MECHANICAL ENGINEERING

R2024

CURRICULUM & SYLLABI

GRT INSTITUTE OF ENGINEERING AND TECHNOLOGY, Tiruttani

(An Autonomous Institution)

Accredited by NBA (ECE), NAAC with "A++" Grade & An ISO 9001:2015 Certified Institution

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai.

B.E - MECHANICAL ENGINEERING

CURRICULUM REGULATIONS - 2024

CHOICE BASED CREDIT SYSTEM

CURRICULUM AND SYLLABI (SEMESTER I TO VIII)

(FOR THE STUDENTS ADMITTED DURING 2024)

SEMESTER – I									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1	IP24101	Induction Programme	-	-	-	-	-	0	-
THEORY COURSES									
2	HS24101	Professional English	HS	3	-	-	3	3	60/40
3	MA24101	Algebra and Calculus	BS	3	1	-	4	4	60/40
4	PH24101	Engineering Physics	BS	3	-	-	3	3	60/40
5	CY24101	Engineering Chemistry	BS	3	-	-	3	3	60/40
6	GE24101	Problem Solving and Python Programming	ES	3	-	-	3	3	60/40
7	TA24101	Heritage of Tamils / தமிழர் மரபு	HS	1	-	-	1	1	60/40
PRACTICAL COURSES									
8	GE24102	Problem Solving and Python Programming Laboratory	ES	-	-	4	4	2	40/60
9	PC24101	Physics and Chemistry Laboratory	BS	-	-	4	4	2	40/60
10	HS24102	English Laboratory	HS	-	-	2	2	1	0/100
TOTAL				**16**	**1**	**10**	**27**	**22**	

SEMESTER – II									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	MA24201	Statistics and Numerical Techniques	BS	3	1	-	4	4	60/40
2	GE24201	Engineering Graphics	ES	2	-	3	5	4	60/40
3	ME24201	Engineering Mechanics	PC	3	1	-	4	4	60/40
4	ME24202	Engineering Materials and Metallurgy	BS	3	-	-	3	3	60/40
5	TA24201	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	HS	1	-	-	1	1	60/40
THEORY CUM PRACTICAL COURSES									
6	EE24203	Basic Electrical and Electronics Engineering	ES	3	-	2	5	4	50/50
PRACTICAL COURSES									
7	GE24202	Engineering Practices Laboratory	ES	-	-	4	4	2	40/60
8	HS24201	English Communication Laboratory	HS	-	-	4	4	2	40/60
TOTAL				**15**	**2**	**13**	**30**	**24**	

SEMESTER – III									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	MA24302	Transforms and Partial Differential Equations	BS	3	1	-	4	4	60/40
2	ME24301	Engineering Thermodynamics	PC	3	-	-	3	3	60/40
3	ME24302	Manufacturing Processes	PC	3	-	-	3	3	60/40
4	GE24301	Environmental Science and Sustainability	BS	2	-	-	2	2	60/40
THEORY CUM PRACTICAL COURSES									
5	ME24303	Fluid Mechanics and Machinery	ES	3	-	2	5	4	50/50
PRACTICAL COURSES									
6	ME24304	Manufacturing Processes Laboratory	PC	-	-	4	4	2	40/60
7	ME24305	Machine Drawing	PC	-	-	4	4	2	40/60
8	GE24S01	Professional Development	EEC	-	-	2	2	1	0/100
TOTAL				**14**	**1**	**12**	**27**	**21**	

SEMESTER – IV									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	ME24401	Kinematics of Machinery	PC	3	-	-	3	3	60/40
2	ME24402	Thermal Engineering	PC	3	-	-	3	3	60/40
3	ME24403	Strength of Materials	ES	3	1	-	4	4	60/40
4	ME24404	Hydraulics and Pneumatics	PC	3	-	-	3	3	60/40
THEORY CUM PRACTICAL COURSES									
5	ME24405	Manufacturing Technology	PC	3	-	2	5	4	50/50
PRACTICAL COURSES									
6	ME24406	Thermal Engineering Laboratory	PC	-	-	4	4	2	40/60
7	ME24407	Strength of Materials Laboratory	ES	-	-	4	4	2	40/60
TOTAL				**15**	**1**	**10**	**26**	**21**	

SEMESTER – V									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	ME24501	Machine Design	PC	3	1	-	4	4	60/40
2	ME24502	Metrology and Measurements	PC	3	-	-	3	3	60/40
3		Open Elective – I	OE	3	-	-	3	3	60/40
4		Professional Elective - I	PE	3	-	-	3	3	60/40
5		Professional Elective - II	PE	3	-	-	3	3	60/40
6		Mandatory course I	MC	3	-	-	3	0	0/100
THEORY CUM PRACTICAL COURSES									
7	ME24503	Dynamics of Machines	PC	3	-	2	5	4	50/50
PRACTICAL COURSES									
8	ME24504	Metrology and Measurements Laboratory	PC	-	-	4	4	2	40/60
9	GE24S02	Soft Skills	EEC	-	-	2	2	1	0/100
TOTAL				**21**	**1**	**8**	**30**	**23**	

SEMESTER – VI									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	ME24601	Finite Element Analysis	PC	3	1	-	4	4	60/40
2	ME24602	Additive Manufacturing	PC	3	-	-	3	3	60/40
3		Open Elective – II	OE	3	-	-	3	3	60/40
4		Professional Elective - III	PE	3	-	-	3	3	60/40
5		Professional Elective - IV	PE	3	-	-	3	3	60/40
6		Mandatory course II	MC	3	-	-	3	0	0/100
THEORY CUM PRACTICAL COURSES									
7	ME24603	Heat and Mass Transfer	PC	3	-	2	5	4	50/50
PRACTICAL COURSES									
8	ME24604	Simulation and Analysis Laboratory	PC	-	-	4	4	2	40/60
9	ME24605	Mini Project	EEC	-	-	4	4	2	40/60
TOTAL				**21**	**1**	**10**	**32**	**24**	

SEMESTER – VII									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	GE24701	Human values and ethics	HS	2	-	-	2	2	60/40
2	GE24702	Industrial Engineering and Management	HS	3	-	-	3	3	60/40
3		Open Elective - III	OE	3	-	-	3	3	60/40
4		Professional Elective - V	PE	3	-	-	3	3	60/40
5		Professional Elective - VI	PE	3	-	-	3	3	60/40
6	ME24701	Mechatronics and IOT	PC	3	-	2	5	4	50/50
PRACTICAL COURSES									
7	ME24702	Summer Internship*	EEC	-	-	-	0	2	0/100
TOTAL				**17**	**-**	**2**	**19**	**20**	

*** Two weeks Summer Internship carries two credit and it will be done during VI semester summer vacation and same will be evaluated in VII semester.**

SEMESTER – VIII									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
PRACTICAL COURSES									
1	ME24801	Project Work / Internship	EEC	-	-	20	20	10	40/60
TOTAL				**-**	**-**	**20**	**20**	**10**	

TOTAL CREDITS	165

MANDATORY COURSES

MANDATORY COURSE I								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	MX24C71	Introduction to Women and Gender Studies	MC	3	-	-	3	-
2	MX24C72	Elements of Literature	MC	3	-	-	3	-
3	MX24C73	Disaster Risk Reduction and Management	MC	3	-	-	3	-
4	MX24C74	Film Appreciation	MC	3	-	-	3	-

MANDATORY COURSE II								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	MX24C75	Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	MC	3	-	-	3	-
2	MX24C76	History of Science and Technology in India	MC	3	-	-	3	-
3	MX24C77	Industrial Safety	MC	3	-	-	3	-
4	MX24C78	Political and Economic Thought for a Human Society	MC	3	-	-	3	-
5	MX24C79	State, Nation Building and Politics in India	MC	3	-	-	3	-

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Modern Mobility Systems	Vertical II Product and Process Development	Vertical III Robotics and Automation	Vertical IV Digital and Green Manufacturing	Vertical V Clean and Green Energy Technologies	Verticals VI Diversified Courses
Hybrid and Electric Vehicle Technology	Design of Experiments	Robotics	Digital Manufacturing and IoT	Bio energy Conversion Technologies	Turbo Machines
Thermal Management of Batteries and Fuel Cells	CAD/CAM	Robots and Systems in Smart Manufacturing	Surface Engineering	Renewable Energy Technologies	Automobile Engineering
CAE and CFD Approach in Future Mobility	Product Life Cycle Management	Smart Mobility and Intelligent Vehicles	Green Manufacturing Design and Practices	Carbon Foot print estimation and reduction techniques	Gas Dynamics and Jet Propulsion
Vehicle Dynamics	Ergonomics in Design	Modern Robotics	Energy Saving Machinery and Components	Energy Efficient Buildings	Composite Materials
Automotive Materials, Components, Design and Testing	Value Engineering	Embedded Systems and Programming	Environment Sustainability and Impact Assessment	Energy Storage Devices	Design for Manufacturing
Vehicle Health Monitoring, Maintenance and Safety	Precision Manufacturing	Sensors and Actuators	Industry 4.0	Power Plant Engineering	Computational Fluid Dynamics and Heat transfer

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I: MODERN MOBILITY SYSTEMS								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	ME24P01	Hybrid and Electric Vehicle Technology	PE	3	-	-	3	3
2	ME24P02	Thermal Management of Batteries and Fuel Cells	PE	3	-	-	3	3
3	ME24P03	CAE and CFD Approach in Future Mobility	PE	3	-	-	3	3
4	ME24P04	Vehicle Dynamics	PE	3	-	-	3	3
5	ME24P05	Automotive Materials, Components, Design and Testing	PE	2	-	2	4	3
6	ME24P06	Vehicle Health Monitoring, Maintenance and Safety	PE	3	-	-	3	3

VERTICAL II: PRODUCT AND PROCESS DEVELOPMENT								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	ME24P07	Design of Experiments	PE	3	-	-	3	3
2	ME24P08	CAD/CAM	PE	3	-	-	3	3
3	ME24P09	Product Life Cycle Management	PE	3	-	-	3	3
4	ME24P10	Ergonomics in Design	PE	3	-	-	3	3
5	ME24P11	Value Engineering	PE	3	-	-	3	3
6	ME24P12	Precision Manufacturing	PE	3	-	-	3	3

VERTICAL III: ROBOTICS AND AUTOMATION								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	ME24P13	Robotics	PE	3	-	-	3	3
2	ME24P14	Robots and Systems in Smart Manufacturing	PE	3	-	-	3	3
3	ME24P15	Smart Mobility and Intelligent Vehicles	PE	3	-	-	3	3
4	ME24P16	Modern Robotics	PE	2	-	2	4	3
5	MR24P17	Embedded Systems and Programming	PE	3	-	-	3	3
6	ME24P18	Sensors and Actuators for Robots	PE	3	-	-	3	3

VERTICAL IV: DIGITAL AND GREEN MANUFACTURING								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	ME24P19	Digital Manufacturing and IoT	PE	2	-	2	4	3
2	ME24P20	Surface Engineering	PE	3	-	-	3	3
3	ME24P21	Green Manufacturing Design and Practices	PE	3	-	-	3	3
4	ME24P22	Energy Saving Machinery and Components	PE	3	-	-	3	3
5	ME24P23	Environment Sustainability and Impact Assessment	PE	3	-	-	3	3
6	ME24P24	Industry 4.0	PE	3	-	-	3	3

VERTICAL V: CLEAN AND GREEN ENERGY TECHNOLOGIES								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	ME24P25	Bio energy Conversion Technologies	PE	3	-	-	3	3
2	ME24P26	Renewable Energy Technologies	PE	3	-	-	3	3
3	ME24P27	Carbon Footprint Estimation and Reduction Techniques	PE	3	-	-	3	3
4	ME24P28	Energy Efficient Buildings	PE	3	-	-	3	3
5	ME24P29	Energy Storage Devices	PE	3	-	-	3	3
6	ME24P30	Power Plant Engineering	PE	3	-	-	3	3

VERTICAL VI: DIVERSIFIED COURSES								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	ME24P31	Turbo Machines	PE	3	-	-	3	3
2	ME24P32	Automobile Engineering	PE	3	-	-	3	3
3	ME24P33	Gas Dynamics and Jet Propulsion	PE	3	-	-	3	3
4	ME24P34	Composite Materials	PE	3	-	-	3	3
5	ME24P35	Design for Manufacturing	PE	3	-	-	3	3
6	ME24P36	Computational Fluid Dynamics and Heat transfer	PE	3	-	-	3	3

OPEN ELECTIVES

OPEN ELECTIVE I AND II								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	AD24901	Artificial Intelligence and Machine Learning Fundamentals	OE	2	0	2	4	3
2	CS24902	IoT Concepts and Applications	OE	2	0	2	4	3
3	AD24905	Data Science Fundamentals	OE	2	0	2	4	3
4	CS24908	Augmented Reality and Virtual Reality	OE	3	0	0	3	3

OPEN ELECTIVE III								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IE24908	Quality Engineering	OE	3	0	0	3	3
2.	EE24902	Electric Vehicle Technology	OE	3	0	0	3	3
3.	EC24901	Fundamentals of Electron Devices	OE	3	0	0	3	3
4.	IE24904	Industrial Design and Rapid Prototyping Techniques	OE	3	0	0	3	3
5.	IM24902	Production Planning and control	OE	3	0	0	3	3
6.	RA24904	Drone Technologies	OE	3	0	0	3	3

SUMMARY

Name of the Programme: Mechanical Engineering										
S.No	Subject Area	Credits per Semester								Total Credits
		1	2	3	4	5	6	7	8	
1	HS	5	3					5		13
2	BS	12	7	6						25
3	ES	5	10	4	6					25
4	PC		4	10	15	13	13	4		59
5	PE					6	6	6		18
6	OE					3	3	3		9
7	EEC			1		1	2	2	10	16
8	Mandatory					✓	✓			
TOTAL		22	24	21	21	23	24	20	10	165

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

HS24101	PROFESSIONAL ENGLISH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Improve the communicative competence of learners.
- Help learners use language effectively in academic /work contexts.
- Build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- Develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.
- Use language efficiently in expressing their opinions via various media

UNIT I INTRODUCTION OF EFFECTIVE COMMUNIATION 1

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 8

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Why/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II NARRATION AND SUMMATION 9

Reading-Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar–Past tense(simple); Subject Verb Agreement; and Prepositions. Vocabulary-Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs

UNIT III DESCRIPTION OF PROCESS AND PRODUCT 9

Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

UNIT IV CLASSIFICATION 9

Reading–Newspaper articles; Journal reports–and Non-Verbal Communication (tables, pie charts etc.,). Writing–Note-making/Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from nonverbal (chart , graph etc., to verbal mode) Grammar–Forms of Verbs, Articles; Pronouns- Possessive & Relative pronouns. Vocabulary-Collocations; Fixed/Semi fixed expressions.

UNIT V EXPRESSION OF VIEWS 9

Reading–Reading editorials; and Opinion Blogs; Writing–Minutes of Meeting, Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary-Cause & Effect Expressions–Content vs Function words.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1 : Use appropriate words in a professional context**.**

CO2 : Gain understanding of basic grammatical structures and use them in right context.

CO3 : Read and interpret and also infer information presented in tables, charts, denotative and connotative meanings of technical texts and other graphic forms.

CO4 : Write definitions, descriptions, narrations and essays on various topics.

TEXTBOOKS:

1. English for Engineers & Technologists Orient Black Swan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology CambridgeUniversityPress,2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. K N. Shoba, and Dr. Lourdes Joevani Department of English, Anna University.

REFERENCEBOOKS:

1. Technical Communication– Principles and Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book on Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. English for Technical Communication (With CD) By Aysha Viswa Mohan, McGraw Hill Education, ISBN: 0070264244.
4. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
5. Learning to Communicate–Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2		2		2	2		3	3	2	2	1		
CO2		2		2		2	2		3	3	2	2	1		
CO3		2		2		2	2		3	3	2	3	1		
CO4		1		2		3	2		3	3	2	3	1		
Avg		**1.75**		**2**		**2.25**	**2**		**3**	**3**	**2**	**2.5**	**1**		

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

MA24101	ALGEBRA AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
- To introduce integral ideas in solving areas, volumes and other practical problems in vector.

UNIT I MATRICES **9+3**

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II DIFFERENTIAL CALCULUS **9+3**

Representation of functions - 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 – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – 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 MULTIPLE INTEGRALS **9+3**

Double integrals in Cartesian and polar coordinates - Change of order of integration in Cartesian coordinates - Area enclosed by plane curves - Change of variables in double integrals -Triple integrals - Volume of Solids. Applications: Moments and centres of mass, moment of inertia.

UNIT V VECTOR CALCULUS **9+3**

Gradient, divergence and curl (excluding vector identities) – Directional derivative –Irrotational and Solenoidal vector fields – Vector integration – Green's theorem in a plane and Gauss divergence theorem and Stoke's theorem (without proof) – Simple applications involving cubes and rectangular parallelopipeds.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1 : Demonstrate the matrix techniques in solving the related problems in engineering and technology.

CO2 : Apply differential calculus tool to solve engineering applications.

CO3 : Use differential calculus ideas on functions several variables.

CO4 : Evaluate the area and volume by applying the concept of multiple integration.

CO5 : Utilize the concept of vector calculus in evaluating integrals.

TEXTBOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition,
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCEBOOKS:

1. M. K. Venkataraman, "Engineering Mathematics", Volume I, 4th Edition, The National Publication Company, Chennai, 2003.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, New Delhi, 2017.
3. H. K. Dass and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand Private Limited, 3rd Edition 2014.
4. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 6th Edition, New Delhi, 2008.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2					2		2	3		1	1
CO2	3	3	1	2					2		2	3		1	1
CO3	3	3	2	2					2		2	3		1	1
CO4	3	3	1	1					2		2	3		1	1
CO5	3	3	2	2					2		2	3		1	1
Avg	**3**	**3**	**1.6**	**1.6**					**2**		**2**	**3**		**1**	**1**

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

PH24101	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I MECHANICS 9

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

UNIT II ELECTROMAGNETIC WAVES 9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - Source of electromagnetic waves. EM waves: Energy, momentum, intensity and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion – resonance –analogy between electrical and mechanical oscillating systems – waves on a string – standing waves – traveling waves – Energy transfer of a wave – sound waves – Doppler effect. Reflection and refraction of light waves – total internal reflection – interference –Michelson interferometer – Theory of air wedge and experiment. Theory of laser – characteristics – Spontaneous and stimulated emission – Einstein's coefficients – population inversion – Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves – Electrons and matter waves –Compton effect – Schrodinger equation (Time dependent and time independent forms) – Physical meaning of wave function – particle in a infinite one-dimensional (1D) potential well - Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator (qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope – Resonant diode – Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1 : Recognized the importance of mechanics.

CO2 : Express their knowledge in electromagnetic waves.
CO3 : Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
CO4 : Illustrate the importance of quantum physics.
CO5 : Comprehend and apply quantum mechanical principles towards the formation of energy bands.

TEXTBOOKS:

1. D. Kleppner and R. Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. E.M. Purcell and D.J. Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.

REFERENCEBOOKS:

1. R. Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3. K. Thyagarajan and A. Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4. Halliday, R. Resnick and J. Walker. Principles of Physics, Wiley (Indian Edition), 2015.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	1	-	-	1	-	1	-	-	-	-	-
CO2	3	2	2	1	2	1	2	2	-	1	-	2	-	1	
CO3	3	2	1	1	2	1	1	1	-	1	-	2	-	1	-
CO4	3	3	2	2	2	-	1	2	-	1	-	2	-	1	1
CO5	2	3	2	1	1	1	-	2	-	1	-	2	-	-	-
Avg	**2.8**	**2.6**	**1.75**	**1.25**	**1.6**	**1**	**1.3**	**1.6**	**-**	**1**	**-**	**2**	-	1	1

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

CY24101	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER AND ITS TREATMENT 9

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT II NANOCHEMISTRY 9

Basics: Distinction between molecules, non-materials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of non-material's: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapor deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process. Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil – cetane number; Power alcohol and biodiesel. - natural gas- compressed natural gas (CNG)- liquefied petroleum gases (LPG).

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO_2 emission and carbon footprint.

UNIT V ENERGY SOURCES AND STORAGE DEVICES **9**

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor- environmental consequences of fossil fuel- Importance of renewable energy sources -Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Batteries: Types of batteries- lead acid battery- Solid Battery – Lithium Battery, Lithium-ion; Battery Electric vehicles-working principles; Fuel cells: H2-O2 fuel cell, microbial fuel cell.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1 : Infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO2 : Identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nonmaterial for engineering and technology applications.

CO3 : Apply the knowledge of phase rule and composites for material selection.

CO4 : Analyze the quality of fuel and its various uses.

CO5 : Recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.

REFERENCE BOOKS:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2				1	1	2							
CO2	2		1	1	2	2	2	1				3		1	1
CO3	3	1				-	-	2				3			
CO4	3	1	1			1	3	2				2			
CO5	3	2	2	2		3	3	1				3			1
Avg	**2.8**	**1.5**	**1.33**	**1.5**	**2**	**1.75**	**2.25**	**1.6**				**2.75**		**1**	**1**

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

GE24101	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

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.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

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, flow chart, 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, guess an 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, operators, 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 conditional (if), alternative (if-else), chained conditional (if-elif-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, Predefined modules (Numpy Pandas, Matplotlib, Scipy, Django) packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 : Develop algorithmic solutions to simple computational problems.

CO2 : Develop and execute simple Python programs.

CO3 : Write simple Python programs using conditionals and loops for solving problems.
CO4 : Represent compound data using Python lists, tuples, dictionaries etc.
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", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
3. Python Data Science Handbook: Essential Tools for Working with Data, Second Edition (Grayscale Indian Edition) by Jake VanderPlas.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st 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", 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.Comparison of Existing and Revised Syllabus

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3		2							1	1		
CO2	3	3	3		2							1	1		
CO3	3	3	3		2							1	1	1	
CO4	3	3	3		2						1	1	1	1	
CO5	3	2	1		1						1	1	1	1	
Avg	**3**	**2.8**	**2.6**		**1.8**						**0.5**	**1**	**1**	**1**	

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

TA24101	தமிழர் மரபு	L	T	P	C
		1	0	0	1

அலகு I மொழி மற்றும் இலக்கியம் 3

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

அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை 3

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

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3

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

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும், விலங்களும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாடடிற்குத் தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு மக்களும் பண்பாடு மற்றும் கல்வியியல் பணிகள் கழகம்.
2. கணினித் தமிழ் முனைவர் இல.சுந்தரம். (விகடன் பிரசுரம்).

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

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

TA24101	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

UNIT I LANGUAGE AND LITERATURE 3

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

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

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

UNIT III FOLK AND MARTIAL ARTS 3

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

UNIT IV THINAI CONCEPT OF TAMILS 3

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

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

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

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – மற்றும் கல்வியியல் பணிகள் கழகம்.
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கறை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print).

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

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

GE24102	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To understand the problem-solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (Reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (Copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (Divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Develop algorithmic solutions to simple computational problems
CO2 : Develop and execute simple Python programs.
CO3 : Implement programs in Python using conditionals and loops for solving problems.
CO4 : Process compound data using Python data structures.
CO5 : Utilize Python packages in developing software applications.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2						3	2	1		
CO2	3	3	3	3	2						3	2	1		
CO3	3	3	3	3	2						3		1	1	
CO4	1	2			1						1		1	1	
CO5	2	2			2						2		1	1	
Avg	**2.4**	**2.6**	**3**	**3**	**1.8**						**2.4**	**2**	**1**	**1**	

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

PC24101	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

PHYSICS LABORATORY

COURSE OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

EXPERIMENT TOPICS: (Any seven experiments to be conducted)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
13. Michelson Interferometer.
14. Melde's string experiment
15. Experiment with lattice dynamics kit.

CHEMISTRY LABORATORY

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electro analytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles.

EXPERIMENT TOPICS: (Any seven experiments to be conducted)

1. Preparation of Na2CO3 as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in water sample. Split the first experiment into two
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using flame photometer.
13. Preparation of nanoparticles (TiO2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

COURSE OUTCOMES:

Upon completion of the course, the students should be able to

CO1 : Analysis the Modulus of elasticity of materials.
CO2 : Illustrate the Laser and Optical fiber.
CO3 : Determine the wavelength of Ultrasonic wave in Liquid.
CO4 : Analyze the effect of chloride in water and DO present in sample water.
CO5 : Identify basicity acidity and pH of the materials

TEXT BOOKS:

1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's, Textbook of Quantitative Chemical Analysis (2009).

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1			2	2	1				2			
CO2	3	1	2			1	2	2				1		1	1
CO3	3	2	1	1			1	1						1	1
CO4	2	1	2			2	2	2							
CO5	2	1	2		1	2	2	2				1	1		1
Avg	**2.6**	**1.3**	**1.6**	**1**	**1**	**1.4**	**1.8**	**1.6**				**1.3**	**1**	**1**	**1**

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

HS24102	ENGLISH LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To improve the communicative competence of learners
- To help learners use language effectively in academic/work contexts
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students' English languages kills by engaging the listening, speaking and grammar learning activities that is relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 6

Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies-making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions (filling out a bank application for example).

UNIT II NARRATION AND SUMMATION 6

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.

UNIT III DESCRIPTION OF PROCESS/ PRODUCT 6

Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product-explaining uses and purposes- Presenting a product- describing shapes and sizes and weights-talking about quantities (large & small)-talking about precautions.

UNIT IV CLASSIFICATOIN AND RECOMMENDATIONS 6

Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation-

UNIT V DISCUSSION 6

Listening –Listening to debates/discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions- understanding a website-describing processes

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

CO1 : To listen and comprehend complex academic texts

CO2 : To speak fluently and accurately in formal and informal communicative contexts

CO3 : To express their opinions effectively in both oral and written medium of communication.

Assessment Pattern

- Conduction of Assessment to test speaking and writing skills

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2		3		2	3		3	3	3	1	1		
CO2		2		3		2	3		3	3	3	1	1		
CO3		2		3		1	1		1	3	1	1	1		
Avg		**2**		**3**		**1.6**	**2.3**		**2.3**	**3**	**2.3**	**1**	**1**		

1 - Low, 2 - Medium, 3 - High

SEMESTER-II
Common To All Branches
(B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH)

MA24201	STATISTICS AND NUMERICAL TECHNIQUES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

The student should be made to:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

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

Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

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

One way and two - way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

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

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method-Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

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 derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATION **9+3**

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

TOTAL: 60 PERIODS

COURSE OUTCOMES

At the end of the course, the students should be able to

CO1 : Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO2 : Apply the basic concepts of classifications of design of experiments in the field of agriculture.

CO3 : Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.

CO4 : Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

CO5 : Solve the partial and ordinary differential equations with initial and boundary condition by using certain techniques with engineering applications.

TEXT BOOKS:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., “Miller and Freund’s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis”, 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis” Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4. Gupta S.C. and Kapoor V. K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum’s Outlines on Probability a nd Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., “Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	1	1						2	2	1		
CO2	3	2	1	2	2						2	3	1	1	
CO3	2	2	1	1	1						2	2	1	1	
CO4	2	3	1	1	1						1	3	1	1	
CO5	2	3	1	1	1						2	2	1		
Avg	**2.2**	**2.6**	**1**	**1.2**	**1.2**						**1.8**	**2.4**	1	1	

1 - Low, 2 - Medium, 3 - High

SEMESTER-II
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

GE24201	ENGINEERING GRAPHICS	L	T	P	C
		2	0	3	4

COURSE OBJECTIVES:

- To understand the importance of the drawing in engineering applications.
- To develop graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings.
- To improve their visualization skills so that they can apply this skill in developing new products.
- To improve their technical communication skill in the form of communicative drawings.

UNIT-I PLANE CURVES AND PROJECTION OF POINTS 5+9

Importance of graphics in engineering applications–Use of drafting instruments– BIS conventions and specifications–size, layout and folding of drawing sheets– lettering and dimensioning. (Not for examination) Curves used in engineering practices: Conics–construction of ellipse, parabola and hyperbola by eccentricity method, cycloidal curves–construction of cycloid, construction of involutes of square and circle–drawing of tangents and normal to the above curves. Orthographic projection – principles – principal planes – first angle projection – projection of points.

UNIT-II PROJECTION OF LINES AND PLANE SURFACES 5+9

Projection of straight lines (only first angle projection) inclined to both the principal planes – determination of true lengths and true inclinations by rotating line method and traces.

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT-III PROJECTION OF SOLIDS AND SECTION OF SOLIDS 5+9

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

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

UNIT-IV DEVELOPMENT OF SURFACE AND ISOMETRIC PROJECTIONS 5+9

Development of lateral surfaces of simple and sectioned solids – prisms, pyramids cylinders and cones. Principles of isometric projection – isometric scale –isometric projections of simple solids and truncated solids –prisms, pyramids, cylinders, cones and combination of two solid objects in simple vertical positions.

UNIT-V FREE HAND SKETCHING AND PERSPECTIVE PROJECTIONS 5+9

Visualization concepts–representation of three-dimensional objects – layout of views–freehand sketching of multiple views from pictorial views of objects.

Principle of perspective projection – terminology –perspective projection of simple solids-prisms, pyramids, cylinder and cone by visual ray method.

UNIT-VI COMPUTER AIDED DRAFTING (Not for examination) 5

Introduction to drafting packages: Initial Setup Commands, Coordinate system in AutoCAD, UCS, WCS, and MCS. Draw Commands, Modify Commands, View Commands, Annotation commands, 2D Drawings and 3D Models -Simple Exercises.

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

CO1 : To construct different plane curves and to comprehend the theory of projection.

CO2 : To project orthographic projections of lines and plane surfaces.

CO3 : To draw the projection of simple solids and sectional solids.

CO4 : To draw the development of lateral surfaces of sectional solids and Isometric projections of solids.

CO5 : To perform freehand sketching of multiple views from pictorial viewand visualize perspective view of simple solids.

TEXT BOOKS:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 51th Edition, 2012.
2. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 31th Edition, 2018.

REFERENCE BOOKS:

1. Varghese P I., "Engineering Graphics", McGraw Hill Education (I) Pvt. Ltd., First Edition, 2013.
2. Venugopal K. and PrabhuRaja V., "Engineering Graphics", New Age International (P) Limited, 12th Edition, 2014.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 23th Edition, 2017.
4. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill Publishing Company Limited, New Delhi, 2nd Edition, 2008.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2					2		3		2	2	2	
CO2	3	2	2					2		3		2	2	2	
CO3	3	2	2					2		3		2	2	2	
CO4	3	2	2					2		3		2	2	2	
CO5	3	2	2					2		3		2	2	2	
Avg	**3**	**2**	**2**					**2**		**3**		**2**	**2**	**2**	

1 - Low, 2 - Medium, 3 - High

SEMESTER-II
B.E. MECHANICAL ENGINEERING

ME24201	ENGINEERING MECHANICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

The students can be able to

- Understand the basics of mechanics and apply the concept of equilibrium of system of forces.
- Understand the concept of equilibrium and to solve problems of rigid bodies
- Learn about the centroid and centre of gravity of objects and moment of inertia
- Learn the principles of friction and frictional forces.
- Develop basic dynamics concepts – force, momentum, impulse, work and energy.

UNIT I STATICS OF PARTICLES 9+3

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles - Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force. Equilibrium of a Particle- Space and Free-Body Diagrams – Equivalent systems of forces – Principle of transmissibility.

UNIT II EQUILIBRIUM OF RIGID BODIES 9+3

Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Moment of a Force about an Axis, Couple - Moment of a Couple, Resolution of a Given Force into a Force - Couple system, Equilibrium in Two Dimensions - Reactions at Supports and Connections.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9+3

Centroids of areas, Centroids of by Integration, Centroids of Composite Areas, Theorems of Pappus-Guldinus, Centre of Gravity, Centroid of a Volume, Centroids of Volumes by Integration. Moments of Inertia of Areas - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Moment of Inertia of a simple solids by Integration.

UNIT IV FRICTION 9+3

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

UNIT V DYNAMICS OF PARTICLES 9+3

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Law of Motion - Equations of Motions, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1 : Analyze the forces in the system and to understand vectorial and scalar representation of forces and moments.

CO2 : Study about the rigid body in equilibrium and to analyze the problems in engineering systems using the concept of static equilibrium.

CO3 : Evaluate the properties of surfaces and solids by means of finding centroid, centre of gravity and moment of inertia.

CO4 : Determine the friction and the effects by the laws of friction.

CO5 : Apply the basic kinematic relationships between position, velocity, acceleration, time and kinetic relationship between force, momentum, impulse, work and energy.

TEXT BOOKS:

1. Beer Ferdinand P, Russell Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12thEdition, 2019.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4thEdition, Pearson Education Asia Pvt. Ltd., 2005.
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5th Edition, McGraw Hill Higher Education, 2013.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2						2	3	1	2
CO2	3	3	3	3	2	2						2	3	1	2
CO3	3	3	3	3	2	2						2	3	1	2
CO4	3	3	3	3	2	2						2	3	1	2
CO5	3	3	3	3	2	2						2	3	1	2
Avg	**3**	**3**	**3**	**3**	**2**	**2**						**2**	**3**	**1**	**2**

1 - Low, 2 - Medium, 3 - High

SEMESTER-II
B.E. MECHANICAL ENGINEERING

ME24202	ENGINEERING MATERIALS AND METALLURGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the constructing the phase diagram and using of iron-iron carbide phase diagram for microstructure formation.
- To learn selecting and applying various heat treatment processes and its microstructure formation.
- To illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field.
- To illustrate the different polymer, ceramics and composites and their uses in engineering field.
- To learn the various testing procedures and failure mechanism in engineering field.

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 – Full annealing, stress relief, recrystallisation and spheroidising –normalizing, hardening and tempering of steel. Isothermal transformation diagrams – 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.

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.

UNIT-IV NON-METALLIC MATERIALS 9

Polymers – types of polymers, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers. Engineering Ceramics – Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ and SIALON. Composites – Classifications - Metal Matrix and FRP- Applications of Composites.

UNIT-V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9

Mechanisms of plastic deformation, slip and twinning – Types of fracture – 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

COURSE OUTCOMES

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

CO1 : Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification.

CO2 : Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
CO3 : Clarify the effect of alloying elements on ferrous and non-ferrous metals
CO4 : Summarize the properties and applications of non-metallic materials.
CO5 : Explain the testing of mechanical properties.

TEXT BOOKS:

1. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 9th Edition, 2018.
2. Sydney H. Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1994

REFERENCE BOOK(S):

1. A. Alavudeen, N. Venkateshwaran, and J. T. Winowlin Jappes, A Textbook of Engineering Materials and Metallurgy, Laxmi Publications, 2006.
2. U. C. Jindal, Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley, 2012.
3. G.S. Upadhyay and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd, New Delhi, 2020.
4. Raghavan. V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd. 6th edition, 2019
5. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, 2nd edition Re print 2019.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2	2								2	2		
CO2	3		2	1		2		1				2	2		
CO3	3		2									2	2		
CO4	3		2				2					2	2		
CO5	3		2	2	2							2	2		
Avg	3		2	1.6	2	2	2	1				2	2		

1 - Low, 2 - Medium, 3 - High

SEMESTER-II

Common To All Branches

(B.Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH)

TA24201	தமிழரும் தொழில்நுட்பமும்	L	T	P	C
		1	-	-	1

அலகு I நெசவு மற்றும் பானை தொழில்நுட்பம் 3

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

அலகு II வடிவமைப்பு மற்றும் கட்டுமான தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெரியகோவில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோவில்கள் - மாதிரி கட்டமைப்புகள் பற்றிய அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாடு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ- சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தி தொழில்நுட்பம் 3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற் சாலை- இரும்பு உருகுதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சாடித்தல் - மணிகள் உருவக்கும் தொழிற் சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத் துண்டுங்கள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசன தொழில்நுட்பம் 3

அணை, ஏரி, குளங்கள், மதகு, - சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக் குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணிதத்தமிழ் 3

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

TOTAL: 15 PERIODS

SEMESTER-II
Common To All Branches
(B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH)

TA24201	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

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

UNIT III MANUFACTURING TECHNOLOGY 3

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

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

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

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

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

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு மக்களும் பண்பாடு மற்றும் கல்வியியல் பணிகள் கழகம்.
2. கணினித் தமிழ் முனைவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தோல்லியல் துறை வெளியீடு).
4. பொருநை - ஆற்றங்கரை நாகரிகம் (தோல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print).
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

SEMESTER-II
Common To B.E. – EEE & MECH

EE24203	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To illustrate the basics of electric circuits and analysis of DC & AC circuits.
- To understand the knowledge in the basics of working principles and application of electrical machines.
- To evaluate the fundamentals of analog electronics and their characteristics.
- To demonstrate the fundamental concepts of digital electronics.
- To compute the functional elements and working of measuring instruments.

UNIT - I BASIC ELECTRIC CIRCUITS 9

DC Circuits: Basic Circuit elements – Ohm's Law - Kirchhoff's Laws with Independent Sources – Resistors in Series and Parallel- Current division and Voltage division- Nodal Analysis, Mesh analysis with independent sources only - Thevenin's and Norton's Theorem. Introduction to AC circuit Fundamentals: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor.

UNIT II ELECTRICAL MACHINES 9

Construction and Working principle - DC Machines, EMF equation, Types and Applications. Construction and Working Principle of Transformers & Induction Motors, V/F drives.

UNIT III ANALOG ELECTRONICS 9

PN Junction Diode, Zener Diode – V-I Characteristics & Applications, BJT, SCR, MOSFET, IGBT Types–Basics of Rectifier and Inverter.

UNIT IV DIGITAL ELECTRONICS 9

Number system and its conversion, binary codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps.

UNIT V MEASUREMENTS AND INSTRUMENTATION 9

Functional elements of an instrument, Standards, Operating Principle, types -Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers - CT and PT, DSO – Block diagram – Data Acquisition.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Simulation and experimental verification of electrical circuit using Mesh analysis.
2. Simulation and experimental verification of electrical circuit using Nodal analysis.
3. Measurement of Three Phase Power using two Wattmeter method.
4. Load test on single-phase transformer.
5. Load test on DC shunt motor.
6. VI characteristic of PN junction diode.
7. VI characteristic of Zener Diode.
8. Study of solar PV.

TOTAL: 30 PERIODS
TOTAL: 75 PERIODS

COURSE OUTCOMES

After completing this course, the students will be able to

CO1 : Compute the electric circuit parameters.

CO2 : Illustrate the working principle and applications of electrical machines.

CO3 : Plot the characteristics of analog electronics.

CO4 : Summarize the basic concepts of digital electronics.

CO5 : Interpret the operating principles of measuring instruments.

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020.
2. S. K. Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
3. Sedha R.S., "A textbook book of Applied Electronics", S. Chand & Co., Third Edition, 2015.
4. James A. Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

REFERENCES:

1. Thomas L. Floyd, 'Digital Fundamentals', 11th Edition, Pearson Education, 2017.
2. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 9th edition, 2021.
3. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 7th Edition 2017.
4. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 4th Edition, 2019.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1					1		1		2		1	1
CO2	2	2	1					1		1		2		1	1
CO3	2	2	1					1		1		2		1	1
CO4	2	2	1					1		1		2		1	1
CO5	2	2	1					1		1		2		1	1
Avg	**2**	**2**	**1**					**1**		**1**		**2**		**1**	**1**

1 - Low, 2 - Medium, 3 - High

SEMESTER-II
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

GE24202	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

- Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in common household wood work.
- Welding various joints in steel plates using arc welding; machining various simple processes like turning, drilling, and tapping in parts.
- Wiring various electrical joints in common household electrical wire work.
- Soldering and testing simple electronic circuits; assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & MECHANICAL ENGINEERING)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:

a. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
b. Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
c. Preparation of plumbing line sketches for water supply.
d. Laying pipe connection to the suction and delivery side of a pump
e. Mixed pipe material connection – Pipe connections with different joining components.

WOOD WORK:

a. Study of the joints in roofs, doors, windows and furniture.
b. Making joints like Mortise and Tenon joint, T-Joint and Dovetail joint by sawing, planning and cutting.

PART II MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a. Welding of Butt joints, Lap joints and Tee joints using arc welding.
b. Gas welding practice

BASIC MACHINING WORK:

a. Simple step turning, taper turning
b. Simple drilling.

ASSEMBLY WORK:

a. Study of centrifugal pump
b. Study of air conditioner
c. Study of household mixer.

SHEET METAL WORK:

a. Making models of a square/Rectangular tray and funnels.

FOUNDRY WORK:

a. Demonstrating basic foundry operations.

GROUP B (ELECTRICAL & ELECTRONICS ENGINEERING)

PART III ELECTRICAL ENGINEERING PRACTICES 15

a. Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket.

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 using Diac/Triac/quadrac).

g. Study of emergency lamp wiring/Water heater.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

STUDY OF ELECTRONIC COMPONENTS

a. Measurement of Resistance of a resistor using Color Coding.

b. Measurement of AC signal parameters (Peak-Peak, RMS period, Frequency) using CRO.

SOLDERING WORK:

a. Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a. Assembling and testing electronic components on a small PCB.

STUDY OF LOGIC GATES:

a. Verification of logic gates - AND, OR, NOT, NAND, NOR, EXOR, EX-NOR.

ELECTRONIC EQUIPMENT STUDY:

a. Study on elements of smart phone.

b. Assembly and dismantle of LED TV.

c. Assembly and dismantle of computer/ laptop.

TOTAL: 60 PERIODS

***At end of the semester students should submit the prototypes of their stem projects.**

COURSE OUTCOMES

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

CO1 : draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.

CO2 : weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, and tapping in parts.

CO3 : assemble simple mechanical assembly of common household equipment's; Make a simple model using sheet metal work.

CO4 : wiring of various electrical joints in common household electrical wire work.

CO5 : solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

CO6 : understand the concept and verification of logic gates.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1	1	1					2	2	2	1
CO2	3	2			1	1	1					2	2	2	1
CO3	3	2			1	1	1					2	2	2	1
CO4	3	2			1	1	1					2	2	1	
CO5	3	2			1	1	1					2	2	1	
CO6	3	2			1	1	1					2	2	1	
Avg	**3**	**2**			**1**	**1**	**1**					**2**	**2**	**1.5**	**1**

1 - Low, 2 - Medium, 3 - High

SEMESTER-II
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

HS24201	ENGLISH COMMUNICATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To be able to communicate effectively through writing.

UNIT I SELFINTRODUCTION AND EMAIL DRAFTING 12

Speaking: Role Play Exercises Based on Workplace Contexts, - talking about competition- discussing progress toward goals-talking about experiences-talking about events in life-discussing past events.
Writing: Writing emails (formal & semi-formal).

UNIT II INDIVIDUAL DISCUSSION ON SOCIAL ISSUES 12

Speaking: discussing news stories-talking about frequency-talking about travel problems- discussing travel procedures- talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms.
Writing: Writing different types of emails.

UNIT III PRESENTATION ON TECHNICAL AND NON-TECHNICAL TOPICS 12

Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios-talking about purchasing-discussing advantages and disadvantages-making comparisons-discussing likes and dislikes-discussing feelings about experiences-discussing imaginary scenarios.
Writing: Short essays and reports-formal/semi-formal letters.

UNIT IV IMPORTANCE OF DESCRIPTIVE WRITING & INSTRUCTIONS 12

Speaking: discussing the natural environment-describing systems-describing position and movement-explaining rules-(example- discussing rental arrangements)- understanding technical instructions.
Writing: Writing instructions. Writing a short article.

UNIT V GROUP DISCUSSION AND IMPORTANCE OF RESUME WRITING 12

Speaking: describing things relatively-describing clothing-discussing safety issues (making recommendations) talking about electrical devices-describing controlling actions.
Writing: Job application (Cover letter+ Curriculum vitae)- product presentation)

TOTAL: 60 PERIODS

COURSE OUTCOMES

After completion of this course, the students should be able to

CO1 : Speak effectively in group discussions held in a formal/semi formal contexts.
CO2 : Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions
CO3 : Write emails, letters and effective job applications.
CO4 : Write critical reports to convey data and information with clarity and precision.
CO5 : Give appropriate instructions and recommendations for safe execution of tasks.

Assessment Pattern

- Conduction of Assessment to test speaking and writing skills

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3		3		3	3		3	3	3	3	1		2
CO2	-	3		3		3	3		3	3	3	3	1		2
CO3	-	2		3		3	3		3	3	3	3	1		2
CO4	-	3		3		3	3		3	3	3	3	1		2
CO5	-	3		3		3	3		3	3	3	3	1		2
Avg	-	**2.8**		**3**		**3**	**3**		**3**	**3**	**3**	**3**	**1**		**2**

1 - Low, 2 - Medium, 3 - High

SEMESTER-III
B.E- BME, MECH

MA24302	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- Understand the concepts of Fourier series, Transforms and formation of partial differential equations, which will enable them to model and analyze the physical phenomena.
- Implement the Fourier analysis, an elegant method in the study of heat flow, fluid mechanics and electromagnetic fields.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

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

UNIT II FOURIER SERIES 9 + 3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

Classification of PDE – Method of separation of variables - Fourier series solutions of one-dimensional wave equation – One-dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9 + 3

Z-transforms - Elementary properties – Convergence of Z-transforms - Initial and final value theorems - Inverse Z-transform using partial fraction- Residue method - convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.

UNIT V 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.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1 : Exemplify the concepts of partial differential equations and able to apply them to solve real scenarios.

CO2 : Analyze the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series.

CO3 : Appreciate the physical significance of Fourier series techniques in solving one and two-

CO4 : Apply the Z-transform to convert a discrete-time signal, which is a sequence of real or complex numbers, into a complex frequency domain representation.

CO5 : Apply Fourier transform to convert the function in time domain into a sum of sine waves of different frequencies, each of which represents a frequency component.

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics", 44thEdition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2016.
3. Sankara Rao. K, "Numerical Methods for Scientists and Engineers", PHI Learning Pvt Ltd., New Delhi, 2007.

REFERENCES:

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.
3. James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi,2016.
4. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi, 2016.
5. Peter V O Neil., Advanced Engineering Mathematics, 7th Edition, TBH Publishers, 2013.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1					2			2			
CO2	2	3	1	1					2			3			
CO3	3	2	1	1					2			3			
CO4	3	2	1	1					2			3			
CO5	2	3	2	2					2			2			
AVG.	**2.6**	**2.6**	**1.2**	**1.2**					**2**			**2.6**			

1 - Low, 2 - Medium, 3 - High

SEMESTER-III
B.E – MECHANICAL ENGINEERING

ME24301	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Teach the fundamentals and practical applications of the zeroth and first laws of thermodynamics.
- Explain the applications of second law of thermodynamics and entropy of pure substance.
- Teach the various properties of steam through steam tables and Mollier chart.
- Impart knowledge on the macroscopic properties of ideal and real gases.
- Provide an understanding of the psychrometric process and air conditioning system.

UNIT-I BASICS, ZEROTH AND FIRST LAW 9

Basic concepts of Thermodynamics - systems, properties and processes - Thermodynamic Equilibrium – Displacement work - P-V diagram. Thermal equilibrium – Temperature and Zeroth law –. First law – application to closed and open systems – steady 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 - Entropy change for a pure substance. Ideal gases undergoing different processes - principle of increase in entropy.

UNIT-III PROPERTIES OF PURE SUBSTANCES AND VAPOUR POWER CYCLES 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. Basic Rankine Cycle, modified, reheat and regenerative cycles.

UNIT-IV 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.

UNIT-V PSYCHROMETRY AND AIR CONDITIONING 9

Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications. Air conditioning system - Processes, Types and Working Principles. (Description only).

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions.

CO2 : Apply second law of thermodynamics to calculate the performance of thermal devices and entropy of Pure substance

CO3 : Calculate the thermodynamic properties for non-flow and flow processes using Steam Table and Mollier Chart.

CO4 : Calculate the properties of gas mixtures and understand the concept of simple thermodynamic relations of ideal and real gases.

CO5 : Analyze the properties of moist air, their application in psychrometric processes, and understand the working of air-conditioning systems.

TEXT BOOKS:

1. Nag. P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill (2017), New Delhi.
2. Natarajan, E., "Engineering Thermodynamics: Fundamentals and Applications", 2nd Edition (2014), Anuragam Publications, Chennai.

REFERENCES:

1. Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,9th Edition, 2019.
2. Chattopadhyay, P, "Engineering Thermodynamics", 2nd Edition Oxford University Press, 2016.
3. Rathakrishnan, E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.
4. Claus Borgnakke and Richard E. Sonntag, "Fundamentals of Thermodynamics", 10th Edition, Wiley Eastern, 2019.
5. Venkatesh. A, "Basic Engineering Thermodynamics", Universities Press (India) Limited, 2007

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2										3		
CO2	3	2	2										2		
CO3	3	2	2										3		
CO4	2	2	2										2		
CO5	3	2	2										3		
Avg.	**2.8**	**2**	**2**										**2.6**		

1 - Low, 2 - Medium, 3 - High

SEMESTER-III
B.E – MECHANICAL ENGINEERING

ME24302	MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the working principles of various metal casting processes.
- To learn and apply the working principles of various metal joining processes.
- To learn the working principles of metal forming process.
- To study and practice the working principles of plastics molding.
- To understanding of composite materials and their various manufacturing processes.

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–Moulding Machines– Types and applications– Melting furnaces; Blast and Cupola Furnaces – Principle of special casting processes- Shell, investment – Ceramic mould – Pressure die casting – Centrifugal Casting – CO_2 casting – Defects in Sand casting process-remedies, Solidification of metals and alloys.

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 - 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, Weld Defects: Types, Causes And Cure.

UNIT-III METAL FORMING PROCESSES 9

Hot working and cold working of metals – Forging processes – Rolling of metals – Types of Rolling – Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion–Sheet metal characteristics– Stretch forming operations– Hydro forming – Rubber pad forming– Introduction of Explosive and Super plastic forming

UNIT-IV 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 –Thermoforming – Bonding of Thermoplastics- duff moulding, Polymer additive manufacturing.

UNIT-V MANUFACTURING OF COMPOSITES 9

Introduction to Composites- Function of the Matrix and Reinforcement in Composites - Thermoset and Thermoplastic- Fiber Reinforcement, Composite manufacturing- Hand Lay-up processes, Spray up Process, Resin transfer moulding - Filament winding - sheet moulding. Metal and ceramic matrix composites, Metal matrix and reinforcement; Manufacturing processes for Metal Matrix Composites- Dispersion hardended and particle composite - Layer composites and inltration method, Metal additive manufacturing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Explain the principle of different metal casting processes.

CO2 : Describe the various metal joining processes.
CO3 : Apply the various metals forming process.
CO4 : Apply suitable molding technique for manufacturing of plastics components.

CO5 : Demonstrate a practical understanding of composite materials and fabrication techniques.

TEXT BOOKS:

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

REFERENCES:

1. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2. S. Gowri P. Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008.
3. Paul Degarma E, Black J.T and Ronald A. Kosher, Eligth Edition, Materials and Processes, in Manufacturing, Eight Edition, Prentice – Hall of India, 1997.
4. Hajra Chouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I andII, Media promoters and Publishers Private Limited, Mumbai, 1997
5. Sharma, P.C., A TEXT BOOKS of production Technology, S.Chand and Co. Ltd., 2004
6. Balasubramanian, M. Composite Materials and Processing, CRC press (2017)

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2			2	3	1	1			1	3	1	2
CO2	3		2			2	3	1	1			1	3	1	2
CO3	3		2			2	3	1	1			1	3	1	2
CO4	3		2			2	3	1	1			1	3	1	2
CO5	3		2			2	3	1	1			1	3	1	2
Avg	**3**		**2**			**2**	**3**	**1**	**1**			**1**	**3**	**1**	**2**

1 - Low, 2 - Medium, 3 - High

SEMESTER III
B.E – BME, ECE, EEE & MECH

GE24301	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To introduce ecological concepts and biodiversity, emphasizing conservation and public awareness.
- To understand pollution types, impacts, and waste management practices, with industrial safety focus.
- To expose students to various renewable energy technologies and their practical applications.
- To study how people harm the environment and learn ways to prevent and manage disasters.
- To promote sustainability awareness and application of sustainable practices in industry and society.

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope, and importance of environment; need for public awareness. Ecosystem and energy flow with ecological succession. Types and values of biodiversity; India as a mega-diversity nation and biodiversity hotspots. Threats like habitat loss, poaching, man-wildlife conflict, impacts from industrial and infrastructure development. Endangered and endemic species of India and conservation methods (in-situ and ex-situ), Role of information technology in species monitoring.

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of water, air, soil, noise, and radioactive pollution. Waste management covers municipal solid waste, hazardous waste, and E-Waste - gold extraction. Carbon Credit and Footprint concepts related to industry. Environmental protection acts. Case studies on OHASMS (Occupational health and safety management systems) emphasizing industrial safety practices and engineering risk management.

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy. Case studies on bio-fuel production from agricultural waste.

UNIT IV HUMAN POPULATION AND ENVIRONMENT IMPACT 6

Human population - Importance of value education, human rights. Land degradation and deforestation-Man-Made Disasters: Industrial Accidents-Nuclear Accidents-Oil Spills - Prediction and management. Science and technology of Carbon Sequestration - Ozone depletion and environmental responsibility. Case Study: A low-cost water purification project implemented in a densely populated village.

UNIT V SUSTAINABILITY MANAGEMENT AND PRACTICES 6

Suitability Management - Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability and protocols Sustainable Development Goals-targets. Suitability Practices - Zero waste and R concept, Circular economy, ISO 14000 Series, Environmental Impact Assessment. Sustainable habitat: green buildings, green materials, energy efficiency, sustainable transports. Sustainable energy. Case studies on sustainable building design in industrial facilities.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1 : Explore ecosystem functions, biodiversity, and the importance of species protection.
CO2 : Identify types of pollution, their effects, and preventive measures including waste management.
CO3 : Describe renewable energy sources and their applications in sustainable energy production.
CO4 : Analyze human impact the environment and propose on disaster management strategies.
CO5 : Apply sustainability concepts and practices in environmental and industrial systems.

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, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38. 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.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		1	1			1	3	2		1		1			
CO2	1	2	2		1	2	3	2		1		2			
CO3	1	1	2		2	3	3	2		1		2			
CO4	1					3	3	3		1		2			
CO5		1	2		1	3	3	3		1		2			
Avg	**1.00**	**1.25**	**1.75**		**1.33**	**2.40**	**3.00**	**2.40**		**1.00**		**1.80**			

1 - Low, 2 - Medium, 3 - High

SEMESTER III
B.E – MECHANICAL ENGINEERING

ME24303	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

The course aims to:

- Introduce the fundamental properties of fluids and analyze their behavior under static and dynamic conditions, with a focus on real world engineering applications.
- Explain the characteristics of laminar and turbulent flow through circular conduits, and evaluate energy losses in pipe systems.
- Develop a solid understanding of dimensional analysis and model testing techniques for fluid systems.
- Analyze the performance of hydraulic turbines using velocity triangles and related calculations.
- Evaluate the performance of pumps and understand their practical applications in fluid systems.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 10

Properties of fluids Hydrostatic Pressure & Measurements Flow characteristics Path line, Streak line and Streamline Pascal's law Eulerian and Lagrangian Principle of fluid flow – the concept of control volume and system – continuity equation, energy equation, Bernoulli's equation and Momentum Equation Applications

UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER 9

Types of Flow, Laminar flow through circular conduits Darcy Weisbach equation – friction factor Moody diagram minor losses Hydraulic and energy gradient (theory) – Pipes in series and parallel Boundary layer concepts – types of boundary layer thickness.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 8

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

UNIT IV HYDRAULIC TURBINES 9

Introduction about Impact of jets Theory of roto dynamic machines Classification of turbines – Pelton wheel, Francis turbine (inward and outward), and Kaplan turbine Working principles Work done by water on the runner Efficiencies – Draft tube Specific speed Performance curves for turbines – Governing of turbines.

UNIT V PUMPS 9

Classification of pumps Centrifugal pumps– working principle Heads and efficiencies– Velocity triangles Work done by the impeller performance curves Reciprocating pump – indicator diagram and its variations (theory) – air vessels (concept basis).

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. (a) Determination of coefficient of discharge of a Venturimeter
   (b) Determination of friction factor for flow through pipes
2. (a) Determination of metacentric height
   (b) Determination of forces due to impact of jet on a fixed plate
3. Characteristics of centrifugal pumps

4. Characteristics of reciprocating pump/ Gear pump
5. Characteristics of Pelton wheel turbine/ Francis turbine.

TOTAL: 30 PERIODS
TOTAL: 75 PERIODS

COURSE OUTCOMES

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

CO1 : Determine the properties and behavior of fluids in motion.
CO2 : Analyze fluid flow through circular pipes.
CO3 : Highlight the significance of dimensional and model analysis.
CO4 : Evaluate the efficiency of hydraulic turbines.
CO5 : Analyze the performance characteristics of pumps.

TEXT BOOKS:

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2019.
2. Bansal, R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P),Ltd., 2019

REFERENCES:

1. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint,2018
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016
3. Robert W.Fox, Alan T. McDonald, Philip J. Pritchard, “Fluid Mechanics and Machinery”, 2017.
4. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2018
5. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2019. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co. (2010).
6. S K Som, Gautam Biswas and Suman Chakraborty “Introduction to Fluid Mechanics and Fluid Machines”, McGraw Hill Publishing Co. 2017

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		1							1	2		
CO2	3	2	1	3	1							1		1	
CO3	3	2	1	3	1									1	
CO4	3	2	1	3	1							1		1	2
CO5	3	2	1	3	1							1	2	1	2
Avg.	3	2	1	3	1							1	**2**	**1**	**2**

1 - Low, 2 - Medium, 3 - High

SEMESTER III
B.E – MECHANICAL ENGINEERING

ME24304	MANUFACTURING PROCESSES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To Selecting appropriate tools, equipment's and machines to complete a given job.
- To Performing various welding process using Arc welding and fabricating gears using casting method.
- To Performing various machining process such as turning, drilling, and analyzing the defects in the cast and machined components.

LIST OF EXPERIMENTS

1. Perform taper turning operation on the given work piece using a lathe.
2. Perform eccentric turning on the given work piece using a lathe.
3. Perform knurling operation on the given work piece using a lathe.
4. Perform internal thread cutting operation on the given work piece using a lathe.
5. Perform external thread cutting operation on the given work piece using a lathe.
6. Perform drilling and tapping operations on the given work piece using a drilling machine and tap set.
7. Prepare a sand mould using the given solid gear pattern.
8. Prepare a sand mould using the given split dumbbell pattern.
9. Fabricate a sheet metal Tray and a Funnel from the given sheet metal.
10. Welding practice by using Arc welding.
11. Projects based on development of models for manufacturing methods. (Students should fabricate a project model based on any specific Manufacturing methods)

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1 : Demonstrate the join two metals using Arc welding and casting the gear models.

CO2 : Make the work piece as per given shape and size using lathe machine.

CO3 : Make the tray and funnel using sheet metal and analyze the defects in the cast and machined components

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3						1		2			1	1	2	2
CO2	3						1		2			1	1	2	2
CO3	3						1		2			1	1	2	2
Avg	**3**						**1**		**2**			**1**	**1**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

SEMESTER III
B.E – MECHANICAL ENGINEERING

ME24305	MACHINE DRAWING	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To familiarize the skills and practical experience in handling 2D drafting and 3D modelling software systems, standard drawing practices using fits and tolerances.
- To prepare assembly drawings using standard CAD packages.
- To Preparing standard drawing layout for modeled parts, assemblies with BoM.

PART I DRAWING STANDARDS 9

Code of practice for Engineering Drawing, BIS specifications – Thread forms, welding symbols, riveted joints, keys, and fasteners Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc.

PART II DRAFTING AND MODELLING 45

Drawing, Editing, Dimensioning, Layering, Hatching, Detailing, Detailed Drawing. Prepare a 2D assembly of machine components

1. Bearings – Bush Bearing / Plummer Block
2. Valves – Safety / Non-return Valves.

Prepare a drawing layout for modeled and assemblies components with BOM

1. Machine Components – Flange / Oldham's, coupling, Universal / Knuckle joint, Gib & Cotter / Sleeve & Cotter joints Screw Jack, Machine Vice, Lathe Tail Stock / Lathe Chuck, Piston, Connecting Rod / Stuffing box.
2. Project Student has to select a component and complete its parts, assembly and drawing layout of the model.

PART III GEOMETRIC DIMENSIONING AND TOLERANCING 6

Conventional Dimensioning and Tolerancing, reason to use GD&T, Standard symbols of GD&T, Fundamental tolerances, Deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerances on drawings.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1 : Draw the different types of thread forms, welding symbols, types of Keys, Riveted joints and fasteners.

CO2 : Model the machine components and prepare standard drawing layout for modeled and assemblies with BoM.

CO3 : Demonstrate an understanding of all the symbols used in GDT.

TEXT BOOKS:

1. Gopalakrishna K. R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore,2013.
2. Bhatt, N.D., Machine Drawing, 51th edition, Charotar Publishing House Pvt. Ltd., India, 2022.

REFERENCES:

1. Ajeet Singh, Machine drawing, 2nd edition, Tata McGraw Hill, India, 2012.
2. K.L. Narayana, Machine Drawing, 4th edition, New Age International publisher, India, 2014.
3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri," Machine Drawing" , published by Tata McGrawHill,2006
4. S. Trymbaka Murthy, "A TEXT BOOKS of Computer Aided Machine Drawing", CBS Publishers, NewDelhi,2007
5. K.C. John, TEXT BOOKS on Machine Drawing, 2nd edition, PHI Learning Pvt, Ltd, India, 2010.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3			3				3	2		3	2	2	1
CO2	2	3			3				3	2		3	2	2	1
CO3	2	3			3				3	2		3	2	2	1
Avg.	**2**	**3**			**3**				**3**	**2**		**3**	**2**	**2**	**1**

1 - Low, 2 - Medium, 3 - High

SEMESTER III
B. Tech-AI&DS / B.E – ECE & MECH

GE24S01	PROFESSIONAL DEVELOPMENT	L	T	P	C
		0	0	2	1

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 presentability 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.
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

UNIT I INTRODUCTION TO MS WORD 5

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.

UNIT II APPLICATIONS OF MS WORD 5

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

UNIT III INTRODUCTION TO MS EXCEL 5

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.

UNIT IV APPLICATIONS OF MS EXCEL 5

Use pivot tables to summarize and analyze 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.

UNIT V INTRODUCTION TO MS POWERPOINT AND ITS APPLICATIONS 10

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: 30 PERIODS

COURSE OUTCOMES

After completion of this course, the students should be able to

CO1 : Create document in MS word for technical requirements.

CO2 : Create document in MS word for academic requirements.

CO3 : Perform Data operation and analytics using MS Excel.

CO4 : Perform record creation and retrieving the data for academic requirements.

CO5 : Develop document for academic presentation using media objects in MS PowerPoint.

TEXT BOOKS:

1. "Microsoft Word Step by Step "Joan Lambert (Microsoft Press)the latest MS Word version (e.g., 2019 or Microsoft 365).
2. "Microsoft Office 365 – In practice (2021 Edition) by Randy Nordel, McGraw Hill Education.

REFERENCES:

1. **MS Word Book:** Microsoft Word 2019 Step by Step by Joan Lambert (Microsoft Press), Covers document creation, formatting, templates, references, and collaboration. ISBN: 978-1509305845.
2. **MS Excel Book:** Excel 2019 Bible by Michael Alexander, Richard Kusleika, and John Walkenbach (Wiley), Comprehensive coverage of Excel functions, data analysis, charts, pivot tables, macros., ISBN: 978-1119517948.
3. **MS PowerPoint Book:** PowerPoint 2019 For Dummies by Doug Lowe (For Dummies Series)\, Clear instructions on templates, animations, media, slide masters, and presentations. ISBN: 978-1119514190.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1								2			
CO2	3	3	3	1								2			
CO3	3	3	3	1								2			
CO4	3	3	3	1								2			
CO5	3	3	3	1								2			
Avg.	**3**	**3**	**3**	**1**								**2**			

1 - Low, 2 - Medium, 3 - High

SEMESTER IV
B.E. MECHANICAL ENGINEERING

ME24401	KINEMATICS OF MACHINERY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To discuss different kinds of mechanisms and how they can be generalized
- To impart skills to analyze velocity and acceleration of linkages in mechanisms
- To develop the cam profiles at various follower motions.
- To solve problems on gears and gear trains.
- To analyze the frictional effects in machine elements.

UNIT I BASICS OF MECHANISMS 9

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four bar chain and slider crank chains –Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Straight line generators, Universal Joint – rocker mechanisms.

UNIT II KINEMATICS OF LINKAGE MECHANISMS 9

Displacement, Velocity and Acceleration Analysis of Simple Mechanisms – Graphical Method– Velocity and Acceleration Polygons – Velocity Analysis using Instantaneous Centers –Velocities and accelerations by Analytical method – Kinematic Analysis of Simple Mechanisms.

UNIT III KINEMATICS OF CAM MECHANISMS 9

Classification of cams and followers – Terminology and definitions – Displacement diagrams –Uniform velocity, parabolic, simple harmonic and cycloidal motions – Derivatives of follower motions – Layout of plate cam profiles –Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting – sizing of cams.

UNIT IV GEARS AND GEAR TRAINS 9

Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions – Gear tooth action – contact ratio – Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains

UNIT V 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 in brakes Band and Block brakes.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Describe various types of mechanisms and generalize them based on kinematic link and pair configurations.
CO2 : Analyze the velocity and acceleration of different linkages in planar mechanisms.
CO3 : Design cam profiles for specified follower motions.
CO4 : Solve problems related to simple, compound, and epicyclic gear trains.
CO5 : Explain the fundamental concepts of friction and analyze the frictional effects in machine elements.

TEXT BOOKS:

1. Rattan, S.S, “Theory of Machines”, 5th Edition, McGraw Hill Education (India) Limited,2020.
2. Uicker J.J, Pennock G.R and Shigley J.E."Theory of Machines and Mechanisms”,4th Edition, Oxford University Press, 2023.

REFERENCES:

1. Robert L. Norton, “Kinematics and Dynamics of Machinery”, McGraw Hill Education(India) Limited, 2017
2. Thomas Bevan, "Theory of Machines", 3rd Edition, Pearson Education, 2009 (2018).
3. R S Khurmi and J K Gupta, "Theory of Machines", 14th Edition, S.Chand Publishing, 2020.
4. V. P. Singh, “Theory of Machines” 6th Edition, Dhanpat Rai& Co (P) Limited, 2017.
5. Sadhu Singh, “Theory of Machines”, 3rd Edition, Pearson Education, 2011 (2016).

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		1									1	2	1	
CO2	2	2	1	2								1	2	2	
CO3	2		1	2								1	2	3	
CO4	2	2	1									1	2	3	
CO5	2		1	2								1	2	1	
Avg.	**2**	**2**	**1**	**2**								**1**	**2**	**2**	

1 - Low, 2 - Medium, 3 - High

SEMESTER IV
B.E. MECHANICAL ENGINEERING

ME24402	THERMAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To integrate the laws and concepts of thermodynamics into the analysis of gas power cycles.
- To analyzing the working of IC engines combustion and its auxiliary systems.
- To understand the working and performance of the steam nozzles and steam turbines.
- To understand the working of air compressors and to evaluate their performance.
- To understand the working of refrigeration and air conditioning systems.

UNIT I GAS POWER CYCLES 9

Air Standard Cycles – Carnot, Otto, Diesel, Dual, Brayton, Stirling – Cycle Analysis, Performance and Comparison.

UNIT II INTERNAL COMBUSTION ENGINES AND AUXILIARY SYSTEMS 9

IC engine – Classification, working, components and their functions. Ideal and actual: Valve and port timing diagrams, p v diagrams two stroke & four stroke, and SI & CI engines – comparison. Combustion in SI & CI Engines. Performance and Emission Testing, Performance parameters and calculations. Morse and Heat Balance tests. Types of Fuel Injection system and Ignition systems. Types of Lubrication and Cooling systems. Concepts of Supercharging and Turbo charging.

UNIT III STEAM NOZZLES AND TURBINES 9

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

UNIT IV AIR COMPRESSOR 9

Classification and comparison, working principle, work of compression with and without clearance, volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.

UNIT V REFRIGERATION AND AIR CONDITIONING 9

Refrigerants Vapour compression refrigeration cycle super heat, sub cooling – Performance calculations working principle of vapour absorption system, Ammonia –Water, Lithium bromide – water systems. Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Apply thermodynamic concepts to different air standard cycles and solve problems.

CO2 : Explain the functioning and features of IC engine combustion and auxiliary systems.

CO3 : Solve problems in steam nozzles and turbines

CO4 : Solve problems in single stage and multistage air compressors.

CO5 : Solve problems using refrigerant table / charts and psychrometric charts

TEXT BOOKS:

1. Rajput. R. K., —Thermal Engineering‖, 10th Edition, Laxmi Publications, 2018.
2. Ganesan V., " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. Mahesh. M. Rathore, “Thermal Engineering”, 1st Edition, Tata McGraw Hill, 2010.
2. Ballaney. P, “Thermal Engineering”, 25th Edition, Khanna Publishers, 2017.
3. Domkundwar, Kothandaraman, &Domkundwar, “A Course in Thermal Engineering”, 6th Edition, DhanpatRai& Sons, 2011.
4. Ramalingam. K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.
5. Rudramoorthy, R, “Thermal Engineering “, Tata McGrawHill, New Delhi,2003

COPO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2										3		
CO2	3	2	2										2		
CO3	3	2	2										3		
CO4	2	2	2										2		
CO5	3	2	2										3		
Avg.	**2.80**	**2.00**	**2.00**										**2.60**		

1 - Low, 2 - Medium, 3 - High

SEMESTER IV
B.E. MECHANICAL ENGINEERING

ME24403	STRENGTH OF MATERIALS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

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

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 12

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 14

Beams – Types Transverse loading and types loads 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 (Study) – Shear stress distribution.

UNIT III TORSION 12

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 13

Elastic curve – Governing differential equation Double integration method Macaulay's method – Theory of Columns Slenderness ratio, End Conditions, Equivalent length, Euler and Rankine's formula

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.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1 : Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.

CO2 : Understand the load transferring mechanism in beams and stress distribution due to 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. Bansal, R.K., "Strength of Materials", 6th edition, Laxmi Publications (P) Ltd., 2022.

REFERENCES:

1. Singh. D.K., “Strength of Materials”, Ane Books Pvt Ltd., New Delhi, 2021.
2. Egor P Popov, “Engineering Mechanics of Solids”, 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2015.
3. Ramamurtham S and R Narayanan., "Strength of Materials", Dhanpat Rai publishing company, 2020.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1							2	3	2	1
CO2	3	3	2	2	1							2	3	2	1
CO3	3	3	3	2	2							2	3	2	1
CO4	3	3	3	3	2							2	3	2	1
CO5	3	3	2	2	2							2	3	2	1
Avg.	**3**	**3**	**2.4**	**2.2**	**1.6**							**2**	**3**	**2**	**1**

1 - Low, 2 - Medium, 3 - High

SEMESTER IV
B.E – MECHANICAL ENGINEERING

ME24404	HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

UNIT I FLUID POWER SYSTEMS 9

Introduction to Fluid power –Applications – Fluid power systems – Types of fluids Properties of fluids and selection – Basics of Hydraulics –Principles of flow Friction loss–Work, Power and Torque Problems, Sources of Hydraulic power: Pumping Theory Various pumps, Selection criteria of pumps –Fixed and Variable displacement pumps – Problems.

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders –Application, Hydraulic cushioning – Rotary Actuators Hydraulic motors Control Components: Direction Control, Flow control and pressure control valves – Servo and Proportional valves–Applications–Accessories: Reservoirs, Pressure Switches – Filters –types and selection Applications – Fluid Power ANSI Symbols – Problems.

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air over oil, Sequence, Reciprocation, Synchronization, FailSafe, 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 – FRL, 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.

Note: (Use of standard Design Data Book is permitted in the University Examination)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the concepts and applications of fluid power systems and operation of different types of pumps

CO2 : Summarize the features and functions of Hydraulic motors, control components and servo, proportional valves.

CO3 : Operate and control the different types of hydraulic circuits and systems.

CO4 : Operate and control the different types of pneumatic circuits, electro pneumatic system and pneumatic logic circuits.

CO5 : Understand the designing and layout of circuits, hydraulic power package and trouble shooting.

TEXT BOOKS:

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

REFERENCES:

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

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1		2	1				1	1			1
CO2	3	1	1	1					2		2	1	1	2	2
CO3	3	1	2	2					3		2	1	2	3	1
CO4	3	1	2	1	1				2			1	3	2	1
CO5	3	2	2	1			2		3	1	3	2	2	3	3
Avg	**3**	**1.2**	**1.6**	**1.2**	**1**	**2**	**1.5**		**2.5**	**1**	**2**	**1.2**	**2**	**2.5**	**1.6**

1 - Low, 2 - Medium, 3 - High

SEMESTER IV
B.E. MECHANICAL ENGINEERING

ME24405	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

The students can be able to

- Understand the mechanism of chip formation in machining.
- Describe the basic principles of machine tools and processes.
- Elaborate principle of gear generation abrasive and finishing operations.
- Familiarize the students with constructional features of CNC machine tools
- Gain knowledge on manual part program and generation of CNC part program using CAM packages

UNIT I METAL CUTTING 9

Mechanics of metal cutting –cutting tool nomenclature cutting tool materials, temperature, wear, and tool life considerations, geometry and chip formation, surface finish, cutting fluids and machinability.

UNIT II BASIC MACHINE TOOLS 9

Lathe and its types Constructional details including accessories and attachments, operations, types of lathes, Constructional and operational details of Shaping Planning Slotting – Drilling Boring – Reaming – Tapping – Broaching Milling Cutters Milling operations Indexing.

UNIT III GEAR GENERATION AND ABRASIVE MACHINING PROCESSES 9

Gear generating principles Gear Hobber Gear finishing methods Bevel gear generator Operations and applications of surface, cylindrical and centreless grinding processes, dressing, truing and balancing of grinding wheels, grading and selection of grinding wheels, micro finishing (honing, lapping, super finishing).

UNIT IV CNC MACHINES AND PROGRAMMING 9

NC, CNC & DNC – types of CNC – constructional features – drives and control systems – Interchangeable tooling system – preset & qualified tools Machining center – Turning center – CNC EDM CNC wire cut EDM. Coordinates, axis and motion, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers – Fixed cycles, Loops and subroutines, setting up a CNC machine for machining.

UNIT V SOLID STATE PROCESSING 9

Introduction to powder metallurgy, Powder manufacture Mechanical methods –chemical methods and Physical methods, powder conditioning, heat treatment, blending and mixing, types of mixing and Blending, Powder Compaction sintering. Additive manufacturing Need Development of AM systems – Principles of 3D printing/Rapid prototyping types: FDM, SLA, SLS, Binder Jetting Design for Additive Manufacturing (DFAM).

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Determination of cutting force measurement using Lathe Tool / Milling Tool Dynamometer.
2. Machining a V block by using shaper.
3. Machining a keyway by using slotting machine.
4. Milling contours on plates using vertical milling machine.

5. Gear cutting using milling and gear hobbing machines.
6. Grinding components using cylindrical /Centreless grinding machine and surface grinding machine.
7. CNC Machining centre
    i) Linear cutting,
    ii) Circular cutting, Canned cycle operations, and
    iii) Drilling and Tapping.
8. CNC Turning centre
    i) Straight, taper and radial turning,
    ii) Thread cutting,
    iii) Rough and finishing cycle.

TOTAL: 30 PERIODS
TOTAL: 75 PERIODS

COURSE OUTCOMES

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

CO1 : Apply the mechanism of chip formation in machining identify the factors involved in improving machinability.

CO2 : Understand the various machining processes such as turning, drilling, boring, shaping, slotting, broaching and milling.

CO3 : Describe the principle of gear generation and abrasive finishing processes.

CO4 : Acquire knowledge on constructional features of CNC machine tools and demonstrate the Program CNC machine tools, writing codes and setting up CNC machine tools to manufacture a given component.

CO5 : To impart the knowledge on additive manufacturing fundamentals and various 3D printing technologies.

TEXT BOOKS:

1. Serope Kalpakjian; Steven R. Schmid (2014), Manufacturing Engineering and Technology, 7th Edition, Publisher: Prentice Hall, ISBN10 0136081681, ISBN 9789810694067.
2. Michael Fitzpatrick, Machining and CNC Technology, McGrawHill Education; 4th edition, 2018.

REFERENCES:

1. P.N.Rao, Manufacturing Technology, McGraw Hill Education, New Delhi, 2013.
2. R.K. Rajput, A Textbook of Manufacturing Technology, Laxmi publications, New Delhi, 2015.
3. A. B. Chattopadhyay, Machining and Machine Tools, Wiley, 2nd edition, 2017.
4. Peter Smid, CNC Programming Handbook, Industrial Press Inc.;Third edition, 2007.
5. P.N.Rao, CAD/CAM: Principles and Applications3rd Edition, Tata McGraw Hill, India, 2010.
6. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	2	2			3		3	3	2	2
CO2	3	3	3	2	1	2	2			3		3	3	2	2
CO3	3	3	3	2	1	2	2			3		3	3	2	2
CO4	3	3	3	2	1	2	2			3		3	3	2	2
CO5	3	3	3	2	1	2	2			3		3	3	2	2
Avg.	**3**	**3**	**3**	**2**	**1**	**2**	**2**			**3**		**3**	**3**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

SEMESTER IV
B.E – MECHANICAL ENGINEERING

ME24406	THERMAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To study the valve and port timing diagram and performance characteristics of IC engines.
- To study the Performance of refrigeration cycle / components.
- To study the Performance and Energy Balance Test on a Steam Generator

PART I IC ENGINES LABORATORY 45

LIST OF EXPERIMENTS:

1. Valve Timing and Port Timing diagrams.
2. Actual pv diagrams of IC engines.
3. Performance Test on four – stroke Diesel Engine.
4. Heat Balance Test on 4 – stroke Diesel Engine.
5. Morse Test on Multi Cylinder Petrol Engine.
6. Retardation Test on a Diesel Engine.
7. Determination of p-θ diagram and heat release characteristics of an IC engine.
8. Determination of Flash Point and Fire Point of various fuels / lubricants
9. Performance test on a two stage Reciprocating Air compressor
10. Determination of COP of a Refrigeration system.

PART II STEAM LABORATORY 15

LIST OF EXPERIMENTS:

1. Study of Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1 : Construct the valve timing and port timing diagram of IC engines.
CO2 : Evaluate the performance of IC engines.
CO3 : Identify the performance of refrigeration cycle.
CO4 : Evaluate the performance of reciprocating air compressor and determine properties of various fuels.
CO5 : Evaluate the performance and energy balance on a Steam Generator and steam Turbine.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1					2	2		3	1	2
CO2	3	3	3	3	1					2	2	2	3	1	2
CO3	3	3	3	3	1					2	1	2	3	1	2
CO4	3	3	3	3	1					1	2	2	3	1	2
CO5	3	3	3	3	1					2	2	1	3	1	2
Avg.	**3**	**3**	**3**	**2.8**	**1**					**1.8**	**1.8**	**1.75**	**3**	**1**	**2**

1 - Low, 2 - Medium, 3 - High

SEMESTER IV
B.E – MECHANICAL ENGINEERING

ME24407	STRENGTH OF MATERIALS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To expose the students to the testing of different materials under the action of various forces and determination of their characteristics experimentally.

LIST OF EXPERIMENTS

1. Tension test on mild steel rod.
2. Izod Impact test on mild steel.
3. Charpy Impact test on mild steel.
4. Torsion test on mild steel rod.
5. Deflection test on beams.
6. Compression test on open coiled helical spring.
7. Tensile test on closed coiled helical spring.
8. Rockwell hardness test on metal.
9. Brinell hardness test on metal.
10. Double shear test on Mild steel and Aluminium rods.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On completion of the course, the student is expected to be able to

CO1 : Perform tensile and double shear tests on metals to evaluate strength and failure modes.

CO2 : Conduct impact and torsion tests on mild steel to assess toughness and shear behavior.

CO3 : Analyze deflection in beams and springs and evaluate hardness of metals.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2						1	2	3	3	
CO2	3	3	2	3	2						1	2	3	3	
CO3	3	2	2	2	3						1	2	2	3	2
Avg.	3	2.7	2	2.7	2.3						1	2	2.7	3	2

1 - Low, 2 - Medium, 3 – High

SEMESTER-V

B.E. MECHANICAL ENGINEERING

ME24501	MACHINE DESIGN	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To learn the various steps involved in the Design Process.
- To learn designing shafts, couplings and bearings for various applications.
- To learn the design of temporary and permanent Joints.
- To learn designing spur gears, helical gears, bevel gears and gear boxes
- To learn designing brakes, clutches and chain drives.

UNIT – I PRINCIPLES OF DESIGN 9 + 3

The Design Process - factors influencing machine design - Direct, Bending and torsional loading - Modes of failure - Factor of safety – Combined loads – Principal stresses – Eccentric loading – curved beams – theories of failure – Design based on strength and stiffness – stress concentration – Fatigue and Endurance Limit.

UNIT – II DESIGN OF SHAFTS, COUPLINGS AND BEARINGS 9 + 3

Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid couplings - Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, - Selection of Rolling Contact bearings.

UNIT – III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9+3

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 - theory of bonded joints.

UNIT – IV DESIGN OF GEARS AND GEAR BOXES 9+3

Design of Gears: Review of kinematics of gears & terminology, interference, tooth profiles, formative number of teeth etc. Design of Spur Gear drive, Helical Gear drive and Bevel Gear drive. Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications.

UNIT – V DESIGN OF BRAKES, CLUTCHES AND CHAIN DRIVES 9+3

Design of plate clutches – axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes – external shoe brakes – Internal expanding shoe brake - Disk Brakes. Design of Transmission chains and Sprockets.

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

CO1 : Explain principles of mechanical design, including material selection, loading, failure modes, factor of safety, and fatigue.

CO2 : Design shafts, axles, couplings, and bearings for strength, rigidity, and performance.

CO3 : Analyze and design joints (threaded, welded, cotter, knuckle, riveted) under different loads.

CO4 : Apply design principles to gears and gearboxes (spur, helical, bevel, multi-speed).

CO5 : Design brakes, clutches, and chain drives for strength, wear, and efficiency.

TEXTBOOKS:

1. Bhandari V B, “Design of Machine Elements”, 5th Edition, Tata McGraw-Hill Book Co, 2021.
2. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2nd Edition 2022.

REFERENCE BOOKS:

1. Khurmi R. S. and Gupta, J. K.- A Text Book of Machine Design, Eurasia Publishing House (P) Ltd, New Delhi. 25th Edition, 2020.
2. Sundararajamoorthy T. V, Shanmugam N., "Machine Design", Anuradha Publications, Chennai, 2nd Edition 2020.
3. Richard G. Budynas, J. Keith Nisbett, Shigley's Mechanical Engineering Design, 12th Edition, McGraw-Hill Education, 2026.
4. Robert L. Norton, Machine Design: An Integrated Approach, 6th Edition, Pearson, 2023.
5. C S Sharma, Kamlesh purohit, Design of Machine Elements, Prentice Hall of India Pvt. Ltd., New Delhi, 1st Edition 2019.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	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**	**3**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**2**

1 - Low, 2 - Medium, 3 - High

SEMESTER-V
B.E. MECHANICAL ENGINEERING

ME24502	METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn basic concepts of the metrology and importance of measurements.
- To understand the Linear and Angular Measurement Techniques
- To teach the tolerance analysis in manufacturing
- To develop the fundamentals of GD & T and surface metrology and form measurements
- To provide the knowledge of the advanced measurements for quality control in manufacturing industries.

UNIT-I BASICS OF METROLOGY 9

Importance, Procedure, and Role of Measurement in Quality Control; Factors Influencing Measurement Accuracy - SWIPE; Errors in Measurements – Types – Control, Estimation, Environment – their effect on Precision and Accuracy, Calibration of measuring instruments - ISO standards.

UNIT-II MEASUREMENT OF LINEAR AND ANGULAR DIMENSIONS 9

Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Telescoping gauge; Gauge blocks, Comparators- mechanical Comparators; Profile projector - Angular measuring instruments – Bevel protractor, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope.

UNIT-III TOLERANCE ANALYSIS 9

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

UNIT-IV METROLOGY OF SURFACES AND FORM MEASUREMENT 9

Fundamentals of GD & T. Introduction to 3D surface metrology- Parameters. Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.

UNIT-V ADVANCES IN METROLOGY 9

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications. Basic concept of CMM – Types of CMM– Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Discuss the concepts of measurements to apply in various metrological instruments.
CO2: Understand 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.
C05: Demonstrate the advances in measurements for quality control in manufacturing Industries

TEXT BOOKS:

1. Dotson Connie, "Dimensional Metrology", Cengage Learning, First edition, 2012.
2. Jain R.K. "Engineering Metrology", Khanna Publishers, 2009.

REFERENCE BOOKS:

1. AmmarGrous, J "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2011.
2. Galyer , J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA; 5th revised edition, 1990.
3. 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.
4. Donald Peckman, "Industrial Instrumentation", Wiley Eastern, 2004.
5. Raghavendra, Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	3	-	-	-	2	-	-	2	3	2
CO2	3	2	1	2	-	-	-	2	-	-	2	2	2
CO3	3	2	2	2	-	-	-	2	-	-	2	3	2
CO4	3	2	2	2	-	-	-	2	-	-	2	3	2
CO5	3	2	2	2	-	-	-	2	-	-	2	3	2
AVG.	**3.00**	**2.00**	**1.80**	**2.2**	**-**	**-**	**-**	**2.00**	**-**	**-**	**2.00**	**3.00**	**2.00**

1 - Low, 2 - Medium, 3 - High

SEMESTER-V
B.E. MECHANICAL ENGINEERING

ME24503	DYNAMICS OF MACHINES	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To develop a comprehensive understanding of force–motion relationships in mechanical components subjected to external forces.
- To identify and evaluate the undesirable effects of unbalances that arise from prescribed motions in mechanisms.
- To analyze the dynamics of vibrations in mechanical systems, understand their causes, and apply methods to reduce or control undesirable vibration effects.
- To apply principles of mechanism design for speed and stability control.

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.

UNIT – II BALANCING 10

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 machines-Field balancing of discs and rotors.

UNIT – III FREE VIBRATION 10

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration– Equations of motion – Natural frequency – Types of Damping – Damped vibration– Transverse vibration of shaft – whirling of shafts – Torsional vibration – Two and three rotor systems.

UNIT – IV FORCED VIBRATION 7

Response of one degree freedom systems to periodic forcing – Harmonic disturbances – Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation.

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

LIST OF EXPERIMENTS:

1. Kinematics of Four Bar / Slider Crank / Crank Rocker / Double crank / Double rocker / Oscillating cylinder Mechanisms.
2. Determination of Mass moment of inertia of Fly wheel and Axle system.
3. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
4. Cams – Cam profile drawing, Motion curves and study of jump phenomenon.
5. Determination of undamped torsional natural frequency of single and Two Rotor systems.
6. Transverse vibration of different beams and different support condition with and without concentrated masses.
7. Forced Transverse Vibration of Cantilever beam – Mode shapes and natural frequencies.
8. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.

9. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
10. Motorized gyroscope – Study of gyroscopic effect and couple.

TOTAL: 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1 : Analyze static and dynamic forces in mechanisms.
CO2 : Determine balancing masses for reciprocating and rotating systems.
CO3 : Compute natural frequencies of free vibration systems.
CO4 : Evaluate forced vibration response and damping.
CO5 : Assess governor performance and gyroscopic effects in vehicles and machines.

TEXTBOOKS:

3. Rattan, S.S. Theory of Machines, 5th Edition, McGraw Hill Education, 2019.
4. Khurmi, R.S., Theory of Machines, 15th Edition, S. Chand Publications, 2022.

REFERENCE BOOKS:

6. Norton, R.L. Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines, 6th Edition, McGraw Hill, 2020.
7. Sharma, C.S. & Purohit, Kamlesh. Theory of Mechanisms and Machines, Revised Edition, PHI Learning, 2021.
8. Uicker, J.J., Pennock, G.R., Shigley, J.E., Theory of Machines and Mechanisms, 5th Edition, Oxford University Press, 2017.
9. Ramamurthi, V., Mechanics of Machines, Revised Edition, Narosa Publishing House, 2017.
10. Rao, J.S., Dukkipati, R.V., Mechanisms and Machine Theory, Revised Edition, New Age International Publishers, 2017.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	-	-	-	3	2
CO2	3	3	2	2	2	-	-	-	-	-	-	3	2
CO3	3	3	2	3	2	-	-	-	-	-	-	3	2
CO4	3	3	2	3	3	2	2	-	-	-	-	3	2
CO5	3	3	2	3	2	2	2	-	-	-	-	3	2
AVG.	**3**	**3**	**2**	**2.6**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**3**	**2**

1 - Low, 2 - Medium, 3 - High

Requirements for a batch of 30 students

S. No.	Description of equipment	Quantity Required
1.	Kinematic Models to study various mechanisms	1
2.	Cam follower setup	1
3.	Torsional Vibration of single rotor & two rotor system setup	1
4.	Transverse vibration setup	1
5.	Forced Transverse Vibration setup	1
6.	Whirling of shaft apparatus	1
7.	Governor apparatus - Watt, Porter, Proell and Hartnell governors	1
8.	Motorised gyroscope	1

SEMESTER-V
B.E. MECHANICAL ENGINEERING

ME24504	METROLOGY AND MEASUREMENTS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To Explain the different measurement equipment and use of this industry for quality inspection.
- To identify and classify different measuring tools and explain accuracy and precision
- To conduct, analyses, interpret, and present measurement data from measurements experiments
- To Understand variability, error, and uncertainties

LIST OF EXPERIMENTS

1. Calibration and use of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge, depth micrometer, bore gauge, Comparators.
2. Measurement of angles using bevel protractor.
3. Measurement of angles using sine bar.
4. Measurement of assembly and transmission elements - Toolmaker's microscope.
5. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM), (Study).
6. Non-contact (Optical) measurement using Profile projector measurement system.
7. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus-based instruments.
8. Machine tool metrology – Level tests using precision level; Testing of straightness of a machine tool guide way using Autocollimator, spindle tests (Study).
9. Measurement of torque.
10. Measurement of temperature using thermocouple.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1 : Explain to measure the linear dimensions, angle using sine bar, gear tooth dimensions and straightness.

CO2 : Analyze measurement data from advanced equipment like coordinate measuring machines, profile projectors, and surface finish testers to evaluate part accuracy.

CO3 : Discuss the straightness, thread parameters, temperature using thermocouple, force and torque measurements.

TEXTBOOKS:

1. Dotson Connie, "Dimensional Metrology", Cengage Learning, First edition, 2012.
2. Jain R.K. "Engineering Metrology", Khanna Publishers, 2009.

REFERENCE BOOKS:

1. AmmarGrous, J "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2011.
2. Galyer , J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA; 5th revised edition, 1990.
3. 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.
4. Donald Peckman, "Industrial Instrumentation", Wiley Eastern, 2004.
5. Raghavendra, Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	3	-	-	2	-	-	3	3	2
CO2	3	3	2	3	3	-	-	2	-	-	2	2	2
CO3	3	2	2	2	3	-	-	2	-	-	2	3	2
AVG.	**3.00**	**2.33**	**2.00**	**2.33**	**3.00**	**-**	**-**	**2.00**	**-**	**-**	**2.33**	**3.00**	**2.00**

1 - Low, 2 - Medium, 3 - High

SEMESTER-V
B.E. – EEE & MECH

GE24S02	SOFT SKILLS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

- To enhance students' interpersonal skills by focusing on the dynamics of leadership, teamwork, and networking, essential for academic and professional success.
- To develop leadership capabilities that include effective communication, managing change, and stepping out of comfort zones.
- To provide strategies for managing stress through emotional intelligence and self-awareness techniques.
- To equip students with conflict resolution skills by understanding the nature of conflicts and exploring practical approaches to resolve them.
- To improve decision-making abilities by teaching structured, rational, and practical evaluation techniques for real-life scenarios.

UNIT I INTERPERSONAL SKILLS 3

Understanding the relationship between Leadership, Networking, and Teamwork-Realizing one's skills in Leadership, Networking & Teamwork-Assessing interpersonal skills. Situation description of interpersonal skill-Teamwork: necessity of teamwork personally, socially, and educationally.

UNIT II LEADERSHIP 3

Skills for a good leader-Assessment of leadership skills-Change Management-Exploring Challenges-Risking comfort zone-Managing change.

UNIT III STRESS MANAGEMENT 3

Causes of stress and its impact-How to manage & de-stress-Understanding the circle of control-Stress busters-Emotional Intelligence: What is Emotional Intelligence, emotional quotient, Why Emotional Intelligence matters-Emotion scales-Managing emotions.

UNIT IV CONFLICT RESOLUTION 3

Conflicts in human relations Definition and types of conflicts (intrapersonal, interpersonal, group, organizational)-Positive and negative outcomes of conflict, reasons-Case studies-Approaches to conflict resolution-Active listening and empathy, assertive communication, emotional regulation and impulse control, problem-solving and consensus-building techniques.

UNIT V DECISION MAKING 3

Importance and necessity of decision making-Process of decision making-Practical ways of decision making-Weighing positives and negatives.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1 : Demonstrate interpersonal skills including leadership, teamwork, and networking.
CO2 : Exhibit leadership qualities and manage change effectively.
CO3 : Apply stress management techniques and understand emotional intelligence.
CO4 : Resolve conflicts constructively using appropriate approaches.
CO5 : Make informed and practical decisions by evaluating situations logically.

TEXTBOOKS

1. Covey Sean, Seven Habit of Highly Effective Teens, New York, Fire side Publishers,1998.

2. Carnegie Dale, How to Win Friends and Influence People, New York: Simon & Schuster, 1998.
3. ThomasA Harris, Iam ok, you are ok, New York-Harper and Row, 1972
4. Daniel Coleman, Emotional Intelligence, Bantam Book,2006.

REFERENCES:

1. Covey, Sean (1998). The 7 Habits of Highly Effective Teens. New York: Fireside Publishers. A practical guide on personal development and interpersonal effectiveness tailored for young adults.
2. Goleman, Daniel (2006). Emotional Intelligence: Why It Can Matter More Than IQ. Bantam Books. A seminal work on the importance of emotional intelligence in personal and professional success.
3. Robbins, Stephen P. & Judge, Timothy A. (2019). Organizational Behavior (18th ed.). Pearson Education. Covers conflict resolution, stress management, leadership, and decision-making in organizational contexts.
4. McGraw, Hill (2020). Soft Skills Training: A Workbook to Develop Skills for Employment. A modern practical workbook for classroom and workshop-based soft skills development.
5. Soft skill: Enhancing Employability and Carrier Growth, Meenakshi Raman and Sangeetha Sharma, Edition 2023, 3RD Edition, McGraw Hill Education.
6. Devdas M. (2004). Stop Sleep walking through life. Yogi Impressions Books Private, Limited.
7. Parthasarathy A (2008). The Fall of the Human Intellect. Kindle Edition.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	1	-	-	-	3	2	3	3	-	3		
CO2	2	-	2	-	-	-	3	2	3	3	-	3		
CO3	-	-	2	-	-	2	3	2	-	3	-	3		
CO4	-	-	-	-	2	2	3	3	2	3	-	3		
CO5	3	3	2	-	-	-	3	3	-	3	-	3		
AVG.	**2.33**	**3.00**	**1.75**	**-**	**2.00**	**2.00**	**3.00**	**2.40**	**2.67**	**3.00**	**-**	**3**		

1 - Low, 2 - Medium, 3 - High

SEMESTER-VI
B.E. MECHANICAL ENGINEERING

ME24601	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To understand mathematical modelling and engineering fundamentals for solving complex engineering problems.
- To analyze finite element equation formulation for one-dimensional structural and thermal problems.
- To develop the ability to formulate and solve two-dimensional scalar and vector variable problems using finite element methods.
- To apply finite element techniques to solve heat transfer and vibration problems using 1D and 2D elements.
- To study higher-order and iso-parametric finite elements with transformation techniques.

UNIT-I INTRODUCTION 9+3

Basic Concepts – History, Relevance and Scope of Finite Element Methods - FEM Procedure - Natural and Essential boundary conditions - Concepts of Potential Energy - Rayleigh Ritz – Weighted Residual Method-Gaussian Elimination Methods – Solved Problems.

UNIT-II ONE-DIMENSIONAL ELEMENTS 9+3

Coordinate Systems -Global, Local and Natural - Shape function, Finite element formulation - Stiffness Matrix, Load Vector, Boundary Condition and Assembly of Global Equation, Temperature Effects for 1D bar, Truss and Beam Element – Solved Problems.

UNIT-III TWO-DIMENSIONAL ELEMENTS 9+3

Shape function for linear triangular element-Finite element formulation Constant Strain Triangular (CST) element -Plane Stress, Plane Strain conditions – Axisymmetric Elements formulation – Solved Problems.

UNIT-IV HEAT TRANSFER AND VIBRATION 9+3

Shape function for 1D and 2D Triangular Element - Stiffness Matrix, Load vector and Assembly of Global Equation - Heat Conduction, Convection and Internal heat Generation for Linear element - Longitudinal and Transverse Vibrations for Bar and Beam Elements.

UNIT-V HIGHER ORDER AND ISOPARAMETRIC ELEMENT 9+3

Higher order Elements, Serendipity elements, Shape function formulation – Iso-parametric, Sub parametric, Super parametric Elements, Iso parametric Transformation, Jacobian formulation and Stress Strain relations for Iso-parametric elements. Gaussian Quadrature. Introduction to CFD.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1 : Learn FEM basics, steps, and boundary conditions.

CO2 : Apply FEM to 1D elements like bars, trusses, and beams.

CO3 : Solve 2D problems using CST elements.

CO4 : Use FEM for heat transfer and vibration problems.

CO5 : Understand advanced FEM concepts and CFD basics.

TEXTBOOKS:

1. Reddy, J.N., An Introduction to the Finite Element Method, 4th Edition, McGraw Hill Education, 2021.
2. Singuresu S. Rao, "Finite Element method in Engineering", Sixth edition, Elsevier Science & Technology Books,2017.

REFERENCE BOOKS:

1. Tirupathi R. Chandrupatla, Ashok D. Belagundu, "Introduction to Finite Elements in Engineering", Third Edition, Reprint, Prentice Hall, Reprint 2021.
2. S. Bhavikati, "Finite Element Analysis", New Age International Publishers, 4th Edition 2021.
3. Daryl L. Logan A, "First Course in the Finite Element Method", Fourth Edition, Cengage Learning, 2007. 5. K. J. Bathe, "Finite Element Procedures", Second Edition, Prentice-Hall Inc., Englewood Cliffs, New Jersey, Prentice Hall 2014.
4. Zienkiewicz, O. C., Taylor, R. L., & Zhu, J. Z., The Finite Element Method: Its Basis and Fundamentals, 7th Edition, Butterworth-Heinemann, 2013.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/104/112104193/
2. https://nptel.ac.in/courses/112/104/112104205/
3. https://nptel.ac.in/courses/105/106/105106051/
4. https://nptel.ac.in/courses/112/106/112106135/
5. https://nptel.ac.in/courses/112/104/112104115/

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	3	3	2	-	-	1	-	2	3	2
CO2	3	3	2	3	3	2	-	-	2	-	2	3	2
CO3	3	3	2	3	3	2	-	-	2	-	2	3	2
CO4	3	3	2	3	3	2	-	-	2	-	2	3	2
CO5	3	3	2	3	3	2	-	-	2	-	2	3	2
AVG.	**3**	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**1.8**	**-**	**2**	**3**	**2**

1 - Low, 2 - Medium, 3 - High

SEMESTER-VI
B.E. MECHANICAL ENGINEERING

ME24602	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce Additive Manufacturing (AM), its growth, business opportunities, and applications.
- To familiarize students with software tools and techniques for product development and prototyping using AM.
- To provide basic knowledge of vat polymerization and direct energy deposition processes.
- To understand powder bed fusion and material extrusion methods.
- To learn the applications of binder jetting, material jetting, and sheet lamination processes.

UNIT – I INTRODUCTION TO ADDITIVE MANUFACTURING 9

Additive Manufacturing Terminologies - Concepts of Layer Manufacturing - Additive Manufacturing Vs Subtractive Manufacturing - Role of AM in Product Development - Applications of AM in Automotive, Aerospace and Bio-medical fields.

UNIT – II DESIGN FOR ADDITIVE MANUFACTURING 9

Concepts and Objectives - AM Unique Capabilities - Part - Multi-Material Parts and Graded Materials - Data Processing: CAD Model Preparation - AM File formats: STL-Problems with STL- AM Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation.

UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION 9

Photo polymerization: Stereolithography Apparatus (SLA) - Materials - Process - top down and bottom-up approach - Applications. Digital Light Processing (DLP) - Process - 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): Materials - Process - Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications.

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES 9

Binder Jetting: Basic Principle- Materials - Process – Benefits - Applications. Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Basic Principle- Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1 : Learn basic concepts, terms, and uses of Additive Manufacturing.
CO2 : Apply AM design principles like topology optimization, generative design, and data preparation.
CO3 : Understand vat polymerization (SLA, DLP) and directed energy deposition (LENS) processes.
CO4 : Explain powder bed fusion (SLS, SLM) and material extrusion (FDM) methods with pros and cons.
CO5 : Identify applications of binder jetting, material jetting, and sheet lamination processes.

TEXTBOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani — Additive Manufacturing Technologies, 3rd Edition, Springer, 2021.
2. Amit Bandyopadhyay Susmita Bose, “Additive Manufacturing”, 2nd Edition, CRC Press, Taylor & Francis Group, 2020.

REFERENCE BOOKS:

1. Kumar, L. Jyothish, Pulak M. Pandey, and David Ian Wimpenny, eds. 3D printing and additive manufacturing technologies. Singapore: Springer, 2019.
2. Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", 5th Edition, World Scientific Publishers, 2022.
3. Ravi Kant Mittal, Abid Haleem, Ajay Kumar, Advances in Additive Manufacturing: Artificial Intelligence, Nature-Inspired, and Biomanufacturing, Elsevier, 2022.
4. Kun Zhou (Ed.), Additive Manufacturing Technology: Design, Optimization, and Modeling, Wiley-VCH, 2023.
5. David Ian Wimpenny, L. Jyothish Kumar, Pulak M. Pandey, 3D Printing and Additive Manufacturing Technologies, Springer , 2019, ISBN: 9789811303050.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	2	2	-	2	-	2	2	3	2
CO2	3	3	3	2	3	2	-	2	-	2	2	3	2
CO3	3	2	2	3	2	2	-	2	-	2	2	3	2
CO4	3	3	2	3	2	2	-	2	-	2	2	3	2
CO5	2	2	2	2	2	2	-	2	-	2	2	3	2
AVG.	**3**	**2.4**	**2.2**	**2.2**	**2.2**	**2**	**-**	**2**	**-**	**2**	**2**	**3**	**2**

1 - Low, 2 - Medium, 3 - High

SEMESTER VI
B.E. MECHANICAL ENGINEERING

ME24603	HEAT AND MASS TRANSFER	L	T	P	C
		3	0	2	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 learn the theory of phase change heat transfer and design of heat exchangers.
- To study the fundamental concept and principles in radiation heat transfer.
- To develop the basic concept and diffusion, convective di mass transfer.

UNIT – I CONDUCTION 9

General Differential equation – Cartesian, Cylindrical Coordinates – One-Dimensional Steady State Heat Conduction — plane and Composite Systems Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts

UNIT – II CONVECTION 9

Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow - over Vertical plates, horizontal Plates, Cylinders and Spheres. Internal flow through tubes

UNIT – III 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 - Overall Heat Transfer Coefficient – Fouling Factors. Analysis - LMTD and NTU methods.

UNIT – IV RADIATION 9

Introduction to Thermal Radiation - Radiation laws - Black Body and Gray body Radiation - Radiosity - View Factor Relations. Electrical Analogy. Radiation Shields.

UNIT – V MASS TRANSFER 9

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

TOTAL: 45 PERIODS

PRACTICAL EXERCISES

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Thermal conductivity measurement of pipe insulation using guarded plate apparatus
3. Determination of thermal conductivity of a composite wall, insulating powder.
4. Determination of heat transfer coefficient under natural convection.
5. Determination of heat transfer coefficient under forced convection.
6. Heat transfer from pin-fin under natural and forced convection.
7. Determination of Stefan – Boltzmann constant.
8. Determination of emissivity of a grey surface.
9. Effectiveness of Parallel heat exchanger.
10. Effectiveness of counter flow heat exchanger.

TOTAL: 30 PERIODS
TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1 : Apply heat conduction principles; perform experiments and evaluate material conductivity.

CO2 : Use convection correlations; conduct tests and determine heat transfer coefficients.

CO3 : Explain boiling and condensation; analyze and assess heat exchanger performance.

CO4 : Apply radiation laws; evaluate emissivity and Stefan–Boltzmann constant through testing.

CO5 : Apply diffusion and convection mass transfer equations to engineering applications.

TEXT BOOKS:

1. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2009
2. Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5thEdition – 2013

REFERENCES:

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 7th Edition, 2014.
2. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010
3. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012
4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
5. S.P. Venkatesan, "Heat Transfer", Ane Books, New Delhi, 2014

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	-	2	-	2	-	-	-	3	3
CO2	3	3	3	3	-	2	-	2	-	-	-	3	2
CO3	3	3	3	3	-	3	-	2	-	-	-	3	2
CO4	3	3	3	2	-	2	-	2	-	-	-	3	2
CO5	3	3	3	2	-	2	-	2	-	-	-	2	2
AVG.	**3**	**3**	**3**	**2.6**	**-**	**2.2**	**-**	**2**	**-**	**-**	**-**	**2.8**	**2.2**

1 - Low, 2 - Medium, 3 - High

SEMESTER-VI
B.E. MECHANICAL ENGINEERING

ME24604	SIMULATION AND ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- Students will gain exposure to software tools for analyzing engineering problems.
- Students will demonstrate familiarity with various applications of simulation and analysis tools.

LIST OF EXPERIMENTS

I. ANALYSIS

1. Force and Stress analysis using link elements in Trusses.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates.
4. Stress analysis of axi–symmetric components.
5. Buckling analysis of column structures.
6. Thermal stress and heat transfer analysis of plates.
7. Thermal stress analysis of cylindrical shells.
8. Vibration analysis of spring-mass systems.
9. Modal analysis of Beams.
10. Harmonic, transient and spectrum analysis of simple systems.

II. SIMULATION

11. Kinematic Analysis four bar and slider crack mechanism and its inversions
12. Dynamic Analysis four bar and slider crack mechanism and its inversions
13. Design of cam Profile for various follower output motion
14. Kinematic & Dynamic Analysis of Gear Trains.

III. CASE STUDY

Each student is required to undertake one case study, perform simulation-based analysis, interpret stress and thermal results, and explore sustainable design optimization strategies. The findings and outcomes shall be presented in a detailed case study report.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1 : Engineering problems are systematically solved through numerical methods using advanced Computer-Aided Finite Element Analysis (FEA) software packages

CO2 : Develop a Finite Element Model to effectively simulate physical behavior.

CO3 : Model systems, analyze them using multi-body dynamics software, and extract key dynamic properties

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	2	-	2	2	2	3	3	2
CO2	3	3	3	3	3	2	-	2	2	2	3	3	2
CO3	3	3	3	3	3	2	-	2	2	2	3	3	2
AVG.	**3**	**3**	**3**	**3**	**3**	**2**	**-**	**2**	**2**	**2**	**3**	**3**	**2**

1 - Low, 2 - Medium, 3 - High

Requirements for a batch of 30 students

S. No.	Description of equipment	Quantity Required
1	Computers – i7 processor, 16GB RAM, 1TB SSD	15
2	Multibody Dynamic Software Suitable for Mechanism simulation and analysis	15

SEMESTER-VI
B.E. MECHANICAL ENGINEERING

ME24605	MINI PROJECT	L	T	P	C
		-	-	4	2

COURSE OBJECTIVES:

- To identify real-world challenges through design thinking to develop innovative, empathy-driven engineering solutions.
- To apply mechanical engineering principles to design a functional system that meets specific safety and performance standards.
- To gain practical experience in manufacturing processes by building a working model of the designed components.

Guidelines for Project Review and Evaluation

Students shall form collaborative groups of two to four members, working under the guidance of a dedicated project supervisor. The selection of the device, system, or component for fabrication should be finalized in consultation with the supervisor, with a strong emphasis on industry-aligned challenges where feasible.

The assessment process is structured into two primary phases:

- **Internal Assessment:** A department-appointed committee will evaluate the group's progress based on the submitted technical project report and the functional quality of the fabricated model.
- **End-Semester Examination:** Final grading will be conducted through a formal oral presentation, viva-voce, and a review of the formal project report, jointly assessed by internal and external examiners appointed by the Head of the Department.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1 : Transform user needs into technical solutions through structured brainstorming and creative prototyping.

CO2 : Design and manufacture functional machine elements or mechanical systems through hands-on engineering.

CO3 : Demonstrate a fully operational working model through user-walkthrough experiences and iterative testing to ensure performance.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3
AVG.	3	3	3	3	3	3	3	3	3	3	3	3	3

1 - Low, 2 - Medium, 3 - High

SEMESTER-VII

B.E – BME, CSE, ECE, EEE, MECH, & B. Tech – AI&DS, IT,

GE24701	HUMAN VALUES AND ETHICS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

- To enable students to analyze and appreciate the vital interdependence between 'values' and 'skills' in achieving sustained happiness and prosperity, which represent the core aspirations of all human beings
- To facilitate students in developing a holistic perspective on life, profession, and happiness—grounded in a correct understanding of human nature and the rest of existence—which serves as the foundation for living a value-based life naturally.
- To evaluate and illustrate the potential implications of a holistic understanding in fostering ethical human conduct, trustful and mutually fulfilling human relationships, and a harmonious, enriching interaction with Nature.

UNIT I DEMOCRATIC VALUES 6

Introduction-need, basic guidelines, Content and process for value education-Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Respect for All, Citizen Participation in Governance – World Democracies: French Revolution, Indian Freedom Movement.

UNIT II SECULAR VALUES 6

Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices. Case Study

UNIT III SCIENTIFIC VALUES 6

Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Safety and risk - Assessment of safety and risk -Validating facts using evidence-based approach – Skepticism and Empiricism – Rationalism and Scientific Temper.

UNIT IV SOCIAL ETHICS 6

Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination –Globalization- Constitutional protection and policies – Inclusive practices.

UNIT V SCIENTIFIC ETHICS 6

Transparency and Fairness in scientific pursuits-Collegiality and loyalty – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society-Case Study

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1 : Analyze the role of democratic, secular, and scientific values in promoting harmony and effective functioning within social life.

CO2 : Practice democratic and scientific values in both their personal and professional life.

CO3 : Develop logical and evidence-based solutions to address contemporary social problems effectively.

CO4 : Demonstrate ethical behavior in various social situations through responsible decision-making.

CO5 : Apply critical thinking skills to evaluate information objectively and seek truth through reasoned analysis.

TEXT BOOKS:

1. Excerpts from John Stuart Mills' On Liberty
2. Excerpt from The Scientific Temper by Antony Michaelis R
3. Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari
4. Excerpt from American Prometheus: The Triumph and Tragedy of J.Robert Oppenheimer by Kai Bird and Martin J. Sherwin.

REFERENCES:

1. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.
2. Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.
3. The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.
4. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,
5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1				1				2		
CO2	2	3	3	1				1				2		
CO3	3	3	2	1				1				2		
CO4	3	2	3	1			1	1				2		
CO5	3	3	2	1				1				2		
Avg	**3**	**3**	**3**	**1**			**1**	**1**				**2**		

1 - Low, 2 - Medium, 3 - High

SEMESTER-VII
B.E. MECHANICAL ENGINEERING

GE24702	INDUSTRIAL ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamental concepts, principles, and functions of management.
- To Study various organizational structures and their applications.
- To learn operations management concepts including product design, process selection, and plan layout.
- To Understand the fundamental functions of management.
- To gain knowledge of job evaluation methods and their industrial applications.

UNIT-I INTRODUCTION TO MANAGEMENT 9

Entrepreneurship and organization-Nature and importance of Management, Functions and Evolution of Modern Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

UNIT-II DESIGNING ORGANIZATIONAL STRUCTURES 9

Departmentation and Decentralization, Forms of Organization, Types of organization structure - Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Cellular Organization, Team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure.

UNIT-III OPERATIONS MANAGEMENT: 9

Objectives-Product design process-Process Selection-Types of production system (Job, Batch and Mass Production). Plant location-factors-Urban & Rural sites comparison-Types of plant layouts-Design of product layout-Line balancing (RPW method).

UNIT-IV FUNCTIONS OF MANAGEMENT 9

Planning - Nature and Purpose - Objectives - Strategies – Policies and Planning Premises – Decision Making - Organizing - Nature and Process, Organizational culture, Staffing - selection and training. Placement – Performance appraisal. Leading – Managing human factor – Leadership. Communication Process –Barriers to communication. Controlling - Process of Controlling – Controlling techniques.

UNIT-V JOB EVALUATION: 9

Methods of job evaluation-simple routing objective systems classification method-factor comparison method-point method –benefits of job evaluation and limitations. Management by Objectives (MBO) - Management by Exception (MBE), Strategic Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Explain the principles, functions, and theories of management.

CO2 : Analyze and design suitable organizational structures.

CO3 : Apply operations management concepts to product design and plant layout.

CO4 : Apply the key functions of management in organizations.

CO5 : Explain job evaluation methods and their applications.

TEXT BOOKS:

1. S.C. Sharma and T.R. Banga "Industrial Engineering and Management", Khanna Publishing House 2nd Edition, 2022

2. Dr. Navin Kumar Dev "Production and Operations Management" Publisher: Khanna Publishing House Edition: 2026 Edition

REFERENCE BOOKS:

1. S.N. Chary "Operations Management" Latest Available Reprint: 2021–2023 Reprints.
2. P.C. Tripathi and P.N. Reddy "Principles of Management" Latest Reprint: 2021 Edition.
3. Salvendy, G. (Ed.), Handbook of Industrial Engineering and Management, Wiley, 2021

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	2	2	2	2
CO2	3	2	-	-	-	-	-	-	-	2	2	2	2
CO3	3	2	-	-	-	-	-	-	-	2	2	3	2
CO4	3	2	-	-	-	-	-	-	-	2	2	3	2
CO5	3	2	-	-	-	-	-	-	-	2	2	2	2
AVG.	**3.0**	**2.0**	**-**	**-**	**-**	**-**	**-**		**-**	**2.0**	**2.0**	**2.4**	**2.0**

1 - Low, 2 - Medium, 3 - High

SEMESTER-VII
B.E. MECHANICAL ENGINEERING

ME24701	MECHATRONICS AND IOT	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understanding sensors and actuators in mechatronic systems
- To provide insight into the signal conditioning circuits, and also to develop competency in plc programming and control
- To fundamentals of embedded systems and internet of things (IoT)
- To impart knowledge about the Arduino and the raspberry pi.
- To design and development of mechatronics and IoT applications

UNIT-I SENSORS AND ACTUATORS 9

Fundamentals of Mechatronics - Modular Approach, Sensors and Transducers: Static and Dynamic Characteristics, Transducers - Resistive, Capacitive. Optical Sensors - Vision Systems. Actuators – Brushless Permanent Magnet DC Motor – PM, VR and Hybrid Stepper motors – DC and AC Servo Motors

UNIT-II SIGNAL CONDITIONING CIRCUITS AND PLC 9

Operational Amplifiers – Wheatstone bridge, Instrumentation Amplifier. Data Logger and Data Acquisition System –Switching Loads by Power Semiconductor Devices Circuits – PLC – Architecture – Input / Output Processing – Logic Ladder Programming – Functional Block Programming using Timers and Counters.

UNIT-III FUNDAMENTALS OF IoT AND EMBEDDED SYSTEMS 9

Overview of IoT Framework and Applications – IoT Enabling Technologies- The Effective Implementation of IoT: The Detailed Procedure. Embedded Systems: An Introduction - Single-Chip Microcontroller Systems - Single-Board Microcontroller Systems.

UNIT-IV CONTROLLERS 9

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

UNIT-V MECHATRONICS AND IoT CASE STUDIES 9

Basics of Mechatronics Engineering Systems: Drone actuation and Control -Autonomous Robot - Automotive Mechatronics: Electronic Ignition System - ABS - EBD. IoT case studies: Remote Monitoring Systems- Centralized Water Management System - Portable, Wireless, Interactive IoT Sensors for Agriculture.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

MECHATRONICS

1. Addition, Subtraction and Multiplication Programming in 8051.
2. Programming and Interfacing of Stepper motor and DC motor using 8051/PLC.
3. Programming and Interfacing of Traffic Light Interface using 8051.
4. Sequencing of Hydraulic and Pneumatic circuits.
5. Sequencing of Hydraulic, Pneumatic and Electro-pneumatic circuits using Software.
6. Electro-pneumatic/hydraulic control using PLC.

INTERNET OF THINGS

7. Familiarization with concept of IoT and its open-source microcontroller/SBC.
8. Write a program to turn ON/OFF motor using microcontroller/SBC through internet.

9. Write a program to interface sensors to display the data on the screen through internet.
10. Interface the sensors with microcontroller/SBC and write a program to turn ON/OFF Solenoid valve through internet when sensor data is detected.

TOTAL: 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

CO4 : Explain Select suitable sensors and actuators to develop mechatronics systems.

CO5 : Discuss Devise proper signal conditioning circuit for mechatronics systems, and also able to implement PLC as a controller for an automated system.

CO6 : Elucidate the fundamentals of IoT and Embedded Systems.

CO7 : Discuss Control I/O devices through Arduino and Raspberry Pi.

CO8 : Design and develop an apt mechatronics/IoT based system for the given real-time application.

TEXTBOOKS:

3. 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.

REFERENCE BOOKS:

6. John Billingsley, "Essentials of Mechatronics", Wiley, 2006
7. 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.
8. Nitin G and Sharad S, "Internet of Things: Robotic and Drone Technology", CRC Press, 2022
9. Newton C. Braga, "Mechatronics for The Evil Genius", McGrawHill, 2005.
10. Bell C., "Beginning Sensor Networks with Arduino and Raspberry Pi", A press, 2013

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	1	2	-	-	-	2	-	-	3	1
CO2	3	3	2	1	2	-	-	1	2	2	2	2	2
CO3	3	2	2	1	2	-	-	-	3	-	-	3	2
CO4	3	2	3	3	2	-	-	3	3	2	3	2	2
CO5	3	2	3	3	2	-	-	3	2	2	3	3	2
AVG.	**3.00**	**2.40**	**2.60**	**1.8**	**2.00**	**-**	**-**	**2.33**	**2.40**	**2.00**	**2.66**	**2.60**	**1.8**

1 - Low, 2 - Medium, 3 - High

SEMESTER VII
B.E. MECHANICAL ENGINEERING

ME24702	SUMMER INTERNSHIP	L	T	P	C
		0	0	0	2

COURSE OBJECTIVE:

- To provide undergraduate engineering students with hands-on exposure to industry facilities, thereby furthering their understanding of the basics and operations of sciences and its applications
- To During the assignment period, students apart from technical exposure, will also learn to work in teams that possess diverse knowledge and skills.
- To Students' communication and presentation skills are expected to improve after the internship period.

GUIDELINE FOR REVIEW AND EVALUATION

Students should undergo industrial training/internship for a minimum period of two weeks during the summer vacation of III year. Registration for this course shall be along with the courses for VII semester. Attachment with an academic institution within the country or university abroad is also permitted instead of industrial training. A report is to be submitted to the Head of the Department and evaluation (2 credit) will be based on work done, quality of report, performance in viva-voce, presentation etc.

TOTAL: 2 WEEKS

COURSE OUTCOMES:

At the end of the course, students will be

CO1 : An ability to function on multi-disciplinary teams.
CO2 : An ability to identify, formulate and solve engineering problems.
CO3 : An understanding of professional and ethical responsibility.
CO4 : An ability to communicate effectively with written, oral and visual means.
CO5 : The broad education necessary to understand the impact of engineering solution in a global and society context.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	2	2	2	2	2	2	3	2
CO2	3	3	2	2	2	2	2	2	2	2	2	3	2
CO3	3	3	2	2	2	2	2	2	2	2	2	3	2
CO4	3	2	2	2	2	2	2	2	2	2	2	3	2
CO5	3	2	2	2	2	2	2	2	2	2	2	3	2
Avg	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**

1 - Low, 2 - Medium, 3 – High

SEMESTER VIII
B.E. MECHANICAL ENGINEERING

ME24801	PROJECT WORK / INTERNSHIP	L	T	P	C
		0	0	20	10

COURSE OBJECTIVE:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To allocate roles to the students with clear lines of responsibility & accountability and learn team work, ethics and professionalism.
- To train the students in preparing project reports and to face reviews and viva voce examination.

GUIDELINE FOR REVIEW AND EVALUATION

Students, either individually or in groups of up to four members, shall undertake a topic approved by the Head of the Department under the guidance of a faculty supervisor. Upon completion, they are required to prepare a comprehensive project report to the satisfaction of the supervising faculty.

The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

On Completion of the project work, students will be able to

CO1 : Identify, analyse and create economical feasible solution for societal/ industrial problems by applying knowledge and skills and inculcating the practice of lifelong learning.

CO2 : Select and apply an appropriate models / methods / mathematical simulation to analyse the data, exhibiting project management skills.

CO3 : Provide solution to problems by using modern tools and techniques and experimental methodologies and by considering environmental and ethical issues.

CO4 : Develop skill to work effectively in a team to achieve a common goal.

CO5 : Write technical precise project report and develop presentation skill to communicate effectively.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

1 - Low, 2 - Medium, 3 - High

MANDATORY COURSE I
B.E – BME, CSE, ECE, EEE, MECH, & B. Tech – AIDS, & IT

MX24C71	INTRODUCTION TO WOMEN AND GENDER STUDIES	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

- To define and evaluate gender as a social construct.
- To identify the ways gender, power, privilege, and oppression play out across a range of cultures and human experiences.
- To identifying systemic oppression and promoting social equity.
- To help in promoting women's empowerment.
- To learn rights and obligations in all spheres of life.

UNIT I CONCEPTS **9**

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binarism, 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, eco-feminist.

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, Gender Equality and Women's Empowerment through NEP 2020.

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:

Upon successful completion of the course, students should be able to

CO1: Recognize the concepts of gender roles and relations.
CO2: Evaluate various feminist theories and their contributions.
CO3: Analyze historical and contemporary women's movements.
CO4: Apply the concept of languages and gender.
CO5: Interpret media representation of gender.

TEXT BOOKS:

1. Melissa Gillis and Andrew T. Jacobs, "Introduction to Women's and Gender Studies", "An Interdisciplinary Approach", 2019.
2. Miliann Kang, Donovan Lessard, Laura Heston and Sonny Nordmarken, "Introduction to women, Gender, Sexuality Studies", 2017.

REFERENCES:

1. Deborah Holt, BS, MA, "HUM210 Introduction to Women and Gender Studies", 2020.
2. Gendered Lives: Communication, Gender, and Culture, Julia T. Wood, Cengage Learning,13th Edition (2021).
3. Feminist Theory: From Margin to Center, bell hooks,2nd Edition (2000)
4. The Second Sex, Simone de Beauvoir, Vintage Books, Reprint Edition (2011, English translation).

5. Intersectionality, Patricia Hill Collins & Sirma Bilge, Polity Press,2nd Edition (2020)

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	1	-	3	3	3	2	2	1	3	1	1
CO2	2	2	1	2	-	3	1	3	2	1	1	3	1	2
CO3	1	2	1	2	-	3	3	3	2	2	1	3	1	1
CO4	1	2	1	1	-	2	2	2	2	2	1	3	1	2
CO5	1	2	1	1	-	3	3	3	2	2	2	3	1	2
Avg	**1.2**	**2**	**1**	**1.4**	**-**	**2.8**	**2.4**	**2.8**	**2**	**1.8**	**1.2**	**3**	**1**	**1.6**

1 - Low, 2 - Medium, 3 - High

MANDATORY COURSE I
B.E – BME, CSE, ECE, EEE, MECH, & B. Tech – AIDS, & IT

MX24C72	ELEMENTS OF LITERATURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understanding the core elements of literature.
- Learning the structure and narrative techniques of fiction.
- Developing the evolution, elements, and expressive power of poetry.
- Analyzing the essential components and types of drama.
- Examining the major schools of literary criticism and critical approaches.

UNIT I INTRODUCTION TO ELEMENTS OF LITERATURE 9

Elements of Literature and Creative Communication, Relevance of Literature, Multidimensional Engagement with Literature, how to read and appreciate Literature, Literature - Learner's Perspective.

UNIT II ELEMENTS OF FICTION 9

Introduction to Fiction, Fiction vs Non-Fiction, Elements of Fiction, Fiction and its Branches, Narrative Techniques in Fiction, Fictional Modes and Patterns, Plot Character and Perspective, Internal and External Conflicts.

UNIT III ELEMENTS OF POETRY 9

Origins of Poetry, Poetry and its Tributaries, Elements of Poetry, English Poetry, Emotions and Imaginations, Figurative Language, Tone and mood in Poetry, Types of Poetry.

UNIT IV ELEMENTS OF DRAMA 9

Introduction to Drama, Elements of Drama, Drama and its types, Dialogue and Monologue, Tragedy vs Comedy vs Tragicomedy, Theoretical Performance, Drama as Narration, mediation and Persuasion.

UNIT V LITERARY CRITICISM AND INTERPRETATION 9

Introduction to literary theory and criticism, Schools of literary criticism: Formalism, Structuralism, Feminism, Postcolonialism, etc., Critical approaches to reading texts, Feminist Literary Criticism, Marxist Literary Criticism.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

CO1: Describe the fundamental elements of literature.

CO2: Analyze the key components of fiction, including plot, character, narrative technique.

CO3: Identify and interpret the elements and types of poetry, including figurative language, tone, and mood.

CO4: Examine the structure and features of drama.

CO5: Apply various literary theories and critical approaches to evaluate literary texts.

TEXT BOOKS:

1. Meyer, Michael. The Bedford Introduction to Literature: Reading, Thinking, Writing. 13th ed., Bedford/St. Martin's, 2020.
2. Mays, Kelly J. The Norton Introduction to Literature. W. W. Norton & Company, 2023.

REFERENCES:

1. Kennedy, X. J., and Dana Gioia. Literature: An Introduction to Fiction, Poetry, Drama, and Writing. 13th ed., Pearson, 2017.

2. Barry, Peter. Beginning Theory: An Introduction to Literary and Cultural Theory. 4th ed., Manchester University Press, 2020 (reprint edition).

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	2	1	2	3	-	-	-	-
CO2	-	-	-	-	-	2	1	2	3	1	1	-	-
CO3	-	-	-	-	-	2	1	2	3	1	1	-	-
CO4	-	-	-	-	-	2	1	2	3	\1	1	-	-
CO5	-	-	-	-	-	3	2	3	3	1	1	-	-
Avg	**-**	**-**	**-**	**-**	**-**	**2.2**	**1.2**	**2.2**	**3.0**	**1.0**	**1.0**	**-**	**-**

1 - Low, 2 - Medium, 3 - High

MANDATORY COURSE I
B.E – BME, CSE, ECE, EEE, MECH, & B. Tech – AIDS, & IT

MX24C73	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

- To enhance awareness of disaster management and risk reduction methods
- To discuss train in planning and managing disaster response operations.
- To understand various types of disasters and their management techniques.
- To understand the tools and technologies used in disaster management.
- To analyse real-life disaster management case studies and their outcomes.

UNIT-I HAZRADS, VULNERABILITY AND DISASTER RISKS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, –Earthquake, Landslide, Flood, Drought, Fire etc. – Technological Disasters-Causes, Impacts including social, Economic, political, environmental, health, etc. - Global trends in disasters: urban disasters, pandemics.

UNIT-II RISK MANAGEMENT IN DISASTERS 9

Global Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation Based DRR, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System

UNIT-III DISASTER MANAGEMENT 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level.

UNIT-IV TOOLS AND TECHNOLOGIES IN DISASTER MANAGEMENT 9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements – Role of GIS and Response and Recovery Phases of Disaster – Standard operation Procedure for disaster response – Financial planning for Disaster Management.

UNIT-V DISASTER MANAGEMENT: CASE STUDIES 9

Analysis of Selected Disaster Case Studies - Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies - Field Work-Mock drill.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR).

CO2 : Understanding Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction.

CO3 : To develop disaster response skills by adopting relevant tools and technology.

CO4 : Discuss awareness of institutional processes for Disaster response in the country.

CO5 : Developing Awareness and Response Skills for Local Disasters

TEXT BOOKS:

1. Taimpo (2016), Disaster Management and Preparedness, CRC Publications.
2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications.

REFERENCE BOOKS:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	-	-	-	2	2	-	-	2	-	2	2
CO2	3	3	2	2	-	2	2	-	-	2	-	2	2
CO3	2	2	3	3	-	1	1	-	2	-	2	2	2
CO4	2	2	1	1	-	2	2	-	2	2	2	2	2
CO5	2	3	2	2	-	2	2	-	2	2	2	2	2
AVG.	**2.20**	**2.40**	**2.00**	**2.00**	**-**	**1.80**	**1.80**	**-**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**

1 - Low, 2 - Medium, 3 - High

MANDATORY COURSE I
B.E – BME, CSE, ECE, EEE, MECH, & B. Tech – AIDS, & IT

MX24C74	FILM APPRECIATION	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

- To enable students to appreciate films by understanding its distinct language
- To familiarize them with early film history.
- To identify different film genres and introduces them to the art of editing and sound
- To watch and critically evaluate a variety of films, learning to appreciate cinematic techniques, storytelling, and cultural impact.
- To enhance students' understanding and enjoyment of films

UNIT I INTRODUCTION TO FILM APPRECIATION 9

Early Film History - The Silent Era, Evolution of Sound Cinema, Talkies, Film Formats Film Technology/Experience: Understanding film as an art form and cultural product- Basic film terminology shot, scene, sequence, mise-en-scene, Viewing and analyzing short films: identifying basic elements.

UNIT II CINEMATIC TECHNIQUES AND STORYTELLING 9

In-depth study of camera movements- Exploring the role of editing, sound, and lighting in storytelling- Screening and analysis: comparing different directorial styles. Cinematography – Scale of Shot, Extreme Long Shot, Long Shot, Medium Shot, Close up, Deep focus, Reverse shot, Over- the- Shoulder Shot, Angle, Long Take Basics of Film Editing - Chronological editing, Continuity editing, Cross cutting, Montage, Continuity cuts, Jump cuts, Match cuts, 30 Degree rule, 180 Degree rule

UNIT III MASTERS OF CINEMA 9

Alfred Hitchcock: Suspense and psychological thrillers- Akira Kurosawa: Epic storytelling and visual style- Quentin Tarantino: Non-linear narratives and stylized violence- Charlie Chaplin: Comedy and social commentary- Satyajit Ray: Realism and humanism in cinema.

UNIT IV FILM GENRE 9

Introduction to major film genres: drama, comedy, horror, science fiction, documentary- Characteristics and conventions of each genre- Screening and discussion of representative films from each genre. Denotative & Connotative meanings; Observation of Signs- Physiology of Perception: reading images & narrative; function of receptor organs – sight, hearing & comprehension

UNIT V FILM THEORIES ANDCRITICISM/APPRECIATION 9

Auteurists, Psychoanalytic, Ideological, Feminists, Film Criticism / Appreciation. Hands-on film analysis sessions- Group projects: Analyzing selected films and presenting findings- Final project: in-depth analysis of a chosen film.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1 : Identify and analyze key cinematic techniques used in

CO2 : Appreciate the narrative structures and storytelling methods

CO3 : Critically evaluate films from different genres and cultural

CO4 : Articulate informed critiques and analyses of films both verbally and in

CO5 : Develop a personal aesthetic and critical approach to film

TEXT BOOKS:

1. Bordwell, David, and Kristin Thompson – Film Art: An Introduction – McGraw Hill Education.

2. Corrigan, Timothy, and Patricia White – The Film Experience: An Introduction – Bedford/St. Martin.
3. Film Art: An Introduction, David Bordwell & Kristin Thompson, McGraw-Hill Education.
4. Engaging Cinema: An Introduction to Film Studies, Bill Nichols, W.W. Norton.

REFERENCES:

1. Giannetti, Louis – Understanding Movies – Pearson
2. Monaco, James – How to Read a Film: Movies, Media, and Beyond – Oxford University Press
3. Phillips, William H – Film: An Introduction – Bedford/St. Martins
4. Louis Giannetti, Understanding Movies (2014), Pearson
5. N. M. Babu, Reeja Thankachan and Binil Kumar M. R., Introducing Film Studies (2015), Mainspring Publishers.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO
CO1	2	3	2	1	3	-	-	1	2	-	-	2		
CO2	3	2	3	2	3	-	-	1	3	-	-	2		
CO3	3	3	3	1	-	-	-	-	-	-	-	2		
CO4	2	3	3	1	-	-	-	-	2	-	-	2		
CO5	2	3	2	1	-	-	-	-	-	-	-	2		
Avg	**2**	**3**	**3**	**1**	**3**	**-**	**-**	**1**	**2**	**-**	**-**	**2**		

1 - Low, 2 - Medium, 3 - High

MANDATORY COURSE II
B.E – BME, CSE, ECE, EEE, MECH, & B. Tech – AIDS, & IT

MX24C75	WELL BEING WITH TRADITIONAL PRACTICES - YOGA, AYURVEDA AND SIDDHA	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Enjoying the life happily with fun filled new style activities that help to maintain health also
- Adapting few lifestyle changes that will prevent many health disorders
- Maintaining cool and handbill every emotion very smoothly in every walk of life
- Learning to eat cost effective but healthy foods that are rich in essential nutrients
- Developing immunity naturally that will improve resistance against many health disorders.

UNIT I HEALTH AND ITS IMPORTANCE 9

Health: Definition, Importance of maintaining health-ten types of health one has to maintain-Present health status-The life expectancy-Types of diseases and disorders: Lifestyle disorders-Obesity- Diabetes-cardiovascular diseases- Cancer-Strokes-COPD-Arthritis-Mental health issues-causes of the above diseases / disorders- Importance of prevention of illness- Simple lifestyle modifications to maintain health.

UNIT II BALANCED DIET 9

Role of diet in maintaining health- Balanced Diet and its 7 Components-Food additives and their merits & demerits- Effects of food additives- Types of food additives- Food additives and processed foods- Food additives and their reactions-Definition of BMI and maintaining it with diet- Common cooking mistakes.

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 9

AYUSH systems and their role in maintaining health- preventive aspect of AYUSH- AYUSH as a soft therapy-Secrets of traditional healthy living-Principles of Siddha & Ayurveda systems- Macrocosm and Microcosm theory- Pancheekarana Theory / (Five Element Theory)-96 fundamental Principles- Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal- Prevention of illness with our traditional system of medicine.

UNIT IV MENTAL WELLNESS 9

Emotional health- Definition and types- Importance of maintaining emotional health- Role of emotions in daily life-leading a healthy life with emotions- Expressing a full range of emotions-Stress management- Sleep and its importance for mental wellness-Sleep and digestion- Immunity-Types and importance- Ways to develop immunity.

UNIT V YOGA 9

Definition and importance of yoga- Types of yoga- How to choose the right kind for individuals according to their age- The Eight Limbs of Yoga-Simple yogasanas for cure and prevention of health disorders- What yoga can bring to our life.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Describe the importance of different components of health.

CO2: Analyze the importance of diet and workouts in maintaining health.

CO3: Identify and interpret the new techniques to prevent lifestyle health disorders.

CO4: Gain confidence to lead a healthy life.

CO5: Develop immunity naturally that will improve resistance against many health disorders.

TEXT BOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA.
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California.
3. B.K.S. Iyengar, "The Path of Holistic Health"June 15 2021, DK publishers ltd.
4. Michael Stone, "The Innerr Tradition of Yoga", July 17 2018, Shambhala publishers ltd.

REFERENCES:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England.
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

MANDATORY COURSE II
B.E – BME, CSE, ECE, EEE, MECH, & B. Tech – AIDS, & IT

MX24C76	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

- To gain knowledge of India's scientific and technological achievements.
- To explore how science and technology were intertwined with Indian Culture
- To appreciate the role of Indian scientists in global fields.
- To develop research, critical thinking, and analytical skills.
- To analyze post-independence developments in India's science and technology.

UNIT I CONCEPTS AND PERSPECTIVES 9

Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology- Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA 9

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA 9

Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.

UNIT IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA 9

Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest.

UNIT V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA & POST –INDEPENDENT INDIA 9

Science and the Empire Indian response to Western Science Growth of techno-scientific institutions. Science, Technology and Development discourse Shaping of the Science and Technology. Policy Developments in the field of Science and Technology Science and technology in globalizing India Social implications of new technologies like the Information Technology and Biotechnology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to:

CO1: Examine India's scientific and technological progress from ancient to modern times.
CO2: Learn how science and technology were linked to Indian culture, religion, and society
CO3: Discuss the importance of Indian scientists in global fields.
CO4: Build skills to assess the impact of science and technology on India and the world.
CO5: Analyze post-independence scientific developments in India, including ISRO, IITs, IT, and biotech.

TEXT BOOKS:

1. Jha, Arun Kumar, and Seema Sahay. Aspects of Science and Technology in Ancient India. Routledge, 2023.
2. Paranjape, Makarand R., New Perspectives in Indian Science and Civilization. Routledge India, 2020.
3. Sarkar, Suvobrata, History of Science, Technology, Environment, and Medicine in India. Routledge, 2022.

4. Ray, N. Indian Science and Technology in the 18th Century. 2021.

REFERENCE BOOKS:

1. Satpathy and Binod Bihari. A. A History of Science and Technology in India: History of Science, Technology, and Medicine in India. 1st ed., Himalaya Publishing House, 2025.
2. Sukumar, Arun Mohan. Midnight's Machines: A Political History of Technology in India. Penguin Random House India, 2024.

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	1	-	1	-	2	1	1	-	2	-		
CO2	-	1	-	-	-	3	2	2	1	2	-		
CO3	-	1	-	1	-	2	1	1	1	2	-		
CO4	-	2	-	2	-	3	2	2	1	2	1		
CO5	1	2	-	2	1	3	2	1	-	2	1		
AVG.	**1.0**	**1.4**	**-**	**1.5**	**1.0**	**2.6**	**1.6**	**1.4**	**1.0**	**2.0**	**1.0**		

1 - Low, 2 - Medium, 3 - High

MANDATORY COURSE II
B.E – BME, CSE, ECE, EEE, MECH, & B. Tech – AIDS, & IT

MX24C77	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

- To understand basics of safety engineering and terminologies
- To enable the students to learn about the important statutory regulations and standards.
- To discuss the students to conduct and participate the various safety activities in the industry.
- To have knowledge about workplace exposures and hazards.
- To analysis of hazards using various risk assessment techniques.

UNIT-I SAFETY TERMINOLOGIES 9

Hazard-Types of Hazards- Risk-Hierarchy of Hazards Control Measures-Lead indicators - Lag Indicators- Flammability- Toxicity Time-weighted Average - Threshold Limit Value - Short Term Exposure Limit- Immediately dangerous to life or health - Personnel Protective Equipment- Health and Safety Policy.

UNIT-II STANDARDS AND REGULATIONS 9

Factory Regulations in India -1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Risk Identification and Hazard Control - Code of practice IS 15656:2006.

UNIT-III SAFETY ACTIVITIES 9

Toolbox Talk- Role of safety Committee- Responsibilities of Industrial Safety Officials - 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 Related Safety Hazard - Particulate matter- Postural Disorders and Ergonomic Evaluation Techniques (RULE & REBA)- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety Toxic Gas Release**.**

UNIT-V HAZARD DETECTION TECHNIQUES 9

Job Hazard 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

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

1. Understand the basic concept of safety.
2. Familiarization of Statutory Regulations and Standards
3. Know about the safety Activities of the Working Place.
4. Analyze on the impact of Occupational Exposures and their Remedies
5. Obtain knowledge of Risk Assessment Techniques.

TEXTBOOKS:

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

REFERENCE BOOKS:

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publication U4th Edition.
2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring. (1996). Safety management system: Chapman &Hall, England.
5. Society of Safety Engineers, USA

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	-	1	3	2	-	-	-	2	1	1
CO2	2	3	2	-	2	2	3	-	2	2	3	2	3
CO3	2	2	2	2	2	2	2	2	-	-	3	1	1
CO4	3	2	2	2	2	2	2	2	3	2	3	2	3
CO5	3	2	3	2	2	2	2	2	2	2	3	3	2
AVG.	**2.66**	**2.40**	**2.40**	**2.00**	**1.80**	**2.20**	**2.20**	**2.00**	**2.33**	**2.00**	**2.80**	**1.80**	**2.00**

1 - Low, 2 - Medium, 3 - High

MANDATORY COURSE II
B.E – BME, CSE, ECE, EEE, MECH, & B. Tech – AIDS, & IT

MX24C78	POLITICAL AND ECONOMIC THOUGHT FOR A HUMAN SOCIETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To enable students to develop a holistic understanding of human aspirations and contributing to the creation of a humane, ethical, and sustainable social order.
- To provide students with a comprehensive understanding of the evolution of modern economic systems.
- To analyze how communist theory relates to human desires, the pursuit of empowerment, and human satisfaction.
- To familiarize students with the core principles of Gandhian thought, emphasizing Swaraj, decentralized political and economic systems, and community empowerment.
- To explore the foundational elements of Indian civilization, with a focus on the role of technology and education in societal development.

UNIT - I HARMONY AND HUMAN ASPIRATIONS 9

Considerations for humane society, holistic thought, human being's desires-harmony in self- harmony in relationships, society, and nature, societal systems.

UNIT II MODERN IDEOLOGIES AND WORLD CONFLICTS 9

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism-Liberal democracy, Fascism and totalitarianism-World war I and II. Cold war.

UNIT III COMMUNISM AND HUMAN FULFILLMENT 9

Communism – Mode of production, theory of labor, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models-Welfare state-Relation with human desires-Empowered human beings, satisfaction.

UNIT IV SWARAJ AND SELF-DETERMINATION 9

Gandhian thought-Swaraj, Decentralized economy & polity, Community-Control over one's lives, Relationship with nature.

UNIT V CORE ELEMENTS OF INDIAN CIVILIZATION 9

Essential elements of Indian civilization-technology as driver of society-Role of education in shaping of society-Future directions.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completing this course, the students will be able to:

CO1 : Examine the principles of a humane and just society based on harmony within self and society.

CO2 : Assess the impact of free markets, demand–supply forces, and monopolies on capitalism's evolution.

CO3 : Evaluate mode of production and surplus value theories.

CO4 : Interpret the concepts of Swaraj and decentralized governance in Gandhian thought.

CO5 : Identify and analyze the essential elements of Indian civilization.

TEXT BOOKS:

1. Acemoglu, Daron, and Simon Johnson. Power and Progress: Our Thousand-Year Struggle Over Technology and Prosperity. PublicAffairs, 2023.
2. Feldstein, Steven. Digital Empires: The Global Battle to Regulate Technology. Oxford University Press, 2023.

3. Slobodian, Quinn. Crack-Up Capitalism: Market Radicals and the Dream of a World Without Democracy. Metropolitan Books, 2023.

REFERENCES:

1. Marx, Karl, Friedrich Engels, and Robert C. Tucker. The Marx-Engels Reader. 2nd ed., W. W. Norton & Company, 2012.
2. Toffler, Alvin. The Third Wave. Updated ed., Bantam Books, 2022.
3. Kalam, A. P. J. Abdul, and Y. S. Rajan. India 2020: A Vision for the New Millennium. Penguin Books India, 2014.
4. Piketty, Thomas. A Brief History of Equality. Harvard University Press, 2022.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PSO1	PSO2
CO1	-	1	-	-	-	3	2	2	1	1	-		
CO2	-	2	-	1	-	2	2	2	1	1	-		
CO3	-	2	-	1	-	2	2	3	1	1	-		
CO4	-	1	-	-	-	3	2	3	1	1	-		
CO5	1	2	-	1	1	2	2	2	-	2	1		
AVG.	**1.0**	**1.6**	**-**	**1.0**	**1.0**	**2.4**	**2.0**	**2.4**	**1.0**	**1.2**	**1.0**		

1 - Low, 2 - Medium, 3 - High

MANDATORY COURSE II
B.E – BME, CSE, ECE, EEE, MECH, & B. Tech – AIDS, & IT

MX24C79	STATE, NATION BUILDING AND POLITICS IN INDIA	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

- The course explains the meaning of the state and the functioning of its major organs such as the Legislature, Executive, and Judiciary.
- It helps students understand the importance of politics, political processes, and the changing concept of sovereignty in a globalized world.
- The course familiarizes students with the history, developments, and legacies of India's freedom struggle and Constitution-making process.
- Students learn the reasons behind adopting the Parliamentary-federal system and the basic philosophy and features of the Constitution of India.
- The course discusses issues related to national integration, nation-building, and contemporary political challenges to develop a vision for a stronger and better India.

UNIT I STATE, POLITICS AND SOVEREIGNTY **9**

Understanding the need and role of the State and politics, Development of the Nation-State, Concept of sovereignty and sovereignty in a globalized world.

UNIT II ORGANS AND FORMS OF GOVERNMENT **9**

Organs of the State: Executive, Legislature and Judiciary, Separation of powers, Forms of government: Unitary and Federal systems, Presidential and Parliamentary forms of government.
Activity-Based Learning: Debate, Discussion and Mock Parliament.

UNIT III NATIONAL MOVEMENT AND CONSTITUTIONAL DEVELOPMENT **9**

Revolt of 1857 and national awakening, Formation of the Indian National Congress in 1885, Development and legacies of the national movement, Constitution making and the Constitution of India.

UNIT IV INDIAN CONSTITUTION AND NATION-BUILDING **9**

Goals, objectives and philosophy of the Constitution, Reasons for adopting a federal system, National integration and nation-building.
Activity-Based Learning: Role Play

UNIT V CONTEMPORARY CHALLENGES AND FUTURE OF INDIAN POLITICS **9**

Challenges of nation-building, State versus democracy (Rajni Kothari), New social movements, changing nature of the Indian Political System, Future scenario and the role of citizens in building a better India.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completing this course, the students will be able to:

CO1 : Describe the concepts of State, politics, and sovereignty.
CO2 : Explain the background and philosophy of the Indian Constitution.
CO3 : Examine national integration and nation-building in India.
CO4 : Analyze governance and democratic institutions in India.
CO5 : Apply democratic values and responsible citizenship in society.

TEX BOOKS:

1. Singh, M. P., and Rekha Saxena. Indian Politics: Constitutional Foundations and Institutional Functioning. 2021 ed., PHI Learning, 2021.
2. Muralidharan, Sukumar. India in the Pandemic Years: Governance, Economy and Democracy. 2022.

REFERENCES:

1. Sharma, Brij Kishore. Introduction to the Indian Constitution. 13th ed., PHI Learning, 2021.
2. Jaffrelot, Christophe. Modi's India: Hindu Nationalism and the Rise of Ethnic Democracy. Princeton University Press, 2021.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	2	1	2	1	1	-		
CO2	-	-	-	-	-	2	1	2	1	1	-		
CO3	-	-	-	-	-	3	2	2	1	1	-		
CO4	-	-	-	-	-	3	2	2	1	2	-		
CO5	-	-	-	-	-	3	3	3	2	2	3		
AVG.	-	-	-	-	-	**2.6**	**1.8**	**2.2**	**1.2**	**1.4**	**3.0**		

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL I
B.E. MECHANICAL ENGINEERING

ME24P01	HYBRID AND ELECTRIC VEHICLE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts of hybrid and electric powertrains.
- To explore how different hybrid and electric drivetrains work and where they are used.
- To learn about the various ac and dc motor drives used in electric vehicles.
- To study different types of EV batteries and energy storage technologies.
- To understand the implement of energy management strategies.

UNIT – I INTRODUCTION 9

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT – II HYBRID ELECTRIC DRIVE TRAINS 9

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

UNIT – III CONTROL OF AC & DC DRIVES 9

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

UNIT – IV ENERGY STORAGE 9

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

UNIT – V ENERGY MANAGEMENT STRATEGIES 9

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

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

CO1 : Characterize and configure hybrid drivetrain requirements based on vehicle needs.

CO2 : Design and integrate appropriate hybrid and electric drivetrain configurations into a vehicle.

CO3 : Design and implement suitable AC and DC motor drive systems for electric vehicles.

CO4 : Select and justify the optimal energy storage technology for specific hybrid or electric vehicles.

CO5 : Apply advanced energy management strategies to maximize vehicle efficiency and fuel economy.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons, 1998.
3. Hybrid, Electric and Fuel-Cell Vehicles, International Edition by Jack Erjavec | 6 June 2012.
4. Energy Management in Hybrid Electric Vehicles using Co-Simulation by Christian Paar | 11 February 2011.
5. Hybrid Electric Vehicle Design and Control: Intelligent Omnidirectional Hybrids (MECHANICAL ENGINEERING) by Yangsheng Xu , Jingyu Yan, et al. | 16 December 2013.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	-	-	2	-	-	-	-	2	2
CO2	3	2	2	2	-	-	2	-	-	-	-	2	2
CO3	3	2	2	2	-	-	2	-	-	-	-	2	2
CO4	3	2	2	2	-	-	2	-	-	-	-	2	2
CO5	3	2	2	2	-	-	2	-	-	-	-	2	2
AVG.	**3**	**2**	**2**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL I
B.E. MECHANICAL ENGINEERING

ME24P02	THERMAL MANAGEMENT OF BATTERIES AND FUEL CELLS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand how lithium-ion batteries and battery packs operate.
- To learn the principles and systems used to control temperatures in battery modules.
- To analyze and develop real-world case studies in battery thermal management systems (BTMS).
- To study the working principles and methods used to cool hydrogen fuel cells.
- To examine the actual thermal management components used in leading commercial electric and fuel cell vehicles.

UNIT – I ADVANCED BATTERIES 9

Li-ion Batteries- chemistry, different formats, operating areas, efficiency, aging. Battery Management System- Configuration, Characteristics. Tesla Model S- 18650 Cell specifications, P85 Battery Pack mechanical structure, Texas Instruments BMS. Supercapacitors Vs batteries. Diamond battery concepts.

UNIT – II THERMAL MANAGEMENT IN BATTERIES 9

Thermal Management Systems- impact, Types- Air, Liquid, Direct refrigerant, Heat pipe, Thermo Electric, Phase Change Material Cooling methods. Solid-liquid PCM Types- Organic, Inorganic, Eutectics. PCM Thermal properties and applications. Tesla Model-S Battery Module- bonding techniques, thermal management.

UNIT – III BATTERY THERMAL MANAGEMENT CASE STUDIES 9

EV Battery Cooling- challenges and solutions. Heat Exchanger Design and Optimization Model for EV Batteries using PCMs- system set up, selection of PCMs. Chevrolet Volt Model Battery Thermal Management System- Case study.

UNIT – IV THERMAL MANAGEMENT IN FUEL CELLS 9

Fuel Cells- operating principle, hydrogen-air fuel cell system characteristics, other fuel cell technologies, polarization curves, applications. Fuel cell thermal management- basic model, energy balance, governing equations, characteristic curve, sizing, cooling methods, advantages, restrictions.

UNIT – V FUEL CELL THERMAL MANAGEMENT CASE STUDIES 9

Fuel cell system- balance of plant- components required. Fuel cell power plant sizing problems- Fuel Cell Electric Vehicle Fuel economy calculations-Battery EVs Vs Fuel Cell EVs. Toyota Mirai FCV- Operating principle, High pressure hydrogen tank, Boost convertor, NiMH Battery, Internal circulation system, Hydrogen refueling- Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO6 : Compare and analyze the performance characteristics of different lithium-ion batteries and fuel cells.

CO7 : Design a battery pack utilizing appropriate Phase Change Materials (PCM) for thermal control.

CO8 : Apply advanced simulation tools to model and analyze battery and fuel cell cooling systems.

CO9 : Estimate and analyze the fuel and energy economy of electric and fuel cell vehicles.

CO10 : Utilize effective thermal management approaches for real-world automotive operating conditions.

TEXT BOOKS:

1. Ibrahim Dinçer, Halil S. Hamut, and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems'', Wiley, 2017.
2. Jiuchun Jiang and Caiping Zhang, "Fundamentals and applications of Lithium-Ion batteries in Electric Drive Vehicles'', Wiley, 2015.
3. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles-Fundamentals, Theory, and Design'', CRC Press, 2005.

REFERENCE BOOKS:

1. John G. Hayes and G. Abas Goodarzi, "Electric Powertrain", Wiley, 2018
2. Davide Andrea, "Battery Management Systems for Large Lithium-Ion Battery Packs" ARTECH House, 2010.
3. Younes Shabany," Heat Transfer: Thermal Management of Electronics Hardcover" 2010, CRC Press.
4. T. Yomi Obidi, "Thermal Management in Automotive applications", 2015, SAE International.
5. Jerry Sergent, Al Krum, "Thermal Management: For Electronic Assemblies Hardcover", 1998, Mc Graw- Hill.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	-	-	-	-	-	2	3	2
CO2	3	2	2	2	2	-	-	-	-	-	2	3	2
CO3	3	2	2	2	2	-	-	-	-	-	2	3	2
CO4	3	2	2	2	2	-	-	-	-	-	2	3	2
CO5	3	2	2	2	2	-	-	-	-	-	2	3	2
AVG.	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL I
B.E. MECHANICAL ENGINEERING

ME24P03	CAE AND CFD APPROACH IN FUTURE MOBILITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the role of Computer Aided Engineering (CAE) and Computational Fluid Dynamics (CFD) in future mobility applications.
- To study computer-aided design (CAD) and rapid prototyping techniques.
- To learn the fundamentals of Finite Element Analysis (FEA).
- To understand the governing equations and numerical methods used in CFD.
- To apply turbulence modeling and simulation techniques to vehicle engineering problems.

UNIT-I INTRODUCTION TO CAE /CFD 9

Introduction to use of computer in Mobility Product Life Cycle, Software for mobility. Introduction to design process and role of computers in the design process, use of modern computational tools used for design and analysis, Concept of modelling and simulation. CFD as a design and research tool, Applications of CFD in mobility engineering

UNIT-II CAD AND RAPID PROTOTYPING 9

Curves and Surfaces: Geometric modelling curves and surfaces, Wire frame models, Parametric representations, Parametric curves and surfaces, Solid modelling: Fundamentals of solid modelling. CAD/CAM Data Exchange Formats: Types of file formats & their exchange, Graphics standards. CAD Data and Programming Techniques for RP: Transformations, Solid modelling for RP, Surface modelling.

UNIT-III INTRODUCTION TO FEA 9

Basic Concept of Finite Element Method, Ritz and Rayleigh Ritz methods, Method of weighed residuals, Galerkin method. Governing differential equations of one- and two-dimensional problems, One Dimensional Second Order Equations – Discretization – Linear and Higher order Elements – Interpolation and shape functions.

UNIT-IV INTRODUCTION TO CFD 9

CFD vs. experimentation; continuity, Navier-stokes and energy equations; modelling and discretization techniques; basic steps in CFD computation Various simplifications, Dimensionless equations and parameters, Incompressible inviscid flows, Source panel method, and Vortex panel method.

UNIT-V PROBLEM SOLVING USING CFD 9

Turbulence Modelling, different turbulent modelling scheme. Incompressible Viscous Flows: Applications to internal flows and boundary layer flows. Eddy viscosity and non-eddy viscosity models; Vehicle Aerodynamic Simulation Wind tunnel and on-road simulation of vehicles;

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Explain the basis of CAE and CAF.
CO2 : Develop CAD models and rapid prototypes.
CO3 : Apply finite element analysis (FEA).
CO4 : Analyze fluid flow using CFD
CO5 : Perform CFD simulations for engineering problems.

TEXT BOOKS:

1. Anup Goel and Ravi “Computer Aided Engineering Design” Gupta Publisher: Khanna Publishing House Edition: 2021 Edition

2. P.N. Rao “CAD/CAM Principles and Applications” Publisher: McGraw Hill Education Latest Reprint: 2021–2023

REFERENCE BOOKS:

1. C.P. Paul “Rapid Prototyping and Additive Manufacturing” Publisher: McGraw Hill Edition: 2022 Edition.
2. S.S. Rao “Finite Element Method” Publisher: Butterworth-Heinemann / Elsevier Edition: 2021 Edition.
3. H.K. Versteeg and W. Malalasekera “Fundamentals of Computational Fluid Dynamics” Publisher: Pearson Latest Reprint: 2021–20244.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	-	-	2	3	2
CO2	3	3	3	2	3	-	-	-	-	-	2	3	3
CO3	3	3	2	2	3	-	-	-	-	-	2	3	3
CO4	3	3	2	2	3	-	-	-	-	-	2	3	3
CO5	3	3	3	2	3	-	-	-	-	-	2	3	3
AVG.	**3**	**3**	**2.0**	**2**	**2.8**	**-**	**-**	**-**	**-**	**-**	**2**	**3.0**	**2.8**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL I
B.E. MECHANICAL ENGINEERING

ME24P04	VEHICLE DYNAMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamental concepts of vibration and their application to vehicle systems.
- To analyze tyre mechanics, forces, and performance under different operating conditions.
- To evaluate vehicle ride dynamics through suspension models and human response to vibration.
- To examine vehicle performance parameters including tractive effort, braking, and control systems.
- To assess vehicle handling and stability using mathematical models and stability criteria.

UNIT – I CONCEPT OF VIBRATION 9

Basic concepts of vibration, Classification of vibration, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, force and displacement transmissibility, Forced vibration due to rotating unbalance.

UNIT – II TYRES 9

Tyre axis system, tyre forces and moments, tyre marking, tyre structure, hydroplaning, wheel and rim. Rolling resistance, factors affecting rolling resistance, Longitudinal and Lateral force at various slip angles, Tractive and cornering property of tire. Performance of tire on wet surface. Various test carried on a tyre.

UNIT – III VEHICLE RIDE DYNAMICS 9

Human response to vibration, Sources of Vibration. Suspension requirements – types. Vehicle ride models-quarter car model, pitch and bounce model, suspension travel and road holding. Surface elevation profile as a random function, road and vehicle power spectral density functions, Frequency response function.

UNIT – IV VEHICLE PERFORMANCE AND CONTROL 9

Vehicle free body diagram and maximum tractive effort - aerodynamic forces and moments. Vehicle power train and transmission characteristics - Prediction of vehicle performance- Braking performance- ideal braking force distribution. Tire dynamics for antilocking braking systems and Traction control system.

UNIT – V VEHICLE HANDLING AND STABILITY 9

Ackermann Steering geometry-low speed cornering, Steady state handling characteristics of two axle vehicle-Bi-cycle model. State space representation of bi-cycle model for response study. Handling tests. Vehicle stability using bi-cycle model, Routh's stability criterion, Electronic and Roll over stability analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1 : Understand and apply vibration principles.
CO2 : Evaluate tyre behavior.
CO3 : Model and simulate ride dynamics.
CO4 : Predict vehicle performance and control.
CO5 : Analyze handling and stability.

TEXTBOOKS:

1. J. Y. Wong, "Theory of Ground Vehicles", Fifth Edition, Wiley-Interscience, 2022.
2. Singiresu S. Rao, "Mechanical Vibrations," Sixth Edition, Prentice Hall, 2021.
3. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics," Society of Automotive Engineers Inc, Revised Edition,2 021.

REFERENCE BOOKS:

1. Dean Karnopp, "Vehicle Dynamics, Stability, and Control", Second Edition, CRC Press, Reissued 2023.
2. Hans B Pacejka, "Tyre and Vehicle Dynamics," Third edition, SAE International, 2012.
3. John C. Dixon, "Tyres, Suspension, and Handling, " Second Edition, Society of Automotive Engineers Inc, 1996
4. Michael Blundell & Damian Harty, "The Multibody Systems Approach to Vehicle Dynamics", Elsevier Limited, Second Edition, 2014.
5. R. Nakhaie Jazar, "Vehicle Dynamics: Theory and Application", Fourth edition, Springer, 2025.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	2	-	2	3	3
CO2	3	3	3	2	2	-	-	-	1	-	2	3	3
CO3	3	3	3	2	2	-	-	-	1	-	2	3	3
CO4	3	3	3	2	2	-	-	-	1	-	2	3	3
CO5	3	3	3	2	2	-	-	-	1	-	2	3	3
AVG.	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**1**	**-**	**2**	**3**	**3**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL I
B.E. MECHANICAL ENGINEERING

ME24P05	AUTOMOTIVE MATERIALS, COMPONENTS, DESIGN AND TESTING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To systematically analyze the functional requirements of critical engine components.
- To develop competency in the design methodologies of cylinder and piston assemblies.
- To acquire advanced knowledge in the design of connecting rods and crankshafts.
- To study and design flywheel and valve train systems.
- To investigate standardized engine testing cycles and contemporary emission measurement technologies.

UNIT – I MATERIALS FOR ENGINE COMPONENTS 6

Functional requirements of engine components – Piston, piston pin, cylinder liner, connecting rod, crank shaft, valves, spring, engine block, cylinder head, and flywheel. Suitable materials for engine components.

UNIT – II DESIGN OF CYLINDER AND PISTON COMPONENTS 6

Design of cylinder block and cylinder - Description on function of piston in an I.C engines, Design of Piston - Description on piston rings - compression ring-oil rings and piston failure

UNIT – III DESIGN OF CONNECTING ROD AND CRANK SHAFT 6

Design of connecting rod – Shank design – small end design – big end design – bolts design. Design of overhang crank shaft under bending and twisting – Crank pin design – Crank web design – Shaft design.

UNIT – IV DESIGN OF FLYWHEEL AND VALVE TRAIN 6

Determination of mass of flywheel for a given coefficient of fluctuation of speed. Design of flywheel - rim - hub – arm. Design of valve – inlet valve – exhaust valve - Valve springs – tappet – rocker arm.

UNIT – V ENGINE TESTING 6

Engine test cycles – WLTC – WHSC – WHVC – NRTC – ISO 8178. Dynamometer - Chassis dynamometer - transient dynamometer. Emission measurement technologies and instruments - NOX – Smoke – Particulate matter – CO – CO_2 - HC -Particle counter

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS

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

TOTAL: 30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1 : Analyze engine component requirements and select materials ensuring strength, thermal stability, and durability.

CO2 : Apply design principles to cylinders and pistons, solving problems related to stress, heat transfer, and lubrication.

CO3 : Employ design concepts for connecting rods and crankshafts, addressing fatigue, balancing, and cyclic loading problems.

CO4 : Design flywheel and valve train systems with focus on energy storage, vibration damping, and kinematic precision.

CO5 : Discuss engine test cycles, dynamometer applications, and emission measurement technologies with modern instrumentation.

TEXTBOOKS:

5. Khurmi. R.S. & Gupta. J.K., "A text book of Machine Design", Eurasia Publishing House (Pvt) Ltd, 25th Revised Edition, 2020.
6. John Kasab and Andrea Strzele, "Automotive Emissions Regulations and Exhaust Aftertreatment Systems", SAE International, 31 Aug 2020.

REFERENCE BOOKS:

1. Sadhu Singh, "Machine Design: –, Khanna Book Publishing Co., Delhi, 2026
2. V. B. Bhandari, "Design of Machine Elements" Tata Mc- Graw Hill, New Delhi. 5th Edition, 2020.
3. Joseph Edward Shigley, "Mechanical Engineering Design", Tata Mc- Graw Hill, New Delhi, 12th Edition, 2024.
4. Design Data Book – PSG Coimbtore, PSG Coimbtore.
5. A.J. Martyr and M.A. Plint, "Engine Testing: theory and practice", Oxford, 2012.

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CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	2	-	-	-	2	-	2	3	3
CO2	3	3	3	2	2	-	-	-	1	-	2	3	3
CO3	3	3	3	2	2	-	-	-	1	-	2	3	3
CO4	3	3	3	2	2	-	-	-	1	-	2	3	3
CO5	3	3	3	2	2	-	-	-	1	-	2	3	3
AVG.	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**1**	**-**	**2**	**3**	**3**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL I
B.E. MECHANICAL ENGINEERING

ME24P06	VEHICLE HEALTH MONITORING, MAINTENANCE AND SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the core principles, functions, and everyday practices of servicing vehicles.
- To learn how to maintain powertrains, diagnose mechanical faults, and service vehicle batteries.
- To develop practical skills for maintaining and servicing clutches, brakes, and other major vehicle systems.
- To study modern vehicle safety concepts and legal automotive regulations.
- To understand how to simulate and test safety systems using modern technology.

UNIT – I INTRODUCTION 9

Need for Maintenance – importance, classification of maintenance work-basic problem diagnosis. Maintenance of vehicle systems – power pack, tyres, safety systems. Scheduled maintenance services – service intervals – On-board diagnostics, Computerized engine analyzer study and practice- OBD and scan tools

UNIT – II POWERTRAIN MAINTENANCE 9

Electronic fuel injection and engine management service - fault diagnosis- OBD-III and scan tool, identifying DTC and servicing emission controls, Maintenance of Batteries, Starting System, Charging System and Body Electrical -Fault Diagnosis Using Scan Tools.

UNIT – III VEHICLE SYSTEM MAINTENANCE 9

Clutch- adjustment and service, Maintenance and Service of Hydraulic brake, Bleeding of brakes, Checking ABS and components. Computerized wheel balancing & wheel alignment, Maintenance and Service of steering linkage, steering column, Rack and pinion steering.

UNIT – IV VEHICLE SAFETY 9

Concepts of vehicle safety -Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, air bags, electronic system for activating air bags, bumper design for safety, Active Safety - ABS, EBD, CSC, Traction control system.

UNIT – V SIMULATION OF SAFETY CONCEPTS 9

Active safety: driving safety, conditional safety, perceptibility safety, operating safety passive safety: exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact. Collision warning system, frontal object detection, rear vehicle object detection system.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Apply core knowledge of vehicle health monitoring, general maintenance, and safety protocols.
CO2 : Effectively maintain and troubleshoot vehicle powertrains.
CO3 : Diagnose and service key vehicle systems, including clutches and brakes.
CO4 : Explain and implement modern vehicle safety features and regulatory standards.
CO5 : Utilize and explain simulation techniques for vehicle safety testing.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	-	-	-	2	-	-	-	2	2
CO2	3	2	2	2	-	-	-	2	-	-	-	2	2
CO3	3	2	2	2	-	-	-	2	-	-	-	2	2
CO4	3	2	2	2	-	-	-	2	-	-	-	2	2
CO5	3	2	2	2	-	-	-	2	-	-	-	2	2
AVG.	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL II
B.E. MECHANICAL ENGINEERING

ME24P07	DESIGN OF EXPERIMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts and principles of optimization and experimental analysis.
- To learn about random variables, probability distributions, and statistical models used in engineering.
- To develop skills to formulate and test hypotheses using statistical methods.
- To gain knowledge of experimental techniques such as Factorial Design and Taguchi Method for solving engineering problems.
- To enable students to perform modern optimization techniques.

UNIT-I INTRODUCTION 9

Brief introduction of optimization techniques – Strategy of experimentation –Basic principles of Design, Terminology used in Design of Experiment – Guidelines for designing experiments – Basic statistical concepts: Types of Data, Graphical representation of Data.

UNIT-II SIMPLE COMPARATIVE EXPERIMENTS 9

Test of significance for single mean and for difference of means of two samples –Paired comparison Designs – Inferences about the Variances of Normal Distributions – Test of significance based on t, F and Chi square distribution.

UNIT-III FITTING REGRESSION MODELS 9

Linear regression models – Estimate of parameters in linear regression models –The method of least square – Hypothesis testing: Null Hypothesis, Alternative Hypothesis –Prediction of new response observations.

UNIT-IV TAGUCHI METHOD 9

Orthogonal array experiments –Taguchi quality loss function, Signal-to Noise ratio – Quality characteristics, Parameter optimization experiment– Introduction One-way ANOVA process, Two-way ANOVA process.

UNIT - V MODERN OPTIMIZATION TECHNIQUES 9

Introduction to Response Surface Methodology– Experimental Designs for Fitting Response Surfaces – Designs for Fitting the First-Order Model –Designs for Fitting the Second-Order Model, Evolutionary Operation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Explain the fundamental principles and techniques of optimization methods.
CO2 : Understand the concepts of experimental analysis, including the selection of random variables.
CO3 : Develop mathematical models for random phenomena using concepts such as Null Hypothesis and Alternative Hypothesis.
CO4 : Apply statistical and experimental methods such as Factorial Design and Taguchi Method to solve engineering problems.
CO5 : Analyze modern optimization techniques

TEXTBOOKS:

11. A. C. Fowler, Mathematical Models in Applied Sciences, Cambridge University Press. 1997.
12. R. Panneerselvam, Design and Analysis of Experiments, 2nd Edition, 2012, PHI Learning.

REFERENCE BOOKS:

1. Madhav S. Phadke, Quality Engineering Using Robust Design, Prentice Hall,1989

2. J. N. Kapoor, Mathematical Modeling, Wiley eastern Limited, 2023
3. K. Venkataraman, Design of Experiments with MINITAB, 1st Edition, 2019, Wiley India.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	3	2
CO2	3	3	-	2	2	-	-	-	-	-	-	3	2
CO3	3	3	2	3	2	-	-	-	-	-	-	3	2
CO4	23	3	3	3	3	-	-	-	-	-	2	3	2
CO5	3	3	2	3	3	-	-	-	-	-	2	3	2
AVG.	**3**	**2.80**	**2.33**	**2.75**	**2.4**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL II
B.E. MECHANICAL ENGINEERING

ME24P08	CAD/CAM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

UNIT-I BASICS OF DESIGNS 9

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

UNIT-II 2D DRAFTING 9

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

UNIT-III 3D MODELING 9

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

UNIT-IV ASSEMBLY MODELING 9

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

UNIT-V CAM 9

Basics of CNC Machining – 3, 4 & 5 Axis machines - CNC and Part Programing, Cutter Path Selection, Cutter Compensation –Machining Stocks, Roughing, Semi Finishing & Finishing - Tool Path Generation. Machining program simulation, integration of program with machine; Estimation of CNC Cycle time.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Discuss the basics of the design and concepts.

CO2 : Develop the two-dimensional drafting and projection views.

CO3 : Discuss the three-dimensional modeling, parametric and non-parametric modeling

CO4 : Discuss the assembly modeling and top down, bottom-up approaches.

CO5 : Develop the computer aided machining and writing part programming

TEXT BOOKS:

1. Ibrahim Zeid," Mastering CAD/CAM", McGraw-Hill Education Special Indian Edition, 2024.
2. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson, 5th Edition, 2020.

REFERENCE BOOKS:

1. P. N. Rao, CAD/CAM: Principles and Applications, McGraw-Hill Education, 5th Edition, 2020.

2. P. Radhakrishnan, S. Subramanyan and V. Raju, CAD/CAM/CIM, 3rd Edition, New Age International Publishers, New Delhi, 2008.
3. A. Alavudeen and N. Venkateshwaran, Computer Integrated Manufacturing, PHI Learning Pvt. Ltd., New Delhi, 2013.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	-	-	2	-	-	-	3	3	2
CO2	3	2	2	2	2	-	-	2	-	-	-	3	3	2
CO3	3	2	2	2	2	-	-	2	-	-	-	3	3	2
CO4	3	2	2	2	2	-	-	2	-	-	-	3	3	2
CO5	3	2	2	2	2	-	-	2	-	-	-	3	3	2
AVG.	**3**	**2**	**2**	**2**	**2**	-	-	**2**	-	-	-	**3**	**3**	**2**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL II
B.E. MECHANICAL ENGINEERING

ME24P09	PRODUCT LIFE CYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the history, concepts, and terminology of Product Lifecycle Management (PLM).
- To gain knowledge of the functions and features of PLM/PDM systems.
- To explore various modules available in commercial PLM/PDM tools.
- To demonstrate the application of PLM/PDM approaches in industrial environments.
- To integrate PLM/PDM systems with legacy databases, CAD/CAM systems, and ERP platforms.

UNIT-I PLM FUNDAMENTALS AND EVOLUTION 9

Engineering Data Management, Product Data Management, Collaborative Product Definition Management, Collaborative Product Commerce, Product Lifecycle Management. PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications.

UNIT-II PLM/PDM FUNCTIONS AND FEATURES 9

User Functions – Data Vault, Document, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.

UNIT-III DETAILS OF MODULES IN A PDM/PLM SOFTWARE 9

Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras and SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault -Architecture of PLM software- selection criterion of software for application- Blockchain based product traceability.

UNIT-IV ROLE OF PLM IN INDUSTRIES 9

Case studies on PLM selection and implementation, PLM visioning, strategy, feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organization, process performance- process compliance and automation.

UNIT-V PLM CUSTOMIZATION AND SYSTEM INTEGRATION 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP- Cybersecurity and data governance in integrated PLM ecosystems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Summarize the history, concepts and terminology of PLM
CO2 : Develop the functions and features of PLM/PDM
CO3 : Discuss different modules offered in commercial PLM/PDM tools.
CO4 : Interpret the implement PLM/PDM approaches for industrial applications.
CO5 : Integrate PLM/PDM with legacy data bases, CAD & ERP systems

TEXT BOOKS:

1. Product Lifecycle Management for a Global Market, Springer; 2014 edition (29 September 2016), ISBN-10: 3662516330
2. Product Life Cycles and Product Management, Praeger Publishers Inc (27 March 1989) ISBN-10: 0899303196

REFERENCE BOOKS:

1. Antti Saaksvuori and Anselmi Immonen, “Product Lifecycle Management”, Springer Publisher, 2011 (3rd Edition)
2. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.
3. John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, 2nd Edition, 2015, Springer.
4. John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, Springer Publisher, 3rd Edition, 2020, Springer.
5. Michael Grieves, “Product Life Cycle Management”, Tata McGraw Hill, 2nd Edition, 2019.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	3	2	-	-	2	2	-	-	2	1	1
CO2	2	2	3	2	-	-	2	2	-	-	2	2	2
CO3	2	2	3	2	-	-	2	2	-	-	2	3	2
CO4	2	2	3	2	-	-	2	2	-	-	2	2	2
CO5	2	2	3	2	-	-	2	2	-	-	2	1	2
AVG.	**2**	**2**	**3**	**2**	**-**	**-**	**2**	**2**	**-**	**-**	**2**	**1.8**	**1.8**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL II
B.E. MECHANICAL ENGINEERING

ME24P10	ERGONOMICS IN DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce industrial design concepts based on ergonomics.
- To understand the role of ergonomics in manufacturing processes.
- To apply ergonomic principles in the design of controls and displays.
- To incorporate environmental factors into ergonomic design.
- To develop aesthetic features suitable for manufacturing and product design.

UNIT-I INTRODUCTION TO INDUSTRIAL DESIGN 9

An approach to industrial design, Elements of design structure for industrial design - Ergonomics and Industrial Design: Introduction to Ergonomics, Communication system, man-machine relationship, Human and Machine component of work system. Concept of Digital ergonomics and virtual work environments.

UNIT-II ERGONOMICS AND PRODUCTION 9

Introduction, Anthropometric data and its applications, working postures, Workstation and Chair Design. Visual Effects of Line and Form: The mechanics and Psychology of seeing, Figure on ground effect, Gestalt's perceptions - Simplicity, Regularity. Digital Human Modelling and Virtual Ergonomic Simulation.

UNIT-III DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS 9

Displays: Design Principles of visual Displays, Quantitative, Qualitative and Representative displays, Situational awareness, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple display Controls: Controls with little efforts and muscular Design of controls.

UNIT-IV COLOUR PSYCHOLOGY AND VISUAL ENVIRONMENT IN DESIGN 9

Colour: Colour and light, Colour and objects, Colour and the eye – after Image, Colour blindness, Colour constancy, Colour terms – Colour circles, Munsel colour notation, reactions to colour and colour combination –colour on engineering equipments, Colour coding, psychological effects, colour and machine form.

UNIT-V AESTHETIC CONCEPTS 9

Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout software's, total layout design.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Recognize the importance of ergonomics in industrial design.
CO2 : Utilize ergonomic principles in developing manufacturing systems.
CO3 : Explain the design aspects of controls and displays.
CO4 : Evaluate environmental considerations in ergonomic design.
CO5 : Analyze the significance of aesthetics in manufacturing systems and products.

TEXT BOOKS:

1. Ergonomics in Design: Methods and Techniques (Human Factors and Ergonomics) by Marcelo M. Soares, Francisco Rebelo
2. Ergonomics Principles in Design: An Illustrated Fundamental Approach by Prabir Mukhopadhyay, published in 2022.

REFERENCE BOOKS:

1. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., 13thEdition, 2013, McGraw-Hill Education.
2. Brain Shakel,"Applied Ergonomics Hand Book", Butterworth Scientific London 1988.
3. Bridger, R.C., Introduction to Ergonomics, 3rd Edition, 2008, CRC Press (Taylor & Francis Group)
4. Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006
5. Mayall W.H. "Industrial design for Engineers", London Hiffee books Ltd., 1988.

WEB RESOURCES:

1. https://nptel.ac.in/courses/107103004
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg130

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	3	-	2	-	3	2	-	-	2	2	-
CO2	2	3	3	2	2	-	3	2	-	-	2	1	2
CO3	2	3	3	2	2	-	3	2	-	-	2	2	3
CO4	2	3	3	2	2	-	3	2	-	-	2	2	2
CO5	2	3	3	-	2	-	3	2	-	-	1	2	1
AVG.	**2**	**3**	**3**	**2**	**2**	**-**	**3**	**2**	**-**	**-**	**1.8**	**1.8**	**2**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL II
B.E. MECHANICAL ENGINEERING

ME24P11	VALUE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the principles, importance, advantages, and applications of value engineering.
- To apply appropriate value engineering methodologies to engineering projects.
- To explain the phases involved in the value engineering process.
- To develop and use decision-making tools and cost evaluation models in product development.
- To analyse value engineering practices in maintenance, repair, manufacturing, and marketing operations.

UNIT – I INTRODUCTION AND CONCEPTS OF VALUE ENGINEERING 10

Definition of Value Engineering and Value Analysis Vs Value Engineering - Types of Value Function - Basic and Secondary Functions - Value Engineering Concepts – Advantages – Applications - Problem Recognition - and Role in Productivity - Criteria for Comparison.

UNIT – II METHODOLOGY AND PHASES 10

Value Engineering Tool – Aspects of Value Engineering -Ten Principles of Value Analysis - Benefits of Value Engineering – Approach of Function – Evaluation of Function – Determining and Classifying Function - Evaluation of Costs Evaluation of Value Engineering.

UNIT – III VALUE ENGINEERING TECHNIQUES 9

Introduction – Orientation - Information Phase - Speculation Phase Creativity - Brain Storming - Gordon Technique - Make or Buy Decisions – Function cost worth analysis (FCWA) - Function Analysis System technique (FAST) - Break Even Analysis - Life cycle cost (LCC).

UNIT-IV ANALYSIS OF MANUFACTURING AND MARKETING 9

Cost Analysis - Idea Listing and Comparison Feasibility Ranking - Financial Aspects Audit Case Studies and Discussion - Value Engineering Operation in Maintenance and Repair Activities - Value Engineering in Non-Hardware Projects - Training Plan.

UNIT – V CASE STUDIES 7

Value Engineering Team - Co-coordinator – Designer - Different Services – Definitions - Construction Management Contracts - Value Engineering Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Understand the importance of the engineering process and value engineering concepts, including their advantages and applications.
CO2 : Apply suitable value engineering methods to different projects.
CO3 : Explain the phases of value engineering.
CO4 : Develop decision-making and cost evaluation models and use them in product development.
CO5 : Analyse value engineering in maintenance, repair, manufacturing, and marketing activities.

TEXTBOOKS:

1. Iyer. S.S., “Value Engineering”, New Age International (P) Limited, 9th Edition, 2009 3Ed”, 2009.

2. Anil Kumar. and Mukhopadhyaya., “Value Engineering: Concepts Techniques and applications”, SAGE Publications, 1st Edition, 2003.

REFERENCE BOOKS:

1. Del L. Younker., “Value Engineering: analysis and methodology”, CRC Press, 2003.
2. Richard Park., “Value Engineering A Plan for Invention”, CRC Press, 1998.
3. Arthur E. Mudge., “Value Engineering: A systematic approach", McGraw Hill, 1989.
4. Alphonse Dell'Isola., “Value Engineering: Practical Applications...for Design, Construction, Maintenance and Operations”, R.S. Means Company, 1997.
5. Lawrence D. Miles., “Techniques of Value Analysis and Engineering”, Lawrence D. Miles Value Foundation, 3rd Edition, 2015.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	2	-	-	-	-	-	-	-	-	3	3
CO3	2	2	-	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3
CO5	2	3	2	-	-	-	-	-	-	3	3	3	2
AVG.	**2.40**	**2.75**	**2.33**	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2.75**	**2.5**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL II
B.E. MECHANICAL ENGINEERING

ME24P12	PRECISION MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand fundamentals and need for precision engineering.
- To learn conventional and advanced micro- and nano-machining techniques.
- To design precision machines and select ultra-precision machine elements.
- To analyze mechanical and thermal errors in machines.
- To apply measurement and characterization techniques for precision features.

UNIT-I INTRODUCTION TO PRECISION ENGINEERING 8

Concepts of Precision Engineering; Need for precision manufacturing; Taniguchi diagram; Four classes of achievable machining accuracy – Normal, Precision, High-precision, Ultra-precision – Introduction to Nanotechnology

UNIT-II PRECISION MACHINING 9

Ultra-precision diamond turning; non-conventional micromachining techniques – Abrasive jet and water jet micromachining, Ultrasonic micromachining, Micro EDM, Photochemical machining, Electrochemical micromachining.

UNIT-III MACHINE DESIGN FOR PRECISION MANUFACTURING 9

Philosophy of precision machine design; Ultra-precision machine elements – Guideways, Drive systems Bearings – Principles, construction, applications of Rolling, Hydrodynamic, Hydrostatic, Aerostatic, Magnetic bearings

UNIT-IV MECHANICAL AND THERMAL ERRORS 9

Sources of errors; Principles of measurement; Errors due to machine elements, bearings, spindles, kinematic design, structural compliance; Vibration effects; Thermal errors – background, thermal effects, environmental control.

UNIT-V MEASUREMENT AND CHARACTERISATION 10

Laser tracking systems, Laser scanners, White-light interference 3D microscopes, Focus-based optical metrology Measurement of nano features; Surface metrology – 3D surface topography– Scanning electron Microscopes, Scanning probe microscopes.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1 : Understand fundamentals of precision engineering and machining processes.

CO2 : Analyze and apply various micro- and nano-machining techniques.

CO3 : Design precision machines and select appropriate machine elements and bearings.

CO4 : Identify and minimize mechanical and thermal errors in precision machinery.

CO5 : Apply modern measurement and characterization techniques for precision components and surfaces.

TEXT BOOKS:

1. Jain, V. K., Introduction to micromachining, Narosa publishers, 2018.
2. Venktesh V.C., SudinIzman, Precision Engineering, Tata McGraw Hill Publishing Company, New Delhi 2008.

REFERENCE BOOKS:

1. David Dornfeld, Dae-Eun Lee, Precision Manufacturing, Springer, 2008.
2. Jain, V.K., Micro manufacturing Processes, CRC Press, 2012.
3. Joseph McGeough, Micromachining of Engineered Materials, Marcel Dekker Inc., 2002.
4. Kevin Harding, "Handbook of Optical Dimensional Metrology, Series: Series in Optics and optoelectronics", Taylor & Francis, 2013.
5. Murty, R.L., Precision Engineering in Manufacturing, New Age publishers, 2005.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	3	-
CO2	3	2	2	2	-	-	-	-	-	-	-	2	2
CO3	3	2	2	2	2	-	-	-	-	-	-	3	2
CO4	2	2	2	2	-	-	-	-	-	-	-	2	-
CO5	3	2	2	2	2	-	-	-	-	-	-	3	2
AVG.	**2.80**	**2.00**	**2.00**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2.60**	**2**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL III
B.E. MECHANICAL ENGINEERING

ME24P13	ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn about basics of robots and their classifications
- To understand the robot kinematics in various planar mechanisms
- To learn about the concepts in robot dynamics
- To understand the concepts in trajectory planning and programming
- To know about the various applications of robots

UNIT-I BASICS OF ROBOTICS 9

Introduction- Basic components of robot-Laws of robotics- classification of robot- robot architecture, work space-accuracy-resolution –repeatability of robot.

UNIT-II ROBOT KINMEATICS 9

Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- D-H, forward & inverse kinematics of 2DOF and 3 DOF planar and spatial mechanisms

UNIT-III ROBOT DYNAMICS 9

Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation

UNIT-IV TRAJECTORY, PATH PLANNING AND PROGRAMMING 9

Trajectory Planning- Joint space and Cartesian space technique, Introduction to robot control, Robot programming and Languages- Introduction to ROS

UNIT-V ROBOT AND ROBOT APPLICATIONS 9

Sensors and Actuators for Robots, Power transmission systems, Rotary to rotary motion, Rotary to linear motion. Robot end effectors & Grippers: Introduction- types & classification- Mechanical gripper- gripper force analysis- other types & special purpose grippers. Robot Applications: pick and place, manufacturing, automotive, medical, space and underwater.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : State the basic concepts and terminologies of robots

CO2 : Know the Procedures for Forward and Inverse Kinematics, Dynamics for Various Robots

CO3 : Derive the Forward and Inverse Kinematics, Dynamics for Various Robots

CO4 : Apply the various programming techniques in industrial applications

CO5 : Analyze the use of various types of robots in different applications

TEXT BOOKS:

1. John J. Craig, Introduction to Robotics: Mechanics and Control, 4th Edition, Pearson Education, 2022. ISBN: 9780137848744.
2. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill Education, Reprint Edition, 2017. ISBN: 9780070226258.

REFERENCE BOOKS:

1. M. P. Groover, M. Weiss, R. N. Nagal, N. G. Odrey, "Industrial Robotics - Technology, programming and Applications" Tata, McGraw-Hill Education Pvt Limited 2nd Edition, 2012
2. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, 2nd Edition, 2010
3. S K Saha, Introduction to Robotics, Tata McGraw-Hill, ISBN: 9789332902800, Second Edition.

4. Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, 2009.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	-	-	-	-	-	2	2	1	3
CO2	3	2	3	2	2	-	-	-	-	-	2	2	2	3
CO3	3	2	3	2	2	-	-	-	-	-	2	2	2	3
CO4	3	2	3	2	2	-	-	-	-	-	2	2	2	3
CO5	3	2	3	1	2	-	-	-	-	-	2	2	2	3
AVG.	**3**	**2**	**3**	**1.8**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1.8**	**3**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL III
B.E. MECHANICAL ENGINEERING

ME24P14	ROBOTS AND SYSTEMS IN SMART MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop practical knowledge of industrial robots and their load-handling capacities.
- To identify and evaluate diverse applications of robotics across manufacturing, assembly, inspection, and service operations.
- to gain familiarity with material handling systems integrated with robotics, emphasizing efficiency, automation, and ergonomic design.
- To acquire foundational knowledge of robotic welding processes, including setup, programming, and quality assurance techniques.
- To understand and differentiate various types of robotic welding operations, enhancing competence in selecting appropriate methods for industrial scenarios.

UNIT-I INTRODUCTION 6

Types of industrial robots - Load handling capacity - general considerations in Robotic material handling-material transfer - machine loading and unloading - CNC machine tool loading - Robot centered cell.

UNIT-II SELECTION OF ROBOTS AND OTHER APPLICATIONS 9

Factors influencing the choice of a robot - robot performance testing - economics of robotisation - Impact of robot on industry and society. Application of Robots in continuous arc welding - Spot welding - Spray painting - assembly operation - cleaning - robot for underwater applications.

UNIT-III MATERIAL HANDLING 11

Concepts of material handling - principles and considerations in material handling systems design - conventional material handling systems - advanced material handling systems - automated guided vehicle systems - automated storage and retrieval systems - bar code technology - radio frequency identification technology.

UNIT-IV ROBOTIC WELDING 10

Robotic welding system, Programmable and flexible control facility –Introduction-Types- Flex Pendant-Lead through programming, Operating mode of robot, Jogging-Types, programming for robotic welding, Welding simulation, Welding sequences, Profile welding.

UNIT-V APPLICATIONS OF ROBOTS IN WELDING AND ALLIED PROCESSES 9

Basics of Mechatronics Engineering Systems: Drone actuation and Control -Autonomous Robot - Automotive Mechatronics: Electronic Ignition System - ABS - EBD. IoT case studies: Remote Monitoring Systems- Centralized Water Management System - IoT Enabled Robotic Camera Dolly.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Recognize key concepts of industrial robots.
CO2 : Select suitable manufacturing procedures for robot development.
CO3 : Apply manufacturing processes in robot production.
CO4 : Understand robotic welding operations and programming.
CO5 : Design a manufacturing plan for robot development.

TEXTBOOKS:

1. Mikell P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", Wiley; 7th edition copyright 2020.
2. Brahmananda Panda and collaborators., "Technologies of Robotic Welding", Springer Nature, 2024.

REFERENCE BOOKS:

1. John J. Craig, "Introduction to Robotics: Mechanics and Control", 4th Edition, Pearson, 2022.
2. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 5th Edition, Pearson, 2023.
3. Tzyh-Jong Tarn, Robotic Welding, Intelligence and Automation, Springer, Reprint, 2021.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	2	-	-	-	-	-	2	3	1
CO2	3	3	2	1	2	-	-	-	-	1	2	2	2
CO3	3	3	3	2	3	-	-	-	-	1	2	3	2
CO4	2	3	2	2	3	-	-	-	-	1	2	2	3
CO5	3	3	3	2	3	-	-	-	-	2	3	3	3
AVG.	**2.80**	**2.80**	**2.40**	**1.6**	**2.60**	-	-	-	-	**1.00**	**2.20**	**2.60**	**2.20**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL III
B.E. MECHANICAL ENGINEERING

ME24P15	SMART MOBILITY AND INTELLIGENT VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of smart mobility and intelligent vehicle technologies.
- To learn the working principles of automotive sensors such as Radar, Ultrasonic, LiDAR, and cameras.
- To study control system and cyber-physical systems used in connected and autonomous vehicles.
- To understand wireless communication, IoT, and networking technologies for vehicle connectivity.
- To analyze connected car and autonomous vehicle technologies, including their applications, challenges, and security issues.

UNIT-I INTRODUCTION TO AUTOMATED, CONNECTED, AND VEHICLES 9

Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles

UNIT-II SENSOR TECHNOLOGY FOR SMART MOBILITY 9

Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems

UNIT-III CONNECTED AUTONOMOUS VEHICLE 9

Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy

UNIT-IV VEHICLE WIRELESS TECHNOLOGY & NETWORKING 9

Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts– Demodulation/Decoding, Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks

UNIT-V CONNECTED CAR & AUTONOMOUS VEHICLE TECHNOLOGY 9

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles – Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Explain the fundamentals of smart mobility and intelligent vehicle systems.

CO2 : Identify and select appropriate sensors used in intelligent and autonomous vehicles.

CO3 : Apply control system and cyber-physical system concepts to connected autonomous vehicles.

CO4 : Apply wireless communication and networking in vehicle systems.

CO5 : Analyze connected car and autonomous vehicle technologies, including V2V, V2I, and security challenges.

TEXT BOOKS:

1. Marco A. Perković, W. Liu (eds.) “Intelligent Vehicles & Autonomous Driving”, Springer Edition: 2021 Edition

REFERENCE BOOKS:

1. Paul P. F. M. Van Den Bosch “Automotive Sensors & Perception Systems”, Elsevier Edition:2021 Reprint.
2. Rajkumar Rajamani, Chris J. Tomlin “Autonomous Vehicle Control Systems”, Springer Edition: 2022 Edition.
3. Honbo Zhou “IoT and Smart Mobility Publisher: Wiley Edition: 2021 Edition

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	2	-	-	-	-	-	-	3	2
CO2	3	2	2	-	3	-	-	-	-	-	-	3	3
CO3	3	2	2	-	3	-	-	-	-	-	-	3	3
CO4	3	2	2	-	3	-	-	-	-	-	-	2	3
CO5	3	2	2	-	3	-	-	-	-	-	-	3	3
AVG.	**3**	**2**	**2**	-	**2.8**	-	-	-	-	-	-	**2.8**	**2.8**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL III
B.E. MECHANICAL ENGINEERING

ME24P16	MODERN ROBOTICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

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

UNIT-I INTRODUCTION 6

Robot definition, history and evolution of robotics, robot anatomy, coordinate systems, robot classification, configuration space and degrees of freedom, task space and workspace, rigid body motions, rotation matrices, homogeneous transformation matrices.

UNIT-II SIMULATION OF ROBOT KINEMATICS 6

Robot kinematics, forward and inverse kinematics of planar manipulators (2–4 DOF), homogeneous transformations, translation and rotation matrices, Denavit-Hartenberg (D-H) parameters, basic robot dynamics, trajectory generation, motion planning, introduction to robot control and stability.

UNIT-III GRASPING AND MANIPULATION OF ROBOTS 6

Contact kinematics, contact types (rolling, sliding and breaking), grasping concepts, form closure and force closure, friction and friction cones, end effectors, grippers and their classifications, gripper force analysis, robot manipulation applications.

UNIT-IV MOBILE ROBOTS 6

Introduction to mobile robots, wheeled mobile robots, kinematic models of omnidirectional and non-holonomic robots, motion planning, feedback control, odometry, mobile manipulation, reference trajectory generation.

UNIT-V APPLICATIONS OF ROBOTS 6

Industrial robots, service robots, domestic robots, medical robots, agricultural robots, military robots, space and aerial robots, applications in inspection, assembly, material handling, healthcare and underwater operations.

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS

1. 3D modeling and motion simulation of rotational joint assembly
2. 3D modeling and motion simulation of prismatic joint assembly
3. 3D modeling and motion simulation of Cartesian robot
4. 3D modeling and motion simulation of articulated robot
5. 3D modeling and motion simulation of spherical robot
6. 3D modeling and motion simulation of cylindrical robot

TOTAL: 30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1 : Discuss the definition, history of robotics and robot anatomy.

CO2 : Develop the simulation of robot kinematics

CO3 : Describe the grasping and manipulation of robots.

CO4 : Explain about mobile robot and manipulation.

CO5 : Discuss the applications of industrial, service, domestic robots.

TEXT BOOKS:

1. Kevin M. Lynch and Frank C. Park, Modern Robotics: Mechanics, Planning, and Control, Cambridge University Press, 1st Edition, Reprinted Edition, 2023. ISBN: 9781107156302.
2. Mark W. Spong, Seth Hutchinson and M. Vidyasagar, Robot Modeling and Control, 2nd Edition, Wiley, 2020. ISBN: 9781119523994.

REFERENCE BOOKS:

1. Jared Kroff, Modern Robotics: Designs, Systems and Control, Willford Press, 2019. ISBN: 9781682856765.
2. Chenguang Yang, Hongbin Ma and Mengyin Fu, Advanced Technologies in Modern Robotic Applications, Springer, Softcover Reprint Edition, 2018. ISBN: 9789811092633.
3. Harry Henderson, Modern Robotics: Building Versatile Machines, Facts On File Inc., Illustrated Edition, 2006. ISBN: 9780816057450.
4. Francis X. Govers, Artificial Intelligence for Robotics, Packt Publishing, 2018. ISBN: 9781788835442.
5. Lauren Barrett (Ed.), Modern Robotics, Murphy & Moore Publishing, 2022. ISBN: 9781639873739.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	3	-	2	-	-	2	-	-	2	-	2
CO2	2	1	3	-	2	-	-	2	-	-	2	-	2
CO3	2	1	3	-	2	-	-	2	-	-	2	-	2
CO4	2	1	3	-	2	-	-	2	-	-	2	-	2
CO5	2	1	3	-	2	-	-	2	-	-	2	-	2
AVG.	**2**	**1**	**3**	**-**	**2**	**-**	**-**	**2**	**-**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL III
B.E. MECHANICAL ENGINEERING

MR24P17	EMBEDDED SYSTEMS AND PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of embedded systems and embedded processors.
- To learn Embedded C programming concepts for hardware interfacing.
- To study real time operating system concepts and scheduling techniques.
- To understand interfacing and communication protocols used in embedded applications.
- To design and develop embedded and IoT based real-time systems.

UNIT-I EMBEDDED SYSTEMS FUNDAMENTALS 9

Introduction to Embedded Systems – Characteristics and Applications – Embedded System Design Process – Embedded Processors and Microcontrollers – 8051/ARM Architecture – Memory Organization – I/O Ports – Timers and Counters – Interrupts – Serial Communication.

UNIT-II EMBEDDED C PROGRAMMING 9

Embedded C Basics – Data Types – Operators – Control Structures – Functions – Arrays and Pointers – Bitwise Operations – Register Level Programming – Port Programming – Timer Programming – Interrupt Programming – Serial Communication Programming.

UNIT-III REAL TIME OPERATING SYSTEMS 9

Introduction to RTOS – Need for RTOS – Tasks and Processes – Task Scheduling – Context Switching – Inter Process Communication – Semaphores – Mutex – Deadlock – Priority Based Scheduling – Real Time Constraints.

UNIT-IV INTERFACING AND COMMUNICATION PROTOCOLS 9

Sensors and Actuators – ADC and DAC Interfacing – UART Communication – SPI Protocol – I2C Protocol – CAN Protocol – Wireless Communication Basics – Bluetooth – Wi-Fi – ZigBee – Embedded Networking Concepts.

UNIT-V EMBEDDED APPLICATIONS AND IoT 9

Introduction to IoT – Arduino Architecture – Raspberry Pi Architecture – Sensor Interfacing – Embedded Application Development – Smart Home Systems – Smart Agriculture – Healthcare Applications – Industrial Automation – Embedded System Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Explain embedded system architecture and processor organization.
CO2 : Develop Embedded C programs for hardware interfacing applications.
CO3 : Apply RTOS concepts for real-time embedded applications.
CO4 : Interface communication protocols and peripheral devices effectively.
CO5 : Design embedded and IoT based real-time applications.

TEXT BOOKS:

1. Raj Kamal, Embedded Systems – Architecture, Programming and Design, Tata McGraw Hill, 2017.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education, 2015.

REFERENCE BOOKS:

1. Frank Vahid and Tony Givargis, Embedded System Design – A Unified Hardware/Software Introduction, Wiley India, 2014.

2. Jonathan W. Valvano, Embedded Microcomputer Systems – Real Time Interfacing, Cengage Learning, 2015.
3. Shibu K.V., Introduction to Embedded Systems, McGraw Hill Education, 2016.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	-	-	2	2	2
CO2	3	3	3	2	2	-	-	-	-	-	2	2	2
CO3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO4	3	3	2	3	-	-	-	-	-	-	2	2	2
CO5	3	2	2	2	-	-	-	-	-	-	2	2	2
AVG.	**3**	**2.8**	**2.4**	**2.4**	**2**	-	-	-	-	-	**2**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL III
B.E. MECHANICAL ENGINEERING

ME24P18	SENSORS AND ACTUATORS FOR ROBOTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of sensors and actuators used in robotic systems.
- To learn the principles of sensing, signal processing, and actuator control.
- To analyze the selection and integration of sensors and actuators for robotic applications.
- To develop knowledge of intelligent sensing and actuation in autonomous systems.
- To apply sensors and actuators in industrial and service robotics.

UNIT I INTRODUCTION TO ROBOTICS AND SENSORS 9

Introduction to robotic systems, components of robots, classification of sensors, sensor characteristics, static and dynamic performance, signal conditioning, sensor interfacing.

UNIT II POSITION AND MOTION SENSORS 9

Position, displacement, velocity and acceleration sensors, encoders, resolvers, proximity sensors, inertial sensors, gyroscopes, accelerometers, applications in robot navigation and control.

UNIT III FORCE, VISION AND INTELLIGENT SENSORS 9

Force and torque sensors, tactile sensors, machine vision systems, image sensors, smart sensors, sensor fusion concepts, robotic perception.

UNIT IV ACTUATORS FOR ROBOTIC SYSTEMS 9

Principles of actuators, electric actuators (DC, AC and servo motors), stepper motors, pneumatic and hydraulic actuators, actuator selection and performance characteristics.

UNIT V SENSOR–ACTUATOR INTEGRATION IN ROBOTICS 9

Sensor-actuator interfacing, feedback control systems, robot motion control, autonomous robotic systems, industrial and service robot applications, emerging trends in robotic sensing and actuation.

TOTAL :45 PERIODS

COURSE OUTCOMES:

CO1 : Explain the fundamentals of sensors and actuators used in robotic systems.
CO2 : Identify and select appropriate sensors for robotic measurement and control applications.
CO3 : Analyze the operation of force, vision, and intelligent sensing systems in robotics.
CO4 : Evaluate the performance and suitability of various actuators for robotic applications.
CO5 : Apply sensor–actuator integration concepts in the design and control of robotic systems.

TEXT BOOKS:

1. Industrial Robotics: Technology Programming and Applications, 2nd Edn, Mikell P Groover, Tata McGraw Hill Education Private Limited, 2012.

REFERENCES:

1. Robotics, Vision and Control, Springer, 2023.
2. Modern Robotics: Mechanics, Planning, and Control, Cambridge University Press, 2017.
3. Introduction to Autonomous Mobile Robots, MIT Press, 2011.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	2	3	3	-	2	-	-	-	-	-	-	2	2
CO3	2	2	3	-	2	-	-	-	-	-	-	3	2
CO4	2	3	3	-	2	-	-	-	-	-	-	3	3
CO5	-	2	3	-		-	-	-	-	-	-	3	3
AVG	**2**	**2.4**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2.6**	**2.5**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL IV
B.E. MECHANICAL ENGINEERING

ME24P19	DIGITAL MANUFACTURING AND IOT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To study the various aspects of digital manufacturing.
- To highlight the importance of Disaster Management in Product Life cycle Management and Supply Chain Management.
- To formulate smart manufacturing systems in the digital work environment.
- To Applying IoT concepts to enable digital manufacturing.
- To Understanding the role of Digital Twin technology

UNIT-I INTRODUCTION 9

Introduction, Need and Evolution of Digital Manufacturing – Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management – Practical Benefits of Digital Manufacturing – Emerging Trends in Digital Manufacturing.

UNIT-II DIGITAL PRODUCT LIFE CYCLE AND SUPPLY CHAIN MANAGEMENT 9

Collaborative Design and Requirements Engineering Process – Part Numbering, Engineering Vaulting, and Product reuse – Engineering Change Management, Bill of Material and Process Consistency – Digital Mockup and Prototype development – Virtual testing and collateral. Digital Transformation in Supply Chain Systems

UNIT-III SMART FACTORY 9

Intelligent Manufacturing Systems – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT- Key Principles of a Smart Factory – Implementation of Smart Factory Systems – Smart Factories and Cybersecurity

UNIT-IV DIGITAL INDUSTRIAL TRANSFORMATION 9

Introduction –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

Principles and Fundamentals – Features and Implementation – Digital Twin: Digital Thread and Digital Shadow- Building Blocks – Types – Characteristics of a Good Digital Twin Platform – Benefits, Impact & Challenges – Emerging Future of Digital Twin Applications

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR).

CO2 : Understanding Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction.

CO3 : To develop disaster response skills by adopting relevant tools and technology.

CO4 : Discuss awareness of institutional processes for Disaster response in the country.

CO5 : Developing Awareness and Response Skills for Local Disasters

TEXT BOOKS:

1. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.

2. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, A press, 2016.

REFERENCE BOOKS:

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

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	3	3	2	2	2	2	2	3	3
CO2	3	-	3	2	3	2	2	2	2	2	2	3	2
CO3	3	2	3	2	3	2	-	3	2	2	2	2	2
CO4	3	-	2	2	3	2	2	2	2	-	2	3	2
CO5	3	3	2	-	3	3	2	2	2	2	2	3	3
AVG.	**3.00**	**2.33**	**2.40**	**2.00**	**3.00**	**2.40**	**2.00**	**2.20**	**2.00**	**2.00**	**2.00**	**2.80**	**2.40**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL IV
B.E. MECHANICAL ENGINEERING

ME24P20	SURFACE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the fundamentals of surface features and different types of friction associated with metals
- and non-metals.
- To study the different types of wear mechanism and its standard measurement.
- To study the different types of corrosion and its preventive measures.
- To study the different types of surface properties and surface modification techniques.
- To study the various types of materials used in the friction and wear applications.

UNIT I SURFACES AND FRICTION 9

Basics of surfaces features – Roughness parameters – surface measurement - Cause of friction- Laws of friction – Static friction – Rolling Friction – Stick-slip Phenomenon - Friction properties of metal and nonmetals – Friction in extreme conditions – Thermal considerations in sliding contact.

UNIT II WEAR 9

Laws of Wear - Types of Wear mechanism – wear debris analysis - Theoretical wear models - Wear of metals and nonmetals – International standards in friction and wear measurements.

UNIT III CORROSION 9

Introduction – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors.

UNIT IV URFACE TREATMENTS 9

Surface properties – Hydrophobic – Super hydrophobic – Hydrophilic - surface metallurgy –Surface coating Techniques – PVD – CVD – Physical CVD – Ion implantation – Thermal spraying –Laser surface hardening and alloying - new trends in coating technology – Thick coatings – Nano engineered coatings.

UNIT V ENGINEERING MATERIALS 9

Introduction – High and low friction materials - Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Bio Tribology - Nano Tribology.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Describe the fundamentals of surface features and different types of friction associated with metals and non-metals

CO2 : Analyze the different types of wear mechanism and its standard measurement.

CO3 : Analyze the different types of corrosion and its preventive measures

CO4 : Analyze the different types of surface properties and surface modification techniques

CO5 : Analyze the various types of materials used in the friction and wear applications.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	3	-
CO4	2	2	2	-	-	-	-	-	-	-	-	2	-
CO5	3	2	2	-	-	-	-	-	-	-	-	3	-
AVG.	**2.80**	**2.00**	**2.00**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.60**	**-**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL IV
B.E. MECHANICAL ENGINEERING

ME24P21	GREEN MANUFACTURING DESIGN AND PRACTICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts of green manufacturing and sustainable engineering practices.
- To develop knowledge of eco-friendly materials and cleaner production techniques.
- To impart understanding of sustainable product design and life cycle assessment.
- To study energy conservation, waste management, and pollution control methods.
- To familiarize students with green manufacturing standards, auditing, and industrial practices.

UNIT-I INTRODUCTION TO GREEN MANUFACTURING 9

Concepts of green manufacturing and sustainable development – Industrial ecology – Environmental impacts of manufacturing – Life cycle assessment (LCA) – Green engineering principles – Design for recycle.

UNIT II – GREEN MATERIALS AND ECO-FRIENDLY PROCESSES 9

Selection of eco-friendly materials – Recyclable and biodegradable materials – Cleaner production techniques – Waste minimization – Energy and efficient manufacturing processes.

UNIT III – SUSTAINABLE PRODUCT DESIGN 9

Design for environment (DFE) – Design for disassembly – Design for recycling and remanufacturing – Product life cycle management and eco-design strategies.

UNIT IV – GREEN ENERGY AND RESOURCE MANAGEMENT 9

Energy conservation in manufacturing – Renewable energy applications – Carbon footprint reduction – Water conservation – Waste management and pollution control techniques.

UNIT V – GREEN MANUFACTURING PRACTICES AND STANDARDS 9

Green supply chain management – Lean and green manufacturing – Environmental management systems – ISO 14001 standards – Green auditing and industrial case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Explain the principles of green manufacturing and sustainable development.
CO2 : Analyze eco-friendly materials and cleaner manufacturing processes.
CO3 : Apply sustainable product design concepts and life cycle assessment techniques.
CO4 : Evaluate energy conservation, waste management, and pollution control methods in industries.
CO5 : Implement green manufacturing practices, standards, and environmental management systems.

TEXTBOOKS:

1. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
2. Dornfeld, David A., ed. Green manufacturing: fundamentals and applications. Springer Science& Business Media, 2012.

REFERENCE BOOKS:

1. David R. Hillis and J. Barry DuVall, Improving profitability through green manufacturing: Creating a profitable and environmentally compliant manufacturing facility, Wiley, 2012
2. Rob Thompson and Martin Thompson, Sustainable Materials, Processes and Production, Thames and Hudson, 2013.
3. Rao M.N. and Dutta A.K. “Wastewater treatment”, Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006

4. Rao CS Environmental Pollution Control Engineering-, Wiley Eastern Ltd., New Delhi, 2006.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	3	-	-	-	-	2	3
CO2	3	3	2	-	-	2	3	-	-	-	-	3	3
CO3	3	3	3	2	-	2	3	-	-	-	-	3	3
CO4	2	3	2	2	-	3	3	-	-	-	-	2	3
CO5	2	2	3	-	-	3	3	-	-	-	-	2	3
AVG.	2.80	2.80	2.50	2	-	2.5	3	-	-	-	-	2.40	3

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL IV
B.E. MECHANICAL ENGINEERING

ME24P22	ENERGY SAVING MACHINERY AND COMPONENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the various energy saving machineries and components to the students for the purpose of conserving energy.
- To study the basics and principles of transforms, Pumps and motors.
- To impart the knowledge about the methods of energy conservation.
- To introduce the energy efficiency devices and concepts of ENCON.
- To impart the knowledge about CO2 mitigation.

UNIT – I BASICS OF ELECTRICAL ENERGY UTILIZATION 9

Fuel to Power Conversion and Cascade Efficiency - Electricity Billing and kVA Demand - Time of Day (TOD) Tariff - Power Factor: Basics and Correction - Introduction to Demand Side Management (DSM) Energy Monitoring and Measurement.

UNIT – II TRANSFORMERS AND MOTORS 9

Transformer Basics, Types, and Selection- AVR and OLTC Concepts - Energy-Efficient Transformers - Motor Specifications, Selection, and Efficiency - Assessment of Motor Performance under Operating Conditions - Energy-Efficient Motors and ENCON - Transmission Line Parameters and Losses

UNIT – III FANS, PUMPS AND COMPRESSORS 9

Basics – Selection – Performance Evaluation – Cause for inefficient operation – scope for energy conservation – methods adopted for effecting ENCON – Economics of ENCON adoption.

UNIT – IV STUDY OF ILLUMINATION AND ENERGY EFFICIENT DEVICES 9

Specification of luminaries - Types - Efficacy - Selection and Application - ENCON Avenues and Economic Proposition - New Generation Luminaries (LED - Induction Lighting) - Soft Starters- Auto Star - Delta - Star Starters- APFC - Variable Speed and Frequency Drives - Time Sensors - Occupancy Sensors.

UNIT – V ENERGY CONSERVATION, CO2 MITIGATION AND CASE STUDIES 9

Introduction to Energy Conservation Practices in Industries- CO_2 Emission Reduction and Mitigation Techniques - Basics of the PAT (Perform, Achieve and Trade) Scheme - Industrial Energy Audit Methodology - Case Studies on Energy Conservation in Mechanical Industries

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain energy-saving machinery and components used in industrial applications.
CO2: Evaluate different methods of energy conservation in engineering systems.
CO3: Analyse the performance and energy efficiency of fans, pumps, and compressors.
CO4: Describe various energy efficiency devices and their applications in systems improvement.
CO5: Explain CO_2 mitigation techniques and analyse associated cost factors in energy systems.

TEXT BOOKS:

1. Energy-Efficient Shutdown of Circuit Components and Computing Systems, by Ehsan Pakbaznia, Proquest, Umi Dissertation Publishing (1 September 2011) ,ISBN-10 : 1243819898
2. Handbook on Energy Efficiency, TERI, New Delhi, 2001

REFERENCES:

1. Hamies, Energy Auditing and Conservation ; Methods Measurements, management and Case Study, Hemisphere, Washington, 1980
2. Trivedi, PR and Jolka KR, Energy Management, Commonwealth Publication, New Delhi, 1997
3. Handbook on Energy Efficiency, TERI, New Delhi, 2001
4. Peters, Kraushaar and Ristenen, Sustainable Energy, beta – test – draft, Energy and Problems of a Technical Society, 1993
5. Guide book for National Certification Examination for Energy Managers and Energy Auditors (www.energymanagertraining.com)
6. Nagrath IJ and Kothari DP, Power system engineering, TMH, 2007.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	2	2	-	-	1	-	1	2	3
CO2	3	3	2	1	2	3	-	-	1	1	2	2	3
CO3	3	3	2	2	3	2	-	-	1	1	1	3	3
CO4	2	2	2	1	3	3	-	-	1	-	1	2	3
CO5	2	3	2	1	1	3	-	-	1	2	2	2	3
AVG.	**2.6**	**2.6**	**1.8**	**1.25**	**2.2**	**2.6**	**-**	**-**	**1**	**1.34**	**1.4**	**2.2**	**3**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL IV
B.E. MECHANICAL ENGINEERING

ME24P23	ENVIRONMENT SUSTAINABILITY AND IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To make the students to understand the concepts of Environmental Sustainability & Impact Assessment.
- To familiarize the students in environmental decision-making procedure.
- Make the students to identify, predict and evaluate the economic, environmental, and social impact of development activities.
- To provide information on the environmental consequences for decision making.
- To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.

UNIT I ENVIRONMENTAL IMPACT ASSESMENT 9

Environmental impact assessment objectives – rationale and historical development of EIA – Conceptual frameworks for EIA Legislative development – European community directive – Hungarian directive.

UNIT II ENVIRONMENTAL DECISION MAKING 9

Strategic environmental assessment and sustainability appraisal – Mitigation, monitoring and management of environmental impacts- Socio economic impact assessment.

UNIT III ENVIRONMENTAL POLICY, PLANNING AND LEGISLATION 9

Regional spatial planning and policy – Cumulative effects assessment – Planning for climate change, uncertainty and risk.

UNIT IV LIFE CYCLE ASSESSMENT 9

Life cycle assessment; Triple bottom line approach; Industrial Ecology. Ecological foot printing, Design for Environment, Future role of LCA, Product stewardship, design, durability and justifiability, measurement techniques and reporting.

UNIT V SUSTAINABLE URBAN ECONOMIC DEVELOPMENT 9

Spatial economics – Knowledge economy and urban regions Case Studies of Sustainable Urban Economic Development.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1 : Explain the concepts of Environment Sustainability and trained to make decision related to Environment.
CO2 : Make decision that has an effect on our environment.
CO3 : Evaluate the basics of environmental policy, planning and various legislation Get valuable information for exploring decisions in each life stage of materials, buildings, services and infrastructure.
CO4 : Explain the Life cycle assessment of Environmental sustainability.
CO5 : Explain sustainable urban economic development.

TEXTBOOKS:

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

REFERENCE BOOKS:

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

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	3	2	-	1	-	1		
CO2	-	-	-	-	1	2	3	2	-	1	-	2		
CO3	-	-	-	-	2	3	3	2	-	1	-	2		
CO4	-	-	-	-	-	3	3	3	-	1	-	2		
CO5	-	-	-	-	1	3	3	3	-	1	-	2		
Avg	**-**	**-**	**-**	**-**	**1.33**	**2.40**	**3.00**	**2.40**	**-**	**1.00**	**-**	**1.80**		

1 – Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL IV
B.E. MECHANICAL ENGINEERING

ME24P24	INDUSTRY 4.0	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the origin, core concepts, and production systems of Industry 4.0.
- To study the structural framework, key components, and supportive technologies of Industry 4.0.
- To learn the development of technology roadmaps, strategic planning phases.
- To explore advanced robotics, cyber-physical systems, and the industrial applications.
- To investigate advanced manufacturing technologies and strategies for implementing smart factories in the context of Industry 4.0.

UNIT I INTRODUCTION 9

Introduction- Core idea of Industry 4.0 - origin - concept of industry 4.0 - Industry 4.0 production system - current state of industry 4.0 – Technologies - How is India preparing for Industry 4.0.

UNIT II A CONCEPTUAL FRAMEWORK 9

Introduction, Main Concepts and Components of Industry 4.0, State of Art, Supportive Technologies, Proposed Framework for Industry 4.0.

UNIT III TECHNOLOGY ROADMAP 9

Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, Strategy Phase, New Product and Process Development Phase.

UNIT IV ADVANCES IN ROBOTICS 9

Introduction, Recent Technological Components of Robots - Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly.

UNIT V ADVANCED MANUFACTURING AND SMART FACTORIES 9

Introduction to Smart Manufacturing, Key Technologies in Smart Factories: Additive Manufacturing (3DPrinting), Autonomous Robots and Drones. Implementation Strategies for Smart Factories-Future Trends and Emerging Technologies in Industry 4.0

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Explain the core concepts of Industry 4.0 and India's readiness for its adoption.
CO2 : Describe the conceptual framework, main components, and supportive technologies.
CO3 : Outline the technology roadmap and strategic phases for product development.
CO4 : Identify advanced robotic technologies, cloud robotics, and their industrial applications.
CO5 : Develop strategies for implementing advanced manufacturing technologies in smart factories

TEXT BOOKS:

1. Alp Ustundag and Emre Cevikcan, Industry 4.0: Managing the Digital Transformation, Springer, 2017.
2. Ortiz, Jesús Hamilton, “Industry 4.0: Current Status and Future Trends”, Intech Open, 2020.

REFERENCE BOOKS:

1. Bartodziej, Christoph Jan, “The Concept Industry 4.0: An Empirical Analysis of Technologies and Applications in Production Logistics”, Springer, 2017.

2. Klaus Schwab,"The Fourth Industrial Revolution", Currency, 2017.
3. Christian Schröder," The Challenges of Industry 4.0 for Small and Medium-sized Enterprises", Friedrich-Ebert-Stiftung, 2017.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	2	-	2	-	-	-	-	-	-	2	2
CO2	2	3	2	-	2	-	-	-	-	-	-	2	2
CO3	2	3	2	-	2	-	-	-	-	-	-	2	2
CO4	2	3	2	-	2	-	-	-	-	-	-	2	2
CO5	2	3	2	-	2	-	-	-	-	-	-	2	2
AVG.	**2**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL V
B.E. MECHANICAL ENGINEERING

ME24P25	BIOENERGY CONVERSION TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To elucidate on biomass, types, availability, and characteristics
- To study the bio-methanation process.
- To impart knowledge on combustion of biofuels.
- To describe on the significance of equivalence ratio on thermochemical conversion of biomass
- To provide insight to the possibilities of producing liquid fuels from biomass.

UNIT-I INTRODUCTION 9

Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies – typical conversion mechanisms - densification technologies

UNIT-II BIOMETHANATION 9

Biomethenation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent-based biogas plants.

UNIT-III COMBUSTION 9

Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion

UNIT-IV GASIFICATION, PYROLYSIS AND CARBONISATION 9

Chemistry of gasification - types – comparison – typical application – performance evaluation economics. Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonisation

UNIT-V LIQUIFIED BIOFUELS 9

Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the characteristics, availability, assessment methods, and conversion mechanisms of biomass resources for sustainable energy applications.

CO2: Apply bio-methanation principles and biogas plant design concepts for energy generation using various biomass feedstocks and industrial effluents.

CO3: Analyze combustion processes, stoichiometric air requirements, equivalence ratio, and combustion systems used for biofuels.

CO4: Analyze the principles, processes, and performance of gasification, pyrolysis, and carbonization techniques for biomass conversion.

CO5: Evaluate the production methods, properties, engine performance, and emission characteristics of liquefied biofuels such as biodiesel, methanol, and ethanol.

TEXTBOOKS:

1. Biomass for Bioenergy and Biomaterials, by Nidhi Adlakha, Rakesh Bhatnagar, Syed Shams Yazdani, CRC Press; 1st edition (22 October 2021), ISBN-10 : 0367745550.

2. Bioenergy and Biochemical Processing Technologies, by Augustine O. Ayeni, Samuel EshorameSanni , Solomon U. Oranusi, Springer (30 June 2022).

REFERENCES:

1. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester,1984.
2. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S
3. Khandelwal KC, Mahdi SS, Biogas Technology – A Practical Handbook, Tata McGraw Hill, 1986
4. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication,1997.
5. Tom B Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation, 1981.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	1	1	3		1	-	2	2	1
CO2	3	3	2	2	2	1	3	1	1	1	2	3	2
CO3	3	3	2	2	2	-	2	-	1	-	2	3	2
CO4	3	3	2	2	2	-	3	-	1	-	2	3	2
CO5	3	3	2	2	2	1	3	-	1	-	2	3	2
Avg.	**3**	**2.8**	**1.8**	**1.8**	**1.8**	**1**	**2.8**	**1**	**1**	**1**	**2**	**2.8**	**1.8**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE – VERTICAL V
B.E. MECHANICAL ENGINEERING

ME24P26	RENEWABLE ENERGY TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand and analyze the pattern of renewable energy resources.
- To understand different solar energy technologies and their practical applications.
- To gain knowledge about various wind energy conversion technologies.
- To examine different bio-energy technologies and their uses.
- To analyze ocean energy and geothermal energy technologies.

UNIT-I NEED FOR RENEWABLE ENERGY 9

Indian energy scenario in various sectors – Present conventional and renewable energy status -Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans-Energy Scenario in Tamil Nadu, India and around the World- Economics of renewable energy systems.

UNIT-II SOLAR ENERGY 9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors– Flat plate and concentrating collectors–Solar thermal applications–Solar thermal energy storage– Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT-III WIND ENERGY 9

Wind data and energy estimation – Betz limit - Site selection for windfarms-Wind resource assessment – Horizontal and Vertical axis wind turbine-Wind turbine generators–Hybrid systems – Environmental issues. Process of electricity generation. Current and Potential Uses - Issues, Challenges, and Obstacles.

UNIT-IV BIOMASS AND BIO ENERGY 9

Bio resources – Biomass direct combustion – thermochemical and biochemical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonization – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications. Recent advancements in Biomass energy production.

UNIT-V OTHER RENEWABLE ENERGY RESOURCES 9

Introduction to Geothermal, Ocean thermal and tidal energies. Working principles of Geothermal, Ocean thermal and tidal power plants. Hydro Energy, Hydrogen Storage - Fuel Cell Systems – Hybrid Systems. Current trends in geothermal, ocean thermal and tidal power technologies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Analyze the Indian and worldwide energy scenario.

CO2 : Illustrate different solar energy technologies and their applications.

CO3 : Examine various wind energy technologies.

CO4 : Explore the various bio-energy technologies.

CO5 : Evaluate ocean energy and geothermal technologies.

TEXT BOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636
2. Rai, G.D. Non-Conventional Energy Sources. 6th ed., Khanna Publishers, New Delhi, 2018.

REFERENCE BOOKS:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012, ISBN: 9780199545339.
2. B.H. Khan, "Non-Conventional Energy Resources", The McGraw Hill companies, 2017. ISBN: 9789352601882.
3. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, reprinted 2020.
4. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 4th Edition,2021.

WEB RESOURCES:

1. https://nptel.ac.in/courses/108/108/108108078/
2. https://nptel.ac.in/courses/112/105/112105050/
3. https://nptel.ac.in/courses/108/105/108105058/
4. https://nptel.ac.in/courses/112/105/112105051/

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	-	1	3	2	2	2	1	3	-	-
CO2	3	2	2	-	2	3	2	2	2	2	3	2	2
CO3	3	2	3	-	2	3	2	2	2	2	3	2	2
CO4	2	2	2	-	2	3	2	2	2	2	3	2	2
CO5	2	1	2	-	2	3	1	2	1	2	3	2	2
AVG.	**2.4**	**1.8**	**2**	**-**	**1.8**	**3**	**1.8**	**2**	**1.8**	**1.8**	**3**	**1.8**	**2**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL V
B.E. MECHANICAL ENGINEERING

ME24P27	CARBON FOOTPRINT ESTIMATION AND REDUCTION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of climate change and the concept of carbon footprints.
- To study product life cycles and the principles of accounting for Greenhouse Gas (GHG) emissions.
- To learn the standard methodologies used to calculate and measure carbon footprints.
- To explore techniques for reducing emissions and utilizing natural or technical carbon sinks.
- To analyze practical case studies of carbon foot printing in action across various industries.

UNIT – I CLIMATE CHANGE AND CARBON FOOTPRINT 9

Green House Effect and Climate Change - Causes and Impacts of Climate Change – Economic implications of Climate Change -IPCC Reports and Projected Climate Change Scenarios – Green House Gas (GHG) Emission – Carbon footprint of Activities, Processes, Products and Services of Organizations – GHG Emission factors and Calculations

UNIT – II PRODUCT LIFE CYCLE AND GHG EMISSIONS 9

Life-cycle GHG Accounting - Principles of Product Life Cycle GHG Accounting and Reporting - Fundamentals of Product Life Cycle GHG Accounting - Establishing the Scope of a Product Inventory- GHG Emission Inventories and Accounting - Collecting Data and Assessing Data Quality- Allocation and Assessing Uncertainty

UNIT – III METHODOLOGICAL ASPECTS OF CARBON FOOTPRINT 9

Methodology for Carbon Footprint Calculation in Crop and Livestock Production, End of Life Scenarios and Carbon Footprint of Wood Cladding, Carbon Footprints and Greenhouse Gas Emission Savings of Alternative Synthetic Biofuels, Making Food Production GHG Efficient, Carbon Footprint of Wood-Based Products and Buildings, Challenges and Merits of Choosing Alternative

UNIT – IV EMISSION MITIGATION AND CARBON SINK 9

Setting GHG Reduction Targets and Tracking Inventory Changes – Non-Fossil Fuel based Energy Systems - Carbon Dioxide capture and Storage Technologies –Mitigation potentials of different Sectors and systems – Innovation, Technology Development and Transfer, - Social aspects of mitigation –Polcies, Institutions and international corporations – Carbon Pricing and Finance –GHG Offsetting and Green marketing.

UNIT – V CASE STUDIES 9

Carbon Footprint Estimation from Building Sector - Urban Carbon Footprint Evaluation - Applications of carbon footprint in urban planning – Mechanical Equipment and Electronic Product Carbon Footprint - Carbon Footprint of Aqua and Agriculture products- GHG Emissions from Municipal Wastewater Treatment and Solid waste management

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Explain the fundamental drivers of climate change and the core mechanics of carbon footprints.

CO2 : Differentiate and discuss the principles of product life cycle assessment and Greenhouse Gas (GHG) accounting.

CO3 : Apply standard engineering methodologies to calculate and measure carbon footprints accurately.

CO4 : Develop and evaluate viable solutions for emission mitigation and the utilization of carbon sinks.

CO5 : Analyze and critique real-world case studies to assess the effectiveness of carbon footprint reduction efforts.

TEXT BOOKS:

1. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1, by Subramanian Senthil Kannan Muthu, Springer; Softcover reprint of the original 1st ed. 2014 edition (23 August 2016), ISBN-10: 9811011737
2. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 2, by Subramanian Senthil Kannan Muthu, Springer Nature; 2014th edition (30 April 2014), ISBN-10: 9814585742

REFERENCE BOOKS:

1. Subramanian, Senthil Kannan, Muthu (2016), Carbon Foot Print Handbook, CRC Press
2. Subramanian, Senthil Kannan, Muthu (2016), Environmental Carbon Foot Print Industrial case Studies, Butterworth Heinemann Publishers
3. World Resources Institute, Green House Gas Protocol - Product Life Cycle Accounting and Reporting Standard
4. ISO 14067 -2018, Green House gases and carbon footprint, Requirements and Guidelines for Quantification, International Organisation for Standardisation.
5. IPCC (2022) –Sixth Assessment Reports – Intergovernmental Panel on Climate Change, United Framework convention on Climate Change.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	-	3	-	2	-	-	2	2	2
CO2	3	2	2	-	-	3	-	2	-	-	2	2	2
CO3	3	2	2	-	-	3	-	2	-	-	2	2	2
CO4	3	2	2	-	-	3	-	2	-	-	2	2	2
CO5	3	2	2	-	-	3	-	2	-	-	2	2	2
AVG.	**3**	**2**	**2**	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**2**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL V
B.E. MECHANICAL ENGINEERING

ME24P28	ENERGY EFFICIENT BUILDINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the climate and buildings, building efficiency rating and standards.
- To developing energy efficiency in building envelopes through alternate methods
- To study the thermal comfort, passive heating and cooling techniques
- To apply various energy saving concepts in buildings.
- To incorporate renewable energy systems in buildings.

UNIT-I INTRODUCTION 9

Climate and Building, Historical perspective, Aspects of Net Zero building design – Sustainable Site, Water, Energy, Materials and IGBC, LEED, GRIHA, IEQ and ECBC Standards.

UNIT-II LANDSCAPE AND BUILDING ENVELOPES 9

Energy efficient landscape design – Micro climates – various methods – Shading, water bodies – Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, insulation, Design methods and tools.

UNIT-III THERMAL COMFORT, PASSIVE HEATING AND COOLING 9

Thermal comfort, Psychrometry, Comfort indices – ASHRAE / ISHRAE Standards on thermal Comfort Passive heating and cooling systems - HVAC Systems for build environment – Heat Pumps, Evaporative Cooling and Radiant Cooling.

UNIT-IV ENERGY CONSERVATION IN BUILDING UTILITIES 9

Energy conservation in Hot water generator – Boiler, Heat Pumps, DG Sets, Motors, Pumps, Illumination Systems, Electrical distribution systems, Cooling Towers, Refrigeration and Air Conditioning Systems, Water and Waste Management systems.

UNIT-V RENEWABLE ENERGY IN BUILDINGS 9

Introduction of Renewable sources in buildings, Stand-alone PV systems, BIPV, Solar water heating, Solar Air Conditioning in Buildings, Small wind turbines, Poly-generation systems in Buildings.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the principles of sustainable and net-zero energy building design, green building standards, and environmental assessment frameworks.

CO2 : Apply energy-efficient landscape and building envelope design methods to minimize heat gain and heat loss in buildings.

CO3 : Analyze thermal comfort parameters, psychrometric processes, and passive heating and cooling techniques used in building environments.

CO4 : Analyze energy conservation opportunities in major building utilities including HVAC, illumination, electrical distribution, refrigeration, and water management systems.

CO5 : Evaluate the integration and performance of renewable energy systems such as solar PV, solar thermal, wind, and poly-generation systems in buildings.

TEXTBOOKS:

1. Advanced Decision Making for HVAC Engineers, by Javad Khazaii, Springer; Softcover reprint of the original 1st ed. 2016 edition (23 June 2018), ISBN-10: 3319814869.
2. Thermal Comfort and Energy-Efficient Cooling of Nonresidential Buildings, by Doreen E. Kalz, Jens Pfafferott, Springer; 2014th edition (8 April 2014), ISBN-10: 9783319045818.

REFERENCES:

1. ASHRAE Handbook – Fundamentals / Equipment's/ Applications – ASHRAE 2021,2020, 2019 Editions
2. Baruch Givoni: Climate considerations in building and Urban Design, John Wiley & Sons, 1998
3. Baruch Givoni: Passive Low Energy Cooling of Buildings by, John Wiley & Sons, 15-Jul-1994
4. JA Duffie and WA Beckman: Solar Engineering of Thermal Processes, Third Edition, John Wiley & Sons, 2006.
5. Jan F. Kreider, Peter S. Curtiss, Ari Rabl, Heating and Cooling of buildings: Design for Efficiency, Revised Second Edition, CRC Press, 28-Dec-2009.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	1	2	3	1	-	2	2	2	1
CO2	3	3	3	2	2	-	3	-	-	1	2	3	2
CO3	3	3	2	3	2	-	3	-	-	1	2	3	3
CO4	3	3	3	3	3	1	3	-	1	1	2	3	3
CO5	3	3	3	2	3	2	3	-	1	2	2	3	3
Avg.	**3**	**2.8**	**2.6**	**2.2**	**2.2**	**1.67**	**3**	**1**	**1**	**1.4**	**2**	**2.8**	**2.4**

1 - Low, 2 - Medium, 3 – High

PROFESSIONAL ELECTIVE - VERTICAL V
B.E. MECHANICAL ENGINEERING

ME24P29	ENERGY STORAGE DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the various types of energy storage devices and technologies and them comparison.
- To learn the techniques of various energy storage devices and their performances.
- To learn the basics of batteries and hybrid systems for EVs and other mobile applications.
- To learn about the renewable energy storage systems and management systems.
- To have an insight into other energy storage devices, hydrogen, and fuel cells

UNIT-I INTRODUCTION TO ENERGY STORAGE 9

Need for Energy Storage – Types of Energy Storage – Various forms of Energy Storage – Mechanical Thermal - Chemical– Electrochemical – Electrical - Other alternative energy storage technologies Efficiency and Comparison.

UNIT-II ENERGY STORAGE SYSTEMS 9

Pumped Air Energy Storage – Compressed Air Energy Storage – Flywheel – Sensible and Latent Heat Storage – Storage Materials – Performance Evaluation - Thermochemical systems – Batteries – Types Charging and Discharging – Battery testing and performance.

UNIT-III MOBILE AND HYBRID ENERGY STORAGE SYSTEMS 9

Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby supplies – V2G and G2V technologies – HESS.

UNIT-IV RENEWABLE ENERGY STORAGE AND ENERGY MANAGEMENT 9

Storage of Renewable Energy Systems –Solar Energy – Wind Energy – Energy Storage in Micro grid–Smart Grid – Energy Conversion Efficiency - Battery Management Systems – EVBMS – Energy Audit and Management.

UNIT-V OTHER ENERGY DEVICES 9

Superconducting Magnetic Energy Storage (SMES), Supercapacitors – MHD Power generation – Hydrogen Storage - Fuel Cells – Basic principle and classifications – PEMFC, AMFC, DMFC, SOFC, MCFC and Biofuel Cells – Biogas Storage.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the need for energy storage, different types of energy storage systems, and their comparison based on efficiency and applications.

CO2 : Apply the principles of mechanical, thermal, chemical, electrochemical, and electrical energy storage systems for evaluating batteries, flywheels, and thermal storage devices

CO3 : Analyze mobile and hybrid energy storage systems including EV batteries, V2G/G2V technologies, and hybrid energy storage system (HESS) performance in real-world applications.

CO4 : Analyze renewable energy storage systems and energy management strategies in smart grids and microgrids including battery management systems (BMS).

CO5 : Evaluate advanced energy storage technologies such as SMES, supercapacitors, hydrogen storage, fuel cells, and bio-energy storage systems based on performance, efficiency, and applications.

TEXTBOOKS:

1. Rober Huggins, "Energy Storage: Fundamentals, Materials and Applications", 2nd Edition, Springer, 2015.
2. Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, 2001.

REFERENCES:

1. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication, 2016.
2. Ibrahim Dincer and Mark A Rosen, "Thermal Energy Storage Systems and Applications", John Wiley & Sons, 2002.
3. Lindon David, "Handbook of Batteries", McGraw Hill, 2002.
4. Aulice Scibioh M. and Viswanathan B, "Fuel Cells – principles and applications', University Press (India), 2006
5. Ru-Shiliu, Leizhang, Sueliang Sun, "Electrochemical Technologies for Energy Storage and Conversion", Wiley Publications, 2012.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	1	2	-	-	1	2	3	3
CO2	3	3	3	2	3	2	3	-	1	1	2	3	3
CO3	3	3	3	3	3	2	3	1	1	1	2	3	3
CO4	3	3	2	2	2	2	3	1	-	2	3	3	2
CO5	3	3	2	2	2	1	2	-	-	1	2	3	3
Avg	**3**	**3**	**2.4**	**2.2**	**2.4**	**1.6**	**2.6**	**1**	**1**	**1.2**	**2.2**	**3**	**2.8**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE – VERTICAL V
B.E. MECHANICAL ENGINEERING

ME24P30	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study coal-based thermal power plant systems and their operation.
- To understand diesel, gas turbine, and combined cycle power plant technologies.
- To gain knowledge of fundamentals of nuclear engineering and power generation systems.
- To explore power generation through renewable energy sources.
- To analyze energy, economic, and environmental aspects of power plants.

UNIT-I COAL BASED THERMAL POWER PLANTS 9

Rankine cycle, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Condensers, Subsystems of thermal power plants – Fuel and ash handling, Feed water treatment. Binary and Cogeneration Systems-Integration of carbon capture and storage technologies for emission reduction in thermal power plants.

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

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

UNIT-III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering, Layout of Nuclear Power Plants, Working of Nuclear Reactors: Boiling and Pressurized Water Reactor, CANada Deuterium- Uranium reactor, Gas and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants- Case study of the Kudankulam Nuclear Power Plant, Tamil Nadu.

UNIT-IV RENEWABLE ENERGY POWER GENERATION SYSTEMS 9

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

UNIT-V ENERGY, ECONOMICS AND ENVIRONMENT OF POWER PLANTS 9

Power tariff types, Load distribution parameters, load curve, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants-Integration of smart grids with AI-based energy management for efficient power system optimization.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Describe the configuration, structure, and operation of thermal power plant components.

CO2 : Illustrate the arrangement, design, and functioning of diesel, gas, and combined cycle power plants.

CO3 : Summarize the configuration, structure, and operation of nuclear power plant components.

CO4 : Explain the layout, construction and working of the components inside Renewable energy power plants

CO5 : Demonstrate power plant applications, economics, environmental impacts, and electrical energy cost estimation.

TEXTBOOKS:

1. Nag, P.K., “Power Plant Engineering”, Tata McGraw Hill Education, Latest Edition (2014).
2. R.K. Rajput, “A Textbook of Power Plant Engineering”, S. Chand Publishing, 5th Edition, 2017.

REFERENCE BOOKS:

1. El-Wakil, M.M., “Power Plant Technology”, Tata McGraw Hill Education, Latest Edition (2016).

2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Power Plant Engineering by B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar | 1 November 2019
4. Power Plant Engineering, as per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. | 1 January 2019.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/107/112107291/
2. https://nptel.ac.in/courses/112/103/112103277/
3. https://nptel.ac.in/courses/112/103/112103243/
4. https://nptel.ac.in/courses/112/105/112105050/

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	1	1	-	3	-	-	-	2	2	2	3
CO2	3	2	2	2	-	3	-	-	-	2	2	2	3
CO3	3	2	2	2	-	3	-	-	-	2	2	2	3
CO4	3	2	2	2	-	3	-	-	-	2	2	2	3
CO5	3	2	2	2	-	3	-	-	-	2	2	2	3
AVG.	**3**	**1.8**	**1.8**	**1.8**	**-**	**3**	**-**	**-**	**-**	**2**	**2**	**2**	**3**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL VI
B.E. MECHANICAL ENGINEERING

ME24P31	TURBO MACHINES	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.
- To analyzing flow behavior and flow losses in axial flow compressor.
- To study the types and working of axial and radial flow turbines.

UNIT-I WORKING PRINCIPLES 9

Classification of Turbomachines. Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbomachines.

UNIT-II CENTRIFUGAL FANS AND BLOWERS 9

Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves – various losses. Fan bearings, drives and noise.

UNIT-III CENTRIFUGAL COMPRESSOR 9

Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.

UNIT-IV AXIAL FLOW COMPRESSOR 9

Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forced vortex flow.

UNIT-V AXIAL AND RADIAL FLOW TURBINES 9

Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types – Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the fundamental working principles of turbomachines, including classification, Euler's equation, velocity triangles, degree of reaction, efficiencies, and dimensionless parameters.

CO2 : Apply the principles of fluid flow and velocity triangle analysis to centrifugal fans and blowers for determining performance parameters and stage characteristics.

CO3 : Analyze the working and performance characteristics of centrifugal compressors including stage work, slip factor, degree of reaction, and loss mechanisms.

CO4 : Analyze the flow behavior, performance characteristics, and losses in axial flow compressors including stalling and surging phenomena.

CO5 : Evaluate the performance and efficiency of axial and radial flow turbines based on velocity diagrams, h-s analysis, stage work, and loss mechanisms.

TEXTBOOKS:

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

REFERENCES:

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

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	1	2	1
CO2	3	3	2	1	2	-	-	-	-	-	1	3	2
CO3	3	3	2	2	2	-	-	-	-	-	1	3	2
CO4	3	3	2	2	2	-	-	-	-	-	1	3	3
CO5	3	3	2	2	2	-	-	-	1	-	1	3	2
Avg	**3**	**2.8**	**2**	**1.75**	**1.8**	-	-	-	**1**	-	**1**	**2.8**	**2**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE – VERTICAL VI
B.E. MECHANICAL ENGINEERING

ME24P32	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the construction and working principles of various automobile components.
- To gain practical knowledge of assembling and dismantling engine parts and transmission systems.
- To study different types of automobile transmission systems and their operation.
- To learn about steering, braking, and suspension systems used in vehicles.
- To explore alternative energy sources used in automobiles.

UNIT-I FUNDAMENTALS OF VEHICLE STRUCTURE AND ENGINE SYSTEMS 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- Electronic engine management systems (ECU and sensors).

UNIT-II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines, electronically controlled diesel 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.

UNIT-III TRANSMISSION SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, 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 AND SUSTAINABLE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Biodiesel, Gasohol and Hydrogen in Automobiles- Engine modifications required-Combustion and Emission Characteristics of SI and CI engines-Electric and Hybrid Vehicles, Fuel Cell-Emerging trends in solid-state batteries, fast charging technologies.

OTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Recognize the various parts of the automobile and their functions and materials.
CO2 : Discuss the engine auxiliary systems and engine emission control.
CO3 : Distinguish the working of different types of transmission systems.
CO4 : Understand and describe the Steering, Brakes and Suspension Systems.
CO5 : Predict possible alternate sources of energy for IC Engines.

TEXT BOOKS:

1. Jain K.K. and Asthana R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, Latest Edition (2014).

2. Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014.

REFERENCE BOOKS:

1. Ganesan V. “Internal Combustion Engines”, Third Edition, Tata McGraw-Hill, 2012.
2. Heinz Heisler, “Advanced Engine Technology,” SAE International Publications USA, 1998.
3. Joseph Heitner, “Automotive Mechanics,” Second Edition, East-West Press, 1999.
4. Martin W, Stockel and Martin T Stockle, “Automotive Mechanics Fundamentals,” The Good heart - Will Cox Company Inc, USA ,1978.
5. Newton, Steeds and Garet, “Motor Vehicles”, Butterworth Publishers,1989.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/104/112104033/
2. https://nptel.ac.in/courses/103/105/103105110/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-61-internalcombustion-engines-spring-2017/

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	2	-	2	3
CO2	2	2	2	2	-	-	-	-	-	2	-	2	3
CO3	2	2	2	2	-	-	-	-	-	2	-	2	2
CO4	2	2	2	2	-	-	-	-	-	2	-	2	3
CO5	2	2	2	2	-	-	-	-	-	2	-	2	2
AVG.	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**2.6**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE -VERTICAL - VI
B.E. MECHANICAL ENGINEERING

ME24P33	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

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

UNIT II FLOW THROUGH DUCTS 9

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

UNIT III NORMAL AND OBLIQUE SHOCKS 9

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

UNIT IV JET PROPULSION 9

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

UNIT V SPACE PROPULSION 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon the completion of this course the students will be able to

CO1 : Apply the concept of compressible flows in variable area ducts.
CO2 : Apply the concept of compressible flows in constant area ducts.
CO3 : Examine the effect of compression and expansion waves in compressible flow.
CO4 : Use the concept of gas dynamics in jet propulsion.
CO5 : Apply the concept of gas dynamics in space propulsion.

TEXT BOOKS:

1. S.M. Yahya, “Fundamentals of Compressible Flow with Aircraft and Rocket propulsion”, New Age International (P) Limited, 4th Edition, 2012.
2. Anderson, J.D., “Modern Compressible flow”, 3ed Edition, McGraw Hill, 2012.

REFERENCES:

1. R. D. Zucker and O Biblarz, “Fundamentals of Gas Dynamics”, 2nd edition, Wiley, 2011.
2. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2010.
3. Shapiro. A.H.," Dynamics and Thermodynamics of Compressible fluid Flow", John Wiley, New York, 1953.
4. Sutton. G.P., Zucrow. N.J., "Rocket Propulsion Elements", John Wiley, New York,2010,.
5. "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York, 1970.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	2	-	-	-	2	-	-	2	3	-
CO2	3	2	-	2	-	-	-	2	-	-	2	2	-
CO3	3	2	-	2	-	-	-	2	-	-	2	2	-
CO4	3	2	-	2	-	-	-	2	-	-	2	3	-
CO5	3	2	-	2	-	-	-	2	-	-	2	2	-
Avg	3	2	-	2	-	-	-	2	-	-	2	2.1	-

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL VI
B.E. MECHANICAL ENGINEERING

ME24P34	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of modern engineering materials including metals, polymers, ceramics, and composites.
- To gain knowledge of polymer matrix composites, their reinforcements, and manufacturing processes.
- To explore the characteristics, processing techniques, and applications of metal matrix composites.
- To analyze ceramic matrix composites, their properties, limitations, and fabrication methods.
- To apply mechanics of composites to evaluate lamina and laminate behavior, structural moduli, and design considerations.

UNIT-I BASICS OF COMPOSITE MATERIALS 9

Modern materials in design: Types, metals, polymers, ceramics, composites; Polymers: Classification, properties of thermo plastics and thermo setting plastics; Classification of composites: Matrices and reinforcements: roles, classification, properties and composite structures.

UNIT-II POLYMER MATRIX COMPOSITES 9

Polymer resins – reinforcement fibres – rovings– woven fabrics – non woven random mats – various types of fibres. PMC processes - hand lay-up processes – spray up processes – compression moulding - resin transfer moulding – Pultrusion – Filament winding – Injection moulding.

UNIT-III METAL MATRIX COMPOSITES 9

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, Reinforcements – particles – fibres. Effect of reinforcement - volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process - diffusion bonding – stir casting – squeeze casting.

UNIT-IV CERAMIC MATRIX COMPOSITES 9

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

UNIT-V MECHANICS OF COMPOSITES 9

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

CO1 : Describe types, properties, and roles of matrices and reinforcements.
CO2 : Explain polymer matrix composites and basic manufacturing methods.
CO3 : Compare alloys and MMCs, apply rule of mixtures, and outline processing.
CO4 : Identify the need for CMCs, differentiate ceramics, and explain fabrication methods.
CO5 : Use lamina and laminate equations to analyze composite plates and laminates.

TEXTBOOKS:

1. Autar K Kaw, "Mechanics of Composite Materials", 2 nd Edition, CRC Press, 2007.

2. Krishan K Chawla. Composite Materials: Science and Engineering, Springer India,2015.

REFERENCE BOOKS:

1. Madhujit Mukhopadhyay, Mechanics of Composite Materials and Structures, Universities Press, 2022.
2. Ronald F. Gibson, Principles of Composite Material Mechanics, CRC Press, 2016.
3. Ever J. Barbero, Introduction to Composite Materials Design, 2n^{d} edition, CRC Press, 2010.
4. M. Balasubramanian, Composite materials processing, 1st edition, CRC press, 2013.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	3	2	-	-	-	-	2	3	1
CO2	3	2	3	2	3	2	-	2	2	2	2	3	1
CO3	3	3	2	2	3	2	-	-	-	-	2	3	1
CO4	3	2	2	2	3	2	-	-	-	-	2	3	1
CO5	3	3	3	3	3	2	-	2	2	3	2	3	1
AVG.	**3**	**2.4**	**2.4**	**2**	**2**	**2**	**-**	**2**	**2**	**2**	**2**	**3**	**1**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE - VERTICAL VI
B.E. MECHANICAL ENGINEERING

ME24P35	DESIGN FOR MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products**.**
- To learn design consideration principles of forming in the design of extruded, stamped, and forged products**.**
- To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
- To learn design consideration principles of assembly in the design of assembled products
- To learn design consideration principles of welding in the design of welded products

UNIT-I INTRODUCTION TO DFM 9

Overview of DFM and its importance, History and evolution of DFM, The relationship between design and considerations for different manufacturing processes

UNIT-II FORMING & MACHINING 9

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts –Forged parts. Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts

UNIT-III DFM TOOLS AND SOFTWARE 9

Overview of DFM tools and software applications, Integration of DFM tools in the design process- Design and Manufacturing Real-world examples of successful DFM implementation, Analysis of DFM failures and lessons learned

UNIT-IV WELDING 9

Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment & heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash & Upset weldment.

UNIT-V 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 – Automatic assembly.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Discuss the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.

CO2 : Explain design consideration principles of forming in the design of extruded, stamped, and forged products.

CO3 : Explain design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.

CO4 : Analyze the impact of material selection and manufacturing processes on product design.

CO5 : Explain design consideration principles of assembly in the design of assembled products.

TEXT BOOKS:

1. James G. Bralla, “Handbook of Product Design for Manufacture”, McGraw Hill, 1986.
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998

REFERENCE BOOKS:

1. Design for Manufacturability & Concurrent Engineering" by David M. Anderson
2. Product Design for Manufacture and Assembly" by Geoffrey Boothroyd, Peter Dewhurst, and Winston Knight.
3. Corrado Poli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.
4. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004
5. Henry Peck, “Designing for Manufacture”, Sir Isaac Pitman & Sons Ltd., 1973.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	1	-	-	-	-	-	-	-	2	2
CO2	3	3	3	1	-	-	-	-	-	-	-	2	2
CO3	3	3	3	1	-	-	-	-	-	-	-	2	2
CO4	3	3	3	1	-	-	-	-	-	-	-	2	2
CO5	3	3	3	1	-	-	-	-	-	-	-	2	2
AVG	**3.00**	**2.00**	**2.00**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.00**	**2.00**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE -VERTICAL - VI
B.E. MECHANICAL ENGINEERING

ME24P36	COMPUTATIONAL FLUID DYNAMICS AND HEAT TRANSFER	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study the fluid flow simulation techniques and its mathematical behavior
- To learn the Discretise 1D and 2D systems using finite difference and finite volume techniques
- To Formulate diffusion –convection problems using finite volume method
- To study the flow field for different types of grids
- To learn the need for turbulence models and its types

UNIT – I INTRODUCTION 9

Basics of Computational Fluid Dynamics (CFD)-Governing Equations: Continuity, Momentum, and Energy Boundary Conditions and Their Types - Classification of Partial Differential Equations (Elliptic, Parabolic, and Hyperbolic)-Comparison of Analytical, Experimental, and Numerical Techniques.

UNIT – II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

Finite Difference Method: Basic Formulation-Finite Volume Method for Diffusion Problems -Steady and Transient 1D Diffusion Problems -Euler, Crank–Nicolson, and Implicit Methods -Accuracy and Stability of Numerical Schemes.

UNIT – III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes, properties of discretization schemes, Hybrid, Power-law, QUICK Schemes, Computation of Boundary layer flow, von Neumann stability analysis.

UNIT – IV FLOW FIELD ANALYSIS 9

Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms, Computation of internal and external thermal boundary layer.

UNIT – V TURBULENCE MODELLING AND CFD TOOLS 9

Turbulence model requirement and types, mixing length model, Two equation (k-Є) models – High and low Reynolds number models, LES, DNS, Mesh Generation and refinement Techniques-software tools, Stability of solver, Courant Fredrick Levy number, relaxation factor, and grid independence test.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Apply the fundamentals of CFD, and develop case specific governing equations.
CO2 : Discuss finite difference and finite volume-based analysis for steady and transient diffusion problems.
CO3 : Implement various mathematical schemes under finite volume method for convention diffusion.
CO4 : Solve complex problems in the field of fluid flow and heat transfer with the support of high speed computers.
CO5 : Apply the various discretization methods, solution procedure and the concept of turbulence modelling.

TEXT BOOKS:

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

REFERENCES:

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

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	2	-	-	-	-	-	1	3	1
CO2	3	3	1	2	2	-	-	-	-	-	1	3	1
CO3	3	3	2	2	2	-	-	-	-	-	1	3	2
CO4	3	3	2	3	3	-	-	-	-	-	2	3	2
CO5	3	3	2	3	3	-	-	-	-	-	2	3	2
AVG.	**3**	**2.8**	**1.6**	**2.4**	**2.4**	**-**	**-**	**-**	**-**	**-**	**1.4**	**3**	**1.6**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE I & II
B.E. EEE & MECH

AD24901	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To Understand the importance, principles, and search methods of AI.
- To Provide knowledge on predicate logic and Prolog.
- To Introduce machine learning fundamentals.
- To Study and understand supervised learning algorithms.
- To Study and understand unsupervised learning algorithms.

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

Introduction - History of AI - Risks and Benefits of AI - Intelligent Agents - Structure of Agent - Problem Solving Agents - Formulating Problems - Uninformed Search**.**

UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES 6

Informed Search - Adversarial Game and Search - Game theory - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - Constraint Satisfaction Problems (CSP) - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP.

UNIT III LEARNING 6

Regression: Linear Regression - Logistic Regression - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, bias and variance.

UNIT IV SUPERVISED LEARNING 6

Neural Network: Introduction, Perceptron Networks – Adaline - Back propagation networks - Decision Tree - classification algorithm - Rule based Classification - Naïve Bayesian classification - Support Vector Machines (SVM).

UNIT V UNSUPERVISED LEARNING 6

Unsupervised Learning – Principal Component Analysis – Clustering: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm.

30 PERIODS

LIST OF EXPERIMENTS: 30 PERIODS

1. Implement breadth first search.
   Implement depth first search.
2. Analysis of breadth first and depth first search in terms of time and space.
3. Implement and compare Greedy and A* algorithms.
   Implement the non-parametric locally weighted regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
4. Write a program to demonstrate the working of the decision tree based algorithm.
5. Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets.
6. Write a program to implement the naïve Bayesian classifier.
7. Implementing neural network using self-organizing maps.
   Implementing k-Means algorithm to cluster a set of data.

REQUIREMENTS:

- Python (recommended version: 3.9+)
- Anaconda Distribution (for package management + Jupyter)
- VS Code (coding + debugging alternative)
- NumPy, SciPy, Matplotlib, Scikit-learn → all open-source Python libraries

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 : Understand the foundations of AI and the structure of Intelligent Agents.
CO2 : Use appropriate search algorithms for any AI problem.
CO3 : Apply regression and model evaluation techniques in machine learning.
CO4 : Solve problem using Supervised learning.
CO5 : Solve problem using Unsupervised learning.

TEXT BOOKS:

1. Russell, S. & Norvig, P., "Artificial Intelligence: A Modern Approach", Pearson, 4th Edition, 2021.
2. Géron, A., "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly Media, 3rd Edition, 2022.

REFERENCES:

1. Alpaydin, E., "Introduction to Machine Learning", MIT Press, 4th Edition, 2023.
2. Bishop, C. M., "Pattern Recognition and Machine Learning", Springer, 2nd Edition, 2024.

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	2	-	-	-	-	-	-	3	2
CO2	3	3	2	2	2	-	-	-	-	-	-	3	3
CO3	3	3	2	3	3	-	-	-	-	-	1	3	3
CO4	3	3	3	2	3	-	-	-	1	-	-	2	3
CO5	3	3	2	2	3	-	-	-	-	-	-	2	3
Avg	**3**	**2.8**	**2.4**	**2.0**	**2.6**	**-**	**-**	**-**	**1**	**-**	**1**	**2.6**	**2.8**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE I & II
B.E. EEE & MECH

AD24905	DATA SCIENCE FUNDAMENTALS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To Familiarize students with the data science process.
- To Understand the data manipulation functions in Numpy and Pandas.
- To Explore different types of machine learning approaches.
- To Understand and practice visualization techniques using tools.
- To Learn to handle large volumes of data with case studies.

UNIT I INTRODUCTION **6**

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals –Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing.

UNIT II DATA MANIPULATION **6**

Python Shell - Jupyter Notebook - IPython Magic Commands - NumPy Arrays-Universal Functions – Aggregations –Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing.

UNIT III MACHINE LEARNING **6**

The modeling process - Types of machine learning - Supervised learning - Unsupervised learning -Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis.

UNIT IV DATA VISUALIZATION **6**

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots –Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting -Geographic Data with Basemap - Visualization with Seaborn.

UNIT V HANDLING LARGE DATA **6**

Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Data preparation - Model building – Presentation and automation.

30 PERIODS

LIST OF EXPERIMENTS: **30 PERIODS**

1. Create and manipulate NumPy arrays using indexing, slicing and arithmetic operations.

Create a Pandas DataFrame and perform data cleaning, filtering and statistical operations.

2. Develop basic plots using Matplotlib such as line charts, bar charts and histograms.
3. Construct a frequency distribution table and visualize it using a histogram.

Calculate measures of central tendency including mean, median and mode for a dataset.

4. Compute measures of variability such as range, variance and standard deviation.
5. Plot and analyze the normal distribution curve for a given dataset.
6. Create scatter plots to study the relationship between two variables.
7. Determine and interpret the correlation coefficient between variables.

Perform simple linear regression and predict output values from the model.

REQUIREMENTS:

- Python (recommended version: 3.9+)
- Anaconda Distribution (for package management + Jupyter)
- VS Code (coding + debugging alternative)
- NumPy, SciPy, Matplotlib, Scikit-learn → all open-source Python libraries

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 : Gain knowledge on data science process.
CO2 : Perform data manipulation functions using Numpy and Pandas.
CO3 : Understand different types of machine learning approaches.
CO4 : Perform data visualization using tools.
CO5 : Handle large volumes of data in practical scenarios.

TEXT BOOKS:

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2nd Edition, 2019.
2. Cathy O'Neil, Rachel Schutt, "Doing Data Science", O'Reilly Media, 1st Edition, 2020.

REFERENCES:

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media, 2nd Edition, 2023.
2. Foster Provost, Tom Fawcett, "Data Science for Business", O'Reilly Media, 2nd Edition, 2023.
3. Jure Leskovec, Anand Rajaraman, Jeffrey Ullman, "Mining of Massive Datasets", Cambridge University Press, 3rd Edition, 2020.
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, 2nd Edition, 2021 Reprint.

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	2	-	-	-	-	-	-	3	2
CO2	3	3	2	2	3	-	-	-	-	-	-	3	3
CO3	3	3	2	2	3	-	-	-	-	-	-	3	3
CO4	2	3	2	3	3	-	-	-	1	1	-	2	3
CO5	3	2	3	3	3	-	-	-	1	-	1	3	3
Avg	**2.8**	**2.6**	**2.0**	**2.2**	**2.8**	**-**	**-**	**-**	**1.0**	**1.0**	**1.0**	**2.8**	**2.8**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE I & II
B.E. EEE & MECH

CS24902	IoT CONCEPTS AND APPLICATIONS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

To enable the students:

- To understand the fundamentals and architecture of the Internet of Things (IoT).
- To learn sensors, actuators, communication protocols, and embedded devices used in IoT.
- To study IoT networking, cloud integration, and data analytics concepts.
- To develop IoT applications using modern platforms and tools.
- To explore security, privacy, and emerging trends in IoT systems.

UNIT I INTRODUCTION TO IoT **6**

Overview of IoT – Characteristics and Applications – IoT Architecture – Physical and Logical Design – IoT Enabling Technologies – Sensors and Actuators – Embedded Systems for IoT – IoT Communication Models.

UNIT II IoT DEVICES AND COMMUNICATION **6**

Microcontrollers and Single Board Computers – Arduino and Raspberry Pi – IoT Communication Protocols – RFID, NFC, Bluetooth, ZigBee, Wi-Fi, MQTT, and CoAP – Machine-to-Machine (M2M) Communication – Wireless Sensor Networks.

UNIT III IoT NETWORKING AND CLOUD **6**

IoT Networking Concepts – IPv6 and 6LoWPAN – Edge and Fog Computing – Cloud Computing for IoT – IoT Data Storage and Analytics – IoT Platforms and Middleware – Real-Time Monitoring Systems.

UNIT IV IoT APPLICATIONS **6**

Smart Homes – Smart Cities – Industrial IoT – Healthcare IoT – Agriculture and Environmental Monitoring – Smart Transportation – Wearable Devices – Energy Management Systems.

UNIT V IoT SECURITY AND EMERGING TRENDS **6**

IoT Security Challenges – Authentication and Access Control – Privacy Issues – Secure IoT Communication – Blockchain for IoT – AI and Machine Learning in IoT – Digital Twin – Industry 4.0 and Future Trends in IoT.

30 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Introduction to Arduino and Raspberry Pi programming.
2. Interfacing sensors and actuators with IoT devices.
3. Implementation of IoT communication using Bluetooth and Wi-Fi.
4. MQTT and CoAP protocol-based communication exercises.
5. IoT cloud platform integration and real-time monitoring.
6. Smart home automation system development.
7. Mini project on IoT application development.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After the completion of the course, the students will be able to:

CO1 : Explain IoT concepts, architecture, and enabling technologies.
CO2 : Analyze IoT devices, sensors, and communication protocols.

CO3 : Apply IoT networking and cloud integration concepts.

CO4 : Develop IoT-based applications for real-world scenarios.

CO5 : Evaluate IoT security challenges and emerging IoT technologies.

TEXTBOOKS:

1. Internet of Things: A Hands-On Approach, Universities Press, 2015.
2. The Internet of Things: Enabling Technologies, Platforms and Use Cases, CRC Press, 2017.

REFERENCES

1. Building the Internet of Things with Arduino and Raspberry Pi – Agus Kurniawan, Packt Publishing, 2023.
2. Practical Internet of Things Security (2nd Edition) – Brian Russell & Drew Van Duren, Packt Publishing, 2023.
3. Internet of Things and Sensor Networks – S. Misra, C. Roy & A. Mukherjee, McGraw Hill, 2022.
4. AI and IoT-Based Intelligent Automation in Robotics – Krishna Kant Singh et al., Wiley, 2024.
5. Industry 4.0 and Digital Twin Technologies – A. J. Tallón-Ballesteros, Springer, 2023.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1	PO2
CO1	3	2	2	1	2	–	–	–	–	1	–	–	–
CO2	3	3	3	2	3	–	–	–	1	1	2	–	–
CO3	3	3	3	2	3	1	–	–	1	1	2	–	–
CO4	3	3	3	3	3	2	–	–	2	2	3	–	–
CO5	3	3	2	2	3	2	–	–	1	2	2	–	–
Avg	**3**	**2.8**	**2.6**	**2**	**2.8**	**1.6**	**–**	**–**	**1.25**	**1.4**	**2.2**	**–**	**–**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE I & II
B.E. CSE. ECE, EEE, MECH, & B.TECH. AIDS &IT

CS24908	AUGMENTED REALITY AND VIRTUAL REALITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications.

UNIT I INTRODUCTION **9**

Introduction to Virtual Reality and Augmented Reality –Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture – Output Devices – Graphics Display – Human Visual System

UNIT II VR MODELING **9**

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling –.

UNIT III VR PROGRAMMING **9**

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D - Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management

UNIT IV APPLICATIONS **9**

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society - Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – VR in Education.

UNIT V AUGMENTED REALITY **9**

Introduction to Augmented Reality-Computer vision for AR-Interaction - Modeling and Annotation Navigation-Wearable devices.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 : Understand VR and AR fundamentals and components.
CO2 : Apply VR modeling techniques for virtual environments.
CO3 : Develop VR applications using programming tools and interaction methods.
CO4 : Analyze VR applications in various domains.
CO5 : Design AR systems using computer vision and wearable technologies.

TEXT BOOKS:

1. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2nd Edition, 2023.
2. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles and Practice", Addison-Wesley Professional, 2nd Edition, 2024.

REFERENCES:

1. Alan B. Craig, William R. Sherman, Jeffrey D. Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2nd Edition, 2022.
2. Jason Jerald, "The VR Book: Human-Centered Design for Virtual Reality", Morgan & Claypool Publishers, 2nd Edition, 2023.
3. Steve Aukstakalnis, "Practical Augmented Reality", Addison-Wesley Professional, 2nd Edition, 2021.
4. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley-IEEE Press, 3rd Edition, 2020.

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	2	-	-	-	-	-	-	3	2
CO2	3	3	2	2	3	-	-	-	-	-	-	3	3
CO3	3	3	3	2	3	-	-	-	-	-	-	3	3
CO4	2	3	2	2	2	-	-	-	-	-	-	2	3
CO5	3	3	3	3	3	-	-	-	-	-	-	2	3
Avg	**2.8**	**2.8**	**2.2**	**2.0**	**2.6**	-	-	-	-	-	-	**2.6**	**2.8**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE III
B.E. EEE., & MECH.

IE24908	QUALITY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Developing a clear knowledge in the basics of various quality concepts.
- Facilitating the students in understanding the application of control charts and its techniques.
- Developing thespecialcontrolproceduresforserviceandprocessorientedindustries.
- Analyzing and understanding the process capability study.
- Developing the acceptance sampling procedures for incoming raw material.

UNIT I INTRODUCTION TO QUALITY MANAGEMENT 9

Meaning and Importance of quality-Different Dimensions–Quality definitions–Inspection-Quality control–Quality Assurance–Quality Planning-Quality costs–Economics of quality– Quality loss function

UNIT II CONTROLCHARTS 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 of control charts.

UNIT III ADVANCED CONTROL PROCEDURES 9

Warning and modified control limits, control chart for individual measurements, multi-vari chart, *X* chart with a linear trend, chart for moving averages and ranges, CUSUM and EWMA control charts.

UNIT IV STATISTICAL PROCESS CONTROL 9

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNITV ACCEPTANCE SAMPLING 9

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105DandMIL-STD-414E&IS2500 standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Apply control charts for variables to monitor and control process quality in manufacturing industries.

CO2 : Analyze and reduce product defects in manufacturing processes using quality control techniques.

CO3 : Apply quality control tools to minimize defects in service processes.

CO4 : Analyze process capability using appropriate statistical methods.

CO5 : Develop and implement acceptance sampling plans for incoming raw materials.

TEXT BOOKS:

1. Montgomery Douglas C, 2012, "Statistical Quality Control: A Modern Introduction", 7th Edition, John Wiley & Sons, New York.
2. Juran J M and Gryna Frank M, 2005, "Quality Planning and Analysis", 5th Edition, McGraw-Hill Education, New York.

REFERENCES:

1. Grant E L and Leavenworth R S, 2017, "Statistical Quality Control", 7th Edition, McGraw-Hill Education, New Delhi.
2. Biesterfield Dale H, 2013, "Quality Control", 9th Edition, Pearson Education, New Jersey.

3. Feigenbaum A V, 2004, "Total Quality Control", 4th Edition, McGraw-Hill, New York.
4. Ishikawa Kaoru, 1990, "Introduction to Quality Control", 1st Edition, 3A Corporation, Tokyo.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	3	2	-	-	-	-	-	1	3	1
CO2	2	3	2	3	-	1	-	-	-	-	1	2	3
CO3	2	2	2	1	-	1	-	-	-	-	1	1	2
CO4	3	3	1	3	2	-	-	-	-	-	1	3	2
CO5	2	2	-	2	-	-	-	-	-	2	1	2	1
AVG.	**2.4**	**2.6**	**1.75**	**2.4**	**2**	**1**	**-**	**-**	**-**	**2**	**1**	**2.2**	**1.8**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE III
B.E, ECE., & MECH,

EE24902	ELECTRIC VEHICLE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals, architecture, and performance characteristics of electric vehicles.
- To analyze electric propulsion systems, motor drives, and regenerative braking techniques used in EVs.
- To study energy storage systems, battery technologies, and battery management systems for electric vehicles.
- To understand the operation of power electronic converters and EV charging infrastructure.
- To gain knowledge on hybrid electric vehicles, energy management strategies, safety standards, and emerging trends in electric mobility.

UNIT I INTRODUCTION TO ELECTRIC VEHICLES 9

Evolution of electric vehicles – Need for electric mobility – Environmental impact and sustainability – Comparison of ICE vehicles and EVs – Classification of electric vehicles: BEV, HEV, PHEV, and FCEV – Architecture and components of EVs – Sensors and Actuators for EV's – Vehicle performance parameters – Vehicle dynamics – Tractive effort – Drive cycles and energy consumption analysis – EV standards and regulations.

UNIT II ELECTRIC PROPULSION SYSTEMS AND TRACTION DRIVES 9

Requirements of electric propulsion systems – Selection criteria for traction motors – Operating principles and characteristics of DC motors, Induction Motors, PMSM and BLDC motors – Torque-speed characteristics – Motor sizing and rating – Electric drive configurations for EVs – Control techniques for EV drives – Regenerative braking systems – Transmission systems in EVs – Efficiency improvement techniques and thermal considerations in traction drives.

UNIT III ENERGY STORAGE SYSTEMS AND BATTERY MANAGEMENT 9

Energy storage requirements in EVs – Lead-acid, Nickel Metal Hydride, Lithium-ion, and Solid- State batteries – Fuel cells and supercapacitors – Battery characteristics – Charging and discharging methods – State of Charge (SOC), State of Health (SOH), and Depth of Discharge (DOD) estimation – Battery Management System (BMS): architecture, monitoring, protection methods – Battery safety – EV waste management.

UNIT IV POWER ELECTRONICS AND CHARGING SYSTEMS 9

Power electronic converters for EV applications – DC-DC converters, AC-DC converters, choppers, and traction inverters – PWM techniques and converter control strategies – On-board and off-board charging systems – EV charging methods – Fast charging and wireless charging – Smart charging infrastructure – Grid integration of EVs – Vehicle-to-Grid (V2G) and Vehicle-to- Home (V2H) technologies – Charging station architecture and energy management.

UNIT V HYBRID ELECTRIC VEHICLES AND FUTURE TRENDS 9

Hybrid electric vehicles – Series, parallel, and series-parallel hybrid configurations – Plug-in hybrid vehicles – Energy management strategies for HEVs and EVs – Intelligent transportation systems and connected mobility – Autonomous electric vehicles – Cyber security in electric vehicles – Recent advancements and future trends in electric mobility.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1 : Explain the architecture, classifications, and vehicle dynamics of electric vehicles.

CO2 : Analyze the operation and performance of electric propulsion systems and motor drives used in EVs.

CO3 : Evaluate battery technologies, energy storage systems, and battery management techniques for electric vehicles.

CO4 : Illustrate the operation of power electronic converters and charging systems used in EV applications.

CO5 : Discuss hybrid electric vehicles, energy management strategies, and recent developments in electric mobility.

TEXT BOOKS:

1. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 3rd Edition, CRC Press, 2021.
2. Mehrdad Ehsani, Yimin Gao, Stefano Longo and Kambiz Ebrahimi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, 3rd Edition, CRC Press, 2026.

REFERENCES:

1. James Larminie and John Lowry, Electric Vehicle Technology Explained, 2nd Edition, Wiley, 2012.
2. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
3. Chris Mi, M. Abul Masrur and David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, 2nd Edition, Wiley-IEEE Press, 2017.
4. Ali Emadi (Ed.), Advanced Electric Drive Vehicles, CRC Press, 2014.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			3	2	3	-	-	-	-	2	3
CO2	3	3	3	3	2		2	-	-	-	-	3	2
CO3	3	3	3	3	2	2	3	-	-	-	-	2	3
CO4	3	2	3	1	3	2	3	-	-	-	-	3	2
CO5	2	2	3		3	3	3	-	-	-	-	3	3
Avg	**2.8**	**2.4**	**3.0**	**2.3**	**2.6**	**2.3**	**2.8**	**-**	**-**	**-**	**-**	**2.6**	**2.6**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE III
B.E. MECH. & B.TECH. AIDS.

EC24901	FUNDAMENTALS OF ELECTRON DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand semiconductor physics and PN junction diode characteristics.
- Analyze the construction and operation of Bipolar Junction Transistors.
- Study the characteristics and applications of FET and MOSFET devices.
- Understand the operation and applications of special semiconductor devices.
- Learn semiconductor fabrication processes and modern electronic device technology.

UNIT I SEMICONDUCTOR PHYSICS AND PN JUNCTION DEVICES 9

Semiconductor materials – Intrinsic and extrinsic semiconductors – Energy band theory – Charge carriers – Drift and diffusion currents – PN junction diode – V-I characteristics – Diode equation – Breakdown mechanisms

UNIT II BIPOLAR JUNCTION TRANSISTORS 9

Construction and operation of BJT – Transistor configurations –CE,CB,CC – Input and output characteristics.

UNIT III FET AND MOSFET 9

Construction and characteristics of JFET – Drain and transfer characteristics – MOSFET types – Enhancement and depletion MOSFET — Applications and Comparisons of FET and MOSFET.

UNIT IV SPECIAL SEMICONDUCTOR DEVICES 9

Zener diode – Varactor diode – Tunnel diode – Schottky diode – LED – Photodiode – Solar cell – Optocoupler – LCD –UJT.

UNIT V SEMICONDUCTOR FABRICATION TECHNOLOGY 9

Crystal growth techniques – Wafer preparation – Oxidation – Diffusion – Ion implantation – Photolithography – Epitaxy – Thin film deposition.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

CO1 : Explain semiconductor fundamentals and PN junction operation.
CO2 : Analyze the characteristics and applications of BJTs.
CO3 : Evaluate FET and MOSFET device performance.
CO4 : Explain the working of special semiconductor devices.
CO5 : Describe semiconductor fabrication and IC manufacturing processes.

TEXTBOOKS:

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 11th Edition, Pearson Education, 2013.
2. Sedra and Smith, Microelectronic Circuits, 7th Edition, Oxford University Press, 2015.
3. Jacob Millman and Christos C. Halkias, Electronic Devices and Circuits, 3rd Edition, McGraw Hill, 2010.

REFERENCES:

1. Donald A. Neamen, Electronic Circuit Analysis and Design, 3rd Edition, McGraw Hill, 2007.
2. Thomas L. Floyd, Electronic Devices, 10th Edition, Pearson Education, 2017.
3. S. M. Sze, Semiconductor Devices: Physics and Technology, 3rd Edition, Wiley India, 2012.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	3	-	-	-	-	-	-	2	3	2
CO2	3	3	2	3	-	-	-	-	-	-	2	3	2
CO3	3	3	3	3	2	-	-	-	-	-	2	3	2
CO4	3	3	3	3	-	-	-	-	-	-	2	3	2
CO5	3	3	3	3	-	-	-	-	-	-	2	3	2
Avg	**3**	**3**	**2.6**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**

1 – Low, 2 - Medium, 3 - High

OPEN ELECTIVE - III
B.E. MECHANICAL ENGINEERING

IE24904	INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline fundamental concepts in UI & UX
- To introduce the principles of design and building a mobile app
- To illustrate the use of cad in product design
- To outline the choice and use of prototyping tools
- To understanding design of electronic circuits and fabrication of electronic devices

UNIT I UI/UX **9**

An approach to industrial design - elements of design structure for industrial design in engineering application in modem manufacturing systems. Ergonomics and Industrial Design: Introduction - general approach to the man-machine relationship- work station design-working position.

UNIT II APP DEVELOPMENT **9**

SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps.

UNIT III INDUSTRIAL DESIGN **9**

Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation - Assembly - Product design and rendering basics - Dimensioning & Tolerancing.

UNIT IV MECHANICAL RAPID PROTOTYPING **9**

Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping; 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing.

UNIT V ELECTRONIC RAPID PROTOTYPING **9**

Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1 : Create quick UI/UX prototypes for customer needs
CO2 : Develop web application to test product traction / product feature
CO3 : Develop 3D models for prototyping various product ideas
CO4 : Built prototypes using Tools and Techniques in a quick iterative methodology
CO5 : Analyze basic electronic circuits and their behavior using simulation tools.

TEXT BOOKS:

1. Peter Fiell, Charlotte Fiell, Industrial Design A-Z, TASCHEN America Llc(2003)
2. Samar Malik, Autodesk Fusion 360 - The Master Guide.
3. Steve Krug, Don't Make Me Think, Revisited: A Common-Sense Approach to Web Usability, Pearson,3rd edition (2014)

REFERENCE BOOKS:

1. Chua C.K., Leong K.F. and Lim C.S., (2010), Rapid Prototyping: Principles and Applications, 3rd Edition, World Scientific Publishers.
2. Ali K. Kamrani and Emad Abouel Nasr, (2010), Rapid Prototyping: Theory and Practice, Springer.
3. Pham D.T. and Dimov S.S., (2001), Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer.
4. Ian Gibson, David Rosen and Brent Stucker, (2015), Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping and Direct Digital Manufacturing, Springer.
5. Chitale A.K. and Gupta R.C., (2014), Product Design and Manufacturing, PHI Learning Pvt. Ltd.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	3	-
CO4	2	2	2	-	-	-	-	-	-	-	-	2	-
CO5	3	2	2	-	-	-	-	-	-	-	-	3	-
AVG.	**2.80**	**2.00**	**2.00**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.60**	**-**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE – III
B.E. MECHANICAL ENGINEERING

IM24902	PRODUCTION PLANNING AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of production planning and control act work study,
- To apply the concept of product planning,
- To analyse the production scheduling,
- To apply the Inventory Control concepts.
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION 9

Objectives and benefits of planning and control-Functions of production control-Types of production- job-batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II WORK STUDY 9

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING 9

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi-product system.

UNIT IV PRODUCTION SCHEDULING 9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual Loading-Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling-Product sequencing – Production Control systems- Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting- Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder Procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL PERIODS: 45

OUTCOMES: Upon the completion of this course the students will be able to

CO1 : The students can able to prepare production planning and control act work study,
CO2 : The students can able to prepare product planning,
CO3 : The students can able to prepare production scheduling,
CO4 : The students can able to prepare Inventory Control.
CO5 : They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

TEXT BOOKS:

1. James. B. Dilworth, "Operations management – Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition 1992.
2. Martand Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2000.

REFERENCES:

1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000.
3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
4. Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007.
5. Melynk, Denzler, " Operations management – A value driven approach" Irwin Mcgraw hill.
6. Norman Gaither, G. Frazier, "Operations Management" 9th Edition, Thomson learning IE, 2007
7. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984
8. Upendra Kachru, " Production and Operations Management – Text and cases" 1st Edition, Excel books 2007

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	2	3	-
CO2	3	2	-	-	2	-	-	-	-	-	2	2	2
CO3	3	2	-	-	2	-	-	-	-	-	2	-	2
CO4	2	2	-	-	2	-	-	-	-	-	2	-	2
CO5	2	2	-	-	2	-	-	-	-	-	2	-	-
Avg	2.6	2	-	-	2	-	-	-	-	-	2	2.5	2

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE III
B.E, BME, CSE, EEE, ECE, MECH, & B.TECH. AIDS, IT

RA24904	DRONE TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand the fundamentals of drone systems and UAV architecture.
- Study aerodynamic principles and flight mechanics of drones.
- Analyze components such as sensors, controllers, and communication systems.
- Learn navigation, control, and autonomous flight techniques.
- Explore applications of drones in various engineering and societal domains.

UNIT I INTRODUCTION TO DRONE SYSTEM 9

Overview of UAVs and drones, classification of drones, applications of drones, basic flight principles, drone anatomy and system components, regulatory framework and safety guidelines.

UNIT II AERODYNAMICS AND FLIGHT MECHANICS 9

Basics of aerodynamics, lift, thrust, drag, and weight, multirotor dynamics, stability and control, propulsion systems, battery and power systems.

UNIT III DRONE HARDWARE AND SENSORS 9

Flight controller architecture, IMU, GPS, magnetometer, barometer, ultrasonic and vision sensors, motor and ESC systems, communication modules.

UNIT IV NAVIGATION AND CONTROL SYSTEMS 9

Drone navigation systems, PID control, trajectory planning, autonomous flight control, obstacle detection and avoidance, path planning algorithms.

UNIT V DRONE APPLICATIONS AND EMERGING TRENDS 9

Applications in agriculture, surveillance, disaster management, delivery systems, mapping and surveying, AI-based drones, swarm robotics, future trends in UAV technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, students will be able to

CO1 : Explain drone architecture and UAV systems.
CO2 : Apply aerodynamics and flight principles in drones.
CO3 : Analyze sensors and control systems used in UAVs.
CO4 : Analyze navigation and autonomous flight techniques.
CO5 : Identify real-world applications and emerging drone technologies.

TEXT BOOKS:

1. Reg Austin, Unmanned Aircraft Systems: UAV Design, Development and Deployment, Wiley, 2023 Edition.
2. Kimon P. Valavanis, Advances in Unmanned Aerial Vehicles, Springer, 2022 Updated Edition.

REFERENCE BOOKS:

1. Rafael Yanushevsky, Guidance of Unmanned Aerial Vehicles, CRC Press, 2023 Edition.
2. Abdul Basit et al., Drone Technology in Engineering Applications, Elsevier, 2024 Edition.
3. S. N. Omkar, Unmanned Aerial Vehicles: A Primer on Drone Technology, CRC Press, 2024 Edition.

CO- PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	2	2
CO2	3	3	-	2	-	2	-	-	-	-	2	2	2
CO3	3	2	-	2	-	2	-	-	-	-	2	2	2
CO4	3	3	-	2	-	2	-	-	-	-	2	3	3
CO5	3	3	-	2	-	-	-	-	-	-	2	3	3
AVG.	**3**	**2.6**	-	**2**	-	**2**	-	-	-	-	**2**	**2.4**	**2.4**

1 - Low, 2 - Medium, 3 – High