Apply the design processes to develop a successful product.	Ap	20%
CO3	Apply scientific approaches to provide design solutions.	Ap	20%
CO4	Design solution through relate the human needs and provide a solution.	Cr	20%
CO5	Apply the principles of material selection, costing and manufacturing in design.	Ap	20%

UNIT I- DESIGN TERMINOLOGY	**(9)**
Definition-various methods and types of design-importance of product design-various design projects-morphology of design-requirements of a good design-design guidelines-design catalogs-codes and standards-design product and process cycles-bench marking.	
UNIT II - INTRODUCTION TO DESIGN PROCESSES	**(9)**
Basic modules in design process-scientific method and design method- identification, importance of problem - structured problem, real life problem- information gathering -customer requirements- Quality Function Deployment (QFD)- Detail design and engineering drawings-prototyping and testing-Design for X.	
UNIT III - CREATIVITY IN DESIGN	**(9)**
Creativity and problem solving-vertical and lateral thinking-invention, innovation, diffusion-psychological view, mental blocks- Creativity methods-brainstorming, mind map, concept map-Theory of innovative problem solving (TRIZ) –Axiomatic design.	
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 Manufacture (DFM)-Design for Assembly (DFA).	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Dieter. G. N., Linda C. Schmidt, "Engineering Design", McGraw Hill, 2013.
2. Horenstein, M. N., Design Concepts for Engineers, Prentice Hall, 2010.

REFERENCES:

1. Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and Peter A. Sandborn, "Integrated Product and Process Design and Development", CRC Press, 2009.
2. Sumesh Krishnan and MukulSukla, Concepts in Engineering Design, Notion Press, 2016.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	3		1									3	
2	3		1										2	
3	2		3	1									2	
4		2	3		1								1	
5										1	2	2	1	
CO (W.A)	**2.3**	**2.5**	**2.3**	**2.0**	**1.0**					**1.0**	**2.0**	**2.0**	**1.8**	

22MEX05 DESIGN OF TRANSMISSION SYSTEMS				
	L	T	P	C
	3	1	0	3

PREREQUISITE : 22MEC14

Course Objective:	• To understand and apply the fundamental design principles • To analyze complex gear drive problems • To design and draft gearbox layouts • To evaluate mechanical power transmission systems • To implement standards and regulations

Course Outcomes The Student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Apply fundamental design principles to calculate the parameters for various gear drives, belt drives, chain drives, clutches, and brakes.	Ap	20%
CO2	Analyze complex problems related to spur, helical, bevel and worm gear drives by considering factors like materials, loads, stresses and efficiency.	An	40%
CO3	Design the multistage gear box and draft the kinematic arrangement and ray diagram.	An/E	20%
CO4	Evaluate various mechanical power transmission systems, including belts, chains, gears, gearboxes, clutches, and brakes by using engineering principles and manufacturer data	E	20%
CO5	Implement standards, codes, and regulations in transmission system design.	U/Ap	Internal Assessment

UNIT I - DESIGN OF FLEXIBLE POWER TRANSMISSION SYSTEMS	**(9+3)**
Design flat belt and V belt drive based on manufacturer's catalogue- design of transmission chains and sprockets. Introduction to timing belt and silent chain.	
UNIT II - SPUR GEARS AND HELICAL GEARS	**(9+3)**
Gear materials- design of straight tooth spur gear & Parallel axis helical gears based on speed ratio, number of teeth, Fatigue strength, Factor of safety, Strength and wear considerations. Forces on teeth-stresses on teeth-gear failures-Helical gear-Module-Normal and transverse, Equivalent number of teeth.	
UNIT III - BEVEL AND WORM GEARS	**(9+3)**
Straight bevel gear: Gear materials - tooth terminology - tooth forces and stresses – Design of straight bevel gears based on speed ratio, number of teeth, Fatigue strength, Factor of safety, Strength and wear considerations – Worm gear: Gear materials –tooth terminology, Thermal capacity, Forces and stresses, efficiency, design of worm gear drive by checking surface and bending stresses.	
UNIT IV - DESIGN OF GEAR BOXES	**(9+3)**
Gear boxes - speed selection - geometric progression - standard step ratio - ray diagram, kinematic layout - design of multistage multi speed constant mesh gear boxes. Introduction to automobile gear box design.	
UNIT V - MOTION CONTROL: CLUTCHES AND BRAKES	**(9+3)**
Clutches - types - materials - design of single plate, multi plate and cone clutches - brakes - types - friction materials – design of single block brake, simple band brake, and internal expanding brake. Introduction to Design of Disc brake.	
TOTAL (L:45 +T:15) =60 PERIODS	

Sl.No	Practice Titles	Unit
1 2 3	Flat belt and V belt drive Design of straight tooth spur gear Design of straight bevel gears	1 2 3

TEXTBOOKS:

1. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 10th ed., Tata McGraw-Hill, 2015
2. Bhandari V.B, "Design of Machine Elements", 4th ed., Tata McGraw-Hill Book Co, 2017

REFERENCES:

1. Jalaludeen S.Md, "Machine Design (Volume-2)", 4th ed., Anuradha Publications, Chennai, 2012
2. Robert C. Juvinall, Kurt M. Marshek, "Machine Component Design", Wiley India Pvt Ltd., 2016
3. Sharma P. C, Aggarwal D. K., "A Textbook of Machine Design" S K Kataria & Sons-New Delhi, 2013
4. Spotts M. F, Shoup T. E , Hornberger L.E , David O. Kazmer, "Design of Machine Elements", 8th ed., Pearson India, 2006
5. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 200

Mapping of COs with POs / PSOs

Cos	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												3	
2		3											3	
3			3										3	
4			3										3	
5						2		2						
CO (W.A)	**3**	**3**	**3**	**-**	**-**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**-**

22MEX06 - AUTOMOBILE ENGINEERING				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To introduce the types of automobiles, structure and construction details • To acquire knowledge on engine auxiliary system and ignition systems • To know about the engine transmission systems • To learn the working principle of steering, brakes and suspension systems • To introduce the types of emissions in automobiles, emission control techniques and advanced technologies

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the working concept of cooling and lubrication system in internal combustion engines	Ap	30%
CO2	Apply the design concept in clutch, gear box and other transmission systems.	Ap	30%
CO3	Analyze the performance of steering, braking and suspension systems.	An	20%
CO4	Analyze the emission norms and safety systems in automobile.	An	20%
CO5	Seminar presentation in the recent technologies in automobiles	U	Internal Assessment

UNIT I - VEHICLE STRUCTURE AND ENGINE COMPONENTS	(9)
Types of automobiles - vehicle construction and layouts - chassis - frame and body – Vehicle aerodynamics, resistances and moments - components of IC engines- their forms, functions and materials – cooling system - lubrication system.	
UNIT II - ENGINE AUXILIARY SYSTEMS	(9)
Fuel supply system, Simple Carburetor - electronically controlled gasoline injection system for SI engines - Mono point and multi point fuel injection system - electronically controlled diesel injection system - rotary distributor type, CRDI, unit injector system - Ignition system - battery coil ignition system, magneto coil ignition system, electronic coil ignition system (Transistorized coil ignition system, capacitive discharge ignition system) -Turbo charger - super charger - electronic engine management system	
UNIT III - TRANSMISSION SYSTEMS	(9)
Clutch - Types and construction - single plate, multi plate, diaphragm clutch - types of gear boxes - sliding mesh, constant mesh, synchromesh - gear shifting mechanism - overdrive – transfer box- fluid flywheel - torque converter - propeller shaft - slip joint - universal joint - differential - Hotchkiss drive and torque tube drive.	
UNIT IV - STEERING, BRAKES AND SUSPENSION SYSTEMS	(9)

Principle of steering - steering geometry - steering linkages - steering gear box - power steering – Direct adaptive steering - brakes - types and construction - drum brake, disc brake, pneumatic braking system, hydraulic braking system, anti lock braking system (ABS) - types of front and rear axle - suspension system - types and construction - coil spring, leaf spring, stabilizer bars- air suspension -shock absorber	
UNIT V - EMISSION CONTROL, SAFETY SYSTEMS	(9)
Automobile emissions - standards - Control techniques - exhaust gas recirculation - 3 way catalytic converter - Safety standards for automobiles - seat belts - air bags -Electronic Brake Distribution (EBD) - Electronic Stability Program (ESP) - Traction Control System (TCS) - Global Positioning System (GPS) - Collision avoiding system, low tire pressure warning system, driver information system. Blind spot detection and warning.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Babu.A.K and Ajit Pal Singh, "Automobile Engineering", 1st ed., S.Chand Publications, 2014
2. Kirpal Singh, "Automobile Engineering Vol.1 and 2", Standard Publishers, New Delhi, 2021

REFERENCES:

1. William H. Crouse and Donald L Anglin, "Automotive Mechanics", McGraw Hill Education (India) Private Limited, 10th Edition, 2017
2. Rajput.R.K, "A textbook Automobile Engineering" Laxmi Publishers, 3rd ed., New Delhi, 2018
3. Ramakrishna K, "Automobile Engineering", Prentice Hall India Learning Private Limited, 2012
4. Srinivasan.S, "Automotive Mechanics", 2nd ed., McGraw Hill Education (India) Private Limited, 2017
5. Jain K.K and Asthana.R.B, "Automobile Engineering", 1st ed., McGraw Hill Education Pvt. Ltd., 2017

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2												1	
2	2												1	
3		1												
4		1												
5										1				
CO (W.A)	2	1								1			1	

22MEX07 INDUSTRIAL LAYOUT DESIGN AND SAFETY				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				
Course Objective:	• To introduce the industrial facility layout design principles, process and material flow analysis and product and equipment analysis. • To learn the facilities layout design algorithms and selecting appropriate software. • To study the facilities layout problem modelling tools and algorithms for production, warehouse, and material handling. • To learn the safety planning and management principles in industries. • To learn the various safety management approaches in industries.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze industrial facility layout design principles, process and material flow analysis and product and equipment analysis.	An	20%
CO2	Apply the engineering design problem approach to analyze products, select equipment and analyze space requirements and availability.	Ap	20%
CO3	Upgrade safety developmental programs by implementing safety procedures, arrangements, and performance measures.	Ap	20%
CO4	Evaluate safety performance by understanding accidents, occupational health, and industrial hygiene.	An	20%
CO5	Illustrate the various safety management approaches in industries.	An	20%

UNIT I- INTRODUCTION	**(9)**
Industrial Facility Layout: Definition, Types of Layout Problems, Engineering Design Problem Approach – Product Analysis, Equipment Selection, Personnel Requirement Analysis, Space Requirement and Availability – Process and Material Flow Analysis, Data Requirement for Layout Decisions, Tools for Presenting Layout Designs.	
UNIT II - FACILITIES LAYOUT DESIGN & ALGORITHMS	**(9)**
.Traditional Approaches to Facility Layout, Systematic Layout Planning, Special Considerations in Office Layout, Engineering Design Problem Approach, Code Compliance, OSHA, ADA Regulations, and Other Considerations in Facility Design – Algorithms for the Layout Problem, Construction Algorithms, Improvement Algorithms, Hybrid Algorithms, Layout Software (CRAFT, BLOCPLAN, PFAST, Layout-iQ, VIP-PLANOPT, Factory CAD, Factory FLOW, Plant Simulation)	
UNIT III - FACILITIES LAYOUT PROBLEM MODELS & ALGORITHMS	**(9)**
Models for the Layout Problem, Generic Modeling Tools, Models for the Single-Row Layout Problem, Models for the Multi row Layout Problem with Departments of Equal and Unequal Area – Material Handling, Principles, Types, Models for Material-Handling System Design – Storage and Warehousing, Warehouse Functions, Warehouse Design and Operation.	
UNIT IV - SAFETY PLANNING & MANAGEMENT	**(9)**

Introduction: Elements of Safety Programming, Safety Management. Upgrading Safety Developmental Programs: Safety Procedures, Arrangements and Performance Measures, Education, Training and Development in Safety. Safety Performance: An Overview of an Accident, Occupational Health and Industrial Hygiene. Understanding the Risks: Prevention of Accidents Involving Hazardous Substances. Indian Factories Act 1948 for Health and Safety. .

UNIT V – APPROACHES IN SAFETY MANAGEMENT **(9)**

Safeguarding against Common Potential Hazards: Trips, Slips and Falls, Preventing Electrocution, Static Electricity, Hazardous Energy Control. Specific Hazard Control Measures: Forklift Hazard Control, Tractor Hazard Control. Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers.

TEXT BOOKS

1.Sunderesh S. Heragu, “Facilities Design”, 3rd Edition, CRC Press Taylor & Francis Group, 2008.

2. L. M. Deshmukh, “Industrial Safety Management: Hazard Identification and Risk Control”, Tata McGraw-Hill Publishing
Co. Ltd., 2005.

REFERENCES:

1.EricTeicholz, “Facility Design and Management Handbook”, Tata McGraw-Hill Publishing Co. Ltd., 2001.

2.James A. Tompkins, John A. White, Yavuz A. Bozer, and J. M. A. Tanchoco, “Facilities Planning”, 4th Edition, John Wiley &Sons, 2010.

3.Matthew P. Stevens and Fred E. Meyers, “Manufacturing Facilities Design and Material Handling”, 5th Edition, Purdue University Press, 2013.

4.CharlesD.Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.

5.JMaiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.

6.Industrial Hazard and Safety Handbook: (Revised impressionby Ralph W King and John Magid | 24 September 2013

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	*2*	2	*2*		3		3	2	1		3	2	2
2	1	*2*	2	*2*		3		3	2	1	1	3	2	2
3						3		3					2	2
4		*2*		*2*									2	2
5						3		3					2	2
CO (W.A)	1	*2*	2	*2*		3		3	2	1	1	3	2	2

22MEX08 – MODERN ROBOTICS				
	L	T	P	C
	3	0	0	3

PREREQUISITE :

Course Objective:	• To introduce definition, history of robotics and robot anatomy. • To learn the simulation of robot kinematics • To study the grasping and manipulation of robots. • To study about mobile robot and manipulation. • To study the applications of industrial, service, domestic robots.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the definition, history of robotics and robot anatomy.	Ap	20%
CO2	Design and Develop the simulation of robot kinematics	An	20%
CO3	Optimize ethical knowledge in the grasping and manipulation of robots.	An	40%
CO4	Establish real time working about mobile robot and manipulation.	Ap	20%
CO5	Manipulate the applications of industrial, service, domestic robots.	An/ Cr	Internal Assessment

UNIT I - INTRODUCTION	(9)
Robot: Definition, History of Robotics, Robot Anatomy, Co-ordinate systems, types and classification, Configuration space and degrees of freedom of rigid bodies and robots, Configuration space topology and representation; configuration and velocity constraints; task space and workspace, Rigid-body motions, rotation matrices, angular velocities, and exponential coordinates of rotation, Homogeneous transformation matrices.	
UNIT II - SIMULATION OF ROBOT KINEMATICS	(9)
Robot kinematics, Forward and inverse kinematics (two three four degrees of freedom), Forward and inverse kinematics of velocity, Homogeneous transformation matrices, translation and rotation matrices Dennavit and Hartenberg (D-H) transformation, Dynamics of Open Chains, Trajectory Generation, motion planning, robot control: First- and second-order linear error dynamics, stability of a feedback control system. Sensors- Infrared, Temperature, Proximity, Ultrasonic, Gyroscope, Hall effect and Light sensor.	
UNIT III - GRASPING AND MANIPULATION OF ROBOTS	(9)
Kinematics of contact, contact types (rolling, sliding, and breaking), graphical methods for representing kinematic constraints in the plane, and form-closure grasping, Coulomb friction, friction cones, graphical methods for representing forces and torques in the plane, End effectors, grippers, types of gripper, gripper force analysis, and examples of manipulation and grasping.	
UNIT IV - MOBILE ROBOTS	(9)

Mobile robot, Wheeled Mobile Robots: Kinematic models of omnidirectional and non-holonomic wheeled mobile robots, Controllability, motion planning, feedback control of non-holonomic wheeled mobile robots; odometry for wheeled mobile robots; and mobile manipulation. Reference Trajectory generation, feed forward control. Mobile Robots applications and case studies on aerospace, medical, chemical industry, UAV's & UGV's triage and surveillance.

UNIT V - APPLICATIONS OF ROBOTS	(9)

Application of robotic: industrial robots, Service robots, domestic and house hold robots, Medical robots, military robots, agricultural robots, space robots, Aerial robotics Role of robots in inspection, assembly, material handling, underwater, space and healthcare. Case studies on mobile manipulator, transportation and picking areas.

TOTAL (L:45) = 45 PERIODS

TEXT BOOKS:

4. Modern Robotics: Mechanics, Planning, and Control, by Kevin M. Lynch , Frank C. Park , Cambridge University Press; 1st edition (25 May 2017), ISBN-10 : 110715
5. Modern Robotics: Mechanics, Systems and Control, by Julian Evans, Larsen and Keller Education (27 June 2019), ISBN-10 : 1641720751

REFERENCES:

7. Modern Robotics: Designs, Systems and Control, by Jared Kroff, Willford Press (18 June 2019)ISBN-10 : 1682856763
8. Advanced Technologies in Modern Robotic Applications, by ChenguangYang, Hongbin Ma, Mengyin Fu, Springer; Softcover reprint of the original 1st ed. 2016 edition (30 May 2018), ISBN - 10 : 981109263X
9. Modern Robotics: Building Versatile Machines, by Harry Henderson, Facts On File Inc; Illustrated edition (1 August 2006), ISBN-10 : 0816057451
10. Artificial Intelligence for Robotics, by Francis X. Govers, Packt Publishing Limited; Standard Edition (30 August 2018), ISBN-10 : 1788835441
11. Modern Robotics Hardcover by Lauren Barrett (Editor), Murphy & Moore Publishing (1 March 2022), ISBN-10 : 1639873732

Mapping of COs with POs / PSOs

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												2	
2					2									
3			3											
4												3		
5								3						
CO (W.A)	**3**		**3**		**2**			**3**				**3**	**2**	

22MEX11 - AUTOMOTIVE MATERIALS, COMPONENTS, DESIGN AND TESTING				
	L	T	P	C
	2	0	2	3
PREREQUISITE : Nil				

Course Objective:	• To analyze and prioritize functional requirements of engine components while critically assessing suitable materials for optimal performance • To design cylinder and piston components • To design connecting rod and crank shaft • To design of flywheel and valve train • To describe the Engine Testing cycles, Emission measurement technologies

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply knowledge to select suitable materials for various engine components based on their functional requirements.	Ap	20%
CO2	Design the cylinder and piston components considering engineering principles and material properties.	C	30%
CO3	Apply analytical skills to design a connecting rod and crankshaft under different loading conditions.	C	30%
CO4	Design a flywheel and valve train design to meet specified performance criteria.	C	20%
CO5	Demostrate the engine testing procedures and current standards followed in India for engine testing.	U	Internal Assessment

UNIT – I FUNCTIONAL REQUIREMENTS OF ENGINE COMPONENTS AND SUITABLE MATERIALS	(6)
Functional requirements of engine components – Piston, piston pin, cylinder liner, connecting rod, crank shaft, valves, spring, engine block, cylinder head, and flywheel. Suitable materials for engine components.	
UNIT – II DESIGN OF CYLINDER AND PISTON COMPONENTS	(6)
Design of cylinder, cylinder head, piston, piston rings and piston pin	
UNIT – III DESIGN OF CONNECTING ROD AND CRANK SHAFT	(6)
Design of connecting rod – Shank design – small end design – big end design – bolts design. Design of overhang crank shaft under bending and twisting – Crank pin design – Crank web design – Shaft design.	
UNIT – IV DESIGN OF FLYWHEEL AND VALVE TRAIN	(6)
Design of valve – inlet valve – exhaust valve - Valve springs – Camshafts – SOHC & DOHC– tappet – rocker arm. Determination of mass of flywheel for a given coefficient of fluctuation of speed. Design of flywheel - rim - hub – arm.	
UNIT – V ENGINE TESTING	(6)

Engine test cycles – Worldwide harmonized Light-duty vehicles Test Cycles ((WLTC) – World Harmonized Stationary Cycle (WHSC) – World Harmonized Vehicle Cycle (WHVC) – Nonroad Transient Cycle (NRTC) – ISO 8178. Dynamometer - Chassis dynamometer - transient dynamometer. Emission measurement technologies and instruments - NO_X – Smoke – Particulate matter – CO – CO_2 - HC.-Particle counter, Current Standards followed in India for Engine Testing.

TOTAL (L:30 + P:30) = 60 PERIODS

EXPERIMENTS

1. Design and animate Piston Cylinder assembly and motion study using CAD software.
2. Design and simulate Connecting rod and crank shaft
3. Design flywheel and valve
4. Design and simulate Two Cylinder Engine assembly using CAD software.
5. Conduct the engine performance test
6. Conduct the emission test

TEXT BOOKS:

1. Khurmi. R.S. & Gupta. J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001.
2. The Automotive Chassis: Volume 1: Components Design (Mechanical Engineering Series) by Giancarlo Genta and Lorenzo Morello | 24 December 2019

REFERENCES:

1. Hiroshima Yamagata, "The science and technology of materials in automotive engines", Woodhead Publishing Limited, Cambridge, England.
2. Jain.R.K, "Machine Design", Khanna Publishers, New Delhi, 2005
3. Manufacturing Automotive Components from Sustainable Natural Fiber Composites (SpringerBriefs in Materials) by Lobna A. Elseify, Mohamad Midani, et al. | 9 August 2021
4. Mechanical and Materials Engineering of Modern Structure and Component Design (Advanced Structured Materials Book 70) by Andreas Öchsner and Holm Altenbach | 6 June 2015
5. Advanced Technology for Design and Fabrication of Composite Materials and Structures: Applications to the Automotive, Marine, Aerospace and ... Applications of Fracture Mechanics) by George C. Sih, Alberto Carpinteri, et al. | 15 December 2010

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3	3											3	
3	3	3											3	
4	3	3											3	
5							3	3						
CO (W.A)	3	3					3	3					3	

22MEX12 - CONVENTIONAL AND FUTURISTIC VEHICLE TECHNOLOGY				
	L	T	P	C
	3	0	0	3
PREREQUISITE :Nil				

Course Objective:	• To determine the number of stages/plates required • To learn various advanced combustion technologies and its benefits • To learn the methods of using low carbon fuels and its significance • To analyze the advanced engine technologies • To apply advanced principles of drivetrain technology in diverse operational scenarios • To study the application of fuel cell technology in automotives

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply combustion technology principles to analyze and optimize Spark Ignition and Compression Ignition combustion processes.	Ap	20%
CO2	Evaluate and apply low carbon fuel technologies such as Alcohol Fuels, Methane, and Hydrogen for automotive applications.	E	20%
CO3	Apply advanced engine technologies in engine design and performance optimization.	Ap	30%
CO4	Analyze the design and performance challenges of hybrid and pure electric vehicles to propose solutions for efficiency improvements.	An	30%
CO5	Demonstrate the advancements and operational principles of fuel cell technology for automotive applications and their road map to market integration.	U	Internal Assessment

UNIT – I COMBUSTION TECHNOLOGY	(9)
Spark Ignition combustion, Compression Ignition Combustion, Conventional Dual Fuel Combustion, Low Temperature Combustion Concepts– Controlled Auto Ignition, Homogeneous Charge Compression Ignition, Premixed Charge Compression Ignition, Partially Premixed Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition.	
UNIT – II LOW CARBON FUEL TECHNOLOGY	(9)
Alcohol Fuels, Ammonia Fuel and Combustion, Methane Technology, Dimethyl Ether, Hydrogen Fuel Technology, Challenges, and way forward	
UNIT – III ADVANCED ENGINE TECHNOLOGY	(9)
Gasoline Direct Injection, Common Rail Direct Injection, Fixed Geometry Turbocharger, Variable Geometry Turbocharger (VGT), Variable Compression Ratio Turbocharged Engines, Electric Turbochargers, Variable valve timing (VVT), Intelligent Cylinder De-activation, After Treatment Technologies, Electric Exhaust Gas Recirculation, recent Engine Management System architecture	

UNIT – IV ADVANCED DRIVE TRAIN TECHNOLOGY	(9)
Automatic Planetary Gearbox, Torque Converter, Fluid Coupling, Continuously Variable Transmission (CVT), Automated Manual Transmission (AMT), Dual clutch transmission (DCT)/ Direct Shift Gearbox (DSG), Intelligent Manual Transmission (IMT) / Clutch-less Transmission, Limited Slip Differential	
UNIT – V FUEL CELL TECHNOLOGY	(9)
Fuel cells for automotive applications - Technology advances in fuel cell vehicle systems - Onboard hydrogen storage - Liquid hydrogen and compressed hydrogen - Metal hydrides, Fuel cell control system - Alkaline fuel cell - Road map to market.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004
2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines. ISBN 978-3-319-68507-6, SPRINGER

REFERENCES:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003
3. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons, 1998
4. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
5. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2	3	3											3	
3	3												3	
4	3	3											3	
5							3							
CO (W.A)	**3**	**3**					**3**						**3**	

22MEX13 -RENEWABLE POWERED OFF HIGHWAY VEHICLES AND EMISSION CONTROL TECHNOLOGY				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PREREQUISITE :Nil				
Course Objective:	• To study the low and zero carbon fuels suitability and methods of use in off-road vehicles • To learn and understand the green energy production methodologies and its use in off-road vehicle categories • To learn various fuel cell types and its suitability in off-highway vehicles applications • To illustrate the impact of in-cylinder technologies on engine out emissions control • To study the existing after-treatment technologies used in off-highway vehicle applications			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze the suitability and technologies of low and zero carbon fuels for powering off-road vehicles.	An	20%
CO2	Apply solar and hydrogen technologies to develop green energy solutions for off-highway vehicles.	Ap	30%
CO3	Evaluate the design and application of fuel cells for off-highway vehicle power systems.	E	30%
CO4	Analyze the effectiveness of in-cylinder treatment technologies in reducing engine emissions.	An	20%
CO5	Demonstrate the principles and applications of after-treatment technologies in emission control for off-highway vehicles.	U	Internal Assessment

UNIT – I LOW AND ZERO CARBON FUELS POWERED OFF-HIGHWAY VEHICLES	(9)
Ethanol, Methanol, Butanol, Biodiesel, Compressed natural gas, liquefied natural gas, Dimethyl ether, Polyoxymethylene Dimethyl Ether, Ammonia and Hydrogen Fuels suitability, methods, and technologies for powering off-road vehicles.	
UNIT – II GREEN ENERGY POWERED OFF-HIGHWAY VEHICLES	(9)
Solar Technology for Green Electricity, Green Electricity for Hydrogen Production, Hydrogen Smart Grid Technologies, Hydrogen to ICE powered vehicles, Hydrogen to Fuel Cell Powered Vehicles.	
UNIT – III FUEL CELL POWERED OFF-HIGHWAY VEHICLES	(9)
Fuel Cell, Types, Applications, Fuel Cell Requirement, Sizing and Design for Off-Highway applications, Merits and Demerits, Pathway to overcome the limitations. Scope of the fuel cell research on Off-road vehicle applications.	
UNIT – IV IN-CYLINDER TREATMENT TECHNOLOGIES	(9)

Low temperature Combustion Modes - Homogeneous Charge Compression Ignition, Premixed-Charge Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition, Water Injection Technologies.	
UNIT – V AFTER TREATMENT TECHNOLOGIES	(9)
Diesel Oxidation Catalyst, Diesel Particulate Filter, Selective Catalytic Reduction, Ammonia slip / clean up catalyst. CO2 absorption techniques, Waste Heat Recovery and Organic Rankine Cycle.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. John Twidell, and Tony Weir. Renewable Energy Sources – 3rd Edition 2015
2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines.

REFERENCES:

1. Daniel J Holt. Fuel Cell Powered Vehicles: Automotive Technology of the Future. Society of Automotive Engineers, 2001 - Technology & Engineering,
2. W. Addy Majewski, Magdi K. Khair. Diesel Emissions and Their Control.
3. Toward Zero Carbon: The Chicago Central Area DeCarbonization Plan by Adrian Smith and Gordon Gill | 1 June 2011
4. Transportation in a Net Zero World: Transitioning Towards Low Carbon Public Transport (Green Energy and Technology) by Kathryn G. Logan, Astley Hastings, et al. | 7 April 2022
5. The Political Economy of Low Carbon Transformation: Breaking the habits of capitalism (Routledge Studies in Low Carbon Development) by Harold Wilhite | 21 December 2017

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3											3	
2	3												3	
3	3	3											3	
4	3	3											3	
5							3							
CO (W.A)	3	3					3						3	

22MEX14 - VEHICLE HEALTH MONITORING, MAINTENANCE AND SAFETY				
	L	T	P	C
	3	0	0	3

PREREQUISITE :Nil

Course Objective:	• To learn the fundamentals of vehicle maintenance, including diagnostics, service intervals, and international safety standards • To acquire knowledge on vehicle maintenance principles and advanced diagnostic technologies to service powertrain and vehicle systems. • To analyze the stresses acting on the temporary and permanent joints • To apply machine learning techniques to improve electronic fuel injection and engine management systems • To study and understand the simulation of safety concepts

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply knowledge of vehicle maintenance principles and advanced diagnostic technologies to service powertrain and vehicle systems	Ap	40%
CO2	Analyze and implement maintenance strategies for vehicle systems, including powertrain components and vehicle systems	An	20%
CO3	Analyze safety concepts, including active and passive safety systems, collision warning systems, and object detection mechanisms	An	20%
CO4	Apply machine learning techniques to enhance electronic fuel injection and engine management services	Ap	20%
CO5	Implement maintenance practices for ensuring optimal vehicle handling and safety	U/Ap	Internal Assessment

UNIT – I INTRODUCTION	**9**
`Need for maintenance – importance, classification of maintenance work-basic problem diagnosis. maintenance of vehicle systems – power pack, tyres, safety systems. scheduled maintenance services – service intervals – on-board diagnostics, computerized engine analyzer study and practice- obd and scan tools; Importance of advanced diagnostic technologies, Overview of international vehicle safety standards and regulations	
UNIT – II POWERTRAIN MAINTENANCE	**9**
Exhaust emission test of petrol and diesel engine; - Electronic fuel injection and engine management service - fault diagnosis- OBD-III and scan tool, identifying DTC and servicing emission controls, Maintenance of Batteries, Starting System, Charging System and Body Electrical - Application of Machine Learning in Electronic Fuel Injection and Engine Management Service.	
UNIT – III VEHICLE SYSTEM MAINTENANCE	**9**
Clutch- adjustment and service, Maintenance and Service of Hydraulic brake, Bleeding of brakes, Checking ABS and components. Maintenance and Service of McPherson strut, coil spring. tyre wear, measurement of read depth and tyre rotation, Smart tyre wear monitoring and management systems Computerized wheel balancing & wheel alignment, Maintenance and Service of steering linkage, steering column, Rack and pinion steering	

UNIT – IV VEHICLE SAFETY	9
Concepts of vehicle safety -Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, air bags, electronic system for activating air bags, bumper design for safety, Active Safety - ABS, EBD, CSC, Traction control system, Modern electronic features in vehicles like tyre pressure monitoring, Automatic headlamp ON, Rain sensing wipers. Cybersecurity measures for vehicle safety and data protection	
UNIT – V SIMULATION OF SAFETY CONCEPTS	**9**
Active safety: driving safety, conditional safety, perceptibility safety, operating safety passive safety: exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact. Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system Interactions.	
TOTAL 45 PERIODS	

TEXT BOOK:

1. 5th Edition, "Advanced Automotive Fault Diagnosis Automotive Technology: Vehicle Maintenance and Repair" By Tom Denton
2. Safety Management System and Documentation Training Programme Handbook by S. V. Paul ISBN: 9788123923444

REFERENCES:

1. Ed May, "Automotive Mechanics Volume One" and Two, Mc Graw Hill Publications, Tenth edition, 2018
2. Bosch Automotive Handbook, Tenth Edition, 2018
3. Jack Erjavek, "A systems approach to Automotive Technology", Cengage Learning, 5th Edition, 2012
4. William H. Crouse and Donald L. Anglin, "Automotive Mechanics", Tata McGraw Hill, 10thEdition, 2004.
5. Vehicle Service Manuals of Reputed Indian Manufacturers

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		2											3	
3		2											3	
4	3													
5						2		2				2		2
CO (W.A)	3	2	2			2	-	2	-	-	-	2	3	2

22MEX15 - CAE AND CFD APPROACH IN FUTURE MOBILITY				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To study the use of computer in mobility software or mobility. • To study the concepts computer aided design and rapid prototyping • To introduce the basic concepts of the finite elements methods. • To introduce basics and fundamental of the computational fluid dynamics • To introduce Turbulence Modeling and various simulation techniques

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts of computational fluid dynamics in mobility engineering.	Ap	30%
CO2	Apply the modeling and discretization technique in various mechanical elements.	Ap	30%
CO3	Analyze the durability, reliability and crash analysis	An	20%
CO4	Analyze the basic concept of the Computer Aided Engineering / Computational Fluid Dynamics	An	20%
CO5	Develop the computer aided design and model in rapid prototyping.	Ap	Internal Assessment

UNIT I - COMPUTER AIDED ENGINEERING AND COMPUTATIONAL FLUID DYNAMICS	(9)
Introduction to use of computer in Mobility Product Life Cycle, Software for mobility. Introduction to design process and role of computers in the design process, use of modern computational tools used for design and analysis, Concept of modeling and simulation. CFD as a design and research tool, Applications of CFD in mobility engineering	
UNIT II - APPLICATIONS OF COMPUTER AIDED ENGINEERING	(9)
Computational Fluid Dynamics – Introduction three dimensional of fluid dynamics, equilibrium equation for a fluid conversation. Injection moulding of plastics simplification of mould geometry for FEA material model. Simulation for manufacturing process like casting and sheet metal applications. Durability analysis, reliability, crash analysis. Noise vibration and hardness NVH analysis.	
UNIT III - FINITE ELEMENT ANALYSIS	(9)
Basic Concept of Finite Element Method, Ritz and Rayleigh Ritz methods, Method of weighed residuals, Galerkin method. Governing differential equations of one and two dimensional problems, One Dimensional Second Order Equations – Discretization – Linear and Higher order Elements – Interpolation and shape functions, Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices - Solution of static problems and case studies in stress analysis of mechanical components using 2D and 3D elements	

UNIT IV - COMPUTATIONAL FLUID DYNAMICS	(9)
CFD vs. experimentation; continuity, Navier-stokes and energy equations; modeling and discretization techniques; basic steps in CFD computation various simplifications, Dimensionless equations and parameters, Incompressible inviscid flows, Source panel method, and Vortex panel method. Conservation form of the equations, shock fitting and shock capturing, Time marching and space marching. 3-D structured and unstructured grid generation, mesh smoothing and sensitivity checks. Different types of codes and grids used for CFD calculations.	
UNIT V - PROBLEM SOLVING USING CFD	(9)
Turbulence Modeling, different turbulent modeling scheme. Incompressible Viscous Flows, Applications to internal flows and boundary layer flows. Eddy viscosity and non-eddy viscosity models; Vehicle Aerodynamic Simulation Wind tunnel and on-road simulation of vehicles; Simulation of Ahmed and Windsor bodies; Vorticity based grid-free simulation technique; simulation in climatic and acoustic wind tunnels; velocity vector and pressure contour simulation	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Computational Fluid Dynamics: A Practical Approach by Jiyuan Tu, Guan Heng Yeoh, Chaoqun Liu, Butterworth – Heinemann Ltd, Second Edition, 2012.
2. Applied Computational Fluid Dynamics by S. C. Gupta, Wiley publisher, 2019

REFERENCES:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007
2. Groover, M. P., CAD/CAM: Computer-Aided Design and Manufacturing, Pearson Education, 2008
3. TirupathiR.Chandrupatla and Ashok D.Belegundu, "Introduction to Finite Elements in Engineering", International Edition, Pearson Education Limited, 2014.
4. Dhanaraj. R and Prabhakaran Nair. K, "Finite Element Analysis", Oxford Publications, 2015.
5. Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2													
2	2													
3		1												1
4		1												1
5						1								
CO (W.A)	2	1				1								1

22MEX16 -HYBRID AND ELECTRIC VEHICLE TECHNOLOGY				
	L	T	P	C
	3	0	0	3
PREREQUISITE : Nil				

Course Objective:	• To introduce the concept of hybrid and electric drive trains. • To elaborate on the types and utilization of hybrid and electric drive trains. • To expose on different types of AC and DC drives for electric vehicles. • To learn and utilize different types of energy storage systems • To introduce concept of energy management strategies and drive sizing

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze the performance and power source characterization of hybrid and electric vehicles in relation to their impact on energy supplies.	An	20%
CO2	Apply power flow control techniques to optimize fuel efficiency in hybrid and electric drive-train topologies.	Ap	20%
CO3	Implement and control AC and DC motor drives in hybrid and electric vehicles to enhance drive system efficiency.	Ap	40%
CO4	Analyze the performance and hybridization of different energy storage devices in hybrid and electric vehicles.	An	20%
CO5	Explain the historical development, social, and environmental significance of hybrid and electric vehicles.	U	Internal Assessment

UNIT I : INTRODUCTION TO HYBRID AND ELECTRIC VEHICLES	(9)
Basics of vehicle performance, vehicle power source characterization, transmission characteristics, History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.	
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 Drive-trains: 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(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Iqbal Husain, - Electric and Hybrid Vehicles: Design Fundamentalsll, Third Edition, 2021
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003

REFERENCES:

3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
4. R and D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley &
5. Sons, 1998
6. Hybrid, Electric and Fuel-Cell Vehicles, International Edition by Jack Erjavec June 2012
7. Energy Management in Hybrid Electric Vehicles using Co-Simulation by Christian Paar11 February 2011
8. Hybrid Electric Vehicle Design and Control: Intelligent Omnidirectional Hybrids
9. (MECHANICAL ENGINEERING) by YangshengXu , Jingyu Yan, et al. 16 December 2013

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3											3	
2	3												3	
3	3												3	
4	3	3											3	
5							3							
CO (W.A)	3	3					3						3	

22MEX17 - THERMAL MANAGEMENT OF BATTERIES AND FUEL CELLS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : 22CHC09				

Course Objective:	• To study the working principle of Li-ion Batteries and Battery Packs. • To learn the thermal management system in Battery modules. • To develop the different case studies in Battery Thermal Management System. • To learn the working principle of Fuel Cells and cooling methods. • To learn the inside components of Thermal Management Systems in various famous Electric and Fuel Cell Electric Vehicles.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply knowledge of Li-ion battery chemistry, formats, and management systems to optimize battery performance and longevity.	Ap	20%
CO2	Apply thermal management techniques to optimize battery performance in electric vehicles.	Ap	20%
CO3	Evaluate the effectiveness of different cooling methods in battery thermal management systems.	E	30%
CO4	Analyze the thermal management requirements and solutions for fuel cell systems in electric vehicles.	An	30%
CO5	Demonstrate the configuration and characteristics of battery management systems in advanced batteries.	U	Internal Assessment

UNIT I : ADVANCED BATTERIES	(9)
Li-ion Batteries- chemistry, different formats, operating areas, efficiency, aging. Battery Management System- Configuration, Characteristics. Tesla Model S-18650 Cell specifications, P85 Battery Pack mechanical structure, Texas Instruments BMS. Super capacitors Vs batteries. Diamond battery concepts.	
UNIT II : THERMAL MANAGEMENT IN BATTERIES	(9)
Thermal Management Systems- impact, Types- Air, Liquid, Direct refrigerant, Heat pipe, Thermo Electric, Phase Change Material (PCM) Cooling methods. Solid-liquid PCM Types- Organic, Inorganic, Eutectics. PCM Thermal properties and applications. Tesla Model-S Battery Module- bonding techniques, thermal management.	
UNIT III : BATTERY THERMAL MANAGEMENT CASE STUDIES	(9)
EV Battery Cooling- challenges and solutions. Heat Exchanger Design and Optimization Model for EV Batteries using PCMs- system set up, selection of PCMs. Chevrolet Volt Model Battery Thermal Management System- Case study. Modeling Liquid Cooling of a Li-Ion Battery Pack with COMSOL Multi physics- simulation concepts	
UNIT IV : THERMAL MANAGEMENT IN FUEL CELLS	(9)

Fuel Cells- operating principle, hydrogen-air fuel cell system characteristics, other fuel cell technologies, polarization curves, applications. Fuel cell thermal management- basic model, energy balance, governing equations, characteristic curve, sizing, cooling methods, advantages, restrictions.
UNIT V : FUEL CELL THERMAL MANAGEMENT CASE STUDIES (9)
Fuel cell system- balance of plant- components required. Fuel cell power plant sizing problems- Fuel Cell Electric Vehicle Fuel economy calculations-Battery EVs Vs Fuel Cell EVs. Toyota Mirai FCV- Operating principle, High pressure hydrogen tank, Boost convertor, NiMH Battery, Internal circulation system, Hydrogen refueling- Case studies.
TOTAL(L:45) = 45 PERIODS

TEXT BOOKS:

1. Ibrahim Dinçer, Halil S. Hamut, and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", Wiley, 2017.
2. Jiuchun Jiang and Caiping Zhang, "Fundamentals and applications of Lithium-Ion batteries in Electric Drive Vehicles", Wiley, 2015.
3. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles-Fundamentals, Theory, and Design", CRC Press, 2005.
4. John G. Hayes and G. Abas Goodarzi, "Electric Powertrain", Wiley, 2018
5. Davide Andrea, "Battery Management Systems for Large Lithium-Ion Battery Packs" ARTECH House, 2010.

REFERENCES:

1. Nag.P.K, "Engineering Thermodynamics", 5th Edition, Tata McGraw Hill Education, New Delhi, 2013.
2. "Vehicle thermal Management Systems Conference Proceedings", 1st Edition; 2013, Coventry Techno centre, UK
3. Younes Shabany," Heat Transfer: Thermal Management of Electronics Hardcover" 2010, CRC Press.
4. T. Yomi Obidi, "Thermal Management in Automotive applications", 2015, SAE International.
5. Jerry Sergent, Al Krum, "Thermal Management Handbook: For Electronic Assemblies Hardcover", 1998, Mc Graw-Hill

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2	3												3	
3	3	3											3	
4	3	3											3	
5							3							
CO (W.A)	3	3					3						3	

22MEX18 SMART MOBILITY AND INTELLIGENT VEHICLES				
	L	T	P	C
	3	0	0	3
PREREQUISITE : Nil				

Course Objective:	• 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 The Student will be able to	**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles	Ap	20%
CO2	Apply the concept of remote sensing and the types of sensor technology needed to implement remote sensing	An	30%
CO3	Apply the concept of fully autonomous vehicles.	Ap	30%
CO4	Apply basic concepts of wireless communications and wireless data networks	Ap	20%
CO5	Integrate the connected vehicle and its role in automated vehicles	C	Internal assessment

UNIT I- INTRODUCTION TO AUTOMATED, CONNECTED, AND 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)**
Concepts of autonomous vehicles, 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 & 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 & 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.	
TEXT BOOKS	
1. "Intelligent transportation systems and connected and automated vehicles", 2016, transportation research board 2. Radovan miucic, "connected vehicles: intelligent transportation systems", 2019, springer	
REFERENCES:	
1. Tom denton, "automobile electrical and electronic systems, roultedge", taylor & francis group,5th edition,2018.	

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													
2		3											1	
3	3													
4	3												1	
5										2		2		
CO (W.A)	**3**	3								**2**		**2**	1	

22MEX21-TURBO MACHINES				
	L	T	P	C
	3	0	0	3
PREREQUISITE : Nil				

Course Objective:	• 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 analyzing flow behavior and flow losses in axial flow compressor. • To study the types and working of axial and radial flow turbines.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the principles of energy transfer in rotor and stator parts of turbomachines.	Ap	30 %
CO2	Analyze the flow behavior and flow losses in axial flow compressors.	An	20 %
CO3	Evaluate the working and performance of centrifugal compressors.	Ap	30 %
CO4	Justify the functions of various elements in centrifugal fans and blowers.	Ap/C	20 %
CO5	Develop teamwork and collaboration skills through group-based on the turbo machines assignments and peer reviews.	Ap/An	Internal Assessment

UNIT I - WORKING PRINCIPLES	**(9)**
Classification of Turbo machines. Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbo machines.	
UNIT II - CENTRIFUGAL FANS AND BLOWERS	**(9)**
Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves – various losses. Fan –bearings, drives and noise.	
UNIT III - CENTRIFUGAL COMPRESSOR	**(9)**
Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.	
UNIT IV - AXIAL FLOW COMPRESSOR	**(9)**
Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forced vortex flow.	
UNIT V – AXIAL AND RADIAL FLOW TURBINES	**(9)**
Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types – Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Ganesan, V., "Gas Turbines", 3rd Edition, Tata McGraw Hill, 2011. .
2. Yahya, S.M., "Turbines, Compressor and Fans", 4th Edition, Tata McGraw Hill, 2011.

REFERENCES:

1. Dixon, S.L., "Fluid Mechanics and Thermodynamics of Turbomachinery", 7th Edition, ButterworthHeinemann, 2014.
2. Gopalakrishnan. G and Prithvi Raj. D," A Treatise on Turbomachines", Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.
3. Lewis, R.I., "Turbomachinery Performance Analysis" 1st Edition, Arnold Publisher, 1996.
4. Saravanamutto, Rogers, Cohen, Straznicky., "Gas Turbine Theory" 6th Edition, Pearson Education Ltd, 2009.
5. Venkanna, B.K., "Fundamentals of Turbomachinery", PHI Learning Pvt. Ltd., 2009.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2		3											3	
3	3												3	
4	3												3	
5	3								1	1			3	
CO (W.A)	**3**	**3**							**1**	**1**			**3**	

22MEX22 - ADVANCED INTERNAL COMBUSTION ENGINEERING				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To study the working of Gasoline fuel `injection systems and SI combustion. • To study the working of Diesel fuel injection systems and CI combustion • To Identifying the source and measure it; explain the mechanism of emission formation and control methods. • To study the Selecting alternative fuel resources and its utilization techniques in IC engines. • To study the advanced combustion modes and future power train systems.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the working concept of Gasoline fuel injection systems in SI combustion.	Ap	30%
CO2	Apply the working concept of Diesel fuel injection systems diesel cycle.	Ap	30%
CO3	Analyze the performance of alternative fuels and utilization techniques in IC engines.	An	20%
CO4	Analyze the characteristics of Fuel Cells in automobiles	An	20%
CO5	Formulate the different advanced combustion modes and future power train systems.	U	Internal Assessment

UNIT I - SPARK IGNITION ENGINES	(9)
Mixture requirements – Fuel injection systems – Mono-point, Multipoint & Direct injection -Stages of combustion – Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers.	
UNIT II - COMPRESSION IGNITION ENGINES	(9)
Diesel Fuel Injection Systems – Mechanical and Common Rail Direct Injection Systems - Stages of combustion – Knocking – Factors affecting knock –Direct and Indirect injection systems –Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Combustion chambers – Turbo charging – Waste Gate, Variable Geometry turbochargers.	
UNIT III - EMISSION FORMATION AND CONTROL	(9)
Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling emissions – In-cylinder treatments – After treatment systems – Three Way Catalytic converter, Selective Catalytic Reduction, De-NOx Catalyst, Diesel Oxidation Catalyst and Particulate Traps – Methods of emission measurement – Emission norms and Driving cycles.	

UNIT IV - ALTERNATIVE FUELS	(9)
Alcohol Fuels, Hydrogen – production, storage - Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits – Utilization Methods - Engine Modifications.	
UNIT V - ALTERNATE COMBUSTION AND POWER TRAIN SYSTEM	(9)
Low Temperature Combustion - Homogeneous charge compression ignition (HCCI) – Reactivity Controlled Compression Ignition (RCCI) – Gasoline Compression Ignition – Spark Assisted HCCI - Hybrid Electric and Electric Vehicles –- Fuel Cells.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. V. Ganesan, "Internal Combustion Engines", V Edition, Tata McGraw Hill, 2012.
2. John B. Heywood, "Internal Combustion Engines Fundamentals", McGraw-Hill, 2009.

REFERENCES:

1. B.P. Pundir, "IC Engines Combustion & Emission", Narosa Publishing House, 2014.
2. Duffy Smith, "Auto Fuel Systems", The Good Heart Wilcox Company, Inc., 2003.
3. EranSher, Handbook of Air Pollution from Internal Combustion Engines: Pollutant Formation and Control, Academic Press, 1998.
4. K.K. Ramalingam, "Internal Combustion Engine Fundamentals", SciTech Publications, 2011.
5. R.B. Mathur and R.P. Sharma, "Internal Combustion Engines", Dhanpat Rai& Sons, 2007

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2												1	
2	2												1	
3		1												
4		1												
5								1						
CO (W.A)	2	1						1					1	

22MEX23- GAS DYNAMICS AND JET PROPULSION				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To study the fundamentals of compressible flow concepts and the use of gas tables. • To learn the compressible flow behaviour in constant area ducts • To study the development of shock waves and its effects • To study the types of jet engines and their performance parameters • To learn the types of rocket engines and their performance parameters.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the fundamentals of compressible flow concepts and the use of gas tables	Ap	20%
CO2	Analyze the compressible flow behaviour in constant area ducts	An	20%
CO3	Evaluate the development of shock waves and its effects	An	20%
CO4	Analyze the ethical implications and responsibilities associated with the design, development, and operation of compressible fluid flow systems and propulsion technologies.	An	20%
CO5	Classify the rocket engines and their performance parameters.	Ap	20%

UNIT I - BASIC CONCEPTS AND ISENTROPIC FLOWS	(9)
Energy and momentum equations of compressible fluid flows, Concepts of compressible flow – Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow and its relations. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.	
UNIT II - COMPRESSIBLE FLOW THROUGH DUCTS	(9)
Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties. Choking. Isothermal flow with friction. Use of Gas tables.	
UNIT III - NORMAL AND OBLIQUE SHOCKS	(9)
Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer expansion and relation. Use of Gas tables.	
UNIT IV - JET PROPULSION	(9)
Theory of jet propulsion – thrust equation – Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines.	
UNIT V – SPACE PROPULSION	**(9)**
Types of rocket engines and propellants. Characteristic velocity – thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Solid propellant geometries. Orbital and escape velocity. Rocket performance calculations.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Anderson, J.D., "Modern Compressible flow", Third Edition, McGraw Hill, 2003.
2. S.M.Yahya, "Fundamentals of Compressible Flow with Aircraft and Rocket propulsion", New Age International (P) Limited, 4th Edition, 2012.

REFERENCES:

1. R. D. Zucker and O Biblarz, "Fundamentals of Gas Dynamics", 2nd edition, Wiley, 2011. .
2. Balachandran. P., "Fundamentals of Compressible Fluid Dynamics", Prentice-Hall of India, 2007.
3. Radhakrishnan. E., "Gas Dynamics", Printice Hall of India, 2006.
4. Hill and Peterson, "Mechanics and Thermodynamics of Propulsion", Addison – Wesley, 1965.
5. Babu, V., "Fundamentals of Compressible Flow", CRC Press, 1st Edition, 2008

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	1
2		3	3										2	1
3													2	1
4								3					2	1
5												3	2	1
CO (W.A)	3	3	3				3						3	3

22MEX24 REFRIGERATION AND AIR CONDITIONING				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To introduce the refrigerants and refrigeration cycles • To know the working principles of vapour compression and vapour absorption refrigeration systems. • To acquire knowledge on non-conventional refrigeration systems. • To acquire knowledge on Air conditioning systems and their components • To get exposure on load estimation in • Refrigeration and air conditioning systems

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Calculate the performance and efficiency of simple vapor compression, absorption system and other non-conventional refrigeration systems.	Ap	20%
CO2	Analyze the different types of refrigeration cycles and determine the most suitable refrigerant for each application.	An	40%
CO3	Analyze the working principle of various air conditioning systems and select the most appropriate systems for specific applications, incorporating noise control methods.	An	20%
CO4	Estimate cooling and heating loads for various applications, including the design and maintenance of cold storage and domestic refrigerators.	An	20%
CO5	Involve in an independent study as a team and make effective oral presentation on Refrigeration and Air Conditioning Systems.	U	Internal Assessment

UNIT I : AIR REFRIGERATION CYCLES AND REFRIGERANTS	**(9)**
Refrigeration - systems, Coefficient of Performance - Reversed Carnot cycle - reversed Brayton cycle - Refrigerants - introduction, classification - primary refrigerants - designation - properties and uses of commonly used refrigerants - comparison and application of refrigerants – Leak detection.	
UNIT II - VAPOUR COMPRESSION AND ABSORPTION REFRIGERATION SYSTEMS	**(9)**
Simple vapour compression system - T-s diagrams - P-h chart - factors affecting the performance - actual vapour compression cycle - volumetric efficiency - methods of improving simple saturation cycle - Simple vapour absorption system - practical vapour absorption system - COP - Lithium Bromide system.	
UNIT III - NON CONVENTIONAL REFRIGERATION SYSTEMS	**(9)**
Thermoelectric refrigeration system - thermoelectric effects, comparison between thermoelectric and vapour compression refrigeration- vortex tube and pulse tube refrigeration.	
UNIT IV - AIR CONDITIONING SYSTEMS AND EQUIPMENTS	**(9)**
Air conditioning cycle - classification of air conditioning systems - central system - zoned system - unitary system - unitary central system – VRF/VRV system- selection of system - RSHF - GSHF - applications of air conditioning - air conditioning equipment - package units, central units - noise and noise control.	
UNIT V – LOAD ESTIMATION, APPLICATIONS OF REFRIGERATION AND AIR	**(9)**

CONDITIONING	
Cooling and heating load - Thermal resistance value (U) for wall, roof, glass, solar radiation and heat gain - thermal barriers - infiltration - internal heat gains - Design of a cold storage - domestic refrigerator - electrical circuit, maintenance - year round air conditioner - year round absorption air conditioner - air conditioning of theatres - manufacture of ice.	

TEXT BOOKS

1. Rajput.R.K, "A textbook of Refrigeration and Air conditioning", S.K.Kataria and Sons, 3rd ed., Reprint 2015
2. Arora, C.P., "Refrigeration and Air Conditioning", 4th ed., McGraw Hill, New Delhi, 2021

REFERENCES:

1. Ananthanarayanan P.N, "Basic Refrigeration and Air Conditioning",4th ed.,McGraw Hill, New Delhi, 2013
2. Paul Lang V, "Principles of Air conditioning", 3rd ed., CBS Publishers and Distributors Pvt Ltd, New Delhi 2003
3. Khurmi.R.S and Gupta.J.K, "A Textbook of Refrigeration and Air Conditioning", 1st ed., S. Chand Publications, 2011
4. Roy.J.Dossat, "Principles of Refrigeration", 4th ed., Pearson education inc, New Delhi, 2012

Mapping of COs with POs / PSOs

COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		3											2	
3		3											2	
4		3											2	
5										2				
CO (W. A)	**3**	**3**								**2**			**2**	

22MEX25 THERMAL POWER ENGINEERING				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To study the fuel properties and arrive at proximate and ultimate analysis of fuels. • To study the different types of boilers and compute their performance parameters. • To study the performance parameters of an air compressor. • To study the working principles of various refrigeration systems and perform COP calculations. • To study the psychrometric properties and how they are utilized in arriving at calculations to determine heating loads.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze the properties of different fuels and conduct proximate and ultimate analysis to determine their composition and characteristics.	An	20%
CO2	Explore the various types of boilers and analyze their performance through boiler trials, including calculations and evaluations of efficiency.	An	40%
CO3	Calculate the performance of air compressors and different refrigeration cycles, such as vapor compression, air cycle, and thermoelectric refrigeration systems for the given condition.	Ap	20%
CO4	Use the psychrometric chart to analyze psychrometric processes and support the design of air conditioning systems tailored to different climatic conditions.	An	20%
CO5	Participate in an independent team study and deliver an effective oral presentation on boilers, refrigeration, and air conditioning systems.	U	Internal Assessment

UNIT I : FUELS AND COMBUSTION	**(9)**
Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels – Fuels Analysis – Proximate and Ultimate Analysis - Moisture Determination - Calorific Value -Gross & Net Calorific Values	
UNIT II - BOILERS	**(9)**
Types of boilers and comparison, Mountings and Accessories. Performance calculations, Boiler trial. Next generation boiler design	
UNIT III - AIR COMPRESSORS	**(9)**
Classification of air compressors, working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency. Multistage air compressor with Intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors	
UNIT IV - REFRIGERATION SYSTEMS	**(9)**
Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration. Advanced refrigeration and Cryogenics	

UNIT V – PSYCHROMETRY AND AIR-CONDITIONING	(9)
Psychrometric properties – Property calculations using Psychrometric chart and expressions. Psychrometric processes – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations. Cooling towers – concept and types.	

TEXT BOOKS

1. Mahesh. M. Rathore, "Thermal Engineering", 4th Edition, Tata McGraw Hill, 2023.
2. Ballaney. P, "Thermal Engineering", 25th Edition, Khanna Publishers, 2017

REFERENCES:

1. Ananthanarayanan P.N, "Basic Refrigeration and Air-Conditioning", 4th Edition, Tata McGraw Hill, 2013.
2. Arora, "Refrigeration and Air-Conditioning", 4th ed., McGraw Hill, New Delhi, 2021.
3. Mathur M.L and Mehta F.S., "Thermal Science and Engineering", 3rd Edition, Jain Brothers Pvt. Ltd, 2017.
4. Nag P.K, " Basic and Applied Thermodynamics", 4th Edition, Tata McGraw Hill, 2017
5. Soman. K, "Thermal Engineering", 2nd Edition, Prentice Hall of India, 2011

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2	3												2	
3		3											2	
4	3												2	
5									2	2				
CO (W.A)	**3**	**3**							**2**	**2**			**2**	

22MEX26 RENEWABLE ENERGY TECHNOLOGIES				
	L	T	P	C
	3	0	0	3

PREREQUISITE :

Course Objective:	• To analyze the global energy status and potential of various renewable energy sources. • To understand the different types of bio-resources and their conversion technologies

	Course Outcomes The Student will be able to	Cognitive Level	Weightage of COs in End Semester Examination
CO1	Describe the energy consumption and demands in various sectors like domestic, industrial, commercial, agriculture and transportation in India.	U	20%
CO2	Calculate wind energy potential using wind data, considering factors like the Betz limit and site selection for wind farms.	Ap	20%
CO3	Analyze and Design the biomass gasifiers, biogas plants, biodiesel production plants and ethanol production systems.	An	20%
CO4	Define the methods of hydrogen production and storage and their potential applications in the energy sector	U	20%
CO5	Evaluate applications and design the solar thermal collectors, including flat plate and concentrating collectors, and.	Ev	20%

UNIT I: ENERGY SCENARIO	(9)
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status- Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans	
UNITII:SOLAR ENERGY	(9)
Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.	
UNITIII:WIND ENERGY	(9)
Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.	
UNITIV:BIO-ENERGY	(9)
Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion- mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.	
UNITV:OTHER ENERGY SOURCES	(9)
Geothermal energy, magneto hydrodynamic system (MHD), thermionic and thermos- electric generator, micro-hydel systems, hybrid systems and applications; Fuel cells: Classification, reactions and performance; Hydrogen production and storage methods.	
TOTAL=45PERIODS	

TEXT BOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707

REFERENCES:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
2. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
3. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		2	2				3						3	
2	3	2	2				3							
3	3	2	2				3						3	
4	3	2	2	3			3							
5	3	2	2			3	3						3	
CO (W.A)	**3**	**2**	**2**	**3**		**3**	**3**						**3**	

22MEX27 - ADVANCED VEHICLE ENGINEERING				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE : NIL

Course Objective:	• To introduce the basic concepts of electric vehicle and their characteristics • To introduce different types of motors and the selection of motor for vehicle applications. • To acquaint the student with different sensors and systems used in autonomous and connected vehicles. • To give an overview of networking with sensors and systems. • To introduce the modern methods of diagnosing on-board the vehicle troubles.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concept of electric vehicles and their importance in automotive.	Ap	30%
CO2	Analyze the performance, characteristics and configuration of electric vehicle motors.	Ap	30%
CO3	Analyze the characteristics of networking and Diagnostic Interfaces.	An	20%
CO4	Analyze the on-board diagnostics systems	An	20%
CO5	Seminar presentation in the autonomous vehicle and connected vehicles	U	Internal Assessment

UNIT I - ELECTRIC VEHICLES	(9)
EV architectures, advantages and disadvantages, Electrical and mechanical energy storage technologies, battery management. Performance of Electric Vehicles, Electric Power Steering. Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving.	
UNIT II - ELECTRIC VEHICLE MOTORS	(9)
Electric Propulsion basics, motor capacity determination, Induction motor, DC motor, Permanent Magnet Motor, Switch Reluctance Motor, Configuration, Characteristics, Performance and control of Drives.	
UNIT III - AUTONOMOUS AND CONNECTED VEHICLES	(9)
Vehicle-to-Vehicle Technology, Vehicle to Road and Vehicle to Vehicle Infrastructure, Basic Control System, Surroundings Sensing Systems, Role of Wireless Data Networks, Advanced Driver Assistance Systems, Basics of Radar System, Ultrasonic Sonar Systems, Lidar System, Camera Technology, Basics of Wireless Technology, Receiver System.	
UNIT IV - AUTOMOTIVE NETWORKING	(9)
Bus Systems – Classification, Applications in the vehicle, Coupling of networks, networked vehicles, Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces.	

UNIT V - ON-BOARD TESTING	(9)
Integration of Sensor Data to On-Board Control Systems (OBD), OBD requirements, certification, enforcement, systems, testing, Introduction to Cyber-physical system.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. John G Hayes and G AbaasGoodarzi, Electric Powertrain -, 1st Edition, John Wiley & Sons Ltd., 2018
2. Hussain T Mouftah, Melike Erol-kantarci and Samesh Sorour, Connected and Autonomous Vehicles in Smart Cities,CRC Press, 1st Edition, 2020.

REFERENCES:

1. Dominique Paret, Multiplexed Networks for Embedded Systems, John Wiley & Sons Ltd., 2007.
2. Hong Cheng, - Autonomous Intelligent Vehicles: Theory, Algorithms & amp; Implementation‖, Springer, 2011
3. Advanced Technology Vehicles Manufacturing (ATVM) Loan Program (Energy Science, Engineering and Technology: Congressional Policies, Practices and Procedures)by Andrew M Wright and Harrison R Scott | 5 September 2012
4. Advanced Vehicle Technology by Heinz Heisler MSc BSc FIMI MIRTE MCIT | 17 July 2002
5. Advanced Motorsport Engineering: Units for Study at Level 3by Andrew Livesey | 1 September 2011

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2												1	
2	2												1	
3		1												
4		1												
5										1				
CO (W.A)	2	1								1			1	

22MEX28 - POWER PLANT ENGINEERING				
	L	T	P	C
	3	0	0	3

PRE REQUISITE: NIL

Course Objectives

- To acquire knowledge on working principle of steam power plant
- To understand the working principle of gas turbine power plant
- To introduce the principles and operation of nuclear power plant and its economics
- To introduce the principles and operation of a power plant and its economics.
- To introduce the principles and its economics.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Describe the fundamental principles of various types of power plants, including fossil fuel, nuclear, hydroelectric, and renewable energy plants.	Ap	20%
CO2	Explain the processes involved in converting different forms of energy into electrical power.	An	30%
CO3	Identify and explain the functions of key components and systems in power plants, such as boilers, turbines, generators, condensers, and cooling towers.	Ap	30%
CO4	Explore current innovations and emerging technologies in power generation, including advancements in renewable energy.	An	20%
CO5	Analysis of the power generation in various power plants in india.	An	Internal Assessment

UNIT I : STEAM POWER PLANT	**(9)**
. Essentials of steam power plant equipment - coal handling - fuel burning furnaces - methods of fuel firing - pulverizing mills - ball mill, ball and race mill, shaft mill - pulverized coal firing - steam condensers - surface condensers, jet condensers, cooling tower- ash disposal - handling equipment - smoke and dust removal - dust collectors - fluidized bed combustion - types - boiler - classification, working principles of Cochran boiler and La Mont boiler	
UNIT II : DIESEL AND GAS TURBINE POWER PLANT	**(9)**
Diesel engines - heavy oil engines - dual fuel engines - high compression gas engines - general layout of diesel power plant - performance of characteristics diesel engine - fuel system - common rail injection, individual pump injection, distributor system - diesel plant operation, efficiency - heat balance of a diesel engine power plant - Gas Turbine power plants. Combined Cycle Power Plants	
UNIT III : NUCLEAR POWER PLANT	**(9)**
Nuclear energy concepts and terms - energy from nuclear fission - radioactivity - nuclear reactor - parts, nuclear fuel, moderator, moderating ratio, reflector, reactor vessel, biological shielding, coolant, nuclear reactor, classification of nuclear reactors, Pressurized Water Reactor (PWR), Boiling Water Reactor (BWR), CANDU Reactor - Safety measures for Nuclear Power plants.	
UNIT IV : RENEWABLE ENERGY SOURCES	**(9)**
Classification of energy - construction and working principles of solar energy, flat plate collectors, focusing collector, solar pond technology, low temperature thermal power generation, medium temperature systems using focusing collectors, high temperature systems – solar farm and solar power plant - wind, ocean thermal and geothermal power plant - Fuel Cell power systems, Recent developments in the area of renewable energy systems	

UNIT V : HYDROELECTRIC POWER PLANT AND POWER PLANT ECONOMICS	**(9)**

Hydroelectric power plant - run-off - selection of site - essential features -pumped storage plants, economics - terms and factors - factors affecting power plant design - effect of power plant type - costs, rates, fixed elements, customer elements - plant selection, power generation - load curves - ideal and realized load curves - Waste Heat Recovery Boilers in Cement, Sugar and Steel Plants.

TEXT BOOKS

1. El.Wakil. M. M, "Power Plant Technology", McGraw-Hill Higher Education, 2017
2. Raja.A.K, Amit Prakash Srivastava, Manish Dwivedi, "Power Plant Engineering", New Age International (P) Limited, 1st ed., Reprint 2010

REFERENCES:

1. Rajput .R.K, "A Textbook of Power Plant Engineering", 5th ed., Laxmi Publications, New Delhi, 2016
2. Nag.P.K, "Power Plant Engineering", 4th ed., Tata McGraw Hill Publishing Company Ltd, 2014
3. Arora .S.C, Domkundwar, "Power Plant Engineering", 6th ed., DhanpatRai& Co, 2013
4. Manoj Kumar Gupta, "Power Plant Engineering", 1st ed., Prentice Hall India, 2010
5. Black, Veatch, "Power Plant Engineering", 1st ed., CBS Publishers, 2005

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		2											2	
3			2											
4					2									2
5	2													2
CO (W.A)	2.5	2	2		2								2	2

22MEX31-COMPUTATIONAL SOLID MECHANICS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : Nil				

Course Objective:	• To study the definition and basics on theory of elasticity • To learn finite element method and procedure for static linear elasticity • To study the Non Linear and History depend problems • To study time dependent and dynamic problems of Small and large strain visco-plasticity • To study Structural Elements & Interfaces and contact using penalty method

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Utilize the theory of elasticity to solve basic problems in structural analysis.	Ap	40%
CO2	Differentiate between non-linear problems and history-dependent problems in the context of structural mechanics.	An	20%
CO3	Evaluate methods for solving structural elements, interfaces, and contact problems.	Ap	20%
CO4	Derive the finite element method for static linear elasticity from first principles.	Ap/C	20%
CO5	Develop teamwork and collaboration skills through group-based on the solid mechanicsassignments and peer reviews.	Ap/An	Internal Assessment

UNIT I - BASIC ON THEORY OF ELASTICITY	**(9)**
Definitions- notations and sign conventions for stress and strain, Equations of equilibrium. Strain – displacement relations, Stress – strain relations, Lame's constant –cubical dilation, Compressibility of material, bulk modulus, Shear modulus, Compatibility equations for stresses and strains, Principal stresses and principal strains, Mohr's circle, Saint Venant's principle.	
UNIT II - FINITE ELEMENT METHOD FOR STATIC LINEAR ELASTICITY	**(9)**
Derivation and implementation of a basic 2D FE code with triangular constant strain elements. Generalization of finite element procedures for linear elasticity: interpolation and numerical integration in 1D, 2D and 3D. Deriving finite element equations - constructing variational forms; mixed methods. Accuracy and convergence; the Patch test.	
UNIT III - NON LINEAR AND HISTORY DEPEND PROBLEMS	**(9)**
Small strain hypo-elastic materials - Small strain visco-plasticity - Large strain elasticity -Large strain visco-plasticity	
UNIT IV - TIME DEPENDENT AND DYNAMIC PROBLEMS	**(9)**
First-order systems - the diffusion equation - Explicit time integration – the Newmark method - Implicit time integration - Modal analysis and modal time integration.	
UNIT V – AXISYMMETRIC CONTINUUM AND PLANE TRUSS	**(9)**
Axisymmetric formulation - Element stiffness matrix and force vector - Body forces and temperature effects - Stress calculations - Boundary conditions – 2D axis symmetric elements.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. L.S.Srinath, Advanced Mechanics Of Solids, 3rd Edition 2008.(0070139881 · 9780070139886).
2. J.N.Reddy, Introduction To Finite Element Method, 4th Edition 2020. (939038527X · 9789390385270).
3. R.D.Cook, Concepts and Applications of Finite Element Analysis, 4th Edition 2001 (978- 0-471-35605-9).
4. S.Timoshenko, Theory of Elasticity, McGraw-Hill Education (India) Pvt Limited, 2010.(9780070701229-0070701229)
5. G. Ramamurty, Applied Finite Element Analysis, I.K. International Publishing House Pvt. Limited,2013. (9789380578453- 9380578458)

REFERENCES:

1. The Mechanics of Solids and Structures - Hierarchical Modeling and the Finite Element Solution (Computational Fluid and Solid Mechanics)by Miguel Luiz Bucalem and KlausJurgen Bathe | 25 February 2013
2. The Finite Element Analysis of Shells - Fundamentals (Computational Fluid and Solid Mechanics)by Dominique Chapelle and Klaus-Jurgen Bathe | 27 January 2013
3. Inelastic Analysis of Solids and Structures (Computational Fluid and Solid Mechanics)by M. Kojic and Klaus-Jurgen Bathe | 22 October 2010
4. High-Resolution Methods for Incompressible and Low-Speed Flows (Computational Fluid and Solid Mechanics)by D. Drikakis and W. Rider | 22 October 2010
5. Discontinuous Finite Elements in Fluid Dynamics and Heat Transfer (Computational Fluid and Solid Mechanics)by Ben Q. Li | 22 October 2010

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2		3											3	
3	3												3	
4	3												3	
5	3								1	1			3	
CO (W.A)	3	3							1	1			3	

22MEX32 - COMPUTATIONAL FLUID DYNAMICS AND HEAT TRANSFER				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To study the fluid flow simulation techniques and its mathematical behaviour • To learn the discretise 1D and 2D systems using finite difference and finite volume techniques • To Formulate diffusion – convection problems using finite volume method • To study the flow field for different types of grids • To learn the need for turbulence models and its types

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the fundamentals of CFD, and develop specific governing equations	Ap	30%
CO2	Apply the various discretization methods, solution procedure and the concept of turbulence modeling.	Ap	30%
CO3	Analyze the fluid flow and heat transfer process	An	20%
CO4	Analyze various mathematical schemes under finite volume method for convention diffusion	An	20%
CO5	Design a different environmental friendly model by using the software tools and relate to the course.	Ap	Internal Assessment

UNIT I - COMPUTATIONAL FLUID DYNAMICS	(9)
Basics of Computational Fluid Dynamics – Governing equations– Continuity, Momentum and Energy equations – Boundary conditions & Types– Time-averaged equations for Turbulent Flow – Classification and Mathematical behavior of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations, comparison between Analytical, Experimental and Numerical techniques, Techniques of Discretisation and Numerical errors. Post processing techniques.	
UNIT II - FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION	(9)
Derivation of finite difference equations– General Methods for first and second order accuracy – Finite volume formulation for steady and transient diffusion 1D and 2D problems – Use of Finite Difference and Finite Volume methods, Accuracy of solution, optimum step-size, Euler, Crank-Nickolson methods, stability of schemes.	
UNIT III - FINITE VOLUME METHOD FOR CONVECTION DIFFUSION	(9)
Steady one-dimensional convection and diffusion – Central, upwind differencing schemes, properties of discretization schemes, Hybrid, Power-law, Quick Schemes, Computation of Boundary layer flow, von Neumann stability analysis.	

UNIT IV - FLOW FIELD ANALYSIS	(9)
Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections – Pressure Correction equation, Simple algorithm and its variants – PISO Algorithms, Computation of internal and external thermal boundary layer.	
UNIT V - TURBULENCE MODELLING	(9)
Turbulence model requirement and types, mixing length model, Two equation (k-Є) models – High and low Reynolds number models, LES, DNS, Mesh Generation and refinement Techniques-software tools, Stability of solver, Courant Fredrick Levy number, relaxation factor, and grid independence test.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

6. Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014 .
7. Ghoshdastidar, P.S., "Computational Fluid Dynamics and Heat Transfer", Cengage Learning, 2017.

REFERENCES:

1. John. F. Wendt, "Computational Fluid Dynamics – An Introduction", Springer, 2013.
2. K. Muralidhar & T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora Publishing House, 1994.
3. Suhas V, Patankar, "Numerical Heat transfer and Fluid flow", Taylor & Francis, 2009.
4. Uriel Frisch, Turbulence, Cambridge University Press, 1999.
5. Yogesh Jaluria & Kenneth E. Torrance, "Computational Heat Transfer", CRC press, 2002.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2													
2	2													
3		2			1								1	1
4		2											1	1
5							1							
CO (W.A)	2	2			1		1						1	1

22MEX33 THEORY ON COMPUTATION AND VISUALIZATION				
	L	T	P	C
	3	0	0	3

PREREQUISITE : Nil

Course Objective:	• To study the concepts and techniques of discrete mathematics for theoretical computer science. • To learn different formal languages and their relationship. • To classify and construct grammars for different languages and vice-versa • To study visualization, graphical and quantitative information • To learn Visualization design and data Ink

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts and techniques of discrete mathematics for theoretical computer science	Ap	30%
CO2	Analyze the different formal languages and their relationship	An	20%
CO3	Classify and construct grammars for different languages and vice-versa	Ap	30%
CO4	Evaluate the visualization, graphical and quantitative information	E	20%
CO5	Create visualization design and data ink	U	Internal Assessment

UNIT I- REVIEW OF MATHEMATICAL THEORY	(9)
Sets, functions, logical statements, proofs, relations, languages, principal of mathematical induction, strong principle, recursive definitions, structural induction.	
UNIT II - REGULAR LANGUAGES AND FINITE AUTOMATA	(9)
Regular expressions, regular languages, application of finite automata, automata with output –mealy machine, finite automata, definitions, union- intersection and complement of regular languages, non deterministic finite automata, conversion from NFA to FA, - non deterministic finite automata, conversion of NFA- to NFA, kleene's theorem, minimization of finite automata, regular and non regular languages – pumping lemma.	
UNIT III - CONTEXT FREE GRAMMAR (CFG) AND PUSHDOWN AUTOMATA	(9)
Definitions and examples, unions concatenations and kleene's of context free language, regular grammar for regular language, derivations and ambiguity , unambiguous CFG and algebraic expressions, bacosnaur form (BNF), normal form – CNF. Definitions, deterministic PDA, equivalence of CFG and PDA conversion, pumping lemma for CFL, intersections and complements of CFL, non-CFL.	
UNIT IV - VALUE OF VISUALIZATION	(9)
Information visualization, in readings in information visualization, graphical excellence, graphical integrity, sources of graphical integrity in the visual display of quantitative information.	
UNIT V – VISUALIZATION DESIGN	(9)
The power of representation, data-ink and graphical redesign, data-ink maximization and graphical design, data density and small multiples.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Introduction to the theory of computation by michael sipser.
2. Automata theory, languages, and computation by john hopcroft, rajeev motowani, and jeffrey ullman.

REFERENCES:

1. Introduction to languages and the theory of computation, 4th by john martin, tata mc graw hill
2. An introduction to automata theory and formal languages by adesh k. pandey, publisher: s.k. kataria&sons
3. Introduction to computer theory by deniel i. cohen , joh wiley & sons, inc
4. Computation: finite and infinite by marvin l. minsky prentice-hall.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												1	
2		3											1	
3			2										1	
4				2									1	
5												2		
CO (W.A)	3	3	2	2								2	1	

22MEX34-COMPUTATIONAL BIO-MECHANICS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : Nil				

Course Objective:	• To Introduction of principles and concepts of bio-mechanics. • Focuses on the studies of tissues and structure of musculoskeletal system. • To study the mechanics of joints and human motion. • To explain the computational approaches in biomechanics • To learn the quantification of forces and motion.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Utilize the principles of mechanics to analyze various biomechanical systems	Ap	40%
CO2	Investigate the tissues and structures of the musculoskeletal system in detail.	An	20%
CO3	Assess the effectiveness of different computational mathematical models applied in biomechanics.	Ap	30%
CO4	Formulate new techniques for analyzing and understanding human motion.	Ap/C	10%
CO5	Develop teamwork and collaboration skills through group-based biomechanics assignments and peer reviews.	Ap/An	Internal Assessment

UNIT I - INTRODUCTION TO BIOMECHANICS	**(9)**
Perspective of biomechanics, Terminologies, Kinematic and kinetic concepts for analyzing human motion, Kinetic concepts for analyzing human motion, Linear kinetics of human movement, Equilibrium, Angular kinetics of human Movement, Mechanical properties of soft tissues, bones, and muscles	
UNIT II - BIOMECHANICS OF TISSUES AND STRUCTURES OF THE MUSCULOSKELETAL SYSTEM	**(9)**
Biomechanics of Bone, Biomechanics of Articular Cartilage, Tendons and Ligaments, Peripheral Nerves and Spinal Nerve Roots, Skeletal Muscle	
UNIT III - BIOMECHANICS OF JOINTS AND HUMAN MOTION	**(9)**
Knee, Hip, Foot and Ankle, Lumbar Spine, Cervical Spine, Shoulder, Elbow Wrist, and Hand, Linear kinematic and kinetic aspects of human movement, angular kinematic and kinetic aspects of human movement, equilibrium and human moment.	
UNIT IV - COMPUTATIONAL APPROACHES IN BIOMECHANICS	**(9)**
Finite Element Analysis in Biomechanics, Computational modelling of Vancouver Periprosthetic Fracture in Femur, Scaffolds, artificial hip and knee joints, Aortic Valve.	
UNIT V – GAIT ANALYSIS	**(9)**
Exoskeleton design, Ergonomics, Sports mechanics, Performance Analysis, Biomechanical analysis, 3D printing.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Susan J Hall, —Basic Biomechanics, 6th Edition, The McGraw-Hill Companies Inc., 2011
2. Jay D Humphrey and Sherry L Delange, —An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, 1st edition, Springer-Verlag, 2010

REFERENCES:

1. Margareta Nordin and Victor H Frankel, —Basic Biomechanics of the Musculoskeletal System, 3rd Edition, Lippincott Williams and Wilkins, 2001.
2. Ozkaya, Nihat, Nordin, and Margareta, —Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation, 2nd Edition, Springer, 2009.
3. Pritam Pain, Sreerup Banerjee, Goutam Kumar Bose , Advances in Computational Approaches in Biomechanics, 2022
4. Kinetics and Dynamics: From Nano- to Bio-Scale: 12 (Challenges and Advances in Computational Chemistry and Physics)by Piotr Paneth and Agnieszka Dybala-Defratyka | 12 August 2010
5. Computational Approaches to Biochemical Reactivity: 19 (Understanding Chemical Reactivity) by GáborNáray-Szabó and AriehWarshel | 31 March 2002

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2		3											3	
3	3												3	
4	3												3	
5	3								1	1			3	
CO (W.A)	3	3							1	1			3	

22MEX35 - DESIGN OF PRESSURE VESSELS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : Nil

Course Objective:

- To introduce the Mathematical knowledge to design pressure vessels and piping
- To learn the ability to carry of stress analysis in pressure vessels and piping
- To study the design of vessels and theory of reinforcement.
- To study buckling and fracture analysis in vessels.
- To learn piping layout and flow diagram.

Course Outcomes The Student will be able to		Cognitive Level	Weightage of COs in End Semester Examination
CO1	Apply the various method to determine stree in pressure vessels.	Ap	20%
CO2	Apply the stress concept in pressure vessels.	Ap	20%
CO3	Analysis of stresses in pressure, buckling and fracture analysis in vessels.	An	30%
CO4	Design and analysis of vessels, piping layout and piping.	An	30%
CO5	Engage independent study as a member of team and make effective oral presentation on the application of PLM	U	Internal Assessment

UNIT I - INTRODUCTION	**(9)**
Methods for determining stresses – Terminology and Ligament Efficiency – Applications	
UNIT II - STRESSES IN PRESSURE VESSELS	**(9)**
Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.	
UNIT III - DESIGN OF VESSELS	**(9)**
Design of Tall cylindrical self-supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design	
UNIT IV - BUCKLING AND FRACTURE ANALYSIS IN VESSELS	**(9)**
Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.	
UNIT V – PIPING	**(9)**
Introduction – Flow diagram – piping layout and piping stress Analysis.	
	TOTAL : 45 PERIODS

TEXT BOOKS:

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors,1987.
2. Theory And Design Of Pressure Vessels (Pb 2001) by HARVEY J.F. | 1 January 2001

REFERENCES:

1. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors,1987.
2. Stanley, M. Wales, "Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.
3. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Sam Kannapan, "Introduction to Pipe Stress Analysis". John Wiley and Sons, 1985.
5. Theory and design of Pressure Vessels (Pb 2001)by HARVEY J.F. | 1 January 2001

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1													1	
2	3												1	
3		3											1	
4			1										1	
5										1			1	
CO (W.A)	3	3	1							1			1	

22MEX36 - CAD and CAE				
	L	T	P	C
	3	0	0	3

PREREQUISITE : Nil

Course Objective:	• Applying the fundamental concepts of computer graphics and its tools in a generic framework. • Creating and manipulating geometric models using curves, surfaces, and solids. • Applying concept of 3D modeling, visual realism, and CAD standard practices in engineering design • Developing mathematical models for Boundary Value Problems and their numerical solution. • Formulating solution techniques to solve non-linear problems.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Utilize fundamental concepts of computer graphics and its tools within a generic framework.	Ap	30%
CO2	Investigate the concepts of 3D modeling, visual realism, and standard CAD practices in engineering design.	An	20%
CO3	Assess various solution techniques for solving non-linear problems in engineering and design contexts.	Ap	30%
CO4	Develop innovative geometric models using advanced curves, surfaces, and solid manipulation techniques.	Ap	20%
CO5	Develop teamwork and collaboration skills through group-based CAD and CAE assignments and peer reviews.	Ap/An	Internal Assessment

UNIT I - FUNDAMENTALS OF COMPUTER GRAPHICS	**(6)**
Design process - Computer Aided Design – Computer graphics – co-ordinate systems- 2D and 3D transformations - Graphic primitives (point, line, circle drawing algorithms) - Clipping- viewing transformation. Standards for computer graphics	
UNIT II - GEOMETRIC MODELING	**(6)**
Representation of curves - Hermite cubic spline curve, Bezier curve, B-spline curves, Surface Modeling – Surface Entities, Representation of Surface, Bezier Surface, B-Spline Surface and Coons Surface. SolidModeling - Solid Entities, Solid Representation, Boundary Representation (B-Rep), Sweeps Representation, Constructive Solid Geometry (CSG).	
UNIT III - VISUAL REALISM and CAD STANDARDS	**(6)**
Need for hidden surface removal, The Depth - Buffer Algorithm, Properties that help in reducing efforts, Scan Line coherence algorithm, Span - Coherence algorithm, Area-Coherence Algorithms, Warnock's Algorithm, Priority Algorithms– shading – coloring – computer animation.Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange imagesOpen Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc.	
UNIT IV - FINITE ELEMENT ANALYSIS	**(6)**
Introduction to Finite Element Analysis- Historical Background – Weighted Residual Methods - Basic Concept of FEM – Variational Formulation of Boundary Value Problems – Ritz Method – Finite Element Modelling -Procedure to solving any Analytical or Numerical Problem.	

UNIT V – NON-LINEAR ANALYSIS	(6)
Introduction to Non-linear problems - some solution techniques- computational procedure- material nonlinearity-Plasticity and visco-plasticity, stress stiffening, contact interfaces- problems of gaps and contact - geometric non-linearity - modeling considerations - Free and Mapped meshing -Mesh quality- Error estimate- Introduction to Analysis Software.	
CAD & CAE LABORATORY **Experiments** 1. Design and animate Piston Cylinder assembly and motion study using CAD software. 2. Design and simulate Connecting rod and crank shaft using CAD software. 3. Design and simulate Two Cylinder Engine assembly using CAD software. 4. Coupled Simulation of structural /thermal analysis 5. Harmonic, Transient and spectrum analysis of simple systems. 6. Buckling analysis	
	TOTAL(L:45) = 45 PERIODS

TEXT BOOKS:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007
2. Seshu.P, "Textbook of Finite Element Analysis", PHI Learning Pvt. Ltd., NewDelhi, 2012.

REFERENCES:

1. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.
2. Donald Hearn and M. Pauline Baker "Computer Graphics"". Prentice Hall, Inc, 1992.
3. Foley, Wan Dam, Feiner and Hughes – "Computer graphics principles & practice", Pearson Education - 2003
4. Rao, S.S., "The Finite Element Method in Engineering", 6th Edition, ButterworthHeinemann,2018.
5. Reddy,J.N. "Introduction to the Finite Element Method", 4thEdition, Tata McGrawHill,2018.Nitin S.Gokhale, Sanjay S Deshpande, Sanjeev V Bedekar and Anand N Thite "Practical Finite Element Analysis", Finite to Infinite; 2008.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2		3											3	
3	3												3	
4	3												3	
5					3				1	1			3	
CO (W.A)	3	3			3				1	1			3	

22MEX37 FAILURE ANALYSIS AND NDT TECHNIQUES				
	L	T	P	C
	3	0	0	3

PREREQUISITE :

Course Objective:	• To gain knowledge on the need, scope, and methodologies of failure analysis • To learn the principles and applications of visual and penetrant testing • To Understand the principles, techniques, and advanced methods of magnetic particle testing • To learn the principles and techniques of radiographic inspection using X-ray and gamma radiography • To teach various safety standards and precautions in nondestructive testing methods.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the principles, methods, and applications of various non-destructive testing techniques	Ap	40%
CO2	Apply the failure analysis strategies in engineering.	Ap	20%
CO3	Analyze non-destructive testing methods for suitable application and interpret failure modes	An	20%
CO4	Analyze failure analysis, including FMEA and RCA, to investigate and prevent engineering failures	An	20%
CO5	Implement safety protocols in non-destructive testing methods.	U/Ap	Internal Assessment

UNIT I - FAILURE ANALYSIS	**(9)**
Introduction and need and scope of failure analysis. Engineering Disasters and understanding failure analysis. Fundamental sources of failures.Failuremodes and effects analysis (FMEA) in industry.Role of root cause analysis (RCA) in failure investigation.failure prevention strategies: Design optimization, material selection, quality control	
UNIT II - VISUAL INSPECTION AND PENETRANT TESTING	**(9)**
Non destructive testing - advantages- comparison between destructive and non destructive testing -visual inspection - basic terms, equipments used - machine vision Health and safety considerations in NDT: Personal protective equipment (PPE), exposure limits-Principle of penetrant testing - test stations - accessories - applications - types of penetrants - characteristics of good penetrants - developer and its types - quality and process control - health and safety precautions in Liquid penetrant Inspection.	
UNIT III : MAGNETIC PARTICLE TESTING	**(9)**
Principle of Magnetic particle testing - scope - basic terms associated with magnetic materials, classification of magnetic materials - magnetic field orientation - direct magnetization, indirect magnetization - DC and AC magnetization – skineffect - equipments - lights - magnetic field indicator - Advanced magnetic particle testing methods: Multi-directional magnetization, rotational magnetization, automated magnetic particle inspection systems: Robotics, Computer vision Integration, Emerging trends in magnetic particle inspection: Nano-particle enhanced testing.	
UNIT IV: RADIOGRAPHIC INSPECTION	**(9)**
Types of radiations - X-Ray radiography principle - X ray tube generator - gamma radiation sources - advantages of gamma rays over X ray radiography - X-Ray film and accessories - film interpretation - digital radiography - precautions against radiation hazards and health - Real-time radiography and tomography techniques. Radiographic image interpretation: Defect detection and sizing	

UNIT V : ULTRASONIC AND EDDY CURRENT TESTING	(9)
Principle of ultrasonic testing - equipments used in ultrasonic testing -Ultrasonic inspection techniques – transmission method, pulse echo method, immersion technique, angle beam technique- applications – cathode ray oscilloscope – Ultrasonic testing for composite materials and additive manufacturing parts- Introduction to Phased Array Ultrasonic Testing (PAUT).Eddy current testing - working principle - basic terms -factors affecting eddycurrents - eddy current flow characteristics - applications	
TOTAL=45PERIODS	

TEXTBOOKS:

1. Osama Lari, Rajeev Kumar, "Basics of Non-Destructive testing", 1st ed., S.K.Kataria and Sons, 2013
2. Baldev Raj, T.Jayakumar, M.Thavasimuthu Practical Non-Destructive Testing, Narosa Publishing House, 2014.

REFERENCES:

1. ASM International,"ASM Handbook: Nondestructive Evaluation and Quality Control - Volume 17", 9th Revised edition, 1989
2. Charles, J. Hellier, Handbook of Non destructive evaluation, McGraw Hill, New York 2001.
3. Ravi Prakash, "Non-Destructive Testing Techniques", First Revised edition, New Age International (P) Limited, 2010
4. Prasad.J and Nair.C.G.K, "Non-Destructive Test and Evaluation of Materials", 2nd ed., Tata McGraw-Hill Publishing company Limited, 2011
5. Yoshida Kenichi and Laodeno Rem N, "Non-Destructive Testing Technique", LAP Lambert Academic Publishing, 2013

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	2
2	3												3	2
3		2											2	
4		2												
5						2		2				2		
CO (W.A)	**3**	**2**	**-**	**-**	**-**	**2**	**-**	**2**	**-**	**-**	**-**	**2**	**3**	**2**

22MEX38 MACHINE LEARNING FOR INTELLIGENT SYSTEMS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : Nil

Course Objective:	• To introduce basic machine learning techniques such as regression, classification • To learn about introduction of clustering, types and segmentation methods • To learn about fuzzy logic, fuzzification and defuzzification • To learn about basics of neural networks and neuro fuzzy networks • To learn about recurrent neural networks and reinforcement learning

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply basic machine learning techniques such as regression, classification	Ap	20%
CO2	Develop and analyze clustering and segmentation methods	An	20%
CO3	Applying a fuzzy logic system with fuzzification and defuzzification.	Ap	40%
CO4	Apply the concepts of neural networks and neuro fuzzy networks	Ap	20%
CO5	Improve knowledge on reinforcement learning	U	Internal Assessment

UNIT I- INTRODUCTION TO MACHINE LEARNING	(9)
Philosophy of learning in computers, overview of different forms of learning, classifications vs. regression, evaluation metrics and loss functions in classification, evaluation metrics and loss functions in regression, applications of ai in robotics.	
UNIT II - CLUSTERING AND SEGMENTATION METHODS	(9)
Introduction to clustering, types of clustering, agglomerative clustering, K-means clustering, mean shift clustering, K-means clustering application study, Introduction to recognition, K-nearest neighbor algorithm, KNN application case study, principal component analysis (PCA), PCA application case study in feature selection for robot guidance.	
UNIT III - FUZZY LOGIC	(9)
Introduction to fuzzy sets, classical and fuzzy sets, overview of classical sets, membership function, fuzzy rule generation, fuzzy rule generation, operations on fuzzy sets, numerical examples, fuzzy arithmetic, numerical examples, fuzzy logic, fuzzification, fuzzy sets, defuzzification, application case study of fuzzy logic for robotics application.	
UNIT IV - NEURAL NETWORKS	(9)
Mathematical models of neurons, ANN architecture, learning rules, multi-layer perceptrons, back propagation, introduction of neuro-fuzzy systems, architecture of neuro fuzzy networks, application case study of neural networks in robotics.	

UNIT V – RNN AND REINFORCEMENT LEARNING	(9)
Unfolding computational graphs, recurrent neural networks, application case study of recurrent networks in robotics, reinforcement learning, examples for reinforcement learning, markov decision process, major components of RL, Q-learning. application case study of reinforcement learning in robotics.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Micheal negnevitsky, artificial intelligence: a guide to intelligent systems, 3rd edition, addision wesley, england, 2011.
2. The Elements of Statistical Learning, by Trevor Hastie, Robert Tibshirani, Jerome H. Friedman (freely available online)
3. Pattern Recognition and Machine Learning, by Christopher Bishop.

REFERENCES:

1. Bruno siciliano, oussama khatib, "handbook of robotics", 2016 2nd edition, springer
2. Simon haykin, "neural networks and learning machines: a comprehensive foundation", third edition, pearson, delhi 2016.
3. Timothy j ross, "fuzzy logic with engineering applications", 4th edition, chichester, 2011, sussex wiley.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												1	
2		3												
3	3													
4					3								1	
5												2		
CO (W.A)	3	3			3							2	1	

22MEX41 – DIGITAL MANUFACTURING AND IoT				
	L	T	P	C
	3	0	0	3
PREREQUISITE :				

Course Objective:	• 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 The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply and Impart knowledge to use various elements in the digital manufacturing.	Ap	20%
CO2	Differentiate the concepts involved in digital product development life cycle process and supply chain management in digital environment.	An	20%
CO3	Develop the proper procedure of validating practical work through digital validation in Factories.	An	40%
CO4	Explore and Implement the concepts of IoT and its role in digital manufacturing.	Ap	20%
CO5	Evaluate and optimize various practical manufacturing process through digital twin.	Ap	Internal Assessment

UNIT I - INTRODUCTION TO DIGITAL MANUFACTURING AND IoT	(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. IoT Sensors – Temperature, Pressure, Gyroscope, Motion detection and proximity.	
UNIT II - DIGITAL LIFE CYCLE & 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, New Product Development (NPD) process, stages, test marketing & product launch	
UNIT III - SMART FACTORY	(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 Cyber security – Advanced Simulation Tool – Solid works, MATLAB, SIMUL8, Logisim.	

UNIT IV - INDUSTRY 4.0	(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 (CPS) –Machine to Machine communication – Case Studies. IoT Applications in Agriculture, Healthcare, Transportation, Hospitality, Smart Grid and Energy saving.	
UNIT V - STUDY OF DIGITAL TWIN	(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 (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.
2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", A press, 2016.

REFERENCES:

1. Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009.
2. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019.
3. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017
4. Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2					3							3		
3			3			3								
4														
5														
CO (W.A)	3		3		3	3						3	3	

22MEX42 ADDITIVE MANUFACTURING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objective:	• To introduce the fundamental concepts of Additive Manufacturing (AM) technology and to identify the business opportunities and future directions in AM • To understand the role of CAD modeling in AM and the post-processing techniques.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Evaluate the benefits and diverse applications of AM in the areas of building, bio, food, and electronics.	Ev	20%
CO2	Describe the processes, materials, advantages, and limitations of stereolithography (SLA), digital light processing (DLP), and continuous liquid interface production (CLIP).	U	20%
CO3	Generate accurate STL files and address errors through CAD software for AM.	Ap	20%
CO4	Identify the current and potential business opportunities in the AM industry and predict future trends.	An	20%
CO5	Analyze the suitable process for different AM techniques for specific applications.	An	20%

UNITI: FUNDAMENTALS OFADDITIVE MANUFACTURING AND BUSINESS OPPORTUNITIES	**(9)**
Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling-Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing- Electronics Printing. Business Opportunities and Future Directions –	
UNITII:DESIGN FOR ADDITIVE MANUFACTURING	**(9)**
Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization- Generative design - Lattice Structures - Multi-Material Parts and Graded Materials - AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation – Design rules for Extrusion based AM.	
UNITIII:VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION	**(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.Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery - Materials -Benefits -Applications.	
UNITIV:POWDER BED FUSION AND MATERIAL EXTRUSION	**(9)**
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. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.	

UNITV:CAD MODELLING AND POST-PROCESSING	(9)
CAD Software for AM: AM file format, STL file generation, accuracy of STL files, errors and repairs in STL files, direct and adaptive slicing; Design for additive manufacturing - design for minimum material usage. Post-processing: Support material removal, surface texture improvements, aesthetic improvements, property enhancement using thermal and non-thermal techniques.	
TOTAL= 45PERIODS	

TEXT BOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, MahyarKhorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.

REFERENCES:

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
2. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States, 2006, ISBN: 978-1-4614-9842-1.
5. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3				3						3	3
2	3	3					3						2	3
3	3	3					3							3
4	3	3					3				3			3
5	3	3	3				3					3	3	3
CO (W.A)	**3**	**3**	**3**				**3**				**3**	**3**	**2.6**	**3**

22MEX43 – GREEN MANUFACTURING DESIGN & PRACTICES				
	L	T	P	C
	3	0	0	3
PREREQUISITE :				

Course Objective:	• To familiarize the concept of environmental design and industrial ecology. • To impart knowledge of air pollution and its effects on the environment. • To emphasize knowledge about noise pollution and its control. • To enlighten the students with knowledge about water pollution and its effects on the environment. • To emphasize the need of green co-rating and its benefits.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply knowledge on the environmental design and selection of eco-friendly materials.	Ap	20%
CO2	Analyze the processes plan minimization for preventing air pollution.	An	20%
CO3	Recognize the methods to prevent noise pollution and its hazards	Ap	40%
CO4	Design and develop the impact of water demand and pollutants of water.	Ap	20%
CO5	Evaluate green co-rating and its benefits.	An/ Cr	Internal Assessment

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 equation-the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants - sulfur dioxide-nitrogen dioxide, 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 (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
2. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006

REFERENCES:

1. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
2. Frances Cairncross– Costing the Earth: The Challenge for Governments, the Opportunities for Business – Harvard Business School Press – 1993.
3. World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.
4. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006
5. Rao CS Environmental Pollution Control Engineering-, Wiley Eastern Ltd., New Delhi, 2006.
6. Lewis H Bell and Douglas H Bell, Industrial noise control, Fundamentals and applications, Marcel Decker, 1994.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1			3				3						2	
2	3													
3												3		
4		3												
5														
CO (W.A)	3	3	3				3					3	2	

22MEX44 - CASTING AND WELDING PROCESSES				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To study the ferrous casting metallurgy and its applications • To study the nonferrous casting metallurgy and its applications • To study the ferrous welding metallurgy and its applications • To study the welding metallurgy of alloy steels and nonferrous metals and its applications • To Identifying the causes and remedies of various welding defects; applying welding standards and codes.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply comprehensive knowledge of ferrous and non-ferrous alloys, to effectively contribute to the field of metallurgical engineering.	Ap	20%
CO2	Analyze the advanced principles of solidification, microstructural analysis, alloy composition, and welding techniques.	An	20%
CO3	Design and develop advanced materials and processes in metallurgical engineering by applied comprehensive knowledge of ferrous and non-ferrous alloy.	Ap	20%
CO4	Apply ethical principles and professional responsibility in the practice and management of metallurgical engineering processes.	Ap	20%
CO5	Continuously update knowledge and skills in metallurgical engineering, including solidification processes, alloy compositions, welding techniques, and defect analysis	Ap	20%

UNIT I- FERROUS CAST ALLOYS	**(9)**
Solidification of pure metals and alloys and eutectics -Nucleation - Growth Process, Critical nucleus size-Super cooling- Niyama Criterion -G/R ratio- Cell- Dendritic - Random dendritic structure-Segregation and Coring- Eutectics-Compositions and alloys in Cast Irons, FG-CGI- SG structures, Metallic Glass- Mold dilation, Mold metal reactions- Structure and Section sensitivity Cast irons- family & microstructures-Alloying effects- Malleable Iron, ADI, Charge calculations- Effect of normal elements and alloying elements in steels-Compositional aspects and properties of alloy steels- melting procedure and composition control for carbon steels- low alloy steels - stainless steels- composition control- slag-metal reactions-desulphurization-dephosphorization, specifications for carbon steels- low alloy steels and stainless steels .	
UNIT II - NON-FERROUS CAST ALLOYS	**(9)**
Copper- Aluminium- Magnesium- zinc - Nickel base alloys- melting practices - Al alloys, Mg alloys, Nickel alloys, Zinc alloys and copper alloys-modification and grain refinement of Al alloys- problems in composition control- degassing techniques -Heat Treatment of Aluminium alloys – Basics of Solution and Precipitation process. - Applications of Aluminium Alloy castings in various fields. Residual Stresses- defects in castings.	
UNIT III - PHYSICAL METALLURGY OF WELDING	**(9)**
Welding of ferrous materials: Formation of different microstructural zones in welded plain-carbon steels. Welding of C-Mn and low-alloy steels, phase transformations in weld and heat - affected zones, cold cracking, role of hydrogen and carbon equivalent, formation of acicular ferrite and effect on weld metal toughness.	

UNIT IV - WELDING OF ALLOY STEELS AND NON-FERROUS METALS	(9)
Welding of stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, Sensitisation, hot cracking, sigma phase and chromium carbide formation, ways of overcoming these difficulties, welding of cast iron. Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys, problems encountered and solutions.	
UNIT V – DEFECTS, WELDABILITY AND STANDARDS	**(9)**
Defects in welded joints: Defects such as arc strike, porosity, undercut, slag entrapment and hot cracking, causes and remedies in each case. Joining of dissimilar materials, weldability and testing of weldments. Introduction to International Standards and Codes.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Heine R W, Loper C R and Rosenthal P C, "Principles of Metal Castings", Tata McGraw Hill, 2017
2. A.K.Chakrabarthi, 'Casting Technology and Cast Alloys, Prentice Hall, 2005.

REFERENCES:

1. Baldev Raj, Shankar V, Bhaduri A K, "Welding Technology for Engineers", Narosa Publications, 2009.
2. Beeley P, "Foundry Technology" Butterworth-Heinemann, 2001.
3. R.S.Parmar, 'Welding Engineering and Technology', Khanna Publishers, 2010
4. John Campbell, "Casting", Butterworth-Heinemann, 2003.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	1
2		3											2	1
3			3										2	1
4								3					2	1
5												3	2	1
CO (W.A)	3	3	3					3				3	2	1

22MEX45– ENVIRONMENT SUSTANABILITY AND IMPACT ASSESSMENT				
	L	T	P	C
	3	0	0	3
PREREQUISITE : Nil				

Course Objective:	• To understand the concepts of Environmental Sustainability & Impact Assessment • To familiarize the students in environmental decision making procedure. • 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 The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts of Environment Sustainability and trained to make decision related to Environment.	Ap	20%
CO2	Implement lifelong learning skills to make a decision that has an effect on our environment	An	20%
CO3	Evaluate the basics of environmental policy, planning and various legislation	An	40%
CO4	Design and optimize the Life cycle assessment of Environmental sustainability.	Ap	20%
CO5	Analyze the suitable sustainable urban economic development.	An/Ap	Internal Assessment

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. Case studies on air quality, water quality, noise pollution and ecosystem upset.	
UNIT II - ENVIRONMENTAL DECISION MAKING	(9)
Strategic environmental assessment and sustainability appraisal – Mitigation, monitoring and management of environmental impacts- Socio economic impact assessment. Case Studies on use of transport, making consumer decisions, planning new or improved developments and managing natural resources.	
UNIT III - ENVIRONMENTAL POLICY, PLANNING AND LEGISLATION	(9)
Regional spatial planning and policy – Cumulative effects assessment – Planning for climate change, uncertainty and risk. Case studies on Strategy for the Chemical BREFs series review cycle, Carbon Monoxide Emissions from Medium Combustion Plants and Assessment of permitting stringency in industrial installations.	
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. Life cycle inventory analysis (LCI). Social Life Cycle Assessment (SLCA).	

UNIT V - SUSTAINABLE URBAN ECONOMIC DEVELOPMENT	(9)
Spatial economics – Knowledge economy and urban regions. Case studies on market forces in the development of cities, land use within cities, urban transportation, urban problems and public policy, housing and public policy, and local government expenditures and taxes.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. The Application of Science in Environmental Impact Assessment, by Aaron J. MacKinnon, Peter N. Duinker , Tony R. Walker , Routledge; 1st edition (14 May 2019), ISBN-10 : 0367340194
2. Routledge Handbook of Environmental Impact Assessment, by Kevin Hanna, Routledge; 1st edition (11 April 2022), ISBN-10 : 0367244470

REFERENCES:

1. Clive George, C. Collin, H. Kirkpolarice – Impact Assessment and sustainable development – Edward Elgar Publishing, 2007
2. Robort B Gibsan, Sustainability Assessment, Earth Scan publishers, 2005
3. Simon Dresner, The principle of sustainability – Earth Scan publishers, 2008
4. Canter, R.L., "Environmental Impact Assessment", McGraw Hill Inc., New Delhi, 1996.
5. Shukla, S.K. And Srivastava, P.R., "Concepts In Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 1992.
6. John G. Rau And David C Hooten "Environmental Impact Analysis Handbook", McGraw Hill Book Company, 1990.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		2											2	
3			3											
4												3		
5							3							
CO (W.A)	3	2	3				3					3	2	

22MEX46-SURFACE ENGINEERING				
	L	T	P	C
	3	0	0	3
PREREQUISITE : Nil				

Course Objective:	• 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 The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts and terminology of surface engineering	Ap	30%
CO2	Apply the surface engineering methods to the mechanical component	Ap	30%
CO3	Analyze the surface of the mechanical component	Ap	20%
CO4	Design surface treatments for industrial applications.	An	20%
CO5	Engage independent study as a member of team and make effective oral presentation on the surface Engineering techniques	U	Internal Assessment

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 nonmetals – 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 nonmetals – 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 – ENGINEERING MATERIALS	**(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 : 45 PERIODS

TEXT BOOKS:

1. G.W .Stachowiak and A.W.Batchelor, "Engineering Tribology", Butterworth-Heinemann, 2005.
2. S.K. Basu, S.N.Sengupta and B.B.Ahuja ,"Fundamentals of Tribology", Prentice Hall of India, 2005.

REFERENCES:

1. Fontana G., "Corrosion Engineering", McGraw Hill, 1985.
2. H lling, J. (Editor), "Principles of Tribology ", MacMillian, 1984.
3. Rabinowicz.E., "Friction and Wear of materials", John Willey &Sons,1995.
4. Williams J.A., "Engineering Tribology", Oxford University Press, 1994.
5. Joseph R. Davis, Corrosion: Understanding the Basics, ASM International, 2000.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												1	
2	3												1	
3		3											1	
4			1										1	
5										1			1	
CO (W.A)	3	3	1							1			1	

22MEX47 – GREEN SUPPLY CHAIN MANAGEMENT				
	L	T	P	C
	3	0	0	3

PREREQUISITE : Nil

Course Objective:	• To familiar the various standards and legislation of modern green electronic manufacturing. • To know the conventional electronic processing and lead-free electronic manufacturing techniques. • To recognize the steps involved in assembly process and understand the need of recycle the electronics • To implement reliability and product life cycle estimation tools in green electronic manufacturing. • To demonstrate the green electronic manufacturing procedure in real time applications.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply fundamentals to concise awareness of standards and legislation of modern electronic manufacturing for green environment.	Ap	20%
CO2	Optimize the conventional electronic processing and lead free electronic manufacturing techniques.	An	20%
CO3	Design and realize the assembly process and the need of recycle in electronics.	Ap	40%
CO4	Analyze reliability and product life cycle estimation tools for green electronic manufacturing.	An	20%
CO5	Validate the green electronic manufacturing procedures in real time applications.	An/ Cr	Internal Assessment

UNIT I - INTRODUCTION TO GREEN ELECTRONICS	(9)
Environmental concerns of the modern society- Overview of electronics industry and their relevant regulations in China, European Union and other key countries- global and regional strategy and policy on green electronics industry. Restriction of Hazardous substances (RoHS) - Waste Electrical and electronic equipment (WEEE) - Energy using Product (EuP) and Registration - Evaluation, Authorization and Restriction of Chemical substances (REACH).	
UNIT II - GREEN ELECTRONICS MATERIALS AND PRODUCTS	(9)
Basics of IC manufacturing and its process – Electronics with Lead (Pb) – free solder pastes, conductive adhesives, Introduction to green electronic materials and products - halogen-free substrates and components. Substitution of non-recyclable thermosetting polymer based composites with recyclable materials X-Ray Fluorescence (XRF) for identifying hazardous substances in electronic products.	

UNIT III - GREEN ELECTRONICS ASSEMBLY AND RECYCLING	(9)
Various processes in assembling electronics components - the life-cycle environmental impacts of the materials used in the processes - substrate interconnects. Components and process equipments - Technology and management on e-waste recycle system construction, global collaboration, and product disassembles technology. Sustainable Electronics Materials in PCB Manufacturing – Restriction of Hazardous Substances Directive in PCB Assembly.	
UNIT IV - PRODUCT DESIGN AND SUSTAINABLE ECO-DESIGN	(9)
Stages of product development process in green design: Materials- Manufacturing - Packaging and use - End of Life and disposal - Design for recycling - Life Cycle Assessment (LCA), and Eco-design tools - Environmental management systems, and International standards - Eco-design in electronics industry.	
UNIT V - CASE STUDIES	(9)
Reliability of green electronics systems , Reuse and recycle of End-of-Life(EOL) electrical and electronic equipment for effective waste management – Introduction of Green Supply Chain, and Modeling green products from Supply Chain point of view - A life-cycle assessment for eco-design of Cathode Ray Tube Recycling. Case studies on Green Supply Chains and Enabling RFID Technology, Healthcare, Aerospace, GSCM and construction industry.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Green Supply Chain Management, by Charisios Achillas , Dionysis D. Bochtis , Dimitrios Aidonis, Routledge; 1st edition (16 November 2018), ISBN-10 : 1138644617
2. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008.

REFERENCES:

1. David Austen, Green Electronic Morning, Ingleby Gallery, 2006.
2. John Hu. Mohammed Ismail, CMOS High Efficiency on – Chip Power Management, Springer Publications 4th edition, 2011.
3. Yuhang yang and Maode Ma, Green Communications and Networks, Springer Publication., 2014.
4. Sanka Ganesan, Michael Pecht, Lead free Electronics, John Wiley & Sons, 2006.
5. Charles A. Harper, Electronic Materials and Processes Hand book, McGraw-Hill, 2010.
6. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008.

Mapping of COs with POs / PSOs

	POs												PSOs	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3		3										2	
2											3			
3		2					3							
4														
5														
CO (W.A)	**3**	**2**	**3**				**3**				**3**		**2**	

22MEX48 - PRODUCT LIFE CYCLE MANAGEMENT				
	L	T	P	C
	3	0	0	3

PREREQUISITE : Nil

Course Objective:	• To study about the history, concepts and terminology in PLM • To learn the functions and features of PLM/PDM • To develop different modules offered in commercial PLM/PDM tools • To demonstrate PLM/PDM approaches for industrial applications • To use PLM/PDM

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Summarize the history and apply the concepts and terminology of PLM.	Ap	30%
CO2	Apply the features of PLM/PDM.	Ap	30%
CO3	Analyze the different modules offered in commercial PLM/PDM tools.	Ap	20%
CO4	Design PLM/PDM for industrial applications.	An	20%
CO5	Engage independent study as a member of team and make effective oral presentation on the application of PLM	U	Internal Assessment

UNIT I - INTRODUCTION TO PRODUCT LIFECYCLE MANAGEMENT	**(9)**
Introduction to PLM, Fundamentals of PLM- Objective of PLM -Activities of PLM -Joined-up and Holistic Approach - Generic Product Lifecycle Phases, PLM Grid, Components of PLM Grid, Why PLM, How PLM.	
UNIT II - COMPLEX AND CHANGING ENVIRONMENT	**(9)**
Changes and Interconnections, Macroeconomic and Geopolitical Changes, Environmental and Social Changes, Corporate Changes, Technological Changes, Product Changes, The Result and the Requirements	
UNIT III - PLM DEPLOYMENT AND BUSINESS BENEFITS	**(9)**
Deployment Stages of PLM, PLM maturity model, Realization stage of the project, Accomplishing change, Business benefits of a PLIM system -Factors leading to PLM, Benefits of the PLM system, Improving the productivity of labour, Costs of quality, PLM and data warehousing as a tool to support decision-making	
UNIT IV - SERVICE INDUSTRY AND PLM	**(9)**
Introduction to service, Further productization of services, Making a service, PLM in service business - PLM challenges in service business, Services modularization, Making items out of product functions, IT specifically variable product.	
UNIT V – PRODUCT AND PRODUCT MANAGEMENT STRATEGY AS A PART OF BUSINESS STRATEGY	**(9)**
Product lifecycle management as a business strategy tool, From changes in the business environment to product strategy, Making a product strategy, Product management strategy, Time to market, Time to react, Time to volume, Time to service, Electronic business and PLM	
	TOTAL : 45 PERIODS

TEXT BOOKS:

1. John Stark, "Product Lifecycle Management: 21st Century Paradigm for Product Realisation", Springer Publisher, 2011 (2nd Edition).
2. AnttiSaaksvuori and AnselmiImmonen, "Product Lifecycle Management", Springer Publisher, 2008 (3rd Edition)

REFERENCES:

1. International Journal of Product Lifecycle Management, Inderscience Publishers
2. Ivica Cmkovic, Ulf Asklund and Annita Persson Dahlqvist, "Implementing and Integrating ProductData
3. Management and Software Configuration Management", Art ech House Publishers, 2003.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1													1	
2	3												1	
3		3											1	
4			1										1	
5										1			1	
CO (W.A)	3	3	1							1			1	