MIET
Mohamed Institute of Education & Technology
INSTITUTIONS
Since 1984

M.I.E.T. ENGINEERING COLLEGE

(Autonomous)

Tiruchirappalli-620007

Curriculum & Syllabus

(Regulations 2024)

B.E. Mechanical Engineering

M.I.E.T. ENGINEERING COLLEGE
(AUTONOMOUS)
(Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai)
Accredited by NBA (CIVIL, CSE, ECE, EEE & MECH)
Accredited with 'A+' grade by NAAC
(An ISO 9001:2015 Certified Institution)
(Recognized by UGC under section 2(f) & 12(B) of UGC Act, 1956)
TRICHY - PUDUKKOTTAI MAIN ROAD, TRICHY - 620 007

DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULUM AND SYLLABUS

B.E. MECHANICAL ENGINEERING
(Regulations 2024)

Vision

Establish a globally recognized school of Excellence in the field of Mechanical Engineering.

Mission

- Impart quality education in Mechanical Engineering through effective teaching – learning techniques.
- Provide necessary infrastructure and facilities for the student's personal and professional growth.
- Expose to specialised Mechanical Engineering domains to harness evolving technologies.
- Create awareness in ethical practices followed internationally.

Program Outcomes (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.
9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

1. Ability to apply the concepts of Mechanical Engineering fields to design mechanical systems and processes.
2. Ability to demonstrate professional and entrepreneurial skills to meet the industrial requirements.

Program Educational Objectives (PEOs)

1. To expose to the solutions of real life problems applying the skills of basic science, engineering design, manufacturing, thermal science and management.
2. To educate the students to effectively participate in multidisciplinary projects for the development of our society.
3. To create awareness among the students in the fields of research and development in mechanical engineering and other allied fields.

Mapping of PEOs with POs & PSOs

PEOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**2**
PEO2	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**2**	**2**	**3**	**2**	**3**	**2**
PEO3	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**2**

1 - Low, 2 - Medium, 3 – High

CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABI FOR SEMESTERS I TO VIII

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24IP1101	Induction Programme	-	-	-	-	-	0
2.	24HS1101	Professional English	HSMC	3	0	2	5	4
3.	24MU1101	Matrices and Calculus	BSC	3	1	0	4	4
4.	24PH1101	Engineering Physics	BSC	3	0	2	5	4
5.	24CY1101	Engineering Chemistry	BSC	3	0	2	5	4
6.	24GE1101	Problem Solving and Python Programming	ESC	3	0	2	5	4
7.	24GE1102	Heritage of Tamils தமிழர் மரபு	HSMC	1	0	0	1	1
8.	24GE1201	Professional Development	ESC	0	0	4	4	2
			Total	**16**	**1**	**12**	**29**	**23**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24HS2101	Writing Skills for Professionals / Language Elective	HSMC	3	0	0	3	3
2.	24MU2101	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	24PH2102	Material Physics	BSC	3	0	0	3	3
4.	24GE2101	Engineering Graphics	ESC	2	0	4	6	4
5.	24EE2101	Fundamentals of Electrical and Electronics Engineering	ESC	3	0	2	5	4
6.	24ME2101	Engineering Mechanics	ESC	3	1	0	4	4

7.	24GE2103	Tamils and Technology தமிழரும் தொழில்நுட்பமும்	HSMC	1	0	0	1	1
8.	24GE2201	Engineering Practice Laboratory	ESC	0	0	4	4	2
			Total	**18**	**2**	**10**	**30**	**25**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	**T**	**P**		
1.	24MU3101	Transforms and Partial Differential Equations	BSC	3	1	0	4	4
2.	24ME3101	Engineering Thermodynamics	PCC	3	0	0	3	3
3.	24ME3102	Fluid Mechanics and Machinery	PCC	3	1	0	4	4
4.	24ME3103	Strength of Materials	PCC	3	0	0	3	3
5.	24ME3104	Manufacturing Processes	PCC	3	0	2	5	4
6.	24ME3105	Engineering Materials and Metallurgy	PCC	3	0	2	5	4
7	24MC31XX	Mandatory Course I	MC	1	0	0	1	-
8.	24ME3201	Materials Testing Laboratory	PCC	0	0	3	3	1.5
9.	24ME3202	Fluid Mechanics and Machinery Laboratory	PCC	0	0	3	3	1.5
			Total	**19**	**2**	**10**	**31**	**25**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	**T**	**P**		
1.	24ME4101	Theory of Machines	PCC	3	0	0	3	3
2.	24ME4102	Thermal Engineering	PCC	3	0	2	5	4
3.	24ME4103	Machine Tools and Technology	PCC	3	0	0	3	3

4.	24ME4104	Applied Fluid Power Engineering	PCC	3	0	0	3	3
5.	24ME4105	Computer Aided Design	PCC	3	0	2	5	4
6.	24CY4101	Environmental Science	BSC	2	0	0	2	2
7.	24ME4201	Kinematics and Dynamics Laboratory	PCC	0	0	3	3	1.5
8.	24ME4202	Manufacturing Processes Laboratory	PCC	0	0	3	3	1.5
9.	24GE4201	Technical Seminar	EEC	0	0	2	2	1
			Total	**17**	**0**	**12**	**29**	**23**

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ME5101	Design of Machine Elements	PCC	3	0	2	5	4
2.	24ME5102	Heat and Mass Transfer	PCC	3	0	2	5	4
3.	24HS5101	Industrial Engineering and Management	HSMC	3	0	0	3	3
4.	24MEPEXX	Professional Elective I	PEC	3	0	0	3	3
5.	24MEPEXX	Professional Elective II	PEC	3	0	0	3	3
6.	24OXXXXX	Open Elective I	OEC	3	0	2	5	4
7.	24MC51XX	Mandatory Course II	MC	1	0	0	1	-
8.	24ME5201	Computational Fluid Dynamics Laboratory	PCC	0	0	2	2	1
			Total	**19**	**0**	**8**	**27**	**22**

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ME6101	Engineering Metrology	PCC	3	0	2	5	4
2.	24ME6102	Finite Element Analysis	PCC	3	0	2	5	4

3.	24MEPEXX	Professional Elective III	PEC	3	0	0	3	3
4.	24MEPEXX	Professional Elective IV	PEC	3	0	0	3	3
5.	24MEPEXX	Professional Elective V	PEC	3	0	0	3	3
6.	24OXXXXX	Open Elective II	OEC	3	0	0	3	3
7.	24ME6201	CAD/CAM Laboratory	PCC	0	0	2	2	1
8.	24ME6202	Design and Fabrication Project	EEC	0	0	4	4	2
9.	24PD6201	NCC/NSS/NSO*#	-	2	0	0	2	2*#
			Total	**18**	**0**	**10**	**28**	**23**

***# Guidelines for evaluation is provided in detail in the regulations/syllabus. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.**

SEMESTER VII

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	**T**	**P**		
1.	24ME7101	Mechatronics and IoT	PCC	3	0	2	5	4
2.	24HS7101	Professional Ethics in Engineering	HSMC	2	0	0	2	2
3.	24MEPEXX	Professional Elective VI	PEC	3	0	2	5	4
4.	24MEPEXX	Professional Elective VII	PEC	3	0	0	3	3
5.	24MEPEXX	Professional Elective VIII	PEC	3	0	0	3	3
6.	24OXXXXX	Open Elective III	OEC	3	0	0	3	3
7.	24ME7201	Mechatronics Laboratory	PCC	0	0	4	4	2
8.	24IS7201	Internship##	EEC	-	-	-	-	1
9.	24CA7201	Case study***	EEC	-	-	-	-	1
			Total	**17**	**0**	**8**	**25**	**23**

Students should undergo internship for a period of 2- 4 weeks during 6th Semester vacation.

***** Students should perform case study during 6th Semester vacation.**

SEMESTER VIII

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ME8501	Project Work	EEC	0	0	20	20	10
			Total	**0**	**0**	**20**	**20**	**10**

BASIC SCIENCE COURSES (BSC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MU1101	Matrices and Calculus	BSC	3	1	0	4	4
2.	24PH1101	Engineering Physics	BSC	3	0	2	5	4
3.	24CY1101	Engineering Chemistry	BSC	3	0	2	5	4
4.	24MU2101	Statistics and Numerical Methods	BSC	3	1	0	4	4
5.	24PH2102	Material Physics	BSC	3	0	0	3	3
6.	24MU3101	Transforms and Partial Differential Equations	BSC	3	1	0	4	4
7.	24CY4101	Environmental Science	BSC	2	0	0	2	2
							Total	**25**

ENGINEERING SCIENCE COURSES (ESC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24GE1101	Problem Solving and Python Programming	ESC	3	0	2	5	4
2.	24GE1201	Professional Development	ESC	0	0	4	4	2
3.	24GE2101	Engineering Graphics	ESC	2	0	4	6	4
4.	24EE2101	Fundamentals of Electrical and Electronics Engineering	ESC	3	0	2	5	4

5.	24ME2101	Engineering Mechanics	ESC	3	1	0	4	4
6.	24GE2201	Engineering Practice Laboratory	ESC	0	0	4	4	2
							Total	**20**

HUMANITIES, SOCIAL SCIENCES AND MANAGEMENT COURSES (HSMC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24HS1101	Professional English	HSMC	3	0	2	5	4
2.	24GE1102	Heritage of Tamils – தமிழர் மரபு	HSMC	1	0	0	1	1
3.	24HS2101	Writing Skills for Professionals / Language Elective	HSMC	3	0	0	3	3
4.	24GE2103	Tamils and Technology தமிழரும் தொழில்நுட்பமும்	HSMC	1	0	0	1	1
5.	24HS5101	Industrial Engineering and Management	HSMC	3	0	0	3	3
6.	24HS7101	Professional Ethics in Engineering	HSMC	2	0	0	2	2
							Total	**14**

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24GE4201	Technical Seminar	EEC	0	0	2	2	1
2.	24ME6202	Design and Fabrication Project	EEC	0	0	4	4	2
3.	24IS7201	Internship	EEC	-	-	-	-	1
4.	24CA7201	Case study	EEC	-	-	-	-	1
5.	24ME8501	Project Work	EEC	0	0	20	20	10
							Total	**15**

PROFESSIONAL CORE COURSES (PCC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ME3101	Engineering Thermodynamics	PCC	3	0	0	3	3
2.	24ME3102	Fluid Mechanics and Machinery	PCC	3	1	0	4	4
3.	24ME3103	Strength of Materials	PCC	3	0	0	3	3
4.	24ME3104	Manufacturing Processes	PCC	3	0	2	5	4
5.	24ME3105	Engineering Materials and Metallurgy	PCC	3	0	2	5	4
6.	24ME3201	Materials Testing Laboratory	PCC	0	0	3	3	1.5
7.	24ME3202	Fluid Mechanics and Machinery Laboratory	PCC	0	0	3	3	1.5
8.	24ME4101	Theory of Machines	PCC	3	0	0	3	3
9.	24ME4102	Thermal Engineering	PCC	3	0	2	5	4
10.	24ME4103	Machine Tools and Technology	PCC	3	0	0	3	3
11.	24ME4104	Applied Fluid Power Engineering	PCC	3	0	0	3	3
12.	24ME4105	Computer Aided Design	PCC	3	0	2	5	4
13.	24ME4201	Kinematics and Dynamics Laboratory	PCC	0	0	3	3	1.5
14.	24ME4202	Manufacturing Processes Laboratory	PCC	0	0	3	3	1.5
15.	24ME5101	Design of Machine Elements	PCC	3	0	2	5	4
16.	24ME5102	Heat and Mass Transfer	PCC	3	0	2	5	4
17.	24ME5201	Computational Fluid Dynamics Laboratory	PCC	0	0	2	2	1

18.	24ME6101	Engineering Metrology	PCC	3	0	2	5	4
19.	24ME6102	Finite Element Analysis	PCC	3	0	2	5	4
20.	24ME6201	CAD/CAM Laboratory	PCC	0	0	2	2	1
21.	24ME7101	Mechatronics and IoT	PCC	3	0	2	5	4
22.	24ME7201	Mechatronics Laboratory	PCC	0	0	4	4	2
							Total	**65**

PROFESSIONAL ELECTIVE COURSES (PEC)

SEMESTER V, PROFESSIONAL ELECTIVE I
THERMAL ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MEPE01	Computational Fluid Dynamics	PEC	3	0	0	3	3
2.	24MEPE02	Fuel Cells and Hydrogen Technology	PEC	3	0	0	3	3
3.	24MEPE03	Energy Conservation in Industrial Applications	PEC	3	0	0	3	3
4.	24MEPE04	Design of Heat Exchangers and Pressure Vessels	PEC	3	0	0	3	3
5.	24MEPE05	Solar Energy Techniques	PEC	3	0	0	3	3
6.	24MEPE06	Advanced Internal Combustion Engines	PEC	3	0	0	3	3
7.	24MEPE07	Measurement in Thermal Engineering	PEC	3	0	0	3	3
8.	24MEPE08	Advanced Nuclear Engineering	PEC	3	0	0	3	3
9.	24MEPE09	HVAC Systems	PEC	3	0	0	3	3
10.	24MEPE10	Gas Dynamics and Jet Propulsion	PEC	3	0	0	3	3

SEMESTER V, PROFESSIONAL ELECTIVE II
MANUFACTURING ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MEPE11	Additive Manufacturing	PEC	3	0	0	3	3
2.	24MEPE12	Lean, Micro and Green Manufacturing	PEC	3	0	0	3	3
3.	24MEPE13	Advanced Manufacturing Technologies	PEC	3	0	0	3	3
4.	24MEPE14	Non-Traditional Manufacturing Processes	PEC	3	0	0	3	3
5.	24MEPE15	Advanced Welding Technology	PEC	3	0	0	3	3
6.	24MEPE16	Industrial Robotics and Material Handling System	PEC	3	0	0	3	3
7.	24MEPE17	Production Planning and Control	PEC	3	0	0	3	3
8.	24MEPE18	Foundry Technology	PEC	3	0	0	3	3
9.	24MEPE19	MEMS and NEMS	PEC	3	0	0	3	3
10.	24MEPE20	Non-Destructive Testing	PEC	3	0	0	3	3

SEMESTER VI, PROFESSIONAL ELECTIVE III
AUTOMOTIVE ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MEPE21	Automobile Engineering	PEC	3	0	0	3	3
2.	24MEPE22	Automotive Electricals and Electronics	PEC	3	0	0	3	3
3.	24MEPE23	Hybrid and Electric Vehicles Technology	PEC	3	0	0	3	3

4.	24MEPE24	Vehicle Body and Aerodynamics Engineering	PEC	3	0	0	3	3
5.	24MEPE25	Sensors and Instrumentation	PEC	3	0	0	3	3
6.	24MEPE26	Autonomous Vehicle Systems	PEC	3	0	0	3	3
7.	24MEPE27	Marine and Aerospace Engineering	PEC	3	0	0	3	3
8.	24MEPE28	Lubrication Engineering	PEC	3	0	0	3	3
9.	24MEPE29	Petroleum Engineering	PEC	3	0	0	3	3
10.	24MEPE30	Nano-Science and Technology	PEC	3	0	0	3	3

SEMESTER VI, PROFESSIONAL ELECTIVE IV
MECHANICAL DESIGN

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MEPE31	Design of Process Equipment	PEC	3	0	0	3	3
2.	24MEPE32	Design of Robot Elements	PEC	3	0	0	3	3
3.	24MEPE33	Design Practices and Principles	PEC	3	0	0	3	3
4.	24MEPE34	Design of Industrial Vehicles	PEC	3	0	0	3	3
5.	24MEPE35	Ergonomics in Design	PEC	3	0	0	3	3
6.	24MEPE36	Industrial Tribology	PEC	3	0	0	3	3
7.	24MEPE37	Design of Machine Drives	PEC	3	0	0	3	3
8.	24MEPE38	Fracture Mechanics	PEC	3	0	0	3	3
9.	24MEPE39	Optimization in Engineering Design	PEC	3	0	0	3	3
10.	24MEPE40	Dynamics and Vibrations	PEC	3	0	0	3	3

SEMESTER VI, PROFESSIONAL ELECTIVE V
MANAGEMENT AND QULAITY ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MEPE41	Total Quality Management	PEC	3	0	0	3	3
2.	24MEPE42	Supply Chain management	PEC	3	0	0	3	3
3.	24MEPE43	Product Life Cycle Management	PEC	3	0	0	3	3
4.	24MEPE44	Strategic Manufacturing Management	PEC	3	0	0	3	3
5.	24MEPE45	Process and Product Quality in Engineering	PEC	3	0	0	3	3
6.	24MEPE46	Operational Management	PEC	3	0	0	3	3
7.	24MEPE47	Product Innovation and Startup Strategy	PEC	3	0	0	3	3
8.	24MEPE48	Maintenance Engineering	PEC	3	0	0	3	3
9.	24MEPE49	Business Economics and Financial Analysis	PEC	3	0	0	3	3
10.	24MEPE50	Operations Research	PEC	3	0	0	3	3

SEMESTER VII, PROFESSIONAL ELECTIVE VI
ADVANCED TECHNOLOGIES IN SUSTAINABLE MECHANICAL ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MEPE51	Energy Resources and Storage Techniques	PEC	3	0	2	5	4
2.	24MEPE52	Fuels, Combustion and Pollution Control Techniques	PEC	3	0	2	5	4
3.	24MEPE53	Composite Materials and Mechanics	PEC	3	0	2	5	4

4.	24MEPE54	Waste to Energy Conversion Technologies	PEC	3	0	2	5	4
5.	24MEPE55	Refrigeration and Air-Conditioning	PEC	3	0	2	5	4
6.	24MEPE56	Design of Jigs, Fixtures and Press Tools	PEC	3	0	2	5	4
7.	24MEPE57	Product Design and development	PEC	3	0	2	5	4
8.	24MEPE58	Artificial Intelligence in Mechanical Engineering	PEC	3	0	2	5	4
9.	24MEPE59	CAD & CAE Tools	PEC	3	0	2	5	4
10.	24MEPE60	Alternative Fuels for Transportation	PEC	3	0	2	5	4

SEMESTER VII, PROFESSIONAL ELECTIVE VII
THERMAL AND ENERGY SYSTEMS

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MEPE61	Battery Thermal Management Systems	PEC	3	0	0	3	3
2.	24MEPE62	Steam Generator Technology	PEC	3	0	0	3	3
3.	24MEPE63	Compressible Flow	PEC	3	0	0	3	3
4.	24MEPE64	Turbo Machinery	PEC	3	0	0	3	3
5.	24MEPE65	Cryogenic Engineering	PEC	3	0	0	3	3
6.	24MEPE66	Boilers and Accessories	PEC	3	0	0	3	3
7.	24MEPE67	Pumps, Blowers and Compressor	PEC	3	0	0	3	3
8.	24MEPE68	Power Plant Engineering	PEC	3	0	0	3	3
9.	24MEPE69	Energy Audit and Management	PEC	3	0	0	3	3
10.	24MEPE70	Thermal and Fired Equipment Design	PEC	3	0	0	3	3

SEMESTER VII, PROFESSIONAL ELECTIVE VIII
ADVANCED MANUFACTURING AND INDUSTRIAL ENGINEERING

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MEPE71	Safety and Reliability Engineering	PEC	3	0	0	3	3
2.	24MEPE72	Process Planning and Cost Estimation	PEC	3	0	0	3	3
3.	24MEPE73	Computer Assisted Process Planning	PEC	3	0	0	3	3
4.	24MEPE74	Computer Integrated Manufacturing	PEC	3	0	0	3	3
5.	24MEPE75	Flexible Manufacturing	PEC	3	0	0	3	3
6.	24MEPE76	Ceramic Processing and Technology	PEC	3	0	0	3	3
7.	24MEPE77	Microprocessor Applications in Manufacturing	PEC	3	0	0	3	3
8.	24MEPE78	Digital Manufacturing	PEC	3	0	0	3	3
9.	24MEPE79	Material Characterization and Techniques	PEC	3	0	0	3	3
10.	24MEPE80	Precision Machining	PEC	3	0	0	3	3

MANDATORY COURSES (MC)
MANDATORY COURSES I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MC3101	Legal System of India	MC	3	0	0	3	0
2.	24MC3102	IPR and Patent Drafting	MC	3	0	0	3	0
3.	24MC3103	Literary Forms and Techniques	MC	3	0	0	3	0
4.	24MC3104	Disaster Risk Reduction and Management	MC	3	0	0	3	0
5.	24MC3105	Film Appreciation	MC	3	0	0	3	0
6.	24MC3106	Women and Gender Studies	MC	3	0	0	3	0

MANDATORY COURSES II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MC5101	Food and Nutrition	MC	3	0	0	3	0
2.	24MC5102	Design Thinking	MC	3	0	0	3	0
3.	24MC5103	History of Science and Technology in India	MC	3	0	0	3	0
4.	24MC5104	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
5.	24MC5105	State, Nation Building and Politics in India	MC	3	0	0	3	0
6.	24MC5106	Industrial Safety	MC	3	0	0	3	0

OPEN ELECTIVE COURSES (OEC)
OPEN ELECTIVE I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24OCI101	Estimation and Costing of Building	OEC	3	0	2	5	4
2.	24OCI102	Quality assessment of Building Materials	OEC	3	0	2	5	4
3.	24OCI103	Project Management	OEC	3	0	2	5	4
4.	24OCI104	Building planning using Vaastu Sastra	OEC	3	0	2	5	4
5.	24OAI101	Web technology	OEC	3	0	2	5	4
6.	24OAI102	Object oriented programming	OEC	3	0	2	5	4
7.	24OAI103	Computational data analytics	OEC	3	0	2	5	4
8.	24OAI104	Networking concepts	OEC	3	0	2	5	4
9.	24OEI101	Control System Engineering	OEC	3	0	2	5	4
10.	24OEI102	Power Electronics and Drives	OEC	3	0	2	5	4
11.	24OEI103	PLC Programming	OEC	3	0	2	5	4
12.	24OEI104	Electronic Devices and Power Amplifires	OEC	3	0	2	5	4

13.	24OBI101	Digital Signal Processing	OEC	3	0	2	5	4
14.	24OBI102	IoT and Sensors Types	OEC	3	0	2	5	4
15.	24OBI103	Medical Diagnostic and Therapeutic quipments	OEC	3	0	2	5	4
16.	24OBI104	Biomedical Instrument and Design	OEC	3	0	2	5	4

OPEN ELECTIVE II & III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24OCT201	Building Planning and Approval	OEC	3	0	0	3	3
2.	24OCT202	Energy Efficient Building	OEC	3	0	0	3	3
3.	24OCT203	Environmental Impact Assessment	OEC	3	0	0	3	3
4.	24OCT204	Rehabilitation of Structures	OEC	3	0	0	3	3
5.	24OCT205	Drinking water supply and Treatment	OEC	3	0	0	3	3
6.	24OCT206	Project Scheduling and Optimization using CPM and PERT Techniques	OEC	3	0	0	3	3
7.	24OAT201	Principles of programming languages	OEC	3	0	0	3	3
8.	24OAT202	Information security management	OEC	3	0	0	3	3
9.	24OAT203	Human computer interaction	OEC	3	0	0	3	3
10.	24OAT204	Computer application in agricultures	OEC	3	0	0	3	3
11.	24OAT205	Mobile computing	OEC	3	0	0	3	3
12.	24OAT206	Object oriented analysis and design	OEC	3	0	0	3	3
13.	24OET101	Electrical Vehicle Technologies	OEC	3	0	0	3	3
14.	24OET102	Power System	OEC	3	0	0	3	3

15.	24OET103	Circuit Theory	OEC	3	0	0	3	3
16.	24OET104	Advanced Electrical Machines	OEC	3	0	0	3	3
17.	24OET105	Hybrid Renewable Power Generation	OEC	3	0	0	3	3
18.	24OET106	Electrical Maintenance and Safety	OEC	3	0	0	3	3
19.	24OBT201	Hospital Management	OEC	3	0	0	3	3
20.	24OBT202	Assist Devices	OEC	3	0	0	3	3
21.	24OBT203	Robotics in Medicine	OEC	3	0	0	3	3
22.	24OBT204	DSP Architecture	OEC	3	0	0	3	3
23.	24OBT205	Image Processing Techniques	OEC	3	0	0	3	3
24.	24OBT206	Wireless Sensor Networks	OEC	3	0	0	3	3

SUMMARY

S. No.	Subject Area	Credits per Semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1.	Basic Science Course (BSC)	12	7	4	2	-	-	-	-	**25**
2.	Professional Core Courses (PCC)	-	-	21	20	9	9	6	-	**65**
3.	Professional Elective Courses (PEC)	-	-	-	-	6	9	10	-	**25**
4.	Open Elective Courses (OEC)	-	-	-	-	4	3	3	-	**10**
5.	Employability Enhancement Courses (EEC)	-	-	-	1	-	2	2	10	**15**
6.	Engineering Science Courses (ESC)	6	14	-	-	-	-	-	-	**20**
7.	Mandatory Courses (MC)	-	-	-	-	-	-	-	-	**-**
8.	Humanities, Social Sciences and Management Courses (HSMC)	5	4	-	-	3	-	2	-	**14**
	Total Credits	**23**	**25**	**25**	**23**	**22**	**23**	**23**	**10**	**174**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 174

24HS1101 PROFESSIONAL ENGLISH **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To enable the students to learn the fundamentals of English grammar.
- To develop the ability to write complex texts and essays that are relevant to authentic contexts.
- To present their opinions through letters and reports that will be relevant for their future endeavours.

UNIT I FUNDAMENTALS & SUMMATION **9**

Grammar & Vocabulary: Parts of Speech, Articles, Pronoun, Homonyms & Homophones, Word Formation (Prefix and Suffix). **Listening:** Telephonic Conversations - different viewpoints on a topic. **Speaking:** Self-Introduction Conversation - politeness strategies; asking for information to fill details in a form **Reading:** Reading biographies, travelogues, newspaper reports. **Writing**: Report writing (Accident report, Survey Report), Checklist.

UNIT II PROBLEM SOLVING & RECOMMENDATIONS **9**

Grammar & Vocabulary: Abbreviations & Acronyms, Tenses, Subject -Verb Agreement, Active, Passive and Impersonal Passive Voice. **Listening:** Listening to anecdotes, stories & event narration. **Speaking:** Narrating personal experiences/ events, Extempore, Story-Telling. **Reading:** Reading Editorials; and Opinion Blogs. **Writing**: Letter Writing (Complaint Letter, Response to complaint), Recommendations.

UNIT III DESCRIPTION OF A PROCESS OR PRODUCT AND USAGE OF IMPERATIVE **9**

Grammar & Vocabulary: Adjective, Degrees of Comparison, Imperative and Gerund, One Word Substitution. **Listening:** Classroom Lecture, advertisements about products. **Speaking –** Picture description; giving instruction to use the product; presenting a product. **Reading:** Reading advertisements, gadget reviews; user manuals. **Writing**: Instructions, Process and Product Description.

UNIT IV DRAFTING AND RESUME MAKING **9**

Grammar & Vocabulary: Collocations, Conjunction, Framing Question Tags/ "Wh" questions. **Listening:** TED talks, educational videos. **Speaking** – Small Talk; Mini presentations and making recommendations. **Reading**: Reading brochures (technical context). **Writing:** Email writing and Email etiquette- Job Application Letter and Resume.

UNIT V EXPRESSING IDEAS **9**

Grammar & Vocabulary: Discourse Markers, Cause and Effect words, Modal verbs, Spotting Errors. **Listening:** Panel Discussions, listening to debates. **Speaking:** Group discussions, Debates and Expressing opinions & Role play. **Reading:** Reading Newspaper articles; Journal reports. **Writing:** Essay writing (Narrative, Descriptive), Reading Comprehension, Transcoding (Bar chart, Pie chart, Table).

TOTAL: 45 PERIODS

LIST OF ACTIVITIES

1. Self-Introduction-Politeness Strategies.
2. Extempore.
3. Story Telling.
4. Picture Description.
5. Product Description.
6. Presentations.
7. Group Discussion.
8. Role-Play.
9. Debates and Expressing Opinions.
10. Narrating Personal Experiences.
11. Reading Biographies, Travelogues.
12. Reading Advertisements, User Manuals.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explore the basic grammatical structures and use them in right context.

CO2: Write complaint letters and recommendations with utmost accuracy.

CO3: Describe about products and processes clearly.

CO4: Write a job application letter and resume without flaws.

CO5: Speak fluently and interpret information presented in tables, charts and other graphic forms.

TEXT BOOKS

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, 2020.
2. Dr S Gunasekaran, "A Workbook of Professional English", Vishnu Prints Media, 2021.
3. Meenakshi Raman & Sangeeta Sharma, "Technical Communication – Principles and Practices", Oxford Univ. Press, 2022.

REFERENCE BOOKS

1. Raymond Murphy, "Essential English Grammar", 2^{nd} Edition, Cambridge University Press, 2024.
2. Brain Chanen, "IB English A: Language and Literature", Oxford Publications, 2019.
3. Phil Williams, "Advanced Writing Skills for Students of English", Goodwill Publishing House, 2022.
4. Stella Cortrell, "The Study Skills Handbook", Red Globe Press, 2019.
5. Adrian Wall, "English for Academic Correspondence and Socializing", Springer Publications, 2017.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO2	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO3	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO4	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO5	-	-	-	-	-	-	-	2	2	2	2	2	2	-
AVG	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**2**	**2**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MU1101 MATRICES AND CALCULUS **L T P C**
3 1 0 4

COURSE OBJECTIVES

- To familiarize the students with Eigen values and Eigen vectors to reduce the quadratic form to canonical form.
- To familiarize the students with differential calculus and functions of several variables.
- To make the students to solve the problems on integration and multiple integration.

UNIT I MATRICES **9+3**

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley-Hamilton theorem(without proof) – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS **9+3**

Limit of a function – Continuity – Derivatives – Differentiation rules (sum, product, quotient, chain rules) – Implicit differentiation – Logarithmic differentiation – Applications: Maxima and Minima of functions of one variable.

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

Partial differentiation – Homogeneous functions and Euler's theorem (without proof) – Jacobians – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS **9+3**

Definite and Indefinite integrals – Substitution rule – Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions – Improper integrals.

UNIT V MULTIPLE INTEGRALS **9+3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Apply matrix algebra methods for solving various application problems.
- CO2: Apply differential calculus methods in solving various application problems.
- CO3: Apply the differential calculus ideas on several variable functions.
- CO4: Apply different methods of integration in solving practical problems.
- CO5: Apply multiple integral methods in solving areas, volumes and other practical problems.

TEXT BOOKS

1. T. Veerarajan, "Engineering Mathematics (Volume I & II)", McGraw Hill Education, New Delhi, 2018.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 45th Edition, 2024.
3. Erwin Kreyszig, "Advanced_Engineering Mathematics", Wiley India Pvt Ltd., New Delhi, 2015.

REFERENCE BOOKS

1. B.V .Ramana, "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd., New Delhi, 2016.
2. John Bird, "Bird's Higher Engineering Mathematics", 9th Edition, Routledge Taylor and Fransis Group, 2021.
3. H.Anton, I.Bivens. I and S. Davis, "Calculus ", Wiley, 10th Edition, 2016.
4. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
5. G.B.Thomas, J.Hass and M.D.Weir, "Thomas Calculus ", 14th Edition, Pearson India, 2018.

Mapping of COs with POs & PSOs

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO2	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO3	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO4	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO5	2	3	-	2	-	-	-	-	-	-	-	-	2	-
AVG	**2**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24PH1101 ENGINEERING PHYSICS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To make the students to understand the properties of matter.
- To analysis the ultrasonic wave and laser with applications.
- To get knowledge on optical fibers and the importance of quantum theory.

UNIT I PROPERTIES OF MATTER 9

Introduction – Elasticity – Hooke's Law – Stress –strain diagram – Types of modulus of elasticity –bending of beams – bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – twisting couple – torsion pendulum: theory and experiment – I – shaped girders.

UNIT II ULTRASONICS AND BIO MEDICAL APPLICATIONS 9

Introduction – Production of ultrasonics: magnetostriction effect and piezo electric effect – Velocity measurement: acoustic grating – Industrial applications: drilling, welding, soldering and cleaning –SONAR – Non Destructive testing – pulse echo system through transmission and reflection modes- A, B and C – scan displays, Clinical Applications -Sonograms.

UNIT III LASERS 9

Introduction – Einstein's theory – Population inversion, pumping – Types of lasers; Nd-YAG Laser, He-Ne Laser,Semiconductor lasers (homo junction & hetero junction) – Industrial Applications-Lasers in welding, heat treatment, cutting.

UNIT IV FIBER OPTICS 9

Principle and propagation of light in optical fibres – Acceptance angle and Numerical aperture-Types of optical fibres (material, refractive index, mode) – Optical Loss in optical fibre – attenuation, dispersion, bending – Fibre optical communication system (Block diagram) – Endoscope.

UNIT V QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Compton effect – Theory and experimental verification – Matter waves – Schrodinger's wave equation – Time independent and time dependent equations – Physical significance of wave function–Transmission Electron microscope –Scanning electron microscope.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Determination of rigidity modulus – Torsion pendulum.
2. Determination of unknown mass of a body for known rigidity modulus – Torsion pendulum.
3. Determination of Young's modulus by non – uniform bending method.
4. Determination of unknown mass of a body for known Young's modulus by non – uniform bending method.
5. Determination of Young's modulus by uniform bending method.

6. Determination of unknown mass of a body for known Young's modulus by uniform bending method.
7. Determination of wavelength of Laser by diffraction grating method.
8. Determination of thickness of material using Air wedge.
9. Determination of width of the groove in a CD using Laser Diffraction.
10. Determination of Compressibility of given liquid using Ultrasonic interferometer.
11. Simple harmonic oscillations of cantilever.
12. Determination of unknown mass of a body for known Young's modulus by cantilever simple harmonic oscillations.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Gain knowledge on basics of properties of matter.
CO2: Acquire knowledge on magnetic ultrasonic waves and its applications.
CO3: Demonstrate the strong fundamental knowledge in Laser.
CO4: Acquire knowledge on function of fiber optical devices and its applications.
CO5: Explore the concepts of quantum physics.

TEXT BOOKS

1. Bhattacharya D K & Poonam T, "Engineering Physics", Oxford University Press, 2015.
2. Gaur R K & Gupta S L, "Engineering Physics", Dhanpat Rai Publishers, 2018.
3. Arthur Beiser, Shobhit Mahajan Sand Rai Choudhury, "Concepts of Modern Physics", McGraw-Hill (Indian Edition), 2017.

REFERENCE BOOKS

1. Serway R A & Jewett J W, "Physics for Scientists and Engineers", Cengage Learning, 2016.
2. Tipler P A & Mosca G, "Physics for Scientists and Engineers with Modern Physics", W.H.Freeman, 2017.
3. K Thyagarajan & A Ghatak, "Lasers: Fundamentals and Applications", Laxmi Publications, (Indian Edition), 2019.
4. D. Halliday, R. Resnick and J Walker, "Principles of Physics", Wiley (Indian Edition), 2015.
5. Pandey B K & Chaturvedi S "Engineering Physics", Cengage Learning India, 2012.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	3	-	-	-	-	-	-	-	3	2	-
CO2	3	2	3	2	-	-	-	-	-	-	-	3	2	-
CO3	3	2	2	2	-	-	-	-	-	-	-	2	2	-
CO4	3	2	3	2	-	-	-	-	-	-	-	2	2	-
CO5	3	2	3	2	-	-	-	-	-	-	-	3	2	-
AVG	3	2	2.8	2.8	-	-	-	-	-	-	-	2.6	2	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24CY1101 ENGINEERING CHEMISTRY **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To familiarize students about the treatment of boiler feed water.
- To gain the knowledge about the various types of batteries and fuels.
- To understand the properties of Engineering materials and Nanomaterials.

UNIT I WATER TECHNOLOGY **9**

Hardness of water - Types - Boiler troubles - Scale - Sludge - Caustic embrittlement - Priming and Foaming - Softening of boiler feed water - Internal conditioning (phosphate, calgon and carbonate conditioning) - External conditioning - Ion Exchange process - Zeolite process.

UNIT II ENERGY STORAGE **9**

Batteries - Types of batteries - Primary battery - Dry cell, Secondary battery - Lead acid battery and Lithium- ion-battery - Fuel cells - H_2-O_2 fuel cell- E-Vehicles - Advantages of E-Vehicles.

UNIT III ENGINEERING MATERIALS **9**

Refractories - classification - properties and applications of refractories - Abrasives - properties and Applications of abrasives - Cement - composition of cement - setting and hardening of cement - Glass - Manufacture - Types of glass and its uses.

UNIT IV NANOCHEMISTRY **9**

Nanomaterials - Distinction between Nanoparticles, Molecules and Bulk materials - Types of Nanomaterials - Nanoparticle - Nanowire and Nanotube - Preparation of Nanomaterials - sol-gel- solvothermal Methods and Applications of Nanomaterials in Agriculture and Medicine field.

UNIT V FUELS **9**

Fuels - Coal - Analysis of coal (Proximate Analysis)-Refining of Petroleum - Fractional Distillation - Manufacture of metallurgical coke (Otto Hoffmann method) - Manufacture of synthetic petrol (Bergius process) - Power alcohol – Biodiesel.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Estimation of total, temporary and permanent Hardness of the sample water by EDTA method.
2. Estimation of strength of given Hydrochloric acid using pH meter.
3. Estimation of strength of given Hydrochloric acid using conductivity meter.
4. Determination of strength of acids in a mixture of acids using conductivity meter.
5. Estimation of amount of $BaCl_2$ present in the given solution using Std.Na_2SO_4 using conductivity meter.
6. Estimation of iron content of the given solution using potentiometer.
7. Estimation of amount of Cl^- ion present in the given solution by Argentometric method.
8. Determination of alkalinity of the water sample using HCl with Na_2CO_3 as the primary standard.
9. Prepare Na_2CO_3 as primary standard and using it to estimate the acidity present in the given water sample.

10. Estimation of copper content of the given solution by EDTA method.
11. Determination of Dissolved oxygen content of water sample by Winkler's method.
12. Preparation of Biodiesel by using vegetable oil.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Assess water impurities, determining hardness and eliminating substances responsible for hardness.

CO2: Identify diverse energy resources and effectively apply them in various sectors of the energy industry.

CO3: Assess engineering materials that meet industry specifications and requirements.

CO4: Identify and apply basic concepts of Nano science and technology in designing the synthesis of Nanomaterials for Engineering and Technology.

CO5: Recommend suitable fuels for engineering processes and applications.

TEXT BOOKS

1. P C Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company(P) Ltd, New Delhi , 17th Edition, 2022.
2. Friedrich Emich, "Engineering Chemistry", Scientific International Pvt. Ltd., New Delhi, 2017.
3. S S Dara, "A text book of Engineering Chemistry", S Chand Publishing, 12th Edition, 2018.

REFERENCE BOOKS

1. Hammer Sr and Hammer Jr, "Water and waste water technology", Pearson Education India, 7th Edition, 2015.
2. Nihal Kularatna and Kosala Gunawardane, "Energy Storage Devices for Renewable Energy-based Systems", Academic Pr, 2nd Edition, 2021.
3. Kenneth G Budinski, Michael K Budinski, "Engineering Materials", Pearson, 9th Edition, 2016.
4. Chattopadhyay K K, "Introduction to Nanoscience and Nanotechnology", Prentice Hall India Learning Private Limited, 2021.
5. James G Speight, "Handbook of Natural Gas Analysis", Wiley, 1st 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
CO1	2	2	2	2	-	2	-	-	-	-	-	2	2	-
CO2	2	2	2	2	-	2	-	-	-	-	-	2	2	-
CO3	2	2	2	2	-	2	-	-	-	-	-	2	2	-
CO4	2	2	2	2	-	2	-	-	-	-	-	2	2	-
CO5	2	2	2	2	-	2	-	-	-	-	-	2	2	-
AVG	**2**	**2**	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24GE1101 PROBLEM SOLVING AND PYTHON PROGRAMMING **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING **9**

Fundamentals of Computing – Identification of Computational Problems – Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flowchart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guessan integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS **9**

Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if – else), chained conditional (if el if – else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES **9**

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter‘s age validation, Marks range validation (0-100).

TOTAL: 45 PERIODS

LIST OF PROGRAMS

1. Calculate the GCD of two numbers.
2. Find the square root of an integer using Newton‘s method.
3. Find power of a number using Exponential operator.
4. Find the maximum of a list of numbers.
5. Develop a program to search the given numbers using linear search and binary search.
6. Develop a program that sorts a list by implementing selection sort, insertion sort.
7. Develop a program that sorts a list by implementing mergesort.
8. Program to print n prime numbers.
9. Find multiplication of two matrix.
10. Programs that take command line arguments (word count).
11. Find the most frequent words in a text read from a file.
12. Simulate elliptical orbits and bouncing ball using Py game.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Develop algorithmic solutions to simple computational problems.

CO2: Write simple Python programs using conditionals, loops and functions for solving problems.

CO3: De compose a Python program into functions.

CO4: Represent compound data using Python lists, tuples, and dictionary e set c.

CO5: Read and write data from / to files in Python programs.

TEXT BOOKS

1. Allen B Downey, ""Think Python: How to Think like a Computer Scientist”, 2^{nd} Edition, O‘Reilly Publishers, 2016.
2. Karl Beecher, ""Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1^{st} Edition, BCS Learning & Development Limited,2017.
3. Eric Matthes, “Python Crash Course: Python for beginners”, 3^{rd} Edition, No Strach Press Limited, 2024.

REFERENCE BOOKS

1. Paul Deitel and Harvey Deitel, “"Python for Programmers, Pearson Education”, 1^{st} Edition, 2021.
2. G Venkatesh and Madhavan Mukund,"" Computational Thinking: A Primer for Programmers and Data Scientists”, 1^{st} Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, Third Edition, MIT Press, 2021.
4. Eric Matthes, “Python Crash Course, A Hands – on Project Based Introduction to Programming”, 2^{nd} Edition, No Starch Press, 2019.
5. Martin C Brown, “Python: The Complete Reference”, 4^{th} Edition, Mc-Graw Hill, 2018.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	3	-	-	-	-	-	-	-	2	-
CO2	3	3	3	2	3	-	-	-	-	-	-	-	2	-
CO3	3	3	3	2	3	-	-	-	-	-	-	-	2	-
CO4	3	3	3	2	3	-	-	-	-	-	-	-	2	-
CO5	3	3	3	2	3	-	-	-	-	-	-	-	2	-
AVG	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24GE1101 தமிழர் மரபு **L T P C**
1 0 0 1

பாடத்தின் நோக்கங்கள்

- மாணவர்கள் மொழி மற்றும் இலக்கியம் பற்றி கற்றறிதல்.
- தமிழர்களின் பாரம்பரிய மரபு மற்றும் நாட்டுப்புற கலைகளை அறிந்து கொள்ளுதல்.
- தமிழர்களின் திணைக்கோட்பாடுகள் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு பற்றி அறிந்து கொள்ளுதல்.

அலகு I மொழி மற்றும் இலக்கியம் **3**

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் -திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள் - தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் -சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வரலாற்றில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக்கலை **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரி முனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுகள் 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக்கோட்பாடு 3

தமிழகத்தின் தாவரங்களும் விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்க கால நகரங்களும் துறைமுகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப் படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL: 15 PERIODS

பாடநெறி முடிவுகள்

பாடதிட்டத்தை முடித்த பிறகு, மாணவர்கள் செய்ய கூடியவை:

- CO1: செம்மொழி மற்றும் சமகால படைப்புகளில் கவனம் செலுத்தி, மொழிப்புலமை மற்றும் இலக்கிய பகுப்பாய்வின் முக்கியத்துவத்தை கற்றறிந்தனர்.
- CO2: தமிழ் இலக்கியத்தின் பாரம்பரிய மரபு கலைகளை மாணவர்கள் அறிந்து கொண்டனர்.
- CO3: சங்ககால இலக்கியங்களையும் இக்கால இலக்கிய கவிஞர்களின் தமிழையும் மாணவர்கள் அறிந்து கொண்டனர்.
- CO4: தமிழ் இலக்கியத்தின் கலாச்சார மற்றும் சமூக தாக்கங்களை அறிந்து கொண்டனர்.
- CO5: பண்டைக்கால மக்களின் தமிழ் அடையாளம் மற்றும் கலாச்சார பாரம்பரியத்தைப் பற்றி கற்றறிந்தனர்.

பாட புத்தகங்கள்

1. கே கே பிள்ளை "தமிழக வரலாறு - மக்களும் பண்பாடும்" தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் கழகம், 2004.

2. முனைவர் இல சுந்தரம், “கணினித் தமிழ்” , விகடன் பிரசுரம், 2015.
3. டாக்டர். எஸ் வி சுப்ரமணியன், டாக்டர். கே டி திருநாவுக்கரசு, “தமிழர்களின் வரலாற்றுப் பாரம்பரியம்”, சர்வதேச தமிழாய்வு நிறுவனம்.

குறிப்பு புத்தகங்கள்

1. டாக்டர். சிங்காரவேலு, “தமிழர்களின் சமூக வாழ்க்கை”, சர்வதேச தமிழாய்வு நிறுவனம்.
2. கீழடி “வைகை ஆற்றின் கரையில் உள்ள சங்க நகர நாகரிகம் கூட்டு” தொல்லியல் துறை, தமிழ்நாடு பாடநூல் மற்றும் கல்வி சேவைகள் கழகம், தமிழ்நாடு, 2015.
3. டாக்டர். கே கே பிள்ளை, “இந்திய வரலாறு” வெளியீடு ஆசிரியர்.
4. “பொருணை நாகரிகம்”, தொல்லியல்துறை & தமிழ்நாடு பாடநூல் மற்றும் கல்வி சேவைகள் கழகம்.
5. ஆர் பாலகிருஷ்ணன், “வைகை, சிந்து நாகரிகத்தின் பயணம்” வெளியீடு – EMRL.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO2	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO3	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO4	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO5	-	-	-	-	-	2	-	2	-	-	-	-	2	-
AVG	-	-	-	-	-	2	-	2	-	-	-	-	2	-

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24GE1201 PROFESSIONAL DEVELOPMENT **L T P C**
0 0 4 2

COURSE OBJECTIVES

- To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWER POINT.
- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the present ability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered.

MS WORD 15

- Create and format a document.
- Working with tables.
- Working with Bullets and Lists.
- Working with styles, shapes, smart art, charts.
- Inserting objects, charts and importing objects from other office tools.
- Creating and Using document templates.
- Inserting equations, symbols and special characters.
- Working with Table of contents and References, citations.
- Insert and review comments.
- Create bookmarks, hyperlinks, endnotes footnote.
- Viewing document in different modes.
- Working with document protection and security.
- Inspect document for accessibility.

MS EXCEL 15

- Create worksheets, insert and format data.
- Work with different types of data: text, currency, date, numeric etc.
- Split, validate, consolidate, Convert data.
- Sort and filter data.
- Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,).
- Work with Lookup and reference formulae.
- Create and Work with different types of charts.
- Use pivot tables to summarize and analysis data.
- Perform data analysis using own formulae and functions.
- Combine data from multiple worksheets using own formulae and built-in functions to generate results.
- Export data and sheets to other file formats.
- Working with macros.
- Protecting data and Securing the workbook.

MS POWERPOINT 15

- Select slide templates, layout and themes.
- Formatting slide content and using bullets and numbering.
- Insert and format images, smart art, tables, charts.
- Using Slide master, notes and handout master.
- Working with animation and transitions.
- Organize and Group slides.
- Import or create and use media objects: audio, video, animation.
- Perform slideshow recording and Record narration and create presentable videos.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Use MS Word to create quality documents, by structuring and organizing content.

CO2: Use MS Word for their day to day technical and academic requirements.

CO3: Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements.

CO4: Use MS EXCEL to visualize data for ease of understanding.

CO5: Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO2	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO3	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO4	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO5	-	-	-	-	-	-	-	2	2	2	2	2	2	-
AVG	-	-	-	-	-	-	-	**2**	**2**	**2**	**2**	**2**	**2**	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24HS2101 WRITING SKILLS FOR PROFESSIONALS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To use appropriate language structures to write letters.
- To write reports and emails with ease.
- To think critically and write different types of essays.

UNIT I SELF EXPRESSION 9

Grammar: Punctuation-Direct and Indirect Questions - Adverbs- Prepositions. **Vocabulary:** Commonly confused words. **Writing:** Extended Definitions- Letter to the Editor.

UNIT II FORMAL EXPRESSION 9

Grammar: Phrasal Verbs, Adverbs, Simple, Compound and Complex Sentences. **Vocabulary:** Synonyms & Antonyms. **Writing:** Email Writing (formal & informal) –Report Writing (Industrial Visit & Field Visit).

UNIT III CREATIVE EXPRESSION 9

Grammar: Prepositional Phrases, Numerical Adjectives, Compound Nouns. **Vocabulary:** British and American words. **Writing:** Compare and Contrast Essay, SOP.

UNIT IV EXPRESSION OF IDEAS 9

Grammar: Direct and Indirect Speech, Relative Pronoun. **Vocabulary:** Idioms & phrases. **Writing:** Asking for information and making suggestions- Report Writing on College Event.

UNIT V PROFESSIONAL EXPRESSIONS **9**

Grammar: Fixed and Semi- fixed - Content vs Function words. **Vocabulary:** Jumbled Sentences. **Writing:** Accepting/ Declining an Offer/ invitation-Note- Making, Argumentative Essay.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Enhance their grammatical competency for flawless writing.

CO2: Write reports, emails meeting professional expectations.

CO3: Use grammar to form correct sentences with maximum accuracy.

CO4: Present their ideas and opinions in a planned and logical manner.

CO5: Write essays on various topics.

TEXT BOOKS

1. English for Engineers & Technologists, Orient Blackswan Private Ltd. Department of English, Anna University, 2020.
2. English for Science & Technology Cambridge University Press, 2021.
3. Communication Skills for Professionals, Nira KonarSecond Edition, PHI Learning Pvt.Ltd, 2021.

REFERENCE BOOKS

1. William Zinsser Paperback, "On Writing Well", Harper Perennial Publishers, 2016.
2. D S Paul, "Advanced Writing Skills", Good will Publishing House, 2022.
3. Matthew T Zakaria, "Successful Writing Skills", Commonwealth Publishers, 2022.
4. G S Hook, "Effective Communication" (Updated version 2nd edition), Sannainvest Ltd., 2021.
5. Alan Baker, "Improve Your Communication Skills" (How to Build Trust, Be Heard and Communicate with Confidence), Kogan Page Publishers, 2019.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO2	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO3	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO4	-	-	-	-	-	-	-	2	2	2	2	2	2	-
CO5	-	-	-	-	-	-	-	2	2	2	2	2	2	-
AVG	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**2**	**2**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MU2101 STATISTICS AND NUMERICAL METHODS **L T P C**
3 1 0 4

COURSE OBJECTIVES

- To understand the concept of Correlation, Regression, Testing of hypothesis and design of experiments.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To understand the concept of numerical methods for solving differentiation and integration equations.

UNIT I CORRELATION AND REGRESSION **9+3**

Correlation – Coefficient of Correlation – Rank Correlation – Regression – Estimation of Regression lines.

UNIT II TESTING OF HYPOTHESIS & DESIGN OF EXPERIMENTS **9+3**

Sampling distributions – Small samples – t-test – Tests for single mean and difference of means – F-test – Tests for single variance and equality of variances – One way and two-way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **9+3**

Solution of Algebraic and Transcendental equations – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Inverse of Matrix by Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power Method.

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

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

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **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 Adam's – Bash forth predictor corrector methods for solving first order differential equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Apply the correlation and regression equations for engineering problems.

CO2: Apply the concept of testing of hypothesis for small samples in real life problems and classifications of design of experiments in the field of agriculture.

CO3: Apply the numerical methods to solve the algebraic, transcendental and linear system of equations.
CO4: Apply interpolation techniques and numerical methods to solve the derivatives and integrals.
CO5: Apply various numerical methods for solving ordinary differential equations.

TEXT BOOKS

1. Gupta S.C., and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
2. Gupta S.P., "Statistical Method", Sultan Chand & Sons, New Delhi, 46th Edition, 2019.
3. Grewal B. S., and Grewal J. S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCE BOOKS

1. Spiegel M.R., Schiller J., and Srinivasan R.A., "Schaum's easy Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2020.
2. Devore J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 9th Edition, 2020.
3. Johnson R. A., Miller I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, 9th Edition, 2020.
4. Burden R.L and Faires J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
5. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical Methods", New International Publishers, 8th Edition, 2022.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO2	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO3	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO4	2	3	-	2	-	-	-	-	-	-	-	-	2	-
CO5	2	3	-	2	-	-	-	-	-	-	-	-	2	-
AVG	2	3	-	2	-	-	-	-	-	-	-	-	2	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24PH2102 MATERIAL PHYSICS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To make the students to understand the various types of crystal structures and semiconducting materials.
- To gain knowledge on properties of magnetic and dielectric materials.
- To get knowledge of advanced engineering materials.

UNIT I CRYSTAL PHYSICS **9**

Lattice – Unit cell – Bravais lattice – Calculation of number of atoms per unit cell – Atomic radius –Coordination number – Characteristics of SC, BCC, FCC and HCP structures – Lattice planes –Miller indices – d spacing in cubic lattice – Crystal defects – point, line and surface defects – Burger vector.

UNIT II SEMICONDUCTING MATERIALS **9**

Intrinsic semiconductor – intrinsic carrier concentration derivation – Fermi level – electrical conductivity – band gap determination – derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration – Hall effect – Determination of Hall coefficient – Applications.

UNIT III MAGNETIC MATERIALS **9**

Origin of magnetic moment – Bohr magneton – properties of Dia, Para and Ferro magnetic materials – Domain theory – Hysteresis – soft and hard magnetic materials – anti-ferromagnetic materials – Ferrites and its applications.

UNIT IV DIELECTRIC MATERIALS **9**

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – ferro electricity and applications.

UNIT V ADVANCED ENGINEERING MATERIALS **9**

Metallic glasses – Properties, preparations and its applications – Shape memory alloys (SMA): Characteristics, properties of Ni-Ti alloy and its applications – Carbon nano tubes – Types of CNT – Nanomaterials synthesis – chemical vapour deposition – electro deposition – ball milling – properties and applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Know the basics of crystallography and its importance.

CO2: Get adequate knowledge on charge carrier's distribution in different types of semiconductors.

CO3: Get the necessary understanding of magnetic materials and its types.

CO4: Gain knowledge on dielectric properties of materials.

CO5: Gain knowledge on new engineering materials and their preparation methods.

TEXT BOOKS

1. V.Raghavan. "Materials Science and Engineering: A First Course", Prentice Hall India Learning Private Limited, 2015.
2. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
3. S.O. Kasap, "Principles of Electronic Materials and Devices", Mc-Graw Hill, 2018.

REFERENCE BOOKS

1. R. Balasubramaniam, Callister's "Materials Science and Engineering". Wiley (Indian Edition), 2014.
2. Wendelin Wright and Donald Askeland, "Essentials of Materials Science and Engineering", CL Engineering, 2013.
3. Charles Kittel, "Introduction to Solid State Physics", Wiley India Edition, 2019.
4. Parag K. Lala, "Quantum Computing: A Beginner's Introduction", McGraw-Hill Education Indian Edition, 2020.
5. G.W.Hanson." Fundamentals of Nano electronics. Pearson Education", Indian Edition, 2019.

Mapping of COs with POs & PSOs

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	3	2	-	-	-	-	-	-	-	-	2	-
CO2	3	2	3	2	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	2	-	-	-	-	-	-	-	-	2	-
CO4	3	2	3	2	-	-	-	-	-	-	-	-	2	-
CO5	3	2	3	2	-	-	-	-	-	-	-	-	2	-
AVG	**3**	**2**	**2.8**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24GE2101 ENGINEERING GRAPHICS

L T P C
2 0 4 4

COURSE OBJECTIVES

- Drawing engineering curves, freehand sketch of simple objects and orthographic projections.
- Drawing Projection, section and development of solids.
- Drawing isometric and perspective projections of simple solids.

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.

UNIT I PLANE CURVES AND FREEHAND SKETCHING 6+12

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

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection – principles – 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. Projection of planes (polygonal and circular surfaces) inclined to one principal plane by rotating object method.

UNIT III PROJECTION OF SOLIDS 6+12

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+12

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

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection — isometric scale - isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

TOTAL: 90 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Construct the conic curves, involutes and cycloid.
CO2: Solve practical problems involving projection of line and plane surfaces.
CO3: Develop the orthographic, isometric and perspective projections of simple solids
CO4: Draw the section of solids and development of surfaces.
CO5: Draw the isometric and perspective projections.

PUBLICATION OF BUREAU OF INDIAN STANDARDS

1. IS 10711 - 2001: Technical products Documentation - Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) — 2001: Technical products Documentation — Lettering.
3. IS 10714 (Part 20) — 2001 & SP 46 — 2003: Lines for technical drawings.
4. IS 11669 — 1986 & SP 46 —2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) — 2001: Technical drawings — Projection Methods.

TEXT BOOKS

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
3. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015.

REFERENCE BOOKS

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I & II combined), Subhas Stores, Bangalore, 2007.
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. Shah M B, and Rana B C, "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
CO1	2	3	3	2	-	-	-	-	2	2	-	2	3	-
CO2	2	3	3	2	-	-	-	-	2	2	-	2	3	-
CO3	2	3	3	2	-	-	-	-	2	2	-	2	3	-
CO4	2	3	3	2	-	-	-	-	2	2	-	2	3	-
CO5	2	3	3	2	-	-	-	-	2	2	-	2	3	-
AVG	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24EE2101 FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING

L T P C
3 0 2 4

COURSE OBJECTIVES

- To impart knowledge in electric circuits and electrical machines.
- To educate the fundamental concepts of Analog and digital electronics.
- To gain the knowledge on principle and working of measuring instruments.

UNIT I ELECTRICAL CIRCUITS **9**

DC Circuits – Ohm's Law - Kirchhoff's Laws – Nodal Analysis, Mesh analysis with independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value – Steady state analysis of RLC circuits (Simple problems only).

UNIT II MACHINES AND TRANFORMER **9**

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications, Construction and Working principle – Three Phase Induction motor, Construction, Working principle and Applications of Transformer.

UNIT III ANALOG ELECTRONICS **9**

Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode – Characteristics, Applications – Bipolar Junction Transistor-Principle of transistor, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters.

UNIT IV DIGITAL ELECTRONICS **9**

Review of number systems – Basic Gates – Universal gates – Combinational logic circuit – representation of logic functions – SOP and POS forms – Minimization of Boolean function using K maps (Simple Problems only).

UNIT V MEASUREMENTS AND INSTRUMENTATION **9**

Functional elements of an instrument, Standards and calibration, Operating Principle, types – Moving Coil and Moving Iron meters, Energy Meter, Instrument Transformers – CT and PT, DSO – Block diagram.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Verification of ohms Law.
2. Verification of Kirchhoff's Laws.
3. Load test on DC Shunt Motor.
4. Load test on Induction motor.
5. Load test on Single-phase Transformer.
6. Characteristics of PN Junction diode.
7. Characteristics of Zener diode.
8. Characteristics of SCR.
9. Characteristics of MIOSFET.
10. Characteristics of IGBT.
11. Verification of Logic Gates.
12. Verification of Boolean function.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Compute the electric circuit parameters for simple problems.
CO2: Explain the working principle and applications of electrical machines.
CO3: Analyses the characteristics of analogy electronic devices.
CO4: Explain the basic concepts of digital electronics.
CO5: Explain the operating principles of measuring instruments

TEXT BOOKS

1. A Sudhakar Shya mohan S Palli, “Electrical Circuit Analysis -I”, Tata McGraw Hill Education, 2015.
2. Kothari D P and I J Nagrath, “Basic Electrical and Electronics Engineering”, Second Edition, McGraw Hill Education, 2020.
3. A K Sawhney, Puneet Sawhney “A Course in Electrical & Electronic Measurements & Instrumentation”, Dhanpat Rai and Co, 2015.

REFERENCES BOOKS

1. Kothari D P and I J Nagrath, “Basic Electrical Engineering”, Fourth Edition, McGraw Hill Education, 2019.
2. Thomas L Floyd, “Digital Fundamentals”, 11th Edition, Pearson Education, 2017.
3. Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7th edition, 2017.
4. Sedha R S, “A textbook book of Applied Electronics”, S. Chand & Co, 2008.
5. S K Bhattacharya, “Basic Electrical and Electronics Engineering”, Pearson Education, Second Edition, 2017.

Mapping of COs with POs & PSOs

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CO1	2	3	3	2	-	-	-	-	-	-	-	-	2	-
CO2	2	3	3	2	-	-	-	-	-	-	-	-	2	-
CO3	2	3	3	2	-	-	-	-	-	-	-	-	2	-
CO4	2	3	3	2	-	-	-	-	-	-	-	-	2	-
CO5	2	3	3	2	-	-	-	-	-	-	-	-	2	-
AVG	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24EM2101 ENGINEERING MECHANICS **L T P C**
3 1 0 4

COURSE OBJECTIVES

- To familiarize the effect of forces in statics of particles and rigid bodies.
- To determine the properties of surfaces and solids.
- To gain knowledge on frictional and dynamics related problems.

UNIT I BASICS AND STATICS OF PARTICLES **12**

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

UNIT II EQUILIBRIUM OF RIGID BODIES **12**

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

UNIT III PROPERTIES OF SURFACES AND SOLIDS **12**

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

UNIT IV DYNAMICS OF PARTICLES **12**

Displacements – Velocity and acceleration – their relationship – Relative motion – Curvilinear motion – Newton's laws of motion – Work Energy Equation – Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION **12**

The Laws of Dry Friction – Coefficients of Friction – Angles of Friction – Wedge friction, Wheel Friction – Rolling Resistance – Ladder friction.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Apply the equilibrium equation for solving the statics of the particle
- CO2: Apply the equilibrium equation to solve the problem of rigid body.
- CO3: Determine the geometrical and Inertial properties of surfaces and solids
- CO4: Solve the problems related to Friction
- CO5: Solve the dynamic problems.

TEXT BOOKS

1. Beer F P and Johnston Jr E R, "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8^{th} Edition, Tata McGraw-Hill Publishing company, New Delhi 2004.
2. N Kottiswaran, "Engineering Mechanics", Sri Balaji Publications, Coimbatore 2017.
3. Bhavikatti S S and Rajashekarappa K G, "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.

REFERENCE BOOKS

1. Hibbeller R C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
2. Irving H Shames and Krishna Mohana Rao G, "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
3. Meriam J L and Kraige L G, "Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons, 1993.
4. Rajasekaran S and Sankara Subramanian G, "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
5. Kumar K L, "Engineering Mechanics", 3rd Revised Edition, Tata McGraw-Hill Publishing company, New Delhi, 2008.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	2	-	-	-	-	-	-	-	-	3	-
CO2	2	3	3	2	-	-	-	-	-	-	-	-	3	-
CO3	2	3	3	2	-	-	-	-	-	-	-	-	3	-
CO4	2	3	3	2	-	-	-	-	-	-	-	-	3	-
CO5	2	3	3	2	-	-	-	-	-	-	-	-	3	-
AVG	2	3	3	2	-	-	-	-	-	-	-	-	3	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24GE2103 தமிழரும் தொழில்நுட்பமும் **L T P C**
1 0 0 1

பாடத்தின் நோக்கங்கள்

- மாணவர்கள் நெசவு மற்றும் பானைத் தொழில்நுட்பத்தைக் கற்றறிதல்.
- கட்டிட மற்றும் உற்பத்தித் தொழில்நுட்பத்தை அறிந்து கொள்ளுதல்.
- வேளாண்மை நீர்பாசனம் மற்றும் அறிவியல் தமிழ் கணினித் தமிழ் தொழில்நுட்பத்தை அறிந்து கொள்ளுதல்.

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம் 3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் - சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு - சங்க காலத்தில்

கட்டுமானப் பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும் கோயில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபட்டுத் தலங்கள்- நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல் -மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சரோசெனிக் கட்டிடக்கலை.

அலகு III உற்பத்தித் தொழில்நுட்பம் 3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல் - எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத் துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு VI வேளாண்மை மற்றும் நீர்பாசனத் தொழில்நுட்பம் 3

அணை, ஏரி, குளம், மதகு - சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவு சார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ் 3

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

TOTAL: 15 PERIODS

பாடநெறி முடிவுகள்

பாடதிட்டத்தை முடித்த பிறகு, மாணவர்கள் செய்ய கூடியவை:

CO1: மாணவர்கள் நெசவு மற்றும் பானைத் தொழில்நுட்பத்தைக் கற்றறிந்தனர்.

CO2: கட்டிடத் தொழில்நுட்ப முக்கியத்துவத்தை அறிந்து கொண்டனர்.

CO3: உற்பத்தித் தொழில்நுட்பத்தை கற்றறிந்தனர்.

CO4: வேளாண்மை மற்றும் நீர்பாசனம் தொழில்நுட்பங்களை தெரிந்துகொண்டனர்.

CO5: அறிவியல் தமிழ் மற்றும் கணித் தமிழ் தொழில்நுட்பத்தை அறிந்துகொண்டனர்.

பாட புத்தகங்கள்

1. கே கே பிள்ளை “தமிழக வரலாறு - மக்களும் பண்பாடும்”, தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் கழகம், 2004.
2. முனைவர் இல சுந்தரம், “கணினித் தமிழ்”, விகடன் பிரசுரம், 2015.
3. டாக்டர். எஸ் வி சுப்ரமணியன், டாக்டர். கே டி திருநாவுக்கரசு, “தமிழர்களின் வரலாற்றுப் பாரம்பரியம்”, சர்வதேச தமிழாய்வு நிறுவனம்.

குறிப்பு புத்தகங்கள்

1. டாக்டர் சிங்காரவேலு, “தமிழர்களின் சமூக வாழ்க்கை”, சர்வதேச தமிழாய்வு நிறுவனம்.
2. கீழடி - “வைகை ஆற்றின் கரையில் உள்ள சங்க நகர நாகரிகம் கூட்டு” தொல்லியல் துறை & தமிழ்நாடு பாடநூல் மற்றும் கல்வி சேவைகள் கழகம், தமிழ்நாடு, 2015.
3. டாக்டர். கே கே பிள்ளை, “இந்திய வரலாறு” வெளியீடு ஆசிரியர்.
4. “பொருணை நாகரிகம்”, தொல்லியல் துறை, தமிழ்நாடு பாடநூல் மற்றும் கல்வி சேவைகள் கழகம்.
5. ஆர். பாலகிருஷ்ணன், “வைகை, சிந்து நாகரிகத்தின் பயணம்” வெளியீடு (EMRL).

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO2	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO3	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO4	-	-	-	-	-	2	-	2	-	-	-	-	2	-
CO5	-	-	-	-	-	2	-	2	-	-	-	-	2	-
AVG	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24GE2201 ENGINEERING PRACTICES LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES

- To develop practical skills in handling and assembling various components used in household plumbing, woodworking, welding, and electronic circuits.
- To provide hands-on experience in operating basic tools and equipment essential for engineering practices.
- To provide hands-on experience in domestic wiring procedures practically.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES **15**

PLUMBING WORK:

a) Connecting various basic pipefittings like valves, taps, coupling, unions, reducers, elbows and other components, which are commonly, used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump, delivery side of a pump and pipes of different materials: Metal, plastic and flexible pipes used in house hold appliances.

WOOD WORK EXCERSIES:

a) Excises on sawing and planning of woods.
b) Prepare joints like T-Joint, Mortise joint, Tenon joint, and Dovetail joint.
c) Studying joints in door panels, wooden furniture and common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES **15**

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin sockets.
b) Staircase wiring.
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration.
e) Study of Iron Box wiring and assembly.
f) Study of Fan Regulator (Resistor type and Electronic type).

GROUP – B (MECHANICAL & ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES **15**

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) Turning (simple).
b) Drilling and Tapping.

SHEET METAL WORK:

a) Making of a square tray.

STUDY AND ASSEMBLE THE FOLLOWING:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air conditioner.

FOUNDRY WORK:

a) Demonstrating of basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES **15**

a) Soldering simple electronic circuits and checking continuity.
b) Assembling and testing electronic components on a small PCB.
c) Study an element of smart phone.
d) Assembly and dismantle of LED TV.
e) Assembly and dismantle of computer.
f) Assembly and dismantle of laptop.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Proficiently connect and troubleshoot plumbing systems using various pipefittings and materials.

CO2: Demonstrate competence in woodworking techniques including sawing, planning, and joint preparation.

CO3: Understand and execute electrical wiring tasks, including switchboard installations and appliance connections.

CO4: Gain practical skills in welding, machining, sheet metal work, and foundry operations.

CO5: Assemble and test electronic devices such as PCBs, smartphones, LED TVs, and computers, enhancing their understanding of electronic assembly and testing procedures.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	2	-	-	-	2	-	-	2	3	2
CO2	3	3	3	2	2	-	-	-	2	-	-	2	3	2
CO3	3	3	3	2	2	-	-	-	2	-	-	2	3	2
CO4	3	3	3	2	2	-	-	-	2	-	-	2	3	2
CO5	3	3	3	2	2	-	-	-	2	-	-	2	3	2
AVG	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**3**	**2**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MU3101 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS **L T P C 3 1 0 4**

COURSE OBJECTIVES

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To learn the Fourier series analysis which is central to many applications in engineering.
- To familiarize the Fourier and Z - transforms techniques used in wide variety of situations.

UNIT I FOURIER SERIES **9+3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series –Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT II FOURIER TRANSFORMS **9+3**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III Z - TRANSFORMS AND DIFFERENCE EQUATIONS **9+3**

Z- Transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) –Convolution theorem - Formation of difference equations – Solution of difference equations using Z –Transform.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Formation of partial differential equations – Singular integrals -Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT V APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9+3**

Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Solve Fourier series techniques for heat flow problems and wave equations.
CO2: Apply the Fourier transform techniques for engineering applications.
CO3: Analyze the discrete time systems using Z- Transform and differential equations.
CO4: Apply the PDE to solve the linear equations.
CO5: Apply the PDE to solve the boundary value problems.

TEXT BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 11th Edition, Wiley India, 2020.
2. Grewal. B.S., "Higher Engineering Mathematics", 45th Edition, Khanna Publishers, Delhi, 2020.
3. Ramana.B.V, "Higher Engineering Mathematics", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2018.

REFERENCE BOOKS

1. Narayanan.S. Manicavachagom Pillay T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students," Vol.II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 2019.
2. Manish Goyal, N.P. Bali – "Transforms and Partial Differential Equations" 2nd Edition, Laxmi Publications
3. Ray Wylie.C and Barrett.L.C, "Advanced Engineering Mathematics" Tata Mc Graw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2017.
4. Glyn James, "Advanced Modern Engineering Mathematics", 5th Edition, Pearson Education, 2017.
5. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2016.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	2	-
AVG	2	3	-	-	-	-	-	-	-	-	-	-	2	-

1 - Low, 2 - Medium, 3 - High, '-' No correlation

24ME3101 ENGINEERING THERMODYNAMICS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To learn the laws of thermodynamics and how it is reflected in the systems under equilibrium, and the natural and engineered processes.
- To provide the way the laws of thermodynamics govern chemical transformations.
- To familiarize how thermodynamic laws are applied to various cyclic industrial processes.

UNIT I BASICS, ZEROTH AND FIRST LAW — 9

Review of basics – thermodynamic systems, Properties and processes thermodynamic equilibrium - displacement work - P-V diagram. Thermal equilibrium - Zeroth law – concept of temperature and temperature scales. First law – application to closed and open systems – steady and unsteady flow processes.

UNIT II SECOND LAW AND ENTROPY **9**

Heat Engine – refrigerator - heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - reversed Carnot cycle - performance - Clausius inequality. Concept of entropy - T-s diagram – Tds Equations - Entropy change for a pure substance.

UNIT III AVAILABILITY AND APPLICATIONS OF II LAW **9**

Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. High and low-grade energy. Availability and irreversibility for open and closed system processes - I and II law Efficiency.

UNIT IV PROPERTIES OF PURE SUBSTANCES **9**

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

UNIT V GAS MIXTURES AND THERMODYNAMIC RELATIONS **9**

Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. Vander Waal's relation - reduced properties - compressibility factor - principle of corresponding states – generalized compressibility chart. Maxwell relations - TdS Equations - heat capacities relations - Energy equation, Joule Thomson experiment – Clausius Clapeyron equation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

- CO1: Apply the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.
- CO2: Apply the second law of thermodynamics in analysing the performance of thermal devices through energy and entropy calculations.
- CO3: Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart.
- CO4: Apply the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.
- CO5: Apply the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.

TEXT BOOKS

1. Rao, Y.V.C., “An Introduction to Thermodynamics”, Universities Press, Hyderabad, India, 2019.
2. Cengal, Y.A and Boles, M.A, “Thermodynamics: An Engineering Approach”, 5th edition, McGrawHill, 2006.
3. Nag, P.K., “Engineering Thermodynamics”, 3rd Edition, Tata McGraw-Hill, 2005.

REFERENCE BOOKS

1. Sonntag, R.E., Borgnakke, C., and Van Wylen, G.J., "Fundamentals of Thermodynamics", 6th edition, John Wiley, 2003.
2. Michael J. Moran & Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley & Sons, 6th edition, 2010.
3. Adrian Bejan, Advanced Engineering Thermodynamics, John Wiley & Sons, 4th edition, 2016.
4. Arora .C.P., "Refrigeration and Air Conditioning", Tata McGraw Hill, 1994.
5. Kenneth K. Kuo, Principles of Combustion, Wiley India Pvt. Ltd, 2nd edition, 2012.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	-	3	3
AVG	**3**	**3**	**2.6**	**2**	-	-	-	-	-	-	-	-	**3**	**3**

1 - Low, 2 - Medium, 3 – High, '-' No correlation

24ME3102 FLUID MECHANICS AND MACHINERY **L T P C**
3 1 0 4

COURSE OBJECTIVES

- To impart basic knowledge of the dynamics of fluids and boundary layer concept.
- To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends.
- To expose the students to basic principles of working of hydraulic machineries and to design Pelton Wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS **12**

Properties of fluids – fluid statics - pressure measurements - buoyancy and floatation – flow characteristics - eulerian and lagrangian approach - concept of control volume and system - continuity equation, energy equation and momentum equation - applications.

UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER **12**

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

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES **12**

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

UNIT IV TURBINES **12**

Impact of jets - velocity triangles - theory of rotodynamic machines - classification of turbines – working principles - Pelton wheel - modern Francis turbine - Kaplan turbine - work done - efficiencies - draft tube- specific speed - performance curves for turbines - governing of turbines.

UNIT V PUMPS **12**

Classification of pumps - centrifugal pumps - working principle - heads and efficiencies– velocity triangles - work done by the impeller - Performance curves - Reciprocating pump working principle -Indicator diagram and it's variations - Work saved by fitting air vessels - Rotary pumps.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Eplore fluid properties, static behavior, and conservation laws.

CO2: Estimate energy losses in laminar and turbulent flows, and analyze pipe networks.

CO3: Explain boundary layer concepts and determine thickness over flat surfaces.

CO4: Formulate parameter relationships and predict prototype performance using model studies.

CO5: Explain the turbines and pumps based on their working principles.

TEXT BOOKS

1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22^{nd} edition 2019.
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
3. R.K.Bansal, Fluid Mechanics and Hydraulic Machines, lakshmi publications, 9^{th} edition, 2019.

REFERENCE BOOKS

1. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House (P) Ltd. New Delhi, 2016.
2. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2011.
3. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
4. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.
5. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO3	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO4	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO5	3	3	2	2	-	-	-	-	-	-	-	-	2	2
AVG	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME3103 STRENGTH OF MATERIALS **L T P C**
3 0 0 3

COURSE OBJECTIVES

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

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS **9**

Rigid bodies and deformable solids – tension, compression and shear stresses - deformation of simple and compound bars – thermal stresses – elastic constants - volumetric strains – stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM **9**

Beams – types - transverse loading on beams – shear force and bending moment in beams – cantilever, simply supported and over hanging beams. Theory of simple bending – bending stress distribution – load carrying capacity – proportioning of sections – flitched beams – shear stress distribution.

UNIT III TORSION **9**

Theory of Torsion – stresses and deformations in solid and hollow circular shafts – combined bending moment and torsion of shafts - power transmitted to shaft – shaft in series and parallel – closed and open coiled helical springs – springs in series and parallel.

UNIT IV DEFLECTION OF BEAMS **9**

Elastic curve – governing differential equation - double integration method - Macaulay's method - area moment method - conjugate beam method for computation of slope and deflection of determinant beams.

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS **9**

Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses - deformation in thin cylinders – spherical shells subjected to internal pressure – deformation in spherical shells – thick cylinders - lame's theory.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Solve simple stress and strain problems.

CO2: Solve the beams problems for shearing force and bending moment.

CO3: Apply basic equation of torsion in designing of shafts and helical springs.

CO4: Calculate slope and deflection in beams using different methods.

CO5: Analyze thin and thick shells for applied pressures.

TEXT BOOKS

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 7th edition, 2018
2. Rattan S.S., "Strength of Materials", Tata McGraw Hill Education Pvt .Ltd., New Delhi, 2017.
3. K. Bhaskar, T. K. Varadan., "Strength of Materials", Springer Cham., 2023.

REFERENCE BOOKS

1. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009.
2. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2002.
3. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.
4. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013.
5. Subramanian R., "Strength of Materials", Oxford University Press, 2010.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO3	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO4	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO5	3	3	2	2	-	-	-	-	-	-	-	-	2	2
AVG	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME3104 MANUFACTURING PROCESSES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To impart the working principles of various molding and metal casting processes.
- To apply the principles of various metal joining techniques and bulk metal deformation techniques.
- To explore the principles of sheet metal forming processes and plastic molding techniques.

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 – co_2 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 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: 45 PERIODS

LIST OF EXPERIMENTS

1. Fabrication of butt joint using arc welding.
2. Fabrication of T joint using arc welding.
3. Fabrication of lap joint using arc welding.
4. Manufacturing of sheet metal components: rectangular tray operation.
5. Manufacturing of sheet metal components: funnel operation.
6. Preparation of green sand mould using split pattern.
7. Preparation of green sand mould using solid pattern.
8. Preparation of green sand mould for making gear.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Describe the working principles of various metal casting processes.

CO2: Identify the importance of permanent joining and principle behind different welding processes.

CO3: Explore the different bulk deformation processes.

CO4: Elaborates the uniqueness of extrusion, forging and high energy rate forming processes in metal working.

CO5: Apply suitable molding techniques for the manufacturing of plastic components.

TEXT BOOKS

1. P.N. Rao, "Manufacturing Technology, Vol.1", Mc Graw Hill Education, 5th Edition, 2018.
2. Serope Kalpakjian, Steven R. Schmid, "Manufacturing Engineering & Technology", Pearson, 7th Edition, 2014.
3. S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, Elements of Workshop Technology, Vol.1,Media Publishers & Promoters Pvt. Ltd.,1st Edition,2008.

REFERENCE BOOKS

1. P.C. Sharma, "A Text book of Production Technology (Manufacturing Processes)", S.Chand Publications /1st edition, 2006.
2. H. S. Shan, "Manufacturing processes", Second Edition, Cambridge University Press, 2017.
3. S. Gowri P. Hariharan, A.Suresh Babu, "Manufacturing Technology I", Pearson Education, 2008.
4. Paul Degarma E, Black J.T and Ronald A. Kosher, Eligth Edition, "Materials and Processes, in Manufacturing", 8th edition, Prentice – Hall of India, 1997.
5. R.K.Rajput," Manufacturing Technology, Laxmi Publications; Second edition, 2019.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	-	-	-	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME3105 ENGINEERING MATERIALS AND METALLURGY **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To learn the phase diagram, iron-iron carbide phase diagram and heat treatment processes for microstructure formation.
- To illustrate the different types of ferrous, non-ferrous alloys, different polymer, ceramics and composites and its applications in engineering field.
- To learn deformation mechanism and the various testing procedures.

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS **9**

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

UNIT II HEAT TREATMENT **9**

Definition, steps-Types of heat treatment of steel. Isothermal transformation diagrams – steps to construct-cooling curves superimposed on I.T. diagram – continuous cooling Transformation (CCT) diagram – austempering, martempering – hardenability, Jominy end quench test -case hardening, carburizing, nitriding, cyaniding, carbonitriding – flame and Induction hardening – vacuum and plasma hardening – thermo-mechanical treatments-elementary ideas on sintering. Introduction to cryogenic treatment.

UNIT III FERROUS AND NON-FERROUS METALS **9**

Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V,Ti& W) – stainless and tool steels – HSLA - maraging steels – Grey, white, malleable, spheroidal – alloy cast irons, copper and its alloys – brass, bronze and cupronickel – aluminium and its alloys; Al-Cu – precipitation strengthening treatment – titanium alloys, Mg-alloys, Ni-based super alloys – shape memory alloys- Properties and Applications-overview of materials standards.

UNIT IV NON-METALLIC MATERIALS **9**

Polymers – types of polymers, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPO, PPS, PEEK, PTFE, Thermoset polymers – Urea and Phenol formaldehydes –Nylon, Engineering Ceramics-

Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ and SIALON – intermetallics-composites- matrix and reinforcement materials-applications of composites - nano composites.

UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9

Mechanical properties-mechanisms of plastic deformation, slip and twinning – types of fracture – fracture mechanics- Griffith's theory- testing of materials under tension, compression and shear loads – hardness tests (Brinell, Vickers and Rockwell), micro and nano-hardness tests, Impact test, lzod and charpy, fatigue and creep failure mechanisms.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Metallurgical microscope study: principles and operations.
2. Determine the apparent, tapped and bulk densities of various samples.
3. Conduct the annealing heat treatment on plain carbon steel.
4. Conduct the normalizing heat treatment on plain carbon steel.
5. Conduct the hardening heat treatment on plain carbon steel.
6. Conduct the tempering heat treatment on hardened plain carbon steel.
7. Sample preparation for metallographic examination.
8. Preparation of PMC by using hand layup method.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explian alloys and phase diagram, Iron-Iron carbon diagram and steel classification.
CO2: Exdplain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
CO3: Apply the effect of alloying elements on ferrous and non-ferrous metals.
CO4: Explore the properties and applications of non-metallic materials.
CO5: Apply the testing of mechanical properties for various metals.

TEXT BOOKS

1. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, 2nd edition Re print 2019.
2. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 9th edition, 2018.
3. Sydney H.Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1994.

REFERENCE BOOKS

1. ASM Handbook Volume 9: Metallography and Microstructures.
2. Alavudeen, N. Venkateshwaran, and J. T.Winowlin Jappes, "A Textbook of Engineering Materials and Metallurgy", Laxmi Publications, 2006
3. Amandeep Singh Wadhwa, and Harvinder Singh Dhaliwal, "A Textbook of Engineering Material and Metallurgy", University Sciences Press, 2008.
4. G.S .Upadhyay and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt.Ltd, New Delhi, 2020.
5. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt.Ltd. 6th edition, 2019.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	3	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	2	-
AVG	**3**	**2.6**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME3201 MATERIALS TESTING LABORATORY **L T P C**
0 0 3 1.5

COURSE OBJECTIVES

- To inculcate knowledge on mechanical behaviour of engineering materials.
- To equip students with the skills to determine the mechanical properties of engineering materials.
- To know influence of the heat treatment process on properties of metals.

LIST OF EXPERIMENTS

1. Measure the Rockwell hardness for ferrous and non-ferrous materials.
2. Measure the Brinell hardness for ferrous and non-ferrous materials.
3. Measure the Vicker's hardness for ferrous and non-ferrous materials.
4. Impact Performance comparison of heat-treated material with non-heat-treated material using an IZOD impact test.
5. Impact Performance comparison of heat-treated material with non-heat-treated material using a CHARPY impact test.
6. Test a specimen by using torsion testing machine.
7. Perform fatigue strength of a specimen using fatigue testing machine.
8. Perform a tensile test on a closed coil spring.
9. Perform a compression test on an open coil spring.
10. Determine the deflection of a simply supported wooden and steel beam.
11. Deflection of a cantilever wooden and steel beam.
12. Conduct a tensile test on mild steel specimen and find the mechanical properties.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Analyze hardness of ferrous and nonferrous metals by using different hardness measuring methods.
CO2: Analyze impact strength of heat-treated and non-heat treated specimen.
CO3: Measure the torsional and fatigue strength of given specimen.
CO4: Evaluate the tensile properties of mild steel rod, open and closed coil spring
CO5: Measure the deflection of steel and wooden beam.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	-	-	-	-	-	-	-	-	2	2
CO2	3	2	3	2	-	-	-	-	-	-	-	-	2	2
CO3	3	2	2	2	-	-	-	-	-	-	-	-	2	-
CO4	3	2	3	2	-	-	-	-	-	-	-	-	2	-
CO5	3	2	2	2	-	-	-	-	-	-	-	-	2	2
AVG	**3**	**2**	**2.6**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME3202 FLUID MECHANICS AND MACHINERY LABORATORY

L T P C
0 0 3 1.5

COURSE OBJECTIVES

- To know the performance of hydraulic and fluid flow measuring devices by calculating discharge coefficients and flow rates.
- To study fluid dynamics in hydraulic machines by conducting experiments and plotting characteristic curves.
- To learn energy losses and efficiency in fluid flow systems to optimize hydraulic design.

LIST OF EXPERIMENTS

1. Experimental analysis for determining the discharge coefficient of an orifice meter.
2. Evaluation of the discharge coefficient in a Venturi meter setup.
3. Flow rate measurement using a rotameter: a practical approach.
4. Determination of pipe friction factor through experimental data.
5. Performance evaluation and characteristic curve plotting of a centrifugal pump.
6. Operational analysis and characteristics of a reciprocating pump system.
7. Efficiency and flow characteristics of a gear pump under variable loads.
8. Performance testing and characteristic curve development of a Pelton wheel turbine.
9. Experimental study on the operating characteristics of a Francis turbine.
10. Analysis and performance curve generation of a Kaplan turbine.
11. Functional evaluation and performance assessment of an industrial blower.
12. Performance testing and flow characteristics of a submersible pump.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Set up flow measuring devices and determine discharge coefficients.
CO2: Analyze fluid machinery data to evaluate flow rate, efficiency and head.
CO3: Plot and interpret characteristic curves for pumps and turbines under varying loads.
CO4: Calculate pipe friction factors and flow losses through experiments and theory.
CO5: Develop technical reporting skills and apply engineering judgment to fluid systems.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	3	-	-	-	-	-	-	-	-	2	2
CO2	2	3	3	3	-	-	-	-	-	-	-	-	3	2
CO3	2	2	3	3	-	-	-	-	-	-	-	-	3	3
CO4	2	3	2	3	-	-	-	-	-	-	-	-	3	2
CO5	-	2	2	2	-	-	-	-	-	-	-	-	2	3
AVG	2	2.4	2.4	2.8	-	-	-	-	-	-	-	-	2.6	2.4

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME4101 THEORY OF MACHINES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To familiarize the basic mechanisms, fundamentals of gears and gear trains.
- To analyze the relationship of friction with machine elements and the force-motion on different mechanisms.
- To study the statics and dynamics mechanism in terms of balancing and vibration.

UNIT I KINEMATICS OF MECHANISMS **9**

Kinematic analysis of mechanism, plane motion, kinematic concept of links, kinematic chains, basic terminology and definitions– kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons– analytical methods and graphical approach.

UNIT II GEARS AND GEAR TRAINS **9**

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

UNIT III FRICTION IN MACHINE ELEMENTS **9**

Surface contacts – sliding and rolling friction – friction drives – friction in screw threads – bearings and lubrication – friction clutches – belt and rope drives – friction aspects in brakes– friction in vehicle propulsion and braking.

UNIT IV FORCE ANALYSIS **9**

Applied and constrained forces – free body diagrams – static equilibrium conditions – two, three and four members – static force analysis in simple machine members – dynamic force analysis – inertia forces and inertia torque – D'Alembert's principle – superposition principle – dynamic force analysis in simple machine members.

UNIT V BALANCING AND VIBRATION **9**

Static and dynamic balancing – balancing of revolving masses – balancing machines – free vibrations – equations of motion – natural frequency – damped vibration – bending critical speed of simple shaft – torsional vibration. basics of forced vibration.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Analyze the various kinematic motions of mechanisms.

CO2: Evaluate the different gear trains for appropriate application.

CO3: Evaluate the effect of friction in mechanical static and dynamic systems.

CO4: Analyze the effect of forces in the different mechanisms.

CO5: Develop the precise mechanical system by reducing undesirable effects.

TEXT BOOKS

1. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, Oxford University Press, 2017.
2. Rattan, S.S, “Theory of Machines”, McGraw-Hill Education Pvt. Ltd., 5th edition 2019
3. Amitabha Ghosh and Asok Kumar Mallik, “Theory of Mechanisms and Machines”, Affiliated East-West Pvt. Ltd., 1988.

REFERENCE BOOKS

1. Rao.J.S. and Dukkipati.R.V. “Mechanism and Machine Theory”, New Age International Pvt. Ltd., 2nd edition, 2014.
2. Ramamurthi. V, “Mechanics of Machines”, Narosa Publishing House, 3rd edition 2019
3. Robert L. Norton, “Kinematics and Dynamics of Machinery”, Tata McGraw-Hill, 2013.
4. Wilson. FW, "Fundamentals of Tool Design" ASTME PHI 2010.
5. Wilson and Sadler, “Kinematics and Dynamics of Machinery”, Pearson, 2008.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	3	-	-	-	-	-	-	-	-	-	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	2	2
AVG	3	3	3	-	-	-	-	-	-	-	-	-	2.5	2

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24ME4102 THERMAL ENGINEERING

L	T	P	C
3	0	2	4

COURSE OBJECTIVES

- To compare air standard cycles and steam cycles in terms of thermodynamic efficiency and power generation applications.
- To understand the design, working principles, and combustion of SI engines.
- To understand the design, working principles, and combustion of CI engines.

UNIT I GAS POWER CYCLES **10**

Air Standard Cycles – Carnot, Otto, Diesel, Dual, and Brayton – Cycle Analysis, Performance and comparison, basic Rankine cycle, modified, reheat and regenerative cycles.

UNIT II SPARK IGNITION ENGINES **8**

SI engine basics: classification, working, components and their functions. Valve and port timing: ideal and actual valve timing diagrams. Geometric, operating, and performance characteristics of SI engines. SI engine – fuels, air-fuel ratio, combustion and knocking.

UNIT III COMPRESSION IGNITION ENGINES **9**

CI engine basics: classification, working, components and their functions. Valve and port timing: ideal and actual valve timing diagrams for CI engines. Geometric, operating, and performance characteristics of CI engines. CI engine - fuels, air-fuel ratio, combustion and knocking.

UNIT IV IC ENGINE PERFORMANCE **9**

Performance and emission testing, performance parameters and calculations. Morse and heat balance tests.

UNIT V AUXILIARY SYSTEMS **9**

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.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Valve timing diagram of a four-stroke engine.
2. Port timing diagram of a two-stroke engine.
3. Performance test on a four-stroke diesel engine.
4. Heat balance test on a four-stroke diesel engine.
5. Morse test on a multi-cylinder petrol engine.
6. Retardation test on a diesel engine.
7. Determination of flash point and fire point of fuels and lubricants.
8. Viscosity measurement using a redwood viscometer.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Compare the performance of gas power cycles.

CO2: Identify and describe the working, components, and combustion in SI engines.

CO3: Explain the operation and combustion in CI engines, including knocking.

CO4: Analyze engine performance and emissions using tests like Morse and heat balance.

CO5: Evaluate the role of auxiliary systems on engine performance and emissions.

TEXT BOOKS

1. Mahesh. M. Rathore, "Thermal Engineering", 1st Edition, Tata McGraw Hill, 2010.
2. Ganesan.V, " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.
3. John B. Heywood, Internal Combustion Engines Fundamentals, Tata McGraw Hill, 2017.

REFERENCE BOOKS

1. Ballaney. P, "Thermal Engineering", 25th Edition, Khanna Publishers, 2017.
2. Domkundwar, Kothandaraman, &Domkundwar, "A Course in Thermal Engineering", 6th Edition, DhanpatRai& Sons, 2011.
3. Gupta H.N, "Fundamentals of Internal Combustion Engines", 2nd Edition Prentice Hall of India, 2013.
4. Mathur M.L and Mehta F.S., "Thermal Science and Engineering", 3rd Edition, Jain Brothers Pvt. Ltd, 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
CO1	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	3	-	-	-	-	-	-	-	-	3	2
CO4	3	3	2	3	-	-	-	-	-	-	-	-	3	2
CO5	2	2	2	2	-	-	-	-	-	-	-	-	3	2
AVG	2.8	2.4	2	2.4	-	-	-	-	-	-	-	-	3	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME4103 MACHINE TOOLS AND TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To provide fundamental knowledge and principles in material removal processes.
- To provide the knowledge of different drives and mechanisms used in machine tools, the design of gearboxes & feed boxes, structures, guide ways, spindles and various control systems used in machine tools.
- To apply knowledge of Computer Numerical Control machines.

UNIT I MECHANICS 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, cutting forces, Merchants circle- thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and machinability.

UNIT II LATHE, SEMI-AUTOMATIC LATHEAND AUTOMATIC LATHE **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 BULK METAL REMOVAL 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.

UNIT IV SURFACE FINISHING PROCESSES **9**

Grinding wheel– specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centerless grinding, internal grinding, dressing, truing, selection of grinding wheels-sand blasting-Precision grinding -Honing -Polishing – Buffing-Super finishing-micro finishing methods- Nano finishing Methods.

UNIT V 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, coolant systems, safety features. Coordinates, axis and motion, absolute vs incremental, interpolators, polar coordinates, program planning 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: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Apply the mechanism of metal removal process.
CO2: Explore the lathe and its operations.
CO3: Explain the mechanism of bulk metal removal processes.
CO4: Intepret the various surface finishing processes.
CO5: Discus the computer numerical control machine tools.

TEXT BOOKS

1. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India,7th Edition, 2018.
2. Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Education; 4th edition, 2018.
3. D. K Pal, S. K. Basu," Design of Machine Tools", 5th Edition, Oxford IBH, 2008.

REFERENCE BOOKS

1. Roy. A. Lindberg, "Processes and materials of manufacture", PHI / Pearson education, 2006.
2. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984.
3. Rao. P.N "Manufacturing Technology," Metal Cutting and Machine Tools, Tata McGraw- Hill, New Delhi, 2009.
4. B. Chattopadhyay, Machining and Machine Tools, Wiley, 2nd edition, 2017.
5. Peter Smid, CNC Programming Handbook, Industrial Press Inc.;Third edition, 2007.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	2	-	-	-	-	-	-	-	3	2
CO2	2	3	-	-	2	-	-	-	-	-	-	-	3	2
CO3	2	3	-	-	2	-	-	-	-	-	-	-	3	2
CO4	2	3	-	-	2	-	-	-	-	-	-	-	3	2
CO5	2	3	-	-	2	-	-	-	-	-	-	-	3	2
AVG	**2**	**3**	-	-	**2**	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME4104 APPLIED FLUID POWER ENGINEERING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce fundamental principles of fluids in power transmission.
- To impart constructs to design fluid power circuits for widespread industrial applications.
- To realize the maintenance and troubleshooting procedures for fluid power systems.

UNIT I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 9

Introduction to fluid power – advantages and applications – fluid power systems – types of fluids - properties of fluids and selection – basics of hydraulics – Pascal's law – principles of flow - friction loss – work, power and torque- problems, sources of hydraulic power: pumping theory – pump classification – construction, working, design, advantages, disadvantages, performance, selection criteria of pumps – fixed and variable displacement pumps – problems.

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

hydraulic actuators: cylinders – types and construction, application, hydraulic cushioning – rotary actuators-hydraulic motors - control components: direction control, flow control and pressure control valves – types, construction and operation – accessories: reservoirs, pressure switches – filters –types and selection- applications –servo and proportional valves – applications -fluid power ANSI Symbols – problems.

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, intensifiers, industrial hydraulic circuits – regenerative, pump unloading, double-pump, pressure intensifier, air-over oil, sequence, reciprocation, synchronization, fail-safe, speed control, deceleration circuits, sizing of hydraulic systems, hydrostatic transmission, electro hydraulic circuits-mechanical, hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air –air preparation and distribution – filters, regulator, lubricator, muffler, air control valves, quick exhaust valves, pneumatic actuators, design of pneumatic circuit – classification- single cylinder and multi cylinder circuits-cascade method –integration of fringe circuits, electro pneumatic system – elements – ladder diagram – timer circuits-problems, introduction to fluidics and pneumatic logic circuits.

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, selection, maintenance, trouble shooting and remedies in hydraulic and pneumatic systems, conditioning of hydraulic fluids design of hydraulic circuits for drilling, planning, shaping, surface grinding, press and forklift applications- mobile hydraulics; design of pneumatic circuits for metal working, handling, clamping counter and timer circuits – low-cost automation – hydraulic and pneumatic power packs, IoT in hydraulics and pneumatics.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Describe the working principles of fluid power systems and hydraulic pumps.
CO2: Analyze the functions of hydraulic actuators and control components.
CO3: Design and develop hydraulic circuits and systems.
CO4: Develop the working principles of pneumatic circuits and power system and its components.
CO5: Examine the maintenance and identify faults in fluid power systems.

TEXT BOOKS

1. Anthony Esposito, “Fluid Power with Applications”, Prentice Hall, 2009.
2. John S. Cundiff, Michael F. Kocher, “Fluid Power Circuits and Controls: Fundamentals and Applications”, Second Edition. CRC Press, 2019.
3. Srinivasan.R., “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 3rd edition, 2019.

REFERENCE BOOKS

1. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997.
2. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.
3. Daines, J. R., Daines, M. J, "Fluid Power: Hydraulics and Pneumatics", United States: Goodheart-Willcox Company, Incorporated, 2019.
4. Shanmugasundaram.K., "Hydraulic and Pneumatic Controls". Chand & Co, 2006.
5. Meinhard T. Schobeiri, Applied Fluid Mechanics for Engineers, McGraw-Hill 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
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	-	-	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME4105 COMPUTER AIDED DESIGN **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To introduce the fundamental principles of CAD and the underlying computer graphics concepts.
- To learn the techniques used for surface and solid modelling.
- To provide an understanding of the standards used in CAD systems.

UNIT I FUNDAMENTALS **9**

Computer aided design – CAD system architecture- computer graphics – co-ordinate systems- 2D and 3D transformations homogeneous coordinates - line drawing -clipping- viewing transformation.

UNIT II GEOMETRIC MODELING **9**

Surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep.

UNIT III VISUAL REALISM **9**

Hidden – line- surface- solid removal algorithms – shading – colouring – computer animation.

UNIT IV ASSEMBLY OF PARTS **9**

Assembly modelling – interferences of positions and orientation – tolerance analysis-mass property calculations – mechanism simulation and interference checking.

UNIT V CAD STANDARDS **9**

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images Open Graphics Library (OpenGL) - data exchange standards - IGES, STEP, CALS etc. - Communication standards.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Introduction and different features of the CAD Software
   a) Study of Capabilities of Software for Drafting & Modeling – Co-Ordinate System.
   b) Creation of simple figures like polygon and general multiline figures.
   c) Drawing of a title block with necessary text and projection symbol.
2. 2-D Drafting
   a) Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
   b) Drawing front view, top view and side view of objects from the given pictorial views.
3. 3-D Modeling
   a) To draw the plan view of gear.
   b) Drawing of a connecting rod in 3D.
4. 3-D Advanced modelling
   a) Universal joint.
   b) Screw jack.
   c) Knuckle joint.
   d) Flange coupling.
   e) Gears (spur, helical, bevel, worm).

TOTAL: 30 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students can able to

CO1: Explain the basics of computer graphics, coordinate systems, and transformations used in design.
CO2: Model complex geometries using surfaces and solid representations.
CO3: Apply rendering techniques and visualization tools for realistic display of models.
CO4: Model assemblies and perform interference checks and mechanism simulations.
CO5: Apply various graphics and data exchange standards.

TEXT BOOKS

1. Zeid, I. CAD/CAM: Theory and Practice, 3rd ed. New Delhi, India: McGraw-Hill Education, 2018.
2. Radhakrishnan, P. CAD/CAM/CIM, 4th ed. New Delhi, India: New Age International Pvt Ltd, 2016.
3. Rao, P. N. CAD/CAM: Principles and Applications, 3rd ed. New Delhi, India: McGraw Hill Education, 2017.

REFERENCE BOOKS

1. Foley, J. D. A. van Dam, S. K. Feiner, and J. F. Hughes, Computer Graphics: Principles and Practice, 3rd ed. Boston, MA, USA: Addison-Wesley, 2013.
2. Tzetzis D. and P. Kyratsis, Computer-Aided Design: Advances in Research and Applications, Nova Science Publishers, 2022.
3. Bi Z. and X. Wang, Computer-Aided Design and Manufacturing, ASME Press, 2021.
4. Mustun, A. QCAD: An Introduction to Computer-Aided Design, 2nd ed., 2021.
5. Bi, Z. Computer Aided Design and Manufacturing, Wiley, 2020.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	3	2	3	-	-	-	-	-	-	-	3	2
CO2	2	2	3	2	3	-	-	-	-	-	-	-	3	2
CO3	2	2	3	2	3	-	-	-	-	-	-	-	3	2
CO4	2	2	3	2	3	-	-	-	-	-	-	-	3	2
CO5	2	2	3	2	3	-	-	-	-	-	-	-	3	2
AVG	**2**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24CY4101 ENVIRONMENTAL SCIENCE AND ENGINEERING

L T P C
2 0 0 2

COURSE OBJECTIVES

- To introduce the fundamental ideas of environment and interrelationship between living organism.
- To impart knowledge on pollution and perspectives on renewable resources.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials.

UNIT I ENVRONMENT AND BIODIVERSITY — 6

Definition - scope and importance of environment. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In- situ and ex-situ.

UNIT II NATURAL RESOURCES — 6

Forest resources: deforestation, timber extraction, mining, dams and their effects on forests and tribal people. Water resources: over-utilization of surface and ground water. Mineral resources: environmental effects of extracting and using mineral resources. Food resources: World food problems, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

UNIT III ENVIRONMENTAL POLLUTION **6**

Causes, Effects and Preventive measures of Water, Soil and Air Pollution. Environmental protection acts [Environment Act, Air Act, Water Act]. Disaster management: causes - effects - control measures of floods – earthquake.

UNIT IV NON-CONVENTIONAL ENERGY **6**

Energy management and conservation, New Energy Sources: Solar energy, Wind energy, Biomass energy, Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT V SUSTAINABILITY MANAGEMENT **6**

Sustainable development, Unsustainability to sustainability, GDP, Carbon Credit, Carbon Footprint, Zero waste and R concept, Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports, Green Engineering.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Understand the functions of environment, ecosystems and biodiversity.
CO2: Examine the relationship between natural resources and their environment.
CO3: Identify the causes, effects of environmental pollution.
CO4: Recognize the sources of Non-conventional energy.
CO5: Understand the needs of sustainable development and green materials.

TEXT BOOKS

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi,
3. 2016.
4. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCES

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38th Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

Mapping of COs, POsand PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	-	-	-	-	3	-	-	-	-	-	2	-
CO2	2	2	-	-	-	-	3	-	-	-	-	-	2	-
CO3	2	2	-	-	-	-	3	-	-	-	-	-	2	-
CO4	2	2	-	-	-	-	3	-	-	-	-	-	2	-
CO5	2	2	-	-	-	-	3	-	-	-	-	-	-	-
AVG	2	2	-	-	-	-	3	-	-	-	-	-	2	-

1-Low,2 -Medium, 3– High, '-' No correlation

24ME4201 KINEMATICS AND DYNAMICS LABORATORY **L T P C**
0 0 3 1.5

COURSE OBJECTIVE

- To study the different measurement equipment and use of this industry for quality inspection.
- To supplements, the principles learnt in dynamics of machinery's.
- To understand how certain measuring devices are used for dynamic testing.

LIST OF EXPERIMENT

1. Study of gear parameters.
2. Epicyclic gear trains.
3. Determination of moment of inertia of flywheel and axle system.
4. Determination of mass moment of inertia of a body about its axis of symmetry.
5. Undamped free vibration of a single degree of freedom spring mass system.
6. Torsional vibration of single rotor shaft system.
7. Dynamic analysis of cam mechanism.
8. Experiment of Watts governor.
9. Experiment of Porter governor.
10. Experiment on Proell governor.
11. Experiment on motorized gyroscope.
12. Determination of critical speed of shaft.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On completion of the course, the students will be able to

CO1: Describe the working of different gear systems including spur, helical, and epicyclic gear trains, and calculate speed ratios.

CO2: Experimentally find the mass moment of inertia for flywheels, axles, and bodies with rotational symmetry using standard methods.

CO3: Examine undamped free vibrations in single degree of freedom systems and torsional vibrations in shaft-rotor setups.

CO4: Investigate the behavior of Watt, Porter, and Proell governors under varying speeds and loads to understand stability and sensitivity.

CO5: Explore gyroscopic effects, conduct critical speed tests on shafts, and perform dynamic analysis of cam-follower mechanisms.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	2	-	-	-	-	-		-	-	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	3	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	3	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	3	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	**2.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME4202 MANUFACTURING PROCESSES LABORATORY

L T P C
0 0 3 1.5

COURSE OBJECTIVES

- To study appropriate tools, equipment's and machines to machine a given job.
- To study the various casting and welding process for making simple components.
- To learn various machining process such as turning, shaping, drilling, milling and grinding of components.

LIST OF EXPERIMENTS

1. Taper turning on circular parts using lathe machine.
2. Eccentric turning on circular parts using lathe machine.
3. Knurling, external and internal thread cutting on circular parts using lathe machine.
4. Shaping – square and hexagonal heads on circular parts using shaper machine.
5. Prepare keyway on circular shaft by using shaper machine.
6. Drilling and reaming using vertical drilling machine.
7. Milling contours on plates using vertical milling machine.
8. Cutting spur and helical gear using milling machine.
9. Generating gears using gear hobbing machine.
10. Grinding components using cylindrical and centerless grinding machine.
11. Grinding components using surface grinding machine.
12. Cutting force calculation using dynamometer in lathe machine.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Perform various types of joints in Arc Welding machine.

CO2: Apply the knowledge of metal casting for different requirements.

CO3: Make the work piece as per given shape and size using machining process such as turning, shaping, drilling and milling.

CO4: Make the gears using gear making machines and analyze the defects in the machined components.

CO5: Recognize cutting tool wear and identify possible causes and solutions.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	2	-
AVG	3	2.6	-	-	-	-	-	-	-	-	-	-	2	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24GE4201 TECHNICAL SEMINAR **L T P C**
0 0 2 1

COURSE OBJECTIVES

- To gain knowledge on literature survey in a selected area of study.
- To know an academic document from the literate and to give a presentation about it.
- To prepare a technical report.

COURSE SUMMARY

The course 'Technical Seminar' is anticipated to support a B.E./B.Tech graduate to read, understand, present and prepare report of an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his Technical seminar coordinator/guide. This course can help the learner to experience how a presentation can be made about a selected academic document and also empower her/him to prepare a technical report.

GENERAL GUIDELINES

1. The Department shall form an Internal Evaluation Committee (IEC) for the seminar for that program as the Chairperson/Chairman and seminar coordinator & seminar guide as members.
2. During the seminar presentation of a student, all members of IEC shall be present.
3. Formation of IEC and guide allotment shall be completed within a week after the University examination (or last working day) of the previous semester.
4. Guide shall provide required input to their students regarding the selection of topic/ paper.

Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than a very specific research work. It's advisable to choose a topic for the Seminar to be closely linked to the final year project area. Every member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.

- A topic/paper relevant to the discipline shall be selected by the student during the semester break.

- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IEC.
- The IEC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

Evaluation pattern (Only internal evaluation)

Guide: (i) 20 marks (Background knowledge –10 & relevance of the paper/topic selected –10).

Seminar Coordinator: 20 marks (Seminar Diary – 10 (Each student shall maintain a seminar diary and the guide shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation: 40 marks to be awarded by the IEC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report: 20 marks to be awarded by the IEC (check for technical content, overall quality, templates followed, adequacy of references etc.).

COURSE OUTCOMES

CO1: Identify academic documents from the literature which are related to her/his areas of interest.

CO2: Read and apprehend an academic document from the literature which is related to her/ his areas of interest.

CO3: Prepare a presentation about an academic document.

CO4: Give a presentation about an academic document.

CO5: Prepare a technical report.

Mapping of COs with POs & PSOs

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	-	-	**2**	-	-	-	-	2	-	3	3	3
CO2	3	2	-	-	-	-	-	-	-	2	-	3	3	3
CO3	3	3	-	-	-	-	-	-	-	2	-	3	3	3
CO4	3	3	-	-	**2**	-	-	-	-	2	-	3	3	3
CO5	3	3	-	-	**2**	-	-	-	-	2	-	3	3	3
AVG	**2.8**	**2.6**	-	-	**2**	-	-	-	-	**2**	-	**3**	**3**	**3**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24ME5101 DESIGN OF MACHINE ELEMENTS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To familiarize machine components failure under various loadings.
- To develop the basic steps involved in the design of shaft and couplings.
- To understand the factors involved in the design of springs, flexible elements and bearings.

UNIT I INTRODUCTION TO DESIGN **9**

Design process - problem formulation and calculation – factor of safety. materials and process, direct, bending and torsional loading, combined loads, design of curved beams-crane hook and ‘c’ frame loading, stress concentration, displacement, stress, strain, principal stresses, types of stresses. Fluctuating stresses – endurance limit –design for finite and infinite life under variable loading

UNIT II DESIGN OF SHAFTS, KEYS AND COUPLINGS **9**

Shafts and axles - design of solid and hollow shafts based on strength, rigidity and critical speed – keys– rigid and flexible couplings.

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS **9**

Threaded fasteners - bolted joints including eccentric loading, knuckle joints, cotter joints – welded joints- butt, fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads, riveted joints for structures.

UNIT IV DESIGN OF ENERGY STORAGE DEVICES **9**

Helical compression springs – terminologies, static and fatigue loading and concentric springs. Design of leaf springs - design of flywheel.

UNIT V DESIGN OF BEARINGS **9**

Sliding contact and rolling contact bearings - hydrodynamic journal bearings, Sommerfeld number, Raimondi & Boyd graphs, - selection of rolling contact bearings.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Design and fabricate a solid shaft for power transmission.
2. Design and fabricate a hollow shaft for power transmission.
3. Design and fabricate a key for given torque.
4. Design and fabricate a nut for a given specification.
5. Design and fabricate a bolt for a given specification.
6. Design and fabricate a welded joint.
7. Design and fabricate a closed coil spring.
8. Design and fabricate an open coil spring.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Design the basic machine members under various loadings.
CO2: Design the shaft and couplings.
CO3: Design the different temporary and permanent joints.
CO4: Design the various springs for different load conditions.
CO5: Design the rolling and sliding contact bearings.

TEXT BOOKS

1. Bhandari V B, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill, 2015.
3. Sundararajamoorthy T. V. and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

REFERENCE BOOKS

1. Ansel C Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co,2004.
2. Merhyle Franklin Spotts, Terry E. Shoup, and Lee Emrey Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2004.
3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design", 6th Edition, Wiley, 2017.
4. M F Spotts Terry E. Shoup L. E. Hornberge, Design of Machine Elements, SI Edition, 8th Edition, Paperback, 2019.
5. Design Data: Data Book of Engineers By PSG College-Kalaikathir Achchaga, Coimbatore, 2012.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	2
CO2	3	3	3	3	-	-	-	-	-	-	-	-	2	2
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	2
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	2
AVG	3	3	3	3	-	-	-	-	-	-	-	-	3	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME5102 HEAT AND MASS TRANSFER **L T P C**
3 0 1 4

COURSE OBJECTIVES

- To learn the principal mechanism of heat transfer under steady state and transient conditions.
- To learn the fundamental concept and principles in convective heat transfer.
- To study the fundamental concept and principles in radiation heat transfer.

UNIT I CONDUCTION **9**

General differential equation – Cartesian, cylindrical and spherical coordinates – one dimensional steady state heat conduction –– plane and composite systems – conduction with internal heat generation – extended surfaces – unsteady heat conduction – lumped analysis – semi-infinite and infinite solids –use of Heisler's charts – methods of enhanced thermal conduction.

UNIT II CONVECTION **9**

Conservation equations, boundary layer concept – forced convection: external flow – flow over plates, cylinders spheres and bank of tubes. Internal flow – entrance effects. Free convection – flow over vertical plate, horizontal plate, inclined plate, cylinders and spheres. Mixed convection.

UNIT III RADIATION **9**

Introduction to thermal radiation - radiation laws and radiative properties - black body and gray body radiation - Radiosity - view factor relations. Electrical analogy, radiation shields.

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

Nusselt's theory of condensation- regimes of pool boiling and flow boiling - correlations in boiling and condensation. Heat exchanger types – TEMA standards - overall heat transfer coefficient – fouling factors. LMTD and NTU methods. Fundamentals of heat pipes and its applications.

UNIT V MASS TRANSFER **9**

Basic concepts – diffusion mass transfer – Fick's law of diffusion – steady state and transient diffusion - Stefan flow –convective mass transfer – momentum, heat and mass transfer analogy – convective mass transfer correlations.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
2. Determination of heat transfer coefficient under forced convection from a tube.
3. Determination of Thermal conductivity of insulating powder.
4. Heat transfer from pin-fin apparatus (natural convection modes).
5. Heat transfer from pin-fin apparatus (Forced convection modes).
6. Determination of emissivity of a grey surface.
7. Effectiveness of Parallel flow heat exchanger / counter flow heat exchanger.
8. Determination of Stefan – Boltzmann constant.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

- CO1: Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems.
- CO2: Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.
- CO3: Apply basic laws for Radiation and to radiative heat transfer between different types of surfaces to solve problems.
- CO4: Apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems.
- CO5: Apply diffusive and convective mass transfer equations to solve problems for different applications.

TEXT BOOKS

1. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2017.
2. Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5th Edition – 2013.
3. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2017.

REFERENCE BOOKS

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 7th Edition, 2014.
2. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012.
3. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
4. S.P . Venkateshan, "Heat Transfer", Ane Books, New Delhi, 2014.
5. D.S.Kumar, "Heat and Mass Transfer", S.K. Kataria & Sons,2024.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	2	-	-	-	-	-	-	-	-	3	2
AVG	3	3	3	2	-	-	-	-	-	-	-	-	3	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24HS5101 INDUSTRIAL ENGINEERING AND MANAGEMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To study the leading, controlling and decision-making functions of management in professional organization.
- To learn the principles of productivity and modern concepts in management in professional organization.
- To understand the industrial engineering behaviour and plant location, layout.

UNIT I INTRODUCTION TO INDUSTRIAL MANAGEMENT 9

Management: introduction; definition and functions – Mintzberg's ten managerial roles-directing (leading): leadership traits; style; morale; managerial grids (Blake-Mounton, Reddin) –Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; Mcclelland's three needs motivation theory; vroom's valence-expectancy theory – change management: concept of change; Lewin's process of change model.

UNIT II INVENTORY CONTROL AND PROJECT MANAGEMENT 9

Inventory management: objectives, types of inventories, inventory costs. Economic order quantity (EOQ) - Gantt chart, CPM, PERT-depreciation and break-even analysis- ABC analysis. Project cost management:

UNIT III PRODUCTIVITY AND MODERN TOPICS 9

Productivity: concept; measurements; affecting factors; methods to improve – modern topics (concept, feature/characteristics, procedure, merits and demerits): business process reengineering (BPR); benchmarking; SWOT/SWOC analysis; total productive maintenance (TPM); enterprise resource planning (ERP); management of information systems (MIS), Industry 4.0.

UNIT IV INTRODUCTION TO INDUSTRIAL ENGINEERING 9

History and evolution of industrial engineering-work study: method study and work measurement-time study and standard time estimation- work sampling-value engineering - process charts, flow diagrams, string diagrams, SIMO charts.

UNIT V PLANT LOCATION AND LAYOUT 9

Factors influencing plant location-types of plant layout: product, process, fixed-position, cellular-layout planning tools: travel charts, REL charts-materials handling principles and equipment computer-aided layout planning.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain organizational structures and management principles.
CO2: Describe inventory control and project management.
CO3: Apply productivity improvement techniques and modern topics.
CO4: Utilize industrial engineering techniques and improve work systems and processes.
CO5: Analyze plant layout, materials handling, and facility location problems.

TEXT BOOKS

1. O.P. Khanna, “Industrial Engineering and Management”, Dhanpat Rai Publications, 2020.
2. V. Ravi, “Industrial engineering and management”, PHI Learning, 2015
3. M. Govindarajan and S. Natarajan, “Principles of Management”, Prentice Hall of India, New Delhi, 2009.

REFERENCE BOOKS

1. Joseph J, Massie, “Essentials of Management”, 4th Edition, Pearson Education, 1987.
2. Mahajan, M. Industrial Engineering and Production Management. Dhanpat Rai & Co.
3. S. Chandran, “Organizational Behaviours”, Vikas Publishing House Pvt. Ltd., 1994.
4. Banga, T.R., & Sharma, S.C. Industrial Organization and Engineering Economics. Khanna Publishers.
5. S. TrevisCerto, “Modern Management Concepts and Skills”, Pearson Education, 2018.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	-	-	-	2	-	2	2	3	-	-	2	2
CO2	2	3	-	-	-	2	-	2	2	3	-	-	2	2
CO3	2	3	-	-	-	2	-	2	2	3	-	-	2	2
CO4	2	3	-	-	-	2	-	2	2	3	-	-	2	2
CO5	2	3	-	-	-	2	-	2	2	3	-	-	2	2
AVG	**2**	**3**	-	-	-	**2**	-	**2**	**2**	**3**	-	-	**2**	**2**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24ME6101 ENGINEERING METROLOGY

L T P C
3 0 2 4

COURSE OBJECTIVES

- To describe the evolution of quality standards and metrology.
- To study the measurements of linear, angular dimensions and tolerance analysis in manufacturing.
- To provide the knowledge of the advanced measurements for quality control in manufacturing industries.

UNIT I BASICS OF METROLOGY 9

Measurement – need, process, role in quality control; factors affecting measurement - errors in measurements – types – control –calibration of measuring instruments, principle of air gauging- ISO standards.

UNIT II MEASUREMENT OF LINEAR DIMENSIONS 9

Linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge, depth micrometer, bore gauge, telescoping gauge; gauge blocks – use and precautions, comparators – working and advantages; Opto-mechanical measurements using measuring microscope and profile projector.

UNIT III MEASUREMENT OF ANGULAR DIMENSIONS 9

Angular measuring instruments – bevel protractor, clinometer, angle gauges, precision level, sine bar, autocollimator, angle dekkor, alignment telescope. Measurement of screw threads – pitch diameter - lead - pitch. Measurement of gears – purpose – analytical measurement – runout, pitch variation, tooth profile, tooth thickness, lead – functional checking – rolling gear test. tolerancing– interchangeability, selective assembly, tolerance representation, terminology, limits and fits, problems (using tables IS919); design of limit gauges, problems.

UNIT IV METROLOGY OF SURFACES 9

Inspection of geometric deviations like straightness, flatness, roundness deviations; simple problems – measurement of surface finish – functionality of surfaces, parameters, comparative, stylus based and optical measurement techniques, filters, introduction to 3D surface metrology- parameters.

UNIT V ADVANCES IN METROLOGY 9

Lasers in metrology - advantages of lasers – laser scan micrometers; laser interferometers – applications – straightness, alignment; basic concept of CMM – Types of CMM – constructional features – probes – accessories – software – applications – multi-sensor CMMs - machine vision - basic concepts of machine vision system – elements – applications.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Calibration and use of measuring instruments – Vernier caliper, micrometer, Vernier height gauge – using gauge blocks.
2. Calibration and use of measuring instruments – depth micrometer, bore gauge, telescopic gauge.
3. Measurement of linear dimensions using Comparators.
4. Measurement of angles using bevel protractor and sine bar.
5. Measurement of screw thread parameters – Screw thread Micrometers and Three wire method (Floating Carriage Micrometer).
6. Measurement of gear parameters using gear tooth Vernier Caliper.
7. Non-contact (Optical) measurement using Toolmaker's microscope / Profile projector measurement system.
8. Measurement of Surface finish in components manufactured using various processes (turning/ milling / grinding, etc.,) using stylus based instruments.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Describe the concepts of measurements to apply in various metrological instruments.
CO2: Explain the principle and applications of linear and angular measuring instruments.
CO3: Discuss the tolerance symbols and tolerance analysis for industrial applications.
CO4: Apply the principles and methods of form and surface metrology.
CO5: Discuss the advances in measurements for quality control in manufacturing Industries.

TEXT BOOKS

1. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.
2. Dotson Connie, "Dimensional Metrology", Cengage Learning, 1st edition, 2016.
3. R.K.Jain, "Engineering Metrology", Khanna publishers, 2022.

REFERENCE BOOKS

1. Beckwith Marangoni and Lienhard, "Mechanical Measurements", Pearson Education, 6th edition, 2006.
2. Richard S Figliola, Donald E Beasley, "Theory and Design for Mechanical Measurements", 3rd edition, WILEY India Publishers
3. Ammar Grous, J "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2011.
4. National Physical Laboratory Guide No. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. http://www.npl.co.uk.
5. R.K. Rajput,"A Textbook of Measurements & Metrology", S.K. Kataria & Sons,2025

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	3	-	-	-	-	-	-	-	3	2
CO2	3	2	-	-	3	-	-	-	-	-	-	-	3	2
CO3	3	2	-	-	3	-	-	-	-	-	-	-	3	2
CO4	3	2	-	-	3	-	-	-	-	-	-	-	3	2
CO5	3	2	-	-	3	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME6102 FINITE ELEMENT ANALYSIS

L T P C
3 0 1 4

COURSE OBJECTIVES

- To familiarize the basics of the Finite Element Technique.
- To impart knowledge analysis methodologies for 1-D and 2-D problems.
- To gain knowledge on numerical iso-parametric formulation.

UNIT I ONE DIMENSIONAL BAR AND TRUSS **9**

Basic concepts of the finite element method. Discretization – element types- linear and higher order elements – derivation of shape functions and stiffness matrices and force vectors-assembly of matrices. Generic form of one dimensional finite element equations –bar, truss - 1D thermal problem.

UNIT II ONE DIMENSIONAL BEAMS 9

Beam Elements – element types- linear and higher order elements – derivation of shape functions and stiffness matrices and force vectors- assembly of matrices. Generic form of one dimensional finite element equations -1D thermal problem.

UNIT III ANALYSIS OF 2D VECTOR VARIABLE PROBLEMS 9

Second Order 2D equations involving scalar variable functions – Variational formulation – finite element formulation – triangular elements – shape functions and element matrices and vectors. Equations of elasticity – plane stress, plane strain– body forces and temperature effects – stress calculations.

UNIT IV AXISYMMETRIC AND ISOPARAMETRIC PROBLEMS 9

Axisymmetric elements- body forces and temperature effects – stress calculations. Natural co-ordinate systems – isoperimetric elements – shape functions for isoperimetric elements – one and two dimensions.

UNIT V ANALYSIS OF VIBRATIONAL PROBLEMS 9

Longitudinal vibration frequencies and mode shapes. Fourth order beam equation –transverse deflections and natural frequencies of beams.

TOTAL: 45 PERIODS

EXPERIMENTS

1. Force and Stress analysis using link elements in trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates, simple shells and axisymmetric components.
4. Thermal stress and heat transfer analysis of plates.
5. Thermal stress analysis of cylindrical shells.
6. Model analysis of beams.
7. Harmonic vibration of simple systems.
8. Transient and spectrum analysis of simple systems.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Solve the 1D bar problems using finite element technique.
CO2: Evaluate the 1D-beam problems using Finite Element technique.
CO3: Solve the 2D vector variable problems using Finite Element technique.
CO4: Solve the axisymmetric problems using FEM.
CO5: Analyse the vibrational problem of bar and beam by FE Technique.

TEXT BOOKS

1. Seshu, P., Textbook of Finite Element Analysis, Prentice-Hall, India, 2003.
2. D.L. Logan, A First Course in Finite Element Method, Fifth Edition, Thomson, 2012.
3. J. N. Reddy, An introduction to the Finite Element Method, 4th edition, McGraw-Hill, 2020.

REFERENCE BOOKS

1. R.D.Cook, Concepts and Applications of Finite Element Analysis, 4th Edition 2001
2. S.S.Rao, Finite Element Method in Engineering, Pergamon Press, 1989.
3. Tirupathi R. Chandrupatla and Ashok D. Belugundu, Introduction to Finite Elements in Engineering, 2011, 4th Edition, Prentice Hall.
4. Cook Robert Devis et al, Concepts and Application of finite Element Analysis, Wiley John & Sons, 1999.
5. Barna Szabo and Ivo Babuska," Finite Element Analysis', John Wiley & Sons,2021.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
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CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	3	-	-	-	-	-	-	-	-	-	2	2
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CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	-	2	-	-	-	-	-	-	-	3	2
AVG	**3**	**3**	**3**	-	**2**	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME6201 CAD/CAM LABORATORY **L T P C**

0 0 2 1

COURSE OBJECTIVES

- To get familiarize in 2D detailed drawing of machine components.
- To train the students in part and assembly modeling of machine components using latest 3D software.
- To train the students on writing part programming for CNC turning and milling machining.

3D GEOMETRIC MODELLING **20**

1. CAD Introduction

Sketch:
Solid modeling: extrude, revolve, sweep, variational sweep and loft.
Surface modeling: extrude, sweep, trim, mesh of curves and free form.
Feature manipulation: copy, edit, pattern, suppress, history operations.
Assembly: constraints, exploded views, interference check
Drafting: layouts, standard & sectional views, detailing & plotting

2. Creation of 3D assembly model of following machine elements using 3D Modelling software

1. Flange Coupling
2. Plummer Block
3. Screw Jack
4. Lathe Tailstock
5. Universal Joint
6. Machine Vice

7. Stuffing box
8. Crosshead
9. Safety Valves
10. Non-return valves
11. Connecting rod
12. Piston
13. Crankshaft

MANUAL PART PROGRAMMING **10**

1. CNC Machining Centre

i) Linear Cutting.
ii) Circular cutting.
iii) Cutter Radius Compensation.
iv) Canned Cycle Operations.

2. CNC Turning Centre

i) Straight, Taper and Radial Turning.
ii) Thread Cutting.
iii) Rough and Finish Turning Cycle.
iv) Drilling and Tapping Cycle.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Perform the basic operation using 3D software.
CO2: Create the part model of machine components using 3D modelling software.
CO3: Create the assembly model of machine components using 3D modelling software.
CO4: Write the manual programme to perform CNC turning operations.
CO5: Write the manual programme to perform CNC milling operations.

REFERENCE BOOKS

1. Gopal Krishna K.R., "Machine Drawing", 2nd revised edition, Subhas Stores, 2007.
2. K. L. Narayana, P. Kannaiah, "Machine Drawing", Scitech Publications (India) PVT. LTD, 2012.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	3	2	3	-	-	-	-	-	-	-	3	2
CO2	3	2	3	2	3	-	-	-	-	-	-	-	3	2
CO3	3	2	3	2	3	-	-	-	-	-	-	-	3	2
CO4	3	2	3	2	3	-	-	-	-	-	-	-	3	2
CO5	3	2	3	2	3	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**3**	**2**	**3**	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME6202 DESIGN AND FABRICATION PROJECT **L T P C**
0 0 4 2

COURSE OBJECTIVES

- To learn the exiting mechanisms for applying various applications.
- To develop the ability to conceptualize a product, apply standard/innovative design techniques and realize the product through fabrication with focus on design-manufacturing integration.
- To gain the knowledge on report preparation.

DESCRIPTION

Identification of possible improvements in an existing product, conceptualization of a new product/part, design of the part using design methodologies, selection of material(s), preparation of process flow chart for manufacturing, fabrication of the part using the available in-house facilities, assembly, testing of the functionality of the product. The students should come up with their own original and innovative ideas for product design. The task may be performed by student teams/groups.

GUIDELINES

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

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: The student is expected to learn realization of a product, conceptualized and designed by him.
CO2: Get hands on experience of the entire chain of manufacturing steps with an understanding of design manufacturing integration.
CO3: Design and fabricate the machine element or the mechanical product.
CO4: Demonstrate the working model of the machine element or the mechanical product.
CO5: Prepare project report and communication very clearly.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	3	2	2	2	2	3	2	2	3	2
CO2	3	2	3	2	3	2	2	2	2	3	2	2	3	2
CO3	3	2	3	2	3	2	2	2	2	3	2	2	3	2
CO4	3	2	3	2	3	2	2	2	2	3	2	2	3	2
CO5	3	2	3	2	3	2	2	2	2	3	2	2	3	2
AVG	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**

1 - Low, 2 - Medium, 3 – High, '-' No correlation

24PD6201 NCC/NSS/NSO **L T P C**
2 0 0 2

All students shall enroll on admission in any one of the personality and character development program. NCC/NSS/NSO/YRC/SPORTS is a mandatory requirement and undergo training / conduct activities for about 80 hours and attend a camp of about seven days. The training shall include classes on hygiene and health awareness and also training in first aid. Alternately activities of science, literature and arts also help for personality and character development. The training activities will normally be during weekends and the camp will normally be during vacation period. A certificate will be given by the authorities concerned and duly forwarded by the Head of the Department to the Controller of Examinations for the purpose of record and scrutiny. No fee shall be charged for all these activities.

(OR)

Enroll as a student member of a recognized professional society/other bodies such as

- Student Chapters of Institution of Engineers (India)/ISTE/ Department Association
- Student Chapters of other Professional bodies like ICI, IEEE, SAE, ASHRAE, CSI, IEI, IIC, IGS, IETE, IWS etc. Students will have activities to improve technical skills, innovative skills, and career development.

24ME7101 MECHATRONICS AND IOT **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the types, characteristics, and applications of sensors, transducers and logic controllers.
- To provide an understanding of embedded systems and their types.
- To develop IoT applications using Arduino and Raspberry PI.

UNIT I INTRODUCTION TO SENSORS, TRANSDUCERS, AND ACTUATORS 9

Concepts of mechatronics - modular approach, sensors and transducers: static and dynamic characteristics, transducers - resistive, capacitive, inductive and resonant, – LVDT –– strain gauges – eddy current sensor – hall effect sensor – temperature sensors – light sensors ––solid state sensors, ultrasonic sensors. Actuators – brushless permanent magnet DC Motor – PM, VR and hybrid stepper motors – DC and AC Servo Motors.

UNIT II ELECTRONICS AND PROGRAMMABLE LOGIC CONTROLLERS 9

Operational amplifiers – inverting and non-inverting amplifier – Wheatstone bridge amplifier –instrumentation amplifier – PID controller, protection circuits, filtering circuits, multiplexer, data logger and data acquisition system – Thyristors – TRIAC– Darlington Pair –MOSFET and Relays. PLC – Architecture – input / output processing – logic ladder programming – functional block programming using timers and counters – applications.

UNIT III FUNDAMENTALS OF IoT AND EMBEDDED SYSTEMS 9

The Internet of Things (IoT) - introduction to the IoT framework – IoT enabling technologies- the effective implementation of IoT: the detailed procedure. Embedded systems: an introduction - single-chip microcontroller systems - single-board microcontroller systems - single-board computer systems -embedded systems: peripherals - software considerations.

UNIT IV IOT WITH ARDUINO & RASPBERRY PI 9

Arduino: the Arduino boards - Arduino peripherals- Arduino IDE – ESP8266 Wi-Fi module. Raspberry Pi: The Raspberry Pi Boards - The Raspberry Pi Peripherals - The Raspberry Pi Operating System. (typical peripherals) interfacing and controlling I/O devices by Arduino and Raspberry Pi: LEDs - push buttons - light intensity sensor - ultrasonic distance sensor – temperature sensor- humidity sensor - sensor and actuator interactions.

UNIT V ADVANCED MECHATRONICS AND IOT APPLICATIONS 9

Mechatronics systems: drone actuation and control -autonomous robot with vision system, automotive mechatronics. IoT case studies: remote monitoring systems- remotely operated autonomous systems - centralized water management system - portable, wireless, interactive IoT sensors for agriculture - IoT vehicle.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

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

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Describe the fundamental concepts of Mechatronics, including sensors, transducers, and actuators.

CO2: Design electronic circuits and PLC-based control systems for automation.

CO3: Use the IoT framework, enabling technologies and embedded systems.

CO4: Implement IoT and embedded applications using Arduino and Raspberry Pi.

CO5: Apply Mechatronics and IoT solutions to real-world engineering problems.

TEXT BOOKS

1. Bradley D.A., Burd N.C., Dawson D., Loader A.J., “Mechatronics: Electronics in Products and Processes”, Routledge, 2017.
2. Sami S.H and Kisheen Rao G “The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers”, CRC Press, 2022.
3. Bell C., “Beginning Sensor Networks with Arduino and Raspberry Pi”, A press, 2013.

REFERENCE BOOKS

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. Biswanath Samanta,”Introduction to Mechatronics’, springer, 2023.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
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CO3	3	3	3	2	-	-	-	-	-	-	-	-	2	-
CO4	3	2	2	3	-	-	-	-	-	-	-	-	2	-
CO5	3	3	2	3	-	-	-	-	-	-	-	-	2	-
AVG	3	2.4	2.5	2.5	-	-	-	-	-	-	-	-	2	-

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24HS7101 PROFESSIONAL ETHICS IN ENGINEERING **L T P C 2 0 0 2**

COURSE OBJECTIVES

- To enable the students to create an awareness on professional ethics
- To Impart Moral and Social Values.
- To learn the moral leadership and corporate responsibility.

UNIT I SOCIAL ETHICS **6**

Application of ethical reasoning to social problems – Gender bias and issues –Social discrimination – Constitutional protection and policies – Inclusive practices. Engineering as Experimentation – Engineers as responsible experimenters – codes of ethics – A balanced outlook on law.

UNIT II ENGINEERING ETHICS **6**

Senses of engineering ethics – variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – Kohlberg’s theory – Gilligan’s theory – consensus and controversy – models of professional roles – theories about right action – self-interest – customs and religion – uses of ethical theories.

UNIT III SCIENTIFIC ETHICS **6**

Transparency and fairness in scientific pursuits – scientific inventions for the betterment of society - unfair application of scientific inventions – role and responsibility of scientist in the modern society.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **6**

Safety and risk – assessment of safety and risk – risk benefit analysis and reducing risk – respect for authority – collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights – employee rights – intellectual property rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES **6**

Multinational corporations – environmental ethics – computer ethics – weapons development – engineers as managers – consulting engineers – engineers as expert witnesses and advisors – moral leadership –code of conduct – corporate social responsibility.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Describe the human values with regard to the individual lifestyle for the society.
CO2: Explain the role of ethics to the engineering field.
CO3: Describe how engineering is applied in association with ethics based on engineering experimentation.
CO4: Explain the engineering ethics-based safety, responsibilities and rights.
CO5: Discuss the global issues of professional ethics in engineering.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”. McGraw-Hill, New York, 2005.
2. Edmund G Seebauer and Robert L Barry, Fundamentals of Ethics for Scientists and Engineers‖, Oxford University Press, Oxford, 2001.
3. Charles B. Fleddermann, ―Engineering Ethic, Pearson Prentice Hall, New Jersey, 2004.

REFERENCE BOOKS

1. Luke W. Galen “The Nonreligious: Understanding Secular People and Societies”, Oxford University Press, 2016.
2. Bullivant, Stephen; Lee, Lois, “Secularism: A Dictionary of Atheism”, Oxford University Press, 2016.
3. Soumitro Banerjee, “Research Methodology for Natural Sciences”, IISc Press, January 2022.
4. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2014.
5. Laura P. Hartman and Joe Desjardins, ―Business Ethics: Decision Making for Personal Integrity and Social Responsibility‖ Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	3	2	3	3	3	-	3	2	3
CO2	-	-	-	-	-	2	2	3	3	3	-	3	2	3
CO3	-	-	-	-	-	2	2	3	3	3	-	3	2	3
CO4	-	-	-	-	-	3	2	3	3	3	-	3	2	3
CO5	-	-	-	-	-	2	2	3	3	3	-	3	2	3
AVG	-	-	-	-	-	2.4	2	3	3	3	-	3	2	3

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME7201 MECHATRONICS LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES

- To develop skills in motor control, device interfacing, and microcontroller/PLC programming for automation.
- To design and implement hydraulic, pneumatic circuits using hardware and simulation tools.
- To learn electro-pneumatic circuits using hardware and simulation tools.

LIST OF EXPERIMENTS

1. Speed and directions control of DC Servomotor,
2. Speed and directions control of AC Servomotor and Induction motors.
3. Addition, subtraction and multiplication programming in 8051/8085.
4. Decending and Assending order programming in 8051/8085.
5. Programming and Interfacing of stepper motor and DC motor using 8051/PLC.
6. Programming and Interfacing of traffic light interface using 8051.
7. Design and Sequencing of pneumatic circuits.
8. Design and Sequencing of hydraulic circuits.
9. Sequencing of hydraulic and pneumatic circuits using software.
10. Electro-pneumatic circuits using Software.
11. Electro-pneumatic/hydraulic control using PLC.
12. Study of various types of transducers.

COURSE OUTCOMES

At the end of the course the students would be able to

CO1: Demonstrate the ability to control the speed and direction of different types of motors using microcontrollers and PLCs.

CO2: Develop and execute programs for arithmetic operations and device control using 8051/8085 microcontrollers.

CO3: Design and implement sequence control for hydraulic, pneumatic, and electro-pneumatic systems.

CO4: Interface sensors and actuators with microcontrollers.

CO5: Study of various types of transducers for various sectors.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	3	-	-	-	-	-	-	-	3	-
CO2	3	3	3	-	3	-	-	-	-	-	-	-	3	-
CO3	3	2	3	3	3	-	-	-	-	-	-	-	3	-
CO4	3	2	2	-	3	-	-	-	-	-	-	-	3	-
CO5	3	2	2	-	3	-	-	-	-	-	-	-	3	-
AVG	3	2.2	2.4	3	3	-	-	-	-	-	-	-	3	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24IS7201 INTERNSHIP **L T P C**
0 0 0 1

COURSE OBJECTIVES

- Students acquire practical knowledge through hands-on experience in an area of modern industries.
- Gain real-world experience in the profession and enables correlation of classroom learning.
- To experience the career development goals involve exploring the duties and qualifications of different careers.

COURSE DESCRIPTION

The purpose of the Internship Education Program is to provide each student practical experience in a standard work environment. An internship is an integral part of engineering education. It provides real-world experience in the profession; enables correlation of classroom learning with applications in industry; broadens understanding of the types of employment available in the field; helps the student discover individual interests; builds resume credentials; and develops relationships with industrial companies.

MONITORING OF INTERNSHIP

Documents required after the internship

1. Final report with full details of internship activities and contents learned during the entire period of internship.
2. Students shall maintain a day-to-day record of their engagement for the period of training. This will be recorded in an authorized diary to be counter signed by the concern authority at the each day and the same diary shall be submitted to the internship co-ordinator.
3. At the end of the training period, a student shall produce a certificate of satisfactory completion of training.

The final report should address the following:

- Projects and duties performed during the Internship.
- Learning that occurred as a result of the internship, in regard to
- The engineering profession.
- The particular industry.

- The organization/company.
- The technical skills developed.
- The individual interests and preferences discovered.
- Suggestions.
- Goals and plans regarding future professional development.

EVALUATION PROCEDURE

The weightage as follows

1. Internship final report : 30%
2. Authorized diary : 30%
3. Oral presentation through PPT : 40%

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Apply appropriate workplace behaviors in a professional setting.

CO2: Demonstrate content knowledge appropriate to job assignment.

CO3: Exhibit evidence of increased content knowledge gained through practical experience.

CO4: Evaluate the internship experience in terms of their personal, educational and career needs.

CO5: Refine and clarify professional and career goals through critical analysis of the internship experience.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2	3	-	-	-	-	2	-	-	2	-
CO2	3	2	2	2	3	-	-	-	-	2	-	-	2	-
CO3	3	2	2	2	3	-	-	-	-	2	-	-	2	-
CO4	3	2	2	2	3	-	-	-	-	2	-	-	2	-
CO5	3	2	2	2	3	-	-	-	-	2	-	-	2	-
AVG	**3**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24CA7201 CASE STUDY **L T P C**

0 0 0 1

COURSE OBJECTIVES

- To gain hands on industrial experience.
- To introduce industry problem solving skill.
- To familiarize the industrial operations.

The students should study at least two case studies during 6th Semester vacation and submit a details report not less than 20 pages with a copy of case study completion certificate from the Industry.

Part A: Case study on Industry Operation

The students should undergo case study on Industrial Operations.

- They should understand the company's structure, operational workflow, safety norms, and business model.
- Learn the specific department such as production, quality control, logistics, human recourses, turn-over and other major tools and software used by the industry.
- Students interact with industry experts, gather background information relevant to the industry.
- The students have to collect data, gather real-time processes, and analyse the challenges faced by the industry by using standard tools such as Fishbone diagrams, Pareto charts, or SWOT analysis.

Part B: Case study on Completed Project

The students should identify and select case study 2 as previously completed project relevant to their domain.

- Students should follow the work flow structure such as interacting with team leader or manager, identify and understand the problem, collect relevant data, analyse roots & methodology employed to complete the project and should understand the final outcome of the project.
- Students consolidate their findings and prepare a comprehensive report.

At the end of study,

The students should prepare a report not less than 20 pages and should include the copy of case study completion certificate in the report.

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Describe the industry operations.
CO2: Analyze and interpret industrial data.
CO3: Apply engineering principles to industry real time problems.
CO4: Collaborate effectively with industry experts and teams.
CO5: Communicate technical information clearly and professionally.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	3	-	-	-	-	2	2	2	2	-	-
CO2	3	3	2	3	3	-	-	-	2	2	2	2	-	-
CO3	3	3	2	3	3	-	-	-	2	2	2	2	-	-
CO4	2	2	-	-	-	-	-	-	2	2	2	2	-	-
CO5	2	2	-	-	3	-	-	-	2	2	2	2	-	-
AVG	**2.6**	**2.6**	**2**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**-**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24ME8501 PROJECT WORK **L T P C**
0 0 20 10

COURSE OBJECTIVES

- The objective of this course is to help the students to develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same, and to train the students in preparing project reports and to face reviews and viva voce examination.

COURSE DESCRIPTION

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

TOTAL: 300 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Identify real world problems of core engineering and related systems.
CO2: Formulate new set of problems.
CO3: Take on with industrial changes.
CO4: Evaluate to obtain solution for problems in mechanical engineering systems.
CO5: Document preparation and communication very clearly.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	2	3	2	2	2	3	2	2	2	3	2
CO2	3	3	2	2	3	2	2	2	3	2	2	2	3	2
CO3	3	3	2	2	3	2	2	2	3	2	2	2	3	2
CO4	3	3	2	2	3	2	2	2	3	2	2	2	3	2
CO5	3	3	2	2	3	2	2	2	3	2	2	2	3	2
AVG	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE01 COMPUTATIONAL FLUID DYNAMICS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand heat transfer and fluid flow equations relevant to CFD.
- To learn discretization methods like finite difference and finite volume.
- To model diffusion and convection-diffusion with stability analysis.

UNIT I GOVERNING DIFFERENTIAL EQUATIONS AND DISCRETISATION **9**

basics of heat transfer, fluid flow – mathematical description of fluid flow and heat transfer – conservation of mass, momentum, energy and chemical species - classification of partial differential equations – initial and boundary conditions – discretization techniques using finite difference methods – Taylor’s series - uniform and non-uniform grids, numerical errors, grid independence test.

UNIT II DIFFUSION PROCESSES: FINITE VOLUME METHOD **9**

Steady one-dimensional diffusion, two- and three-dimensional steady state diffusion problems, discretization of unsteady diffusion problems – explicit, implicit and crank-Nicholson’s schemes, stability of schemes.

UNIT III CONVECTION-DIFFUSION PROCESSES: FVM **9**

One dimensional convection – diffusion problem, central difference scheme, upwind scheme –hybrid and power law discretization techniques – QUICK scheme.

UNIT IV FLOW PROCESSES: FINITE VOLUME METHOD **9**

Discretization of incompressible flow equations – pressure based algorithms, SIMPLE, SIMPLER & PISO algorithms.

UNIT V TURBULENCE MODELS **9**

Turbulence – RANS equation - algebraic models, one equation model, two equation models – k & standard $k - \epsilon$ model, low Reynold number models of $k\text{-}\epsilon$, Large Eddy Simulation (LES), Direct Numerical Simulation (DNS) - Introduction. Solving simple cases using standard CFD codes.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

- CO1: Apply mass, momentum, energy, and species in fluid flow and heat transfer.
- CO2: Use numerical methods to solve diffusion and convection-diffusion equations.
- CO3: Choose suitable discretization techniques for accuracy and stability.
- CO4: Simulate incompressible flows using pressure-based algorithms.
- CO5: Apply turbulence models ($k\text{-}\varepsilon$, LES) in CFD using standard software.

TEXTBOOKS

1. Versteeg, H. K., & Malalasekera, W. An Introduction to Computational Fluid Dynamics: The Finite Volume Method. Pearson Education Ltd, 2018.
2. Anderson, J. D. Computational Fluid Dynamics: The Basics with Applications. McGraw-Hill Education, 1995.
3. Ferziger, J. H., & Perić, M. Computational Methods for Fluid Dynamics. Springer, Third Edition, 2002.

REFERENCE BOOKS

1. Blazek, J. Computational Fluid Dynamics: Principles and Applications. Elsevier, Third Edition, 2015.
2. Pozrikidis, C. Introduction to Theoretical and Computational Fluid Dynamics. Oxford University Press, Second Edition, 2011.
3. Cebeci, T. Turbulence Models and Their Application: Efficient Numerical Methods with Computer Programs. Springer, 2004.
4. Thompson, J. F., Warsi, Z. U. A., & Mastin, C. W. Numerical Grid Generation: Foundations and Applications. North-Holland, 1985.
5. Canuto, C., Hussaini, M. Y., Quarteroni, A., & Zang, T. A. Spectral Methods in Fluid Dynamics. Springer-Verlag, 2005.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	2	3	-	-	-	-	-	-	-	3	-
CO2	3	3	3	2	3	-	-	-	-	-	-	-	3	-
CO3	3	3	2	3	3	-	-	-	-	-	-	-	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	-
CO5	2	2	2	2	3	-	-	-	-	-	-	-	3	-
AVG	**2.8**	**2.8**	**2.4**	**2.4**	3	-	-	-	-	-	-	-	**3**	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE02 FUEL CELLS AND HYDROGEN TECHNOLOGY

L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce the fundamental properties of hydrogen and its role as an energy carrier.
- To explore various methods of hydrogen production, both conventional and renewable.
- To study hydrogen storage technologies and distribution infrastructure.

UNIT I INTRODUCTION TO HYDROGEN AS AN ENERGY CARRIER 9

Hydrogen Properties and comparison with other fuels. Hydrogen production - Conventional and renewable methods. Hydrogen storage and transportation methods - Applications of hydrogen energy - Safety and handling of hydrogen - Environmental and economic aspects of hydrogen energy.

UNIT II FUNDAMENTALS OF FUEL CELLS 9

Basic principles of fuel cells - thermodynamics and electrochemical aspects. Fuel cell components and materials: electrodes, electrolytes, catalysts. Types of fuel cells - proton exchange membrane fuel cells, solid oxide fuel cells, alkaline fuel cells, phosphoric acid fuel cells, molten carbonate fuel cells, comparison of fuel cell types and their applications.

UNIT III HYDROGEN PRODUCTION TECHNOLOGIES 9

Electrolysis of water, Thermochemical water splitting, reforming of hydrocarbons (steam methane reforming, partial oxidation). Biomass gasification, fermentation Photo electrochemical and photo biological methods. Recent advancements in hydrogen production.

UNIT IV HYDROGEN STORAGE AND DISTRIBUTION 9

Physical storage - Compressed gas, liquid hydrogen. Material-based storage - Metal hydrides, chemical hydrides, carbon-based materials. Storage challenges and solutions. Hydrogen distribution infrastructure: Pipelines, tankers, refueling stations. Codes, standards, and regulations related to hydrogen storage and transport.

UNIT V HYDROGEN & FUEL CELL: APPLICATIONS AND FUTURE 9

Stationary power generation, Transportation and automotive applications. Portable power systems, Fuel cell hybrid systems, Integration with renewable energy systems, Global hydrogen roadmap and policy frameworks, Future prospects and challenges.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Evaluate the properties of hydrogen.

CO2: Explore various methods of hydrogen production.

CO3: Explain fuel cell working principles, types, and components.

CO4: Analyse the hydrogen storage technologies and distribution infrastructure.

CO5: Examine real-world applications and future prospects of hydrogen fuel cells.

TEXT BOOKS

1. Barclay F.J., Fuel Cells, Engines and Hydrogen, Wiley, 2009.
2. Bent Sorensen (Sørensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier, UK 2011.
3. Hart A.B. and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, New York Ltd., London 1989.

REFERENCE BOOKS

1. Jeremy Rifkin, the Hydrogen Economy, Penguin Group, USA 2002.
2. Kordesch K. and G.Simader, Fuel Cell and Their Applications, Wiley-Vch, Germany 1996.
3. Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn WellCorporation, Oklahoma, 2005.
4. Viswanathan B. and AuliceScibioh.M, Fuel Cells – Principles and Applications, UniversitiesPress, 2006.
5. J Larminie, A L Dicks, Fuel Cell Systems Explaind, 2^{nd} Edition, Wiley, 2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	-	-	3	-	-	-	-	2	2	-
CO2	3	3	2	2	-	-	3	-	-	-	-	2	3	-
CO3	3	2	3	-	-	-	3	-	-	-	-	2	2	-
CO4	3	3	2	2	-	-	3	-	-	-	-	2	3	-
CO5	2	2	2	-	-	-	3	-	-	-	-	2	2	-
AVG	**2.8**	**2.4**	**2**	**2**	**-**	**-**	3	**-**	**-**	**-**	**-**	**2**	**2.4**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE03 ENERGY CONSERVATION IN INDUSTRIAL APPLICATIONS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the significance of energy conservation in industrial operations.
- To explore energy-efficient technologies in thermal and electrical systems.
- To learn methods and tools used in energy auditing and monitoring.

UNIT I INTRODUCTION TO ENERGY CONSERVATION 9

Importance of energy conservation in industries. Overview of energy demand and supply. Energy audit: types, methodology, and benefits. Energy policy and standards (ISO 50001). Role of government, regulatory bodies, and international initiatives.

UNIT II ENERGY EFFICIENT SYSTEMS IN THERMAL APPLICATIONS 9

Boilers: types, performance evaluation, and efficiency improvement. Furnaces and kilns: classification, heat losses, and energy saving methods. Steam systems: steam distribution, condensate recovery, and insulation. Heat exchangers: types and optimization. Waste heat recovery systems (WHRS): recuperators, regenerators, economizers.

UNIT III ELECTRICAL ENERGY MANAGEMENT 9

Electrical load management and peak demand control. Electric motors: efficiency, selection, and variable speed drive (VSDs). Lighting systems: types, design, and automation. Power factor improvement techniques. Energy-efficient transformers and distribution systems.

UNIT IV ENERGY MANAGEMENT IN SPECIFIC INDUSTRIES 9

Case studies: Cement, Iron & Steel, Textile, Pulp & Paper, and Food industries. Sector-specific energy conservation techniques. Use of cogeneration and tri-generation systems. Renewable energy integration in industries (solar, biomass, wind). Benchmarking and performance assessment.

UNIT V ENERGY AUDIT AND MANAGEMENT TOOLS 9

Energy audit instruments and techniques - Data logging and monitoring systems - Energy Management Information Systems (EMIS) - Cost-benefit analysis and life cycle costing - Implementation barriers and strategies for energy conservation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the need for energy conservation and key policies like ISO 50001.
CO2: Analyze thermal systems to identify energy-saving opportunities.
CO3: Evaluate electrical systems for energy efficiency and load management.
CO4: Apply conservation methods and renewable energy in industries case studies.
CO5: Use audit tools and cost analysis for energy management planning.

TEXT BOOKS

1. P. W. Woodruff, Energy Management and Conservation, Reston Publishing Company, 8th edition, 2001.
2. Albert Thumann, Handbook of Energy Audits, Fairmont Press, 9th Edition, 2013.
3. S. C. Tripathy, Electric Energy Utilization and Conservation, Tata McGraw-Hill Education, 9th Edition, 2010.

REFERENCE BOOKS

1. Guide Book, General Aspects of Energy Management and Energy Audit, Bureau of Energy Efficiency (BEE), Government of India, 4th Edition, 2021.
2. L. C. Witte, P. S. Schmidt, and D. R. Brown, Industrial Energy Management and Utilization, Springer, 7thEdition, 2005.
3. D. Yogi Goswami and Frank Kreith, Energy Efficiency and Renewable Energy Handbook, CRC Press, 2nd Edition, 2015.
4. M. A. Attia, Energy Efficiency: Concepts and Calculations, CRC Press, 1st Edition, 2020.
5. G. G. Rajan, Optimizing Energy Efficiencies in Industry, Tata McGraw-Hill, 1st Edition, 2001.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	3	-	-	-	-	-	3	2
CO2	3	3	3	2	-	-	2	-	-	-	-	-	3	2
CO3	3	3	3	3	-	-	2	-	-	-	-	-	3	2
CO4	3	2	3	2	-	-	3	-	-	-	-	-	3	2
CO5	3	3	3	3	-	-	2	-	-	-	-	-	3	2
AVG	**3**	**2.6**	**3**	**2.5**	**-**	**-**	**2.4**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE04 DESIGN OF HEAT EXCHANGERS AND PRESSURE VESSELS L T P C
3 0 0 3

COURSE OBJECTIVES

- To make students familiarize with the various types of heat exchangers.
- To inculcate the thermal design aspects of tubular heat exchangers.
- To perform finite element analysis on high pressure and temperature components.

UNIT I FUNDAMENTALS OF HEAT EXCHANGER 9

Temperature distribution and its implications types– shell and tube heat exchangers– regenerators and recuperators – analysis of heat exchangers– LMTD and effectiveness method.

UNIT II DESIGN ASPECTS 9

Effect of turbulence – friction factor – pressure loss – stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses – types of failures.

UNIT III DESIGN ASPECTS 9

Heat transfer and pressure loss – flow configuration – effect of baffles – effect of deviations from ideality – design of double pipe – finned tube – shell and tube heat exchangers – simulation of heat exchangers.

UNIT IV COMPACT AND PLATE HEAT EXCHANGERS 9

Types– merits and demerits– design of compact heat exchangers, plate heat exchangers– performance influencing parameters– limitations. Design of surface and evaporative condensers–cooling tower –performance characteristics.

UNIT V DESIGN OF PRESSURE VESSELS 9

Establishment of design conditions – fracture mechanics – heads, basic shell thickness - reinforcement of openings – special components like flange, tube plate, supports. Development of cracks - fracture mechanics - corrosion - selection of working stress for ductile and brittle materials.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Utilize the concept of heat exchangers and illustrate the applications of various types of heat exchangers.
CO2: Interpret the significance of stress analysis of heat exchangers.
CO3: Analyze the design of tubular heat exchangers for various applications.
CO4: Appraise the design of compact heat exchangers and condensers cooling towers for industrial requirements.
CO5: Analyze the FEM models on high pressure and temperature components.

TEXT BOOKS

1. Arthur.P Frass, "Heat Exchanger Design", John Wiley & Sons, 1989.
2. Ganapathy, V., Applied Heat Transfer, Pennwell Books, 1982.
3. Bickell, M.B. and Ruiz, C., Pressure Vessel Design and Analysis, MacMillan, London, 1967.

REFERENCE BOOKS

1. Sadik Kakac, Hongtan Liu, Anchasa Pramuanjaroenkij, "Heat Exchangers Selection, Rating and Thermal Design", CRC Press,Third Edition,2012.
2. Ramesh K.Shah, Dušan P.Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.
3. Robert W. Serth, "Process heat transfer principles and applications", Academic press, Elesevier, 2010.
4. T. Kuppan, "Heat exchanger design hand book", New York: Marcel Dekker,2009.
5. Bickell, M.B. and Ruiz, c., Pressure Vessel Design and Analysis, MacMillan, London, 1967.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	-	-	-	-	-	-	-	-	3	2
CO2	3	2	3	2	-	-	-	-	-	-	-	-	3	2
CO3	3	2	3	2	-	-	-	-	-	-	-	-	3	2
CO4	3	2	3	2	-	-	-	-	-	-	-	-	3	2
CO5	3	2	3	2	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**3**	**2**	-	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE05 SOLAR ENERGY TECHNIQUES

L T P C
3 0 0 3

COURSE OBJECTIVES

- To clarify impression of various solar thermal energy collectors.
- To study the various types and configurations of solar space conditioning system.
- To learn the various solar applications.

UNIT I SOLAR COLLECTORS **9**

Collectors: flat plate: water, air - evacuated tube – concentrated – construction – function - suitability – comparison – design of storage tank - solar fluids.

UNIT II SOLAR WATER HEATING SYSTEMS **9**

Integral collector storage system – thermos syphon system - open loop, drain down, drain back, antifreeze systems - refrigerant solar water heaters - solar heated pools - solar heated hot tubs and spas.

UNIT III SOLAR SPACE CONDITIONING SYSTEMS **9**

Liquid type solar heating system with / without storage - heat storage configurations – heat delivery methods - air-type solar heating systems - solar refrigeration and air conditioning.

UNIT IV OTHER SOLAR APPLICATIONS **9**

Solar cooking – distillation - desalination - solar ponds – solar passive architecture – solar drying – solar chimney.

UNIT V SOLAR ECONOMICS **9**

Application of economic methods to analyze the feasibility of solar systems to decide project /policy alternatives - net energy analysis - and cost requirements for active and passive heating and cooling - for electric power generation - and for industrial process-heating. Economics – fixed and variable cost - payback period - net present value - internal rate of return - carbon credit –embodied energy analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the technical and physical principles of different solar collectors.

CO2: Evaluate different solar energy technologies through knowledge of the physical function of the devices.

CO3: Articulate the technical and economic fundamentals of solar thermal energy.

CO4: Describe the spectrum of possible solar thermal technologies to assist industrial processing or power production.

CO5: Analyze technological and socio-economic issues of solar Energy.

TEXT BOOKS

1. Tiwari G.N.,“Solar Energy–Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015.
2. David M. Buchla., “Renewable Energy Systems”, pearson education publication, Hard cover/Paperback-2017.
3. Shaw.M.C, Metal cutting principles, Oxford Clare don press, 2012.

REFERENCE BOOKS

1. Duffie, J.A., and Beckman, W.A. Solar Energy Thermal Process - 4th Edition (2013), John Wiley and Sons, New York, ISBN: 978-0-470-87366-3, Solar Energy Laboratory, University of Wisconsin-Madison, pp. 944.
2. H P Garg, M Dayal, G Furlan, Physics and Technology of Solar Energy- Volume I: Solar Thermal Applications, Springer, 2007.
3. Sukhatme S.P. J K Nayak, Solar Energy, Tata McGraw Hills P Co., ISBN: 9789352607112, 4th Edition, 2017, pp. 568.
4. Charles Christopher Newton - Concentrated Solar Thermal Energy- Published by VDM Verlag, 2008.
5. H.P.Garg, S.C.Mullick, A.K.Bhargava, D.Reidal, Solar Thermal Energy Storage Springer, 2005.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	-	-	3	-	-	-	-	2	3	2
CO2	3	2	3	3	-	-	3	-	-	-	-	2	3	2
CO3	3	3	3	3	-	-	3	-	-	-	-	2	3	2
CO4	3	3	3	3	-	-	3	-	-	-	-	2	3	2
CO5	3	3	3	3	-	-	3	-	-	-	-	2	3	2
AVG	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	2	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE06 ADVANCED INTERNAL COMBUSTION ENGINES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To learn the principles of operation of different IC Engines and components.
- To analyze combustion process, supercharging and turbo charging in CI engine.
- To study the recent developments in IC Engines.

UNIT I INTRODUCTION **9**

Introduction: historical review – engine types – design and operating parameters. cycle analysis: thermo-chemistry of fuel – air mixtures, properties – ideal models of engine cycles – real engine cycles - differences and factors responsible for – computer modeling.

UNIT II COMBUSTION SYSTEMS IN SI ENGINES **9**

Spark ignition engine mixture requirements - Feedback control carburetors - Fuel-Injection systems - Monopoint and Multipoint injection - Stages of combustion - Normal and Abnormal combustion - Factors affecting knock - Combustion chambers -Introduction to Thermodynamic Analysis of S.I.Engine combustion.

UNIT III COMBUSTION SYSTEMS IN CI ENGINES **9**

Air motion in CI engines – delay period in CI engines – types of diesel combustion systems. Scavenging and super charging in CI engines : types of scavenging systems in two stroke SI engines – improved and modified scavenging systems – super charging and engine performance – methods of super charging.

UNIT IV POLLUTANT FORMATION AND CONTROL **9**

Pollutant Formation and Control: Nature and extent of problems – Nitrogen Oxides, Carbon monoxide, unburnt Hydrocarbon and particulate – Emissions – Measurement – Exhaust Gas Treatment, Catalytic converter, SCR, Particulate Traps, Lean, NOx, Catalysts.

UNIT V MODERN TRENDS IN IC ENGINES **9**

Fuel supply systems for S.I. and C.I engines to use gaseous fuels like LPG, CNG and Hydrogen. Modern Trends in IC Engines: Lean Burning and Adiabatic concepts, Rotary Engines, Modification in I.C engines to suit Bio – fuels, HCCI and GDI concepts.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain parameters like fuel-air mixtures and cycle analysis.

CO2: Analyse combustion process in SI engine.

CO3: Analyse combustion process, supercharging, turbo charging and flow through ports and valves in CI engine.

CO4: Analyze pollutant formation, control etc.

CO5: Explain the recent developments in IC Engines.

TEXT BOOKS

1. Mathur R.B. and R.P.Sharma,"Internal Combustion Engines",Dhanpat Rai &Sons 2007.
2. V. Ganesan-Internal Combustion Engines - Tata McGraw Hill, 2003.
3. K.K.Ramalingam-Internal Combustion engines, Scitech Publications India(P) Ltd. 2018.

REFERENCE BOOKS

1. John B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill International Editions, 1998
2. Gupta H.N “Fundamentals of Internal Combustion Engines”Prentice Hall of India, 2006.
3. Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987.
4. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995.
5. Patterson D.J. and HeneinN.A,“Emissions from combustion engines and their control,”Ann Arbor Science publishers Inc, USA, 1978.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2.8**	**2.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2.2**

1-Low, 2 -Medium, 3– High, ‘-’ No correlation

24MEPE07 MEASUREMENT IN THERMAL ENGINEERING

L T P C
3 0 0 3

COURSE OBJECTIVES

- To classify various measuring instruments.
- To categorize temperature sensors and their applications in measurement.
- To outline the advancements in pressure and volume measurements.

UNIT I MEASUREMENT CHARACTERISTICS **9**

Instrument classification, characteristics of instruments – static and dynamic, experimental error analysis, systematic and random errors, statistical analysis, uncertainty, experimental planning and selection of measuring instruments, reliability of instruments.

UNIT II TEMPERATURE MEASUREMENT **9**

Temperature, types, materials, accuracy - selection of temperature sensors - effect of length of sensor on temperature measurements- calibration of thermocouple, RTD's & thermistors- standards for temperature measurement - cryogenic & high temperature measurement techniques.

UNIT III PRESSURE FLOW & VOLUME MEASUREMENTS **9**

Pressure sensors: types & materials - piezoelectric transducers- calibration of pressure sensors selection of pipes & fittings for pressure sensors. Volume sensors: standard volumetric flask-types, density measurement instruments for liquids & gases. flow sensors: Caroli's mass flow measurements - flow measurements for water, gases, other oils & other chemicals.

UNIT IV MEASUREMENT OF THERMO PHYSICAL PROPERTIES **9**

Thermal Conductivity measurement of solids - liquids & gases- Sensors & calibration methods- Thermal conductivity of microbar nano composites - Specific heat of liquids, solids through DSC Analysis - viscosity measurement of Newtonian & non-Newtonian fluids through rheological analysis.

UNIT V DATA ACQUISITION SYSTEM **9**

Data acquisition systems, Evolution of SCADA, communication technologies, monitoring and supervisory functions, SCADA applications in utility automation, industries - SCADA system components: Schemes- Remote Terminal Unit (RTU), intelligent electronic devices (IED), communication network, SCADA Server, SCADA/HMI systems various SCADA architectures.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

- CO1: Infer the role of uncertainty analysis in measuring instruments.
- CO2: Select the appropriate temperature sensors based on specific applications.
- CO3: Identify the suitable sensors for pressure and volume measurements.
- CO4: Evaluate thermos physical properties of media.
- CO5: Appraise the advantages of data acquisition systems.

TEXT BOOKS

1. Holman J.P., Experimental methods for engineers, McGraw-Hill, 2023.
2. Bolton.W, Industrial Control & Instrumentation, Universities Press, Second Edition, 2001.
3. Nkra, B.C., Choudhry K.K., Instrumentation, Measurements and Analysis Tata McGraw Hill, New Delhi, 2nd Edition 2003.

REFERENCE BOOKS

1. Barnery, Intelligent Instrumentation, Prentice Hall of India, 2010.
2. John G Webster, The measurement, Instrumentation and sensors Handbook, CRC and IEE Press, 2014.
3. Morris A.S, Principles of Measurements and Instrumentation Prentice Hall of India, 2004.
4. T.Beekwith R.D., Marangoni and J.H. Lienhard, Mechanical Measurements, Pearson Education, 2001.
5. Raman, C.S. Sharma, G.R., Mani, V.S.V., "Instrumentation Devices and Systems", 2nd Edition, Tata McGraw-Hill., 2001.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	2	2	-	-	-	-	-	-	-	-	2	2
CO2	2	3	2	3	-	-	-	-	-	-	-	-	2	-
CO3	2	3	2	3	-	-	-	-	-	-	-	-	2	-
CO4	2	3	2	3	-	-	-	-	-	-	-	-	2	2
CO5	2	3	2	3	-	-	-	-	-	-	-	-	2	2
AVG	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE08 ADVANCED NUCLEAR ENGINEERING **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the fundamental principles of nuclear reactions and reactor physics.
- To analyze different types of nuclear reactors and their design features.
- To study the thermal-hydraulic aspects and safety analysis of nuclear reactors.

UNIT I NUCLEAR PHYSICS **9**

Nuclear reactions and fission process - Neutron life cycle and multiplication factor - Reactor kinetics and dynamics - Radiation interaction with matter - Neutron cross-section and diffusion theory.

UNIT II NUCLEAR REACTORS **9**

Classification: Thermal, Fast, Breeder, Fusion reactors - Pressurized Water Reactor (PWR) and Boiling - Water Reactor (BWR) - Fast Breeder Reactor (FBR) - Gas-cooled and Heavy Water Reactors - SMRs (Small Modular Reactors) and Generation IV concepts.

UNIT III NUCLEAR FUEL CYCLE AND WASTE MANAGEMENT **9**

Nuclear fuel enrichment and fabrication - Front-end and back-end of the fuel cycle - Spent fuel storage and reprocessing techniques - Radioactive waste classification and treatment - Waste disposal: geological, vitrification, transmutation.

UNIT IV REACTOR THERMAL HYDRAULICS AND SAFETY ANALYSIS 9

Heat generation in reactor cores - Heat transfer mechanisms and coolant systems - Thermodynamic analysis of reactors - Safety systems: ECCS, containment, SCRAM - Probabilistic risk assessment and regulatory frameworks.

UNIT V ADVANCES IN NUCLEAR ENERGY 9

Nuclear fusion: principles and devices (e.g., Tokamak, ITER) - Accelerator-driven systems - Nuclear hydrogen production and desalination - AI and machine learning in nuclear systems. Nuclear policy, security, and public perception.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain nuclear reactions, fission, and neutron life cycle.
CO2: Classify nuclear reactors and their operational features.
CO3: Analyze the nuclear fuel cycle and waste management methods.
CO4: Apply thermal-hydraulics to assess reactor safety.
CO5: Evaluate emerging nuclear technologies for sustainable energy.

TEXT BOOKS

1. J. R. Lamarsh, A. J. Baratta, Introduction to Nuclear Engineering, Pearson Education, 2017.
2. Samuel Glasstone, Alexander Sesonske, Nuclear Reactor Engineering: Reactor Systems Engineering, Springer, 2007.
3. M. M. El-Wakil, Nuclear Heat Transport, American Nuclear Society, 2005.

REFERENCE BOOKS

1. K. S. Krane, Introductory Nuclear Physics, Wiley, 2001.
2. John R. Lamarsh, The Physics of Nuclear Reactors, Springer, 2021
3. G. R. Keepin, Physics of Nuclear Kinetics, Addison-Wesley, 2015
4. R. E. Hester, R. M. Harrison (Editors), Nuclear Power and the Environment, Royal Society of Chemistry, 2011.
5. P. Mohanakrishnan, Om Pal Singh, K. Uma Maheswari, Nuclear Reactor Technology Development and Utilization, Woodhead Publishing (Elsevier), 2022.

Mapping of COs with POs & PSOs

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	2	-	-	-	-	-	-	-	-	3	-
CO2	2	2	3	2	-	-	-	-	-	-	-	-	3	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO5	2	2	3	2	-	-	-	-	-	-	-	-	3	-
AVG	**2.6**	**2.4**	**2.6**	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MEPE09 HVAC SYSTEMS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the procedures for plotting the refrigeration cycle, piping, tubing, soldering, and brazing.
- To learn installation, maintenance, and troubleshooting procedures for different heating systems.
- To familiarize themselves with green building principles, indoor air quality, and building energy efficiency.

UNIT I FUNDAMENTALS OF AIR CONDITIONING AND REFRIGERATION 9

introduction to air conditioning and refrigeration – basic thermodynamics of HVAC, types of refrigeration systems, the refrigeration cycle, refrigerants and their properties, plotting the refrigeration cycle, piping and tubing, soldering and brazing, refrigerant leak testing, refrigerant system evacuation, refrigerant system charging, control systems.

UNIT II OVERVIEW OF THE HEATING SYSTEMS 9

Heating systems - gas furnaces, gas furnace controls, gas furnace installation, troubleshooting gas furnaces, oil fired heating systems, oil furnace and boiler service, residential oil heating installation, troubleshooting of oil heating systems, electric heat, electric heat installation, troubleshooting of electric heat, heat pump system fundamentals, heat pumps applications, geothermal heat pumps, heat pump installation, troubleshooting of heat pump systems.

UNIT III COMFORT AND PSYCHOMETRICS BUILDING SYSTEMS 9

Comfort and psychometrics - fundamentals: psychometrics & airflow, air filters, ventilation and dehumidification, heat transmission in building structures -solar radiation -infiltration and ventilation-cooling/heating load calculations, residential load calculations, green buildings and systems, indoor air quality (IAQ), building energy calculations.

UNIT IV HVAC DUCT SERVICES 9

Duct installation, duct design, zone control systems, testing and balancing air systems.

UNIT V INDUSTRIAL AND COMMERCIAL COOLING SYSTEMS 9

Chilled water systems, cooling towers, commercial refrigeration systems, supermarket equipment and ice machines.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After the completion of this course, the student will be able to

CO1: Identify the components and operation of various refrigeration systems.
CO2: Apply knowledge of heating system principles and practices to real-world scenarios.
CO3: Calculate heating and cooling loads for residential and commercial buildings using industry-accepted methods.
CO4: Design duct systems that meet industry standards and optimize HVAC system performance.
CO5: Develop a comprehensive understanding of safety protocols, industry standards.

TEXT BOOKS

1. Faye C. McQuiston by "Heating, Ventilating, and Air Conditioning: Analysis and Design", 2023, Wiley.
2. Herbert W. Stanford by "HVAC Systems: Design, Installation, and Operation", 2012, CRC Press.
3. Richard R. Janis by "Mechanical and Electrical Systems in Buildings", 2013, Prentice Hall.

REFERENCE BOOKS

1. Jan. F. Kreider, Handbook of heating, ventilation and Air-conditioning, CRC press, 2000.
2. Mike Stubblefield and John H Haynes, Automotive heating and Air-conditioning, 1993.
3. Jan F. Kreider, Heating ventilation and air conditioning, 2001.
4. Roger W. Haines, Control systems for Heating, ventilating and air conditioning, Springer, 2016.
5. Arthur A. Bell Jr., PE, HVAC Equations, Data, and Rules of Thumb - McGraw-Hill, 2007.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	3	2	-	-	-	-	-	-	-	3	-
CO2	3	3	3	3	2	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	-
CO4	3	3	3	3	2	-	-	-	-	-	-	-	3	-
CO5	3	3	3	3	2	-	-	-	-	-	-	-	3	-
AVG	**3**	**2.8**	**2.8**	**3**	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE10 GAS DYNAMICS AND JET PROPULSION **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To discuss the effect of compressibility in gas flow and derive the steady one-dimensional isentropic flow equation.
- To discuss the effects of friction and heat transfer on compressible flows through constant area duct.
- To familiarize the occurrence of shocks and calculate property changes across a shock wave.

UNIT I BASIC CONCEPTS **9**

Energy and momentum equations of compressible fluid flows – Stagnation states – Mach waves and Mach cone – Effect of Mach number on compressibility. Isentropic flows: Isentropic flow through variable area ducts.

UNIT II ISENTROPIC FLOW **9**

Nozzle and Diffusers, compressors and turbines – Use of Gas tables. Flow through ducts: Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – Variation of flow properties – Use of tables and charts – Generalized gas dynamics.

UNIT III NORMAL AND OBLIQUE SHOCKS **9**

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl Meyer relations – Expansion of supersonic flow, Use of table and charts – Applications.

UNIT IV JET PROPULSION **9**

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

UNIT V SPACE PROPULSION **9**

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Apply the thermodynamics concepts in relation to compressible flows.
CO2: Differentiate the isentropic compressible flows in variable area ducts.
CO3: Solve for compressible flow characteristics with friction and heat transfer.
CO4: Determine shocks characteristics under various conditions.
CO5: Analyze the performance of aircraft and rocket propulsion engines.

TEXT BOOKS

1. Yahya S. M. “Fundamentals of Compressible Flow with aircraft and rocket propulsion”, 5/e, New Age International publishers, 2016.
2. Balachandran P. “Fundamentals of Compressible Fluid Dynamics”, PHI Learning India Private Ltd., 2009.
3. John D. Anderson Jr. “Modern Compressible Flow with historical perspective”, 2/e, McGraw Hill Publishing company, International Edition, 1990.

REFERENCE BOOKS

1. Shapiro A. H. “Dynamics and Thermodynamics of Compressible Fluid Flow – Volume I”, John Wiley, New York, 1953.
2. Flack, R.D.., “Fundamentals of Jet Propulsion”, Cambridge University Press, 2005.
3. Baskharone, E.A., “Principles of Turbomachinery in Air-Breathing Engines”, Cambridge University Press, 2006.
4. Kerrebrock J.L., “Aircraft Engines and Gas Turbines”, MIT Press, 1992.
5. Mattingly, J.D., “Elements of Gas Turbine Propulsion”, McGraw-Hill Inc., 1996.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
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CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	2
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	2
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	2
AVG	3	3	3	3	-	-	-	-	-	-	-	-	3	2

1-Low, 2 -Medium, 3 - High, '-' No correlation

24MEPE11 ADDITIVE MANUFACTURING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To discuss the basic concepts of Additive Manufacturing (AM) and their principles.
- To acquaint with software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
- To familiarize with VAT polymerization and material extrusion processes, powder bed fusion and direct energy deposition.

UNIT I INTRODUCTION **9**

Overview - 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 – case studies: automobile, aerospace, healthcare.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING **9**

Concepts and objectives- AM unique capabilities: part consolidation -topology optimization -lightweight structure - DFAM for part quality improvement. data processing - CAD model preparation - part orientation and support structure generation -model slicing - tool path generation customized design and fabrication for medical applications.

UNIT III VAT POLYMERIZATION AND MATERIAL EXTRUSION **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.

UNIT IV 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.

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES 9

Binder jetting: three-dimensional printing - materials - process - benefits- limitations - applications. Material jetting: multijet modeling- materials - process - benefits - applications. Sheet lamination: laminated object manufacturing (LOM)- basic principle- mechanism: gluing or adhesive bonding - thermal bonding- materials-application and limitation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Develop AM technology and opportunities for transforming a concept into product development.

CO2: Convert concept into the final product in AM technology.

CO3: Explain the vat polymerization and material extrusion processes and its applications.

CO4: Describe the powder bed fusion and material extrusion.

CO5: Explain the basics of binder jetting, material jetting and sheet lamination processes.

TEXT BOOKS

1. Ian Gibson, David W. Rosen and Brent Stucker "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", 2nd edition, Springer., United States, 2015.
2. Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015.
3. Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016.

REFERENCE BOOKS

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, RapidManufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011.
2. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press.,United States, 2015.
3. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States, 2006.
4. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box forprototype development", CRC Press., United States, 2011.
5. Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", Third edition, World Scientific Publishers, 2010.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	2
AVG	3	2	2	-	-	-	-	-	-	-	-	-	3	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE12 LEAN, MICRO AND GREEN MANUFACTURING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To describe the objectives and principles of lean manufacturing.
- To discuss the various concepts used in lean manufacturing.
- To acquire a broad understanding of micro manufacturing, green product and process.

UNIT I LEAN - INTRODUCTION **9**

Objectives of lean manufacturing-Lean process - 3M concept - key principles and implications of lean manufacturing - traditional vs lean manufacturing characteristics –roadmap for lean implementation and lean benefits. Toyota production system - JIT manufacturing.

UNIT II LEAN MANUFACTURING CONCEPTS **9**

Value creation and waste elimination – seven types of waste- pull production – different models of pull production -The Kanban system - continuous flow-The continuous improvement process / Kaizen-Worker involvement - Design of kanban quantities - Leveled production - tools for continuous improvement.

UNIT III MICRO MACHINING **9**

Mechanical Micro machining – Ultra Sonic Micro Machining – Abrasive Jet Micro Machining – Water Jet Micro Machining – Abrasive Water Jet Micro Machining – Micro turning – Chemical and Electro Chemical Micro Machining – Electric discharge micro machining.

UNIT IV GREEN MANUFACTURING **9**

Environmental effects of design – Environmental damage – In efficient energy use – Design for recycling. Material flow and cycles – Material recycling – Emission less manufacturing.

UNIT V GREEN MANUFACTURING PRACTICES **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.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Apply various tools and methodologies used in lean manufacturing.

CO2: Discuss about value creation and waste reduction techniques.

CO3: Impart the principles of various basic micro manufacturing processes.

CO4: Design manufacturing systems, which will be environmental friendly.

CO5: Explore the Industrial Ecology, Eco design and Pollution prevention.

TEXT BOOKS

1. Bralla, Design for Manufacture handbook, McGraw hill, 2015.
2. Jain V. K., Micro Manufacturing Processes, CRC Press, Taylor & Francis Group, 2012.
3. Fixel, J. Design for the Environment, McGraw hill., 2016.

REFERENCE BOOKS

1. Boothroyd, G, Design for Assembly Automation and Product Design. New York, Marcel Dekker, 2015.
2. Dornfield David, Green Manufacturing, Springer, 2012.
3. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010.
4. Jain V.K., 'Introduction to Micro machining' Narosa Publishing House, 2011.
5. World Commission on Environment and Development (WCED), Our Common Future, Oxford University 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
CO1	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	2	-
AVG	**2**	**2**	**2**	-	-	-	-	-	-	-	-	-	**2**	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE13 ADVANCED MANUFACTURING TECHNOLOGIES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To explore advanced metal forming processes and analyzes their parameters.
- To gain knowledge of micro-machining technologies.
- To study the fabrication processes involved in micro-device manufacturing.

UNIT I ADDITIVE PROCESSES **9**

fundamentals of rapid prototyping and additive manufacturing -friction stir processing, process variables and applications and advantages, electron beam welding, laser beam welding: process variables and applications and advantages. Advanced materials processing techniques- materials removal processes; finishing processes; forming; advanced surface engineering processes; joining technologies. Diffusion and ion implantation, conversion coating, organic coatings and porcelain enameling and other ceramic coatings-thermal and mechanical coating processes.

UNIT II ADVANCES IN METAL FORMING **9**

Conventional processes-high energy rate forming techniques- explosive forming, electro hydraulic forming, magnetic pulse forming, super plastic forming, rubber forming , flow forming - principles and process parameters- advantages -limitations and applications. Overviews of powder metal forming technique-advantages- applications-powder perform forging- hot and cold isostatic pressing-powder rolling-tooling and process parameters.

UNIT III MICRO-MACHINING **9**

Introduction to micromachining technologies, Micro-electro discharge Machining: Principles of micro-EDM, micro-EDM by Die-sinking and WEDG, micro-WEDM, micro-WEDG, micro-ECM, Principles of micro-turning, micro-drilling and micro-milling, micro grinding, hybrid micro-machining method, online measurement by machine vision and integrated probe, Measuring Techniques in micro-machining, surface integrity and other related measurements.

UNIT IV SEMICONDUCTOR MANUFACTURING **9**

Semiconductors – films and film depurification – Oxidation – diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication.

UNIT V LASER MATERIALS PROCESSING **9**

Fundamentals of industrial lasers. Laser materials interaction theories. Laser processing for various industries such as metals, non-metals, photovoltaic, bio-medical applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Describe the various additive manufacturing processes.

CO2: Explain the advanced metal forming technologies.

CO3: Categarize micro-machining techniques for engineering materials.

CO4: Explain the fabrication processes of micro-devices.

CO5: Calsify the laser materials processing techniques.

TEXT BOOKS

1. M P Groover,“Fundamentals of Modern Manufacturing: Materials, Processes, and Systems”Wiley India,2018.
2. Steven R. Schmid, Serope Kalpakjian,”Manufacturing Processes for Engineering Materials”, 5/e, Pearson Education, 2009.
3. J.A. McGeough,”Micromachining of Engineering Materials”, CRC Press, 2001.

REFERENCE BOOKS

1. Serope Kalpakjian, Steven R Schmid,"Manufacturing Engineering and Technology", 4/e, Pearson Education, 2020.
2. P M Dixit, U M Dixit, Modeling of Metal Forming and Machining Processes by Finite Element and Soft Computing Methods,Springer, 2021.
3. Pandey, P.C., and Shan, H.S, Modern Machining Processes, Tata McGraw-Hill Education, 2000.
4. Mark Madou, Fundamentals of Microfabrication, CRC Press, 2018.
5. McGeough, J.A, Advance Method of Machining Springer, 1988.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	3	-	-	-	-	-	-	-	-	3	2
CO2	3	2	-	3	-	-	-	-	-	-	-	-	3	2
CO3	3	2	-	3	-	-	-	-	-	-	-	-	3	2
CO4	3	2	-	3	-	-	-	-	-	-	-	-	3	2
CO5	3	2	-	3	-	-	-	-	-	-	-	-	3	2
AVG	3	2	-	3	-	-	-	-	-	-	-	-	3	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE14 NON-TRADITIONAL MANUFACTURING PROCESSES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To classify non-traditional machining processes and describe mechanical energy based non-traditional machining processes.
- To describe thermo-electric energy-based processes.
- To explain nano-finishing processes.

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 PROCESSES9

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.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Formulate different types of non-traditional machining processes
CO2: Catergorize the chemical and electro chemical energy based processes.
CO3: Evaluate thermo-electric energy based processes.
CO4: Interpret nano finishing processes.
CO5: Analyze hybrid non-traditional machining processes.

TEXT BOOKS

1. Adithan. M., “Unconventional Machining Processes”, Atlantic, New Delhi, India, 2009.
2. Ana nd Pandey, “Modern Machining Processes”, Ane Books Pvt. Ltd., New Delhi, India, 2019
3. Vijay K.Jain,”Advanced machining Processes”, Allied Publishers, 2009.

REFERENCE BOOKS

1. Benedict, G.F., “Non-traditional Manufacturing Processes”, Marcel Dekker Inc., New York 1987.
2. Carl Sommer, “Non-Traditional Machining Handbook”, Advance Publishing., United States, 2000.
3. Golam Kibria, Bhattacharyya B. and Paulo Davim J., “Non-traditional Micromachining Processes: Fundamentals and Applications”, Springer International Publishing., Switzerland, 2017.
4. Jagadeesha T., “Non-Traditional Machining Processes”, I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017.
5. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., “Hybrid Machining Processes: Perspectives on Machining and Finishing”, 1st edition, Springer International Publishing., Switzerland, 2016.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-
AVG	3	2	-	-	-	-	-	-	-	-	-	-	2	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE15 ADVANCED WELDING TECHNOLOGY **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To provide an in-depth understanding of modern and advanced welding techniques.
- To analyze welding metallurgy, residual stresses, and distortions.
- To impart knowledge on inspection, testing, and quality control of welded joints.

UNIT I ADVANCED WELDING PROCESSES **9**

Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – laser beam welding –plasma welding – electroslag welding- narrow gap, hybrid twin wire active tig – tandem mig- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and underwater welding.

UNIT II WELDING METALLURGY AND DESIGN **9**

Heat affected Zone and its characteristics – weldability of steels, cast iron, stainless steel, aluminum, Mg, Cu, Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control, Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment-welding thermal cycle.

UNIT III 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.

UNIT IV WELDING AUTOMATION AND QUALITY CONTROL **9**

Automation and robotics in advanced welding-Sensors and control systems for welding processes-Computer aided welding (CAW) and simulation-non-destructive testing (NDT) methods for weld inspection: Ultrasonic Testing (UT), Radiographic Testing (RT), Magnetic

Particle Testing (MPT), Liquid Penetrant Testing (LPT). Quality assurance and quality control in welding- Industry 4.0 applications in welding.

UNIT V WELDING OF METALS AND SIMULATION MODEL 9

Welding of stainless steels-Welding of non-ferrous materials-Thermal modeling and simulation of welding processes-Software tools for welding simulation. Analysis of residual stresses and distortion-Optimization of welding parameters.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the various advanced welding processes and their applications.
CO2: Analyze the thermal and metallurgical aspects of welding.
CO3: Identify the causes and remedies of various welding defects; apply welding standards and codes.
CO4: Explore the automation and robotics in advanced welding technologies.
CO5: Apply modern tools and technologies for welding simulations.

TEXT BOOKS

1. R.S. Parmar, ‘Welding Engineering and Technology’, Khanna Publishers, 2010.
2. Baldev Raj, Shankar V, Bhaduri A K, “Welding Technology for Engineers”, Narosa Publications, 2009.
3. Reza Beygi, Eduardo Marques, Lucas F.M. da Silva, “Computational Concepts in Simulation of Welding Processes”, Springer International Publishing 2022.

REFERENCE BOOKS

1. Srinivasan N.K., Welding Technology, Khanna Tech Publishers, 2002.
2. Lancaster.J.F. – Metallurgy of welding – George Alien & Unwin Publishers, 1999.
3. Carry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2005.
4. ASM Handbook vol.6, welding Brazing & Soldering, 2010
5. Ruifeng Li and Taotao Li., Advanced Welding Methods and Equipment, Springer Singapore, 2024.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	-
CO3	3	2	3	2	-	-	-	-	-	-	-	-	2	-
CO4	3	2	3	3	-	-	-	-	-	-	-	-	2	-
CO5	3	2	3	2	-	-	-	-	-	-	-	-	2	-
AVG	**3**	**2.2**	**2.8**	**2.2**	-	-	-	-	-	-	-	-	**2.2**	-

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MEPE16 INDUSTRIAL ROBOTICS AND MATERIAL HANDLING SYSTEM **L T P C 3 0 0 3**

COURSE OBJECTIVES

- To introduce the basic components, configurations, and drive systems used in industrial robots.
- To develop the ability to construct and analyze forward and inverse kinematic models of robotic manipulators.
- To provide an understanding of vision systems and the application of image processing techniques in robotic object recognition.

UNIT I INTRODUCTION **9**

Evolution of robotics. Robot anatomy- Co-ordinate Systems, Work envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Basic robot motions – Point to point control, Continuous path control. Robot Parts and Their Functions – Need for Robots Different Applications.

UNIT II ROBOT DRIVE SYSTEMS **9**

Robot drive systems: pneumatic drives – hydraulic drives – mechanical drives – electrical drives – D.C. servomotors, stepper motor, A.C. servo motors – salient features, applications.

UNIT III GRIPERS **9**

Grippers – mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers; two fingered and three fingered grippers; internal grippers and external grippers; selection and design considerations.

UNIT IV MATERIAL HANDLING SYSTEM **9**

Storing equipment like pallets, bins, racks, decking, order picking, positioning equipment. Hoisting equipment like jacks, pulleys, hand trolleys, hoists, power hoist, various types of cranes and elevators. Conveying equipment like belt, chain, roller, wheel, trolley, tray conveyors, gravity and vibratory type conveyors, screw conveyors. Mobile equipment like hand trucks, fork lift trucks, powered industrial trucks and tractors, powered stackers, reach trucks, order pickers.

UNIT V AUTOMATED GUIDED VEHICLE SYSTEM **9**

Automated Guided Vehicle system – Types &applications – Vehicle guidance technology – Vehicle management and safety. Storage system performance – storage location strategies – Conventional storage methods and equipment – Automated storage/Retrieval system- Smart manufacturing – Industry 4.0 – Digital manufacturing – Virtual manufacturing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion of this course, the students will be able to

CO1: Categorize the various components of a robot and distinguish the types of robot configurations.

CO2: Enumurate the various robotic drive system.

CO3: Explain the working of grippers.

CO4: Exploere the various material handling system process.

CO5: Describe the automated guided vehicle and automated manufacturing.

TEXT BOOKS

1. K. S. Fu, R. C. Gonzalez, and C. S. G. Lee, Robotics: Control, Sensing, Vision, and Intelligence, 1st ed., New York, NY, USA: McGraw-Hill, 1987.
2. M. P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, fifth ed., Boston, MA, USA: Pearson, 2021.
3. P. Radhakrishnan, S. Subramanyan, and V. Raju, CAD/CAM/CIM, fifth ed., New Delhi, India: New Age International, 2023.

REFERENCES BOOKS

1. R. K. Mittal and I. J. Nagrath, Robotics and Control, 1st ed., New York, NY, USA: McGraw-Hill Education, 2017.
2. CIM: Computer Integrated Manufacturing: Computer Steered Industry Book by August-Wilhelm Scheer.
3. R. S. Jain, Material Handling Equipment Operation, first ed., New York, NY, USA: Springer, 2024.
4. A. P. Kumar, Warehousing and Material Handling Systems for the Digital Industry, 1st ed., Berlin, Germany: Springer, 2023.
5. M. R. Gupta, Bulk Material Handling, first ed., Singapore: World Scientific, 2021.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	2	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE17 PRODUCTION PLANNING AND CONTROL **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To learn the problems and opportunities faced by the operations manager in manufacturing and service organizations.
- To develop an ability to apply PPC concepts in a various areas like marketing, accounting, finance, engineering, personnel management, logistics, etc.
- To examine several classic Operations Management planning topics including production planning and inventory control.

UNIT I INTRODUCTION **9**

Definition – Objectives of production Planning and Control – Functions of production planning and control – Elements of production control – Types of production – Organization of production planning and control department – Internal organization of department.

UNIT II INVENTORY MANAGEMENT **9**

Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems Introduction to MRP-I, MRP-II & ERP, JIT inventory, Kanban system.

UNIT III ROUTING AND SCHEDULING **9**

Definition – Routing procedure –Route sheets – Bill of material – Factors affecting routing procedure. SCHEDULING Definition – Activities-Difference with loading, Scheduling types: Forward, Backward scheduling, Job shop scheduling methods – Arrival pattern, processing pattern, number of workers available, machine varieties available, Priority rules for job sequencing FIFO, SPT, SOT, EDD, STR, CR, LISO, Random Orders. Scheduling Techniques Gantt Charts, LOB, Johnson's job sequencing rules- n jobs on 2machines, n jobs on 3 machines, n jobs on m machines.

UNIT IV LINE BALANCING **9**

Introduction, objectives, terms related to line balancing, procedures, simple problems Aggregate Planning: Introduction, Inputs to aggregate planning, strategies- Line strategy, chase strategy, capacity options, demand options.

UNIT V DISPATCHING **9**

Centralized and Decentralized Dispatching- Activities of dispatcher – Dispatching procedure – follow-up – definition – Reason for existence of functions – types of follow up, applications of computer in production planning and control.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Recognize the objectives, functions, applications of PPC and forecasting techniques.
CO2: Explain different Inventory control techniques.
CO3: Solve routing and scheduling problems.
CO4: Summarize various aggregate production planning techniques.
CO5: Apply the way of integrating different departments to execute PPC.

TEXT BOOKS

1. Buffa, E.S., Sarin, R.K., "Modern Production / Operations Management", John Willey and Sons, 1994.
2. Mukhopadhyaya, S.K., "Production Planning and Control – Text and Cases", Prentice Hall of India 2015.
3. Adam, Jr., E.E., Ebert, R.J., "Production and Operations Management Concept, Models and Behaviour", 5th Ed., Prentice Hall of India 2001.

REFERENCE BOOKS

1. C. Hax and D. Candea (1984), Production and Inventory Management, Prentice Hall.
2. H. Noori and R. Radford (1995), Production and Operations Management, McGraw Hill Inc.
3. L. A. Johnson and D. C. Montgomery (1974), O.R. in Production Planning, Scheduling and Inventory Control, John Wiley and Sons.
4. P. F. Bestwick and K. Lockyer (1982), Quantitative Production Management, Pitman Publications.
5. Elsayed and T. O. Boucher (1985), Analysis and Control of Production Systems, 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
CO1	3	2	3	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	3	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-	2	-
CO4	2	2	3	-	-	-	-	-	-	-	-	-	2	-
CO5	2	2	3	-	-	-	-	-	-	-	-	-	2	-
AVG	2.5	2	3	-	-	-	-	-	-	-	-	-	2	-

1-Low, 2 -Medium, 3– High, '-' No correlation

24MEPE18 FOUNDRY TECHNOLOGY

L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart the basics of casting and foundry practice.
- To be acquainted with design of gating system and to obtain defect free castings.
- To overview of the designing of molds, casting defects, inspection and testing of castings and modernization of foundries.

UNIT I INTRODUCTION **9**

Introduction to moulding and casting processes - steps involved advantages, limitations, application of casting process. Patterns - types, applications, pattern allowances-pattern materials, colour coding as per BIS, pattern making, core and core making, core boxes, core prints, core blowers, core shooters. Sand mould making: Moulding and core sands, ingredients, properties, types of sands, sand selection - machine moulding, types of machines, applications.

UNIT II CASTING PROCESSES **9**

Sand preparation and sand reclamation-sand control tests. Sand casting process, types of moulding processes - plaster mould casting, die casting process - die casting methods. Centrifugal casting, continuous casting, shell moulding, CO_2 moulding - investment casting, full mould process.

UNIT III MELTING, POURING AND TESTING **9**

Foundry remelting furnaces – selection of furnaces – crucible furnaces -oil fired furnace, electric furnaces – resistance, arc, induction furnaces –cupola steel melting, non-ferrous melting practices - pouring equipments – cleaning and inspection of casting –destructive and nondestructive testing - defects in sand casting and remedies.

UNIT IV GATING, FEEDING AND MECHANIZATION **9**

Elements of gating system, functions, types and design of gating systems, gating ratio, risers, functions, types and designs, methods controlling solidification, solidification time calculations, foundry mechanization.

UNIT V FERROUS AND NON-FERROUS METALS **9**

Production of iron castings - Steel foundry practice - Copper alloy foundry practice - Aluminium alloy foundry practice - Magnesium alloy foundry practice - Zinc alloy foundry practice. Foundry metallurgy: Heat treatment of castings, inspection, testing and quality control in foundries, salvage in defective castings, foundry mechanization. Foundry environment, health and safety: Dust problems in foundries, preventive maintenance in foundries, returning a sick foundry to profitability.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Select suitable casting process for application requirement.
CO2: Apply gating design and mould design knowledge to overcome defects in casting.
CO3: Selecting the type of sand, for molds and cores as well as the molding process.
CO4: Explian the special molding processes and when their use is warranted.
CO5: Apply knowledge of casting of ferrous and non-ferrous alloys and of the inspection techniques to detect casting defects.

TEXT BOOKS

1. T.R.Banga,”Foundry Engineering” Khanna Publishers, 2024
2. P.N. Rao, “Manufacturing Technology”, TMH, 5th Edition, 2013.
3. O.P. Khanna, “A Text Book of Foundry Technology”, Dhanpat Rai & Sons, 15th Edition, 2011.

REFERENCE BOOKS

1. Campbell J., "Castings Practice: The Ten Rules of Castings", Butterworth-Heinemann., United Kingdom, 2004, ISBN (13): 978 0750647915, (10) 9780750647915.
2. R.K. Jain, "Production Technology", Khanna Publishers, 17th Edition, 2011.
3. Peter Beeley "foundry technogy", Butterworth Heinemann 2nd Edition, 2001
4. P.L.Jain, "Principle of foundry Technology " Tata McGraw hill 4th Edition, 2006
5. Heine, R.W., Loper, C.R., and Rosenthal, P.C., "Principles of Metal casting" 2nd Edn. Tata McGraw Hill Pub. Co. Ltd., New Delhi, 1997.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	2	-	-	-	-	-	-	-	-	2	-
CO2	2	2	2	2	-	-	-	-	-	-	-	-	2	-
CO3	2	2	2	2	-	-	-	-	-	-	-	-	2	-
CO4	2	2	2	2	-	-	-	-	-	-	-	-	2	-
CO5	2	2	2	2	-	-	-	-	-	-	-	-	2	-
AVG	**2**	**2**	**2**	**2**	-	-	-	-	-	-	-	-	**2**	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE19 MEMS AND NEMS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the need of MEMS/NEMs and applications.
- To understand the microstructures and fabrication methods.
- To provide an insight of micro and nano sensors, actuators.

UNIT I INTRODUCTION **9**

Overview of micro electro mechanical systems and nano electro mechanical systems, devices and technologies, laws of scaling- Materials for MEMS and NEMS - applications of MEMS and NEMS. Definition of MEMS. MEMS devices. Silicon as a MEMS material – mechanical properties of silicon. Mechanical components in MEMS. Working Principles of microsystems. Engineering Science for microsystems design and Fabrication. Electrostatic forces, electromagnetic forces, electricity-fluid mechanics and heat transfer.

UNIT II MICRO-MACHINING AND MICROFABRICATION TECHNIQUES **9**

Photolithography- micro manufacturing, bulk micro machining, surface micro machining, LIGA. Ion implantation – diffusion – oxidation – CVD – Physical Vapor Deposition – Etching.

UNIT III MICRO SENSORS AND MICRO ACTUATORS **9**

Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors. micro actuators: actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- electrostatic, magnetic, fluidic, inverse piezo effect, other principles.

UNIT IV NEMS TECHNOLOGY **9**

Atomic scale precision engineering- nano fabrication techniques – NEMS for sensors and actuators.

UNIT V MEMS AND NEMS APPLICATION **9**

Bio MEMS- Optical NEMS- Micro motors- Smart Sensors - Recent trends in MEMS and NEMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the material properties and the significance of MEMS & NEMS for industrial automation.

CO2: Describe on micromachining and micro fabrication.

CO3: Apply the fabrication mechanism for MEMS sensor and actuators

CO4: Apply the concepts of MEMS and NEMS to model and process the sensors and actuators

CO5: Identify the application of MEMS and NEMS.

TEXT BOOKS

1. Tai Ran Hsu – 'Mems & Microsystems Design and Manufacturing' – John Wiley & Sons 2008 2nd Edition.
2. Julian W Gardner and Vijay K Varadan, "Microsensors, MEMS and Smart Devices", John Wiley and Sons Ltd, 2001, 1st Edition.
3. Chang Liu, "Foundations of MEMS", Pearson International Edition, 2011, 2nd Edition.

REFERENCE BOOKS

1. Marc F madou"Fundamentals of micro fabrication" CRC Press 2002 2nd Edition.
2. M.H.Bao "Micromechanical transducers: Pressure sensors, accelerometers and gyroscopes",Elsevier, Newyork, 2000, 1st Edition.
3. Mohamed Gad – el – Hak "MEMS Handbook" Edited CRC Press 2001, 1st edition.
4. Stephen D. Senturia," Micro system Design", Kluwer Academic Publishers,2001.
5. Thomas B. Jones, Electromechanics and MEMS, Cambridge University Press, 2001.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	-
AVG	3	2	2.5	-	-	-	-	-	-	-	-	-	2	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE20 NON-DESTRUCTIVE TESTING **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To introduce the concepts and importance of NDT in quality assurance and visual testing.
- To learn the basic principles of liquid penetrant & magnetic particle testing.
- To learn the basic principles of thermography.

UNIT I NDT AND VISUAL TESTING **9**

Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibro scopes – light sources and special lighting.

UNIT II LIQUID PENETRANT & MAGNETIC PARTICLE TESTING **9**

Liquid penetrant inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, methods &interpretation. Magnetic particle inspection: principles, applications, magnetization methods, magnetic particles, testing procedure, demagnetization, advantages and limitations, – interpretation and evaluation of test indications.

UNIT III THERMOGRAPHY **9**

Thermography- principle, contact & non-contact inspection methods, active & passive methods, liquid crystal – concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, instrumentation and methods, applications.

UNIT IV ULTRASONIC TESTING AND AET **9**

Ultrasonic testing: types of ultrasonic waves, characteristics, inspection methods-pulse echo, transmission and phased array techniques, acoustic emission technique – introduction, types of ae signal, ae wave propagation, source location, Kaiser effect, ae transducers, principle, ae parameters, ae instrumentation, advantages& limitations, interpretation of results, applications.

UNIT V RADIOGRAPHY TESTING **9**

Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan).

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion of this course, the students will be able to

CO1: Explain the concept of NDT in quality assurance and visual testing.
CO2: Describe the basic principles of liquid penetrant & magnetic particle testing.
CO3: Elaborate the basic principles of thermography.
CO4: Explore the basic principles of ultrasonic testing and AET.
CO5: Explain the basic principles of radiography testing.

TEXT BOOKS

1. Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Narosa Publishing House, 3rd edition, 2019.
2. J. Prasad and C. G. K. Nair, Nondestructive Testing and Evaluation of Materials, 2nd ed. New Delhi, India: McGraw-Hill Education, 2021.
3. R. Prakash, Non-Destructive Testing Techniques, 2nd ed. New Delhi, India: New Age International Pvt Ltd, 2022.

REFERENCES BOOKS

1. ASM International, ASM Handbook, Volume 17: Nondestructive Evaluation of Materials, 2018.
2. B. Hull and V. John, Non-Destructive Testing. New York, NY, USA: Springer, 2012.
3. N. Ida, C. Boller, and R. Diederichs, Eds., Handbook of Advanced Nondestructive Evaluation, 2nd ed. Cham, Switzerland: Springer, 2023.
4. Chuck Hellier, “Handbook of Nondestructive Evaluation”, Mc Graw Hill, 2021.
5. G. Lacidogna, Ed., Nondestructive Testing (NDT). Basel: MDPI, 2021.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	2	2	-	-	-	-	-	-	-	-	3	2
CO2	3	-	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	2	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MEPE21 AUTOMOBILE ENGINEERING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the construction, layout, and types of automobiles.
- To familiarize with auxiliary systems in IC engines.
- To explain transmission systems and components.

UNIT I VEHICLE STRUCTURE AND ENGINES **9**

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

UNIT II ENGINE AUXILIARY SYSTEMS **9**

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

UNIT III TRANSMISSION SYSTEMS **9**

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

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS **9**

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

UNIT V ALTERNATIVE ENERGY SOURCES **9**

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explore the vehicle structures, layouts, and aerodynamics.
CO2: Optimizing Engine Auxiliaries and Electronics for Performance and Emissions.
CO3: Explain transmission components and operation in manual/automatic drive trains.
CO4: Evaluate steering, braking, and suspension systems in vehicle dynamics and safety.
CO5: Assess alternative fuels and advanced propulsion systems.

TEXT BOOKS

1. S.K. Gupta, A Textbook of Automobile Engineering, Revised Edition, S. Chand Publishing, New Delhi, 2022.
2. R.K. Rajput, A Textbook of Automobile Engineering, Laxmi Publications, New Delhi, 2020.
3. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, NewDelhi, 1997.

REFERENCE BOOKS

1. Prof. R.B. Gupta, Automobile Engineering, Satya Prakashan, New Delhi, 2016.
2. A.K. Babu and Ajit Pal Singh, Automobile Engineering, S. Chand Publishing, New Delhi, 2013.
3. Devendra Vashist, Automobile Engineering, TechSar Pvt. Ltd., New Delhi, 2020.
4. Shivani Publications, Automobile Engineering (B.Tech 8th Sem ME 2024 Edition), Shivani Publications, Gwalior, 2024.
5. Er. S.K. Gupta, A Textbook of Automobile Engineering, S. Chand Publishing, New Delhi, 2020.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	2	-	-	-	-	-	-	-	2	3	2
CO2	3	3	3	2	-	-	-	-	-	-	-	2	3	2
CO3	3	3	2	3	-	-	-	-	-	-	-	2	3	2
CO4	3	3	3	3	-	-	-	-	-	-	-	2	3	2
CO5	3	2	2	2	-	-	-	-	-	-	-	2	3	2
AVG	**3**	**2.8**	**2.4**	**2.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE22 AUTOMOTIVE ELECTRICAL AND ELECTRONICS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the need for starter batteries, starter motor and alternator in the vehicle.
- To differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols.
- To learn common types of sensor and actuators used in vehicles.

UNIT I ELECTRICAL CIRCUITS AND BATTERIES **9**

Introduction - Overview of vehicle electrical systems- Electrical circuits - Electrical power supply in conventional vehicle - Dimensioning of wires- Circuit diagrams and symbols - Electromagnetic Compatibility and interference suppression. Batteries – Battery design - Method of operation - Lead acid battery construction – Battery ratings and testing- Maintenance -free batteries - Battery - Substitute, versions, special cases.

UNIT II STARTING AND CHARGING SYSTEM **9**

Alternators - Generation of electrical energy in vehicle - physical principles - Alternator and voltage regulations versions - power losses - characteristics curve - Alternator operation in the vehicle - Alternator circuitry. Starter Motors - Development and Starting requirements in the IC engines - starter motor design.

UNIT III IGNITION, LIGHTING AND AUXILLARY SYSTEM **9**

Ignitions System - Electronic ignition - Distributor less ignition - Direct ignition - Spark plugs. Automotive lighting Technology - Technical demands - Development of lighting technology - Light sources - physical principles - Front and rear lighting system - Interior lighting system - Special purpose lamps - Adaptive Lighting system - Instrument clusters - Wiper and Washer systems - electric horns.

UNIT IV AUTOMOTIVE ELECTRONICS SENSORS AND ACTUATORS **9**

Combined ignition and fuel management systems. Exhaust emission control, Digital control techniques – Automotive Sensors – Basics – Sensors : Position, speed, Acceleration / Vibrational, Force / Torque, Flow meters, Gas / Concentration , Temperature - Measured Quantities, Measuring Principles and automotive applications Automotive Actuators - Electromechanical actuators – Fluid mechanical actuators - Electrical machines – Direct current machines – Three phase machines – Single phase alternating current Machines – Duty type ratings for electrical machines.

UNIT V VEHICLE NETWORKING **9**

Data transfer between automotive Electronics systems - Basic principles of networking - Network topology - Network organization - OSI reference model - Control mechanisms - communication protocols in embedded systems - Vehicle Communication Protocols – Cross system functions - Requirements for bus systems - Classification of bus systems - Applications in the vehicle - Coupling of networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain for terms associated with vehicle electrical and electronic systems.

CO2: List the need for starter batteries, starter motor and alternator in the vehicle.

CO3: Discuss the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols.

CO4: List common types of sensor and actuators used in vehicles.

CO5: Categorize the networking in vehicles.

TEXT BOOKS

1. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007,
2. Tom Denton. Automobile Electrical and Electronic Systems, 2017, 5th Edition, Routledge, UK.
3. De Silva, Clarence W. Sensors and actuators: control system instrumentation. CRC Press, 2007.

REFERENCE BOOKS

1. Barry Holembeak, “Automotive Electrical and Electronics”, Delmar Publishers, Clifton Park, USA, 2010.
2. James D Halderman, “Automotive Electrical and Electronics”, Prentice Hall, USA, 2013.
3. Tom Denton, “Automotive Electrical and Electronics Systems,” Third Edition, 2004, SAE International.
4. William Ribbens, "Understanding Automotive Electronics, an Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.
5. Robert Bosch GmbH, “Bosch Automotive Handbook” 10th Edition, Robert Bosch, 2018.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO4	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO5	3	3	2	2	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MEPE23 HYBRID AND ELECTRIC VEHICLES TECHNOLOGY

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the fundamentals of vehicle performance and power train technologies.
- To learn about hybrid and electric drive trains, including topologies and power flow control.
- To study electric traction and motor drives, including motor types and control strategies.

UNIT I BASICS OF VEHICLE PERFORMANCE AND POWER TRAIN 9

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. History of hybrid and electric vehicles.

UNIT II HYBRID AND ELECTRIC DRIVE - TRAINS 9

Hybrid Electric Drive-trains: 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.

UNIT III ELECTRIC TRACTION AND MOTOR DRIVES **9**

Basic concept of electric traction, Power-Torque Characteristic curves, Selection of Electric motors, Motors types: DC motor drives, induction motor drives, brushless DC PM motor drives, Switched Reluctance motor drives, starter/alternator, Electric Control Drives.

UNIT IV ADVANCED ENERGY STORAGE SYSTEMS **9**

Energy Storage Requirements in Hybrid and Electric Vehicles with Battery, Flywheel based energy storage, Fuel reformer and Hydrogen storage systems, Hybridization of different energy storage devices. Matching the electric machine and the internal combustion engine, Energy Management Strategies.

UNIT V 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: 45 PERIODS

COURSE OUTCOMES

After the completion of this course, the student will be able to

CO1: Analyze the basics of vehicle performance and power train technologies.

CO2: Design and evaluate hybrid and electric drive trains.

CO3: Select and apply electric motors and motor drives for electric traction.

CO4: Evaluate advanced energy storage systems for hybrid and electric vehicles.

CO5: Develop energy management strategies for hybrid and electric vehicles.

TEXT BOOKS

1. S. Leitman, Build Your Own Electric Vehicle, McGraw Hill, 1st Edition, WW, 2013.
2. J. Larminie, J. Lowry, Electric Vehicle Technology Explaind, 2nd edition, John Wiley & Sons Ltd, U.K., 2012.
3. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Boca Raton: CRC Press 2018.

REFERENCE BOOKS

1. Aulice Scibioh M. and Viswanathan B., Fuel Cells Principles and Applications, India: University Press, 2009Heating ventilation and air conditioning – Jan F. Kreider.
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, Boca Raton: CRC Press, 2011.
3. I. Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, Washington, 2011.
4. Barbir F., PEM Fuel Cells: Theory and Practice, Burlington: Elsevier, 2012.
5. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	-	-	-	-	-	-	-	-	2	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	-
CO3	3	2	2	2	-	-	-	-	-	-	-	-	3	-
CO4	3	2	2	2	-	-	-	-	-	-	-	-	2	-
CO5	3	2	2	2	-	-	-	-	-	-	-	-	2	-
AVG	**3**	**2.4**	**2.4**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.4**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE24 VEHICLE BODY AND AERODYNAMICS ENGINEERING

L T P C
3 0 0 3

COURSE OBJECTIVES

- To convey knowledge in the construction of automobile vehicle body.
- To provide knowledge vehicle aerodynamics and body materials.
- To acquire various vehicle body mechanism of repair work.

UNIT I CAR BODY 9

Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car –car body terminology - Visibility- regulations, driver's visibility, improvement in visibility and tests for visibility. Driver seat design -Car Body Construction - Various panels in car bodies. Safety: Safety design, safety equipment for cars.

UNIT II BUS BODY 9

Types of bus body: based on capacity, distance travelled and based on construction. – Bus body lay out, floor height, engine location, entrance and exit location. Types of metal sections used – Regulations – Constructional details: Conventional and integral.

UNIT III COMMERCIAL VEHICLE BODY 9

Types of commercial vehicle bodies - Light commercial vehicle body. Construction details of Flat platform body, Tipper body and Tanker body – Dimensions of driver's seat in relation to controls – Drivers cab design.

UNIT IV VEHICLE AERODYNAMICS 9

Objectives, Vehicle drag and types. Various types of forces and moments. Effects of forces and moments. Side wind effects on forces and moments. Various body optimization techniques for minimum drag. Wind tunnels – Principle of operation, Types.

UNIT V BODY MATERIALS, TRIM, MECHANISMS AND BODY REPAIR 9

Types and properties of materials used in body construction and insulation -Such as steel sheet, timber, plastics and GRP, Insulation materials. Body trim items-body mechanisms. Hand tools power tools for body repair. Vehicle corrosion – Anticorrosion methods - Modern painting process procedure.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the various components and features of a car body.

CO2: Explain various bus body and commercial vehicle bodies.

CO3: Analyze various aerodynamic forces and moments, measuring instruments In vehicle body design.

CO4: Apply material used in bodybuilding.

CO5: Familiarize with tools used in body repairs and proficiency in vehicle body Engineering applications.

TEXT BOOKS

1. Dieler Anselm., The passenger car body, SAE International, 2000
2. James E Duffy, Body Repair Technology for 4-Wheelers, Cengage Learning,2009.
3. Powloski, J., Vehicle Body Engineering, Business Books Ltd., 1998.

REFERENCE BOOKS

1. Braithwaite, J.B., Vehicle Body building and drawing, Heinemann Educational Books Ltd., London, 1997.
2. Giles, G.J., Body construction and design, Illiffe Books Butterworth & Co., 1991.
3. John Fenton, Vehicle Body layout and analysis, Mechanical Engg. Publication Ltd., London, 1992.
4. Giri. N.K. Automobile Mechanics, Khanna Publishers. New Delhi, 1986.
5. Rao. J.S. & Gupta. K., Theory and Practice of Mechanical Vibrations, Wiley Eastern Ltd., New Delhi, 1999.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**3**	**2.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE25 SENSORS AND INSTRUMENTATION **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on the measurement of various physical parameters using Data Acquisition system.
- To learn the working of different sensors.
- To learn to select the measuring instruments.

UNIT I INTRODUCTION **9**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS **9**

Motion sensors – potentiometers, resolver, encoders – optical, magnetic, inductive, capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, ultrasonic ranging, reflective beacons, laser range sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain gage, load cell, magnetic sensors –types, principle, requirement and advantages: magneto resistive – Hall Effect – current sensor heading sensors – compass, gyroscope, inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS **9**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – pressure– diaphragm, bellows, piezoelectric – tactile sensors, temperature – IC, thermistor, RTD, thermocouple. Acoustic sensors – flow and level measurement, radiation sensors – smart sensors - film sensor, mems & nano sensors, laser sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS **9**

Amplification – filtering – sample and hold circuits – data acquisition: single channel and multichannel data acquisition – data logging - applications - automobile, aerospace, home appliances, manufacturing, environmental monitoring.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Recognize with various calibration techniques and signal types for sensors.

CO2: Explain the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducers.

CO3: Apply the various sensors and transducers in various applications.

CO4: Select the appropriate sensor for different applications.

CO5: Acquire the signals from different sensors using Data acquisition systems.

TEXT BOOKS

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, Dhanpat Rai & Co, 12th edition New Delhi, 2017.
3. A.K. Sawhney, Dhanpat Rai & sons. A course in Electrical & Electronic Measurements & Instrumentation, Dhanpat Rai, 2015.

REFERENCE BOOKS

1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons,Canada, 2001.
2. Hans Kurt Tönshoff (Editor), Ichiro, “Sensors in Manufacturing” Volume 1, Wiley-VCHApril2001.
3. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
4. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2011.
5. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	-	-	-	-	-	-	-	-	3	2
CO2	2	3	3	3	-	-	-	-	-	-	-	-	3	2
CO3	2	3	3	3	-	-	-	-	-	-	-	-	3	2
CO4	2	3	3	3	-	-	-	-	-	-	-	-	3	2
CO5	2	3	3	3	-	-	-	-	-	-	-	-	3	2
AVG	**2**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MEPE26 AUTONOMOUS VEHICLE SYSTEMS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To impart the required fundamentals of autonomous vehicles design and test.
- To provide an exposure about sensors and sensor fusion technology in automotive systems.
- To develop design skills in autonomous vehicle systems.

UNIT I INTRODUCTION **9**

Introduction - SAE autonomous level classification-examples-application of autonomous vehicle advantages and disadvantages of autonomous vehicles.

UNIT II PATH PLANNING AND DECISION MAKING 9

Principles of decision making and path planning for autonomous vehicles-Decision making approaches-Approximation-Heuristic-Graph based-Point guidance. Verification and validation of decision-making and path planning- Application examples of task allocation and path planning algorithms.

UNIT III SENSORS, PERCEPTION AND VISUALISATION 9

Introduction to sensors, perception and visualisation for autonomous vehicles-Sensor integration architectures and multiple sensor fusion-AI algorithms for sensing and imaging-neural networks.

UNIT IV NETWORKING AND CONNECTED VEHICLES 9

Current and future vehicle networking technologies- CAN, LIN, MOST and Flex-ray. The use of modern validation and verification methods- software-in-the-loop, and hardware-in-the-loop techniques. The role of Functional Safety and ISO26262 within the overall control system. Interdependency between software engineering and control system-advanced test methods for the validation of safety-critical systems. Connected vehicle control (CACC). Vehicle-to-vehicle [V2V], vehicle-to-infrastructure [V2I], and Vehicle to "Cloud" [V2C]. Applications such as intelligent traffic signals, collaborative adaptive cruise and vehicle platooning.

UNIT V HUMAN FACTORS AND ETHICAL DECISION MAKING 9

Introduction to human factors-human performance: perception and attention-situation awareness and error-human reliability: driver workload and fatigue-emotion and motivation in design-trust in autonomous vehicles and assistive technology-designing ADAS systems driverless vehicles and ethical dilemmas: human factors and decision making software application of human factors in autonomous vehicles. International and national regulatory frameworks for CAV and their safe operation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the required fundamentals of autonomous driving.
CO2: Discuss the autonomous vehicle localization.
CO3: Comprehend the sensors and sensor fusion technology.
CO4: Realize the perception system for autonomous driving system.
CO5: Discuss the autonomous vehicles decision, planning and control.

TEXT BOOKS

1. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot," Creating Autonomous Vehicle Systems" Morgan and Claypool Publishers.
2. Tim Schule, Advanced Microsystems for Automotive Applications: Smart Systems for Green and Automated Driving, 2015, Springer Publishers, USA.
3. Vermesan, "Digitizing the Industry: Internet of things connecting Physical, Digital and Virtual Worlds", 2016, River Publishers.

REFERENCE BOOKS

1. Newton, K., Steeds, W., and Garrett, T.K., The Motor Vehicle, Butterworths, 1989.
2. Daniel Minouli, ”Building the Internet of Things with IPv4 and IPv6”, 2015, John Wiley, USA.
3. Tom Denton, “Automotive Electrical and Electronics Systems,” Third Edition, 2004, SAE International.
4. Marko Wolf, “Secure In-Vehicle Communications”, 2012, Springer, USA.
5. The Internet of Things and Connected Cars, Business White paper, 2015, HPE.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	-
AVG	**3**	**2.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MEPE27 MARINE AND AEROSPACE ENGINEERING

L T P C
3 0 0 3

COURSE OBJECTIVE

- To learn the knowledge on the historical evaluation of Airplanes.
- To learn the basics of different structures & construction and the various types of power plants used in aircrafts.
- To acquire knowledge on shipbuilding materials and marine propeller and rudder.

UNIT I HISTORY OF FLIGHT 9

Balloon flight- Ornithopter- Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II AIRCRAFT CONFIGURATIONS AND ITS CONTROLS 9

Different types of flight vehicles, Classifications-Components of an airplane and their functions Conventional control, powered control- Basic instruments for Flying-Typical systems for control actuation.

UNIT III BASICS OF AIRCRAFT STRUCTURES AND PROPULSION 9

General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials. Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust Production- Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

UNIT IV INTRODUCTION TO MARINE ENGINEERING **9**

Archimedes Principle- Laws of floatation– Meta centre – stability of floating and submerged bodies Density, relative density - Displacement –Pressure –centre of pressure. General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical tankers -Passenger ships.

UNIT V SHIPBUILDING MATERIALS AND MARINE PROPELLER **9**

Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys, Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced Composites. Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitation and its effects on propeller.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the fundamentals of Airplanes.
CO2: Expalin the different component systems and functions.
CO3: Compare the different structures & construction of power plants used in aircrafts.
CO4: Describe the basics of hydrostatics and familiarization on types of merchant ships.
CO5: Utilze the shipbuilding materials, marine propeller and rudder.

TEXT BOOKS

1. D. A. Taylor, Introduction to Marine Engineering, 4^{th} ed. Amsterdam, Netherlands: Elsevier Butterworth-Heinemann, 2021.
2. D. J. Eyres and G. J. Bruce, Ship Construction, 8^{th} ed. Amsterdam, Netherlands: Butterworth-Heinemann, 2021.
3. Anderson, J.D., Introduction to Flight, McGraw-Hill; 8^{th} edition, 2015

REFERENCES BOOKS

1. Witherbys, Ships and Naval Architecture, Rev. ed. Livingston, U.K.: Wither by Publishing Group, 2020.
2. P. A. Russell and E. A. Stokoe, Reeds Vol. 5: Ship Construction for Marine Engineers, 7^{th} ed. London, U.K.: Bloomsbury Publishing, 2022.
3. A. C. Molland, The Maritime Engineering Reference Book, 2^{nd} ed. Oxford, UK: Elsevier, 2022.
4. P. A. Russell, Reeds Vol 8: General Engineering Knowledge for Marine Engineers, 17^{th} ed. London, UK: Bloomsbury, 2020.
5. D. J. Peery, Aircraft Structures, 2^{nd} ed. New York, NY: McGraw-Hill, 2018.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	-	-	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE28 LUBRICATION ENGINEERING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on concepts of friction and wear of engineering materials.
- To develop the understanding of tribological phenomena and fluid-film lubrication.
- To understanding of other lubrication process, industrial lubricants and additives.

UNIT I INTRODUCTION **12**

Tribological consideration, nature of surfaces and their contact. Introduction, physico-Mechanical properties of surface layer; Geometrical properties of surfaces, method of studying surface; Contact of smooth surfaces, contact of rough surfaces. Role of friction, laws of static friction, causes of friction; Adhesion. Adhesion theory, laws of rolling friction, friction of metals and nonmetals, friction measurement; Wear definitions, types of wear, mechanism of wear, factors affecting wear behavior, measurement of wear a brief introduction of wear test equipment's, wear in plastics.

UNIT II INDUSTRIAL LUBRICANTS AND THEIR ADDITIVES **9**

Functions of lubricants, types of lubricants and their industrial uses; Solid lubricants and their functions, liquid mineral lubricants, synthetic liquid lubricants, greases, properties of liquid and grease lubricants, viscosity, Newtonian and Non-Newtonian lubricants, temperature and pressure dependence measurement, other properties of lubricants; Lubricant additives, general properties and selection for machines and processes; Oil reclamation and preventive maintenance for lubricants.

UNIT III FLUID-FILM LUBRICATION **9**

Fluid mechanics concepts, equations of continuity and motion; Generalized Reynold's equation with incompressible and compressible lubricants; Hydrodynamic lubrication, Tower's experiment, finite bearings, partial journal bearings, solution of finite bearings using Galerkin, finite difference and FEM.

UNIT IV GAS LUBRICATION **9**

Types of gas bearings and their characteristics; Reynolds equation for iso-thermal, polytropic and adiabatic supporting gas films; Introduction to porus bearing permeability, solution of thrust and journal bearings.

UNIT V CASE STUDIES OF LUBRICATION **6**

Metal Forming, IC engines, Gear and other mechanisms, and other specified application.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Comprehend the theories of friction and wear.
CO2: Explain various types of industrial lubricant and additives.
CO3: Discuss the basic calculations for fluid film lubrication problems.
CO4: Explain concept and fundamentals of gas lubrication and applications.
CO5: Explore the various practical application in lubrication.

TEXT BOOKS

1. Bhushan, B., “Introduction to tribology’, John Wiley and Sons, UK, 2013.
2. G.W .Stachowiak and A.W.Batchelor, “Engineering Tribology”, Butterworth-Heinemann, 2005.
3. Garg, HP, Maintenance Engineering, S. Chand Publishing, 1987.

REFERENCE BOOKS

1. Takadoum, J., “Materials and Surface Engineering in Tribology”, John Wiley and Sons, Inc., London, 2008.
2. Hutchings, I.M., “Tribology: Friction and Wear of Engineering Materials”, Edward Arnold, London, 1992.
3. R. Keith Mobley, Maintenance Fundamentals, Elsevier, 2011.
4. Mishra R C and Pathak K., “Maintenance Engineering and Management”, PHI,2012
5. S.K. Basu, S.N.Sengupta and B.B.Ahuja ,”Fundamentals of Tribology”, Prentice Hall of India, 2005.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	3	-	-	-	-	-	-	-	-	-	2	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	2
AVG	**2.8**	**2.4**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.4**	**2**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MEPE29 PETROLEUM ENGINEERING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the broad array of tools used in the search for and production of hydrocarbon reserves.
- To provide knowledge of production operations in the oil and gas wells such as artificial lifts and subsurface equipment.
- To gain knowledge of environment issues, disaster management, Hazop in drilling rigs and all related Acts.

UNIT I PETROLEUM GEOLOGY **9**

Classification of Igneous, Sedimentary and Metamorphic rocks, – Sedimentation and Sedimentary environment. Identification of rocks in the field, Introduction to microfossils-types-Importance - Application of microfossil in hydrocarbon application , Sedimentalogy of Petroleum bearing sequences- Generation and migration of Petroleum. Physical and chemical properties of Petroleum, Petroleum traps, Introduction to plate tectonics - sedimentary basins.

UNIT II DRILLING TECHNOLOGY **9**

Drilling operations – location to rig, rig types – land types – marine types- release well bore diagram, components- types of power, fluid, drill bit selection - overall drilling rig, drilling sub systems – mud circulation system, drill pipe, heavy weight drill pipe (HWDP), drill string loads, bottom hole assembly-drilling assembly.

UNIT III OIL SEPARATION AND METERING TECHNIQUES **9**

Surface equipment and operations. Flow control and well heads. Gathering systems; service and cleaning systems; design and testing of flow lines. Separation and separators; separator components, stage separation; design and construction of separators. Meeting - Oil and gas metering techniques.

UNIT IV ECONOMICS IN PETROLEUM ENGINEERING **9**

Introduction, outline and key terminologies and generic issues of micro-economic analysis applicable to all sectors of the oil and gas supply chain, Capital budgeting and capital efficiency, Sources of revenue and cost and profitability analysis, Operating expenditures (opex) and their fixed, variable and marginal components, Economic indicators and yardsticks used to rank asset values (NPV, IRR, etc.).

UNIT V SAFETY ASPECTS IN PETROLEUM ENGINEERING **9**

Hazard identification- Hazard evaluation- Hazop and what if reviews- Developing a safe process and safety management- Personal protection systems and measures. Guidelines on internal safety audits (procedures and checklist) - Inspection & Safe practices during electrical installations- Safety instrumentation for process system in hydrocarbon industry- Safety aspects in functional training-Work permit systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explore petroleum resources across the entire value chain or throughout their life cycle.

CO2: Comprehend the concepts and techniques used in well drilling and optimize the design of a drilling program.

CO3: Explain basics of oil and gas production engineering and separation techniques.

CO4: Explore concept and fundamentals of engineering economics of energy industry.

CO5: Discuss the various acts related to safety, health and environment in petroleum industry.

TEXT BOOKS

1. F. G. Bell, "Engineering Geology", 2nd Edition, Butterworth Heimann, 2016.
2. J. H. Gray & G. E. Handwerk, "Petroleum Refining, Technology & Economics", 5th Edition, CRC Press, 2007.
3. T.O.Allen and A.P.Roberts. "Production operations", SPE - Vol-I 5th edition, 2012.

REFERENCES BOOKS

1. WL Nelson, "Petroleum Refining Engineering", 4th Edition, McGraw Hill Company, 1958.
2. "Petrochemical Processes Handbook", Hydrocarbon Processing, 2010.
3. "Guidelines for Hazard Evaluation Procedures Centre for Chemical Safety", Wiley AIChE, 3rd Edition, 2008.
4. Jean Masseron, "Petroleum Economics", Technip; 4th revised Edition, 2000.
5. Tarek Ahmed & Paul D. McKinney, "Advanced Reservoir Engineering", Gulf Professional Publishing, Elsevier, 2005.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO4	3	3	-	-	-	-	-	-	-	-	-	-	2	2
CO5	3	3	-	-	-	-	-	-	-	-	-	-	2	2
AVG	3	3	-	-	-	-	-	-	-	-	-	-	2	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE30 NANO-SCIENCE AND TECHNOLOGY

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand various Nanomaterial characterization techniques.
- To understand overview on properties of Nanomaterials in their design and fabrication.
- To Educate them on various nano structuring processes and recent trends.

UNIT I SCIENCE AND SYNTHESIS OF NANO MATERIALS 9

Classification of nano structures – effects of nano scale dimensions on various properties– structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics–effect of nano scale dimensions on mechanical properties - vibration, bending, fracture nanoparticles, sol-gel synthesis, inert gas condensation, high energy ball milling, plasma synthesis, electro deposition and other techniques. Synthesis of carbon nanotubes – solid carbon source-based production techniques – gaseous carbon source-based production techniques – diamond like carbon coating. Top down and bottom-up processes.

UNIT II CHARACTERIZATION OF NANO MATERIALS 9

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunnelling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

UNIT III OVER VIEW OF NANOTECHNOLOGY 9

Definition – historical development – properties, design and fabrication Nano systems, working principle, applications and advantages of nano system. Nanomaterials – ordered oxides – Nano arrays – potential health effects.

UNIT IV NANODEFECTS, NANO PARTICLES AND NANOLAYERS 9

Nano defects in crystals – applications – Nuclear Track nano defects. Fabrication of nano particles – LASER ablation – sol gels – precipitation of quantum dots. Nano layers – PVD, CVD, Epitaxy and ion implantation – formation of Silicon oxide- chemical composition – doping properties – optical properties.

UNIT V NANOSTRUCTURING 9

Nano photolithography – introduction – techniques – optical – electron beam – ion beam – X-ray and Synchrotron – nanolithography for microelectronic industry – nano-polishing of Diamond – Etching of Nano structures – Nano imprinting technology – Focused ion beams - LASER interference Lithography nanoarrays –Near-Field Optics - case studies and Trends.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

- CO1: Explain the concepts and techniques to design various nanomaterial-based devices.
- CO2: Describe the various morphological techniques tools for their future research.
- CO3: Explore the basics on Nano systems and its applications.
- CO4: Utilize the fundamentals of Nano defects and properties.
- CO5: Restate the fundamentals of Nano structuring and fabrication techniques.

TEXT BOOKS

1. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmom, Burkhard Raguse, "Nano Technology: Basic Science & Engineering Technology", 2005, Overseas Press.
2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications" Imperial College Press, 2004.
3. William A Goddard "Handbook of Nanoscience, Engineering and Technology", CRC Taylor and Francis group 2018.

REFERENCE BOOKS

1. R.H.J. Hannink & A.J.Hill, Nanostructure Control, Wood Head Publishing Ltd., Cambridge, 2006.
2. C.N.R. Rao, A.Muller, A.K.Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gibtl& Co.
3. Ivor Brodie and Julius J. Muray,'The physics of Micro/Nano-Fabrication,' Springer International Edition,2010.
4. Fahrner W.R., Nanotechnology and Nanoelectronics, Springer (India) Private Ltd.,2011.
5. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	2	3	-	-	-	-	-	-	-	-	1	-
CO2	2	3	-	3	-	-	-	-	-	-	-	-	2	-
CO3	2	2	2	3	-	-	-	-	-	-	-	-	2	-
CO4	2	2	-	3	-	-	-	-	-	-	-	-	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	-
AVG	**2.2**	**2.4**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.2**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE31 DESIGN OF PROCESS EQUIPMENT

L T P C
3 0 0 3

COURSE OBJECTIVES

- To equip students with the ability to design heat transfer equipment.
- To develop proficiency in the design of cooling towers and dryer.
- To design and analysis of mass transfers equipment.

UNIT I DESIGN OF HEAT EXCHANGER CONDENSER AND EVAPORATOR 9

Design of heat exchangers -types, design parameters, factors consideration for heat exchanger and selection of material. Condensers - types, design consideration, selection of material and design of evaporators- types, design consideration, selection of material, factors consideration for evaporator.

UNIT II DESIGN OF COOLING TOWER AND DRYER **9**

Design of cooling tower- types, design parameters, factors consideration for cooling tower and selection of material. Dryers -types, design parameters, factors consideration for dryer and selection of material.

UNIT III MASS TRANSFER EQUIPMENT **9**

Types, design parameters, Factors consideration and selection of material for Absorption column, distillation column, extraction column, adsorption column.

UNIT IV PROCESS VESSELS AND REACTORS **9**

Design of packed bed reactors- types, design parameters, factors consideration for cooling tower and selection of material, design of pressure vessel- types, design parameters, factors consideration for cooling tower and selection of material, design of storage vessel -types, design parameters, factors consideration for cooling tower and selection of material.

UNIT V DESIGN OF PLANT LAYOUT **9**

Design of plant layout, pipe lines and pipe layouts, schematics and presentation materials of construction and selection of process equipment.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion of this course, the students will be able to

CO1: Design heat transfer equipment according to standards such as BIS, TEMA

CO2: Design cooling towers and dryer.

CO3: Design of mass transfer equipment.

CO4: Design of reactor and pressure vessels, bins and silos.

CO5: Design process of power plant.

TEXTBOOKS

1. S. Ray and G. Das, Process Equipment and Plant Design: Principles and Practices, 1^{st} ed. Amsterdam, Netherlands: Elsevier, 2020.
2. J. M. Smith, H. Van Ness, and M. M. Abbott, Introduction to Chemical Engineering Thermodynamics, 9^{th} ed. New York, NY, USA: McGraw-Hill Education, 2021.
3. L. E. Brownell and E. L. Young, Process Equipment Design, 3^{rd} ed. New York, USA: Wiley, 2022.

REFERENCES BOOKS

1. C. J. Geankoplis, Transport Processes and Separation Process Principles (Includes Unit Operations), 5^{th} ed. Upper Saddle River, NJ, USA: Pearson Education, 2021.
2. S. P. K. Lee, The Art of Process Engineering, 1^{st} ed. Berlin, Germany: Springer, 2021.
3. S. Moran, Plant Design and Operations, Amsterdam, Netherlands: Elsevier, 2022.
4. C. A. Smith, Process Control: Designing Processes and Control Systems for Dynamic Performance, 3^{rd} ed. New York, NY, USA: McGraw-Hill Education, 2021.
5. J. A. Romagnoli and A. Palazoglu, Introduction to Process Control, 2^{nd} ed. Upper Saddle River, NJ, USA: Prentice Hall, 2021.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	2
AVG	3	2	2	-	-	-	-	-	-	-	-	-	3	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE32 DESIGN OF ROBOT ELEMENTS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the structural and functional aspects of robotic joints, actuators, and drive systems.
- To learn the principles of designing robotic links, manipulators, and structural frames.
- To gain knowledge on motion transmission, sensors, feedback systems, and integration of electronic and mechanical components.

UNIT I ROBOT ELEMENTS **9**

Types of robots: Cartesian, SCARA, Cylindrical, Spherical, Articulated, Parallel, Mobile-Basic building blocks: Base, joints, links, actuators, sensors, controllers-Structural hierarchy of manipulators-Types of kinematic pairs – constrained and unconstrained- Degrees of freedom (DoF) analysis- Robot work envelope and workspace optimization.

UNIT II MECHANICAL DESIGN OF JOINTS AND LINKS **9**

Design of robotic arms, links and supports – material selection, weight vs. strength analysis. Joint types: revolute (R), prismatic (P), helical, cylindrical, spherical – design considerations-Elastic deformation, stiffness, fatigue, and stress distribution. Structural optimization techniques – topology and parametric optimization- CAD modeling of robotic links – with case studies.

UNIT III ACTUATORS, TRANSMISSION AND MOBILITY SYSTEMS **9**

Electric actuators: DC motors, brushless DC, servo motors, stepper motors – torque-speed characteristics- Hydraulic and pneumatic actuators – application in high load robots-Transmission systems: gear trains, belt-pulley systems, ball screws, lead screws, and harmonic drives- Actuator sizing, efficiency, backlash, and resolution-Redundancy and safety in actuator systems.

UNIT IV SENSORS AND FEEDBACK SYSTEMS **9**

Position sensors: rotary and linear encoders, potentiometers- Force and torque sensors, tactile and proximity sensors-vision systems – basics of camera integration and 2D/3D feedback-

Inertial sensors and IMUs for mobile robots- Signal conditioning, interfacing, and microcontroller-based integration- Closed-loop feedback design for real-time control.

UNIT V GRIPERS **9**

Gripper types: parallel, angular, suction, magnetic, and soft grippers- Design of grippers – force calculations, material and surface selection- Tool changers, multi-fingered hands, wrist mechanisms- Robotic tools for assembly, surgery, painting, and welding- Bio-inspired design approaches for manipulation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the students would be able to

CO1: Explain the architecture and components of various robot configurations.

CO2: Design joints and mechanical linkages based on degrees of freedom and motion range.

CO3: Select and analyze actuators, drives, and motion transmission systems suitable for specific tasks.

CO4: Integrate sensors and feedback-based control mechanisms.

CO5: Design customized end effectors and tool interfaces for industrial and medical robotics.

TEXTBOOKS

1. Groover, M.P, Industrial Robotics: Technology, Programming, and Applications, McGraw Hill, 2017
2. Craig, J.J., Introduction to Robotics: Mechanics and Control, Pearson, 2009
3. Niku, S.B., Introduction to Robotics: Analysis, Control, Applications, Wiley, 2020.

REFERENCE BOOKS

1. Spong, M.W., Hutchinson, S., Vidyasagar, M. – Robot Modeling and Control, Wiley, 2020.
2. Fu, Gonzalez, and Lee – Robotics: Control, Sensing, Vision, and Intelligence, McGraw-Hill, 2017.
3. Mittal, R.K., Nagrath, I.J. – Robotics and Control, TMH, McGraw-Hill, 2003.
4. Bolton, W. – Mechatronics, Pearson, 2010.
5. Appuu Kuttan, K.K. – Robotics, I.K. International, 2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	-	-	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MEPE33 DESIGN PRACTICES AND PRINCIPLES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To know the general design principles for manufacturability in GD&T.
- To acquire knowledge in design considerations while designing the formed and machined components
- To comprehend the design considerations for environmental issues.

UNIT I INTRODUCTION **9**

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric tolerances - Assembly limits - Datum features - Tolerance stacks.-Factors Influencing form design-Working principle, Material, Manufacture, Design- Possible solutions - Materials choice – Influence of materials on form design - form design of welded members, forgings and castings.

UNIT II COMPONENT DESIGN - MACHINING CONSIDERATION **9**

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility.

UNIT III DESIGN FOR ASSEMBLY **9**

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Design for assembly – Product design for manual assembly - Product design for automatic assembly – Robotic assembly-Automatic assembly – Computer Application for DFMA -Case studies.

UNIT IV DESIGN FOR RELIABILITY **9**

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress-strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair.

UNIT V SUSTAINABLE DESIGN **9**

Industrial ecology, multiple life cycle design, principles of design, green engineering, cradle to cradle design, The Natural Step, biomimicry, design for reuse, dematerialization, modularization, Design to minimize material usage – Design for disassembly – Design for recyclability – design for flexibility, design for disassembly, design for inverse manufacturing, design for the environment, – Design for energy efficiency – Design to regulations and standards etc.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Apply the general design principles for manufacturability in GD&T.

CO2: Apply design considerations while designing the formed and machined components

CO3: Apply design considerations for assembled systems.

CO4: Exposed to maintenance systems and reliability based design.

CO5: Apply design considerations for environmental issues.

TEXT BOOKS

1. Boothroyd, G, Design for Assembly Automation and Product Design. New York, Marcel Dekker., 2005.
2. Bralla, Design for Manufacture handbook, McGraw hill, 1999.
3. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.

REFERENCE BOOKS

1. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.
2. K.Venkataraman "Maintenance Engineering and Management", PHI Learning, 2007.
3. David J.Smith, "Reliability and Maintainability in Perspective", McMillan, 2nd Edition, 1985.
4. Fixel, J. Design for the Environment McGraw Hill., 1996.
5. Finster, Mark P., 2013. Sustainable Perspectives to Design and Innovation.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-
AVG	3	3	2.5	-	-	-	-	-	-	-	-	-	2.5	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE34 DESIGN OF INDUSTRIAL VEHICLE

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the functional requirements of various industrial vehicles.
- To analyze the components and subsystems used in the design of industrial vehicles.
- To develop the ability to design suitable vehicle layouts for industrial applications.

UNIT I INTRODUCTION **9**

Types – Classification – Application areas – Load characteristics – Operating environments – Design specifications – Government and industrial standards.

UNIT II POWERTRAIN AND CHASSIS DESIGN **9**

Powertrain selection – Gearbox and transmission – Chassis types and load distribution – Vehicle dynamics – Frame materials and design.

UNIT III SUSPENSION AND STEERING SYSTEMS **9**

Types of suspension systems – Hydraulic and pneumatic systems – Steering geometry – Types of steering mechanisms – Turning radius and maneuverability.

UNIT IV BRAKING SYSTEMS AND SAFETY **9**

Mechanical, hydraulic, pneumatic brakes – ABS and EBS – Safety systems – Load holding and release mechanisms – Stability and control in heavy vehicles.

UNIT V ERGONOMICS, ENVIRONMENT AND VEHICLE LAYOUT **9**

Driver ergonomics – Cabin design – Visibility – NVH – Emission standards – Electric and hybrid systems – Complete design case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the students would be able to

CO1: Identify the functions of industrial vehicles.
CO2: Analyze vehicle chassis and transmission systems used in industrial vehicles.
CO3: Design the appropriate suspension, braking, and steering systems.
CO4: Evaluate ergonomic, safety, and environmental considerations in vehicle design.
CO5: Develop complete layouts of industrial vehicles.

TEXTBOOKS

1. N. K. Giri, Automobile Mechanics, Khanna Publishers, 2017.
2. K. Singh, Automobile Engineering, Vol. 1 & 2, Standard Publishers, 2008.
3. P. M. Heldt, Automotive Chassis Design, Chilton Book Company, 1986.

REFERENCE BOOKS

1. J. G. Giles, Steering, Suspension and Tyres, Illiffe Books, 1978.
2. H. Heisler, Advanced Vehicle Technology, Butterworth-Heinemann, 2002.
3. N. Newton, D. Steeds, and E. Garrett, Motor Vehicle, Butterworths, 1994.
4. R. B. Gupta, Automobile Engineering, Satya Prakashan, 2012.
5. Z. D. Jastrzebski, The Nature and Properties of Engineering Materials, John Wiley, 2000.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	2
AVG	3	2	2	-	-	-	-	-	-	-	-	-	3	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE35 ERGONOMICS IN DESIGN

L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce to industrial design based on ergonomics.
- To apply environmental factors in ergonomics design.
- To develop aesthetics applicable to manufacturing and product.

UNIT I INTRODUCTION 9

An approach to industrial design, Elements of design structure for industrial design-Ergonomics and Industrial Design: Ergonomics, Communication system, general approach to the man-machine relationship, Human and Machine component of work system, Local environment-light, Heat, Sound.

UNIT II ERGONOMICS AND PRODUCTION 9

Introduction, anthropometric data and its applications in ergonomic, working postures, body movements, work station design, chair design. Visual effects of line and form: the mechanics of seeing, psychology of seeing, figure on ground effect, gestalt's perceptions - simplicity, regularity, proximity, wholeness. Optical illusions, influences of line and form.

UNIT III DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS 9

Design principles of visual displays, classification, quantitative displays, qualitative displays, check readings, situational awareness, representative displays, design of pointers, signal and warning lights, color coding of displays, design of multiple displays controls: design considerations, controls with little efforts – push button, switches, rotating knobs. controls with muscular effort – hand wheel, crank, heavy lever, pedals. design of controls in automobiles, machine tools.

UNIT IV ENVIRONMENTAL FACTORS 9

Colour and light, colour and objects, colour and the eye – after image, colour blindness, colour constancy, colour terms – colour circles, munsel colour notation, reactions to colour and colour combination – colour on engineering equipments, colour coding, psychological effects, colour and machine form, colour and style.

UNIT V AESTHETIC CONCEPTS **9**

Concept of unity, concept of order with variety, concept of purpose, style and environment, aesthetic expressions - symmetry, balance, contrast, continuity, proportion. Style - the components of style, house style, style in capital good. Introduction to ergonomic and plant layout software's, layout design.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course the students would be able to

CO1: Explore the ergonomic needs in the industrial design.

CO2: Apply ergonomics in creation of manufacturing system.

CO3: Discuss on design of controls and display.

CO4: Consider environmental factors in ergonomics design.

CO5: Report on importance of aesthetics to manufacturing system and product.

TEXT BOOKS

1. M. M. Soares and F. Rebelo, Ergonomics in Design: Methods and Techniques, 1^{st} ed. Boca Raton, FL, USA: CRC Press, 2016.
2. S. Lin, Ed. Ergonomics in Product Design, 1^{st} ed. Sendpoints Publishing, 2018.
3. J. L. Hernández Arellano and A. Maldonado-Macías, Handbook of Research on Ergonomics and Product Design, Hershey, PA, USA: IGI Global, 2017.

REFERENCES BOOKS

1. M. J. Burke, Applied Ergonomics Handbook, CRC Press, 2020.
2. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., 7^{th} Edition, 2012.
3. Brain Shakel, "Applied Ergonomics Hand Book", Butterworth Scientific London 1988.
4. R. S. Bridger, Introduction to Ergonomics, 3^{rd} ed. Boca Raton, FL: CRC Press, 2008.
5. Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2016.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE36 INDUSTRIAL TRIBOLOGY **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To study the fundamentals of industrial tribology.
- To impart knowledge on friction, wear and lubrication.
- To acquire knowledge on surface coatings and measurements.

UNIT I INTRODUCTION **9**

Tribology – definition - Industrial significance - economic aspects – trends - Factors influencing Tribological phenomena - Engineering surfaces - Surface characterization - Computation of surface parameters.

UNIT II FRICTION **9**

Genesis of friction - friction in contacting rough surfaces - sliding and rolling friction - various laws and theory of friction - Stick-slip friction behavior - frictional heating and temperature rise - Friction measurement techniques.

UNIT III WEAR **9**

Wear and wear types. Mechanisms of wear - Adhesive, abrasive, corrosive, erosion, fatigue, fretting, etc., Wear of metals and non-metals. Wear models - asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage. Wear in various mechanical components, wear controlling techniques.

UNIT IV LUBRICATION **9**

Introduction to lubrication - Lubrication regimes - Introduction to micro and nano tribology - Coating characteristics - Coating performance evaluation - Powder coatings and types - application methods.

UNIT V SURFACE TOPOGRAPHY **9**

Surface topography measurements - Electron microscope and friction and wear measurements - Laser method - Sliding friction and wear abrasion test- rolling contact and fatigue test - solid particle and erosion test - Use of transducers and instruments in Tribology.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Apply the knowledge of tribology in industries.
CO2: Describe the fundamentals of surface features and different types of friction associated with metals and non-metals.
CO3: Analyze the different types of wear mechanism and its standard measurement.
CO4: Analyze the different types of lubrication and their characteristics.
CO5: Explain the working of surface measuring instruments.

TEXT BOOKS

1. Bhushan, "Nanotribology and Nanomechanics: An Introduction", Springer, 2008.
2. G. W. Stachowiak, A. W. Batchelor, "Engineering Tribology", Elsevier Limited, 2005.
3. S.K. Basu, S.N.Sengupta and B.B.Ahuja ,"Fundamentals of Tribology", Prentice Hall of India, 2005.

REFERENCE BOOKS

1. Williams J.A . "Engineering Tribology", Oxford Univ. Press, 1994.
2. Neale M.J , "Tribology Hand Book ", Butterworth Heinemann, 1995.
3. I.M. Hutchings, "Tribology: Friction and Wear of Engineering Materials", Elsevier Limited, 1992.
4. K.C. Ludema, "Friction, wear, lubrication: A text book in tribology", CRC Press, 1996.
5. Michael M Khonsari, Applied Tribology (Bearing Design and Lubrication),John Wiley & Sons, 2001.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	2	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	**2**	-	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE37 DESIGN OF MACHINE DRIVES **L T P C 3 0 0 3**

COURSE OBJECTIVES

- To provide the knowledge on materials selection and mechanical properties from manufacturer's catalogue
- To impart knowledge on design procedure of flexible and rigid mechanical transmission drives.
- To analyze various components of forces acting on the power transmission elements and evaluate load carrying capacity.

UNIT I DESIGN OF FLEXIBLE MECHANICAL DRIVES **9**

Introduction to flexible drives – design of flat belt drive and pulley – design of V-belt drive and pulley – ratio of tensions – belt materials – design procedure using manufacturer's catalogue – design of chain drives and sprockets – load carrying capacity – design of wire ropes – construction and designation – selection procedure.

UNIT II PARALLEL AXES GEAR DRIVES **9**

Gear Nomenclature – stresses on gear tooth – gear materials – design of spur gear pair – design of helical gear pair – surface compressive stress and bending stress calculation – force analysis of parallel axes gear drives – design based on beam strength and wear considerations – gear tooth failures.

UNIT III DESIGN OF BEVEL AND WORM GEARS **9**

Introduction to bevel gear drive – types – terminology of bevel gears – stresses on bevel gear tooth – design of bevel gear drive using manufacturer's catalogue – equivalent number of teeth – force analysis on bevel gear – design based on beam strength and wear considerations. friction in worm gear pair – design procedure for worm and worm wheel – selection of materials – efficiency of worm gear drive – modes of failure – thermal considerations – analysis of forces – design based on beam strength and wear considerations.

UNIT IV DESIGN OF MULTISPEED GEARBOX **9**

Introduction to multispeed gearbox – components of speed reduction unit – principles for optimum gearbox design – progression ratio – construction of kinematic layout and speed diagram – center distance calculation – selection of number of teeth.

UNIT V DESIGN OF CLUTCHES AND BRAKES **9**

Friction materials – types of clutches – uniform pressure and uniform wear theories- design of disc or plate clutches – cone clutch – centrifugal clutch – types of mechanical brakes – design procedure – block brakes with short and long shoe – internal expanding shoe brakes – band brakes – disc brakes – thermal considerations.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Design flexible power transmission systems such as belt drives, chain drives and wire ropes.

CO2: Design the parallel axis gears based on gears using manufacturer's catalogue.

CO3: Design the non-parallel axis gears based on gears using manufacturer's catalogue.

CO4: Design the gearbox for different speed.

CO5: Design different types of clutches and brakes used in the mechanical drives.

TEXT BOOKS

1. Bhandari V B, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill, 2015.
3. Robert L. Norton, Machine Design, 2018, 5th edition, Pearson.

REFERENCE BOOKS

1. Ansel C Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co,2004.
2. Merhyle Franklin Spotts, Terry E. Shoup, and Lee Emrey Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2004.
3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design", 6th Edition, Wiley, 2017.
4. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
5. Design Data: Data Book of Engineers By PSG College-Kalaikathir Achchaga, Coimbatore, 2012.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	3	-	-	-	-	-	-	-	-	-	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE38 FRACTURE MECHANICS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the fundamental principles of fracture mechanics and failure theories.
- To study linear and elastic-plastic fracture mechanics and associated parameters.
- To evaluate the fatigue and fracture behavior of engineering components.

UNIT I FUNDAMENTALS OF FRACTURE MECHANICS 9

Need for fracture mechanics-Limitations of conventional strength of materials-Historical development of fracture theories-Types of fractures: brittle, ductile-Griffith theory of brittle fracture-Stress concentration and notch effects.

UNIT II STRESS ANALYSIS AND FRACTURE CRITERIA 9

Linear Elastic Fracture Mechanics (LEFM) - Stress Intensity Factor (SIF), Energy release rate, Instability and R-curve, Stress analysis of cracks - Stress intensity factor, Relationship between K and global behaviour, Crack tip stress analysis.

UNIT III ADVANCED TOPICS IN FRACTURE MECHANICS 9

Elastic Plastic Fracture Mechanics (EPFM) - Crack tip opening displacement (CTOD), J-integral, relationship between J and CTOD.

UNIT IV FATIGUE AND CRACK GROWTH **9**

Fatigue crack initiation and propagation-Paris' Law and fatigue life estimation-Threshold SIF-Variable amplitude loading and fatigue behavior-Crack closure and retardation effects.

UNIT V FRACTURE TESTING AND APPLICATIONS **9**

Experimental determination of plane strain fracture toughness, K- R curve testing, J measurement, CTOD testing, Failure assessment diagram, Crack arrest and repair methodologies-Fracture mechanics in aerospace, automotive, and structural engineering.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Apply the basic concepts mechanics in fracture mechanics.

CO2: Analyze stress intensity factors and different crack propagation modes

CO3: Apply principles of LEFM and EPFM in component design.

CO4: Evaluate fatigue crack growth and fracture resistance of materials.

CO5: Interpret fracture toughness testing in practical engineering contexts.

TEXT BOOKS

1. Anderson, T.L., Fracture Mechanics: Fundamentals and Applications, Taylor & Francis Group, 2017.
2. Evalds, H.L. and Warnhil, R.J.H., Fracture Mechanics, Edward Arnold Ltd, Baltimore,1984.
3. Prashant Kumar, Elements of Fracture Mechanics, Wheeler Publishing, 2012.

REFERENCE BOOKS

1. Campbel, J.E., Underwood, J.H, and Gerberich, W.W., Applications of Fracture Mechanics for the selection of Materials, American Society for Metals, Metals Park Ohio, 1982.
2. Fracture Mechanics Metals Handbook, ninth edition, American Society of Metals Metal Park ohio, 1985.
3. Kare Hellan, Introduction of Fracture Mechanics, McGraw-Hill Book Company, 1985.
4. Suresh S., Fatigue of Materials, Cambridge University Press.
5. David Broek, Elementary Engineering Fracture Mechanics, Springer.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	2	-	-	-	-	-	-	-	-	3	-
AVG	**3**	**2.8**	**2.8**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.8**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE39 OPTIMIZATION IN ENGINEERING DESIGN **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To prepare the students for imparting knowledge on various categories of existing engineering problems
- To train to solve problems through different optimization techniques and approaches.
- To gain knowledge various categories of ANN methods.

UNIT I UNCONSTRAINED OPTIMIZATION TECHNIQUES **9**

Introduction to optimum design - general principles of optimization – statement of an optimization problem & their classifications – single variable and multi variable optimization, techniques of unconstrained minimization – exhaustive search, dichotomous search, interval halving method, Fibonacci method and golden section, random, steepest descent method.

UNIT II CONSTRAINED OPTIMIZATION TECHNIQUES **9**

Optimization with equality and inequality constraints – Direct methods – Indirect methods uses penalty functions, Lagrange multipliers – Geometric programming.

UNIT III ARTIFICIAL NEURAL NETWORKS AND SWARM INTELLIGENCE **9**

Introduction – Activation functions, types of activation functions, neural network architectures, Single layer feed forward network, multilayer feed forward network, Neural network applications. Swarm intelligence various animal behaviors, Ant Colony optimization, Particle Swarm optimization.

UNIT IV ADVANCED OPTIMIZATION TECHNIQUES **9**

Multistage optimization – Dynamic programming; stochastic programming; Multi objective optimization – Genetic algorithms and simulated annealing technique.

UNIT V STATIC AND DYNAMIC APPLICATIONS **9**

Structural applications – Design of simple truss members – Design of simple axial, transverse loaded members for minimum cost, weight – Design of shafts and torsionally loaded members – Design of springs. Design of brakes, gears and gearboxes.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Formulate unconstrained optimization techniques in engineering design application.
CO2: Formulate constrained optimization techniques for various applications.
CO3: Implement neural network technique to real world design problems.
CO4: Apply genetic algorithms to combinatorial optimization problems.
CO5: Evaluate solutions by various optimization approaches for a design problem.

TEXT BOOKS

1. Goldberg, David.E, “Genetic Algorithms in Search, Optimization and Machine Learning”, Pearson, 2009.
2. Jang, J.S.R,Sun, C.Tand Mizutani E.,"Neuro- Fuzzy and Soft Computing", Pearson Education, 2015.
3. Kalyanmoy Deb, “Optimization for Engineering Design:Algorithms and Examples”, PHI Learning Private Limited,2nd Edition,2012.

REFERENCE BOOKS

1. Johnson Ray, C., “Optimum design of mechanical elements”, Wiley, 2nd Edition 1980.
2. Rajasekaran S and Vijayalakshmi Pai,G .A, "Neural Networks, Fuzzy Logic and Genetic Algorithms" ,PHI, 2011.
3. Rao Singiresu S., “Engineering Optimization – Theory and Practice”, New Age International Limited, NewDelhi, 3rd Edition, 2013.
4. G. Hadley,"Linear programming", Narosa Publishing House, New Delhi, 1990.
5. H.A. Taha,"Operations Research:An Introduction", 5th Edition, Macmillan, New York, 1992.

Mapping of COs with POs & PSOs

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	2	-
AVG	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	**2**	-

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MEPE40 DYNAMICS AND VIBRATIONS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To know the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To acquire knowledge in the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To study the balancing of machine parts.

UNIT I FORCE ANALYSIS **9**

Dynamic force analysis – Inertia force and Inertia torque– D Alembert’s principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses- Dynamics of Cam- follower mechanism.

UNIT II BALANCING 9

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines-Field balancing of discs and rotors.

UNIT III FREE VIBRATION 9

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration– Equations of motion – Natural frequency – Types of Damping – Damped vibration– Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems.

UNIT IV FORCED VIBRATION 9

Response of one degree freedom systems to periodic forcing – Harmonic disturbances – Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement.

UNIT V MECHANISM FOR CONTROL 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

- CO1: Analyze static and dynamic forces of mechanisms.
- CO2: Estimate the balancing masses and their locations of reciprocating and rotating masses.
- CO3: Solve the frequency of free vibration problems.
- CO4: Compute the frequency of forced vibration problems.
- CO5: Determine the speed, lift of the governor, and estimate the gyroscopic effect on automobiles, ships and airplanes.

TEXT BOOKS

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.
2. Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 5th edition 2019
3. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 3rd edition 2019.

REFERENCE BOOKS

1. AmitabhaGhosh and Asok Kumar Mallik, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., 1988.
2. Rao.J.S. and Dukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2nd edition, 2014.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2013.
4. Wilson. FW, "Fundamentals of Tool Design" ASTME PHI 2010.
5. Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	3	-	-	-	-	-	-	-	-	-	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	2	2
AVG	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	**2.5**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE41 TOTAL QUALITY MANAGEMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To know the need for quality, its evolution, basic concepts, and contribution of quality gurus.
- To explain the TQM Principles for application.
- To teach the basics of Six Sigma and apply Traditional tools, new tools, Benchmarking and FMEA.

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) - TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES **9**

Leadership - deming philosophy, quality council, quality statements and strategic planning- customer satisfaction –customer perception of quality, feedback, customer complaints, service quality, kano model and customer retention – employee involvement – motivation, empowerment, team and teamwork, recognition & reward and performance appraisal-- continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – partnering, supplier selection, supplier rating and relationship development.

UNIT III TQM TOOLS & TECHNIQUES I **9**

The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II **9**

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM –Concepts, improvement needs – Performance measures- Cost of Quality – BPR.

UNIT V QUALITY MANAGEMENT SYSTEM **9**

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Apply TQM concepts in a selected enterprise.

CO2: Apply TQM principles in a selected enterprise.

CO3: Apply Six Sigma, Traditional tools, New tools, Benchmarking and FMEA

CO4: Apply Taguchi's Quality Loss Function, Performance Measures and applies QFD, TPM, COQ and BPR.

CO5: Apply QMS and EMS in any organization.

TEXT BOOKS

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third.
2. Joel.E. Ross, “Total Quality Management – Text and Cases”, Routledge.,2017.
3. Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth –Heinemann Ltd, 2016.

REFERENCE BOOKS

1. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, ThirdEdition, 2003.
2. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006.
3. Janakiraman. B and Gopal.R.K., “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd., 2006.
4. Mitra A., Fundamentals of Quality Control and Improvement,PHI, 2nd Ed., 1998.
5. D. C. Montgomery, Introduction to Statistical Quality Control, John Wiley & Sons, 3rd Edition.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO3	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO4	2	2	-	-	-	-	-	-	-	-	-	-	3	2
CO5	2	2	-	-	-	-	-	-	-	-	-	-	-	-
AVG	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MEPE42 SUPPLY CHAIN MANAGEMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To learn the critical facets of SCM and focusing on their interrelationships.
- To introduce the inventory management, logistics network management, strategic alliances and supplier relationship, Information Technology.
- To expose the customer-driven retail supply chain for efficient and effective distribution strategies.

UNIT I INTRODUCTION TO SUPPLY CHAIN MANAGEMENT **9**

Fundamentals of Supply Chain Management, Supply chain networks, integrated supply chain planning, and Decision phases in s supply chain, Supply chain models and modeling systems.

UNIT II SUPPLY CHAIN PLANNING **9**

Strategic, operational and tactical, Supply chain strategies, Supply chain drivers and obstacles, Strategic Alliances and Outsourcing, purchasing aspects of supply chain.

UNIT III SUPPLY CHAIN PERFORMANCE MEASUREMENT **9**

The balanced score card approach, Performance Metrics. Planning demand and supply, Demand forecasting in supply chain, aggregate planning in supply chain, Predictable variability. Supply Chain Inventory Management.

UNIT IV INVENTORY THEORY MODELS **9**

Economic Order Quantity Models, Reorder Point Models and Multi-echelon Inventory Systems, Relevant deterministic and stochastic inventory models and Vendor managed inventory models. Role of transportation in a supply chain: direct shipment, warehousing, cross docking; push vs. pull systems; transportation decisions (mode selection, fleet size), market channel structure, vehicle routing problem. Decisions in a supply chain, Mathematical Foundations of distribution management, Supply chain facility layout and capacity planning.

UNIT V STRATEGIC COST MANAGEMENT IN SUPPLY CHAINS **9**

The financial impacts, Volume leveraging and cross docking, global logistics and material positioning, global supplier development, target pricing, cost management enablers, Measuring service levels in supply chains, Customer Satisfaction.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explore the nuances of retail supply chain management.
CO2: Illustrate the integrative role of technology in driving the retail Supply chain
CO3: Demonstrate how to build a customer-driven retail supply chain for efficient.
CO4: Apply analytical tools and emerging technologies for effective Omni-channel.
CO5: Analyze the global logistics, material positioning and global supplier development.

TEXT BOOKS

1. David Simchi-Levi, Philip Kaminsky, and Edith Simchi-Levi, "Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies", 4th Edition, McGraw-Hill, 2022.
2. Christopher, M. "Logistics and Supply Chain Management: Strategies for Reducing Costs and Improving Services". London: Financial Times/Pitman, 2001.
3. Agarwal D.K. - A Text Book of Logistics and Supply chain management, Macmillan, 1st Ed, 2004.

REFERENCE BOOKS

1. Simchi-Levi, Kaminsky and Simchi-Levi, “Designing and Managing the Supply Chain”, McGraw-Hill Publication 2022.
2. Chopra, Meindl and. Kalra, “Supply Chain Management: Strategy and Analysis”, Pearson Education Asia.
3. Coyle, Bardi and Langley, “Management of Business Logistics: A Supply Chain Perspective”; Thomson Learning.
4. Ballou and Srivastava, “Business Logistics/SCM”, Pearson Education Publication.
5. Raghuram G. (I.I.M.A.) - Logistics and Supply Chain Management, Macmillan, 1st Ed.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	-
AVG	**3**	**2**	**2**	-	-	-	-	-	-	-	-	-	**2**	-

1-Low, 2 -Medium, 3– High, ‘-’ No correlation

24MEPE43 PRODUCT LIFE CYCLE MANAGEMENT

L T P C
3 0 0 3

COURSE OBJECTIVES

- To learn how a Product Lifecycle Management (PLM) system is used to structure and manage the information which guides the product during its lifecycle
- To identify different stakeholders, which both generates and consumes information related to the product and its manufacturing system over the lifecycle?
- To presents an overview of integration of PLM with other applications.

UNIT I INTRODUCTION TO PLM 9

Background, Overview, Need, Benefits, Concept of Product Life Cycle. Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement. Product Data and Product Workflow, Company’s PLM vision, The PLM Strategy, Principles for PLM strategy, Preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection, Change Management for PLM.

UNIT II PRODUCT DEVELOPMENT 9

Product Development Approaches: Bottom-up design, Top-down design, Front-loading design workflow, Design in context, Modular design. Concurrent engineering, partnership with supplier, collaborative and Internet based design, work structuring and team deployment, Product and process systemization, problem, identification and solving methodologies, improving product development solutions.

UNIT III PRODCUT MODELING 9

Product Modelling - Definition of concepts - Fundamental issues – Role of Process chains and product models -Types of product models – model standardization efforts-types of process chains - Industrial demands. Foundation technologies and standards (e.g. visualization, collaboration and enterprise application integration).

UNIT IV PRODUCT DATA MANAGEMENT 9

Product Data Management (PDM) –Benefits and Terminology, PDM functions, definition and architectures of PDM systems, product data interchange, portal integration, PDM acquisition and implementation. Information authoring tools (e.g., MCAD, ECAD, and technical publishing), Core functions (e.g., data vaults, document and content management, workflow and program management), Functional applications.

UNIT V INTEGRATION OF PLM WITH OTHER APPLICATIONS 9

Different ways to integrate PLM systems, Transfer file, Database integration, System roles, ERP, Optimization of ERP for PLM and CAD. Different ways to integrate PLM systems, Transfer file, Database integration, System roles, ERP, Optimization of ERP for PLM and CAD. PLM Softwares-Basic features and modules of ENOVIA and Wind chill.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain basic concepts of product life cycle management.
CO2: Demonstrate product development approaches.
CO3: Explain elements of product modelling.
CO4: Discuss in detail the concept of product data management.
CO5: Explore about integration of PLM with other applications.

TEXT BOOKS

1. Grieves, Michael. Product Lifecycle Management, McGraw-Hill, 2006.
2. Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006.
3. John, S., Product Lifecycle Management: Paradigm for 21st Century Product Realisation, Springer, 2019.

REFERENCE BOOKS

1. John, S., 2019, Product Lifecycle Management: Paradigm for 21st Century Product Realisation, Springer.
2. Saaksvuori Antti, ImmonenAnselmie, product Life Cycle Management Springer, Dreamtech, 3-540-25731-4
3. Antti, S., and Anselmi, I., 2005, Product Life Cycle Management, Springer
4. Udhayan Elongovan, Product Life Cycle Management (PLM), A Digital Journey using Industrial Internet of Things, CRC Press, 2020
5. Cecil B. Bozarth, Robert B. Handfield, Introduction to Operations and Supply Chain Management, 5th Edition, Pearson, 2019.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	2	-	2	-	-	-	-	-	-	-	-	-	2	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	2	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO5	-	-	2	-	-	-	-	-	-	-	-	-	2	-
AVG	2.3	2	2	-	-	-	-	-	-	-	-	-	2	-

1-Low,2 -Medium, 3– High, '-' No correlation

24MEPE44 STRATEGIC MANUFACTURING MANAGEMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce fundamental concepts of management and organization to students.
- To understand the various aspects of marketing, quality control and marketing strategies.
- To familiarize with the concepts of planning process and business strategies.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANISATION 9

Concepts of Management and organization- nature, importance and Functions of Management, Systems Approach to Management - Taylor's Scientific Management Theory- Fayal's Principles of Management- Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's Theory X and Theory Y-Hertzberg Two Factor Theory of Motivation-Leadership Styles, Social responsibilities of Management, designing organizational structures: basic concepts related to organization - departmentation and decentralization.

UNIT II MANUFACTURING STRATEGY FORMULATION 9

Strategic planning process-Manufacturing strategy formulation models (Wheelwright & Hayes, Skinner's framework)-Make or buy decisions-Facility planning and capacity strategy-Product-process matrix.

UNIT III PROJECT MANAGEMENT 9

Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path

Method (CPM), identifying critical path-Aggregate Planning and Master Production Scheduling (MPS)-Project Cost Analysis- Project Crashing (simple problems)-Shop Floor Control and Scheduling.

UNIT IV OPERATIONS STRATEGY AND PROCESS DESIGN 9

Lean manufacturing principles and tools -trends in global manufacturing - process and capacity analysis -shop floor control and scheduling-designing for manufacturing and Assembly (DFMA) -strategic supply chain design-computer-integrated manufacturing.

UNIT V STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES 9

Mission, goals, objectives, policy, strategy, programmes, elements of corporate planning process, environmental scanning, value chain analysis, SWOT analysis, steps in strategy formulation and implementation, generic strategy alternatives. Bench marking and balanced score Carda contemporary business strategies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Formulate organizational structure for a given context in the organization to carryout manufacturing operations.

CO2: Formulate manufacturing strategies aligned with corporate goals.

CO3: Utilize the project management.

CO4: Use operations strategy and process design.

CO5: Evaluate strategy for a business service organization.

TEXT BOOKS

1. Terry Hill, ‘Manufacturing Strategy: Text and Cases’, Palgrave Macmillan, 2000.
2. Lawrence RJauch, R.Guptaand William F. Glueck: Business Policy and Strategic Management Science, McGrawHill, 2012.
3. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2013.

REFERENCE BOOKS

1. ThomasN. Duening & John M. Ivancevich Management Principles and Guidelines, Biztantra,2007.
2. Kotler Philip and KellerKevinLane: Marketing Management, Pearson, 2021.
3. KoontzandWeihrich: Essentials of Management, McGraw-Hill, 2012.
4. SamuelC. Certo: Modern Management, 2012.
5. Krajewski, Ritzman, Malhotra, Operations Management: Processes and Supply Chains, Pearson, 2014.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	2	-
AVG	**3**	**2.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE45 PROCESS AND PRODUCT QUALITY IN ENGINEERING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To develop a clear knowledge in the basics of various quality concepts.
- To facilitate the students in understanding the application of control charts and its techniques.
- To familiarize students with quality management systems and standards.

UNIT I INTRODUCTION **9**

Quality Dimensions–Quality definitions–Inspection-Quality control–Quality Assurance–Quality Planning-Quality costs–Economics of quality– Quality loss function.

UNIT II CONTROL CHARTS **9**

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X, R and S charts, attribute control charts - p, np, c and u- Construction and application.

UNIT III STATISTICAL PROCESS CONTROL **9**

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT IV QUALITY MANAGEMENT SYSTEMS **9**

Introduction to ISO 9001:2015- Documentation, audits, and certification processes - Total Quality Management (TQM)- Six Sigma concepts: DMAIC, DPMO, sigma level - Continuous Improvement Models: Kaizen, PDCA.

UNIT V TOOLS FOR QUALITY IMPROVEMENT **9**

Seven basic quality tools: Cause-effect diagram, Pareto chart, Histogram, Control chart, Scatter diagram, Check sheet, Flowchart, Advanced tools: FMEA, QFD, Taguchi methods, Benchmarking, and Life Cycle Analysis (LCA).

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explore the role of quality in product and process design.
CO2: Apply statistical process control (SPC) tools to monitor and improve processes.
CO3: Analyze process capability and variation for continuous improvement.
CO4: Evaluate quality systems such as ISO 9001, Six Sigma, and TQM.
CO5: Use quality improvement tools for defect prevention and performance enhancement.

TEXT BOOKS

1. Amata Mitra "Fundamentals of Quality Control and improvement" Pearson Education.1998.
2. Bester field D.H., "Quality Control" Prentice Hall, 2011.
3. Joseph M. Juran & Joseph A. Defeo, 'Juran's Quality Handbook', McGraw Hill,1999.

REFERENCE BOOKS

1. Subburaj Ramasamy, Total Quality Management, McGraw Hill, 2017.
2. Kanishka Bedi, Quality Management, Oxford University Press,2006
3. Douglas C. Montgomery, Introduction to Statistical Quality Control, Wiley.
4. Balbir S. Dhillon, 'Quality control, reliability, and engineering design 'Taylor & Francis,1985.
5. D. C. Montgomery, Introduction to Statistical Quality Control, John Wiley & Sons, 3rd Edition.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	2	-	-	-	-	-	-	-	-	-	-	-
CO5	-	2	-	-	-	-	-	-	-	-	-	-	-	-
AVG	2.6	2.7	2.7	-	-	-	-	-	-	-	-	-	-	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE46 OPERATIONAL MANAGEMENT

L T P C
3 0 0 3

COURSE OBJECTIVES

- To study the role and importance of operation manager in an organization.
- To learn the analytical techniques for forecasting and scheduling of jobs and services.
- To study the six sigma quality standards and statistical control charts.

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT 9

Definition, need, responsibilities, key decisions of Operation Manager. Production vs

Operations Management. Operations as a key functional area in an organization. Operation Strategies-Definition, relevance, strategy formulation process, order qualifying and order winning attribute.

UNIT II MAINTENANCE MANAGEMENT **9**

Maintenance Management: Need of maintenance management, equipment life cycle (Bathtub curve), measures for maintenance performance (MTBF, MTTR, Reliability and Availability), and Reliability of Series and Parallel hardware products. Lean production: Definition of lean production, lean Demand Pull logic, waste in operations, elements that address elimination of waste, 2-card Kanban Production Control system.

UNIT III ANALYZING CAPACITY IN OPERATIONS **9**

Process Selection: Definition, Characteristics that influence the choice of alternative processes (volume and variety), type of processes- job shop, batch, mass and continuous, product- process design Matrix and Services design matrix, technology issues in process design, flexible manufacturing systems (FMS), and computer integrated manufacturing (CIM). Capacity Planning: Definition, measures of capacity (input and output), types of planning over time horizon. Decision trees analysis.

UNIT IV PRODUCTIVITY IMPROVEMENT IN OPERATIONS **9**

Forecasting-Definition, types, qualitative (grass roots, market research and delphi method) and quantitative approach (simple moving average method, weighted moving average and single exponential smoothing method and Holt Winter method), forecast error, MAD, MSE, MAPE, issues related with forecasting in services, basic idea of technology forecasting. Scheduling: Operation scheduling, goals of short term scheduling, job sequencing (FCFS, SPT, EDD, LPT, CR) & Johnson's rule on two machines, Gantt charts, examples of FCFS, SPT and LPT priority rules in banking and finance.

UNIT V ASSURING QUALITY IN OPERATIONS **9**

Statistical Quality control: Variations in process (common & assignable causes), Control charts: Variable measures (mean and range chart), Attribute measures (proportion of defects and no. of defects) using control tables, quality control in finance. Elementary Queuing Theory: the need of queuing theory in service and manufacturing operations, Poisson- Exponential Single Server Model with Infinite Population.(M/M/1 and M/M/2 queuing models).

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

- CO1: Explore the roles/functions of operation management.
- CO2: Develop skills to identify and solve operations management problems.
- CO3: Explain the basic concepts of consumer behaviour and its linkages to marketing.
- CO4: Analyse the phenomenon of consumer learning about a brand and forming perceptions.
- CO5: Compare how the theoretical aspects of consumer behaviour are practiced in real scenarios by marketers and brands.

TEXT BOOKS

1. F. Robert Jacobs, Ravi Shankar, Richard B. Chase, Operations and Supply Chain Management, Tata McGraw Hill, New Delhi, 2023.
2. Buffa, E.S., "Modern Production/Operations Management", 7th edition, John Wiley sons, 1983.
3. Krajervaki & Ritzman, "Operations management", Addison Wesley Pub. Co, 1987.

REFERENCE BOOKS

1. Jay Heizer, Amit Sachan, Chuck Munson and Barry Render, Operations management: Sustainability and Supply Chain Management, Pearson Education.
2. Adam,E.E and Ebert, Production & operations Management (latest edition), Prentice Hall of India, New Delhi.
3. Operations Research, P. K. Gupta, Man Mohan, KantiSwarup, (latest edition), Sultan Chand and Sons.
4. Heizer Jay and Render Barry (2017). Production & Operations Management, 12th ed., Pearson Education.
5. Fundamentals of Applied Statistics, S. C. Gupta and V. K. Kapoor, (latest edition), Sultan Chand and Sons.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	2	-	2	-	-	-	-	-	-	-	-	-	2	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	2	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO5	-	-	2	-	-	-	-	-	-	-	-	-	2	-
AVG	**2.3**	**2**	**2**	-	-	-	-	-	-	-	-	-	**2**	-

1-Low, 2 -Medium, 3– High, '-' No correlation

24MEPE47 PRODUCT INNOVATION AND STARTUP STRATEGY

L T P C
3 0 0 3

COURSE OBJECTIVES

- To educate the knowledge of creative intelligence essential for entrepreneurs
- To develop the creativity skills among the learners.
- To develop innovative business models for business.

UNIT I CREATIVITY 9

Definition- forms of creativity-essence, elaborative and expressive creativities- quality of creativity-existential, entrepreneurial and empowerment creativities – creative environment-creative technology- - creative personality and motivation.

UNIT II CREATIVE INTELLIGENCE 9

Convergent thinking ability – traits congenial to creativity – creativity training-criteria for evaluating creativity-credible evaluation- improving the quality of our creativity – creative tools and techniques - blocks to creativity- fears and disabilities- strategies for unblocking-designing creativity enabling environment.

UNIT III INNOVATION **9**

Definition- levels of innovation- incremental vs radical innovation-product innovation and process- technological, organizational innovation – indicators- characteristics of innovation in different sectors. Theories in innovation and creativity- design thinking and innovation-innovation as collective change-innovation as a system.

UNIT IV ENTREPRENEURSHIP **9**

Entrepreneurial mindset, motivations and behaviours- opportunity analysis and decision making- industry understanding - entrepreneurial opportunities- entrepreneurial strategies – technology pull/market push – product -market fit.

UNIT V INNOVATIVE BUSINESS MODELS **9**

Customer discovery-customer segments-prospect theory and developing value propositions-developing business models: elements of business models –innovative business models: elements, designing innovative business models- responsible innovation and creativity.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Acquire basics of creativity for developing new product.

CO2: Comprehend the significance of creative intelligence for business growth.

CO3: Recognize the requirement for Innovation in Industries.

CO4: Trained about applications of innovation in building successful ventures.

CO5: Develop innovative business models to effectively do the business efficiently.

TEXT BOOKS

1. S S Kankha, Creativity and Inovation in Entrepreneurship, Sultan Chand, 2021
2. Pradip N Khandwalla, Lifelong Creativity, an Unending Quest, Tata Mc Graw Hill, 2004.
3. Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.

REFERENCE BOOKS

1. Vinnie Jauhari, Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014.
2. Innovation Management, C.S.G. Krishnamacharyulu, R. Lalitha, Himalaya Publishing House, 2010.
3. Strategic Innovation: Building and Sustaining Innovative Organizations- Course Era, Raj Echambadi.
4. Trott, Paul, Innovation Management and New Product Development, Fifth Edition, Pearson, 2012
5. Ahmed, Pervaiz K. and D. Shepherd, Innovation Management, Prentice Hall, 2010.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	-	-	-	-	-	-	-	3	-	2	-
CO2	3	2	3	-	-	-	-	-	-	-	3	-	2	-
CO3	3	2	3	-	-	-	-	-	-	-	3	-	2	-
CO4	2	2	3	-	-	-	-	-	-	-	3	-	2	-
CO5	2	2	3	-	-	-	-	-	-	-	3	-	2	-
AVG	2.5	2	3	-	-	-	-	-	-	-	3	-	2	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE48 MAINTENANCE ENGINEERING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To acquaint the student with fundamental concept of Maintenance.
- To create an awareness for the need for maintenance policies.
- To impart the basic concepts in maintenance management and various maintenance policies.

UNIT I MAINTENANCE CONCEPT **9**

Need for maintenance - Challenges in maintenance - Objectives of maintenance – Maintenance organization- Scope of maintenance department- Maintenance management-Tero Technology-Five zero concept Maintenance performance measurement- Maintenance costs-Maintenance audit.

UNIT II MAINTENANCE POLICIES **9**

Planned vs unplanned maintenance-Preventive maintenance vs Breakdown maintenance-Predictive maintenance -Corrective maintenance-Opportunistic maintenance-Design out maintenance-Condition Based Maintenance (CBM)-Analysis of downtime-Repair time distribution (exponential, lognormal)- MTTR-System repair time-Maintainability prediction.

UNIT III MAINTENANCE LOGISTICS **9**

Proactive and Reactive maintenance-Minimum vs Extensive maintenance - Work order form - Maintenance planning - Maintenance scheduling - Spare parts control &inventory management - Human factors in maintenance-Maintenance crew size-Replacement models.

UNIT IV WEAR FAULT DIAGNOSIS **9**

Nondestructive and destructive testing-Shock pulse monitoring-Condition monitoring-Lubrication practices-Wear Debris Monitoring (WDM)-Vibration monitoring-Corrosion control-Signature analysis- Computerized Maintenance Management System-Use of Fault Trees.

UNIT V TOTAL PRODUCTIVE MAINTENANCE 9

TPM Philosophy-Chronic and sporadic losses- Six big losses- Overall Equipment Effectiveness-Autonomous Maintenance-TPM Pillars-Reliability prediction-MTBF, MTTF-Reliability of series & parallel systems Reliability Centered Maintenance.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Describe the evolution of maintenance strategies.
CO2: Analyse failure of equipment using appropriate tools.
CO3: Interpret the eight pillars of Total Productive Maintenance.
CO4: Make use of reliability to improve the maintenance.
CO5: Estimate the maintenance level of an equipment or organization.

TEXT BOOKS

1. Tanmoy Deb, "Maintenance Management and Engineering", Ane Books Pvt. Ltd., 2011.
2. E Balagurusamy, “Reliability Engineering”, McGraw Hill Education,(India) Pvt.Ltd, 2017.
3. Mishra.R.C. Pathak. K, "Maintenance Engineering and Management", Second Edition, PHI Learning, 2012.

REFERENCE BOOKS

1. Charles E.Ebeling, "An Introduction to Reliability and Maintaibaility Engineering", McGraw Hill Education (India) Pvt.Ltd, 2013.
2. Seiichi Nakajima, "Introduction to Total Productive Maintenance", Productivity Press, 1988.
3. Masaji Tajiri and Fumio Gotoh, "Autonomous Maintenance in seven steps", Productivity Inc., Oregon, 1999.
4. M. Ben – Daya, S.O. Duffuaa, A. Raouf, J. Knezevic, "Handbook of Maintenance Management and Engineering", Springer, 2009.
5. Davies, “Handbook of Condition Monitoring”, Chapman &Hall, 1996.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	-	-	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MEPE49 BUSINESS ECONOMICS AND FINANCIAL ANALYSIS **L T P C**
3 0 0 3

COURSE OBJECTIVE

- To introduce the foundational concepts of business structures, economic principles, and market systems.
- To explain the role of demand, supply, and elasticity in business decision-making.
- To analyze production processes, cost structures, and pricing strategies under different market conditions.

UNIT I INTRODUCTION **9**

Structure of business firm, theory of firm, types of business entities, limited liability companies, sources of capital for a company, non-conventional sources of finance. significance of economics, micro and macroeconomic concepts, concepts and importance of national income, inflation, money supply in inflation, business cycle, features and phases of business cycle. Nature and scope of business economics, role of business economist, multidisciplinary nature of business economics.

UNIT II DEMAND AND SUPPLY ANALYSIS **9**

Elasticity, types of elasticity, law of demand, measurement and significance of elasticity of demand, factors affecting elasticity of demand, elasticity of demand in decision-making, demand forecasting: characteristics of good demand forecasting, steps in demand forecasting, methods of demand forecasting. Determinants of supply, supply function & law of supply.

UNIT III PRODUCTION, COST, MARKET STRUCTURES & PRICING **9**

Factors of production, production function, production function with one variable input, two variable inputs, returns to scale, different types of production functions. Types of costs, short run and long run cost functions, nature of competition, features of perfect competition, monopoly, oligopoly, monopolistic competition. Types of pricing, product life cycle based pricing, break even analysis, cost volume profit analysis.

UNIT IV FINANCIAL ACCOUNTING **9**

Accounting concepts and conventions, accounting equation, double-entry system of accounting, rules for maintaining books of accounts, journal, posting to ledger, preparation of trial balance, elements of financial statements, and preparation of final accounts.

UNIT V FINANCAL ANALYSIS THROUGH RATIOS **9**

Concept of ratio analysis, liquidity ratios, turnover ratios, profitability ratios, proprietary ratios, solvency, leverage ratios (simple problems). Introduction to fund flow and cash flow analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completing this course, students will be able to:

CO1: Describe different types of business entities and their sources of finance.
CO2: Apply demand and supply concepts in real-life business scenarios.

CO3: Analyze production functions, cost behavior, and pricing under various market structures.
CO4: Prepare and interpret basic financial statements using accounting principles.
CO5: Use ratio analysis to evaluate a company's financial health and performance.

TEXT BOOKS

1. D.D. Chaturvedi, S.L. Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
2. Dhanesh K Khatri, Financial Accounting, Tata McGraw Hill, 2017.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, Managerial Economics, 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.

REFERENCES BOOKS

1. Paresh Shah, Financial Accounting for Management 2e, Oxford Press, 2015.
2. S.N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.
3. D. N. Dwivedi, Essentials of Business Economics, New Delhi, India: S. Chand Publishing, 2021.
4. H. L. Ahuja, Business Economics, 13th ed., New Delhi, India: S. Chand Publishing, 2020.
5. N. G. Mankiw, M. P. Taylor, and A. Ashwin, Business Economics, 2nd ed., London, UK: Pearson Education, 2020.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	-	-	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE50 OPERATIONS RESEARCH **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To classify and formulate real-life problem for modelling, solving and applying for decision-making.
- To study the formulation and various methods of solutions for linear programming, transportation, assignment , CPM and PERT problems
- To solve problems using dynamic programming method.

UNIT I INTRODUCTION TO OPERATIONAL RESEARCH **9**

Introduction to Operations Research, scope, phases-merits and limitations – concept of optimization. Theory of simplex methods to solve canonical and general LPP, Primal – Dual problem and its properties, dual simplex method, sensitivity analysis. Concept of goal programming.

UNIT II LINEAR PROGRAMMING 9

Dual theory and Sensitivity analysis-Transportation and assignment problems-Applications (Emphasis should be more on problems than theory).

UNIT III NETWORK ANALYSIS 9

Network analysis – drawing of arrow diagram – critical path method – calculation of critical path duration , total , free and independent floats , PERT problems; Inventory Theory , Deterministic models – purchase problem without and with shortages , with price breaks , production problem without shortages.

UNIT IV GAME THEORY 9

Decision under risk – expected money value criterion – decision trees – decision under uncertainty – minimax criterion; Theory of Games – pure and mixed strategies, Principles of dominance, graphical methods, simplex methods.

UNIT V DYNAMIC PROGRAMMING 9

Dynamic programming-Formulation-Invest problem-General allocation problem-Stage coach problem-Production Scheduling. Replacement problems-Capital equipment-Discounting costs-Group replacement. Inventory models-various costs- Deterministic inventory models-Economic lot size-Stochastic inventory models-Single period inventory models with shortage cost.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

- CO1: Analyse problems in engineering, management, or business environment, focusing on important details
- CO2: Formulate of real problems in terms of input-output-parameters relationships and identify the solution procedure.
- CO3: Comprehensive knowledge about different techniques of Operations Research.
- CO4: Differentiate the appropriate mathematical model.
- CO5: Apply the methods to solve different industrial and managerial problems.

TEXT BOOKS

1. H. A. Taha, operational research-An introduction, Macmillan, 1976
2. F. S. Hiller and G. J. Liebermann, Introduction to operational research (7th edition), 2017.
3. K. Sharma: Operations Research-Theory and applications, Macmillan.

REFERENCE BOOKS

1. B. E. Gillet, Introduction to operational research-A computer oriented algorithmic approach, McGraw Hill, 1989.
2. H. M. Wagner, Principles of operational research with applications to managerial decisions, PH, Inc, 1975.

3. Prem Kumar Gupta & D. S. Hira, Operations Research, S Chand publication.
4. F. S. Hiller & G. J. Leiberman: Introduction to Operations Research, McGraw Hill.
5. E. N. Barron "Game Theory an Introduction" John Wiley & Sons publication.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	-	-	-	-	-	-	-	-	-	2	3
CO2	3	2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	-	-	-	-	-	-	-	-	-	2	1
AVG	**3**	**2.6**	**2.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

1-Low,2 -Medium, 3– High, '-' No correlation

24MEPE51 ENERGY RESOURCES AND STORAGE TECHNIQUES **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To give the Indian and global energy scenario and various conventional energy sources.
- To explore the various bio, solar, wind, fuel cell energy technologies.
- To study the various types of energy storage devices and technologies and them comparison.

UNIT I CONVENTIONAL ENERGY SOURCES **9**

Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT II BIO ENERGY AND FUEL CELL TECHNOLOGY **9**

Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, Hydrogen fuel cells - alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell.

UNIT III RENEWABLE ENERGY SOURCES **9**

Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV ENERGY STORAGE **9**

Need for energy storage – types of energy storage – various forms of energy storage – mechanical– thermal - chemical– electrochemical – electrical - other alternative energy storage technologies – efficiency and comparison. Pumped air energy storage – compressed air energy storage – flywheel – sensible and latent heat storage – storage materials – performance evaluation – thermochemical systems.

UNIT V RECENT ENERGY STORAGE TECHNOLOGIES **9**

Thermochemical systems – batteries – types- charging and discharging – battery testing and performance, energy storage in micro grid– smart grid – energy conversion efficiency - battery management systems – EVBMS – Superconducting Magnetic Energy Storage (SMES), Super capacitors – MHD power generation.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Hydrogen production from water using electrolysis.
2. Experimentation on mini hydel power plant.
3. V-I characteristics of solar PV cells.
4. Performance testing on solar thermal flat plate collector.
5. Performance testing on solar thermal parabolic type collector.
6. Performance testing on solar thermal dish type collector.
7. Testing on PCM influenced heat pipe.
8. Testing on PCM influenced solar air cooler.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the Indian and global energy scenario and various conventional energy sources.
CO2: Explore the various bio-energy and fuel cell technologies.
CO3: Explain the various solar energy technologies and its applications.
CO4: Explore need and identify the suitable energy storage devices for applications.
CO5: Explain the basic characteristics of batteries for mobile and hybrid systems.

TEXT BOOKS

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, Graw Hill; First edition 2020.
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition 2011.
3. Rober Huggins, “Energy Storage: Fundamentals, Materials and Applications”, 2nd Edition, Springer, 2015.

REFERENCE BOOKS

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, Modeling and applications", Alpha Science Intl Ltd, 2015.
5. Ru-Shiliu, Leizhang, Sueliang Sun, "Electrochemical Technologies for Energy Storage and Conversion", Wiley Publications, 2012.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	2	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	2
AVG	**3**	**2.4**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.6**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE52 FUELS, COMBUSTION AND POLLUTION CONTROL TECHNIQUES **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To learn the types of fuels and compare the fuels in specific point.
- To study the principles of combustion and combustion equipment.
- To learn the thermodynamic process behind the combustion and level of emission standards.

UNIT I SOLID FUELS **9**

Solid fuel types - coal family - properties - calorific value - ROM, DMMF, DAF and bone dry basis - ranking - bulk & apparent density - storage - washability - coking & caking coals – renewable solid fuels - biomass - wood waste - agro fuels - manufactured solid fuels.

UNIT II LIQUID FUELS **9**

Liquid fuel types - sources - petroleum fractions - classification - refining - properties of liquid fuels - calorific value, specific gravity, flash & fire point, octane number, cetane number etc., - alcohols - tar sand oil - liquefaction of solid fuels.

UNIT III GASEOUS FUELS **9**

Gaseous fuel classification - composition & properties - estimation of calorific value - gas calorimeter. rich & lean gas - wobbe index - natural gas - dry & wet natural gas - stripped NG - Foul & Sweet NG - LPG - LNG - CNG - methane - producer gas - gasifiers - water gas - town gas - coal gasification - gasification efficiency - non - thermal route - biogas - digesters - reactions - viability - economics.

UNIT IV COMBUSTION: STOICHIOMETRY & KINETICS 9

Stoichiometry – mass basis & volume basis – excess air calculation – fuel & flue gas compositions - calculations – rapid methods – combustion processes – stationary flame – surface or flameless combustion – submerged combustion – pulsating & slow combustion explosive combustion. Mechanism of combustion – ignition & ignition energy – spontaneous combustion – flame propagation – solid, liquid & gaseous fuels combustion – flame temperature – theoretical, adiabatic & actual – ignition limits – limits of inflammability. Thermos chemistry - equilibrium combustion products. Low temperature combustion products – high temperature combustion products.

UNIT V EMISSION CONTROL METHODS 9

Emissions - emission index - corrected concentrations - control of emissions for premixed and non-prefixed combustion. Flue gas desulphurization, coal beneficiation, coal blending, efficiency improvement methods (CO_2 reduction)–super critical boilers, integrated gasification combined cycle power plant, carbon capture & storage (CCS).

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Conducting proximate analysis test on fuels.
2. Determination of Flash and Fire points of Liquid fuels/Lubricants using open cup apparatus.
3. Determination of Viscosity of Liquid lubricants and Fuels using Saybolt Viscometer.
4. Determination of calorific value of solid/liquid fuels using Bomb calorimeter.
5. Determination of calorific value of gaseous fuels using Junkers gas calorimeter.
6. Measurement of exhaust emissions from C.I. engine by given fuel.
7. Measurement of exhaust emissions from S.I. engine by given fuel.
8. Comparison of properties of synthesized fuel with conventional fuel.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Classify the fuels used for different purposes.
CO2: Examine the fuels at different conditions.
CO3: Summarize the fuels and its combustion levels.
CO4: Select the correct Equipment's on combustion techniques.
CO5: Illustrate the emission control at a standard rate.

TEXT BOOKS

1. Samir Sarkar, Fuels & Combustion, 2nd Edition, Orient Longman, 1990.
2. Sharma SP., Mohan Chander, Fuels & Combustion, Tata Mcgraw Hill, 1984.
3. Dunnivant, F.M. and Anders Elliot, A Basic Introduction to Pollutant Fate and Transport, Wiley Interscience, 2006.

REFERENCE BOOKS

1. Blokh A.G., Heat Transfer in Steam Boiler Furnace, Hemisphere Publishing Corpn, 1988.
2. Civil Davies, Calculations in Furnace Technology, Pergamon Press, Oxford, 1966.
3. Holman J.P., Thermodynamics, Fourth Edition, McGraw-Hill Inc., 1988.
4. B.I. Bhatt and S.M. Vora, Stoichiometry, 2nd Edition, Tata Mcgraw Hill, 2010.
5. Boubel, R.W., Fox, D.L., Turner, D.B. and Stern, A.C., Fundamentals of air pollution, Academic Press, New York, 1994, 3rd Edition.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	2	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**3**	**3**	**2**	-	-	-	-	-	-	-	-	**3**	**2**

1-Low,2 -Medium, 3– High, '-' No correlation

24MEPE53 COMPOSITE MATERIALS AND MECHANICS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To study the behavior of composite materials.
- To investigate the failure modes of composite materials.
- To understand the fracture mechanics of composite materials.

UNIT I INTRODUCTION **9**

Introduction and overview of composite materials and their need, Enhancement of properties, classification of composites, Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC), Properties of Unidirectional Long Fiber Composites, and Short Fiber Composites-Characteristics of composites-Application of composites.

UNIT II REINFORCEMENTS AND MATRIX MATERIALS **9**

Metallic, Polymer, Ceramic and Composite fibres, Whiskers and Particulates, Nano-fillers used in polymer composites. Reinforcement fibers, Woven fabrics and Non-woven random mats. Types of matrix: Commonly used Matrices (Metal matrix, Polymer matrix, Ceramic matrix, Inter-metallic matrix, Carbon-Carbon composites), Basic Requirements in Selection of constituents-Rule of mixture.

UNIT III PRODUCTION TECHNIQUES AND PROPERTIES 9

Processing of cast composites - XD process, Spray processes (Osprey Process, Rapid solidification processing), In-situ Dispersion Processes (Stir-casting & Compo casting, Screw extrusion), Liquid-metal impregnation technique (Squeeze casting, Pressure infiltration, Lanxide process). Hand lay-up processes – Spray up processes, Compression molding, Reinforced reaction injection molding, Resin transfer molding, Pultrusion, Filament winding, Injection molding.

UNIT IV MECHANICS OF COMPOSITE MATERIALS 9

Continuous fibres–iso-stress and iso-strain conditions, discontinuous fibres, Nature of stress vs. strain curves for different composite materials. Mechanical Properties: Mechanical testing of composites – tensile, flexure (3 point and 4 point bend tests), interfacial tests of laminates; Modes of fracture; Toughening mechanisms in composites-failure criterion, maximum stress, maximum strain, fracture mechanics of composites, sandwich construction.

UNIT V RECENT DEVELOPMENTS IN COMPOSITES 9

Self-healing composites, Molecular composites, Micro and Nanocomposites, Bio-composites, Left handed composites, Stiffer than stiff composites, Carbon / carbon composites (Advantages and limitations of carbon matrix).RC-Ferro cement-Nano cement composite- SIFCON-Polymer concretes.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Fabrication of a reinforced/laminated composite using hand lay-up process.
2. Study on the flexural properties of reinforced/laminated composites using three point bend fixture.
3. Tensile test on PMC.
4. Flammability test on PMC.
5. Moisture absorption test on PMC.
6. Preparation of metal matrix composites using casting technique.
7. Determine the hardness of MMCs.
8. Determine the density by using rule of mixture, Archemedic's principles and analytical methods. Comment by using graphical representation.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Describe the various types of composite materials.
CO2: Explain the matrix and reinforcement materials.
CO3: Utilize the various fabrication techniques of composite materials.
CO4: Clasify the mechanism of composite materials.
CO5: Discuss the recent advancement in composite materials.

TEXT BOOKS

1. Chawla K.K., Composite materials, Springer, New York, 2015.
2. Daniel and Ishai, “Engineering Mechanics of Composite Materials”, Oxford UniversityPress, 2005
3. Mathews F.L. and Rawlings R.D., Composite materials: Engineering and Science, Chapman and Hall, London, England, 1st edition, 1994.

REFERENCE BOOKS

1. Jones R.M., “Mechanics of Composite materialsMcGraw-Hill, Kogakusha Ltd., Tokyo, 1975.
2. Agarwal.B.D. and Broutman.L.J. “Analysis and Performance of fiber composites”, John- Wiley and Sons, 1980.
3. Michael W.Hyer, “Stress Analysis of Fiber-Reinforced Composite Materials”, McGraw Hill, 1999.
4. Mukhopadhyay.M, “Mechanics of Composite Materials and Structures”, University Press, India, 2004.
5. Mallick, P.K, Composite Materials Technology: Process and Properties, Hanser, New York, 1990.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	3
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	3
CO3	3	2	2	2	-	-	-	-	-	-	-	-	2	3
CO4	3	2	3	3	-	-	-	-	-	-	-	-	2	3
CO5	3	2	2	2	-	-	-	-	-	-	-	-	2	3
AVG	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MEPE54 WASTE TO ENERGY CONVERSION TECHNOLOGIES — L T P C 3 0 2 4

COURSE OBJECTIVES

- To introduce students to the different types of waste and their characterization.
- To develop students’ understanding of the principles behind the conversion processes.
- To equip students with the knowledge and skills to design and implement waste-to energy.

UNIT I WASTES — 9

Introduction and characterization of wastes, definition of waste, types of waste, properties analysis of waste, waste disposal methods.

UNIT II THERMOCHEMICAL CONVERSION — 9

Energy production through incineration, gasification, pyrolysis and syngas utilization.

Incineration: principle, advantages, and disadvantages; Gasification: principle, advantages, and disadvantages; Pyrolysis: principle, advantages, and disadvantages; Syngas utilization: principle, advantages, and disadvantages.

UNIT III ENERGY PRODUCTION FROM ORGANIC WASTES 9

Energy production through anaerobic digestion, fermentation, transesterification and introduction to microbial fuel cells. Anaerobic digestion: principle, advantages, and disadvantages; Fermentation: principle, advantages, and disadvantages; Transesterification: principle, advantages, and disadvantages; Introduction to microbial fuel cells: principle, advantages, and disadvantages.

UNIT IV ENERGY PRODUCTION FROM ALGAE 9

Cultivation of algal biomass from wastewater and energy production from algae. Algae cultivation: principle, advantages, and disadvantages; Energy production from algae: principle, advantages, and disadvantages; Applications of algae in waste management.

UNIT V ENERGY PRODUCTION FROM SOLID WASTES 9

Densification of solids, efficiency improvement of power plant and energy production from waste plastics. Densification of solids: principle, advantages, and disadvantages; Efficiency improvement of power plants: principle, advantages, and disadvantages; Energy production from waste plastics: principle, advantages, and disadvantages; Applications of waste plastics in energy generation.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Hydrogen production from water using electrolysis.
2. Preparation of bio fuels from agro waste by pelleting method.
3. Preparation of bio fuels from veg oil/ animal fat by esterification/ trans-esterification method.
4. Performance testing on updraft (TLUD) gasifier cook stove.
5. Estimation of carbon conversion efficiency of DDG/FBG/CFBG/EFG gasifier.
6. Performance testing of any one gasification system.
7. Performance testing of syngas from gasifier on CI/SI engines.
8. Measurement of exhaust emissions from syngas fuel.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Characterize different types of waste and understand the principles behind waste-to-energy conversion processes.

CO2: Analyze the suitability of different waste-to-energy conversion methods for specific waste types.

CO3: Analyze different type of organic waste-to-energy conversion techniques.

CO4: Apply practical experience in algae waste-to-energy conversion techniques.

CO5: Analyze different type of solid waste-to-energy conversion techniques.

TEXT BOOKS

1. Waste-to-Energy Technologies and Global Applications, Efstratios N. Kalogirou, CRC Press, Taylor & Francis Group, 2018
2. Bioenergy Research: Biomass Waste to Energy, Manish Srivastava, Neha Srivastava Rajeev Singh, Springer Publisher, 2023
3. Dutta, B. P. Parida, B. K. Guha and T. R. Surkrishnan. Industrial Solid Waste Management and Landfilling practice. Narosa Publishing House, New Delhi, 1999.

REFERENCE BOOKS

1. Rogoff, M. J. and Screve, F., "Waste-to-Energy: Technologies and Project Implementation", Elsevier Store, 2011.
2. Young G. C., "Municipal Solid Waste to Energy Conversion processes", John Wiley and Sons, 2010.
3. Harker, J. H. and Backhusrt, J. R., "Fuel and Energy", Academic Press Inc, 1981.
4. EL-Halwagi, M. M., "Biogas Technology - Transfer and Diffusion", Elsevier Applied Science, 1986.
5. Hall, D.O. and Overeed, R.P.," Biomass - Renewable Energy", John Willy and Sons. Mondal, P. and Dalai, A. K. eds., Sustainable Utilization of Natural Resources. CRC Press, 2017.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	2	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	2
AVG	**3**	**2.4**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.6**	**2**

1-Low,2 -Medium, 3– High, '-' No correlation

24MEPE55 REFRIGERATION AND AIR CONDITIONING

L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration & Air conditioning systems.
- To study the Vapor absorption and air refrigeration systems.

UNIT I INTRODUCTION 9

Introduction to refrigeration - unit of refrigeration and C.O.P. – Ideal cycles- refrigerants desirable properties – classification - nomenclature - ODP & GWP.

UNIT II VAPOUR COMPRESSION REFRIGERATION SYSTEM **9**

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

UNIT III OTHER REFRIGERATION SYSTEMS **9**

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

UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES **9**

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

UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION **9**

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

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Study of vapor compression refrigeration and vapor absorption refrigeration systems.
2. Study of Air conditioning system (window/ centralized).
3. Performance test on VCR system (R 12/ R22).
4. Performance test on HC refrigeration system (LPG/ NH_3).
5. Performance test on Air conditioning system (R 12/ R22).
6. Performance test on Air conditioning system (LPG/ NH_3).
7. Performance test on PCM influenced domestic cooler.
8. Performance test on solar powered Air conditioning system.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the basic concepts of Refrigeration.

CO2: Analyze Vapor compression Refrigeration systems parameters.

CO3: Test the various types of Refrigeration systems.

CO4: Calculate the Psychrometric properties and its use in psychrometric processes.

CO5: Evaluate the air conditioning system performance.

TEXT BOOKS

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010.
2. Textbook of Refrigeration And Air-Conditioning (M.E.)by R.S. Khurmi | 10 February 2019.
3. JonesW.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007.

REFERENCE BOOKS

1. Stoecker,W.F. and Jones J.W., Refrigeration and Air Conditioning, McGraw Hill, New Delhi,1986.
2. Roy J. Dossat, Principles of Refrigeration, 4th edition, Pearson Education Asia, 2009.
3. Rajput R.K., A Textbook of Refrigeration and Air-Conditioning, S.K. Kataria & Sons, 2013.
4. Manohar Prasad, Refrigeration and Air Conditioning, New Age International, 2004.
5. Ysen - Yao Sun, Air handling system design, McGraw–Hill, Inc., NY, 1994.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	2	-
AVG	2	2	2	-	-	-	-	-	-	-	-	-	2	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE56 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the functions and design principles of Jigs, and fixtures.
- To understand the functions and design principles of press tools.
- To gain proficiency in the development of required views of the final design.

UNIT I LOCATING AND CLAMPING PRINCIPLES **9**

Objectives of tool design- function and advantages of jigs and fixtures – basic elements – principles of location – locating methods and devices – redundant location – principles of clamping – mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

UNIT II JIGS AND FIXTURES **9**

Design and development of jigs and fixtures for given component- types of jigs – post, turnover, channel, latch, box, pot, angular post jigs – indexing jigs – general principles of milling, lathe, boring, broaching and grinding fixtures – assembly, inspection and welding fixtures – modular fixturing systems- quick change fixtures.

UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES **9**

Press working terminologies - operations – types of presses – press accessories – computation of press capacity – strip layout – material utilization – shearing action – clearances – press work materials – center of pressure- design of various elements of dies – die block – punch holder, die set, guide plates – stops – strippers – pilots – selection of standard parts – design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT IV BENDING AND DRAWING DIES **9**

Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

UNIT V FORMING TECHNIQUES AND EVALUATION **9**

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

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Design and model a locator.
2. Design and model a clamp.
3. Design and model a drill jig.
4. Design and model a milling fixture.
5. Design and model a grinding fixture.
6. Design and model a welding fixture.
7. Design and model a broaching fixture.
8. Design and model a modular fixture.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Review the different methods of Locating Jigs and Fixtures and Clamping principles.
CO2: Design the jigs and fixtures for given component.
CO3: Explain the press working terminologies and elements of cutting dies
CO4: Develop the Bending and Drawing dies
CO5: Confer the different types of forming techniques.

TEXT BOOKS

1. Joshi, P.H. "Jigs and Fixtures", Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2013.
2. Joshi P.H "Press tools - Design and Construction", wheels publishing, 1996.
3. Venkataraman. K., "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi, 2023.

REFERENCE BOOKS

1. Donaldson, Lecain and Goold "Tool Design", 5^{th} Edition, Tata McGraw Hill, 2017.
2. Hoffman "Jigs and Fixture Design", Thomson Delmar Learning, Singapore, 2004.
3. Kempster, "Jigs and Fixture Design", Third Edition, Hoddes and Stoughton, 1974.
4. Design Data Hand Book, PSG College of Technology, Coimbatore.
5. ASTME Handbook of Fixture design, 1960.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	2	-
AVG	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	**2**	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE57 PRODUCT DESIGN AND DEVELOPMENT

L T P C
3 0 2 4

COURSE OBJECTIVES

- To learn to know the necessity for a New Product by analysing the market trend.
- To select methodology and process for development.
- To understand make a prototype of a problem adhering to design principles to enhance manufacturability.

UNIT I PRODUCT DEVELOPMENT AND CONCEPT SELECTION 9

Product development process – Product development organizations- Identifying the customer needs – Establishing the product specifications – concept generation – Concept selection.

UNIT II PRODUCT ARCHITECTURE 9

Product architecture – Implication of the architecture – Establishing the architecture – Related system level design issues.

UNIT III INDUSTRIAL AND MANUFACTURING DESIGN **9**

Need for industrial design – Impact of industrial design – Industrial design process. Assessing the quality of industrial design- Human Engineering consideration - Estimate the manufacturing cost – Reduce the component cost – Reduce the assembly cost – Reduce the support cost – Impact of DFM decisions on other factors.

UNIT IV PROTOTYPING AND ECONOMIC ANALYSIS **9**

Principles of prototyping – Planning for prototypes - Elements of economic analysis – Base case financial model – Sensitivity analysis – Influence of the quantitative factors.

UNIT V MANAGING PRODUCT DEVELOPMENT PROJECTS **9**

Sequential, parallel and coupled tasks - Baseline project planning – Project Budget Project execution – Project evaluation- patents- patent search-patent laws international code for patents.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Identifying the customer needs for a selected product.
2. Plan for the design process.
3. Develop Engineering Specification.
4. Generate a concept for a product.
5. Develop a clay model for a new product.
6. Perform a design calculation.
7. Fabricate a prototype model of the new product as per the design.
8. Perform economic analysis for the new product.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Identify the need for a new product.
CO2: Design and develop various products.
CO3: Evaluate the cost of developing a product.
CO4: Make the prototype of product.
CO5: Patent the new design or the product.

TEXT BOOKS

1. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGrawHill, Fifth Edition, 2020.
2. Charles Gevirtz, Developing New products with TQM, McGraw – Hill International editions, 1994.
3. Kevin otto, Kristin wood, Product Design: Techniques in Reverse Engineering and New Product Development, Pearson education, 2003.

REFERENCE BOOKS

1. S. Rosenthal, Effective product design and development, Irwin 1992.
2. Harry Peck, Designing for Manufacture, Pitman Publishing, London, 1973.
3. Arlindo Silva, Ricardo Simoes, "Handbook of Research on Trends in Product Design and Development",Business Science Reference, 2011.
4. George E Deiter, Engineering Design, 5th Edition, McGraw-Hill , 2012 .
5. G, Dewhurst P and Knight W, Product Design for Manufacture and Assembly, 2nd Edition, Marcel Dekker, New York, 2002.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	-	2	2	-	-	-	-	-	-	-	-	-	2	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	2	-
CO5	-	2	2	-	-	-	-	-	-	-	-	-	2	-
AVG	**2.3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE58 ARTIFICIAL INTELLIGENCE IN MECHANICAL ENGINEERING — **L T P C: 3 0 2 4**

COURSE OBJECTIVES

- Understand the fundamentals of artificial intelligence and machine learning techniques.
- Apply AI/ML tools to solve complex problems in mechanical systems and processes.
- Analyze mechanical engineering problems using data-driven and intelligent algorithms.

UNIT I INTRODUCTION TO AI IN ENGINEERING **9**

Overview of Artificial Intelligence and Machine Learning - Role of AI in engineering and specifically in mechanical systems - Types of learning: Supervised, Unsupervised, Reinforcement - Python basics and tools for AI.

UNIT II MACHINE LEARNING IN MECHANICAL SYSTEMS **9**

Regression, Classification - Clustering and Dimensionality Reduction - Data preprocessing and feature extraction for mechanical data - Applications in structural analysis, thermal systems.

UNIT III AI IN DESIGN AND MANUFACTURING **9**

Design optimization using Genetic Algorithms, ANNs - Process planning, CNC and CAD/CAM integration - AI in Additive manufacturing and smart manufacturing - digital twin concepts and applications.

UNIT IV ROBOTICS AND INTELLIGENT CONTROL **9**

Introduction to robotics and sensors - Path planning, obstacle avoidance using AI - Fuzzy logic and neural networks for control - Autonomous systems and applications in mechanical domains.

UNIT V SMART MAINTENANCE SYSTEMS **9**

Vibration analysis, fault detection using ML - Case studies on rotating machinery and HVAC - Smart sensors and IoT integration - Real-time data analytics for maintenance.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Stress prediction via linear regression.
2. Fault classification in rotating machinery.
3. Thermal data clustering with k-means.
4. PCA for vibration data reduction.
5. Beam optimization using genetic algorithm.
6. Robot path planning via A* algorithm.
7. Fuzzy logic temperature control.
8. HVAC fault detection with smart sensors.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain basic AI concepts and their relevance to mechanical engineering.

CO2: Apply supervised and unsupervised learning techniques in mechanical engineering.

CO3: Utilize AI for predictive maintenance, fault detection, and design optimization.

CO4: Develop intelligent control systems for robotics and automation.

CO5: Implement machine-learning models using python in engineering case studies.

TEXT BOOKS

1. S. Rajasekaran, G. A. VijayalakshmiPai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, PHI Learning, 2004.
2. Kevin D. Dorf, Artificial Intelligence and Mechanical Systems, Springer.
3. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education.

REFERENCE BOOKS

1. TarekSobh, Innovations and Advanced Techniques in Computer and Information Sciences and Engineering, Springer, 2007.
2. J.S.R. Jang, C.T. Sun, E. Mizutani, Neuro-Fuzzy and Soft Computing, Pearson, 2015.
3. Jay Lee et al., Industrial AI: Applications with Sustainable Performance, Springer.
4. Matthew Kirk, Thoughtful Machine Learning with Python, O'Reilly.
5. Yegnanarayana B., Artificial Neural Networks, PHI Learning Verlag, 2005.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	-	-	-	-	-	-	-	-	2	3	2
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CO3	3	3	2	-	-	-	-	-	-	-	-	2	3	2
CO4	3	3	3	-	-	-	-	-	-	-	-	2	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	2	3	2
AVG	**3**	**2.8**	**2.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE59 CAD & CAE TOOLS **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To apply the fundamental concepts of computer graphics and its tools in a generic framework.
- To create and manipulate geometric models using curves, surfaces and solids.
- To apply concept of 3D modeling, visual realism and CAD standard practices in engineering design.

UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS **9**

Design process - Computer Aided Design – Computer graphics – co-ordinate systems- 2D and 3Dtransformations - Graphic primitives (point, line, circle drawing algorithms) - Clipping-viewing transformation. Standards for computer graphics.

UNIT II GEOMETRIC MODELING **9**

Surface Modeling – Surface Entities, Representation of Surface, Bezier Surface, B-Spline Surface and Coons Surface. Solid Modeling - Solid Entities, Solid Representation, Boundary Representation (B-Rep), Sweeps Representation, Constructive Solid Geometry (CSG).

UNIT III VISUAL REALISM AND CAD STANDARDS **9**

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 images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc.

UNIT IV FINITE ELEMENT ANALYSIS **9**

Historical Background – Weighted Residual Methods - Basic Concept of FEM – Variational Formulation of Boundary Value Problems – Ritz Method – Finite Element Modelling – Element, Equations – Linear and Higher order Shape functions – Bar, Beam Elements – Applications to Heat Transfer problems.

UNIT V NON-LINEAR ANALYSIS 9

Introduction to Non-linear problems - some solution techniques- computational procedure-material on -linearity-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.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Write a C++ programming to draw basic geometries using AutoCAD.
2. Write a C++ programming to scale the basic geometries using AutoCAD.
3. Write a C++ programming to model a 3D geometry using AutoCAD.
4. Evaluate the mass property for the basic 3D model.
5. Evaluate the properties of exported STEP file for the basic 3D model using modeling software.
6. Analyze deflection of the truss using analysis software.
7. Analyze deflection of the cycle frame using analysis software.
8. Perform the stress analysis for beam using analysis software.

TOTAL: 30 PERIODS

COURSE OUTCOMES

At the end of the course, the students would be able to

CO1: Discuss the fundamental concepts of computer graphics and its tools in a generic framework.

CO2: Create and manipulate geometric models using curves, surfaces and solids.

CO3: Discuss concept of 3D modelling, visual realism and standard CAD practices in engineering design.

CO4: Develop the mathematical models for one dimensional finite element problems and their numerical solutions.

CO5: Formulate solution techniques to solve non-linear problems.

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., New Delhi, 2012.
3. Kuang-Hua ChangKuang-Hua Chang, Product Design Modeling using CAD/CAE: The Computer Aided Engineering Design Series, Academic Press Inc, 2014.

REFERENCE BOOKS

1. William M Neumann and Robert F. Sproul "Principles of Computer Graphics", McGraw HillBook 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, Butterworth Heinemann, 2018.
5. Reddy,J.N. "Introduction to the Finite Element Method", 4th Edition, Tata McGrawHill,2018.

Mapping of COs with POs & PSOs

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2
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CO3	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	2	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE60 ALTERNATIVE FUELS FOR TRANSPORTATION **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To expose potential alternate fuels and their characteristics.
- To use appropriate synthetic fuels and fuel additives for better combustion characteristics.
- To utilize alcohol fuels effectively for lower emissions.

UNIT I INTRODUCTION **9**

Availability, suitability, properties, merits and demerits of potential alternative fuels – alcohols, biodiesel, hydrogen, liquefied petroleum gas, natural gas, biogas, fuel standards – ASTM & EN.

UNIT II SYNTHETIC FUELS **9**

Different synthetic fuels, Merits, and demerits, Dual, Bi-fuel and Pilot injected fuel systems, Fuel additives – types and their effect on performance and emission characteristics of engines, Flexi fuel systems, Ethers – as fuel and fuel additives, properties and characteristics.

UNIT III LIQUID FUELS **9**

Alcohols – Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission Characteristics in engines. Issues & limitation in alcohols.

UNIT IV GASEOUS FUELS **9**

Biogas, Natural gas, LPG, Hydrogen – Properties, problems, storage and safety aspects. Methods of utilisation in engines. Performance, combustion and emission characteristics in engines. Issues & limitation in Gaseous fuels.

UNIT V BIODIESEL **9**

Vegetable oils and their important properties. Fuel properties characterization. Methods of using vegetable oils – Blending, preheating, Transesterification and emulsification – Performance, combustion and emission characteristics in diesel engines. Third generation biofuels, Ternary and Quaternary fuels, Issues & limitation of using vegetable oils in IC engines.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Preparation of biodiesel from vegetable oil via transesterification.
2. Effect of catalyst type on biodiesel yield.
3. Optimization of methanol-to-oil ratio in biodiesel production.
4. Preparation of biodiesel using used cooking oil.
5. Effect of reaction temperature on biodiesel conversion.
6. Biodiesel production using alkaline vs. Acid catalysts.
7. Preparation and testing of emulsified biodiesel fuels.
8. Production of biodiesel from non-edible oil sources.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Expose potential alternate fuels and their characteristics.
CO2: Use appropriate synthetic fuels and fuel additives.
CO3: Utilise alcohol fuels effectively for lower emissions.
CO4: Elaborate on the utilisation of Bio-Diesel as a suitable fuel in CI engines.
CO5: Utilise different gaseous fuels and predict their performance and combustion characteristics.

TEXT BOOKS

1. Paul Richards & Jim Barker, Automotive Fuels Reference Book, Fourth Edition, SAE International, 2023.
2. Er. S.K. Gupta, A Textbook of Automobile Engineering, S Chand Publishing, 2020.
3. Devendra Vashist & Mukhtar Ahmad, Automobile Engineering, Dreamtech Press, 2020.

REFERENCE BOOKS

1. R.B. Gupta, Automobile Engineering, 10th Edition, Satya Prakashan, 2021.
2. Anup Goel & Siddu Patil, Automobile Engineering for BE Anna University R21 CBCS, Technical Publications, 2020.
3. Kirpal Singh, Automobile Engineering Vol. 1, Standard Publishers, 2014.
4. Jain K.K. & Asthana R.B., Automobile Engineering, Tata McGraw Hill Publishers, 2002.
5. Ganesan V., Internal Combustion Engines, Third Edition, Tata McGraw-Hill, 2012.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2	-	-	-	-	-	-	-	2	2	1
CO2	3	3	3	2	-	-	-	-	-	-	-	2	2	1
CO3	3	3	3	3	-	-	-	-	-	-	-	2	2	1
CO4	3	3	3	3	-	-	-	-	-	-	-	2	2	1
CO5	3	2	3	2	-	-	-	-	-	-	-	2	2	1
AVG	**3**	**2.6**	**2.8**	**2.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE61 BATTERY THERMAL MANAGEMENT SYSTEMS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To develop battery management algorithms for batteries with various parameters, modeling and charging requirements.
- To evaluate models using the range of simulation.
- To examine the design standards of a battery.

UNIT I INTRODUCTION **9**

Battery management system, cells & batteries, nominal voltage and capacity, c rate, energy and power, cells connected in series, cells connected in parallel, electrochemical and lithium ion cells, rechargeable cell, charging and discharging process, overcharge and undercharge, modes of charging.

UNIT II BATTERY MANAGEMENT SYSTEM REQUIREMENT **9**

BMS functionality, battery pack topology, BMS functionality, voltage sensing, temperature sensing, current sensing, BMS Functionality, High-voltage contactor control, isolation sensing, thermal control, protection, communication interface, range estimation, SOC estimation, Cell total energy and cell total power.

UNIT III DESIGN OF BATTERY MANAGEMENT SYSTEM **9**

Design principles of battery BMS, Effect of distance, load, and force on battery life and BMS, energy balancing with multi-battery system.

UNIT IV BATTERY CHARGE ESTIMATION **9**

Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Model based state estimation, Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium-ion aging: Positive electrode, Cell Balancing, Causes of imbalance, Circuits for balancing.

UNIT V MODELLING AND SIMULATION **9**

Equivalent-circuit models (ECMs), Physics-based models (PBMs), Empirical modelling approach, Physics-based modelling approach, simulating an electric vehicle, Vehicle range calculations, simulating constant power and voltage, Simulating battery packs.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the role of battery management system.
CO2: Recognize the requirements of Battery Management System.
CO3: Interpret the concept associated with battery charging / discharging process.
CO4: Calculate the various parameters of battery and battery pack.
CO5: Design the model of battery pack.

TEXT BOOKS

1. Bergveld, H.J., Kruijt, W.S., Notten, P.H.L "Battery Management Systems -Design by Modelling" Philips Research Book Series 2002.
2. Davide Andrea," Battery Management Systems for Large Lithium-ion Battery Packs" Artech House, 2010.
3. Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K. M.," Modern electric, hybrid electric, and fuel cell vehicles", CRC press, 2018.

REFERENCE BOOKS

1. Plett, Gregory L. Battery management systems, Volume I: Battery modeling. Artech House, 2015.
2. Plett, Gregory L. "Battery management systems, Volume II: Equivalent-circuit methods", Artech House, 2015.
3. Ru-shiliu, Leizhang, Xueliang sun, "Electrochemical technologies for energy storage and conversion", Wiley publications, 2012.
4. Pop, Valer, et al.," Battery management systems: Accurate state-of-charge indication for battery powered applications", Vol. 9. Springer Science & Business Media, 2008.
5. Xue, Q., Zhang, X., Teng, T., Zhang, J., Feng, Z. and Lv, Q., A comprehensive review on classification, energy management strategy, and control algorithm for hybrid electric vehicles. Energies, 2020.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	-	3	3
AVG	**3**	**3**	**2.6**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE62 STEAM GENERATOR TECHNOLOGY **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To educate the students on the types of boilers with their constructional and functional Significance.
- To understand the working and design of fuel preparation units and boilers.
- To introduce the concept of boiler design, emission aspects.

UNIT I INTRODUCTION **9**

Steam Cycle for Power Generation – Fuel Stoichiometry - Boiler Classification & Components – Specifications - Boiler Heat Balance – Efficiency Estimation (Direct & Indirect) – Sanke Diagram.

UNIT II FUELS AND BOILER **9**

Solid Fuel: coal preparation – pulverization – fuel feeding arrangements, fuel oil: design of oil firing system – components – air regulators, types of boilers – merits & limitations –specialty of fluid bed boilers – basic design principles (stoker, travelling grate etc).

UNIT III COMPONENTS DESIGN **9**

Furnace– Water Wall – Steam Drum – Attemperator –Super heaters – Reheaters – Air Preheaters – Economisers - Steam Turbines: Design Aspects of all these.

UNIT IV AUXILIARY EQUIPMENTS – DESIGN & SIZING **9**

Forced Draft & Induced Draft Fans – PA / SA Fans – Water Pumps (Low Pressure & High Pressure) – Cooling Towers – Softener – DM Plant.

UNIT V EMISSION ASPECTS **9**

Emission Control – Low NOx Burners– boiler blow down - control & disposal: feed water Deaeration & deoxygenation – reverse osmosis - ash handling systems design – ash disposal– chimney design to meet pollution standards – cooling water treatment & disposal.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the working of steam cycles and boiler efficiency estimation methods.
CO2: Compare different types of fuels and boilers based on design and performance.
CO3: Design key boiler components such as furnaces, steam drums, and super heaters.
CO4: Evaluate auxiliary systems like fans, pumps, and cooling towers for power plants.
CO5: Assess emission control and waste management in thermal power plants.

TEXT BOOKS

1. Tadashi Tanuma (Ed.), Advances in Steam Turbines for Modern Power Plants, Woodhead Publishing, 2022.
2. Vernon L. Eriksen, Heat Recovery Steam Generator Technology, Woodhead Publishing, 2017.
3. S. Can Gülen, Gas and Steam Turbine Power Plants, Cambridge University Press, 2023.

REFERENCE BOOKS

1. V. Ganapathy, Steam Generators and Waste Heat Boilers: For Process and Plant Engineers, Taylor & Francis, 2017.
2. Kameshwar Upadhyay, Steam Turbogenerator: Operation & Maintenance, Notion Press, 2019.
3. R.K. Purohit & R. Jaswal, Steam Turbines and Steam Power Plant, Scientific Publishers, 2020.
4. R. Yadav, Steam and Gas Turbines and Power Plant Engineering, 7th Edition, Central Publishing House, 2022.
5. V. Ganapathy, Industrial Boilers and Heat Recovery Steam Generators: Design, Applications, and Calculations, 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**
CO1	2	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	2	3	2	2	-	-	-	-	-	-	-	3	-
CO4	2	2	3	2	2	-	-	-	-	-	-	2	2	-
CO5	2	2	2	2	2	-	-	-	-	-	-	2	2	-
AVG	**2.4**	**2**	**2.2**	**1.6**	**1.6**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2.6**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE63 COMPRESSIBLE FLOW **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To familiarize with the differences between incompressible and compressible flows.
- To provide knowledge on various types of shocks.
- To impart knowledge on the effect of friction and heat transfer on compressible flows.

UNIT I FUNDAMENTALS OF COMPRESSIBLE FLOW **9**

Compressibility, Continuity, Momentum and energy equation for steady one dimensional flow compressible Bernoulli's equation-Calorically perfect gas, Mach Number, Speed of sound, Area – Mach number – Velocity relation, Mach cone, Mach angle, One dimensional Isentropic flow through variable area duct, Static and Stagnation properties, Critical conditions, Characteristic Mach number, Area-Mach number relation, Maximum discharge velocity.

UNIT II SHOCK AND EXPANSION WAVES **9**

Normal shock relations, Prandtl's relation-Hugoniot equation, Raleigh Supersonic Pitot tube equation-Moving normal shock waves, Oblique shocks, θ-β-M relation, Shock Polar, Reflection of oblique shocks, left running and right running waves-Interaction of oblique shock waves, slip line, Rayleigh flow, Fanno flow, Expansion waves, Prandtl-Meyer expansion, Maximum turning angle, Simple and non-simple regions, operating characteristics of Nozzles, under expansion, over expansion.

UNIT III TWO DIMENSIONAL COMPRESSIBLE FLOW **9**

Potential equation for 2-dimensional compressible flow, Linearization of potential equation, perturbation potential, Linearized Pressure Coefficient, Linearized subsonic flow, Prandtl Glauert rule, Linearized supersonic flow, Method of characteristics.

UNIT IV HIGH SPEED FLOW **9**

Critical Mach number, Drag divergence Mach number, Shock Stall, Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock expansion theory, wave drag, supersonic wings, Design considerations for supersonic aircrafts.

UNIT V CHARACTERIZATION OF HIGH SPEED FLOWS **9**

Shock-Boundary layer interaction, Wind tunnels for transonic, Supersonic and hypersonic flows, shock tube, Gun tunnels, Supersonic flow visualization, Introduction to Hypersonic Flows.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Analyze the compressible fluid flow problems.

CO2: Analyze about shock waves and expansion waves.

CO3: Analyze 2D compressible flows.

CO4: Apply the high-speed flow over airfoils and wings.

CO5: Analyze high-speed compressible flow.

TEXT BOOKS

1. Anderson, J. D, Modern Compressible Flow: With Historical Perspective McGraw-Hill Education; 3rd edition, 2003.
2. Yahya, S. M., "Fundamentals of Compressible Flow", New Age International Publishers, 2023.
3. Balachandran, P., "Fundamentals of Compressible Fluid Dynamics", PHI Learning.

REFERENCE BOOKS

1. Shapiro, A.H., "Dynamics and Thermodynamics of Compressible Fluid Flow", Ronald Press.
2. L.J. Clancy, "Aerodynamics" Sterling Book House, 2006.
3. Zucrow, M. J. and Anderson, J. D., Elements of Gas Dynamics, McGraw- Hill &Co., 1989.
4. Oosthuizen, P.H. and Carscallen, W.E., "Compressible Fluid Flow", Mc Graw-Hill Education
5. Hodge B.K, Koenig C, Compressible Fluid Dynamics with personal computer applications, 2015, 1st edition, Pearson Education India.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	2
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	2
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**3**	-	-	-	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE64 TURBO MACHINERY **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To study the energy transfer in rotor and stator parts of the turbo machines.
- To study the function of various elements of centrifugal fans and blowers.
- To evaluating the working and performance of centrifugal compressor.

UNIT I WORKING PRINCIPLES **9**

Introduction to turbo machines, classification of turbo machines, momentum, and moment of momentum theory applied to moving blades, change in total enthalpy and total pressure, velocity triangles for radial and axial flow turbo machines. Basic aerofoil theory applied to axial flow blades, non-dimensional performance parameters, specific speed, flow coefficient and head coefficient.

UNIT II STEAM AND GAS TURBINES **9**

Steam flow through nozzles, critical pressure ratio, and choking of nozzles, throat and exit areas for optimum discharge, impulse and reaction stage, flow of steam through turbine blades, velocity diagrams, stage and other efficiencies, condition for maximum efficiency of a single stage turbine, compounding of steam turbines. Axial flow gas turbines, Turbine characteristics and performance, simple design calculations.

UNIT III CETRIFUGAL AND RECIPROCATING COMPRESSOR **9**

Compressor components and their function, the compression process, work required, polytropic efficiency, pressure rise, slip, effect of blade shape, two dimensional flow through impeller, vaned diffuser and volute casing, surging and choking of compressors, compressor performance and characteristic curves, simple design calculation.

UNIT IV AXIAL FLOW COMPRESSOR **9**

Cascade analysis, vortex theory, work required, polytropic efficiency, pressure rise, degree of reaction, simple design calculations, surging and stalling of compressors, compressor performance and characteristic curves.

UNIT V FANS AND BLOWERS **9**

Classification, construction and power requirement, pressure rise, efficiency calculations, applications in boilers, cooling towers, reversible fans and blowers, and other industrial applications, simple design calculations.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the energy transfer in rotor and stator parts of the turbo machines.
CO2: Enumerate the function of various elements of centrifugal fans and blowers.
CO3: Evaluate the working and performance of centrifugal compressor.
CO4: Analyze flow behavior and flow losses in axial flow compressor.
CO5: Understand the types and working of axial and radial flow turbines.

TEXT BOOKS

1. Yahya, S.M., "Turbines, Compressor and Fans", 4th Edition, Tata McGraw Hill, 2017.
2. Ganesan, V., "Gas Turbines", 3rd Edition, Tata McGraw Hill, 2011.
3. Dixon, S.L., "Fluid Mechanics and Thermodynamics of Turbomachinery", 7th Edition, Butterworth- Heinemann, 2014.

REFERENCE BOOKS

1. Gopalakrishnan. G and Prithvi Raj. D," A Treatise on Turbomachines", Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.
2. Lewis, R.I., "Turbomachinery Performance Analysis" 1st Edition, Arnold Publisher, 1996.
3. Saravanamutto, Rogers, Cohen, Straznicky., "Gas Turbine Theory" 6th Edition, Pearson Education Ltd, 2009.
4. Venkanna, B.K., "Fundamentals of Turbomachinery", PHI Learning Pvt. Ltd., 2009.
5. R.K.Turton, Principles of Turbomachinery, Second Edition, Chapman & Hall.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	2	2	2	-	-	-	-	-	-	-	-	-	3	2
AVG	2	2	2	-	-	-	-	-	-	-	-	-	3	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE65 CRYOGENIC ENGINEERING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To builds a solid foundation in the fundamentals of cryogenics.
- To encourage a "hand's – on" approach to solving cryogenic problems.
- To provide update cryogenic information.

UNIT I FUNDAMENTALS OF CRYOGENICS **9**

Insight on Cryogenics, Properties of Cryogenic fluids, Material properties at Cryogenic Temperatures. Applications of Cryogenics - Space Programs, Superconductivity, Cryo Metallurgy, Medical applications.

UNIT II CRYOGENIC CYCLES **9**

Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles. Inversion Curve- Joule Thomson, Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claude Cycle Dual

Pressure Cycle, Ortho-Para hydrogen conversion, Critical Components in Liquefaction Systems.

UNIT III SEPARATION OF CRYOGENIC GASES 9

Binary Mixtures, T-C and H-C Diagrams, principle of rectification, rectification column analysis-McCabe thiele method, adsorption systems for purification.

UNIT IV CRYOGENIC COOLERS AND REFRIGERATORS 9

Joule-Thomson (J.T.) Cryocoolers, Stirling Cycle Refrigerators, Gifford-McMahon (G.M.) Cryocoolers, pulse tube refrigerators regenerators used in cryogenic refrigerators, magnetic refrigerators.

UNIT V INSTRUMENTATION IN CRYOGENICS 9

Cryogenic Dewar, cryogenic transfer lines. Insulations in cryogenic systems, different types of vacuum pumps, instruments to measure flow, level and temperature.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Recall the material properties at cryogenic temperature.
CO2: Estimate the performance of liquefaction cycle.
CO3: Analyze the cryogenic separation rectification column.
CO4: Discuss the working principle of cryogenic refrigerator.
CO5: Discuss the various vacuum pumps and instruments used in handling of cryogens.

TEXT BOOKS

1. Scott R.B., “Cryogenic Engineering”, Van Nostrand and Co., 1988.
2. Robert W. Vance, “Cryogenic Technology”, John Wiley & Sons, Inc., New York, London, 1969.
3. Mamata Mukhopadhyay, “Fundamentals of Cryogenic Engineering”, Prentice Hall of India.

REFERENCE BOOKS

1. Klaus D. Timmerhaus and Thomas M. Flynn, “Cryogenic Process Engineering”, Plenum Press NewYork, 1989.
2. Mukhopadhay Mamata, “Fundamentals of cryogenic engineering”, PHI learning, 2010.
3. Pipkov, "Fundamentals of Vacuum Engineering", Meer Publication.
4. Randall F. Barron, "Cryogenics Systems", Second Edition Oxford University Press New York, Clarendon Press, Oxford, 1985.
5. Thomas Flynn, “Cryogenic Engineering”, Revised and Expanded, CRC Press, 2004.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	-
CO3	3	2	3	2	-	-	-	-	-	-	-	-	3	-
CO4	3	2	3	2	-	-	-	-	-	-	-	-	3	-
CO5	3	2	3	2	-	-	-	-	-	-	-	-	3	-
AVG	**3**	**2.4**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE66 BOILERS AND ACCESSORIES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the fundamental principles of boiler operation and classifications.
- To analyze the construction and working of various types of boilers and their components.
- To learn the performance parameters and efficiency improvement methods of boilers.

UNIT I INTRODUCTION TO BOILERS **9**

Definition and classification of boilers - Applications of boilers - Comparison of fire tube and water tube boilers - Essential parts of a boiler - Boiler terminologies - Selection of a boiler.

UNIT II TYPES OF BOILERS **9**

Construction and working of: Cochran boiler, Lancashire boiler, Locomotive boiler, Babcock and Wilcox boiler, High-pressure boilers: Lamont, Benson, Loeffler, Velox.

UNIT III BOILER MOUNTINGS AND ACCESSORIES **9**

Boiler mountings: water level indicator, pressure gauge, safety valve, steam stop valve, blow-off cock, etc. Boiler accessories: economizer, air preheater, super heater, feed pump, injector - Differences between mountings and accessories.

UNIT IV PERFORMANCE OF BOILERS **9**

Evaporation capacity - Equivalent evaporation - Boiler efficiency - Heat balance sheet of a boiler - Factors affecting boiler performance.

UNIT V BOILER MAINTENANCE AND REGULATIONS **9**

Boiler inspection and maintenance procedures - Common boiler failures and troubleshooting - Boiler operation safety - Indian Boiler Regulation (IBR) - Energy conservation in boiler operation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the working of different types of boilers used in industries.
CO2: Identify the functions of boiler mountings and accessories.
CO3: Calculate boiler efficiency and analyze performance characteristics.
CO4: Describe various maintenance, inspection, and safety measures for boilers.
CO5: Interpret Indian boiler regulations and standards.

TEXT BOOKS

1. R.S. Khurmi & J.K. Gupta – A Textbook of Thermal Engineering, S. Chand & Company, 2022 Edition.
2. P.K. Nag – Engineering Thermodynamics, Tata McGraw Hill Education, 2021 Edition.
3. R.K. Rajput – Thermal Engineering, Laxmi Publications, 2023 Edition.

REFERENCE BOOKS

1. G.K. Rajan – Steam Boilers, New Age International, 2020 Edition.
2. T.D. Eastop & A. McConkey – Applied Thermodynamics for Engineering Technologists, Pearson Education, 2022 Edition.
3. R.S. Khurmi – Steam Tables, S. Chand & Company, 2021 Edition.
4. V. Ganeshan – Power Plant Engineering, Tata McGraw Hill Education, 2023 Edition.
5. M.L. Mathur & F.S. Mehta – Thermal Engineering, Jain Brothers, 2022 Edition.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	2	-	-	-	-	-	-	-	-	3	-
CO2	3	2	2	2	-	-	-	-	-	-	-	-	3	-
CO3	3	2	3	2	-	-	-	-	-	-	-	-	3	-
CO4	2	2	3	2	-	-	-	-	-	-	-	-	3	-
CO5	2	2	2	2	-	-	-	-	-	-	-	-	3	-
AVG	**2.6**	**2**	**2.4**	**2**	-	-	-	-	-	-	-	-	**3**	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE67 PUMPS, BLOWERS AND COMPRESSORS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To develop knowledge about turbo machinery and its working principles.
- To formulate analysis of compressors, centrifugal blowers and testing of fans.
- To expose the students to basic principles of working of hydraulic machineries and to design centrifugal and reciprocating pumps.

UNIT I INTRODUCTIONS **9**

Introduction to turbo machines - Transfer of energy to fluids - Performance characteristics - fan laws - Dimensionless parameters - Specific speed - selection of centrifugal, axial, and mixed flow machines.

UNIT II ANALYSIS OF CENTRIFUGAL BLOWERS AND FANS **9**

Centrifugal Blowers: Theoretical characteristic curves, Eulers characteristics and Eulers velocity triangles, losses and hydraulic efficiency, flow through impeller inlet volute, diffusers, leakage disc friction mechanical losses multi vane impellers of impulse type, cross flow fans.

UNIT III ANALYSIS OF COMPRESSOR **9**

Rotor design airfoil theory, vortex theory, cascade effects, degree of reaction, blade twist stage design, surge and stall, stator and casing, mixed flow impellers.

UNIT IV TESTING AND CONTROL OF FANS **9**

Fan testing, noise control, materials and components blower regulation, speed control, throttling, control at discharge and inlet.

UNIT V APPLICATIONS **9**

Applications of blowers induced and forced draft fans for air conditioning plants, cooling towers, ventilation systems, booster systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the concept of turbo machineries.
CO2: Explain the working principles, analysis of fans, centrifugal blowers.
CO3: Examine the centrifugal compressors.
CO4: Analyze the fan controlling over specific application.
CO5: Exploring various applications of turbo machineries.

TEXT BOOKS

1. Earl Logan Jr., "Ramendra Roy, Handbook of Turbomachinery", Second Edition, Marcel Dekker, Inc, New York, 2003.
2. S.M. Yahya, "Turbines, Compressors and Fans", Tata McGraw-Hill Education, 2023.
3. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.

REFERENCE BOOKS

1. C.N.Jayapragasan, M.Sai Phani Deep Kumar, Dr.K.Janardhan Reddy, "Redesign and Validation of an Industrial Blower", Engineering, Environmental Science 2014.
2. Brunoeck, "Fans", Pergamon Press, 1973.
3. Austin H. Church, "Centrifugal pumps and blowers", John Wiley and Sons, 1980.
4. Dixon, "Fluid Mechanics, Thermodynamics of turbomachinery", Pergamon Press, 1984.
5. Stepanoff A.J., "Turbo blowers", John Wiley & Sons, 1970.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	-
AVG	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE68 POWER PLANT ENGINEERING

L T P C
3 0 0 3

COURSE OBJECTIVES

- To know the basics of various power plants like steam, hydroelectric, nuclear and diesel power plant.
- To solve problems related to power developed.
- To analysis the power plant economics.

UNIT I COAL BASED THERMAL POWER PLANTS 9

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

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Diesel Power Plant-Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air-starting equipment, lubrication and cooling system – super charging. GAS TURBINE PLANT: Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison. Direct energy conversion: Thermo electric and Thermo ionic, MHD generation.

UNIT III NUCLEAR POWER PLANTS 9

Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation. Types of reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

UNIT IV POWER FROM RENEWABLE ENERGY 9

Waterpower – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spillways. Hydro projects and plant: Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants. Power from non-conventional sources: Utilization of Solar- Collectors- Principle of Working, Wind Energy – types – HAWT, VAWT -Tidal Energy.

UNIT V POWER PLANT ECONOMICS **9**

Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor– related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Identify the different components of the steam power plant for power production.

CO2: Illustrate the component used in the diesel and gas power plant for power production.

CO3: Explore how the nuclear power plants produce the power.

CO4: Emphasize the fundaments of non-conventional power plants.

CO5: Analyze power plant economics and implementation of pollution standards and control of pollution caused by the power plants.

TEXT BOOKS

1. Nag. P.K., "Power Plant Engineering", 4th Edition, Tata McGraw – Hill Publishing Company Ltd., 2017.
2. Rajput R.K., A Textbook of Power Plant Engineering, Laxmi Publications, 2016.
3. Yadav R., Fundamental of Power Plant Engineering, Central Publishing House Allahabad, 2011.

REFERENCE BOOKS

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.
4. Domkundwar, S., Power Plant Engineering, Dhanpat Rai & Sons, 1988.
5. Dipak Kumar Mandal, Somnath, Power Plant Engineering, As per AICTE: Theory and Practice.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	-	-	-	-	-	-	-	-	2	2
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	2	-	-	-	-	-	-	-	-	2	2
CO5	3	2	2	2	-	-	-	-	-	-	-	-	2	2
AVG	**3**	**2.4**	**2.4**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.4**	**2**

1-Low, 2 -Medium, 3– High, '-' No correlation

24MEPE69 ENERGY AUDIT AND MANAGEMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand Energy Audit procedure along with relevant technologies/ tools.
- To recognize Energy Conservation measures undertaken across different user segments using case studies.
- To extend Energy Audit Report writing skills.

UNIT I ENERGY AUDIT METHODOLOGY **9**

Need of energy audit and management, definition and objective of energy management, general principles of energy management. Energy management skills, energy management strategy. economics of implementation of energy optimization projects, it's constraints, barriers and limitations, energy audit definition as per EC act-2001, Objective, need and types of energy audit, benchmarking. Roll of BEE, energy auditors and managers. Project management and financial analysis technique with examples: critical path method, pert analysis. Energy monitoring & targeting: definition, key elements, CUSUM analysis.

UNIT II FINANCIAL ANALYSIS **8**

Simple Payback, IRR, NPV, discounted cash flow; report writing, preparations and presentations of energy audit reports, post monitoring of energy conservation projects, MIS, case-studies / report studies of energy audits. Guidelines for writing energy audit report, data presentation in report, findings recommendations, impact of renewable energy on energy audit recommendations. Instruments for audit and monitoring energy and energy savings, types and accuracy. Case studies of implemented energy cost optimization projects in electrical utilities as well as thermal utilities.

UNIT III ENERGY CONSERVATION IN ELECTRICAL SYSTEM **9**

T & D Losses, losses in transformers and their reductions and efficiency improvement, loading efficiency calculations, parallel operations, demand side management (DSM), load management, energy efficient motors, and energy saving during starting, soft starters, automatic power factor controllers, variable speed drivers, energy conservation in lighting system. LED lighting and its trends and approaches. Different case study of electrical energy audit and management of commercial and industrial sites/projects.

UNIT IV ENERGY EFFICIENCY PERFORMANCE ANALYSIS OF THERMAL SYSTEMS **9**

Study of steam system, types of boiler with energy efficiency performance analysis, types of furnace with energy efficiency performance analysis, types of insulation and refractory with energy efficiency performance analysis, types of heat exchanger with energy efficiency performance analysis, types of turbines with energy efficiency performance analysis. Case study of energy audit & management in industries

UNIT V AUDIT OF MECHANICAL UTILITIES **9**

Pumps, types and application, parallel and series operating pump performance. Energy saving in pumps & pumping systems. Blower types & application, its performance assessment, series & parallel operation applications & advantages. Energy saving in blowers & applications, energy saving in compressors & compressed air systems, cooling towers, its types and performance assessment & limitations, water loss in cooling tower. Energy saving in cooling towers.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Identify the energy management skills and strategies in the energy management system.

CO2: Find out the payback period, depreciation cost for a given energy conservation equipment & projects.

CO3: Examine energy conservation in electrical systems.

CO4: Conduct energy auditing in thermal unit.

CO5: Explore energy conservation skills in mechanical unit.

TEXT BOOKS

1. Murphy, W. R.," Energy Management" 1^{st} edition, Elsevier India Private Limited, 2007.
2. De, B. K., "Energy Management audit & Conservation", 2^{nd} Edition, Vrinda Publication, 2010.
3. Turner, W. C., Doty, S. and Truner, W. C., "Energy Management Hand book", 7^{th} edition, Fairmont Press., 2009.

REFERENCE BOOKS

1. Energy Manager Training Manual by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.
2. L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation", 1^{st} edition, Hemisphere Publication, Washington, 1988.
3. Elias P. Gyftopoulos, "Industrial Energy Conservation Manuals", 1^{st} edition MIT Press, 1982.
4. Patrick, Patrick, Fardo, "Energy Conservation guide book", 1^{st} edition Prentice hall, 1993.
5. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	2
AVG	3	3	3	-	-	-	-	-	-	-	-	-	3	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE70 THERMAL AND FIRED EQUIPEMENT DESIGN **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the concepts of thermal and fired equipment.
- To study the basis, design and construction of boilers.
- To study of typical fuel firing systems in the boiler.

UNIT I INTRODUCTION **9**

Principal equipment in Thermal Power Plant, Historical developments of Boiler, Utility, Industrial boilers, Modern trends in boiler design , Basic knowledge of different types of Thermal Fired Equipment ,sub critical and super critical boilers - Coal , Oil ,Gas , Pulverised fuel cyclone, FBC, CFBC , MSW , and Stoker firing, Boiler efficiency , auxiliary power consumption , Performance data , Performance Correction Curves.

UNIT II BASIS OF BOILERS AND DESIGN **9**

Codes - Design and Construction, IBR, ISO, ASME, BS, Heat balance diagram, Boiler parameters, Fuel analysis and variations, Site conditions, Furnace heat loadings, FOT, plan area loading, volumetric loading balanced draft and pressurized furnace, natural / controlled circulation, constant and sliding pressure, boiler heat transfer surfaces, flue gas velocities, boiler auxiliaries, boiler schemes, boiler layouts.

UNIT III FIRING SYSTEM- FUEL AND MILLING **9**

Coal / oil / natural gas in any combination, lignite, blast furnace gas / coke oven gas / corex gas carbon monoxide / tail gas, asphalt, black liquor, bagasse, rice husk, Washery rejects, wheat / rice straw MSW, wind box, Burner, Type of Stokers, Pulverizes - Bowl mill, Tube mill, Direct firing, Indirect firing, Wall firing (Turbulent / Vortex Burners), Tangential firing (Jet Burners), Fire Ball.

UNIT IV PRESSURE PARTS AND DESIGN AND MATERIALS **9**

Economiser, drums , water walls , headers , links , super hater , super heaters , reheaters, tubes , spiral tubes , surface area , free gas area , metal temperature , LMTD , acid due point temperature , carbon steel , low alloy steel , titanium alloy steel.

UNIT V BOILER AUXILIARIES **9**

Air preheaters (APH) – bi sector APH , tri sector APH, cold PA system, hot PA system, Tubular APH, steam coil air preheater , FANS – axial, radial, performance curves, MILLS- tube , vertical mills , air quality control systems , dust collection system - mechanical precipitator, electrostatic precipitator, FGD , SCR , SNCR

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the concepts of thermal and fired equipment.
CO2: Use the basis, design and construction of boilers.
CO3: Describe of typical fuel firing systems in the boiler.
CO4: Enumerate the materials requirements for pressure parts.
CO5: Analysis of various boiler auxiliaries system.

TEXT BOOKS

1. Ballaney. P, Thermal Engineering, 25^{th} Edition, Khanna Publishers, 2017.
2. Mahesh. M. Rathore, "Thermal Engineering", 1^{st} Edition, Tata McGraw Hill, 2010.
3. Elwakil M, Power Plant Technology, McGraw Hill, New York, 1964.

REFERENCE BOOKS

1. Ganapathy V., Steam Generators and Waste Heat Boilers: For Process and Plant Engineers (Mechanical Engineering), CRC Press; 1^{st} edition, 2017.
2. Steam Generators: Description and Design by Donatello Annaratone, Springer-Verlag Berlin and Heidelberg GmbH & Co. K 2008.
3. An Introduction to Coal and Wood Firing Steam Generators (Power Plants Engineering) by J Paul Guyer.
4. Advances in Power Boilers (JSME Series in Thermal and Nuclear Power Generation) by Mamoru Ozawa and Hitoshi Asano 28 January 2021.
5. Kays, W.M. and London, A.L., Compact Heat Exchangers, McGraw-Hill, 1998.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	-	-	-	-	-	-	-	-	3	2
CO2	2	3	3	3	-	-	-	-	-	-	-	-	3	2
CO3	2	3	3	3	-	-	-	-	-	-	-	-	3	2
CO4	2	3	3	3	-	-	-	-	-	-	-	-	3	2
CO5	2	3	3	3	-	-	-	-	-	-	-	-	3	2
AVG	**2**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE71 SAFETY AND RELIABLITY ENGINEERING **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To give knowledge on safety education & training evaluation of safety performance in an organization.
- To provide knowledge on accident reporting & investigation procedure.
- To demonstrate the ability to design and implement reliability principles.

UNIT I INTRODUCTION 9

Overview of factories act 1948 – ISO-45001, Evolution of modern safety concept- Safety management functions - safety policy - Safety Organization - Safety Committee - budgeting for safety - Behaviour based Safety, Safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign.

UNIT II ACCIDENT, FIRE PREVENTING AND RISK ANALYSIS 9

Concept of an accident, reportable and non-reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – cost of accident, Fire triangle- Types of fire - first aid firefighting equipment – flammability limit- LPG safety - Hazard identification and Risk Analysis.

UNIT III INDUSTRIAL SAFETY 9

machine guarding, guarding of hazards, machine guarding types and its application – safety in welding and gas cutting – safety in manual and mechanical material handling- safety in use of electricity, toxicity- TLV- types of chemical hazards-occupational diseases caused by dust, fumes, gases, smoke and solvent hazards- control measures.

UNIT IV RELIABILITY 9

Reliability definition – quality and reliability– reliability mathematics – reliability functions – hazard rate – measures of reliability – design life –a priori and posteriori probabilities – reliability and hazard functions- exponential, normal, Weibull and gamma failure distribution – time - dependent hazard models – reliability of series and parallel systems.

UNIT V MAINTENANCE RELIABILITY 9

Maintainability and availability functions – frequency of failures – two unit parallel system with repair – k out of m systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Apply principles of safety management, its functions and technique in any organization.

CO2: Categorize the factors contributing to accident, develop accident reporting system within an organization.

CO3: Apply material handling and machine guarding principles in industrial applications.

CO4: Analyze reliability of the systems for various probability distributions.

CO5: Apply the reliability concepts to solve real time industry problem.

TEXT BOOKS

1. Balagurusamy E., “Reliability Engineering”, Tata McGraw Hill Publishing Company Ltd., New Delhi,2010.
2. Deshmukh, L. M. “Industrial Safety Management”, Tata McGraw-Hill Education, 2017.
3. Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay, 1997.

REFERENCE BOOKS

1. Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York, 1980.
2. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
3. Charles Ebeling, “An Introduction to Reliability and Maintainability Engineering” Mc Graw Hill, 2017.
4. L.S.Srinath, “Reliability Engineering”, Affiliated East west press, 2005.
5. Accident Prevention Manual for Industrial Operations”, N.S.C.Chicago, 1982.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	-	3	3
AVG	**2.6**	**2.4**	**2.67**	**2**	-	-	-	-	-	-	-	-	**2.6**	**2.6**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24MEPE72 PROCESS PLANNING AND COST ESTIMATION **L T P C**
3 0 0 3

COURSE OBJECTIVE

- To learn process-planning methods, drawing interpretation, and material selection.
- To calculate process parameters and choose tools, jigs, and fixtures.
- To identify cost elements and estimate labor, material, and overhead costs.

UNIT I PROCESS PLANNING **9**

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

UNIT II PROCESS PLANNING ACTIVITIES **9**

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

UNIT III COST ESTIMATION **9**

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

UNIT IV PRODUCTION COST ESTIMATION **9**

Estimation of different types of jobs - estimation of forging shop, estimation of welding shop, estimation of foundry shop.

UNIT V MACHINING TIME CALCULATION **9**

Estimation of machining time - importance of machine time calculation- calculation of machining time for different lathe operations, drilling and boring - machining time calculation for milling, shaping and planning -machining time calculation for grinding.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

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

TEXT BOOKS

1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.
2. Sinha B.P, “Mechanical estimating and Costing”, Tata-McGraw Hill publishing co, 1995.
3. Bopaya M. Bidanda, Maynard's Industrial and Systems Engineering Handbook, 6th Edition, 2022

REFERENCES BOOKS

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
2. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.
3. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2001.
4. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers 1990.
5. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 1998.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	1	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	-	-	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE73 COMPUTER ASSISTED PROCESS PLANNING

L T P C
3 0 0 3

COURSE OBJECTIVES

- To provide the overview of evolution of automation, CAPP and its principles.
- To familiarize the computer aided process planning in manufacturing.
- To train to utilize latest tools for data analysis.

UNIT I INTRODUCTION 9

Information requirement for process planning - system- role of process planning- advantages of conventional process planning over CAPP- structure of automated process planning system-feature recognition – methods - Generative CAPP system- Importance - principle of generative CAPP system - automation of logical decisions – benefits - Retrieval CAPP system – Significance - group technology – structure - relative advantages - implementation and applications.

UNIT II PROCESS PLANNING AND CONCURRENT ENGINEERING 9

Process planning – CAPP - concurrent engineering - design for manufacturing - advanced manufacturing planning - Selection of manufacturing sequence – Significance - alternative manufacturing processes- reduction of total set-up cost for a particular sequence - quantitative methods for optimal section - examples.

UNIT III MACHINING PARAMETERS AND MANUFACTURING TOLERANCES 9

Reasons for optimal selection of machining parameters - effect of parameters on production rate - cost and surface quality - different approaches - advantages of mathematical approach over conventional approach - solving optimization models of machining processes - design tolerances - manufacturing tolerances - methods of tolerance allocation - sequential approach - integration of design and manufacturing tolerances - advantages of integrated approach over sequential approach.

UNIT IV GENERATION OF TOOL PATH 9

Simulation of machining processes - NC tool path generation - graphical implementation - determination of optimal index positions for executing fixed sequence - quantitative methods - Implementation techniques for CAPP - MIPLAN system - Computer programming languages for CAPP - criteria for selecting a CAPP system and benefits of CAPP.

UNIT V PROCESS CONTROL AND DATA ANALYSIS 9

Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control –Sequence control and PLC& SCADA. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control - Overview of Automatic identification methods – Bar code technology –Automatic data capture technologies.- Quality management (SPC) and automated inspection.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

- CO1: Generate the structure of automated process planning system.
- CO2: Select the manufacturing sequence and explains the reduction of total set up cost for a particular sequence.
- CO3: Create awareness about the implementation techniques for CAPP.
- CO4: Explain the generation of tool path and solve optimization models of machining processes.
- CO5: Acquire knowledge in computer process control techniques.

TEXT BOOKS

1. Mikell P. Groover, “Automation, Production systems and Computer Integrated Manufacturing”, 8th edition, PHI, New Delhi, 2016.
2. James A. Retrg, Herry W. Kraebber, Computer Integrated Manufacturing‖, Pearson Education, Asia, 3rd Edition, 2004.
3. Dr.Sadhu Singh, “Computer Aided Design and manufacturing”, Khanna publishers, 2000.

REFERENCE BOOKS

1. Change T C and Richard A Wysk, “An Introduction to automated process planning systems”, Prentice Hall, 1985.
2. H.P. Wang and J.K. Li, “Computer Aided Process Planning”,Elsevier Science and Technology Publishers, 1st edition, 1991.

3. Radhakrishnan P, Subramanian S and Raju V, CAD/CAM/CIM, New Age International Publishers, 3rd Edition, 2008.
4. Gideon Halevi and Ronald D. Weill, Principles of Process Planning‖, Chapman Hall, 1995.
5. Adam E.(Jr.),Production & operations management: Concepts, Models and Behaviour, Ebert R J., PHI.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
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CO4	3	2	2	-	2	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	2	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	-	**2**	-	-	-	-	-	-	-	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE74 COMPUTER INTEGRATED MANUFACTURING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.
- To apply the group technology and FMS.
- To introduce to basics of data transaction, information integration and control of CIM.

UNIT I INTRODUCTION 9

Introduction to CAD, CAM, CAD/CAM and CIM - Evolution of CIM – CIM wheel and cycle – Production concepts and mathematical models – Simple problems in production models – CIM hardware and software– Major elements of CIM system – Three step process for implementation of CIM – Computers in CIM –Computer networks for manufacturing – The future automated factory – Management of CIM – safety aspects of CIM– advances in CIM.

UNIT II AUTOMATED MANUFACTURING SYSTEMS 9

Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly – Overview of material handling equipment – Consideration in material handling system design – The 10 principles of Material handling. Conveyor systems – Types of conveyors – Operations and features. Automated Guided Vehicle system – Types &applications – Vehicle guidance technology – Vehicle management and safety.

UNIT III COMPUTERISED PROCESS PLANNING **9**

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control-Variant process planning-Generative process planning-Semi generative process planning.

UNIT IV GROUP TECHNOLOGY AND FMS **9**

Part families – Visual – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies. FMS – Components – workstations – FMS layout configurations – Computer control systems – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – Machine cell design – Composite part concept, Holier method, Key machine concept – Quantitative analysis of FMS – Bottleneck model – Simple and complicated problems – Extended Bottleneck model - sizing the FMS ─ FMS applications, Benefits.

UNIT V PROCESS CONTROL AND DATA ANALYSIS **9**

Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control –Sequence control and PLC& SCADA. Computer process control – Computer process interface –Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control- Overview of Automatic iproduct methods – Bar code technology –Automatic data capture technologies. -Quality management (SPC) and automated inspection.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Understand the basics of computer integrated manufacturing.

CO2: Understand the appropriate automotive tools and material handling systems.

CO3: Design using computer aided process planning for manufacturing of various components.

CO4: Understand the overview of group technology, FMS and automation identification methods.

CO5: Utilize the computer process control techniques.

TEXT BOOKS

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016
3. Wilhelm Scheer' "CIM: Computer Integrated Manufacturing: Computer Steered Industry Book" Paperback, 2017.

REFERENCE BOOKS

1. Alavudeen and Venkateshwaran, Computer Integrated Manufacturing‖, PHI Learning Pvt. Ltd., New Delhi, 2013.
2. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical

Approach" Chapman & Hall, London, 1995.

3. James A. Retrg, Herry W. Kraebber, Computer Integrated Manufacturing, Pearson Education, Asia,3rd Edition, 2004.
4. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.
5. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 1998.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	-
AVG	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE75 FLEXIBLE MANUFACTURING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To acknowledge the basics of FMS and its layout.
- To impart the knowledge of development and implementation of FMS.
- To study the various automated material handling systems.

UNIT I INTRODUCTION **9**

Definition of an FMS - principal objectives – basic component – characteristics of FMS - types of FMS – equipment and its functions - FMC vs FMS - Types of flexibility and performance measures - Economic and technological justification for FMS - Study of decision models in designing FMS.

UNIT II DEVELOPMENT AND IMPLEMENTATION OF FMS **9**

Planning phases - integration - system configuration - FMS layouts - simulation - FMS project development steps - Project management - equipment development - host system development – functions of FMS host computer – FMS host and area controller function distribution - planning - hardware and software development - Framework for developing maintenance policy for FMS.

UNIT III AUTOMATED MATERIAL HANDLING AND STORAGE **9**

Functions - types - analysis of material handling equipment - Design of conveyor and AGV systems, storage system performance - AS/RS - carousel storage system - WIP storage system - interfacing handling storage with manufacturing. Tool management of FMS – Case studies: Recent systems in material handling.

UNIT IV RECONFIGURABLE MACHINES AND SYSTEMS **9**

FMS Planning - CAD Considerations FMS planning - CAM Considerations for FMS planning – Hardware - FMS hardware configurations and considerations - Programmable logic controllers(PLC'S)- components of PLC - advantages of PLC - Cell controllers - Communication networks- star network - ring network and bus network - FMS Implementation - Acceptance testing - Performance goals and expectations - Maintenance concerns and continued support.

UNIT V MAINTENANCE OF FMS **9**

Characteristics of JIT pull method, small lot sizes, workstation loads, flexible work force, and line flow strategy. Supply chain management Preventive maintenance - Kanban system, value engineering, MRD JIT, lean manufacture, quality concepts and management

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain objectives and characteristics of flexible manufacturing systems.

CO2: Explain developments and implementation of flexible manufacturing systems.

CO3: Analyse distributed numerical control and programmable controllers.

CO4: Explore the automated material handling and storage.

CO5: Explain reconfigurable machines, systems, and applications of FMS.

TEXT BOOKS

1. Shivanand H.K., Benal MM, Koti V, "Flexible Manufacturing System", New age international (P) Limited, New Delhi, 2006.
2. Parrish D J, ―Flexible Manufacturing‖, Butter Worth Heinemann Ltd, Oxford, 2018.
3. S.B. Joshi, and J.S. Smith (ed.): Computer Control of Flexible Manufacturing Systems, Research and Development, Chapman & Hall, 2018.

REFERENCE BOOKS

1. Mikell P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", PHI, 2008.
2. Kalpakjin, "Manufacturing Engineering and Technology", AddisonWesley Publishing Co., 1995.
3. Reza A Maleki "Flexible manufacturing system" Prentice Hall of Inc New Jersey, 1991.
4. John E Lenz "Flexible Manufacturing" marcel Dekker Inc New York ,1989
5. William W Luggen, "Flexible Manufacturing Cells and System" Prentice Hall of Inc New Jersey, 1991.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE76 CERAMIC PROCESSING AND TECHNOLOGY **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To provide an in-depth study of the processing techniques used to manufacture ceramic materials.
- It familiarize with the entire processing cycle, from raw material preparation to final product fabrication.
- To understand the underlying principles and their practical applications.

UNIT I INTRODUCTION **9**

Overview of ceramic materials – definition and classification, key properties and applications of ceramic processing, basic concepts of traditional Vs modern techniques, steps in ceramic processing, importance of microstructure control, challenges in ceramic processing, processing defects.

UNIT II RAW MATERIALS AND POWDER PREPARATION **9**

Types of raw materials – natural Vs synthetic, powder synthesis of primary and secondary raw materials, solid state synthesis, sol gel process, CVD, particle size and distribution, surface area and porosity, ball milling, spray drying agglomeration and dispersion, flocculation and deflocculation, role of additives and binders.

UNIT III SHAPING AND FORMING METHODS **9**

Drying and semidry pressing – uniaxial and isostatic pressing, equipment and process parameters; casting techniques – slip casting, tape casting; plastic forming methods – extrusion, injection molding; additive manufacturing – 3D printing technologies and applications in ceramics; forming defects and its prevention, common defects, quality control measures.

UNIT IV SINTERING AND DENSIFICATION **9**

Principles of sintering – solid state and liquid phase sintering, sintering mechanism; sintering techniques – conventional sintering, microwave and spark plasma sintering; densification behavior – role of additives, grain growth and control; sintering atmospheres in sintering – inert, reducing and oxidizing atmospheres; post sintering processes – hot isostatic pressing, surface treatments.

UNIT V ADVANCED PROCESSING TECHNIQUES 9

Advanced powder processing – nano-powders and their processing, sol gel derived materials; coating techniques – thermal spraying, PVD and CVD; Composite ceramics – types, processing methods; fabrications of multifunctional ceramics – functionally graded materials, smart ceramics; case studies and applications – high performance ceramics in aerospace, biomedical ceramics, energy related applications

TOTAL: 45 PERIODS

COURSE OUTCOMES

On completion of the course, the students will be able to

CO1: Explain the principles and techniques involved in the processing of ceramic materials.

CO2: Apply knowledge of ceramic processing to solve practical engineering problems.

CO3: Analyze the properties and behavior of ceramic powders and formed bodies.

CO4: Evaluate the effects of processing parameters on the microstructure and properties of ceramics.

CO5: Develop skills in advanced ceramic processing techniques and their applications.

TEXT BOOKS

1. Mohamed N.Rahaman, Ceramic Processing, Taylor & Francis, 2017.
2. Loan D. Marinescu, Handbook of Advanced Ceramic Machining, CRC press, 2007.
3. David W. Richerson, Modern Ceramic Engineering, 3rd Edn., Taylor & Francis, 2005.

REFERENCES BOOKS

1. Alan G.King, Ceramic Technology and Processing, Noyes Publication, USA, 2001.
2. James S. Reed, Principle of Ceramic Processing, John Willey and Sons, NY, 1988.
3. David W. Richerson, Modern Ceramic Engineering, 3rd Edn., Taylor & Francis, 2005.
4. Paul De Garmo E, Black J.J and Ronald A.Kohser, Materials and Processes in Manufacturing, 8th Edn, Prentice - Hall India Pvt. Ltd., New Delhi, 1997.
5. Reed J.S, Introduction to the Principles of Ceramic Processing, Willey, New York, 1988.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	3	-	-	-	-	-	-	-	-	3	2
CO2	3	-	-	3	-	-	-	-	-	-	-	-	3	2
CO3	3	2	-	3	-	-	-	-	-	-	-	-	3	2
CO4	3	2	-	3	-	-	-	-	-	-	-	-	3	2
CO5	3	2	-	3	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE77 MICROPROCESSORS APPLICATIONS IN MANUFACTURING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To acknowledge the concepts of Architecture of 8086 microprocessor.
- To recognize the design aspects of I/O and Memory Interfacing circuits.
- To learn about the fundamentals of Programmable Logic Controller.

UNIT I INTRODUCTION TO MICROPROCESSORS 9

Microprocessor architecture and its operations, Memory, Input & output devices, The 8085 MPU- architecture, Pins and signals, Timing Diagrams, Logic devices for interfacing, Memory interfacing, Interfacing output displays, Interfacing input devices, Memory mapped I/O.

UNIT II PROGRAMMING CONCEPTS 9

Flow chart symbols, Data Transfer operations, Arithmetic operations, Logic Operations, Branch operation, Writing assembly language programs, Programming techniques: looping, counting and indexing. Additional data transfer and 16 bit arithmetic instruction, Logic operation: rotate, compare, counter and time delays, 8085 Interrupts.

UNIT III 16-BIT MICROPROCESSORS 9

Architecture, Pin Description, Physical address, segmentation, memory organization, addressing modes. Peripheral Devices: 8237 DMA Controller, 8255 programmable peripheral interface, 8253/8254programmable timer/counter, 8259 programmable interrupt controller, 8251 USART and RS232C.

UNIT IV 8051 MICROCONTROLLER 9

Inside the Computer, Microcontrollers and Embedded Processors, Block Diagram of 8051, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051, Pins Of 8051.

UNIT V PROGRAMMABLE LOGIC CONTROLLER 9

Industrial Automation - Programmable Logic Controller - Functions of PLCs - Features of PLC - Selection of PLC - Architecture – IEC61131-3 programming standard and types - Basics of PLC Programming – Ladder Logic Diagrams – Communication in PLC – Programming Timers and Counters – Data Handling - PLC modules – Advanced motion controlled Multi Axis PLC - Microcontroller Applications - Designing and implementing microcontroller-based systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Implement programs on 8086 microprocessor.
CO2: Design I/O circuits and Interfacing circuits.
CO3: Design components of ARM processor.
CO4: Explain the various standard fluid power circuits, functions, communication and IO details of PLC.
CO5: Apply the microcontrollers in manufacturing industries.

TEXT BOOKS

1. Ramesh Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 6th Edition, Penram International Publication (India) Pvt. Ltd., 2013.
2. D. V. Hall: Microprocessors Interfacing, TMH 3rd Edition,2006.
3. Frank D, Petruzella, "Programmable Logic Controller" McGraw – Hill Publications, Fourth Edition, 2016.

REFERENCE BOOKS

1. Kenneth L. Short, "Microprocessors and programmed Logic", 2nd Ed, Pearson Education Inc., 2003.
2. Shah Satish, "8051 Microcontrollers MCS 51 Family and its variants", Oxford, 2010.
3. Patranabis. D,"Principles of Industrial Instrumentation", Tata McGraw-Hill Publishing Ltd., New Delhi, 1999.
4. Mackay S., Wrijut E., Reynders D. and Park J., "Practical Industrial Data Networks Design, Installation and Troubleshooting", Newnes Publication, Elsevier, First Edition, 2004.
5. Lucas, M.P., "Distributed Control System", Van Nastrand Reinhold Company, New York, 1986.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	2
AVG	3	2	2	-	-	-	-	-	-	-	-	-	3	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE78 DIGITAL MANUFACTURING

L T P C
3 0 0 3

COURSE OBJECTIVES

- To study the various aspects of digital manufacturing.
- To formulate of smart manufacturing systems in the digital work environment.
- To elaborate the significance of digital twin.

UNIT I INTRODUCTION 9

Introduction – Need – Overview of Digital Manufacturing and the Past – Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management – Practical Benefits of Digital Manufacturing – The Future of Digital Manufacturing.

UNIT II DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT 9

Collaborative Product Development, Mapping Requirements to specifications – Part

Numbering, Engineering Vaulting, and Product reuse – Engineering Change Management, Bill of Material and Process Consistency – Digital Mock up and Prototype development – Virtual testing and collateral. Overview of Digital Supply Chain - Scope& Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM.

UNIT III SMART FACTORY **9**

Smart Factory – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT- Key Principles of a Smart Factory – Creating a Smart Factory – Smart Factories and Cybersecurity.

UNIT IV 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–Machine to Machine communication – Case Studies.

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: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Use various elements in the digital manufacturing.

CO2: Develop life cycle process and supply chain management in digital environment.

CO3: Select the proper procedure of validating practical work through digital validation in Factories.

CO4: Implement the concepts of IoT and its role in digital manufacturing.

CO5: Analyse and optimize various practical manufacturing process through digital twin.

TEXT BOOKS

1. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of DigitalManufacturing Science, Springer-Verlag London Limited, 2012.
2. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, A press, 2016.
3. Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital, 2009.

REFERENCE BOOKS

1. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, “Digital Twin Driven SmartManufacturing”, Elsevier Science., United States, 2019.
2. Alp Ustundag and Emre Cevikcan, “Industry 4.0: Managing the Digital Transformation”, Springer Series in Advanced Manufacturing., Switzerland, 2017
3. Ronald R. Yager and Jordan Pascual Espada, “New Advances in the Internet of Things”, Springer., Switzerland, 2018.
4. Ronald R. Yager and Jordan Pascual Espada, “New Advances in the Internet of Things”, Springer., Switzerland, 2018.
5. Manufacturing, Springer-Verlag London 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
CO1	3	3	2	-	2	-	-	-	-	-	-	-	2	-
CO2	3	3	2	-	2	-	-	-	-	-	-	-	2	2
CO3	3	3	2	-	2	-	-	-	-	-	-	-	2	2
CO4	3	3	2	-	2	-	-	-	-	-	-	-	2	2
CO5	3	3	2	-	2	-	-	-	-	-	-	-	2	2
AVG	3	3	2	-	2	-	-	-	-	-	-	-	2	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE79 MATERIAL CHARACTERIZATION AND TECHNIQUES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To learn fundamental concepts and techniques of materials characterization.
- To familiarize students with various analytical instruments and methods used for characterizing materials.
- To interpret and analyze experimental data obtained from materials characterization techniques.

UNIT I INTRODUCTION **9**

Overview of materials characterization- Importance and applications of materials characterization techniques -Basic principles of materials analysis- Crystal structure and symmetry -X-ray diffraction (XRD) analysis - Electron microscopy techniques (SEM, TEM) for microstructural analysis.

UNIT II SPECTROSCOPIC AND THERMAL ANALYSIS TECHNIQUES **9**

Introduction to spectroscopy -Optical spectroscopy (UV-Vis, FTIR) - Raman spectroscopy - Nuclear magnetic resonance (NMR) spectroscopy -Differential scanning calorimetry (DSC) – Thermo-gravimetric analysis (TGA) - Differential thermal analysis (DTA).

UNIT III SURFACE ANALYSIS, TECHNIQUES OF MECHANICAL AND ELECTRICAL CHARACTERIZATION **9**

Scanning probe microscopy (AFM, STM) - X-ray photoelectron spectroscopy (XPS) - Secondary ion mass spectrometry (SIMS)-Mechanical testing methods (tensile, compressive, hardness) - Electrical conductivity measurements - Dielectric spectroscopy.

UNIT IV DATA ANALYSIS AND INTERPRETATION **9**

Statistical analysis of experimental data - Interpretation of characterization results - Correlation between structure, properties, and performance of materials.

UNIT V ADVANCED TECHNIQUES AND EMERGING TRENDS **9**

Advanced characterization techniques (TEM tomography, in-situ microscopy) - Nanoscale characterization methods - Emerging trends in materials characterization (machine learning, big data analytics)

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Apply appropriate characterization techniques for microstructure examination.

CO2: Choose an appropriate electron microscopy techniques to investigate microstructure of materials at high resolution.

CO3: Determine crystal structure of specimen and estimate its crystallite size and stress.

CO4: Use appropriate spectroscopic technique to measure vibrational / electronic transitions to estimate parameters like energy band gap, elemental concentration, etc.

CO5: Apply thermal analysis techniques to determine thermal stability of and thermodynamic transitions of the specimen.

TEXT BOOKS

1. Sam Zhang and Lin Li, "Materials Characterization Techniques" CRC Press, 2008.
2. William D. Callister Jr. and David G. Rethwisch,"Introduction to Materials Science and Engineering" Willeyplus, 2014.
3. Joseph Goldstein et al, "Scanning Electron Microscopy and X-Ray Microanalysis"springer, 2018.

REFERENCE BOOKS

1. Cullity, B.D., and Stock, R.S., "Elements of X-Ray Diffraction", Prentice-Hall, 2001.
2. David B. Williams and C. Barry Carter "Transmission Electron Microscopy: A Textbook for Materials Science" springer, 2009.
3. Murphy, Douglas B, Fundamentals of Light Microscopy and Electronic Imaging, Wiley-Liss, Inc. USA, 2001.
4. Tyagi, A.K., Roy, Mainak, Kulshreshtha, S.K., and Banerjee, S., Advanced Techniques for Materials Characterization, Materials Science Foundations (monograph series), 2009.
5. Wendlandt, W.W., Thermal Analysis, John Wiley & Sons, 1986.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	2	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	2	-	-	-	-	-	-	-	-	3	-
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CO4	3	3	-	2	-	-	-	-	-	-	-	-	3	-
CO5	3	3	-	2	-	-	-	-	-	-	-	-	3	-
AVG	3	3	-	2	-	-	-	-	-	-	-	-	3	-

1-Low, 2-Medium, 3-High, '-'- No correlation

24MEPE80 PRECISION MACHINING **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To study the principle and working of different methods of precision machining.
- To study the errors involved in precision machine tools and calculate the error budgets for a given situation.
- To study the Selecting a suitable measurement solution to measure and characterize precision machined features.

UNIT I PRECISION ENGINEERING **9**

Introduction to Precision Engineering, Need for precision manufacturing, Taniguchi diagram, Four Classes of Achievable Machining Accuracy – Normal, Precision, High-precision, Ultra-precision Processes and Nanotechnology.

UNIT II PRECISION MACHINING **9**

Overview of Micro- and Nano-machining, Conventional micro machining techniques - micro-turning, micro milling, micro-grinding, Ultra-precision diamond turning, Non-conventional micromachining techniques –abrasive jet and water jet micromachining, Ultrasonic micromachining, micro electrical discharge micro machining, photochemical micromachining, electro chemical micromachining, laser beam micromachining, Electron beam micromachining, Focused Ion Beam micromachining, etc.

UNIT III MACHINE DESIGN FOR PRECISION MANUFACTURING **9**

philosophy of precision machine design, ultra-precision machine elements: guide- ways, drive systems, friction drive, linear motor drive, spindle drive. Bearings: principle, construction and application of rolling, hydrodynamic and hydrostatic bearings, aerostatic bearings, magnetic bearings.

UNIT IV MECHANICAL AND THERMAL ERRORS **9**

Sources of error, Principles of measurement, Errors due to machine elements, bearings, spindles, Kinematic design, Structural compliance. Vibration, Thermal errors – background, thermal effects, Environmental control of precision machinery. Error mapping and error budgets.

UNIT V MEASUREMENT AND CHARACTERISATION **9**

Optical dimensional metrology of precision features – Machine vision, Multi-sensor coordinate metrology, Laser Tracking Systems, Laser scanners, White-Light Interference 3D Microscopes, Focus-Based Optical Metrology- Fringe projection method, Measurement of Typical Nano features.

Surface metrology - 3D surface topography - Need, Measurement – Chromatic confocal Microscopy, Interferometry, Non-optical Scanning Microscopy – Scanning electron Microscopes, Scanning probe microscopes, Parameters for characterizing 3D surface topography.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Categorize the need, significance and progress of precision manufacturing and the different levels of manufacturing.

CO2: Apply the different methods of precision machining.

CO3: Explore the special construction requirements of precision machine tools.

CO4: Estimate the errors involved in precision machine tools and calculate the error budgets for a given situation.

CO5: Select a suitable measurement solution to measure and characterize precision-machined features.

TEXT BOOKS

1. Murty, R.L., Precision Engineering in Manufacturing, New Age publishers, 2005.
2. Venkatesh V.C., SudinIzman, Precision Engineering, Tata McGraw Hill Publishing Company, New Delhi, 2008.
3. David Dornfeld, Dae-Eun Lee, Precision Manufacturing, Springer, 2008.

REFERENCE BOOKS

1. JainV.K., Introduction to micromachining, Narosa publishers, 2018
2. Joseph McGeough, Micromachining of Engineered Materials, Marcel Dekker Inc., 2002.
3. Kevin Harding, "Handbook of Optical Dimensional Metrology, Series: Series in Optics and Optoelectronics," Taylor & Francis, 2013.
4. Richard Leach, Stuart T. Smith, 'Basics of Precision Engineering', CRC press, 2018.
5. Norio Taniguchi, Nanotechnology, Oxford University Press, New Delhi. 1996.

Mapping of COs with POs & PSOs

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CO4	2	2	2	2	-	-	-	-	-	-	-	-	2	2
CO5	2	2	2	2	-	-	-	-	-	-	-	-	2	2
AVG	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24MC3101 LEGAL SYSTEM OF INDIA

L T P C
3 0 0 0

COURSE OBJECTIVES

- To introduce the basic concepts necessity of law among engineers.
- To introduce Indian legal system.
- To familiarize taxations and basic laws.

UNIT I INTRODUCTION TO INDIAN LEGAL SYSTEM **9**
Constitution of India, Sources of Law and Judicial system.

UNIT II CONTRACTS AND ITS ELEMENTS **9**
Employment contracts, Contract Interpretation, Service Contract, Contract of Indemnity, Law of Agency. Employment agreement.

UNIT III LEGAL DOCUMENTATION **9**
Drafting of legal documents including Non-Disclosure Agreements (NDA), Request for Proposal (RFP), collaboration agreements, joint venture agreements, tendering and subcontracting

UNIT IV CYBER AND LABOUR LAWS **9**
E-Commerce and E-Governance. Provident Fund, ESIC, Gratuity, Bonus, Perquisites, Contract labour Health, Safety and welfare of construction workers.

UNIT V TAXATION **9**
Income Tax, Service Tax, VAT, Excise Duty, GST. Alternate Dispute Resolution (ADR) in Domestic and International dealings, Code of Conduct and Ethics for engineering professionals

TOTAL: 45 PERIODS

COURSE OUTCOMES
On successful completion of this course, the students will be able to
- CO1: Explore the Indian Legal System.
- CO2: Explain the basics of different laws.
- CO3: Acquire practical insight of legal system and its application in engineering profession.
- CO4: Analyze the cyber and labour law.
- CO5: Use the tax system.

TEXT BOOKS

1. Karnika Seth, Computer Internet and New Technology Laws, Lexisnexis, First Edition 2013.
2. Prafulla C Pant, The Arbitration and Conciliation Act, 1996, Butterworths India, New Delhi.
3. Joseph Minattur, Indian Legal System, Indian Law Institute, New Delhi.

REFERENCE BOOKS

1. J. Beatson, Anson's Law of Contract, Oxford University Press.
2. V. S. Datey , Indirect Taxes: Law and Practice, Taxmann Publications (P) Ltd.
3. Dr. Vinod K. Singhania and Dr. Monica Singhania , Student's Guide To Income Tax, Taxmann Publications (P) Ltd.
4. S.C. Srivastava, Industrial Relations and Labour Laws, Vikas Publishing House Pvt. Ltd.
5. Singh, M. P., & Kumar, N, The Indian legal system: An enquiry. Oxford University Press, 2019.

24MC3102 IPR AND PATENT DRAFTING **L T P C**
3 0 0 0

COURSE OBJECTIVES

- To introduce the basic concepts intellectual property.
- To familiarize the importance of patent copyrights and trademarks.
- To train the students for drafting of patent.

UNIT I BASICS OF IPR **9**

Introduction – Invention and Creativity – Intellectual Property (IP) – Importance – Protection of IPR – Basic types of property (Movable Property, Immovable Property and Intellectual Property).

UNIT II PATENT, COPYRIGHTS AND TRADEMARKS **9**

IP – Patents – Copyrights and related rights – Trade Marks and rights arising from Trademark registration – Definitions – Industrial Designs and Integrated circuits – Protection of Geographical Indications at national and International levels – Application Procedures.

UNIT III INTERNATIONAL PATENT FILING **9**

International convention relating to Intellectual Property – Establishment of WIPO – Mission and Activities – History – General Agreement.

UNIT IV DRAFT OF PATENT **9**

Pre-drafting requirement, Types of specifications, Drafting of Provisional specifications, Drafting of complete specifications, Drafting of claims, Filing procedure for Ordinary application, Convention application, PCT International Phase application, PCT National Phase application, Patent of addition, Divisional application, Publication of paten, First Examination Report, Time limit for different phase of prosecution, Pre Grant opposition, Post Grant opposition.

UNIT V INFRINGEMENT OF PATENTS AND CASE STUDIES 9

Infringement & remedies, Literal Infringement, Case Studies on – Patents, Copyright and related rights – Trade Marks – Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the basics of IPR.
CO2: Explore the importance of Patenting.
CO3: Discuss the method of international patent filing.
CO4: Draft of patent application.
CO5: Explain the importance of patent infringement.

TEXT BOOKS

1. Kompal Bansal, Parikshit Bansal, Fundamentals of Intellectual Property for Engineers, BS Publications 2013.
2. Pmbuddha Ganguli, Inrelletul property right - Unleasbing the knowledge economy, Tata Mccraw HiU Publishing Company Ltd.
3. Deborah Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets Delmar Cengage Learning; 5^{th} Edition.

REFERENCE BOOKS

1. N.K Acharya, Intellectual property rights, Asia Law House, 9^{th} Edition.
2. Jeffrey G. Sheldon, How to Write a Patent Application, Third Edition, Practising Law Institute, 2016.
3. WIPO Intellectual Prcpeny Handbook. Policy, Law and Use, 2^{nd} Edition.
4. Dr. R. Ashok Raj, Dr. K. Panneer Selvam, and V. Sivaganesan "Introduction to Intellectual Property Rights and Patent Drafting, JBR TRY SEA Publishers, 2024.
5. The American Society of International law, Electronic resource guide, ERC publication.

24MC3103 LITERARY FORMS AND TECHNIQUES **L T P C**
3 0 0 0

COURSE OBJECTIVES

- To make the students aware about the finer sensibilities of human existence through an art form.
- The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.
- To gain knowledge in modern tools for visualization.

UNIT I INTRODUCTION TO ELEMENTS OF LITERATURE **9**

Relevance of literature, Enhances Reading, thinking, discussing and writing skills. Develops finer sensibility for better human relationship. Increases understanding of the problem of humanity without bias. Providing space to reconcile and get a cathartic effect.

UNIT II ELEMENTS OF FICTION **9**

Fiction, fact and literary truth. Fictional modes and patterns. Plot character and perspective.

UNIT III ELEMENTS OF POETRY **9**

Emotions and imaginations. Figurative language. Simile, metaphor, conceit, symbol, pun and irony). Personification and animation. Rhetoric and trend.

UNIT IV ELEMENTS OF DRAMA **9**

Drama as representational art. Content mode and elements. Theatrical performance. Drama as narration, mediation and persuasion. Features of tragedy, comedy and satire.

UNIT V MODERN TOOLS FOR VISUALIZATION **9**

Plot Diagram Infographic, Theme Video Tone & Mood, Visual Set, Setting Diorama or 3D Model Soundtrack for a Story, Symbolism Poster, Book Trailer.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the relevance of literature in human life.

CO2: Explore the relevance various aspects in developing finer sensibilities.

CO3: Explain the essence of poetry.

CO4: Enumerate the essence of drama.

CO5: Use the modern tools for visualization.

TEXT BOOKS

1. W.H. Hudson, An Introduction to the Study of English Literature, Atlantic, 2007.
2. Mario Klarer, Routledge, An Introduction to Literary Studies, 2013.
3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press, 1991.

REFERENCE BOOKS

1. Wolfstuff, The Elements of Fiction: A Survey, Ulf Wolf (ed), 2014
2. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.
3. WIPO Intellectual Prcpeny Handbook. Policy, Law and Us.
4. Kelly J. Mays “The Norton Introduction to Literature, W. W. Norton & Company, Fifteenth Edition, 2025.
5. Eleclronic resource guide ERG published online by the American Society of International law.

24MC3104 DISASTER RISK REDUCTION AND MANAGEMENT **L T P C**
3 0 0 0

COURSE OBJECTIVES

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

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies,-Inter relations between Disasters and Sustainable development Goals.

UNIT II DISASTER RISK REDUCTION (DRR) **9**

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

Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT **9**

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers).

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT **9**

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management.

UNIT V DISASTER MANAGEMENT: CASE STUDIES **9**

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Use the concepts of Disaster, Vulnerability and Disaster Risk reduction.
CO2: Explore on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction.
CO3: Develop disaster response skills by adopting relevant tools and technology.
CO4: Enhance awareness of institutional processes for Disaster response in the country.
CO5: Develop rudimentary ability to respond to their surroundings with potential.

TEXT BOOKS

1. Taimpo, Disaster Management and Preparedness, CRC Publications, 2016.
2. Singh R, Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications, 2017.
3. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012.

REFERENCE BOOKS

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010.
2. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
3. Government of India, National Disaster Management Policy, 2009.

4. Shaw R., Community based Disaster risk reduction, Oxford University Press, 2016.
5. Madu, C. N., Kuei, C.-H., Madu, I. E., Ozumba, B. C., Nnadi, V. E., Odinkonigbo, U. L., & Ezeasor, I. C. (Eds.), Handbook of disaster risk reduction & management: Climate change and natural disasters. World Scientific Publishing Co, 2017.

24MC3105 FILM APPRECIATION **L T P C**
3 0 0 0

COURSE OBJECTIVES

- To gain knowledge on concepts film.
- To acquaint the skills on film language.
- To know the developments in films.

Theme - A: The Component of Films

A-1: The material and equipment
A-2: The story, screenplay and script
A-3: The actors, crew members, and the director
A-4: The process of film making… structure of a film

Theme - B: Evolution of Film Language

B-1: Film language, form, movement etc.
B-2: Early cinema… silent film (Particularly French)
B-3: The emergence of feature films: Birth of a Nation
B-4: Talkies

Theme - C: Film Theories and Criticism/Appreciation

C-1: Realist theory; Auteurists
C-2: Psychoanalytic, Ideological, Feminists
C-3: How to read films?
C-4: Film Criticism / Appreciation

Theme – D: Development of Films

D-1: Representative Soviet films
D-2: Representative Japanese films
D-3: Representative Italian films
D-4: Representative Hollywood film and the studio system

Theme - E: Indian Films

E-1: The early era
E-2: The important films made by the directors
E-3: The regional films
E-4: The documentaries in India

READING:

A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explore the components of film.
CO2: Utilze the development of film languages.
CO3: Explain the film theories.
CO4: Discuss the latest developments in film.
CO5: list the latest developments in Indian film.

TEXT BOOKS

1. Jim Piper, The Film Appreciation Book: The Film Course You Always Wanted to Take, Allworth Pr, 2014.
2. Monaco, How to read a film, Oxford University Press, 2000.
3. Bordwell, D., & Thompson, K., Film art: An introduction, 12^{th} Edition, McGraw-Hill Education., 2020.

REFERENCE BOOKS

1. Nichols, B., Engaging cinema: An introduction to film studies. W. W. Norton & Company, 2017.
2. Cook, D. A., A history of narrative film (4^{th} ed.). W. W. Norton & Company, 2004.
3. Giannetti, L., Understanding movies (14^{th} ed.). Pearson, 2020.
4. Boggs, J. M., & Petrie, D. W., The art of watching films (9^{th} ed.). McGraw-Hill Education, 2017.
5. Hayward, S. (2013). Cinema studies: The key concepts (4^{th} ed.). Routledge.

24MC3106 WOMEN AND GENDER STUDIES

L T P C	
3 0 0 0	

COURSE OBJECTIVES

- To gain knowledge in feminism and its theory's.
- To know the woman's global, national and locals movements.
- To understand the gender and representations.

UNIT I CONCEPTS 9

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY 9

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL 9

Rise of Feminism in Europe and America. Women's Movement in India.

UNIT IV GENDER AND LANGUAGE 9

Linguistic Forms and Gender. Gender and narratives.

UNIT V GENDER AND REPRESENTATION **9**

Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1:Distinguish between key concepts related to sex, gender, patriarchy, and gender roles.

CO2:Analyze various feminist theories, including liberal, Marxist, socialist, radical, and postmodernist perspectives.

CO3:Examine the development of women's movements globally, nationally (India), and locally.

CO4:Interpret the relationship between gender and language, including narrative forms and linguistic structures.

CO5: Evaluate the representation of gender in mainstream, alternative, and social media platforms.

TEXT BOOKS

1. Madhu Nagla, Women and Gender Studies: A Textbook, Rawat Publications; First Edition, 2025.
2. Mary S Evans, Kathy Davis and Judith Lorber, Handbook of Gender and Women's Studies, Sage Publications, 2006.
3. Gillis, M. J., & Jacobs, A. T. Introduction to women's and gender studies: An interdisciplinary approach (2nd ed.). Oxford University Press, 2019.

REFERENCE BOOKS

1. Launius, C., & Hassel, H., Threshold concepts in women's and gender studies (2nd ed.). Routledge, 2018.
2. Hunter College Women's and Gender Studies Collective. Women's realities, women's choices: An introduction to women's and gender studies. Oxford University Press, 2014.
3. Saraswati, L. A., Shaw, B., & Rellihan, H. (2017). Introduction to women's, gender, and sexuality studies. Oxford University Press
4. Clemens, C. L.Introduction to women's & gender studies. The Pennsylvania Alliance for Design of Open Textbooks (PA-ADOPT), 2023.
5. Judith Lorber, Gender Inequality: Feminist Theories and Politics, Oxford University Press, Third Edition, 2010.

24MC5101 FOOD AND NUTRITION **L T P C**

3 0 0 0

COURSE OBJECTIVES

- Obtain knowledge of different food groups, their composition and role in diet.
- To gain knowledge of different plant and animal derived foods and their nutritive values and properties.
- To gain knowledge in different methods of processing and cooking.

UNIT I FOOD GROUPS **9**

Basic 4, 5&7 food groups. Functional food groups-energy yielding, body building and protective foods (only sources and not properties and functions). Food Pyramid, My Plate. Study of various cooking methods - Boiling, steaming, stewing, frying, baking, roasting, broiling, cooking under pressure. Cereals - composition of rice, wheat, effects of cooking on parboiled and raw rice, principles of starch cookery, gelatinization.

UNIT II PULSES AND GRAMS **9**

Varieties of pulses & grams, composition, nutritive value, cooking quality of pulses, germination and its effect. Vegetables - Classification, composition, nutritive value, selection and preparation for cooking, methods and principles involved in cooking. Fruits - Composition, nutritive value, changes during ripening, methods and effects of cooking, enzymatic browning.

UNIT III BEVERAGES **9**

Classification, nutritive value, Milk based beverages- methods of preparing tea and coffee, fruit based beverages and preparation of carbonated non – alcoholic beverages. Spices and Condiments - Uses and abuses. Fats and Oils - Types of oils, function of fats and oils, shortening effects of oil, smoking point of oil, factors affecting absorption of oil. Sugar cookery- Stages of sugar cookery, crystallization and factors affecting crystallization.

UNIT IV MILK **9**

Composition, nutritive value, kinds of milk, pasteurization and homogenization of milk, changes in milk during heat processing, preparation of cheese and milk powder Egg - Structure, composition, classification, nutritive value, uses of egg in cookery, methods of cooking, foam formation and factors affecting foam formation.

UNIT V MEAT **9**

Structure, composition, nutritive value, selection of meat, post mortem changes in meat, aging, tenderness, methods of cooking meat and their effects. Poultry – types, composition, nutritive value, selection, methods of cooking. Fish - Structure, composition, nutritive value, selection of fish, methods of cooking and effects

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Understand the food groups.
CO2: Understand properties of pulses and grams.
CO3: Understand properties of beverages.
CO4: Understand properties of milk.
CO5: Understand properties of meats.

TEXT BOOKS

1. M. Swaminathan. Food science, Chemistry and Experimental foods, International Book House Publication
2. Norman.N.Potter, Food Science, New York: Chapman & HalI, 1995
3. Griswold R.M, Experimental study of Foods, John Wiely & Sons, INC, New York, 1962.

REFERENCE BOOKS

1. Helen Charley, Food Science, Macmillan, 1982
2. A.G. Peckam, Foundation of Food Preparation, Collier Macmillan Ltd, 1969.
3. Modern Cookery for teaching and trade, volume I&II ,Thangam Philip. Orient Longmans Ltd.
4. Food Fundamentals by MacWiliams, John Willy and son‟s, New York.
5. Food Facts & Principles by Shakunthala manay & Shadakhraswamy.

24MC5102 DESIGN THINKING

L	T	P	C
3	0	0	0

COURSE OBJECTIVES

- To learn design thinking concepts and principles.
- To use design thinking methods in every stage of the problem.
- To learn the different phases of design thinking.

UNIT I INTRODUCTION **9**

Why Design? - Four Questions, Ten Tools - Principles of Design Thinking - The process of Design Thinking - How to plan a Design Thinking project.

UNIT II UNDERSTAND, OBSERVE AND DEFINE THE PROBLEM **9**

Search field determination - Problem clarification - Understanding of the problem - Problem, analysis - Reformulation of the problem - Observation Phase - Empathetic design - Tips for observing - Methods for Empathetic Design - Point-of-View Phase - Characterization of the target group - Description of customer needs.

UNIT III IDEATION AND PROTOTYPING **9**

Ideate Phase - The creative process and creative principles - Creativity techniques - Evaluation of ideas - Prototype Phase - Lean Startup Method for Prototype Development - Visualization and presentation techniques.

UNIT IV TESTING AND IMPLEMENTATION **9**

Test Phase - Tips for interviews - Tips for surveys - Kano Model - Desirability Testing - How to conduct workshops - Requirements for the space - Material requirements - Agility for Design Thinking.

UNIT V FUTURE **9**

Design Thinking meets the corporation – The New Social Contract – Design Activism – Designing tomorrow.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the principles of design thinking.
CO2: Define the problems.
CO3: Create prototype.
CO4: Test the product.
CO5: Implement the product in the market sale.

TEXT BOOKS

1. Christian Mueller-Roterberg, Handbook of Design Thinking - Tips & Tools for how to design thinking.
2. Jeanne Liedtka and Tim Ogilvie, Designing for Growth: a design thinking tool kit for managers.
3. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation.

REFERENCE BOOKS

1. Johnny Schneider, "Understanding Design Thinking, Lean and Agile", O'Reilly Media, 2017.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.
3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
4. http://ajjuliani.com/design-thinking-activities/\
5. https://venturewell.org/class-exercices

24MC5103 HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA **L T P C**
3 0 0 0

COURSE OBJECTIVES

- To know the contributions of sciences.
- To gain knowledge astronomy, mathematics and Ayurveda.
- To gain knowledge on technological development of India.

UNIT I INTRODUCTION **9**

Logic and methodology of Indian sciences. An overview of Indian contributions to sciences. An overview of Indian contributions to technology.

UNIT II ASTRONOMY **9**

Development of astronomy in India. Pancanga: Indian calendrical computations. The distinct features of Indian planetary models. Computation of eclipses: Its simplicity, elegance and efficiency. Observational astronomy in India.

UNIT III MATHEMATICS **9**

An overview of the development of mathematics in India. Mathematics contained in Sulbasutras. Combinatorial aspects of the Chandassastra. Solutions to the first and second order indeterminate equations. Weaving mathematics into beautiful poetry: Bhaskaracarya. The evolution of sine function in India. The discovery of calculus by Kerala astronomers

UNIT IV AYURVEDA **9**

History of Ayurveda, Rational foundations of Ayurveda, Textual sources in Ayurveda, Ayurveda and allied disciplines, Approach to health and disease in Ayurveda – 2 lectures, Approach to diet and nutrition in Ayurveda. Modern medicine, Ayurveda and Yoga.

UNIT V TECHNOLOGICAL DEVELOPMENT IN INDIA **9**

Agriculture- Origin, development, and Ancient crops, Water management- Overview, Harappan water management, other case studies, Medieval Water structures, Pottery-technical aspects, Silpasastra: Architecture and Construction- An introduction to Silpasastra and Construction Technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the Indian science.
CO2: Explore the essence of Indian astronomy.
CO3: Enumerate the development of Indian mathematics
CO4: Discuss the sources of Ayurveda.
CO5: Explain the technological development of India.

TEXT BOOKS

1. Soni, S., India's glorious scientific tradition: Exploration of ancient knowledge and modern insights. Prabhat Prakashan.2020.
2. Joseph, G. G, A passage to infinity: Medieval Indian mathematics from Kerala and its impact. SAGE Publications, 2009.
3. Mohan, K., Science and technology in colonial India. Routledge, 2023.

REFERENCE BOOKS

1. Sarma, K. V. A history of the Kerala school of Hindu astronomy. Vishveshvarananda Institute of Sanskrit and Indological Studies, 1972.
2. Seshadri, C. S. (Ed.). Studies in the history of Indian mathematics. Hindustan Book Agency, 2010.
3. Datta, B., & Singh, A. N. History of Hindu mathematics: A source book. Asia Publishing House, 1962.
4. Kashyapa, K., Kashyapa Samhita. Chaukhambha Orientalia, 2007.
5. https://onlinecourses.swayam2.ac.in/arp19_ap87/preview.

24MC5104 POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY	**L**	**T**	**P**	**C**
	3	**0**	**0**	**0**

COURSE OBJECTIVES

- To know the human society and system.
- To understand the capitalism, fascism and communism.
- To gain knowledge in human welfare and essential elements in Indian civilization.

UNIT I HUMAN SOCIETY AND SYSYTEM **9**

Considerations for humane society, holistic thought, human being’s desires, harmony in self, harmony in relationships, society, and nature, societal systems.

UNIT II CAPITALISM **9**

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, Imperialism. Liberal democracy.

UNIT III FASCISM AND COMMUNISM **9**

Fascism and totalitarianism. World War I and II. Cold war. Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical Materialism, historical materialism, Russian and Chinese models.

UNIT IV HUMAN WELFARE **9**

Welfare state. Relation with human desires. Empowered human beings, satisfaction. Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives, Relationship with nature.

UNIT V ESSENTIAL ELEMENTS OF INDIAN CIVILIZATION **9**

Essential elements of Indian civilization, Technology as driver of society, Role of education in shaping of society. Future directions.

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explore the human society and system.
CO2: Explain the principles of capitalism.
CO3: Discuss the fascism and communism.
CO4: Explore the importance of Human Welfare.
CO5: List the essential elements of Indian civilization.

TEXT BOOKS

1. Capra, F, The Turning Point: Science, Society, and the Rising Culture (Revised ed.). HarperOne,2023.
2. Marx, K., & Engels, F. The Communist Manifesto. Penguin Classics. 2022.
3. Paxton, R. O. The Anatomy of Fascism. Vintage, 2022.

REFERENCES BOOKS

1. Kumar, S.,The Song of the Earth. Green Books, 2022.
2. Stiglitz, J. E, Globalization and Its Discontents Revisited: Anti-Globalization in the Era of Trump. Penguin UK, 2017.
3. Lenin, V. I., The State and Revolution. Penguin Random House 2024.
4. Sen, A., Development as Freedom. Oxford University Press.2022.
5. Capra, F., & Luisi, P. L., The Systems View of Life: A Unifying Vision. Cambridge University Press, 2022.

24MC5105 STATE, NATION BUILDING AND POLITICS IN INDIA **L T P C**
3 0 0 0

COURSE OBJECTIVE

- To gain knowledge in need and role of state and politics.
- To gain knowledge in Indian national movements.
- To gain knowledge in national politics and constitution.

UNIT I INTRODUCTION **9**

Understanding the need and role of State and politics. Development of Nation-State, sovereignty, sovereignty in a globalized world.

UNIT II STATE POLITICS 9

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government unitary-federal, Presidential-Parliamentary.

UNIT III INDIAN NATIONAL MOVEMENTS 9

The idea of India. 1857 and the national awakening. 1885 Indian National Congress and development of national movement – its legacies.

UNIT IV CONSTITUTION OF INDIA 9

Constitution making and the Constitution of India. Goals, objective and philosophy.

UNIT V NATIONAL POLITICS 9

National integration and nation-building. Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario.

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Eplore the needs of politics.
- CO2: Explain the organs of state politics.
- CO3: Explain the history of Indian national movements.
- CO4: Discuss the constitution of India.
- CO5: Discuss the roles of national politics.

TEXT BOOKS

1. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.
2. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.
3. Chatterjee, P. (Ed.). State and politics in India. Oxford University Press, 1997.

REFERENCE BOOKS

1. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013.
2. V. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991.
3. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition.
4. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.
5. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.

24MC5106 INDUSTRIAL SAFETY **L T P C**
3 0 0 0

COURSE OBJECTIVES

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.

UNIT I SAFETY TERMINOLOGIES 9

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS 9

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006.

UNIT III SAFETY ACTIVITIES 9

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment.

UNIT IV WORKPLACE HEALTH AND SAFETY 9

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane SafetyToxic gas Release.

UNIT V HAZARD IDENTIFICATION TECHNIQUES 9

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Course outcomes on completion of this course the student will be able:

CO1: Explain the basic concept of safety.
CO2: Obtain knowledge of Statutory Regulations and standards.
CO3: Know about the safety Activities of the Working Place.
CO4: Analyze on the impact of Occupational Exposures and their Remedies
CO5: Obtain knowledge of Risk Assessment Techniques.

TEXT BOOKS

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education
3. Asfahl, C. R., & Rieske, D. W., Industrial safety and health management (7th ed.). Pearson 2018.

REFERENCE BOOKS

1. Frank Lees, 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition., 2012.
2. John Ridley & John Channing, Safety at Work: Routledge, 7th Edition., 2008.
3. Dan Petersen, Techniques of Safety Management: A System Approach, 2003
4. Alan Waring, Safety management system: Chapman & Hall, England 5. Society of Safety Engineers, USA, 1996
5. Ferris, R. W., & Murphy, D, Workplace safety: Establishing an effective violence prevention program. Butterworth-Heinemann.

24OCI101 ESTIMATION AND COSTING OF BUILDING **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand methods for estimating quantities in a range of construction projects, including buildings, roads, and infrastructure.
- To acquire knowledge in rate analysis and cost estimation for construction activities.
- To build proficiency in drafting construction specifications, technical reports, and tender documents.

UNIT I ESTIMATION OF QUANTITIES **9**

Philosophy – Purpose – Methods of estimation – Centre line method – Long and short wall method – Types of estimates – Approximate estimates – Detailed estimate – Estimation of quantities for buildings, bituminous and cement concrete roads, septic tank, soak pit.

UNIT II COSTING AND RATE ANALYSIS **9**

Standard Data – Observed Data – Schedule of rates – Market rates – Materials and Labour – Standard Data for Man Hours and Machineries for common civil works.

UNIT III CONSTRUCTION SPECIFICATIONS AND DOCUMENTATION **9**

Specifications – Detailed and general specifications – Constructions – Sources – Types of specifications – Principles for report preparation – report on estimate of residential building – Culvert – Roads.

UNIT IV TYPES OF CONTRACTS **9**

Contract – Types of contracts – BOT – Types - Formation of contract – Contract conditions – Contract for labour, material, design, construction.

UNIT V PROPERTY VALUATION **9**

Definitions – Various types of valuations – Valuation methods - Necessity –Year's purchase-sinking fund- Capitalised value – Depreciation – Escalation – Valuation of land – Buildings – Calculation of Standard rent.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS (Using MS Excel Software)

1. Deriving an approximate estimate for a multistoried building by approximate methods.
2. Detailed estimate for the following with the required material survey for the same.
3. Derive an estimate for Ground plus three storied RCC Framed structure with blockwork walls.
4. Prepare the detailed estimate for the bridge with minimum 2 spans.
5. Detailed estimate for the factory building.
6. Detailed estimate for the road work cross drainage work.
7. Derive an estimate for Ground plus three storied building with load-bearing walls.
8. Preparation of valuation report in standard Government form.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On Successful completion of this course, the student will able to

CO1: Estimate quantities for construction projects using standard methods and software.

CO2: Analyze rates and create cost estimates for different construction works.

CO3: Gain skills in preparing construction specifications, reports, and tenders.

CO4: Analyze the different types of construction contracts, their formation, and how disputes are resolved.

CO5: Value the properties such as land, buildings, mortgages, and leases.

TEXT BOOKS

1. B.N Dutta 'Estimating and Costing in Civil Engineering', CBS Publishers & Distributors (P) Ltd, Twenty eighth revised edition, 2020.
2. B.S.Patil, 'Civil Engineering Contracts and Estimates', 7th edition, University Press, 2015.
3. D.N. Banerjee, 'Principles and Practices of Valuation', V Edition, Eastern Law House, 2015.

REFERENCE BOOKS

1. Hand Book of Consolidated Data – 8/2000, Vol.1, TNPWD.
2. Tamil Nadu Transparencies in Tenders Act, 1998 and rules 2000.
3. Arbitration and Conciliation Act, 1996.
4. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996.
5. Standard Data Book for Analysis and Rates, IRC, New Delhi, 2019.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	2	3	2	3	3	3	2	3	3	1	1
CO2	2	3	3	2	3	2	3	3	3	2	3	3	1	1
CO3	2	3	3	2	3	2	3	3	3	2	3	3	1	1
CO4	2	3	3	2	3	2	3	3	3	2	3	3	1	1
CO5	2	3	3	2	3	2	3	3	3	2	3	3	1	1
AVG	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**1**	**1**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OCI102 QUALITY ASSESSMENT OF BUILDING MATERIALS — L T P C 3 0 2 4

COURSE OBJECTIVES

- To learn the importance of quality control and testing standards for building materials.
- To understand the methods for testing materials like cement, concrete, aggregates, bricks, and steel.
- To gain hands-on experience in testing the quality of building materials in the laboratory.

UNIT I INTRODUCTION TO QUALITY ASSESSMENT AND TESTING STANDARDS — 9

Importance of quality control in construction - Properties of building materials - physical, chemical, and mechanical properties - Quality assurance vs. quality control - IS codes for material testing (cement, aggregates, steel, etc.) - Sampling techniques and procedures - Acceptance criteria and reporting.

UNIT II CEMENT AND CONCRETE — 9

Types and grades of cement - Testing of cement: fineness, consistency, setting time, strength - Concrete mix design (brief introduction) – Grades of Concrete - Workability and durability tests - Compressive, tensile, and flexural strength of concrete - Nondestructive testing (NDT) - rebound hammer, ultrasonic pulse velocity. Types and roles of admixtures - Quality assessment of chemical and mineral admixtures.

UNIT III AGGREGATES — 9

Types of aggregates - fine and coarse - Tests on aggregates - sieve analysis, specific gravity, water absorption, impact value, crushing value - Bulking of sand - Alkali-aggregate reaction - IS codes relevant to aggregate testing.

UNIT IV BRICKS, BLOCKS, AND MASONRY UNITS — 9

Classification and properties of bricks and blocks - Water absorption, compressive strength, efflorescence of bricks - Testing of solid and hollow concrete blocks - Masonry mortar: types and tests - Quality standards for masonry units relevant to IS codes.

UNIT V STEEL, TIMBER, AND OTHER MATERIALS **9**

Types of steel used in construction – mild steel, HYSD, TMT - Tensile and bend tests for steel – Timber - defects, moisture content, and strength grading - Quality control for paints, plastics, and glass - Modern materials - Geosynthetics, Graphine infused materials, Fiber reinforced polymers, Phase change materials (PCMs), Recycled and sustainable materials, Geopolymer, Advanced composite materials and Nano materials.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Fineness and consistency test on cement.
2. Compressive strength test on cement mortar cubes and concrete cubes.
3. Workability test on fresh concrete using slump cone and compaction factor.
4. Compressive and flexural strength test on hardened concrete.
5. Sieve analysis and specific gravity test on aggregates.
6. Impact and crushing value test on coarse aggregates.
7. Water absorption and compressive strength test on bricks.
8. Non-Destructive test on concrete specimens.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On Successful completion of this course, the students will be able to

CO1: Demonstrate the use of quality control techniques to verify building material standards.

CO2: Evaluate the properties of cement, concrete, and admixtures using standard methods and non-destructive testing.

CO3: Perform tests on different types of aggregates to evaluate their properties and compliance with relevant IS codes.

CO4: Analyze the quality of bricks and blocks to ensure they meet construction requirements.

CO5: Perform testing on steel, timber, and modern materials to determine their construction suitability.

TEXT BOOKS

1. Shetty, M.S., Concrete Technology (Theory and Practice), S. Chand and Company Ltd., 2008.
2. Gambhir, M.L., Concrete Technology, Tata McGraw Hill Education, 5th Edition, 2013.
3. Varghese, P.C., Quality Control and Testing of Construction Materials, PHI Learning Pvt. Ltd., 2007.

REFERENCE BOOKS

1. Duggal, S.K., Building Materials, New Age International Publishers, 4th Edition, 2008.
2. IS 456:2000 – Plain and Reinforced Concrete – Code of Practice, Bureau of Indian Standards, New Delhi.

3. IS 383:2016 – Specification for Coarse and Fine Aggregates for Concrete, Bureau of Indian Standards, New Delhi.
4. IS 516:2018 – Method of Tests for Strength of Concrete, Bureau of Indian Standards, New Delhi.
5. IS 3495 (Parts 1 to 4):1992 – Methods of Tests of Burnt Clay Building Bricks, Bureau of Indian Standards, New Delhi.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	3	2	3	3	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	3	2	3	3	2	2
CO3	2	3	3	2	3	2	3	3	3	2	3	3	1	1
CO4	2	3	3	2	3	2	3	3	3	2	3	3	2	2
CO5	2	3	3	2	3	2	3	3	3	2	3	3	3	3
AVG	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OCI103 PROJECT MANAGEMENT **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To study and understand the formulation, scheduling and various safety concepts and its requirements applied to construction projects.
- To study the various management techniques for successful completion of construction projects.
- To study the effect of management for project organization, workers, material and equipment utilization, and cost estimation.

UNIT I GENERAL OVERVIEW AND PROJECT ORGANIZATION 9

Introduction - Interdisciplinary nature of modern construction projects – execution of project – evaluation of bits – resource management.

UNIT II ESTIMATION OF PROJECT COST & ECONOMICS 9

Estimating quantities – description of items – estimation of project cost – running account bills – decision making in construction projects – depreciation of construction equipment – case study.

UNIT III PLANNING AND SCHEDULING 9

Introduction – project scheduling – uncertainties in duration of activities using PERT – Project monitoring and control system – resource levelling and allocation – crashing of network.

UNIT IV SAFETY DURING CONSTRUCTION **9**

Basic terminology in safety - types of injuries - safety pyramid - Accident patterns - Planning for safety budget, safety culture - Introduction to OSHA regulations - Site safety programs - Job hazardanalysis, accident investigation & accident indices-violation, penalty.

UNIT V SAFE OPERATING PROCEDURES **9**

Safety during alteration, demolition works — Earthwork, steel construction, temporary structures,masonry & concrete construction, cutting & welding - Construction equipment, materials handling- disposal & hand tools - Other hazards – fire, confined spaces, electrical safety - Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Introduction to various construction management software.
2. Planning and creating new project.
3. Scheduling and constraints using PRIMAVERA.
4. Project cost management using PRIMAVERA.
5. Construction project safety management using BIM.
6. Gantt Chart and Network Diagram Creation.
7. Critical Path Method (CPM) & PERT Analysis.
8. Risk Management Simulation.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Perform formulations of projects.

CO2: Analyze project costing.

CO3: Identify and estimate the activity in the construction.

CO4: Develop the knowledge on accidents and their causes.

CO5: Plan, assess, analyze and manage the construction project sites using CPM/PERT.

TEXT BOOKS

1. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 1998.
2. Choudhury S, Project Management, McGraw-Hill Publishing Company, New Delhi, 1988.
3. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.

REFERENCE BOOKS

1. Barcus, S.W. and Wilkinson. J. W., Hand Book of Management Consulting Services, McGraw Hill,New York, 1986.
2. Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd., 1992.

3. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth-Heinemann, USA, 2017.
4. Patrick X.W. Zou, Riza Yosia Sunindijo, Strategic Safety Management in Construction andEngineering John Wiley & Sons, Ltd 2015.
5. Frederick E. Gould, Construction Project Management, Wentworth Institute of Technology, Vary E. Joyce, Massachusetts Institute of Technology, 2000.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	3	2	3	3	3	2	3	3	2	2
CO2	2	3	3	2	3	2	3	3	3	2	3	3	1	1
CO3	2	3	3	2	3	2	3	3	3	2	3	3	1	1
CO4	2	3	3	2	3	2	3	3	3	2	3	3	2	2
CO5	2	3	3	2	3	2	3	3	3	2	3	3	2	2
AVG	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**1.6**	**1.6**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OCI104 BUILDING PLANNING USING VAASTU SASTRA **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To introduce the principles of Vaasthu Shastra and its role in modern building planning.
- To equip students with the knowledge of guidelines for residential and commercial spaces.
- To develop the skills to apply principles in planning spaces for maximum comfort, energy flow, and harmony.

UNIT I INTRODUCTION TO VAASTHU SHASTRA **9**

Introduction to traditional Indian building orientation concepts including Vaasthu Shastra: overview, historical context, and philosophical background. Introduction to the five elements (Pancha Bhootas), cardinal directions, and their relevance in spatial organization. Role of energy flow and psychological comfort in building planning.

UNIT II GUIDELINES FOR RESIDENTIAL BUILDINGS **9**

General Vaasthu planning guidelines for residential buildings with functional and spatial arrangements. Orientation and zoning for daylight, ventilation, and thermal comfort. Introduction to structural load considerations as per IS 875 – Part 1: Dead Loads and IS 875 – Part 2: Imposed Loads. Importance of safety, utility, and aesthetic harmony in layout design.

UNIT III PLANNING OF COMMERCIAL AND PUBLIC BUILDINGS **9**

Design principles for commercial and public buildings such as offices, retail spaces, educational institutions, and hospitals. Functional requirements, circulation, and service zoning. Application of planning standards and integration with IS 875 loading codes and IS 456: Plain and Reinforced Concrete – Code of Practice.

UNIT IV CLIMATIC DESIGN & ENVIRONMENTAL INTEGRATION 9

Importance of site context, solar orientation, prevailing winds, and daylighting in building design. Incorporating passive design strategies for thermal comfort and sustainability. Overview of IS SP 41: Guidelines for Climatic Design and ECBC (Energy Conservation Building Code) basics.

UNIT V COMMON DEFECTS AND SOLUTIONS 9

Common functional and structural design issues in residential and commercial buildings. Remedial measures as per structural codes and basic planning principles. Introduction to basic concepts of defect rectification through both engineering practices and traditional approaches. Real-life examples and mini-case studies.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS

1. Vaasthu analysis of an existing residential floor plan.
2. Designing room layouts based on Vaasthu principles.
3. Vaasthu compliant commercial building layout planning.
4. Identifying and correcting Vaasthu defects in a building plan.
5. Vaasthu guidelines for entrance and exit planning.
6. Selecting a construction site based on Vaasthu considerations.
7. Kitchen layout design following Vaasthu principles.
8. Optimizing solar and wind orientation in building design using Vaasthu.

TOTAL:30 PERIODS

COURSE OUTCOMES

On Successful completion of this course, the student will able to

CO1: Explain the key principles of Vaasthu Shastra.

CO2: Apply guidelines in the design of residential and commercial buildings.

CO3: Plan spaces that promote balance, energy flow, and harmony.

CO4: Design buildings that respond to climate and environment using passive strategies and relevant IS codes.

CO5: Identify and rectify common defects in existing buildings.

TEXT BOOKS

1. Narayan, S. Vastu Shastra: For a better living. Rupa Publications, 2005.
2. Vasudevan, R. Vastu: Transcending time, tradition, and modernity. Orient BlackSwan, 2011.
3. Sastry, B. K. Vastu Shastra: The ancient Indian science of architecture. TBS Publishers, 2002.

REFERENCE BOOKS

1. Bhat, S. Vastu for modern living. New Age International,2009.
2. Chakraborty, P. The art of Vastu Shastra. Allied Publishers, 2010.

3. Nambiar, S. M. Vastu Shastra for home and office. Srishti Publishers, 2013.
4. Kumar, P. Vastu for health, wealth, and happiness. Orient Longman, 2016.
5. Sharma, A. Practical Vastu Shastra for the home. Sterling Publishers Pvt. Ltd, 2008.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
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CO2	2	3	3	2	3	2	3	3	3	2	3	3	1	1
CO3	2	3	3	2	3	2	3	3	3	2	3	3	2	2
CO4	2	3	3	2	3	2	3	3	3	2	3	3	3	2
CO5	2	3	3	2	3	2	3	3	3	2	3	3	3	3
AVG	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**2.2**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OAI101 WEB TECHNOLOGY

L T P C
3 0 2 4

COURSE OBJECTIVES

- To understand different Internet Technologies.
- To learn java-specific web services architecture.
- To develop web applications using frameworks.

UNIT I WEB SITE BASICS, HTML5, CSS3, WEB2.0 — 9

Web Essentials**:** Clients, Servers and Communication – The Internet – World Wide Web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 Control Elements – Drag and Drop – Audio – Video Controls – CSS3 – Inline, Embedded and External Style Sheets – Rule Cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations – Bootstrap Framework.

UNIT II CLIENT-SIDE PROGRAMMING — 9

Java Script: An introduction to JavaScript–JavaScript DOM Model-Exception Handling-Validation- Built-in objects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – Function Files.

UNIT III SERVER-SIDE PROGRAMMING — 9

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC.

UNIT IV PHP AND XML — 9

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built -in functions- Form Validation. XML: Basic XML -Document Type Definition - XML Schema, XML Parsers and Validation, XSL.

UNIT V INTRODUCTION TO ANGULAR AND WEB APPLICATIONS FRAME WORKS **9**

Introduction to AngularJS, MVC Architecture, Understanding ng attributes, Expressions and data binding, Conditional Directives, Style Directives, Controllers, Filters, Forms, Routers, Modules, Services; Web Applications Frameworks and Tools – Firebase- Docker- Node JS- React- Django- UI & UX.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Create a webpage with the following using HTML
   a) To embed an image map in a webpage.
   b) To fix the hotspots.
   c) Show all the related information when the hotspots are clicked.
2. Create a webpage with all types of Cascading Style Sheets.
3. Client-side scripts for validating web form controls using DHTML.
4. Installation of Apache Tomcat web server.
5. Write programs in Java using Servlets:
   a) To invoke servlets from HTML forms.
   b) Session tracking.
6. Write programs in Java to create three-tier applications using JSP and Databases:
   a) For conducting online examination.
   b) For displaying student mark list. Assume that student information is available in a database which has been stored in a database server.
7. Programs using XML – Schema – XSLT/XSL.
8. Write a program to design a simple calculator using (a) JavaScript (b) PHP (c) Servlet and (d) JSP.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Construct a basic website using HTML and Cascading Style Sheets.

CO2: Build dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms.

CO3: Develop server-side programs using Servlets and JSP.

CO4: Construct simple web pages in PHP and to represent data in XML format.

CO5: Develop interactive web applications.

TEXT BOOKS

1. Deitel and Deitel and Nieto, Internet and World Wide Web - How to Program, Prentice Hall,5th Edition, 2011.
2. Jeffrey C and Jackson, Web Technologies: A Computer Science Perspective, Pearson Education, 2011.
3. Angular 6 for Enterprise-Ready Web Applications, Doguhan Uluca, 1st Edition, Publishing.

REFERENCE BOOKS

1. Stephen Wynkoop and John Burke, Running a Perfect Website, QUE, 2nd Edition, 1999.
2. Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley p, 2009.
3. Gopalan N. P. and Akilandeswari J., Web Technology, Prentice Hall of India, 2011.
4. Uttam K. Roy, Web Technologies, Oxford University Press, 2011.
5. Angular: Up and Running – Learning Angular, Step-by-Step, Shyam Seshadri, 1st Edition, O′Reilly.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	–	2	–	3	–	–	–	–	2	–	2	1	1
CO2	3	2	3	–	3	–	–	–	–	–	–	3	1	1
CO3	3	2	3	–	3	–	–	–	–	–	–	3	1	1
CO4	3	2	2	–	3	–	–	–	–	–	–	3	1	1
CO5	3	3	3	2	3	2	2	–	2	2	2	3	1	1
AVG	**3**	**2.3**	**2.6**	**2**	**3**	**2**	**2**	**-**	**2**	**2**	**2**	**2.8**	**1**	**1**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OAI102 OBJECT ORIENTED PROGRAMMING **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand Object Oriented Programming concepts and basics of Java programming Language.
- To know the principles of packages, inheritance and interfaces.
- To develop a Java application with threads and generics classes.

UNIT I INTRODUCTION TO OOP AND JAVA **9**

Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements –Programming Structures in Java – Defining classes in Java – Constructors-Methods -Access specifiers - Static members-Java Doc comments

UNIT II INHERITANCE PACKAGES AND INTERFACES **9**

Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics–Types of Inheritance –Super keyword –Method Overriding – Dynamic Method Dispatch –Abstract Classes –final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access – Importing Packages – Interfaces.

UNIT III EXCEPTION HANDLING AND MULTI THREADING 9

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions–User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.

UNIT IV I/O, GENERICS, STRING HANDLING 9

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.

UNIT V JAVAFX EVENT HANDLING, CONTROLS AND COMPONENT 9

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, Toggle Button – Radio Buttons – List View – Combo Box – Choice Box – Text Controls – ScrollPane.Layouts–FlowPane–HBoxandVBox–BorderPane–StackPane–GridPane.Menus – Basics – Menu – Menu bars – Menu Item.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Develop stack and queue data structures using classes and objects.
2. Write a Java program to create an abstract class named Shape that contains two integers and an empty method named printArea (). Provide three classes named Rectangle, Triangle, and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method printArea () that prints the area of the given shape.
3. Solve the above problem using an interface.
4. Implement exception handling and creation of user-defined exceptions.
5. Write a Java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of the cube of the number.
6. Write a program to perform file operations.
7. Develop applications to demonstrate the features of generics classes.
8. Implement single, multilevel, and hierarchical inheritance with method overriding.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Apply the concepts of classes and objects to solve simple problems.

CO2: Develop programs using inheritance, packages and interfaces.

CO3: Make use of exception handling mechanisms and multithreaded model to solve real-world problems.

CO4: Build Java applications with I/O packages, string classes, Collections and generics Concepts.

CO5: Integrate the concepts of event handling and JavaFX components and controls for developing GUI-based applications.

TEXT BOOKS

1. Herbert Schildt, “Java: The Complete Reference”, 11th Edition, McGraw Hill Education, New Delhi, 2019.
2. Herbert Schildt, “IntroducingJavaFX8Programming”,1st Edition, McGrawHill Education, New Delhi, 2015.
3. Design Patterns: Elements of Reusable Object-Oriented Software" by Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides (The Gang of Four).

REFERENCE BOOKS

1. Cay S. Horstmann, “Core Java Fundamentals”, Volume 1, 11th Edition, Prentice Hall, 2018.
2. Head First Object-Oriented Analysis and Design" by Brett McLaughlin, Gary Pollice, and David West.
3. Meyer, Bertrand. Object-Oriented Software Construction 3rd Edition. Prentice Hall, 1997.
4. Phillips, Dusty. Python 3 Object-Oriented Programming 3rd Edition, Packt Publishing, 2022.
5. Lafore, Robert. Object-Oriented Programming in C++ 3rd Edition, Publishing, 2002.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	1	-	-	-	-	-	-	2	2	2
CO2	3	2	3	-	2	-	-	-	1	-	-	-	1	1
CO3	3	2	-	2	3	-	-	-	-	-	2	-	1	1
CO4	3	2	2	-	3	-	-	-	-	-	-	-	1	1
CO5	2	-	3	-	3	-	-	-	-	2	2	-	1	1
AVG	**2.8**	**2**	**2.5**	**2**	**2.4**	**-**	**-**	**-**	**1**	**2**	**2**	**2**	**1.2**	**1.2**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24OAI103 COMPUTATIONAL DATA ANALYTICS

L T P C
3 0 2 4

COURSE OBJECTIVES

- To understand the concepts of ADTs.
- To learn linear data structures – lists, stacks, and queues.
- To understand non-linear data structures – trees and graphs.

UNIT I LISTS **9**

Abstract Data Types (ADTs) –List ADT –Array-based implementation–Linked list implementation –Singly linked lists–Circularly linked lists–Doubly-linked lists–Applications of lists–Polynomial ADT – Radix Sort – Multi lists.

UNIT II STACKS AND QUEUES **9**

Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions- Infix to Postfix conversion–Function Calls–Queue ADT–Operations–Circular Queue–DeQueue – Applications of Queues.

UNIT III TREES **9**

Tree ADT–Tree Traversals –Binary Tree ADT–Expression trees–Binary Search Tree ADT–AVL Trees –Priority Queue (Heaps) – Binary Heap.

UNIT IV MULTI WAY SEARCH TREES AND GRAPHS **9**

B-Tree –B+Tree – Graph Definition – Representation of Graphs – Types of Graph - Breadth-first traversal –Depth-first traversal –– Bi-connectivity – Euler circuits –Topological Sort – Dijkstra's algorithm – Minimum Spanning Tree –Prim's algorithm –Kruskal's algorithm

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES **9**

Searching –Linear Search –Binary Search. Sorting –Bubble sort –Selection sort –Insertion sort – Shell sort –. Merge Sort – Hashing –Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Array implementation of Stack, Queue and Circular Queue ADTs.
2. Implementation of Singly Linked List.
3. Linked list implementation of Stack and Linear Queue ADTs.
4. Implementation of Polynomial Manipulation using Linked list.
5. Implementation of Binary Search Trees.
6. Implementation of AVL Trees.
7. Implementation of Heaps using Priority Queues.
8. A Real-world case study using LSB (Least Significant Bit) steganography in data analytics.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Define linear and non-linear data structures.

CO2: Implement linear and non–linear data structure operations.

CO3: Use appropriate linear/non–linear data structure operations for solving a given problem.

CO4: Apply appropriate graph algorithms for graph applications.

CO5: Analyze the various searching and sorting algorithms.

TEXT BOOKS

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007.
3. Ivo D. Dinov, Data Science and Predictive Analytics: Biomedical and Health Applications, (2nd Edition)

REFERENCE BOOKS

1. Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition, Pearson Education, 2015.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, 4th Edition, McGraw Hill / MIT Press, 2022.
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, Data Structures and Algorithms, 1st Edition, Pearson, 2002.
4. Kruse, Data Structures and Program Design in C, 2nd Edition, Pearson Education, 2006.
5. Advanced Data Science and Analytics with Python by Jesús Rogel-Salazar.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	1	-	-	-	-	-	-	2	2	2
CO2	3	3	2	-	2	-	-	-	-	-	-	-	1	1
CO3	3	3	3	-	3	-	-	-	1	-	1	-	1	1
CO4	2	3	2	3	2	-	-	-	-	-	1	-	1	1
CO5	3	2	2	-	3	-	-	-	-	-	-	1	1	1
AVG	**2.8**	**2.6**	**2.3**	**3**	**2.2**	**-**	**-**	**-**	**1**	**-**	**1**	**1.5**	**1.2**	**1.2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OAI104 NETWORKING CONCEPTS

L T P C
3 0 2 4

COURSE OBJECTIVES

- To understand the concept of layering in networks.
- To know the functions of protocols of each layer of the TCP/IP protocol suite.
- To visualize the end-to-end flow of information.

UNIT I INTRODUCTION AND APPLICATION LAYER 10

Data Communication – Networks – Network Types – Protocol Layering – TCP/IP Protocol Suite – OSI Model – Introduction to Sockets – Application Layer Protocols: HTTP, FTP, Email Protocols (SMTP, POP3, IMAP, MIME) – DNS – SNMP

UNIT II TRANSPORT LAYER 9

Introduction – Transport Layer Protocols: UDP, TCP – Connection Management – Flow Control – Congestion Control – Congestion Avoidance (DECbit, RED) – SCTP – Quality of Service

UNIT III NETWORK LAYER 7

Switching: Packet Switching – Internet Protocol – IPv4 – IP Addressing – Subnetting – IPv6 – ARP, RARP, ICMP, DHCP.

UNIT IV ROUTING **7**

Routing and Protocols: Unicast Routing – Distance Vector Routing – RIP – Link State Routing – OSPF – Path Vector Routing – BGP – Multicast Routing: DVMRP, PIM

UNIT V DATA LINK AND PHYSICAL LAYERS **12**

Data Link Layer – Framing – Flow Control – Error Control – Data Link Layer Protocols: HDLC, PPP – Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) Physical Layer: Data and Signals – Performance – Transmission Media – Switching – Circuit Switching.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Learn to use commands like TCP dump, net stat, if config, ns lookup, and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.
2. Write a HTTP web client program to download a webpage using TCP sockets.
3. Applications using TCP sockets like:
   a) Echo client and echo server.
   b) Chat.
4. Simulation of DNS using UDP sockets.
5. Use a tool like Wireshark to capture packets and examine the packets.
6. Write code simulating ARP/RARP protocols.
7. Study of Network Simulator (NS) and simulation of congestion control algorithms using NS.
8. Study of TCP/UDP performance using a simulation tool.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the basic layers and their functions in computer networks.
CO2: Explore the basics of how data flows from one node to another.
CO3: Analyze routing algorithms.
CO4: Describe protocols for various functions in the network.
CO5: Analyze the working of various application layer protocols.

TEXT BOOKS

1. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021.
2. Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition, TMH, 2022.
3. Andrew S. Tanenbaum & David J. Wetherall, Computer Networks.

REFERENCE BOOKS

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.

3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill, 2012.
5. William Stallings, Network Security Essentials: Applications and Standards.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	1	-	-	-	-	-	-	2	1	1
CO2	3	3	-	2	2	-	-	-	-	-	1	-	1	1
CO3	3	2	2	2	1	-	-	-	-	-	1	-	1	1
CO4	2	1	-	-	2	-	-	-	-	-	-	-	1	1
CO5	2	2	2	-	3	-	-	-	1	2	2	1	1	1
AVG	2.6	2	2	2	1.8	-	-	-	1	2	1.3	1.5	1	1

1-Low, 2-Medium, 3-High, '-'- No correlation

24OEI101 CONTROL SYSTEM ENGINEERING **L T P C 3 0 2 4**

COURSE OBJECTIVES

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems

UNIT I MATHEMATICAL MODELS OF PHYSICALSYSTEMS 9

Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS 9

Standard test signals – Steady state error & error constants – Time Response of I and II order system.

UNIT III FREQUENCY RESPONSE ANALYSIS 9

Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV STABILITY CONCEPTS & ANALYSIS 9

Concept of stability – Necessary condition – RH criterion – Relative stability – Nyquist stability criterion – Stability from Bode plot – Relative stability from Nyquist & Bode – Closed loop frequency response.

UNIT V STATE VARIABLE ANALYSIS **9**

Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Mathematical modelling and analysis of Mechanical and Electrical systems using transfer function approach.
2. Time domain analysis of second order system.
3. Study of stability using Routh Hurwitz criterion.
4. Root locus technique based stability analysis.
5. Frequency response and stability analysis using Bode plot.
6. Frequency response and stability analysis using Polar plot.
7. Mathematical modelling and analysis of Mechanical and Electrical systems using state space approach.
8. Test of controllability and observability of a state space model.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Design the basic mathematical model of physical System.
CO2: Analyze the time response analysis and techniques.
CO3: Analyze the transfer function from different plots.
CO4: Apply the stability concept in various criterion.
CO5: Assess the state models for linear and continuous Systems.

TEXT BOOKS

1. Farid Golnarghi , Benjamin C. Kuo, Automatic Control Systems Paper back,
2. McGraw Hill Education, 2018.
3. Katsuhiko Ogata, 'Modern Control Engineering', Pearson, 5th Edition2015.
4. J. Nagrath and M. Gopal, Control Systems Engineering (Multi Colour Edition),
5. New Age International, 2018.

REFERENCE BOOKS

1. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Pearson Education, 2010.
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996
3. John J. D'Azzo, Constantine H. Houpis and Stuart N. Sheldon, Linear Control System AnalysisandDesign, 5th Edition, CRC PRESS, 2003.
4. S . Palani, Control System Engineering, McGraw-Hill Education Private Limited, 2009.
5. Yaduvir Singh and S.Janardhanan, Modern Control, Cengage Learning, First mpression, 2010.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	2	1	-	-	-	-	-	1	1	1
CO2	3	3	2	3	1	1	-	-	-	-	-	1	1	1
CO3	3	3	3	2	2	2	-	-	-	-	-	1	1	1
CO4	3	3	3	2	2	1	-	-	-	-	-	1	1	1
CO5	3	3	3	1	1	1	-	-	-	-	-	1	1	1
AVG	**3**	**3**	**2.8**	**2**	**1.6**	**1.2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OEI102 POWER ELECTRONICS AND DRIVES **L T P C**
3 0 2 4

COURSE OBJECTIVES

- Different types of power semiconductor devices and their switching.
- Operation, characteristics and performance parameters of controlled rectifiers and switched mode power supplies.
- Operation of AC voltage controller and various configurations.

UNIT I SINGLE PHASE RECTIFIERS **9**

Power Diode – half wave rectifier – mid-point secondary transformer based full wave rectifier – bridge rectifier - distortion factor - LC filters – SCR-Two transistor analogy based turn- ON, Controlled converters (1 pulse, 2 pulse) displacement factor – ripple and harmonic factor effect of source inductance, inverter angle limit.

UNIT II THREE PHASE RECTIFIERS **9**

Three phase diode rectifiers – Concern for power quality, Controlled converters (3 pulse, 6 pulse) Computation of performance parameters.

UNIT III SWITCHING POWER SUPPLIES **9**

IGBT, MOSFET: dynamic behaviour - driver and snubber circuits -low power high switching frequency switching Power supplies, buck, boost, buck-boost converters – Isolated topologies – resonant converters switching loss calculations and thermal design.

UNIT IV AC PHASE CONTROLLERS **9**

TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers various configurations for SCR based single and three phase controllers.

UNIT V DRIVE CHARACTERISTICS **9**

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Characteristics of PN junction diode.
2. Experimental verification of transfer characteristics of AC Phase Controllers.
3. Characteristics of SCR.
4. Simulation of Single Phase Rectifiers.
5. Experimental verification of transfer characteristic of AC to DC half controlled Converter.
6. Experimental verification of transfer characteristic of of AC to DC fully controlled Converter.
7. Simulation of Three Phase Rectifiers.
8. Characteristics of MOSFET and IGBT.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the operation of semiconductor devices, its dynamic characteristics and
CO2: Design low power SMPS.
CO3: Analyze the various uncontrolled rectifiers and design suitable filter circuits.
CO4: Analyze the operation of the n-pulse converters and evaluate the performance parameters.
CO5: Apply voltage control and harmonic Elimination methods to inverter circuits.

TEXT BOOKS

1. Ned Mohan, T.M.Undeland, W.P.Robbins, ”Power Electronics: Converters, applications and design”, John Wiley and Sons, 3rd Edition (reprint), 2009
2. Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, 3rd Edition, New Delhi, 2004.
3. Bimal.K.Bose “Modern Power Electronics and AC Drives”, Pearson Education, Second Edition, 2003.

REFERENCE BOOKS

1. Cyril.W.Lander, Power Electronics, McGraw Hill International, Third Edition, 1993.
2. P.S.Bimbhra, Power Electronics, Khanna Publishers, Third Edition 2003
3. PhilipT.Krein, Elements of Power Electronics, Oxford University Press, 2013.
4. P.C.Sen, Power Electronics, Tata McGraw-Hill, 30th reprint, 2008.
5. Bin Wu, Mehdi Narimani, "High-Power Converters and AC Drives", Wiley, 2nd Edition, 2017.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	2	-	-	2	2	1	-	1	1	2
CO2	3	2	2	1	2	-	-	2	2	1	-	1	2	2
CO3	3	2	2	1	2	1	-	2	2	1	-	1	2	1
CO4	3	2	2	-	2	1	-	2	2	1	-	1	2	2
CO5	3	2	2	-	2	1	-	2	2	1	-	1	2	2
AVG	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**	**2**	**1**	**-**	**1**	**1.8**	**1.8**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24OEI103 PLC PROGRAMMING **L T P C**

3 0 2 4

COURSE OBJECTIVES

- To understand the fundamental concepts and architecture of Programmable Logic Controllers (PLCs).
- To identify and analyze the hardware components and interfacing devices used in PLC systems.
- To develop proficiency in PLC programming techniques and logic fundamentals for automation applications**.**

UNIT I PLC BASICS **9**

Programmable Logic Controllers (PLCs): Introduction; definition & history of the PLC; Principles of Operation; Various Parts of a PLC: CPU & programmer/monitors; PLC input & output modules; Solid state memory; the processor; I/O modules; power supplies. PLC advantage & disadvantage; PLC versus Computers, PLC Application.

UNIT II PLC HARDWARE COMPONENTS **9**

The I/O section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules,I/O specifications, The CPU, Memory design, Memory Types, Programming Devices, Selection of wire types and size.

UNIT III FUNDAMENTALS OF LOGIC **9**

The Binary Concept, AND, OR and NOT functions, Boolean Algebra, Developing circuits from Boolean Expression expressions, Producing the Boolean equation from given circuit, Hardwired logic versus programmed logic, Programming word level logic instructions. Converting Relay schematics and Boolean equation into PLC Ladder Programs,

UNIT IV VARIOUS INPUT /OUTPUT DEVICES AND ITS INTERFACING WITH PLC **9**

Different types of Input devices: Switches: Push button Switches, Toggle Switches, Proximity switches, Photo switches, Temperature Switch, Pressure Switch, and Level Switch, Flow Switches, manually operated switches, Motor starters, Transducers and sensors, Transmitters etc. Their working, specification and interfacing with PLC.

UNIT V BASICS OF PLC PROGRAMMING **9**

Processor Memory Organization, Program Scan, PLC Programming languages, Relay type Instructions, Instruction addressing, Branch Instructions, Internal Relay Instructions, Programming Examine if Closed and examine If Open instructions, Entering the ladder diagram, Modes of operation. Creating Ladder Diagrams from Process Control Descriptions.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Introduction to ladder programming& to implement basic logic gates.
2. Develop, Simulate and Test Ladder diagram for Bottle Filling system.
3. Develop, Simulate and Test Ladder diagram for Traffic Light Control System.
4. Develop, Simulate and Test Ladder diagram for Car Parking system.
5. Develop Simulate and Test Ladder diagram for an alarm enunciator system.
6. Develop, Simulate and Test Ladder diagram for Batch Mixer.
7. Develop and test PLC program for three phase motor in both direction.
8. Develop, Simulate and Test Ladder diagram for stepper motor control in forward and reverse direction.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Compare conventional sequential control with programmable logic control system

CO2: Develop programs using different PLC programming languages for sequential and continuous process.

CO3: Interface analog and digital input/ output devices with PLC using different communication protocol

CO4: Test the PLC based system and troubleshoot the errors associated with it.

CO5: Develop the fundamentals of logic application.

TEXT BOOKS

1. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York,2019.
2. Stuart Boyer A, "SCADA: Supervisory control and data Acquisition", Fourth Edition, ISA- The Instrumentation, Systems, and Automation Society,2010.
3. Programmable Logic Controllers- Principles and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI.

REFERENCE BOOKS

1. Bolton. W, "Programmble Logic Controllers", Elsevier Newnes, 6th Edition 2015.
2. https://nptel.ac.in/courses/108105062.
3. Programmable Logic Controllers- Programming Method and Applications by
4. JR.Hackworth and F.D Hackworth Jr., Pearson, 2004.
5. Embedded Systems- An integrated approach - Lyla b das, Pearson education 2012. Computers as Components –Wayne Wolf, Morgan Kaufmann (second edition).

Mapping of COs with POs & PSOs

COs	POs												PSOs	
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CO4	3	2	2	-	2	1	-	2	2	1	-	1	3	3
CO5	3	2	2	-	2	1	-	2	2	1	-	1	2	3
AVG	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**	**2**	**1**	**-**	**1**	**1.8**	**2.2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OEI104 ELECRONIC DEVICES AND POWER AMPLIFIRES **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To introduce the fundamentals of analysis of electronic circuits.
- To provide basic understanding of semiconductor devices and analog integrated circuits.
- To explain the design and implementation of OP-AMP circuits.

UNIT I DIODES **9**

The Ideal Diode - Terminal Characteristics of Junction Diodes - Physical Operation of Diodes - Analysis of Diode Circuits - Small Signal Model and Its Application - Operation in the Reverse Breakdown Region - Zener Diodes.

UNIT II BIPOLAR JUNCTION TRANSISTOR **9**

Operation of the NPN transistor in the Active mode – Transistor Characteristics – Transistor as an Amplifier – Basic single Stage BJT Amplifier Configurations-Transistor as a Switch.

UNIT III FIELD EFFECT TRANISITOR **9**

Structure and Physical operation of Enhancement – Type MOSFET – Current Voltage Characteristics of Enhancement – Type MOSFT- The depletion type MOSFET – MOSFET as an Amplifier.

UNIT IV OUTPUT STAGES AND POWER AMPLIFIERS **9**

Classification of output Stages – Class A Output Stage – Class B Output Stage – Biasing the Class AB Stage – Power BJT Tuned Amplifiers – Push Pull Stages.

UNIT V SIGNAL GENERATOR AND WAVEFORM SHAPING CIRCUITS **9**

Basic Principles of Sinusoidal Oscillator – Op Amp- RC Oscillator Circuits – LC and Crystal Oscillators – Multivibrators – Unregulated Power Supply – Integrated Circuit Timers.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Characteristics of PN junction diode.
2. Characteristics of BJT – CB, CE, CC.
3. Op-Amp based amplifier circuits Inverting and Non-inverting amplifier.
4. Op-Amp based Differential amplifier/Instrumentation amplifier.
5. Design of Adder-subtractor circuits using Op-Amp.
6. Square wave and Tri-angular wave oscillator.
7. Op-Amp based Wien bridge and RC oscillator.
8. 555 – timer IC based astable multi-vibrator.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the structure and underlying semiconductor physics concepts.

CO2: Design circuits employing electronic devices.

CO3: Explore the characteristics of OPAMP and its internal components.

CO4: Analyze, design and implement analog electronic circuits involving OP-AMP.

CO5: Analyze, design and implement analog electronic circuits involving timer 555.

TEXT BOOKS

1. David A bell, " Electronic circuits", Oxford University Press, 2011.
2. Ramakant A Gayakwad, " Opamps and Linear Integrated Circuits", IV edition, Pearson Education/PHI, 2009.
3. D. Roy Choudary, S.B. Jain, " Linear Integrated Circuits", Third edition, New Age publishers,2014.

REFERENCE BOOKS

1. Millman and Halkias, "Integrated Electronics", McGraw Hill Publications, 2010.
2. Muhammad H. Rashid, "Linear Integrated Circuits", Cengage Learning, 2014.
3. Donald A Neamen, "Electronic Circuits", McGraw Hill, edition, 2007.
4. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", McGraw Hill,
5. Floyd, Buchla, "Fundamentals of Analog Circuits", Pearson, 2013.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	2	3	3	1	-	-	2	-	-	1	1	1
CO2	2	1	2	3	3	1	-	-	2	-	-	1	1	1
CO3	2	1	2	3	3	1	-	-	2	-	-	1	2	2
CO4	2	1	2	3	3	1	-	-	2	-	-	1	1	2
CO5	2	1	2	3	3	1	-	-	2	-	-	1	2	2
AVG	**2**	**1**	**2**	**3**	**3**	**1**	**-**	**-**	**2**	**-**	**-**	**1**	**1.4**	**1.6**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OBI101 DIGITAL SIGNAL PROCESSING

L T P C
3 0 2 4

COURSE OBJECTIVES

- To introduce the concepts of discrete time random signal processing.
- To introduce about multirate signal processing and its applications.
- To understand the spectrum estimation techniques.

UNIT I MULTIRATE SIGNAL PROCESSING 9

Review of Convolution, DFT and ZT, Multirate Signal Processing - Decimation, Interpolation, Sampling Rate Conversion by a rational factor – digital filter banks, sub band coding, Quadrature Mirror Filter.

UNIT II DISCRETE TIME RANDOM PROCESSES **9**

Stationary random processes, Autocorrelation, Rational Power Spectra, Filters for generating random Processes from white noise and inverse filter – AR, MA and ARMA processes – relationship between autocorrelation and the filter parameters.

UNIT III LINEAR PREDICTION AND FILTERING **9**

Linear Prediction – Forward and Backward - Wiener filters for filtering and prediction – FIR Wiener Filter – IIR Wiener Filter – Kalman Filter.

UNIT IV ADAPTIVE FILTERING **9**

FIR adaptive filters – adaptive filters based on steepest descent method – LMS algorithm – Variants of LMS algorithm – adaptive echo cancellation – adaptive channel equalization – RLS Algorithm.

UNIT V SPECTRUM ESTIMATION **9**

Estimation of power spectra from finite duration observations of signals – Non parametric methods of spectrum estimation – the Bartlett and the Welch method – Parametric spectrum estimation – AR MA and ARMA.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS

1. Study of autocorrelation and Cross Correlation of random signals.
2. Design and Implementation of Multirate Systems.
3. Design and Implementation of Wiener Filter.
4. Design and Implementation of FIR Linear Predictor.
5. Design of adaptive filters using LMS algorithm.
6. Spectrum Estimation using Bartlett and Welch Methods.
7. Design and Implementation of IIR .
8. Design of adaptive filters using RLS algorithm.

TOTAL:30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Comprehend multirate signal processing and demonstrate its applications.

CO2: Demonstrate an understanding of the power spectral density and apply to discrete random signals and systems.

CO3: Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation.

CO4: Analyze adaptive filtering problems and demonstrate its application.

CO5: Apply power spectrum estimation techniques to random signals.

TEXT BOOKS

1. John G. Proakis & Dimitris G.Manolakis, ―Digital Signal Processing – Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.
3. A. V. Oppenheim, R.W. Schafer and J.R. Buck, ―Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.

REFERENCE BOOKS

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.
2. Haykin, Adaptive Filter Theory, 4th Edition, Pearson Education, New Delhi, 2006.
3. Sophoncles J. Orfanidis, “Optimum Signal Processing “, McGraw Hill, 2000.
4. Emmanuel C. Ifeachor& Barrie. W. Jervis, “Digital Signal Processing”, Second Edition, Pearson Education / Prentice Hall, 2002.
5. Sanjit K. Mitra, “Digital Signal Processing – A Computer Based Approach”, Tata Mc Graw Hill, 2007.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	1	1
CO4	2	3	-	-	-	-	-	-	-	-	-	-	1	1
CO5	2	3	-	-	-	-	-	-	-	-	-	-	1	1
AVG	2	3	-	-	-	-	-	-	-	-	-	-	1	1

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24OBI102 IOT AND SENSORS TYPES

L T P C
3 0 2 4

COURSE OBJECTIVES

- To understand the fundamental concepts related to IoT and sensors types.
- To understand basics of an IOT System, IoT hardware and communication protocols, data storage, data analysis and use them for real time IoT enabled domains.
- To become familiar with sensor types and its functions.

UNIT I INTRODUCTION TO IOT AND IOT LEVELS 9

Functional blocks of an IoT system (Sensors, Data Ingress, Data Aggregation Point Communication point back to the cloud, Analysis, Decision making, Actuation) Basic of Physical and logical design of IoT (IoT protocols, communication models) IoT enabled domains (Home automation, Smart cities, environment monitoring, renewable energy, agriculture, industry, healthcare, marketing and management) M2M, Difference between IoT, Embedded Systems and M2M, Industry 4.0 concepts.

UNIT II IOT SENSORS AND HARDWARE 9

Passive and active sensors, differences, Different kinds of sensors (Temperature, humidity, pressure, obstacle, water flow, accelerometer, colour, gyro, load cell, finger print, motion, ultrasonic distance, magnetic vibration, eye blink, hear beat, PPG, glucose, body position, blood pressure), Multi-sensors, Pre-processing (sampling, filtering, ADC, size of data, local memory, compression), IoT front end hardware (Raspberry Pi, Arduino, Galileo, beagle bone equivalent platforms).

UNIT III INTRODUCTION TO IOT PROTOCOLS 9

Infrastructure (6LowPAN, IPv4/IPv6, RPL), Identification (EPC, uCode, IPv6, URIs), Communication/ Transport (Wi-Fi, Bluetooth, ZigBee, LPWAN), Data Protocols (MQTT, CoAP, AMQP, Websocket, Node).

UNIT IV IOT CLOUD AND DATA ANALYTICS 9

Collecting data from sensors, Data Ingress, Cloud storage, IoT cloud platforms (Amazon AWS, Microsoft Azure, and Google APIs), Data analytics for IoT, Software and management tool for IoT, Dashboard design.

UNIT V IOT ARCHITECTURES WITH CASE STUDIES 9

Business models for IoT, smart cities, agriculture, healthcare, industry. Case studies/Mini projectsfor the real time IoT applications.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Introduction to Arduino platform and programming.
2. Explore different communication methods with IoT devices (Zigbee, GSM, and Bluetooth).
3. Introduction to Raspberry PI platform and python programming.
4. Interfacing sensors with Raspberry PI.
5. Communicate between Arduino and Raspberry PI using any wireless medium.
6. Setup a cloud platform to log the data.
7. Log Data using Raspberry PI and upload to the cloud platform.
8. Design an IOT based system.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Enumerate basic premise of an IOT System.

CO2: Implement basic and to be familiar with the sensors available for IoT applications.

CO3: Learn the front-end hardware platforms and communication protocols for IoT.

CO4: Explore the cloud storage, data analysis and management.

CO5: Design and develop the usage for real time IoT enabled domains.

TEXT BOOKS

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
2. Mayur Ramgir, Internet – of – Things, Architecture, Implementation and Security, First Edition, Pearson Education, 2020.
3. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017.

REFERENCE BOOKS

1. Raj kamal, Internet of Things, Architecture and Design Principles, McGraw-Hill, 2017.
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers”, Apress, 2014.H.Gerez, “Algorithms for VLSI Design Automation”, John Wiley, 1999.
3. Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014.
4. Perry Lea, “Internet of things for architects”, Packt, 2018.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	3	-	-	-	-	-	-	-	-	-	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	1	1
CO4	3	3	3	-	-	-	-	-	-	-	-	-	2	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	1	1
AVG	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	**1.6**	**1.6**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24OBI103 MEDICAL DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS L T P C
3 0 2 4

COURSE OBJECTIVES

- To understand the working of the devices for measurement of parameters related to ECG, EEG and EMG.
- To explain diagnostic and therapeutic devices related to respiratory parameters.
- To understand the various sensory measurements that hold clinical importance.

UNIT I CARDIAC EQUIPMENT 9

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor- Holter Monitor, Phonocardiography, Cardiac Pacemaker-Internal and External Pacemaker, AC and DC Defibrillator- Internal and External.

UNIT II NEUROLOGICALEQUIPMENT 9

Clinical significance of EEG, Multi-channel EEG recording system, Evoked Potential– Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph), EEG Bio Feedback Instrumentation.

UNIT III MUSCULAR AND BIOMECHANICAL EQUIPMENT 9

Clinical significance of EEG, Multi-channel EEG recording system, Evoked Potential– Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph), EEG Bio Feedback Instrumentation.

UNIT IV RESPIRATORY MEASUREMENT AND ASSIST SYSTEM 9

Instrumentation for measuring the mechanics of breathing – Spiro meter, Lung Volume and vital capacity, measurements of residual volume, Pneumotacho meter, Whole body Plethysmo graph, Apnoea Monitor.

UNIT V SENSORY DIAGNOSTIC EQUIPMENT 9

Psycho physiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, auto refractometer.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Measurement of visually and auditory evoked potential.
2. Galvanic skin resistance (GSR) measurement.
3. Measurement of output intensity from short wave and ultra sonic diathermy.
4. Electrical safety measurements.
5. Measurement of stimulation current wave forms used in medical stimulator.
6. Recording of Audiogram.
7. Study the working of Defibrillator and pacemakers.
8. Study of ECG, EEG and EMG electrodes.

TOTAL:30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Describe the working and recording setup of all basic cardiac equipment.
CO2: Utilise the working and recording of all basic neurological equipment's.
CO3: Discuss the recording of diagnostic and therapeutic equipment's related to EMG.
CO4: Explain about measurements of parameters related to respiratory system.
CO5: Describe the measurement techniques of sensory responses.

TEXT BOOKS

1. John G.Webster,"Medical Instrumentation Application and Design",4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
2. Joseph J. Carrand John M. Brown,"Introduction to Biomedical Equipment Technology", Pearson education, 2012.
3. Khandpur. R.S., "Handbook of Biomedical Instrumentation". Second Edition. Tata Mc-Graw Hill Pub. Co.,Ltd. 2003.

REFERENCE BOOKS

1. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, 2008.
2. Khandpur. R.S., "Handbook of Biomedical Instrumentation". Second Edition. Tata Mc Graw Hill Pub. Co., Ltd. 2003.

3. Antony Y. K. Chan, "Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008.
4. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.
5. Shakti Chatterjee, Aubert Miller, "Bio medical Instrumentation Systems" 2010 1st edition, Delmar Cencage Learning, Clifton Park, New York.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	-	1	-	-	-	-	-	-	1	2	2
CO2	3	2	1	-	1	-	-	-	-	-	-	1	2	2
CO3	3	2	1	-	1	-	-	-	-	-	-	1	2	2
CO4	3	2	1	-	1	-	-	-	-	-	-	1	2	2
CO5	3	2	1	-	1	-	-	-	-	-	-	1	2	2
AVG	**3**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OBI104 BIOMEDICAL INSTRUMENT AND DESIGN **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To understand the origin of various biological signals and electrode configurations specific to bio-potential measurements.
- To understand the characteristics of Bio signals and the design of bio amplifiers.
- To explain the different techniques used for measurement of non-electrical bio-parameters.

UNIT I ELECTRODE CONFIGURATIONS **9**

Bio signals characteristics – Origin of bio potential and its propagation, Frequency and amplitude ranges, Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, Unipolar and bipolar configuration, classification of electrodes.

UNIT II BIO SIGNAL CHARACTERISTICS **9**

Bio signals characteristics – ECG-frequency and amplitude ranges, Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode.

UNIT III BIO AMPLIFIERS **9**

Infrastructure (6LowPAN, IPv4/IPv6, RPL), Identification (EPC, uCode, IPv6, URIs), Communication/ Transport (Wi-Fi, Bluetooth, ZigBee, LPWAN), Data Protocols (MQTT, CoAP, AMQP, Websocket, Node).

UNIT IV MEASUREMENT OF BIO SIGNALS **9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods and direct methods, Blood flow and cardiac output measurement- Indicator dilution and thermal dilution, Electromagnetic and ultrasound blood flow measurements.

UNIT V BIO CHEMICAL MEASUREMENTS **9**

Biochemical sensors - pH, pO_2 and pCO_2, Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Design of ECG Amplifiers.
2. Design of EMG amplifier.
3. Design of frontal EEG amplifier.
4. Design a Multiplexer and Demultiplexer for any two bio signals.
5. Measurement of body Temperature.
6. Measurement of pulse-rate using Photo transducer.
7. Measurement of pH and conductivity.
8. Measurement of blood pressure using sphygmomanometer.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Illustrate the origin of various biological signals and their characteristics.

CO2: Gain knowledge on characteristics of bio signals.

CO3: Gain knowledge on various amplifiers involved in monitoring and transmission of bio signals.

CO4: Explain the different measurement techniques for non-electrical bio-parameters.

CO5: Explain the biochemical measurement techniques as applicable for diagnosis further treatment.

TEXT BOOKS

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, prentice hall of India, New Delhi, 2015.
2. John G.Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
3. Khandpur R. S, "Handbook of Biomedical Instrumentation", Tata Mc Graw Hill, New Delhi, 2003.

REFERENCE BOOKS

1. John Enderle, Susan Blanchard, Joseph Bronzino, "Introduction to Biomedical Engineering", second edition, Academic Press, 2005.
2. Joseph J. Carrand John M.Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
3. L. A. Geddas and L. E. Baker, "Principles of Applied Biomedical Instrumentation", 2004.
4. John G. Webster, "Bioinstrumentation", John Willey and sons, New York, 2004.
5. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 2003.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1	-	-	-	-	-	-	-	-	2	1
CO2	3	2	1	1	-	-	-	-	-	-	-	-	1	1
CO3	3	2	1	1	-	-	-	-	-	-	-	-	1	1
CO4	3	2	1	2	-	-	-	-	-	-	1	-	3	3
CO5	3	2	1	1	-	-	-	-	-	-	1	-	2	2
AVG	**3**	**2**	**1**	**1.2**	**-**	**-**	**-**	**-**	**-**	**-**	**0.4**	**-**	**1.8**	**1.6**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OCT201 BUILDING PLANNING AND APPROVAL **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the principles of building planning, including utility, economy, aesthetics, and circulation.
- To learn the process of site selection, building orientation, and compliance with legal building regulations.
- To explore sustainable building concepts and smart technologies integrated into modern planning practices.

UNIT I FUNDAMENTALS OF BUILDING PLANNING **9**

Covers basic principles of building planning such as utility, economy, aesthetics, and circulation. Introduces types of buildings, their classification, and key components like walls, doors, windows, and stairs.

UNIT II SITE SELECTION AND ORIENTATION **9**

Explains factors affecting site selection including topography, soil, climate, and access. Emphasizes proper building orientation based on sun path, wind direction, and site features for energy efficiency and comfort.

UNIT III BUILDING RULES AND DEVELOPMENT CONTROL **9**

Introduces building byelaws and development regulations including FAR, setbacks, height limits, and open spaces. Discusses provisions of the National Building Code (NBC) and local municipal norms.

UNIT IV BUILDING APPROVAL PROCESS AND DOCUMENTATION **9**

Covers the step-by-step procedure for obtaining building permissions. Includes preparation of site plans, working drawings, and required documents. Introduces online approval systems and key authorities.

UNIT V SUSTAINABLE AND SMART BUILDING CONCEPTS 9

Highlights eco-friendly planning and green building features. Discusses energy-efficient design, rainwater harvesting, and green certifications (GRIHA, IGBC, LEED). Introduces smart building technologies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On Successful completion of this course, the student will able to

CO1: Use planning principles to design practical buildings.
CO2: Follow building rules and codes.
CO3: Choose the right site for building.
CO4: Prepare the required documents for approval.
CO5: Apply green and smart technologies in building designs.

TEXT BOOKS

1. Bindra, S. P., & Arora, S. P. Building construction: Planning techniques and methods. Dhanpat Rai Publishing Company, 2013.
2. Shah, M. G., Kale, C. M., & Patki, S. Y. Building drawing. Tata McGraw-Hill Education, 2010.
3. Bureau of Indian Standards. National building code of India (NBC). Bureau of Indian Standards, 2016.

REFERENCE BOOKS

1. Varghese, P. C. Building construction. PHI Learning Pvt. Ltd,2007 Rai Publications, 2013.
2. Rangwala, S. C. Building construction. Charotar Publishing House, 2014.
3. Gopi, S. Building drawing and detailing. Pearson Education, 2010.
4. Ching, F. D. K. Architecture: Form, space, and order. Wiley,2015.
5. Birdie, G. S., & Birdie, J. S. Building design and drawing. Dhanpat Rai Publishing Company, 2004.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	3	2	-	2	3	3	-	3	3	3	2	2
CO2	2	-	3	2	-	2	3	3	-	3	3	3	2	2
CO3	2	-	3	2	-	2	3	3	-	3	3	3	1	2
CO4	2	-	3	2	-	2	3	3	-	3	3	3	2	2
CO5	2	-	3	2	-	2	3	3	-	3	3	3	2	2
AVG	**2**	**-**	**3**	**2**	**-**	**2**	**3**	**3**	**-**	**3**	**3**	**3**	**1.8**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OCT202 ENERGY EFFICIENT BUILDING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand climate-responsive design principles and their impact on building performance.
- To learn passive strategies for heating, cooling, ventilation, and daylighting in buildings.
- To apply energy-efficient design techniques for different climatic zones using relevant tools and case studies.

UNIT I INTRODUCTION **9**

Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Greenhouse Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.

UNIT II PASSIVE SOLAR HEATING AND COOLING **9**

General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain – Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Principles – Case studies – Courtyards – Roof Ponds– Cool Pools – Predicting ventilation in buildings – Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odor removal.

UNIT III DAYLIGHTING AND ELECTRICAL LIGHTING **9**

Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts –Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.

UNIT IV HEAT CONTROL AND VENTILATION **9**

Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed.

UNIT V DESIGN FOR CLIMATIC ZONES **9**

Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Analyze heat transfer, thermal comfort, and site-specific microclimate factors.

CO2: Apply passive heating and cooling strategies, including solar design elements and natural ventilation techniques.

CO3: Design effective daylighting systems using optical materials and integrate electrical lighting controls for energy efficiency.

CO4: Evaluate thermal performance and ventilation requirements for various building orientations and climate types.

CO5: Develop energy-efficient design solutions for diverse climatic zones using case studies, tools, and energy audit methods.

TEXT BOOKS

1. Jagadish, K.S., Venkatarama Reddy, B.V., Alternative Building Materials and Technologies, New Age International, 2005.
2. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.
3. Residential Energy: Cost Savings and Comfort for Existing Buildings by John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013.

REFERENCE BOOKS

1. Energy Conservation Building Code, cau of Energy Efficiency, New Delhi, 2018.
2. Handbook on Functional Requirements of Buildings Part 1 to 4 SP: 41 1995.
3. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc,3rd Edition, 2014.
4. Marian Keeler and Prasad Vaidya, Fundamentals of Integrated Design for Sustainable Building, John Wiley & Sons, 2016.
5. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	2	2	-	2	3	3	-	-	3	3	3	3
CO2	2	-	2	2	-	2	3	3	-	-	3	3	2	3
CO3	2	-	2	2	-	2	3	3	-	-	3	3	2	2
CO4	2	-	2	2	-	2	3	3	-	-	3	3	3	2
CO5	2	-	2	2	-	2	3	3	-	-	3	3	3	3
AVG	**2**	**-**	**2**	**2**	**-**	**2**	**3**	**3**	**-**	**-**	**3**	**3**	**2.6**	**2.6**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OCT203 ENVIRONMENTAL IMPACT ASSESSMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment.
- To develop the skill to prepare environmental management plan.
- To Gain working knowledge of environmental and human-health risk assessment methods and the strategies used to manage identified risks.

UNIT I INTRODUCTION **9**

Historical development of Environmental Impact Assessment (EIA), Environmental Clearance- EIA in project cycle, legal and regulatory aspects in India – types and limitations of EIA –EIA process screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation.

UNIT II IMPACT INDENTIFICATION AND PREDICTION **10**

Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modelling for impact prediction – assessment of impacts – air – water – soil – noise – biological –– cumulative impact assessment

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT **8**

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation.

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN **9**

Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment.

UNIT V CASE STUDIES **9**

Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Carry out scoping and screening of developmental projects for environmental and Social assessments.

CO2: Explain different methodologies for environmental impact prediction and Assessment.

CO3: Asses socio-economic investigation of the environment in a project.

CO4: Plan environmental impact assessments and environmental management plans.

CO5: Gain Knowledge to prepare environmental impact assessment reports for various projects.

TEXT BOOKS

1. Canter, L.W., "Environmental Impact Assessment", McGraw Hill, New York. 1996.
2. Lawrence, D.P., "Environmental Impact Assessment – Practical solutions to recurrent problems", Wiley-Inter science, New Jersey. 2003.
3. World Bank –Source book on EIA.

REFERENCE BOOKS

1. Cutter, S.L., "Environmental Risk and Hazards", Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
3. K. V. Raghavan and A A. Khan, "Methodologies in Hazard Identification and Risk Assessment", Manual by CLRI, 1990.
4. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, Butterworth Heineman, 2012.
5. Westman, Walter E., "Ecology, Impact Assessment and Environment Planning" John Wiley and Sons, Canada, 1985.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	2	2	-	2	3	3	-	-	3	3	2	1
CO2	2	3	2	2	-	2	3	3	-	-	3	3	1	1
CO3	2	3	2	2	-	2	3	3	-	-	3	3	1	1
CO4	2	3	2	2	-	2	3	3	-	-	3	3	2	2
CO5	2	3	2	2	-	2	3	3	-	-	3	3	1	1
AVG	**2**	**3**	**2**	**2**	**-**	**2**	**3**	**3**	**-**	**-**	**3**	**3**	**1.4**	**1.2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OCT204 REHABILITATION OF STRUCTURES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To acquire the knowledge on maintenance aspects and causes of deterioration.
- To gain an understanding of concrete quality, durability characteristics and testing techniques.
- To impart knowledge on strengthening techniques and safe demolition procedures.

UNIT I MAINTENANCE AND REPAIR STRATIGES **9**

Maintenance, Repair and Rehabilitation - Facets of Maintenance - Importance of Maintenance - Various aspects of Inspection - Assessment procedure for evaluating a damaged structure - causes of deterioration.

UNIT II STRENGTH AND DURABILITY OF CONCRETE **9**

Quality assurance for concrete – Strength and Durability of concrete - Cracks, different types, causes-Effects due to climate, temperature, Sustained elevated Temperature, Corrosion.

UNIT III TESTING TECHNIQUES AND PROTECTION METHODS **9**

Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

UNIT IV STRENGTHENING AND REPAIR OF STRUCTURES **9**

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage and earthquake - Restoration of Heritage structures- Case studies.

UNIT V DEMOLITION **9**

Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Discuss the importance of inspection and maintenance.
CO2: Study the Impacts of cracks, corrosion and climate on structures.
CO3: Explain about various testing techniques.
CO4: Classify the strengthening techniques and repair strategies.
CO5: Explore the safe demolition techniques.

TEXT BOOKS

1. Shetty,M.S. Jain A K., Concrete Technology - Theory and Practice, S.Chand and Company, Eighth Edition, 2019.

2. B.Vidivelli, Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009.
3. Peter H.Emmons, "Concrete repair and maintenance illustrated", Galgotia Publications Pvt. Ltd., 2001.

REFERENCE BOOKS

1. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
2. Hand Book on "Repair and Rehabilitation of RCC Buildings" – Director General works CPWD, Govt of India, New Delhi – 2002.
3. P.C.Varghese, Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd, 2014.
4. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi 2012.
5. Ravishankar.K. and Krishnamoorthy.T.S, " Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	2	-	2	3	3	-	-	3	3	2	2
CO2	2	3	3	2	-	2	3	3	-	-	3	3	3	3
CO3	2	3	3	2	-	2	3	3	-	-	3	3	2	2
CO4	2	3	3	2	-	2	3	3	-	-	3	3	3	3
CO5	2	3	3	2	-	2	3	3	-	-	3	3	2	2
AVG	2	3	3	2	-	2	3	3	-	-	3	3	2.4	2.4

1-Low, 2-Medium, 3-High, '-'- No correlation

24OCT205 DRINKING WATER SUPPLY AND TREATMENT — L T P C 3 0 0 3

COURSE OBJECTIVES

- To provide a basic understanding of water sources, quality, and supply system planning.
- To introduce the design and operation of water conveyance and treatment systems.
- To explain the components of water distribution systems and plumbing in buildings.

UNIT I SOURCES OF WATER — 9

Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization -Significance – Drinking Water quality standards.

UNIT II CONVEYANCE FROM THE SOURCE **9**

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials - Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes -appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.

UNIT III WATER TREATMENT **9**

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation sand filters – Disinfection -Construction, Operation and Maintenance aspects.

UNIT IV ADVANCED WATER TREATMENT **9**

Water softening – Desalination- R.O. Plant – demineralization – Adsorption – Ion exchange Membrane Systems – Iron and Manganese removal – Defluoridation – Construction and Operation and Maintenance aspects.

UNIT V WATER DISTRIBUTION AND SUPPLY **9**

Requirements of water distribution – Components – Selection of pipe material – Service reservoirs - Functions – Network design – Economics – Computer applications – Appurtenances – Leak detection – Principles of design of water supply in buildings – House service connection - Fixtures and fittings, systems of plumbing and types of plumbing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On Successful completion of this course, the students will be able to

CO1: Identify different sources of water and assess their suitability for supply.

CO2: Design of intake structures, pipes, and pumps used in water conveyance.

CO3: Explain the processes involved in water treatment and apply them in plant design.

CO4: Describe advanced treatment methods like softening, desalination, and removal of contaminants.

CO5: Design water distribution systems and understand plumbing arrangements in buildings.

TEXT BOOKS

1. Garg. S.K., "Water Supply Engineering", Khanna Publishers, Delhi, September 2008.
2. Punmia B.C, Arun K.Jain, Ashok K.Jain, “Water supply Engineering” Laxmi Publications (p) LTD, New Delhi, 2016.
3. Rangwala "Water Supply and Sanitary Engineering", Charotar Publishing house Pvt.Ltd, February 2022.

REFERENCE BOOKS

1. Fair. G.M., Geyer.J.C., “Water Supply and Wastewater Disposal”, John Wiley and Sons, 1954.
2. Babbit.H.E, and Donald.J.J, “Water Supply Engineering”, McGraw Hill book Co,1984.

3. Steel. E.W.et al., “Water Supply Engineering”, Mc Graw Hill International book Co, 1984.
4. Duggal. K.N., “Elememts of public Health Engineering”, S.Chand and Company Ltd, New Delhi, 1998.
5. Birdie.G.S., "Water Supply and Sanitary Engineering", Dhanpat Rai and sons, 2018.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	3	2	-	3	3	2	-	-	2	3	3	3
CO2	2	2	3	2	-	3	3	2	-	-	2	3	3	3
CO3	2	2	3	2	-	3	3	2	-	-	2	3	2	2
CO4	2	2	3	2	-	3	3	2	-	-	2	3	2	3
CO5	2	2	3	2	-	3	3	2	-	-	2	3	2	2
AVG	**2**	**2**	**3**	**2**	**-**	**3**	**3**	**2**	**-**	**-**	**2**	**3**	**2.4**	**2.6**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24OCT206 PROJECT SCHEDULING AND OPTIMIZATION USING CPM AND PERT TECHNIQUES

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand fundamental project management concepts and principles.
- To learn principles and processes related to project scope management.
- To comprehend concepts and tools related to project scheduling and their applications in real-world projects.

UNIT I GENERAL OVERVIEW AND PROJECT ORGANIZATION 9

Introduction to Projects, Types of Projects, Introduction to Construction Project Management, Project Lifecycle and its Phases, Key Activities Involved in Different Project Lifecycle Phases, Role of Various Stakeholders in Different Project Lifecycle Phases, Project Organization Structure and its Types.

UNIT II PROJECT SCOPE MANAGEMENT 9

Gathering Project Requirements, Project Scope and Specifications, Project Scope Matrix, Project Contract Management, Work Breakdown Structure (WBS), WBS Types, Creating WBS, Scope Management Steps and Processes

UNIT III PROJECT PLANNING AND SCHEDULING 9

Project Planning, Planning and Scheduling, Steps Involved in Project Planning, Networking and Non-Networking Techniques Scheduling Techniques, Gantt-Chart, Formulation and Applications of Critical Path Method (CPM), Program Evaluation & Review Technique (PERT) and Precedence Diagram Method (PDM), Introduction to Linear Scheduling Methods

UNIT IV PROJECT CONTROL **9**

Time-Cost Tradeoff, Earned Value Management (EVM), Crashing and Fast-tracking Projects, Resource Constrained Scheduling, Resource Levelling, Schedule Updation and Project Control.

UNIT V ADVANCED TOOLS IN PROJECT SCHEDULING **9**

Software Applications and Use of AI in Project Planning, Scheduling and Control, Data driven Decision Making

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explore the fundamental project management concepts and principles.

CO2: Comprehend the principles and processes related to project scope management.

CO3: Gain the ability to apply concepts and tools related to project scheduling in real world Projects.

CO4: Comprehend the use of advanced project scheduling tools.

CO5: Assess the use of advanced technology platforms in project scheduling and control.

TEXT BOOKS

1. Oberlender, G. D., & Oberlender, G. D. Project management for engineering and construction (Vol. 2). New York: McGraw-Hill,1993.
2. Sears, S. K., Sears, G. A., & Clough, R. H. Construction project management: A practical guide to field construction management. John Wiley & Sons,2010.
3. Callahan, M. T., Quackenbush, D. G., & Rowings, J. E. Construction project scheduling,1992.

REFERENCE BOOKS

1. Barcus, S.W. and Wilkinson.J.W., Hand Book of Management Consulting Services, McGraw Hill, New York, 1986.
2. Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd., 1992.
3. Albert Lester, Project Management, Planning and Control, 7^{th} Edition, Butterworth-Heinemann, USA , 2017.
4. Guide, P. M. B. O. K. A guide to the project management body of knowledge,2008.
5. Mubarak, S. A. Construction project scheduling and control. John Wiley, 2015.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	3	2	-	2	-	3	3	2	3	3	2	1
CO2	2	3	3	2	-	2	-	3	3	2	3	3	1	1
CO3	2	3	3	2	-	2	-	3	3	2	3	3	2	1
CO4	2	3	3	2	-	2	-	3	3	2	3	3	1	2
CO5	2	3	3	2	-	2	-	3	3	2	3	3	2	2
AVG	**2**	**3**	**3**	**2**	**-**	**2**	**-**	**3**	**3**	**2**	**3**	**3**	**1.6**	**1.4**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OAT201 PRINCIPLES OF PROGRAMMING LANGUAGES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand and describe syntax and semantics of programming languages.
- To understand data, data types, and basic statements.
- To understand call-return architecture and ways of implementing them.

UNIT I SYNTAX AND SEMANTICS 9

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing.

UNIT II DATA, DATATYPES AND BASIC STATEMENTS 9

Names–variables–binding–type checking–scope–scope rules–life time and garbage collection–primitive datatypes –strings–array types–associative arrays–record Types– union types–pointers and references–Arithmetic expressions–overloaded operators– type conversions–relational and boolean expressions– assignment statements– mixed mode assignments– control structures– selection– iterations– branching– guarded statements.

UNIT III SUBPROGRAMS AND IMPLEMENTATIONS 9

Sub programs –design issues–local referencing–parameter passing–overloaded methods–generic methods – design issues for functions– semantics of call and return – implementing simple sub programs–stack and dynamic local variables–nested sub programs – blocks – dynamic scoping.

UNIT IV OBJECT-ORIENTATION, CONCURRENCY AND EVENT HANDLING 9

Object - orientation– design issues for OOP languages– implementation of object- oriented constructs –concurrency– semaphores – monitors –message passing – threads – statement level concurrency – exception handling – event handling

UNIT V FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES 9

Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Describe syntax and semantics of programming languages.
CO2: Explain data, data types, and basic statements of programming languages.
CO3: Design and implement subprogram constructs.
CO4: Apply object-oriented, concurrency, and event handling programming constructs and develop programs in Scheme, ML, and Prolog.
CO5: Adopt new programming languages.

TEXT BOOKS

1. Robert W. Sebesta, “Concepts of Programming Languages”, Twelfth Edition (Global Edition), Pearson, 2022.
2. Michael L. Scott, “ProgrammingLanguagePragmatics”,FourthEdition, Elsevier, 2018.
3. Principles of Programming Languages" by Er. Anil Panghal & Ms. Sharda Panghal.

REFERENCE BOOKS

1. R. Kent Dybvig, “The Scheme programming language”, Fourth Edition, Prentice Hall,2011.
2. Jeffrey D. Ullman, “Elements of ML programming”, Second Edition, Pearson,1997.
3. W. F. Clocksin and C. S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2003.
4. Principles of Programming Languages" by Bruce J. MacLennan.
5. Essentials of Programming Languages" by Daniel P. Friedman, Mitchell Wand, and Christopher T. Haynes.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	2	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	2	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	2	-	-	-	-	-	1	-	-	-
CO4	3	2	2	-	3	-	-	-	1	1	1	-	1	1
CO5	2	2	-	-	2	-	-	-	-	-	-	3	1	1
AVG	**2.8**	**2.2**	**2**	**-**	**2.2**	**-**	**-**	**-**	**1**	**1**	**1**	**3**	**1**	**1**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24OAT202 INFORMATION SECURITY MANAGEMENT

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the basics of Information Security
- To know the legal, ethical and professional issues in Information Security
- To know the aspects of risk management

UNIT I INTRODUCTION — 9

History - What is Information Security? - Critical Characteristics of Information - NSTISSC Security Model - Components of an Information System - Securing the Components - Balancing Security and Access - The SDLC - The Security SDLC.

UNIT II SECURITY INVESTIGATION — 9

Need for Security - Business Needs - Threats - Attacks - Legal - Ethical and Professional Issues - An Overview of Computer Security - Access Control Matrix - Policy - Security policies - Confidentiality policies - Integrity policies and Hybrid policies.

UNIT III SECURITY ANALYSIS **9**

Risk Management - Identifying and Assessing Risk - Assessing and Controlling Risk - Systems: Access Control Mechanisms - Information Flow and Confinement Problem.

UNIT IV LOGICAL DESIGN **9**

Blueprint for Security - Information Security Policy - Standards and Practices - ISO 17799/BS 7799 - NIST Models - VISA - International Security Model - Design of Security Architecture - Planning for Continuity.

UNIT V PHYSICAL DESIGN **9**

Security Technology - IDS - Scanning and Analysis Tools - Cryptography - Access Control Devices - Physical Security - Security and Personnel.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Illustrate the legal, ethical and professional issues in information security.
CO2: Demonstrate the aspects of risk management.
CO3: Become aware of various standards in the Information Security System.
CO4: Design and implementation of Security Techniques.
CO5: Apply security technologies and practices to secure physical and logical components, including Cryptography, IDS, and physical security measures.

TEXT BOOKS

1. Michael E Whitman, Herbert J Mattord, “Principles of Information Security”, Vikas Publishing House, New Delhi, 2003.
2. Information Security Management: Concepts and Practice" by Bel G. Raggad.
3. Information Security Management, 2nd Edition" by Michael Workman.

REFERENCE BOOKS

1. Micki Krause, Harold F. Tipton, “Handbook of Information Security Management”, Vol. 1 3, CRC Press LLC, 2004
2. Stuart McClure, Joel Scrambray, George Kurtz, “Hacking Exposed”, Tata McGraw Hill, 2003.
3. Matt Bishop, “Computer Security Art and Science”, Pearson/PHI, 2002.
4. A Comprehensive Guide to Information Security Management and Audit" by Rajkumar Banoth, Gugulothu Narsimha, and Aruna Kranthi Godishala.
5. Information Security Management Handbook, Volume 7, 6th Edition" edited by Richard O'Hanley and James S. Tiller.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	-	3	-	3	-	2	-	-	1	1
CO2	2	2	-	2	-	-	-	-	-	-	2	-	1	1
CO3	2	1	-	-	1	-	1	-	-	-	-	2	1	1
CO4	3	2	3	-	3	-	-	-	-	-	1	-	1	1
CO5	3	2	3	-	3	-	-	-	-	-	1	-	1	1
AVG	**2.4**	**1.8**	**3**	**2**	**2.3**	**3**	**1**	**3**	**-**	**2**	**1.3**	**2**	**1**	**1**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OAT203 HUMAN COMPUTER INTERACTION **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the theoretical dimensions of human factors involved in the acceptance of computer.
- To understand the important aspects of implementation of human computer interfaces.
- To identify the various tools and techniques for interface analysis, design and evaluation.

UNIT I INTRODUCTION **9**

HCI Foundations: Input–output channels - Human memory - Thinking: reasoning and problem solving - Emotion - Individual differences - Psychology and the design of interactive systems - Text entry devices - Positioning - pointing and drawing - Display devices - Devices for virtual reality and 3D interaction - Physical controls - sensors and special devices - Paper: printing and scanning.

UNIT II INTERACTION DESIGNS **9**

Designing - Programming Interactive systems - Models of interaction - Frameworks and HCI - Ergonomics - Interaction styles - Elements of the WIMP interface - The context of the interaction - Experience - engagement and fun - Paradigms for interaction. Cantered Design and testing - Interaction design basics - The process of design - User focus - Scenarios - Navigation design - Screen design and layout, Iteration and prototyping.

UNIT III DESIGN RULES **9**

HCI in the software process - Iterative design and prototyping - Design rules - Principles to support usability - Standards and Guidelines - Golden rules and heuristics - HCI patterns. Implementation support - Elements of windowing systems - Programming the application - Using toolkits - User interface management systems.

UNIT IV ANALYSIS **9**

Evaluation techniques - Evaluation through expert analysis - Evaluation through user participation - Universal design - User support. Models and Theories - Cognitive models - Goal and task hierarchies - Linguistic models - The challenge of display-based systems - Physical and device models - Cognitive architectures.

UNIT V NOTATIONS 9

Collaboration and communication - Face-to-face communication - Conversation - Text-based communication - Group working - Dialog design notations - Diagrammatic notations - Textual dialog notations - Dialog semantics - Dialog analysis and design Human factors and security - Groupware - Meeting and decision support systems - Shared applications and artifacts - Frameworks for groupware - Implementing synchronous groupware - Mixed - Augmented and Virtual Reality.

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Design and Develop processes and life cycle of Human Computer Interaction.

CO2: Analyse product usability evaluations and testing methods.

CO3: Apply the interface design standards/guidelines for cross cultural and disabled Users.

CO4: Categorize, Design and Develop Human Computer Interaction in proper architectural structures.

CO5: Design collaborative and communicative interfaces, incorporating human factors and security.

TEXT BOOKS

1. A Dix, Janet Finlay, G D Abowd, R Beale, “Human - Computer Interaction”, Pearson Publishers, Third Edition, 2008.
2. Shneiderman, Plaisant, Cohen, Jacobs, “Designing the User Interface: Strategies for Effective Human Computer Interaction”, Pearson Publishers, Fifth Edition, 2018.
3. Interaction Design: Beyond Human-Computer Interaction" (5th Edition) by Jenny Preece, Yvonne Rogers, and Helen Sharp.

REFERENCE BOOKS

1. Jonathan Lazar, “Research Methods in Human–Computer Interaction”, John Wiley & Sons.
2. Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications" (3rd Edition) edited by Julie A. Jacko.
3. The Design of Everyday Things" by Don Norman. "Designing Interactions" by Bill Moggridge.
4. "The Humane Interface: New Directions for Designing Interactive Systems" by Jef Raskin.
5. Human Computer Interaction, https://onlinecourses.nptel.ac.in/noc25_cs38/preview.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
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CO4	2	2	2	-	2	-	2	-	-	-	-	-	1	1
CO5	2	-	-	-	2	2	2	3	-	-	-	2	1	1
AVG	**2.4**	**2**	**2.3**	**2**	**2.4**	**2**	**2.2**	**3**	**-**	**-**	**2**	**2**	**1.6**	**1.2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OAT204 COMPUTER APPLICATION IN AGRICULTURES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the students to areas of agricultural systems in which IT and computers play a major role.
- To also expose the students to IT applications in precision farming and environmental control systems
- To also expose the students to IT applications in agricultural systems management and weather prediction models.

UNITI PRECISION FARMING **9**

Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modeling.

UNIT II ENVIRONMENT CONTROL SYSTEMS **9**

Artificial light systems, management of crop growth in greenhouses, simulation of CO_2consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture.

UNIT III AGRICULTURAL SYSTEMS MANAGEMENT **9**

Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems.

UNIT IV WEATHER PREDICTION MODELS **9**

Importance of climate variability and seasonal forecasting, Understanding and predicting world's climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts.

UNIT V E-GOVERNANCE IN AGRICULTURAL SYSTEMS **9**

Expert systems, decision support systems, Agricultural and biological databases, e-commerce, e- business systems & applications, Technology enhanced learning systems and solutions, e- learning, rural development and information society.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explore the applications of IT in remote sensing applications such as Drones, etc.

CO2: Discuss the greenhouse can be automated.

CO3: Apply IT principles and concepts for management of field operations.

CO4: Discuss about weather models, their inputs, and applications.

CO5: Use the e-governance in agriculture.

TEXT BOOKS

1. National Research Council, "Precision Agriculture in the 21st Century", National Academies Press, Canada, 1997.
2. H. Krug, Liebig, H.P. "International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation", 1989.
3. Computers in Agriculture" by Manish Kumar Sharma, Anil Bhat & M. Iqbal Jeelani Bhat.

REFERENCE BOOKS

1. Peart, R.M., and Shoup, W.D., "Agricultural Systems Management", Marcel Dekker, New York, 2004.
2. Hammer, G.L., Nicholls, N., and Mitchell, C., "Applications of Seasonal Climate", Springer, Germany, 2000.
3. ICT & its Applications in Agriculture" by Golla Ravi, MD. Mubeena, Apoorva Veldandi.
4. Communication Technologies in Agriculture" by Dr. P. Jaisridhar & Mrs. Surudhi.
5. Internet and Computers for Agriculture" edited by Dimitre Dimitrov.

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CO4	2	2	-	2	2	-	3	-	-	-	2	2	3	2
CO5	2	2	2	-	2	-	2	2	1	2	3	2	2	2
AVG	2.6	2.4	2.3	2	2.6	1	2.2	2	1	2	2	2	2.4	1.6

1-Low, 2-Medium, 3-High, '-'- No correlation

24OAT205 MOBILE COMPUTING **L T P C**
3 0 0 3

COUSE OBJECTIVES

- To understand the basic concepts of mobile computing.
- To learn the basics of mobile telecommunication system.
- To be familiar with the network layer protocols and Ad-Hoc networks.

UNIT I INTRODUCTION **9**

Introduction to Mobile Computing – Applications of Mobile Computing- Generations of

Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA.

UNIT II MOBILE TELECOMMUNICATION SYSTEM **9**

Introduction to Cellular Systems – GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security – GPRS- UMTS – Architecture – Handover – Security.

UNIT III MOBILE NETWORK LAYER **9**

Mobile IP – DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV , Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks (VANET) –MANET Vs VANET – Security.

UNIT IV MOBILE TRANSPORT AND APPLICATION LAYER **9**

Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML.

UNIT V MOBILE PLATFORMS AND APPLICATIONS **9**

Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the basics of mobile telecommunication systems.

CO2: Illustrate the generations of telecommunication systems in wireless networks.

CO3: Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network.

CO4: Explain the functionality of Transport and Application layers.

CO5: Develop a mobile application using android/blackberry/ios/Windows SDK.

TEXT BOOKS

1. Jochen Schiller, ―Mobile Communications‖, PHI, Second Edition, 2003.
2. Prasant Kumar Pattnaik, Rajib Mall, ―Fundamentals of Mobile Computing‖, PHI Learning Pvt.Ltd, New Delhi – 2012.
3. Mobile Computing: Concepts, Methodologies, Tools, and Applications (6 Volumes) edited by David.

REFERENCE BOOKS

1. Dharma Prakash Agarval, Qing and An Zeng, ―Introduction to Wireless and Mobile systems‖, Thomson Asia Pvt Ltd, 2005.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, ―Principles of Mobile Computing‖, Springer, 2003.
3. William.C.Y.Lee,―Mobile Cellular Telecommunications-Analog and Digital Systems‖, Second Edition,TataMcGraw Hill Edition ,2006.

4. C.K.Toh, ―AdHoc Mobile Wireless Networks‖, First Edition, Pearson Education, 2002.
5. Mobile Computing and Wireless Networks: Concepts, Methodologies, Tools, and Applications (4 Volumes) by Information Resources Management Association.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	2	-	-	-	-	-	-	-	2	2
CO2	3	2	-	-	2	-	-	-	-	-	-	-	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	-	1	1
CO4	2	2	-	-	2	-	-	-	-	-	-	-	2	1
CO5	2	2	3	-	3	-	-	-	1	2	2	2	3	3
AVG	**2.6**	**2.2**	**3**	**2**	**2.4**	**-**	**-**	**-**	**1**	**2**	**2**	**2**	**2**	**1.8**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OAT206 OBJECT ORIENTED ANALYSIS AND DESIGN **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the fundamentals of Object-Oriented Analysis and Design (OOAD) using the Unified Process and various UML diagrams.
- To enable students to model software systems using static and dynamic UML diagrams such as class, use-case, sequence, state, and activity diagrams.
- To develop the ability to apply GRASP principles and GoF design patterns to design robust, maintainable, and scalable object-oriented systems.

UNIT I UNIFIED PROCESS AND USE CASE DIAGRAMS **9**

Introduction to OOAD with OO Basics — Unified Process — UML diagrams — Use Case – Case study — the Next Gen POS system, Inception -Use case Modelling — Relating Use cases — include, extend and generalization — When to use Use-cases

UNIT II STATIC UML DIAGRAMS **9**

Class Diagram—- Elaboration — Domain Model — Finding conceptual classes and description classes — Associations — Attributes — Domain model refinement — Finding conceptual class Hierarchies — Aggregation and Composition — Relationship between sequence diagrams and use cases — When to use Class Diagrams

UNIT III DYNAMIC AND IMPLEMENTATION UML DIAGRAMS **9**

Dynamic Diagrams — UML interaction diagrams — System sequence diagram — Collaboration diagram — When to use Communication Diagrams — State machine diagram and Modelling –When to use State Diagrams — Activity diagram — When to use activity diagrams Implementation Diagrams — UML package diagram — When to use package diagrams — Component and Deployment Diagrams — When to use Component and Deployment diagrams

UNIT IV DESIGN PATTERNS **9**

GRASP: Designing objects with responsibilities — Creator — Information expert — Low Coupling — High Cohesion — Controller Design Patterns — creational — factory method — structural — Bridge — Adapter — behavioural — Strategy — observer –Applying GoF design patterns — Mapping design to code

UNIT V TESTING **9**

Object Oriented Methodologies — Software Quality Assurance — Impact of object orientation on Testing — Develop Test Cases and Test Plans

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain OOAD principles and apply the Unified Process in software development.

CO2: Create and analyze static UML diagrams such as class and domain models.

CO3: Model dynamic behaviors using sequence, state, activity, and implementation diagrams.

CO4: Apply design patterns and GRASP principles in object-oriented design.

CO5: Evaluate object-oriented systems through testing and quality assurance methods.

TEXT BOOKS

1. Booch, Grady,"Object-Oriented Analysis and Design with Applications",3rd Edition, Addison-Wesley Professional, 2007.
2. McLaughlin, Brett, Gary Pollice and David West,"Head First Object-Oriented Analysis and Design", O'Reilly Media, 2006.
3. Gamma, Erich, Richard Helm, Ralph Johnson and John Vlissides. "Design Patterns: Elements of Reusable Object-Oriented Software", Addison-Wesley Professional, 1994

REFERENCE BOOKS

1. Booch, Grady, "Object-Oriented Analysis and Design with Applications", 3rd Edition, Addison-Wesley Professional, 2007.
2. Larman, Craig, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", 3rd Edition, Pearson Education, 2004.
3. Gamma, Erich; Helm, Richard; Johnson, Ralph; Vlissides, John, "Design Patterns: Elements of Reusable Object-Oriented Software", Addison-Wesley Professional, 1994.
4. Fowler, Martin, "UML Distilled: A Brief Guide to the Standard Object Modeling Language", 3rd Edition, Addison-Wesley Professional, 2003.
5. Pressman, Roger S., "Software Engineering: A Practitioner's Approach" 8th Edition, McGraw-Hill 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
CO1	3	2	2	-	1	-	-	-	-	2	-	1	1	1
CO2	2	3	3	-	1	-	-	-	2	2	-	1	1	1
CO3	2	3	3	1	1	-	-	-	-	2	-	1	1	1
CO4	3	2	3	-	2	-	-	-	-	1	2	1	1	1
CO5	1	2	2	-	1	-	-	-	-	1	2	1	1	1
AVG	**2.2**	**2.4**	**2.6**	**1**	**1.2**	**-**	**-**	**-**	**2**	**1.6**	**2**	**1**	**1**	**1**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OET101 ELECTRIC VEHICLE TECHNOLOGIES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the concept and operations of electric and hybrid electric vehicles (EVs and HEVs), including their architecture.
- To explore the need for energy storage in hybrid vehicle and the technologies available for energy storage.
- To provide an overview of various energy storage technologies applicable to electric vehicles.

UNIT I ELECTRIC VEHICLES AND VEHICLE MECHANICS **9**

Electric Vehicles (EV),Hybrid Electric Vehicles (HEV), Engine ratings – Comparisons of EV with internal combustion Engine vehicles – Fundamentals of vehicle mechanics.

UNIT II ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS **9**

Architecture of EV's and HEV's - Plug-n Hybrid Electric Vehicles (PHEV) – Power train components and sizing, Gears, Clutches, Transmission and Brakes.

UNIT III POWER ELECTRONICS AND MOTOR DRIVES **9**

Electric drive components – Power electronic switches – four quadrant operation of DC drive – Induction motor and permanent magnet synchronous motor – based vector control operation – Switched Reluctance Motor (SRM) drives – EV motor sizing.

UNIT IV BATTERY ENERGY STORAGE SYSTEM **9**

Battery Basics – Different types – Battery Parameters – Battery life and safety - Battery modeling – Design of battery for large vehicles.

UNIT V ALTERNATIVE ENERGY STORAGE SYSTEMS **9**

Introduction to fuel cell – Types, operation and Characteristics – proton exchange membrane (PEM) fuel cell for E-mobility – hydrogen storage systems – Super capacitors for transportation applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Utilize the concept of electric vehicle and energy storage systems.

CO2: Describe the working and components of Electric Vehicle and Hybrid Electric Vehicle.

CO3: Explain the principles of power converters and electrical drives.

CO4: Illustrate the operation of storage systems such as battery and super capacitor.

CO5: Analyze the various energy storage systems based on fuel cells and hydrogen storage.

TEXT BOOKS

1. Wei Liu, 'Hybrid Electric Vehicle System Modeling and Control', Second Edition, WILEY, 2017
2. James Larminie and John Lowry, 'Electric Vehicle Technology Explaind', Second Edition, Wiley,2012.
3. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek "Analysis of Electric Machinery and Drive Systems", 3^{rd} Edition, Wiley-IEEE Press, 2013.

REFERENCE BOOKS

1. Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7^{th} Edition, 2020.
2. Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011.
3. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek "Analysis of Electric Machinery and Drive Systems", 3^{rd} Edition, Wiley-IEEE Press, 2013.
4. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Pearson, fourth Edition, 10^{th} Impression 2021.
5. Iqbal Husain, 'Electric and Hybrid Electric Vehicles', CRC Press, 2021.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	1	2	3	3	1	-	-	2	-	-	1	3	3
CO2	2	1	2	3	3	1	-	-	2	-	-	1	3	3
CO3	2	1	2	3	3	1	-	-	2	-	-	1	2	2
CO4	2	1	2	3	3	1	-	-	2	-	-	1	2	2
CO5	2	1	2	3	3	1	-	-	2	-	-	1	3	2
AVG	**2**	**1**	**2**	**3**	**3**	**1**	**-**	**-**	**2**	**-**	**-**	**1**	**2.6**	**2.4**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OET102 POWER SYSTEMS **L T P C**

3 0 0 3

COURSE OBJECTVES

- To develop a comprehensive understanding of power system components, their operation, and the overall structure of electrical power systems.
- To acquire the knowledge of transmission line parameters, insulators, cables, and protective devices such as circuit breakers, enabling effective design, analysis, and maintenance of power systems.
- To familiarize students with modern control and monitoring techniques in power systems.

UNIT I INTRODUCTION **9**

Power scenario in India – Power system components – Structure of Power System – Types of Power – Substation layout components.

UNIT II TRANSMISSION LINE PARAMETERS **9**

Parameters of single and three phase transmission lines with single and double circuits - Resistance, inductance and capacitance of solid, stranded and bundled conductors, conductor types – Symmetrical and unsymmetrical spacing and transposition-application of self and mutual GMD; skin and proximity effects.

UNIT IV INSULATORS AND CABLES **9**

Main components of overhead lines-Insulators-Types, voltage distribution in insulator string, improvement of string efficiency, Underground cables-Types of cables, insulation materials, Parameters of cable, Grading of cables, Capacitance of 3-core cable, heating, thermal resistance of cables.

UNIT IV COMPUTER CONTROL OF POWER SYSTEMS **9**

Need of computer control of power systems-concept of energy control centers and functions – PMU - system monitoring, data acquisition and controls - System hardware configurations - SCADA and EMS functions - state estimation problem – measurements and errors - weighted least square estimation - various operating states - state transition diagram.

UNIT V CIRCUIT BREAKERS **9**

Types of circuit breakers – air blast, air break, oil,SF6, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers –Rating and selection of Circuit breakers – Relays.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the Power System Components and Structure.

CO2: Analyze Transmission Line Parameters and Performance.

CO3: Design and Selection of Insulators and Cables.

CO4: Discuss of Computer Control Systems in Power Systems.

CO5: Interpret the knowledge of Circuit Breakers and Protective Devices.

TEXT BOOKS

1. S.N.Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt.Ltd, New Delhi, 2008.
2. B.R.Gupta, 'Power System Analysis and Design', S.Chand, New Delhi, Fifth Edition2005-08.
3. J.Brian, Hardy and Colin R.Bayliss'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2012.

REFERENCE BOOKS

1. R.K.Rajput, 'Power System Engineering' Laxmi Publications (P) Ltd, New Delhi, 2006.
2. D.P.Kothari, I.J.Nagarath, 'Power System Engineering' Tata Mc Graw -Hill Publishing Company limited, New Delhi, 2007.
3. C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, 2009
4. Luces M.Fualkenberry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
5. Hadi Saadat, 'Power System Analysis, 'PSA Publishing; Third Edition, 2010.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	-	1	2	-	-	1	-	-	2	2
CO2	3	2	2	-	-	1	2	-	-	1	-	-	2	2
CO3	3	2	2	-	-	1	2	-	-	1	-	-	2	2
CO4	3	2	2	-	-	1	2	-	-	1	-	-	2	2
CO5	3	2	2	-	-	1	2	-	-	1	-	-	2	2
AVG	3	2	2	-	-	1	2	-	-	1	-	-	2	2

1-Low, 2-Medium, 3-High, '-'- No correlation

24OET103 CIRCUIT THEORY

L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce electric circuits, including their analysis, solving circuit equations using network theorems, and understanding phasor diagrams and three-phase circuit analysis.
- To explain the phenomenon of resonance in coupled circuits and its significance.
- To educate on determining the transient response of circuits and analyzing their dynamic behavior.

UNIT I BASIC CIRCUITS ANALYSIS 9

Resistive elements - Ohm's Law Resistors in series and parallel circuits – Kirchoffs laws – Mesh current and node voltage - methods of analysis.

UNIT II NETWORK REDUCTION AND THEOREMS **9**

Network reduction: voltage and current division, source transformation – star delta conversion. Thevenins and Norton Theorems – Superposition Theorem – Maximum power transfer theorem.

UNIT III TRANSIENT RESPONSE ANALYSIS **9**

L and C elements -Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

UNIT IV THREE PHASE CIRCUITS **9**

A.C. circuits – Average and RMS value - Phasor Diagram – Power, Power Factor and Energy.- Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power measurement in three phase circuits.

UNIT V RESONANCE AND COUPLED CIRCUITS **9**

Series and parallel resonance – their frequency response – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Enumerate the concepts of electrical circuits, and fundamental laws.
CO2: Analyze electric circuits with theorem.
CO3: Analyze the concepts of three phase circuits.
CO4: Analyze the concepts of resonance circuits.
CO5: Analyze the transient response of circuits.

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”, McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Second Edition, McGraw Hill, 2013.
3. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India, 2013.

REFERENCE BOOKS

1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum’s series, McGraw- Hill, New Delhi, 2010.
4. M E Van Valkenburg, “Network Analysis”, Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India Pvt Ltd., New Delhi, 2015.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	2	3	2	-	-	-	-	-	-	3	2	1
CO2	3	3	3	3	2	-	-	-	-	-	-	2	2	-
CO3	2	3	2	3	3	-	-	-	-	-	-	1	2	1
CO4	3	2	2	2	2	-	-	-	-	-	-	3	2	1
CO5	3	3	3	2	2	-	-	-	-	-	-	1	1	1
AVG	**2.8**	**2.8**	**2.2**	**2.8**	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1.8**	**1**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OT104 ADVANCED ELECTRICAL MACHINES **L T P C**
3 0 0 3

COURSE OBJECTIVS

- To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM.
- To derive torque equation and study the characteristics of special machines.
- To design the controller for special machines and study the working principle of synchronous reluctance motor.

UNIT I PERMANENT MAGNET BRUSHLESS DC MOTORS **9**

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations- Characteristics and control.

UNIT II PERMANENT MAGNET SYNCHROUNOUS MOTORS **9**

Principle of operation – EMF and torque equations - Phasor diagram - Power controllers– performance characteristics – Digital controllers – Constructional features, operating principle and characteristics of synchronous reluctance motor.

UNIT III SWITCHED RELUCTANCE MOTORS **9**

Constructional features –Principle of operation- Torque prediction –performance Characteristics-Power controllers – Control of SRM drive- Sensor less operation of SRM – Applications.

UNIT IV STEPPER MOTORS **9**

Constructional features –Principle of operation –Types – Different modes of excitation - Torque equation – Characteristics – Drive circuits – Closed loop control – Applications.

UNIT V STUDY OF OTHER SPECIAL ELECTRICAL MACHINES **9**

Principle of operation and characteristics of Hysteresis motor – Universal motor – Linear induction motor – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Utilize the control and characteristics for PMBDC motors.

CO2: Optimally design magnetic required in special machines based drive systems using FEM based software tools.

CO3: Analyze the dynamic performance of special electrical machine.

CO4: Explain the operation and characteristics of other special electrical machines.

CO5: Design and conduct experiments towards research.

TEXT BOOKS

1. K.Venkataratnam, ‘Special Electrical Machines’, Universities Press (India) Private Limited, 2008.
2. T. Kenjo, ‘Stepping Motors and their Microprocessor Controls’, Clarendon Press London, 1984
3. E.G. Janardanan, ‘Special electrical machines’, PHI learning Private Limited, Delhi, 2014.

REFERENCE BOOKS

1. T.J.E. Miller, ‘Brushless magnet and Reluctance motor drives’, Clarendon press, London,1989
2. T.Kenjo, ‘ Stepping motors and their microprocessor controls’, Oxford University press, New Delhi, 2000 Dekker 2009
3. R. Krishnan - Switched Reluctance Motor Drives Modeling, Simulation, Analysis, Design and Applications -CRC Press 2017.
4. Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives:fundamentals to applications-CRC 2019.
5. Ramu Krishnan - Permanent Magnet Synchronous and Brushless DC Motor Drives - CRC Press, Marcel Applications -CRC Press 2009.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
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CO1	2	3	2	2	3	1	-	-	-	-	-	1	3	2
CO2	2	3	3	2	3	1	-	-	-	-	-	1	2	3
CO3	2	3	3	2	3	1	-	-	-	-	-	1	2	2
CO4	1	1	1	2	2	1	-	-	-	-	-	1	3	3
CO5	1	2	2	2	1	1	-	-	-	-	-	1	3	3
AVG	**1.6**	**2.4**	**2.2**	**2.2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**2.6**	**2.6**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24OET105 HYBRID RENEWABLE POWER GENERATION **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To learn the working principles and integration of different renewable energy sources.
- To understand the power electronic interfaces and control strategies used in hybrid systems
- To analyze energy storage systems and battery management techniques used in hybrid technologies.

UNIT I HYDRID ENERGY SYSTEMS **9**

Need for Hybrid Energy Systems – Solar-Wind-Fuel Cell-Diesel, Wind Biomass-Diesel, Micro-Hydel-PV, Ocean and geyser energy - Classification of Hybrid Energy systems – Importance of Hybrid Energy systems – Advantages and Disadvantages - Environmental aspects of renewable energy - Impacts of renewable energy generation on the environment - Present Indian and international energy scenario of conventional and RE sources

UNIT II ENERGY STORAGE AND CONTROL SYSTEMS **9**

Energy storage systems: Batteries, flywheels, compressed air, supercapacitors, and pumped hydro- Battery management systems and charge controllers-Control strategies for hybrid systems-Load forecasting and demand-side management.

UNIT III POWER CONVERTERS AND ANALYSIS OF HYBRID SOLAR PV SYSTEMS **9**

Power converters for Solar PV systems: Line-commutated converters (inversion-mode), boost and buck-boost converter-Selection of inverters, battery sizing, and array sizing- Analysis of Solar PV systems: Block diagrams and types (stand-alone PV systems)

UNIT IV ANALYSIS OF POWER CONVERTERS FOR HYBRID ENERGY SYSTEMS **9**

Introduction to Power Converters – Stand-alone Converters -AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters - Bi-Directional Converters - Grid-Interactive Inverters - Matrix converter –Merits and Limitations.

UNIT V CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS **9**

Hybrid Systems- Range and type of Hybrid systems – Performance Analysis – Cost Analysis - Case studies of Diesel-PV, Wind-PV-Fuel-cell, Micro-hydel-PV, Biomass-Diesel-Fuel-cell systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the classification, need, and benefits of hybrid energy systems.
CO2: Explain various energy storage systems and control mechanisms for hybrid systems
CO3: Analyze different combinations of renewable energy sources.
CO4: Design and select appropriate converters and control strategies for hybrid systems.
CO5: Interpret real-time case studies of hybrid systems.

TEXT BOOKS

1. Md. Rabiul Islam et al., Emerging Power Converters for Renewable Energy and Electric Vehicles, CRC Press, First Edition, 2021
2. G.D. Rai, SolarEnergy Utilization, Khanna Publishers, 3rd Edition, 1987
3. B.H. Khan, Non-Conventional Energy Sources, Tata McGraw-Hill Publishing Company, New Delhi, 2017, 3rd Edition.

REFERENCE BOOKS

1. S.N. Bhadra, D. Kastha, & S. Banerjee, Wind Electrical Systems, Oxford University Press, 2005.Rashid M.H., Power Electronics Handbook, Academic Press, 4th Edition, 2018.
2. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, 6th Edition, 2017.
3. Gray L. Johnson, Wind Energy System, Prentice Hall of India, 2nd Edition, 2006
4. Wind Power Integration - Connection and System Operational Aspects, Brendan Fox, 2014, IET, 2nd Edition.
5. G.D. Rai, SolarEnergy Utilization, Khanna Publishers, 3rd Edition, 1987.

Mapping of COs with POs & PSOs

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CO1	3	-	-	-	-	-	2	1	-	2	-	-	3	3
CO2	3	3	-	-	3	-	2	1	-	2	-	-	3	3
CO3	3	-	-	-	-	-	2	1	-	2	-	-	3	3
CO4	3	-	-	-	-	-	2	1	-	2	-	-	3	3
CO5	3	-	-	-	-	-	2	1	-	2	-	-	3	3
AVG	3	3	-	-	3	-	2	1	-	2	-	-	3	3

1-Low, 2-Medium, 3-High, '-'- No correlation

24OET106 ELECTRICAL MAINTENANCE AND SAFETY

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the fundamental principles of electrical safety, including causes and prevention of electrical shocks.
- To develop knowledge of safety protocols and best practices during the installation, testing, commissioning, operation, and maintenance of electrical systems in different settings, including hazardous areas.
- To gain awareness of fire safety measures, including the proper selection and use of fire extinguishers.

UNIT I INTRODUCTION TO ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION 9

Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shop.

UNIT II ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS **9**

Wiring and fitting –Domestic appliances –water tap giving shock –shock from wet wall –fan firing shock –multi-storied building –Temporary installations Agricultural pump installation –Do’s and Don’ts for safety in the use of domestic electrical appliances.

UNIT III ELECTRICAL SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE **9**

Preliminary preparations –safe sequence –risk of plant and equipment –safety documentation –field quality and safety -personal protective equipment –safety clearance notice –safety precautions –safeguards for operators –safety.

UNIT IVELECTRICAL SAFETY IN HAZARDOUS AREAS **9**

Hazardous zones –class 0, 1 and 2 spark, flashovers and corona discharge and functional requirements Specifications of electrical plants, equipment’s for hazardous locations Classification of equipment enclosure for various hazardous gases and vapours classification of equipment/enclosure for hazardous locations.

UNIT V FIRE EXTINGUISHERS **9**

Fundamentals of Fire-Initiation of Fires, Types; Extinguishing Techniques, Prevention of Fire, Types of Fire Extinguishers, Fire Detection and Alarm System, CO2 and Halogen Gas Schemes, Foam Schemes.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Apply the Electrical Safety Principles.
CO2: Explain Safe Electrical Installations and Maintenances.
CO3: Manage Electrical Safety in Hazardous and Special Areas.
CO4: Promote Safety During Electrical Operations and Repairs.
CO5: Implement Fire Safety and Extinguishing Measures.

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TEXT BOOKS

1. Rao, S. and Saluja, H.L., “Electrical Safety, Fire Safety Engineering and Safety Management”, Khanna Publishers, 1988.
   Gupta, B.R., Handbook of Electrical Power System and Wiring, S. Chand, 2013.
2. B.V.S.Rao, “Operation and Maintenance of Electrical Equipment – Volume I & II” Media Promoters & Publishers Private Limited, Mumbai, 1st Edition, 1st Reprint 2011.

REFERENCE BOOKS

1. Cooper.W.F, “Electrical safety Engineering”, Newnes-Butterworth Company, 1978.
2. John Codick, “Electrical safety hand book”, McGraw Hill Inc., New Delhi, 2000.
3. Nagrath, I.J. and Kothari, D.P., “Power System Engineering”, Tata McGraw Hill, 1998.
4. Wadhwa, C.L., “Electric Power Systems”, New Age International, 2004.
5. Pradeep Chaturvedi, “Energy management policy, planning and utilization”, Concept Publishing company, New Delhi, 1997.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	-	-	-	-	-	2	1	-	2	-	-	2	2
CO2	3	3	-	-	3	-	2	1	-	2	-	-	2	2
CO3	3	-	-	-	-	-	2	1	-	2	-	-	3	3
CO4	3	-	-	-	-	-	2	1	-	2	-	-	1	1
CO5	3	-	-	-	-	-	2	1	-	2	-	-	2	2
AVG	**3**	**3**	**-**	**-**	**3**	**-**	**2**	**1**	**-**	**2**	**-**	**-**	**2**	**2**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OBT201 HOSPITAL MANAGEMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Understanding Health System Organization.
- To know Regulatory Requirements and Health Care Codes.
- To learn Equipment and Maintenance Management.

UNIT I HEALTH SYSTEM **9**

Health organization of the country, the state, the cities and the region, Health Financing System, Organization of Technical Section.

UNIT II HOSPITAL ORGANISATION AND MANAGEMENT **9**

Management of Hospital organization, Nursing section Medical Sector, Technical Department, Definition and Practice of Management by Objective, Transactional Analysis, Human relation in Hospital, Legal aspect in Hospital Management.

UNIT III REGULATORY REQUIREMENT AND HEAITH CARE CODES **9**

FDA Regulation, joint commission of Accreditation for Hospitals, National Fire Protection Association Standard, IRPC.

UNIT IV EQUIPMENT MAINTENANCE MANAGEMENT **9**

Organizing Maintenance Operations, Paper Work Control, Maintenance Job, Planning Maintenance Work, Measurement and Standards, Preventive Maintenance, Maintenance Budgeting and Forecasting, Maintenance Training.

UNIT V TRAINED TECHNICAL PERSONNEL **9**

Function of Clinical Engineer, Role to be performed in Hospital, Man power Market, Professional Registration, Structure in hospital.

TOTAL:45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1:Explain the principles, staffing and marketing processes, discussing their significance.

CO2: Manage their role in effective and efficient management of health care organizations.

CO3: Analyze the various regulations and standards to be followed in hospitals for safety.

CO4:Evaluate various aspects of equipment maintenance.

CO5:Apply the aspects of managing the hospital in terms of staff, marketing and the use of computers.

TEXT BOOKS

1. Cesar A. Caceresand Albert Zara,The practice of Clinical Engineering, Academic Press, 1977.
2. Webster,J.G. and Albert M.Cook, Clinical Engineering Principles and Practices, Prentice Hall Inc. Englewood Cliffs, 1979.
3. Antony Kelly, Maintenance planning and control, Butterworths London, 1984.

REFERENCE BOOKS

1. Hans P feiff,Vera Dammann (Ed.) Hospital Engineering in Developing Countries, Zreport Eschborn, 1986.
2. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press, SanDiego1988.
3. R.C.Goyal, Handbook of Hospital Personal Management, Prentice Hall of India,1993.
4. G. D. Kunders, “Hospitals–Facilities Planning and Management”, TMH, New Delhi–5th edition Reprint 2007.
5. Peter Berman, “Health Sector Reforming Developing Countries”, Harvard University Press, 1995.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	-	-	1	-	1	-	1	1	-	1	1
CO2	1	2	1	-	-	1	-	1	-	1	1	-	1	1
CO3	1	2	1	-	-	1	-	1	-	1	1	-	1	1
CO4	1	2	1	-	-	1	-	1	-	1	1	-	2	2
CO5	1	2	1	-	-	1	-	1	-	1	1	-	2	2
AVG	**1**	**2**	**1**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**1**	**-**	**1.4**	**1.4**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24OBT202 ASSIST DEVICES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To study the role and importance of machines that takes over the functions of the heart and lungs.
- To study various mechanical techniques that helps a non-functioning heart.
- To learn the functioning of the unit which does the clearance of urea from the blood.

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART **9**

Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, Blood Handling System, Functioning and different types of Artificial Heart.

UNIT II CARDIAC ASSIST DEVICES **9**

Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves.

UNIT III ARTIFICIAL KIDNEY **9**

Indication and Principle of Haemodialysis, Dialysate, types of filter and membranes, Different types of hemodialyzers, Wearable Artificial Kidney, Implanting Type.

UNIT IV RESPIRATORY AND HEARING AIDS **9**

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques.

UNIT V RECENT TRENDS **9**

Transcutaneous electrical nerve stimulator, bio-feedback, Electrical safety Analyser, Latest use of assistive technology for health care Information technology, Future trends in assistive technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the principles and construction of artificial heart.

CO2: Discuss the various mechanical techniques that improve therapeutic technology.

CO3: Explain the functioning of the membrane or filter that cleanses the blood.

CO4: Describe the tests to assess the hearing loss and development of wearable devices for the same.

CO5: Analyze and research on electrical stimulation and bio feedback techniques in rehabilitation and physiotherapy.

TEXT BOOKS

1. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.
2. John.G. Webster – Bioinstrumentation – John Wiley & Sons (Asia) Pvt Ltd-2004.
3. Joseph D. Bronzino, the Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006.

REFERENCE BOOKS

1. Andreas.F.Vonracum, “Handbook of biomaterial evaluation”, Mc-Millan publishers, 1980.
2. GrayEWnek, GrayLBrowlin, “Encyclopedia of Biomaterials and Biomedical Engineering” Marcel Dekker Inc New York 2004.

3. D.S.Sunder, “Rehabilitation Medicine”, 3rd Edition, Jaypee Medical Publication, 2010.
4. Albert M.Cooka nd WebsterJ.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey,1982.
5. KolffW.J., Artificial Organs, John Wiley and Sons, NewYork, 1979.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	1	-	-	-	-	-	-	-	-	2	1
CO2	3	2	1	1	-	-	-	-	-	-	-	-	2	1
CO3	3	2	1	1	-	-	-	-	-	-	-	-	2	1
CO4	3	2	1	1	-	-	-	-	-	-	-	-	3	2
CO5	3	2	1	1	-	-	-	-	-	-	-	-	3	2
AVG	**3**	**2**	**1**	**1**	-	-	-	-	-	-	-	-	**2.4**	**1.4**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24OBT203 ROBOTICS IN MEDICINE

L T P C
3 0 0 3

COURSE OBJECTIVES

- To get introduced to the fundamental of robotics and position analysis.
- Learn about Parallel robots, different types of motions and force analysis.
- Know the basics of trajectory planning, Motion control systems and actuators.

UNIT I FUNDAMENTALS AND POSITION ANALYSIS 9

Fundamentals, Degrees of freedom, Joints, Coordinates, Reference frames, Programming modes, Collaborative robots, Position analysis – Robots as mechanisms, Conventions, Transformations, Denavit Hartenberg Representation, Degeneracy and Dextrerity, Position analysis of Articulated robot.

UNIT II PARALLEL ROBOTS, DIFFERENTIAL MOTIONS AND FORCE ANALYSIS 9

Parallel robots, Planar and Spatial parallel robots, Differential relationships, The Jacobian, Large scale motions, Frame vs Robot, Differential motions and change, Hand frame, Operator, Jacobian and Inverse for Screw based and Parallel Robots, Differential operator, Lagarangian mechanics.

UNIT III TRAJECTORY PLANNING, MOTION CONTROL SYSTEMS AND ACTUATORS 9

Path and Trajectory, Joint Space and Cartesian Space Descriptions and Trajectory Planning, Cartesian, Trajectory Recording, Basics, Steady state error, Root locus, Proportional, Compensators, Multiple IO systems, Characteristics of Hydraulic, Pneumatic, Electric motors, Other actuators.

UNIT IV SENSORS, IMAGE PROCESSING AND ANALYSIS WITH VISION SYSTEMS **9**

Sensor Characteristics, Micro switches, Visible and IR, Touch, Proximity, Transforms – Fourier, Hough, Resolution, Image processing, Segmentation, Region growing and splitting, Object recognition, Specialized lighting, Compression, Colour images.

UNIT V FUZZY CONTROL AND APPLICATIONS IN MEDICINE **9**

Fuzzy control - Crisp vs Fuzzy, Sets, Inference rules, Defuzzification, Simulation, Applications in Biomedical Engineering and rehabilitation, Nanobots in medicine, Cardiac and abdominal procedures with tele operated robots, Orthopedic surgery with cooperative robots

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Describe the fundamental of robotics and position analysis.

CO2: Outline the functioning of parallel robots, different types of motions and force analysis.

CO3: Portray the basics of trajectory planning, Motion control systems and actuators.

CO4: Recognize and explain the use of various sensors and vision systems in robotics.

CO5: Employ Fuzzy control in robotics and apply it to Robotics in Medicine.

TEXT BOOKS

1. S.B. Niku, Introduction to Robotics, Analysis, Control, Applications, Pearson Education, 2020.
2. Robert Schilling, Fundamentals of Robotics-Analysis and control, Prentice Hall of India, 2003.
3. Fu Gonzales and Lee, "Robotics", Mc Graw Hill, 1987.

REFERENCE BOOKS

1. Grover, Wiess, Nagel and Oderey, Industrial Robotics, McGraw Hill, 2012.
2. Klafter, Chmielewski and Negin, Robot Engineering, Prentice Hall Of India, 1989.
3. Mittal, Nagrath, Robotics and Control, Tata McGraw Hill publications, 2003.
4. Bijay K. Ghosh, NingXi, T.J.Tarn, Controlling Robotics and Automation Sensor – Based integration, Academic Press, 1999.
5. Mikell P. Groover, Mitchell Weiss, Industrial robotics, technology, Programming and Applications, McGraw Hill International Editions, 1986.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1	1	-	-	-	-	-	-	-	3	3
CO2	3	2	1	1	1	-	-	-	-	-	-	-	3	2
CO3	3	2	1	1	1	-	-	-	-	-	-	-	3	3
CO4	3	2	1	1	1	-	-	-	-	-	-	-	3	3
CO5	3	2	1	1	1	-	-	-	-	-	-	-	3	3
AVG	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2.8**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OBT204 DSP ARCHITECTURE **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce architectural features of programmable DSP Processors of TI and Analog Devices.
- To give practical examples of DSP Processor architectures for better understanding.
- To develop the programming knowledge using Instruction set of DSP Processors.

UNIT I INTRODUCTION TO DIGITAL SIGNAL PROCESSING 9

Introduction, a Digital signal-processing system, the sampling process, discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), linear time-invariant systems, Digital filters, Decimation and interpolation.

UNIT II ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES 9

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT III PROGRAMMABLE DIGITAL SIGNAL PROCESSORS 9

Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming.

UNIT IV ANALOG DEVICES FAMILY OF DSP DEVICES 9

Analog Devices Family of DSP Devices – ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor.

UNIT V INTERFACING MEMORY 9

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

TOTAL:45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Classify RFID systems based on frequency, architecture and performance.
CO2: Define standards for RFID technology.
CO3: Illustrate the operation of various components of RFID systems.
CO4: Describe the privacy and security issues in RFID Systems.
CO5: Discuss the construction and applications of RFID enabled sensor.

TEXT BOOKS

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009.
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007.

REFERENCE BOOKS

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co.
4. Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI.
5. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D., California Technical Publishing, ISBN 0-9660176-3-3, 1997.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	1	1	1	-	-	-	-	2	1	2	2	3	3
CO2	3	3	1	1	-	-	-	-	2	1	2	2	1	1
CO3	3	3	1	1	-	-	-	-	2	1	2	2	2	2
CO4	3	3	1	1	-	-	-	-	2	1	2	2	2	2
CO5	3	3	1	1	-	-	-	-	2	1	2	2	2	1
AVG	**3**	**2.6**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**1**	**2**	**2**	**2**	**1.8**

1-Low, 2-Medium, 3-High, '-'- No correlation

24OBT205 IMAGE PROCESSING TECHNIQUES

L T P C
3 0 0 3

COURSE OBJECTIVES

- To become familiar with digital image fundamentals.
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To study the image segmentation and representation techniques.

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II IMAGE ENHANCEMENT **9**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION **9**

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.

UNIT IV IMAGE SEGMENTATION **9**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT V IMAGE COMPRESSION AND RECOGNITION **9**

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL:45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explain the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- CO2: Operate on images using the techniques of smoothing, sharpening and enhancement.
- CO3: Explore the restoration concepts and filtering techniques.
- CO4: Learn the basics of segmentation, features extraction, compression and recognition methods for color models.
- CO5: Comprehend image compression concepts.

TEXT BOOKS

1. Rafael C. Gonzalez, Richard E. Woods, ‘Digital Image Processing’, Pearson, Third Edition,2010.
2. Anil K. Jain, ‘Fundamentals of Digital Image Processing’, Pearson, 2002.
3. G. R. Sinha and B. C. Patel, Medical Image Processing Concepts and Applications, PHI, 2014.

REFERENCE BOOKS

1. Kenneth R. Castleman, ‘Digital Image Processing’, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, ‘Digital Image Processing using MATLAB’, Pearson Education, Inc., 2011.

3. D,E. Dudgeon and RM. Mersereau, ‘Multidimensional Digital Signal Processing’, Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, ‘Digital Image Processing’, John Wiley, New York, 2002.
5. Milan Sonka et al ‘Image processing, analysis and machine vision’, Brookes/Cole, Vikas Publishing House, 2^{nd} edition, 1999.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
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CO1	3	2	-	-	-	-	-	-	-	-	-	2	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2	2	2
CO3	3	2	-	-	-	-	-	-	-	-	-	2	2	2
CO4	3	2	-	-	-	-	-	-	-	-	-	2	2	2
CO5	3	2	-	-	-	-	-	-	-	-	-	2	2	2
AVG	**3**	**2**	-	-	-	-	-	-	-	-	-	**2**	**2**	**2**

1-Low, 2-Medium, 3-High, ‘-’- No correlation

24OBT206 WIRELESS SENSOR NETWORKS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the fundamentals of wireless sensor network.
- To gain knowledge on the MAC and Routing Protocols of WSN.
- To acquire knowledge on the protocols required for developing real time applications using WSN and 6LOWPAN.

UNIT I INTRODUCTION **9**

Principle of Wireless Sensor Network -Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.

UNIT II MAC AND ROUTING PROTOCOLS **9**

MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC,TRAMA, Routing protocols – Requirements, Classification -SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.

UNIT III 6LOWPAN **9**

6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers – Addressing, Routing - MeshUnder - Route-Over, Header Compression - Stateless header compression - Context-based header compression, Fragmentation and Reassembly , Mobility – types, Mobile IPv6, Proxy Home Agent, Proxy MIPv6, NEMO –Routing – MANET, ROLL, Border routing.

UNIT IV APPLICATION **9**

Design Issues, Protocol Paradigms -End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP),Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.

UNIT V TOOLS **9**

TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming.

TOTAL:45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Design solutions for WSNs applications.
CO2: Develop efficient MAC and Routing Protocols.
CO3: Design solutions for 6LOWPAN applications.
CO4: Develop efficient layered protocols in 6LOWPAN.
CO5: Use Tiny OS and Contiki OS in WSNs and 6LOWPAN applications.

TEXT BOOKS

1. V. Daniel Hunt, Alber Puglia, Mike Puglia, “RFID: A guide for radio frequency identification”, Wiley & Sons, Inc., Publication, 2011.
2. Roy Want, RFID Explaind, Springer 2022.
3. Amin Rida, Li Yang, Manos M. Tentzeris, RFID Enabled Sensor Design and Applications, Artech House, 2010.

REFERENCE BOOKS

1. Holger Karl, Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley Publication, 2006.
2. Anna Forster, “Introduction to Wireless Sensor Networks”, Wiley, 2017.
3. Zach Shelby Sensinode and Carsten Bormann, “ 6LoWPAN: The Wireless Embedded”.
4. Philip Levis, “TinyOS Programming”, 2006 –www.tinyos.net.
5. The Contiki Operating System.http://www.sics.se/contiki.

Mapping of COs with POs & PSOs

COs	POs												PSOs	
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CO2	3	3	2	2	2	1	-	-	-	-	-	2	2	1
CO3	3	3	3	2	2	1	-	-	-	-	-	3	2	2
CO4	3	3	3	3	2	2	-	-	-	-	-	2	3	2
CO5	2	-	1	1	3	2	-	-	-	-	-	2	2	2
AVG	**2.8**	**2.4**	**2.2**	**2**	**2.2**	**1.4**	**-**	**-**	**-**	**-**	**2**	**2.2**	**2.4**	**2**

1-Low, 2-Medium, 3-High, ‘-’- No correlation


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