MAHENDRA ENGINEERING COLLEGE

Autonomous| Accredited by NAAC with 'A++' Grade (Cycle-2)

Accredited by NBA Tier-I (WA) UG : CSE, ECE, EEE

Mahendhirapuri, Mallasamudram (W), Namakkal (Dt) - 637 503, Tamil Nadu

04288-288 500 / 521 / 522 | www.mahendra.info

DEPARTMENT OF MECHANICAL ENGINEERING

B.E. Mechanical Engineering

Choice Based Credit System (CBCS)

R 2024 Curriculum and Syllabi

Institute -Vision, Mission

Vision

To be an internationally recognized institute for engineering education and research with ethical values

Mission

- To ensure the effective use of resources to mould the students as professionals and entrepreneurs
- To enhance the industry institute interaction for innovative technology practice
- To encourage the faculty members and students for advanced research
- To inculcate ethical values among the faculty members and students.

Department -Vision, Mission

Vision

- To enable Mechanical Engineering Graduates excel in engineering education, research and innovation with ethical values as global practitioners.

Mission

- To impart quality education, enhance student's skills and make them to compete globally
- To provide State-of-the-Art technologies and enhance students problem solving skills in Mechanical Engineering
- To prepare graduates to pursue lifelong learning, intellectually with ethical values in Mechanical Engineering as professionals and entrepreneurs
- To expand students' knowledge in the Mechanical Engineering domain to conduct research and innovate for a sustainable development.

Department of Mechanical Engineering

Program Educational Objectives (PEOs)

The graduates of Mechanical Engineering will be able to

PEO1: Apply the mathematical and scientific concepts necessary to formulate, solve and analyze engineering problems.

PEO2: Conceptualize and synthesize data, carry out product design and development.

PEO3: Work in teams on multidisciplinary projects.

PEO4: Observe professional ethics and develop successful careers globally

Program Outcomes (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

PSO1: Identify, understand, apply and solve problems in Mechanical Engineering Design.

PSO2: Identify, understand, apply and find solutions for problems in Manufacturing Engineering.

PSO3: Identify, understand, apply and provide solutions for problems in Thermofluid Industrial Applications.

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2024

I Semester

Sl. No.	Course code	CourseTitle	L	T	P	C	Cate-gory
THEORY							
1	24MA12101	Engineering Mathematics-I	3	1	0	4	BS
2	24HS11001	Communicative English	3	0	0	3	SH
3	24CY12001	Engineering Chemistry	3	0	0	3	BS
4	24GE13101	Engineering Drawing	2	0	2	3	ES
5	24HS11002	Heritage of Tamils	1	0	0	1	SH
6	24SH61101	Induction Program	-	-	-	-	MC
PRACTICAL							
7	24HS21001	Personality Development Practice	0	0	2	1	SH
8	24CY22001	Chemistry Laboratory	0	0	3	1.5	BS
9	24GE23101	Computer Aided Drafting and Modeling Laboratory	0	0	3	1.5	ES
		TOTAL	12	1	10	**18**	

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2024

II Semester

Sl. No.	Course code	CourseTitle	L	T	P	C	Cate-gory
THEORY							
1	24MA12201	Engineering Mathematics-II	3	1	0	4	BS
2	24PY12001	Engineering Physics	3	0	0	3	BS
3	24CS13001	Problem Solving Techniques using C	3	0	0	3	ES
4	24EE13001	Basics of Electrical and Electronics Engineering	3	0	0	3	ES
5	24GE13201	Engineering Mechanics	3	0	0	3	ES
6	24HS11003	Tamils and Technology	1	0	0	1	SH
PRACTICAL							
7	24PY22001	Engineering Physics Laboratory	0	0	3	1.5	BS
8	24CS23001	Problem Solving Techniques Laboratory	0	0	3	1.5	ES
9	24GE23001	Engineering Practices Laboratory	0	0	3	1.5	ES
		TOTAL	16	1	9	**21.5**	

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2024

III Semester

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	24MA12301	Transforms and Partial Differential Equations	3	1	0	4	BS
2	24ME14301	Material Science and Metallurgy	3	0	0	3	PC
3	24ME14302	Manufacturing Processes	3	0	0	3	PC
4	24ME14303	Strength of Materials	3	0	0	3	PC
5	24ME14304	Engineering Thermodynamics	3	0	0	3	PC
6		Open Elective-I	3	0	0	3	OE
7	24CY11001	Environmental Science And Sustainability	2	0	0	0	MC
PRACTICAL							
8	24ME24301	Strength of Materials Laboratory	0	0	3	1.5	PC
9	24ME24302	Computer Aided Machine Drawing Laboratory	1	0	2	2.0	PC
		TOTAL	**21**	**1**	**5**	**22.5**	

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2024

IV Semester

Sl. No.	Course code	CourseTitle	L	T	P	C	Cate-gory
THEORY							
1	24MA12405	Statistics And Numerical Methods	3	1	0	4	BS
2	24ME14401	Fluid Mechanics and Machinery	3	0	0	3	PC
3	24ME14402	Metrology and Measurements	3	0	0	3	PC
4		Professional Elective-I*	3	0	0	3	PE
5		Professional Elective-II	3	0	0	3	PE
6		Open Elective-II	3	0	0	3	OE
7	24HS11006	Universal Human Values	3	0	0	3	SH
PRACTICAL							
7	24HS21002	Professional Communication Skills	0	1	2	2.0	SH
8	24ME24401	Fluid Mechanics and Machinery Laboratory	0	0	3	1.5	PC
9	24ME24402	Metrology and Measurements Laboratory	0	0	3	1.5	PC
		TOTAL	**21**	**2**	**8**	**27**	

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2024

V Semester

Sl. No.	Course code	CourseTitle	L	T	P	C	Cate-gory
THEORY							
1	24ME14501	Thermal Engineering	3	0	0	3	PC
2	24ME14502	Design of Machine Elements	3	0	0	3	PC
3	24ME14503	Manufacturing Technology	3	0	0	3	PC
4		Professional Elective- III**	3	0	0	3	PE
5		Professional Elective-IV	3	0	0	3	PE
6		Open Elective-III	3	0	0	3	OE
7	24HS11004	Constitution of India	2	0	0	0	MC
PRACTICAL							
8	24HS21003	Interview Skills and Soft Skills	0	0	4	2.0	SH
9	24ME24501	Thermal Engineering Laboratory	0	0	3	1.5	PC
10	24ME24502	Manufacturing Laboratory	0	0	3	1.5	PC
11	24ME25501	Internship	0	0	2	1.0	PC
		TOTAL	**20**	**0**	**12**	**24**	

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2024

VI Semester

Sl. No.	Course code	CourseTitle	L	T	P	C	Cate-gory
THEORY							
1	24ME14601	Theory of Machines	3	0	0	3	PC
2	24ME14602	Heat and Mass Transfer	3	0	0	3	PC
3	24ME14603	Design of Transmission Systems	3	0	0	3	PC
4	24ME16601	Principles of Management	3	0	0	3	EEC
5		Professional Elective-V	3	0	0	3	PE
6		Professional Elective-VI	3	0	0	3	PE
PRACTICAL							
7	24ME24601	Theory of Machines Laboratory	0	0	3	1.5	PC
8	24ME24602	Heat and Mass Transfer Laboratory	0	0	3	1.5	PC
9	24ME36601	Design and Fabrication Project	0	0	4	2.0	EEC
		TOTAL	**18**	**0**	**10**	**23**	

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2024

VII Semester

Sl. No.	Course code	CourseTitle	L	T	P	C	Category
THEORY							
1	24ME14701	Industrial Automation	3	0	0	3	PC
2	24ME14702	Finite Element Analysis	3	0	0	3	PC
3	24ME14703	Operations Research	3	0	0	3	PC
4		Professional Elective-VII	3	0	0	3	PE
5		Professional Elective-VIII	3	0	0	3	PE
6		Professional Elective-IX	3	0	0	3	PE
PRACTICAL							
7	24ME24701	Industrial Automation Laboratory	0	0	3	1.5	PC
8	24ME24702	Analysis and Simulation Laboratory	0	0	3	1.5	PC
9	24ME36701	Project Work(Phase-I)	0	0	6	3.0	EEC
		TOTAL	**18**	**0**	**12**	**24**	

	MAHENDRA ENGINEERING COLLEGE (Autonomous) DEPARTMENT OF MECHANICAL ENGINEERING	

	CBCS - Regulation 2024						
	VIII Semester						
Sl. No.	**Course code**	**CourseTitle**	**L**	**T**	**P**	**C**	**Cate-gory**
PRACTICAL							
1	24ME36801	Project Work(Phase-II)	0	0	12	6	EEC
		TOTAL	**0**	**0**	**12**	**6**	

Total Credit: 166

Subject Category	**Credits per semester**								**Credit total**	**% of Credits (Actual Credits / Total Credits)**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
SH	5	1	-	5	2	-	-	-	13.0	7.8
BS	8.5	8.5	4	4	-	-	-	-	25.0	15.1
ES	4.5	12	-	-	-	-	-	-	16.5	10.0
PC	-	-	15.5	9	13	12	12		61.5	37.0
PE	-	-	-	6	6	6	9	-	27.0	16.3
OE	-	-	3	3	3	-	-	-	9.0	5.4
EEC	-	-	-	-	-	5	3	6	14.0	8.4
MC	0	-	0	-	0	-	-	-	0	0.0
Total Credits	**18**	**21.5**	**22.5**	**27**	**24**	**23**	**24**	**6**	**166**	**100**

MAHENDRA ENGINEERING COLLEGE
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING

Professional Elective Courses : Verticals

Thermal Engineering	Design Engineering	Manufacturing and Materials Engineering	Industrial System and Design	Mobility Systems	Robotics and Automation
24ME15101 Renewable Energy	24ME15201 Design of Jigs, Fixtures and Press Tools	24ME15301 Composite Materials, Processing and Application	24ME15401 Maintenance Engineering	24ME15501Automobile Engineering	24ME15601 Industrial Robotics
24ME15102 Gas Dynamics and Jet Propulsion	24ME15202 Process Planning and Cost Estimation	24ME15302 Computer Intergraded Manufacturing	24ME15402 Digital Manufacturing and IoT	24ME15502 Conventional and Futuristic Vehicle Technology	24ME15602 Hydraulics and Pneumatics System
24ME15103 Power Plant Engineering	24ME15203 Geometric Dimension, Tolerance and Modeling*	24ME15303 Engineering Economics and Cost Analysis	24ME15403 Manufacturing Information Systems	24ME15503 Renewable Powered Off Highway Vehicles and Emission Control Technology	24ME15603 Sensors and Instrumentation
24ME15104 Refrigeration and Air Conditioning	24ME15204Value Engineering	24ME15304 Smart Materials and Applications	24ME15404 Industrial Safety	24ME15504 Vehicle Health Monitoring, Maintenance and Safety	24ME15604 Embedded Systems and Programming
24ME15105 Heating Ventilation and Air Conditioning	24ME15205 Additive Manufacturing and Wireframe Modeling**	24ME15305 Non-Destructive Testing	24ME15405 Plant Layout and Material Handling	24ME15505 CAE and CFD Approach in Future Mobility	24ME15605 Smart Mobility and Intelligent Vehicles
24ME15106 Computational Fluid Dynamics	24ME15206 Computational Solid Mechanics	24ME15306 Supply Chain Management	24ME15406 Industrial Engineering and Management	24ME15506 Hybrid and Electric Vehicle Technology	24ME15606 Electrical Drives and Actuators

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24MA12101	**Engineering Mathematics-I** (Common to all Branches)	3	1	0	4	100

Objective(s)	To enable the students to: • Learn the types of matrices and linear algebra in a comprehensive manner. • Familiarize with functions of several variables and its applications toengineering. • Define the geometric aspects of curvature, radius of curvature, evolutes and envelopesas application of differential calculus. • Explain various techniques of integration. • Learn double and triple integrals and give their representation as area and volume.

UNIT-I	**Matrices**	**9+3**
Matrix and its types – Rank of matrix –Solving system of linear equations - Characteristic equation - Eigenvalues and Eigenvectors of the matrix - Cayley-Hamilton Theorem, Diagonalization of real and symmetric matrices by Orthogonal transformation – Reduce the quadratic form to canonical form.		
UNIT-II	**Differential Calculus of Several Variables**	**9+3**
Differentiation of implicit functions – Partial derivatives – Total derivative – Euler's theorem – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.		
UNIT-III	**Applications of Differential Calculus**	**9+3**
Curvature in Cartesian co-ordinates– Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes – Evolute as envelope of normals and their properties.		
UNIT-IV	**Integral Calculus**	**9+3**
Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals – Applications to Engineering problems.		
UNIT-V	**Multiple Integrals**	**9+3**
Double integrals in Cartesian co-ordinates – Change of order of integration – Area as double integral – Triple integral in Cartesian co-ordinates – Volume as triple integral – Change of variables in double integrals. Applications to Engineering problems.		
	Total hours	**60**

Outcome(s)	At the end of the course the students will be able to: • Determine the rank of a matrix, eigenvalues, eigenvectors and inverse of a given matrix and diagonalize symmetric matrix by orthogonal transformations, solve system of linear equations. • Determine maxima and minima of functions of several variables. • Apply the concepts of differential calculus in physical problems. • Apply different methods of integration in solving practical problems. • Compute the area and volume by using multiple integrals.

TEXT BOOK :

1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2017.
2	James Stewart, Calculus with Early Transcendental function, Cengage, 2013.

REFERENCES:

1	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2016.
2	Ray Wylie, Louis C. Barrett, Advanced Engineering Mathematics, McGraw-Hill, 2013.
3	Ben Orlin, Change is the Only Constant: The Wisdom of Calculus in a Madcap World, Pearson 2018.

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24HS11001	**Communicative English** (Common to all B.E/B.Tech Degree Programmes)	3	0	0	3	100

Objective(s)	• To help learners to improve their knowledge of grammar • To enable them to use vocabulary appropriately in different academic and professional contexts • To support learners to acquire listening and speaking skills • To facilitate them to develop their reading skills by familiarizing different types of reading strategies • To equip them with writing skills needed for academic as well as professional context

UNIT-I	**9**
Listening- Listening to Short Conversations (Formal and Informal) **Speaking** – Introducing Oneself and Others **Reading** – Skimming and Scanning-Reading Comprehension Passages and Answering Multiple Choice Questions **Writing** - Leave/On Duty application, Bonafide Certificate-requisition, Check list, Instructions **Grammar & Vocabulary** – Parts of Speech, Articles, Prefixes and Suffixes	
UNIT-II	**9**
Listening – Listening to Telephonic Conversations **Speaking** –Word Building Activity **Reading** – Short stories **Writing**- Recommendations, Composing E-Mail(Formal & Informal), Letter Writing- Letter to the Editor **Grammar & Vocabulary** – Sentence Pattern, Tenses, British Terms and American Equivalents	
UNIT-III	**9**
Listening - Listening to TED Talks and Note taking **Speaking** – Role Play **Reading** –Cloze Reading and Fill up the Gaps **Writing** - Letter Writing – Permission Letter (In-Plant Training/Industrial Visit), Business letters- Calling for Quotation and Placing Order **Grammar & Vocabulary** – Modal Verbs, Voice- Active Voice, Passive Voice and Impersonal Passive, Numerical Expressions	
UNIT-IV	**9**
Listening - Listening to Audio Lectures **Speaking** – Taking part in Casual Conversation **Reading** - Reading Advertisements **Writing** – Poster Making, and Job Application **Grammar & Vocabulary** – Cause and Effect Expressions, Question tags, Gerunds and Infinitives, One word substitution	
UNIT-V	**9**
Listening – Listening to Academic lectures **Speaking** – Describing Objects **Reading** – Transcoding (Conversion of Flow Chart, Bar chart, Pie chart into a paragraph) **Writing** –Review writing (Films & Books), Essay Writing **Grammar & Vocabulary** – If Conditionals, Concord, Same Word used as Noun and Verb, Nominal Compounds	
Total hours	**45**

Outcome(s)	At the end of the course, the learners will be able to • Develop listening and reading skills and comprehend the academic articles in English • Develop vocabulary skills and use words appropriately in different academic contexts. • Analyze and interpret the data with correct usage of grammar • Demonstrate effective LSRW skills with emerging technology • Create strong communication skills in both personal and professional life

TEXT BOOK :	
1	Murphy, Raymond, *English Grammar in Use*, Fifth Edition. Cambridge University Press, New Delhi, 2019
2	N.P.Sudharshana and C.Savitha, *English For Technical Communication*, Cambridge University Press, New Delhi, 2016
REFERENCES:	
1	Lewis Norman, *Word Power Made Easy*, Goyal Publishers: New Delhi. 2020.
2	Ashraf Rizvi. *Effective Technical Communication*, Tata McGraw Hill, 2017.
3	Jack C. Richards with Jonathan Hull and Susan Proctor, *Interchange*. 4th Edition, Cambridge University Press, New Delhi, 2016
EXTENSIVE READING:	
1	Khera, Shiv. *You can Win*. Macmillan, Delhi. 2014
WEBSITES:	
1	http://www.englishclub.com
2	http://www.talkenglish.com
3	https:// www.ted.com/talks
4	https://nptel.ac.in/

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24CY12001	Engineering Chemistry	3	0	0	3	100

Objective(s)	To make the students familiar with: • The treatment of water used for domestic and industrial purpose. • Various types of polymers in our day today life. • The basic principle and preparation methods of Nanomaterials. • The Construction and applications of different types of batteries. • The preparation, properties and combustion method of fuels.

UNIT-I	**Water Technology**	**9**

Types of water - Alkalinity, types and determination - Hardness, types and Estimation by EDTA method. Domestic water treatment – disinfection methods (Chlorination, ozonation, UV treatment) – Boiler feed water – requirements – Decreased efficiency of using hard water in boilers – external conditioning – demineralization process, Electro dialysis process, reverse osmosis - Internal conditioning (phosphate, calgon and carbonate conditioning methods) – Conservation of Water using 3R method– WHO and BIS guidelines for drinking water.

UNIT-II	**Polymer Chemistry**	**9**

Introduction - Classification of polymers – Natural and synthetic - Thermoplastic and Thermosetting - Functionality – Degree of polymerization - Types and mechanism of polymerization: Addition (Free Radical); condensation and copolymerization - Preparation, properties & applications of selected commodity and engineering polymers (Polyester, Polystyrene, PVC, Nylon, Teflon, Bakelite and Epoxy resin).

UNIT-III	**Nanochemistry**	**9**

Basic - Distinction between molecules, nanoparticles and bulk materials - size-dependent properties (optical, electrical, mechanical and magnetic) - Types of nanomaterials: Definition, properties and uses of –nanoparticles, nanocluster, nanorod, nanotube and nanowire - Synthesis of nanomaterials: laser ablation, Sol gel, Synthesis of Carbon nano tubes by CVD Method- SWCNT and MWCNT- Applications (Medicine, Agriculture and Electronics).

UNIT-IV	**Energy Storage Device**	**9**

Types of batteries - Primary battery - dry cell - Secondary battery - Construction and application of lead acid battery and Lithium ion batteries – Battery used in EV application – Nuclear energy – Fission and Fusion reactions – Light water nuclear reactor for power generation (block diagram only) - Fuel cell (H2-O2) - Super Capacitors.

UNIT-V	**Fuels and Combustion**	**9**

Introduction - classification of fuels - Coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - Petroleum - manufacture of synthetic petrol (Bergius process) - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - flue gas analysis (ORSAT Method).

Total hours	**45**

Outcome(s)	At the end of the course the student will be able to • Explain the various water quality parameters and their treatments for domestic and industrial applications. • Classify the reaction mechanism, synthesis and application of polymers. • Develop the essential concepts of nanoscience and nanotechnology in designing the nanomaterial for Engineering. • Compare the working principles of batteries and super capacitors. • Illustrate the suitable fuels for engineering processes and applications.

TEXT BOOK :

1	Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2022.
2	Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2021.
3	Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2019.
4	Lindsay S.M., "Introduction to Nanoscience" Oxford University, 2009.

REFERENCES:	
1	Dr.C.K.Charles and Dr.G.Ramachandran, “Applied Chemistry”, CARS Publishers,Chennai,2015
2	Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2012.
3	Linden’s “Handbook of Batteries”, Thomas B. Reddy, Fourth Edition McGraw-Hill, New York, 2011.
4	Shikha Agarwal,”Engineering Chemistry-Fundamental and Application”,Cambridge University press,Delhi,Second Edition,2019.

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24GE13101	**Engineering Drawing** (Common to Non circuit Branches)	2	0	2	3	100

Objective(s)	• To impart knowledge on the importance and standards of engineering drawing in the field of engineering and technology. • To train students in basic geometrical constructions, engineering curves, and scales used in engineering applications. • To develop the ability to visualize and draw orthographic projections of points, lines, and planes. • To enable the students to understand and draw projections of solids, sectioned solids, and their developments. • To familiarize students with the concepts of isometric and perspective projections for 3D visualization.

UNIT-I	**Plane Curves and Free Hand Sketching**	**9**

Importance of drawing in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Basic Geometrical constructions, Curves used in engineering practices: Conics –Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid –construction of involutes of square and circle – Drawing of tangents and normal to the above curves, Scales: Construction of Diagonal and Vernier scales.
Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects.

UNIT-II	**Projection of Points, Lines and Plane Surfaces**	**9**

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

UNIT-III	**Projection of Solids**	**9**

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

UNIT-IV	**Projection of Sectioned Solids and Development of Surfaces**	**9**

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

UNIT-V	**Isometric and Perspective Projections**	**9**

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

Total hours	**45**

Outcome(s)	• Apply the fundamentals of engineering drawing and geometrical constructions. • Construct various plane curves and scales used in engineering. • Visualize and draw orthographic projections of points, lines, and planes. • Visualize and construct projections of solids and sectioned solids. • Develop the surfaces of solids and apply isometric and perspective projection techniques.

TEXT BOOK :

1	S.Gowri &K.Jayapoovan, "Engineering Graphics" 6th Edition, Vikas Publication New Delhi
2	N S Parthasarathy and Vela Murali, "Engineering Drawing" Oxford University Press 2015.
3	K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited, 2011.

REFERENCES:	
1	M.B. Shah and B.C. Rana, “Engineering Drawing”, Pearson Education 2005.
2	K. R. Gopalakrishnana, “Engineering Drawing” (Vol.I&II), Subhas Publications 1998.
3	Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
4	Dhananjay A.Jolhe, “Engineering Drawing with an introduction to AutoCAD” Tata McGraw Hill Publishing Company Limited 2008.

CO MAPPING WITH POs AND PSOs

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	1	-	-	-	-	1	-	-
CO2	3	2	-	-	1	-	-	-	-	1	-	-
CO3	3	2	-	-	1	-	-	-	-	1	-	-
CO4	3	2	-	-	1	-	-	-	-	1	-	-
CO5	3	2	-	-	1	-	-	-	-	1	-	-

MAHENDRA ENGINEERING COLLEGE

Autonomous| Accredited by NAAC with 'A++' Grade (Cycle-2)
Accredited by NBA Tier-I (WA) UG : CSE, ECE, EEE
Mahendhirapuri, Mallasamudram (W), Namakkal (Dt) - 637 503, Tamil Nadu
04288-288 500 / 521 / 522 | www.mahendra.info

Regulations 2024

Semester - I
(Common to all B.E./B.Tech. Programmes)

Course Code	Course Name	Periods/Week			Credit	Maximum Marks
		L	T	P	C	
24HS11002	தமிழர் மரபு	1	0	0	1	100

அலகு 1	மொழிமற்றும் இலக்கியம்	3

இந்தியமொழிக் குடும்பங்கள்–திராவிடமொழிகள்–தமிழ்ஒருசெம்மொழி–தமிழ்செவ்வியக்கங்கள்–சங்கஇலக்கியத்தின் சமயச் சார்பற்றதன்மை–சங்கஇலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில்மேலாண்மைக் கருத்துக்கள்–தமிழ்க் காப்பியங்கள், தமிழகத்தில்சமணபௌத்தசமயங்களின் தாக்கம் –பக்திஇலக்கியம், ஆழ்வார்கள்மற்றும் நாயன்மார்கள்– சிற்றிலங்கியங்கள்–தமிழில்நவீனஇலக்கியத்தின் வளர்ச்சி –தமிழ்இலக்கிய வளர்ச்சியில்பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு 2	மரபு–பாறைஓவியங்கள்முதல்நவீனஓவியங்கள்வரை–சிற்பக் கலை	3

நடுகல்முதல்நவீனசிற்பங்கள்வரை–ஐம்பொன் சிலைகள்–பழங்குடியினர் மற்றும் அவர்கள்தயாரிக்கும் கைவினைப் பொருட்கள்,பொம்மைகள்–தேர் செய்யும் கலை–சுடுமண் சிற்பங்கள்–நாட்டுப்புறத் தெய்வங்கள்– குமரிமுனையில்திருவள்ளுவர் சிலை–இசைக் கருவிகள்–மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூகபொருளாதாரவாழ்வில்கோவில்களின் பங்கு.

அலகு 3	நாட்டுப்புறக் கலைகள்மற்றும் வீரவிளையாட்டுகள்	3

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

அலகு 4	தமிழர்களின் திணைக் கோட்பாடுகள்	3

தமிழகத்தின் தாவரங்களும் விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்கஇலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள்–தமிழர்கள்போற்றிய அறக்கோட்பாடு–சங்ககாலத்தில்தமிழகத்தில்எழுத்தறிவும் கல்வியும் – சங்ககாலநகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில்ஏற்றுமதிமற்றும் இறக்குமதி– கடல்கடந்தநாடுகளில்சோழர்களின் வெற்றி.

அலகு 5	இந்தியதேசியஇயக்கம் மற்றும் இந்தியபண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3

இந்தியவிடுதலைப்போரில்தமிழர்களின் பங்கு–இந்தியாவின் பிறப்பகுதிகளில்தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதைஇயக்கம் – இந்தியமருத்துவத்தில்,சித்தமருத்துவத்தின் பங்கு–கல்வெட்டுகள்,கையெழுத்துப்படிகள்– தமிழ்ப் புத்தகங்களின் அச்சுவரலாறு.

TOTAL – 15 PERIODS

MAHENDRA ENGINEERING COLLEGE
Autonomous| Accredited by NAAC with 'A++' Grade (Cycle-2)
Accredited by NBA Tier-I (WA) UG : CSE, ECE, EEE
Mahendhirapuri, Mallasamudram (W), Namakkal (Dt) - 637 503, Tamil Nadu
04288-288 500 / 521 / 522 | www.mahendra.info

Regulations 2024

Semester - I

(Common to all B.E./B.Tech. Programmes)

Course code	Course Name	Periods/week			Credit	Maximum marks
		L	T	P	C	
24HS11002	HERITAGE OF TAMILS	1	0	0	1	100

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, VilluPattu, KaniyanKoothu, 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 HOURS	**15**

	TOTAL – 15 PERIODS
TEXT BOOK ANDREFERENCE BOOKS	
1.	தமிழகவரலாறு–மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடுதமிழ்நாடுபாடநூல்மற்றும் கல்வியியல்பணிகள்கழகம்)
2.	கணினித் தமிழ்–முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி–வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம் (தொல்லியல்துறைவெளியீடு)
4.	பொருநை–ஆற்றங்கரைநாகரிகம் (தொல்லியல்துறைவெளியீடு)
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.Subaramanian, 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) (Publishedby: The Author)
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24HS21001	Personality Development Practice	0	0	2	1	100

Objective(s)	• To develop listening and speaking skills of students for a variety of purposes like making presentations, attending interviews and participating in discussions • To enhance the non-verbal and social interaction skills of students for becoming effective communicators • To enable learners to hone their linguistic (LSRW) skills with the help of Technology

LIST OF EXPERIMENTS

1	Importance of Communication Skills
2	Building Vocabulary (Basic level)
3	Stage Dynamics (Group PPT Presentation)
4	Predicting the Content of a Given Article (Newspaper, Magazine, etc.,)
5	Common Errors in English
6	Interview Skills
7	Presentation skills
8	Group Discussion
9	Soft Skills (Self-Confidence, Team Work, Time Management, Adaptability, Openness to Criticism)
10	Creative Writing – Any Essay type (Descriptive, Narrative etc.)
	Total hours 45

Outcome(s)	**At the end of the course, the students will be able to** • Understand the language proficiency and its techniques • Prepare the resume with organized details • Develop soft skills to excel in their career

REFERENCES:

1	Joshi, Manmohan, Soft Skills, 1st Edition. Bookboon, 2017
2	Raman, Meenakshi & Sangeeta Sharma. Technical Communication: Principles and Practice, Ed.III, Oxford University Press, New Delhi. 2015

WEBSITES:

1	https:// www.ted.com/talks
2	https://quizziz.com
3	www.pdfdrive.com
4	https://nptel.ac.in/

ACTIVITY:

1	Worksheets for relevant topics

COs Vs POs and PSOs Mapping

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

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24CY22001	Chemistry Laboratory	0	0	3	1.5	100

Objective(s)	• To inculcate experimental skills to test basic understanding of water quality parameters, such as, alkalinity, hardness, DO and chloride. • 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 design and plan the experimental procedure and to record and process the results.

LIST OF EXPERIMENTS

1	Determination of Total, Temporary & Permanent hardness of water using EDTA method.
2	Determination of the Alkalinity level of a water sample.
3	Determination of Chloride content of water sample by Argentometry.
4	Determination of DO content of water sample using Winkler's method.
5	Determination of molecular weight of polyvinyl alcohol using Viscometry.
6	Estimation of Iron content of the given solution using Potentiometry.
7	Determination of strength of given hydrochloric acid using pH meter.
8	Conduct metric titration of strong acid vs strong base.
9	Determination of strength of acids in a mixture using Conductometry.
10	Estimation of sulphate in a solution using Conductometry (precipitation).
	Total hours **45**

Outcome(s)	On completion of this course, students will have the knowledge in • Explain the essential principles and their analysis of water quality parameters, like hardness, alkalinity, DO, and chloride. • Experiment with different types of instruments for analysis of materials using small quantities involved for quick and accurate results. • Analyze the normality of different types of materials such as PVA and Ferrous ion.

TEXT BOOK

1	Chemistry lab Manual, Department of Chemistry, Mahendra Engineering College, Mallasamudram, 2022.
2	Chemistry lab Manual, Department of Chemistry, Mahendra Engineering College, Mallasamudram, 2020.

REFERENCES

1	Applied chemistry theory and practice by O. P. Vermani and A. K. Narula, second edition.
2	J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis (2009).
3	Kolthoff I.M. and Sandell E.B. et al. Quantitative chemical analysis, Mcmillan, Madras 1980

COs Vs POs and PSOs Mapping

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24GE23101	Computer Aided Design and Drafting Laboratory	0	0	3	1.5	100

Objective(s)	• To produce accurate orthographic, sectional, and isometric drawings using conventional and Computer-Aided Design (CAD) methods. • To effectively apply CAD software in developing engineering graphics. • To understand the application of solid modeling and surface development techniques through practical CAD exercises.

Projection of Solids – Introduction to CAD - Projection of solids: prisms, pyramids, cylinders, cones (axis inclined to one plane).

- Projection of a cylinder with its axis inclined to HP
- Projection of a cone with its axis inclined to VP

Section of Solids and Development of Surfaces - Sectioning of solids (prisms, pyramids, cylinders, cones) using inclined cutting plane to one reference plane and perpendicular to the other – True shape of section. Development of lateral surfaces including solids with cylindrical cutouts.

- Sectional view of a truncated cone and cylinder
- Sectional view of a prism and pyramid
- Development of lateral surfaces of simple and truncated solids (prisms, pyramids, cylinders and cones)
- Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

Isometric and Perspective Projections - Isometric scale, projection of solids (prisms, pyramids, cylinders, cones) – Perspective projections using visual ray method.

- Isometric projection of a cylinders and cones
- Isometric projection of a truncated prism and pyramid
- Perspective projection of a pyramid
- Perspective projection of a cylinder

LIST OF EQUIPMENTS

1. Hardware with graphics facility - 30 No.
2. Drafting and Modeling software - 30 users

Total hours: 30

Outcome(s)	• Use Computer-Aided Drafting (CAD) software to construct and modify engineering drawings • Use CAD software to develop sectional drawings, development of surfaces and apply appropriate dimensioning practices. • Use CAD software to produce isometric and perspective projections

COs Vs POs and PSOs Mapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	3	3	-	-	1	-	1	-	1
CO2	1	2	-	3	3	-	-	1	-	1	-	1
CO3	1	2	-	3	3	-	-	1	-	1	-	1
Avg.	1	2	-	3	3	-	-	1	-	1	-	1

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24MA12201	Engineering Mathematics - II	3	1	0	4	100

Objective(s)	To enable the students to: • Define vector function, operators and working procedure to evaluate line, surface and volume integrals. • Explain different types of higher order ordinary differential equations withvariable coefficients and various methods to solve the equations. • Learn Laplace transform, inverse Laplace transform and its properties to solve differential equations. • Know about functions of complex variables, properties and problems involving conformal mapping. • Learn about Taylor's and Laurent's series expansion of complex functions andthe process of evaluating complex integrals.

UNIT-I	**Vector Calculus**	**9+3**

Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs).Verification and application in evaluating line, surface and volume integrals.

UNIT-II	**Ordinary Differential Equations of Higher Orders**	**9+3**

Second and Higher order linear differential equations with constant coefficients– Method of variation of parameters – Cauchy Euler equation, Legendre's type differential equations – System of simultaneous linear differential equations with constant coefficients.

UNIT-III	**Laplace Transform**	**9+3**

Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem, solving Initial value problems by Laplace Transform method.

UNIT-IV	**Analytic Functions**	**9+3**

Functions of a complex variable, Cauchy-Riemann equations – Analytic functions – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w= z+c, cz, 1/z, and Bilinear transformation.

UNIT-V	**Complex Integration**	**9+3**

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula(without proof) – Taylor and Laurent expansions –Types of Singularities-Singular points – Residues – Residue theorem(without proof) – Application of residue theorem to evaluate real integrals – Contour integration.

Total hours	**60**

Outcome(s)	At the end of the course the students will be able to • Solve problems related to vector differentiation, line, surface and volume integrals and theorems involving them. • Solve higher order differential equations with variable coefficients. • Describe Laplace transform and its properties inverse Laplace transform and the solution of linear differential equation using Laplace transform techniques. • Solve Analytic functions, harmonic functions, conformal mapping and its applications. • Expand the functions as Taylor's and Laurent's series and evaluate the complex integrals.

TEXT BOOK :

1	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2017.
2	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2018.

REFERENCES:

1	Michael D. Greenberg, Advanced Engineering Mathematics, Pearson 2013.
2	Lokenath Debnath and Dambaru Bhatta,"Integral Transforms and Their Applications, CRC Press 2015.
3	Dennis G. Zill and Warren S. Wright "Advanced Engineering Mathematics", Jones and Bartlett2014.

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24PY12001	Engineering Physics (For all branches)	3	0	0	3	100

Objective(s)	• To provide fundamental knowledge about lasers, Ultrasonic's, Properties of Matter, Quantum Physics and different kinds of Engineering Materials. • To correlate the principles with application oriented Engineering studies.

UNIT-I	**Laser and Fiber Optics**	**9**

Introduction – Principle of spontaneous emission, stimulated absorption and emission – Einstein's coefficient (derivation) – Types of lasers - CO_2, Nd: YAG – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibers (material, refractive index and mode) – losses associated with optical fibers - fiber optic sensors: pressure and displacement.

UNIT-II	**Ultrasonics**	**9**

Introduction – Production – magnetostriction effect - magnetostriction generator – piezoelectric and inverse piezoelectric effect- piezoelectric generator – properties – Cavitations - Velocity measurement – acoustic grating – SONAR - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C –scan displays-Industrial Applications and medical applications-medical endoscope.

UNIT-III	**Properties of Matter**	**9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT-IV	**Quantum Physics**	**9**

Black body radiation – Planck's theory (derivation) –wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box– scanning tunneling microscope- electron tunneling microscope.

UNIT-V	**Advanced Engineering Materials**	**9**

Smart materials: Shape-memory alloys: Martensite, Austenite, Two way shape memory, characteristics and applications – Metallic glasses – Origin – Preparation – Structure, mechanical and electrical properties.
Biomaterials: First, second and third generation biomaterials – Classification – Metals and alloys – Polymers – Hydrogels – Applications in medicine: Skin and Blood interfacing implants.

Total hours	**45**

Outcome(s)	After completing the course the students • Understand the basics of Laser, Fiber Optics and its types with its applications in various fields. • Gain knowledge about Ultrasonic's their applications in various engineering fields. • Have the necessary understanding on Properties of materials and their uses. • Get Knowledge on basics concepts of Quantum Physics with their Applications. • Understand the properties of SMA, metallic glasses, bio materials and their applications.

TEXT BOOK :

1	Dr. G. Senthil kumar - Engineering Physics-VRB Publication & Co, Chennai- Latest edition 2022.
2	Dr. P.K. Palanisamy , "Engineering Physics", Sci tech Publications, Chennai, 2022.
3	Biomaterial Science and Engineering- JB Park- Plenum Press, NewYork(2014).
4	M N Avadhanulu, A Textbook of Engineering Physics (2008), S. Chand Publishing, New Delhi.
5	Bhattacharya, D.K. & Poonam, T. ―Engineering Physics. Oxford University Press, 2015.

REFERENCES:

1	Pillai S O, "Engineering Physics" (2014), New Age International Publishers, New Delhi.
2	Karl F Renk, Basics of Laser Physics (2017)-Springer International Publishing, Switzerland.

3	Introduction to Quantum Mechanics- J Griffiths-2nd edition(2016).
4	Halliday.D, Resnick.R. & Walker.J, Principles of Physics (2020), Wiley.
5	Serway, R.A. & Jewett, J.W. ―Physics for Scientists and Engineers. Cengage Learning, 2010.
6	William T. Silfvast, Laser Fundamentals (2014), Cambridge University Press.

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24CS13001	Problem Solving Techniques Using C	3	0	0	3	100

Objective(s)	The student should be made to: • Understand the basics of computer and algorithm • Learn the basic concepts of C Programming. • Know the arrays and functions in C • Be familiar with pointers and structures in C • Learn the file handling techniques and preprocessors in C

UNIT-I	**Problem Solving Aspects**	**9**
Computers: Hardware – Software – Processor – Memory – I/O devices – Interface – Programming Languages Problem Solving Aspects: Algorithms Pseudo code, Flowchart-Steps in Problem Solving – simple strategies for developing algorithms (iteration, recursion) – Steps for Creating and Running programs -Illustrative problems: Exchanging The Values – Find minimum in a list - Factorial Computation - Fibonacci Sequence		
UNIT-II	**C Programming Basics**	**9**
Introduction to C programming – Header files – Structure of a C program – compilation and linking processes – Constants, Variables – Data Types – Expressions-, Expression Evaluation, Type conversion Statements – operators – Input and Output operations – Decision Making and Branching – Looping statements- Programming Examples		
UNIT-III	**Arrays and Function**	**9**
Arrays: Introduction – One-Dimensional Arrays – Two and multi-Dimensional Arrays - Strings: Operations of Strings. Function – definition of function – Declaration of function – Function prototype – Types of functions- user defined functions – Pass by value – Pass by reference – Recursion - Programming Examples		
UNIT-IV	**Pointers and Structures**	**9**
Pointers - Definition – Initialization - Pointer variables, Pointer arithmetic, Pointers to Pointers, Pointers with Arrays, Pointers with Functions- Introduction to Structure – structure definition – Structure declaration – Structure within a structure-Structures fusion with Arrays- Unions – Storage classes		
UNIT-V	**File Processing**	**9**
Files: File modes – File functions – Types of file processing: Sequential access, Random access – Text and binary files - Command line arguments – C Preprocessor directives: Macros – Definition – Types of Macros - Creating and implementing user defined header files		
	Total hours	**45**

Outcome(s)	Upon completion of this course , students will be able to • Illustrate algorithms for real time problems through various problem solving techniques • Explain the syntax of C Programming • Summarize the concept of arrays and functions in C • Apply the concepts of pointers and structure • Develop the concepts of files and preprocessors in C

TEXT BOOK :

1	Anita Goeland Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India)Pvt. Ltd. Pearson Education, 2016

REFERENCES:

1	Dromey R.G, "How to Solve it by Computer" Prentice Hall of India, Delhi., 2010.
2	E Balagurusamy, "Computer Programming", First Edition, Tata McGraw Hill Education (India) Private Ltd, New Delhi., 2013.

3	Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", 2nd Edition, Oxford University Press. 2013.
4	M.Rajaram and P.Uma Maheshwari " Computer Programming with C", Pearson Education., 2013.
5	NPTEL course, Problem Solving Through Programming in C, https://nptel.ac.in/courses/106105171
6	NPTEL course, Introduction to Programming in C, https://nptel.ac.in/courses/106104128

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24EE13001	Basics of Electrical and Electronics Engineering	3	0	0	3	100

Objective(s)	• To study the basic concepts of electrical circuits and measuring instruments • To understand the operation of magnetic circuits and electrical machines • To study the concepts of semiconductor devices • To acquire knowledge on the concepts of integrated circuits • To impart knowledge on the basic concepts of communication systems

UNIT-I	**Electrical Circuits and Measurements**	**9**
Ohm's Law – Kirchhoff's Law- Voltage and Current Sources- Basics of Resistance, Inductance, and Capacitance- Series and Parallel circuits- Average value and RMS value – Power and Power Factor- Classification of Instruments – Moving coil and Moving Iron Instruments – Energy Meter-Residential wiring - Earthing.		
UNIT-II	**Electrical Machines**	**9**
Introduction to Magnetic circuits, Faraday's law, Lenz's Law, Fleming's Left-Hand and Right-Hand Rule-Construction and Working Principle: DC Machines -Single phase Transformer – Three phase Squirrel Cage Induction motor- Single phase Induction motor (Qualitative treatment only).		
UNIT-III	**Semiconductor Devices**	**9**
PN Junction Diode –Characteristics – Half wave and Full wave Rectifiers –Zener diode- Characteristics-Voltage Regulator-Bipolar Junction Transistor, FET, JFET-Characteristics.		
UNIT-IV	**Digital ICS and Microcontroller**	**9**
Boolean Algebra - Logic gates - Demorgan's Theorem - Combinational circuits: Adder, Subtractor, Multiplexer, Demultiplexer - Pin Details and Architecture of Microprocessor (8086) and Microcontroller (8051).		
UNIT-V	**Communication Systems**	**9**
Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations (Qualitative Treatment). Communication Systems: TV, Modem, Microwave, Satellite and Mobile communication (Block Diagram Approach only)		
	Total hours	**45**

Outcome(s)	At the end of the course, students will be able to: • Summarize the concepts of electrical circuits and measuring instruments • Illustrate the constructional features and working principle of Electrical machines • Explain the operation of semiconductor devices • Interpret the concepts of integrated circuits • Discuss the basic concepts of Communications systems

TEXT BOOK :

1	V.K Mehta and Rohit Mehta, "Principle of Electrical Engineering and Electronics" S Chand & Company, Third Edition, 2016.
2	S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits", Tata McGraw Hill, Second Edition, 2011.
3	Edward Hughes, "Hughes Electrical and Electronic Technology", Pearson Education, tenth Edition 2008.
4	David A. Bell, "Electronic Devices and Circuits", Oxford University Press, Fifth Edition, 2008.

REFERENCES:

1	Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, Seventh Education, 2006.
2	William H. Hayt, J.V. Jack, E. Kemmebly and steven M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, Sixth, Edition, 2002.

3	J. Millman&Halkins, SatyebrantaJit, “Electronic Devices & Circuits”, Tata McGraw Hill, Second Edition, 2008.
4	**NPTEL :** Prof. L. Umanand, Basic Electrical Technology, IISc Bangalore https://nptel.ac.in/courses/108108076 Prof. M.B. Patil Basic Electronics IIT Bombay https://onlinecourses.nptel.ac.in/noc21_ee55/preview

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24GE13201	**Engineering Mechanics** (Common to Non Circuit Branches)	3	0	0	3	100

Objective(s)	**Students should develop the ability to:** • Work comfortably with basic engineering mechanics concepts required for analyzing static structures. • Model the problem using good free-body diagrams and accurate equilibrium equations. • Apply pertinent mathematical, physical and engineering mechanical principles to the system to solve and analyze the problem. • Understand the meaning of centers of gravity (mass)/centroids and moment of inertia using integration methods. • Gain knowledge in basic design concepts of statics and dynamics of the particle.

UNIT-I	**Statics of Particle**	**9**
Introduction to Mechanics – Fundamental Principles -Units and Dimensions – Laws of Mechanics- Principle of transmissibility- Lame's theorem, Parallelogram and triangular Law of forces- Vectorial representation of forces and moments, Coplanar forces– Resolution and Composition of forces – Equilibrium of particles - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Single equivalent force.		
UNIT-II	**Statics of Rigid Body**	**9**
Free body diagram – Types of supports and their reactions-requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis– Vectorial representation of moments and couples – Scalar components of a moment- Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions.		
UNIT-III	**Properties of Sections**	**9**
Centroid – Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus and Guldinus – Second moment of area — Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula –Parallel axis theorem - perpendicular axis theorem – Product of inertia of plane areas -Polar moment of inertia – Principal axes- Mass moment of inertia of thin rectangular section.		
UNIT-IV	**Dynamics of Particles**	**9**
Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law- D'Alembert's principle – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies- Impact - direct and central impact – coefficient of restitution.		
UNIT-V	**Friction**	**9**
Friction force – Laws of sliding friction -Laws of Coloumb friction – equilibrium analysis of simple systems with sliding friction –wedge friction - equilibrium analysis of simple contact friction –ladder friction - Rolling resistance-Applications of screw jacks and belts.		
	Total hours	**45**

Outcome(s)	End of the learning students will have an ability to: • Analyze the engineering problems in case of equilibrium conditions. • Calculate the reaction forces of various supports on the structural members. • Evaluate various geometrical properties like centroid, centre of gravity, moment of inertia of various surfaces and solids. • Solve the problems involving dynamics of particles and rigid bodies. • Define the effects of friction and its applications, also compute various frictional components.

TEXT BOOK :

1	R.C. Hibbeller, "Engineering Mechanics – Statics and Dynamics", 11th ed., Pearson Education Asia Pvt. Ltd., 2009.
2	Ferdinand P. Beer, E. Russell Johnston, Vector Mechanics for Engineers: Statics and Dynamics (9th Edition),

	Tata McGraw-Hill International Edition, 2010.
3	Dr.N.Koteeswaran, "Engineering Mechanics Statics and Dynamics", Sri Balaji Publications 9th Rv.Ed., S.Chand & Co Ltd, 2013.
4	Vela Murali, "Engineering Mechanics", Oxford University Press 2010.
REFERENCES:	
1	M.S. Palanichamy and S. Nagam, "Engineering Mechanics – Statics & Dynamics", 3rd ed., Tata McGraw-Hill, 2004.
2	S. Rajasekaran, G. Sankarasubramanian, "Fundamentals of Engineering Mechanics", 3rd ed., Vikas Publishing House Pvt. Ltd, 2009.
3	Kumar, K.L., "Engineering Mechanics", 3rd Revised Edition, Tata McGraw-Hill Publishing company, New Delhi 2008.
4	Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", 4th ed., – Pearson Education Asia Pvt. Ltd., 2005.

CO MAPPING WITH POs AND PSOs

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

MAHENDRA ENGINEERING COLLEGE

Autonomous | Accredited by NAAC with 'A++' Grade (Cycle-2)
Accredited by NBA Tier-I (WA) UG : CSE, ECE, EEE
Mahendhirapuri, Mallasamudram (W), Namakkal (Dt) - 637 503, Tamil Nadu
04288-288 500 / 521 / 522 | www.mahendra.info

Regulations 2024

Semester - II
(Common to all B.E./B.Tech. Programmes)

Course Code	Course Name	Periods/Week			Credit	Maximum Marks
		L	T	P	C	
24HS11003	தமிழரும் தொழில்நுட்பமும்	1	0	0	1	100

அலகு 1	நெசவுமற்றும் பானைத் தொழில்நுட்பம்	3

சங்ககாலத்தில்நெசவுத் தொழில்–பானைத் தொழில்நுட்பம் – கருப்புசிவப்புபாண்டங்கள்–பாண்டங்களில்கீறல்குறியீடுகள்

அலகு 2	வடிவமைப்புமற்றும் கட்டிடத் தொழில்நுட்பம்	3

சங்ககாலத்தில்வடிவமைப்புமற்றும் கட்டுமானங்கள்&சங்ககாலத்தில் வீட்டுப் பொருட்களில்வடிவமைப்பு–சங்ககாலத்தில்கட்டுமானபொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில்மேடைஅமைப்பு பற்றிய விவரங்கள்–மாமல்லபுரச் சிற்பங்களும்,கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள்மற்றும் பிறவழிபாட்டுத் தலங்கள்–நாயக்கர் காலக் கோயில்கள்–மாதிரிகட்டமைப்புகள் பற்றி அறிதல், மதுரைமீனாட்சிஅம்மன் ஆலயம் மற்றும் திருமலைநாயக்கர் மஹால்–செட்டிநாட்டுவீடுகள்–பிரிட்டிஷ்காலத்தில்சென்னையில்இந்தோ–சாரோசெனிக் கட்டிடக் கலை.

அலகு 3	உற்பத்தித் தொழில்நுட்பம்	3

கப்பல்கட்டும் கலை–உலோகவியல்–இரும்புத் தொழிற்சாலை–இரும்பைஉருக்குதல், எஃகு–வரலாற்றுச் சான்றுகளாகசெம்புமற்றும் தங்கநாணயங்கள்–நாணயங்கள்அச்சடித்தல்–மணிஉருவாக்கும் தொழிற்சாலைகள்–கல்மணிகள், கண்ணாடிமணிகள்–சுடுமண் மணிகள்–சங்குமணிகள்–எலும்புத் துண்டுகள்–தொல்லியல்சான்றுகள்–சிலப்பதிகாரத்தில்மணிகளின் வகைகள்.

அலகு 4	வேளாண்மைமற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்	3

அணை, ஏரி, குளங்கள், மதகு–சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் – கால்நடைபராமரிப்பு–கால்நடைகளுக்காகவடிவமைக்கப்பட்ட கிணறுகள்–வேளாண்மைமற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள்–கடல்சார் அறிவு–மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல்–பெருங்கடல் குறித்த பண்டையஅறிவு–அறிவுசார் சமூகம்.

அலகு 5	அறிவியல்தமிழ்மற்றும் கணித்தமிழ்	3

அறிவியல்தமிழின் வளர்ச்சி –கணித்தமிழ்வளர்ச்சி –தமிழ்நூல்களைமின்பதிப்புசெய்தல்–தமிழ்மென்பொருட்கள்உருவாக்கம் – தமிழ்இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில்தமிழ்அகராதிகள்–சொற்குவைத் திட்டம்,

TOTAL – 15 PERIODS

MAHENDRA ENGINEERING COLLEGE

Autonomous| Accredited by NAAC with 'A++' Grade (Cycle-2)
Accredited by NBA Tier-I (WA) UG : CSE, ECE, EEE
Mahendhirapuri, Mallasamudram (W), Namakkal (Dt) - 637 503, Tamil Nadu
04288-288 500 / 521 / 522 | www.mahendra.info

Regulations 2024

Semester - II

(Common to all B.E./ B.Tech. Programmes)

Course code	Course Name	Periods/week			Credit	Maximum marks
		L	T	P	C	
24HS11003	TAMILS AND TECHNOLOGY	1	0	0	1	100

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	**HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE**	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)- ThirumalaiNayakarMahal - 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 KumizhiThoompu 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 HOURS	**15**

TEXT BOOK ANDREFERENCE BOOKS	
1.	தமிழகவரலாறு–மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடுதமிழ்நாடுபாடநூல்மற்றும் கல்வியியல்பணிகள்கழகம்)
2.	கணினித் தமிழ்–முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி–வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம் (தொல்லியல்துறைவெளியீடு)
4.	பொருநை–ஆற்றங்கரைநாகரிகம் (தொல்லியல்துறைவெளியீடு)
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.Subaramanian, 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) (Publishedby: The Author)
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24PY22001	**Physics Laboratory** (For All Branches)	0	0	3	1.5	**100**

Objective(s)	• To provide exposure to the students with hands on experience on various basic Physics practices for all branches.

LIST OF EXPERIMENTS

1	(a) Determination of Wavelength, and particle size using Laser (b) Determination of acceptance angle in an optical fiber.
2	Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3	Determination of Thickness of a thin wire-Air Wedge
4	Determination of wavelength of mercury spectrum – spectrometer grating
5	Determination of Young's modulus by Non uniform bending method
6	Determination of viscosity of liquid – Poiseuilles method
7	Determination of Rigidity modulus -Torsional Pendulum
8	Determination of Band gap of a semiconductor-PN Diode
9	Determination of Young's modulus by Uniform bending method (Choose Any 7 Experiments)
	Total hours **45**

Outcome(s)	• Apply experimental techniques to measure fundamental physical properties such as wavelength, particle size, and material constants using optics and mechanical methods. • Analyze and interpret experimental data to determine mechanical properties like Young's modulus, rigidity modulus, and viscosity of fluids through appropriate instrumentation. • Demonstrate proficiency in performing semiconductor and ultrasonic experiments to evaluate electrical and acoustic properties of materials.

REFERENCES

1	Physics Laboratory Manual (2023), Department of Physics, Mahendra Engineering College, Namakkal.
2	Geeta Sanon, B.Sc Practical Physics, 5th Edn. (2015), R. Chand & Co.
3	C. L. Arora B.Sc. Practical Physics (2001), S. Chand and Company Limited, New Delhi.
4	Indu Prakash and Ramakrishna, A. K. Jha (2012), A Text Book of Practical Physics, Kitab Mahal, New Delhi.
5	D. P. Khandelwal, A Laboratory Manual of Physics: For Undergraduate Classes (1985), Vani Educational books, New Delhi.

CO MAPPING WITH POs AND PSOs

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

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24CS23001	**Problem Solving Techniques Using C Laboratory** (Common to All Branches)	0	0	3	1.5	**100**

Objective(s)	The student should be made to: • Understand developing applications using Office package. • Formulate problems and implement algorithms using Scratch and Raptor tool • Make use of arrays and functions in C. • Learn how to use pointer concepts. • Know the concepts of structures, unions and files

LIST OF EXPERIMENTS

1	Prepare A bio-data Using MS Word With Appropriate Page ,Text And Table Formatting Options And Send The Same To Recipients Using Mail Merge
2	Create budget planning of your family with cell referencing, formulae, conditional formatting using Excel
3	Create a Program flow to illustrate the use of Variables and Constants using Scratch Tool
4	Construct flowchart to find the Factorial for a given number Using Raptor
5	Students mark generation using decision statements
6	Calculator using switch statement
7	Prime number generation and to check whether the given number is armstrong or not using looping
8	Greatest number using array (one dimensional)
9	Matrix multiplication using array (two dimensional)
10	Check the given string is palindrome or not.
11	Write a C Program to swap two numbers using two functions one using pointer and other one without using pointer
12	Factorial calculation and Fibonacci series using function
13	Student mark sheet using structures
14	Copy text from one file to other File
	Total hours **30**

Outcome(s)	Upon completion of this course , students will be able to • Demonstrate the applications of Office Packages • Solve the real world problems using Scratch and Raptor Tool • Develop programs using arrays and functions in C. • Illustrate the working of pointers in C • Develop the concepts using structures, unions and files in C

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24GE23001	Engineering Practices Laboratory	0	0	3	1.5	100

Objective(s)	• To understand the fundamentals of various carpentry and plumbing tools and fabricate various carpentry joints. • To understand the basic manufacturing processes and perform simple welding, sheet metal, lathe and drilling operations. • To learn the concepts of electrical wiring and power measurements. • To study the concepts of electronic devices.

LIST OF EXPERIMENTS

Civil and Mechanical Engineering Practices	
1. Making of carpentry joints T-joint, Lap-joint, Dovetail Joint 2. Pipe connections with different joining components. 3. Connections of Two Galvanised Iron Pipe	CO1
4. Preparation of arc welding of butt joints, lap joints and tee joints. 5. Fabrication of sheet metal tray and funnel 6. Facing, plain turning and step turning using lathe 7. Drilling operations	CO2
Electrical and Electronic Engineering Practices	
1. Residential House Wiring using Switches, Fuse, Indicator, Lamp and Energy meter 2. Two way, CFL and LED Lamp Wiring 3. Measurement of Voltage, Current and Power 4. Measurement of Energy using Single Phase Energy Meter	CO3
5. Soldering Practice –Assembly of Electronic Components 6. Verification of Logic Gates 7. V-I Characteristics of PN Junction and Zener Diode 8. Half Wave and Full Wave Rectifiers	CO4
Total hours: 30	

Outcome(s)	**At the end of the course, students will be able to:** • Acquire the knowledge about Plumbing & Carpentry components Joining the two woods and pipes. • Fabricate the models of sheet metal and welding joints and Perform facing, plain turning, step turning and drilling operations. • Demonstrate the domestic wiring and power measurements. • Demonstrate the operation of Electric Circuits and PN Junction Diode.

CO MAPPING WITH POs AND PSOs

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	3	1	-	-	-	-	1	-	1
CO2	1	-	-	3	1	-	-	-	-	1	-	1
CO3	1	2	-	3	1	-	-	-	-	1	-	1
CO4	1	2	-	3	1	-	-	-	-	1	-	1
Avg.		2	-	3	1	-	-	-	-	1	-	1

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24MA12301	Transforms and Partial Differential Equations	3	1	0	4	100

Objective(s)	To enable students to • Acquire knowledge of Z- transform to solve difference equations. • Learn about Fourier transforms, inverse Fourier transform and its properties and apply convolution theorem and Parseval's identity to various functions. • Construct Fourier series of various functions and to compute harmonics of Fourier series. • Understand the partial differential equation concepts. • Study the method of separation of variables and solving boundary value problems using Fourier series.

UNIT-I	**Z -Transforms and Difference Equations**	**9+3**
Z-transforms - Elementary properties – Inverse Z-transform – Partial fraction and Residue method-Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.		
UNIT-II	**Fourier Transforms**	**9+3**
Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.		
UNIT-III	**Fourier Series**	**9+3**
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.		
UNIT-IV	**Partial Differential Equations**	**9+3**
Formation of partial differential equations – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Homogeneous linear partial differential equations of second and higher order with constant coefficients.		
UNIT-V	**Applications of Partial Differential Equations**	**9+3**
Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.		
	Total hours	**60**

Outcome(s)	At the end of the course, the students will be able to • Apply the knowledge of Z-transform to the analysis of digital filters and discrete signals. • Solve the problems using Fourier integral and convolution theorem technique. • Apply Fourier series techniques in solving heat flow problem used in various situations. • Formulate and solve first and higher order partial differential equations. • Solve real time Engineering problems using Partial differential equations.

TEXT BOOK :

1	Dr.P.Kandasamy , Dr.K.Thilagavathy and Dr.K.Gunavathy, " Engineering Mathematics Volume – III",S.Chand & company Ltd. New Delhi, 2012.
2	Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.

REFERENCES:

1	Erwin Kreyszig, Advanced Engineering Mathematics.2011, John Wiley & Sons, 2010.
2	Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Laxmi Publications Pvt Ltd., 2012.
3	Veerarajan.T, "Transforms and Partial Differential Equations" , Tata McGraw Hill, 2011.

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14301	Material Science and Metallurgy	3	0	0	3	100

Objective(s)	• To impart knowledge on the structure, properties and phase diagrams • To understand the advantages of heat treatment and the method of heat treatmentprocesses. • To Learn ferrous and non-ferrous metals for various applications • To understand need and application of polymer and composite materials. • To learn powder metallurgy processes.

UNIT-I	**Alloys and Phase Diagrams**	**9**

Constitution of alloys- Solid solutions, substitutional and interstitial- phase diagrams, isomorphous, eutectic, eutectoid, peritectic reactions, iron carbon equilibrium diagram. Classification of steel and cast iron microstructure, Materials characterization techniques, properties and application.

UNIT-II	**Heat Treatment**	**9**

Definition- Full annealing, stress relief, recrystallisation and spheroidising, normalising, hardening and tempering of steel. Isothermal transformation diagrams- cooling curves superimposed on isothermal diagram- Harden ability, Jominy end quench test - Austempering, martempering – 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- α and β stabilisers– stainless and tool steels – HSLA, Maraging steels –Cast Iron - Grey, white, malleable, spheroidal – alloy cast irons, Copper and copper alloys – Brass, Bronze and Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys, Mg-alloys, Ni- based super alloys and Titanium alloys.

UNIT-IV	**Non-Metallic Materials**	**9**

Polymers–types of polymer, Properties and applications of various thermosetting and thermoplastic polymers- Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON –Composites- Classifications- Metal Matrix and FRP - Applications of Composites.

UNIT-V	**Powder Metallurgy**	**9**

Powder metallurgy process, Preparation of powders, Characteristics of metal powders, Mixing, Compacting, Sintering, Applications of powder metallurgy

Total hours	**45**

Outcome(s)	• Identify the properties of metals with respect to crystal structure and grain size and interpret the phase diagrams of materials. • Describe the concept of heat treatment of steels & strengthening mechanisms • Classify and Distinguish different types of cast irons, steels and non ferrous alloys • Explain types and manufacturing of polymers and composite materials. • Explain powder metallurgy process and applications

TEXT BOOK :

1	Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1994.
2	Williams D Callister, "Material Science and Engineering an introduction" Wiley India Pvt Ltd, 2006.
3	Lawrence H. Van Vlack, "Elements of Material Science and Engineering", Pearson publications, 2011.

REFERENCES:	
1	Raghavan.V, “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd., 2015.
2.	Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited. 2019.
3	Rajput.R.K “Material Science and Engineering”, SK Kataria & Sons, 2009.

CO MAPPING WITH POs AND PSOs

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	1	-	-	-	-	-	1	-	3	-
CO2	3	-	-	-	-	1	-	-	-	-	-	1	-	3	-
CO3	3	-	-	-	-	1	-	-	-	-	-	1	-	3	-
CO4	3	-	-	-	-	1	-	-	-	-	-	1	-	3	-
CO5	3	-	-	-	-	1	-	-	-	-	-	1	-	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14302	Manufacturing Processes	3	0	0	3	100

Objective(s)	• To illustrate the working principles of various metal casting processes. • To learn and apply the working principles of various metal joining processes. • To analyse the working principles of bulk deformation of metals. • To learn the working principles of sheet metal forming process. • To study and practice the working principles of plastics molding.

UNIT-I	**Metal Casting Processes**	**9**

Sand Casting : Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding 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 process – Stir casting; Defects in Sand casting.

UNIT-II	**Metal Joining Processes**	**9**

Fusion welding processes - Arc welding equipments - Electrodes - Coating and specifications- Principles and applications of TIG, MIG, Submerged, Plasma arc welding, Laser beam welding processes. Solid state welding –Friction, Explosive and ultrasonic welding -Gas welding - Equipments used - Flame characteristics - Filler and Flux materials - Brazing and soldering process.- Weld defects.

UNIT-III	**Metal Forming Processes**	**9**

Rolling: Classification of rolling processes- Rolling mill- Rolling of bars and shapes- Rolling defects. Forming: Forming methods- Explosive forming- electromagnetic forming- Electro hydraulic forming.

UNIT-IV	**Theory of Metal Cutting and Sheet Metal Forming**	**9**

Material removal processes- Types of machine tools- Chip formation- Single and multi-point cutting- Orthogonal cutting- Cutting tool materials- Tool wear- Tool life- Surface finish- Cutting fluids.-Sheet metal characteristics – Typical shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods.

UNIT-V	**Turning and Hole Making**	**9**

Lathe: Specifications of centre lathe- Operations performed-Accessories and attachments- Principle of capstan and turret lathes. Hole making: drilling – Introduction, Reaming, Boring, Tapping – Other Hole – Making Operations.

Total hours	**45**

Outcome(s)	• Explain the various casting methods and casting defects. • Select the different types of welding processes used for industrial fabrication process. • Summarize various hot working and cold working methods of metals. • Explain the sheet metal forming processes and make simple sheet metal components. • Outline the construction features and operations performed in lathe and drilling

TEXT BOOK :

1	Sharma, P.C., "A Text Book of Production Technology", S.Chand and Company, Ltd., 2004.
2	Hajra Choudhury S.K. and Hajra Choudhury A.K., "Element of Manufacturing Technology Vol. I", Media Publications, 2013.
3	S.Gowri, P.Hariharan, and A.Suresh Babu, "Manufacturing Technology 1", Pearson Education, 2008.
4	P.N .Rao Manufacturing Technology Volume 1 McGraw-Hill Education 5th edition, 2018.

REFERENCES:	
1	Rao P.N., Manufacturing Technology Vol. I, Foundry, Forming and Welding, TMH, 5th Edition, 2018.
2	Rao P.N., Manufacturing Technology Vol. II, Metal cutting and Machine Tools, McGraw-Hill Education,4th Edition, 2018.
3	Kalpakjian S., "Manufacturing Engineering and Technology", Pearson Education India Edition, 8th Edition, 2020.

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14303	Strength of Materials	3	0	0	3	100

Objective(s)	• To understand the fundamental concepts of stress, strain and elastic constants of solids under external loading. • To learn about the transverse loading and bending loads acting on structural components. • To learn about the deformation of shafts and springs subjected to torsion. • To know about the various methods for calculating deflection of beams. • To learn about the various stresses acting in shell structures like thin cylinders and spheres.

UNIT-I	Stress, Strain and Deformation of Solids	9

Stress and strain – Types of basic stresses - Factor of safety- Deformation of simple and compound bars under axial load- Thermal stresses in simple and compound bar- Poisson's ratio, volumetric strain, relationship between elastic constants- strain energy- gradually applied, suddenly applied and impact loads.

UNIT-II	Transverse Loading on Beams and Stresses In Beams	9

Types of beams: Supports and Loads, Shear force and bending moment diagram in determinate beams. Theory of simple bending – assumptions - Shear stress distribution – Evaluation of bending stress and shear stress in rectangular, circular, T sections and I section.

UNIT-III	Torsion	9

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts –Power transmitted .Helical springs -open and closed coiled including Wahl Factor under axial load- Leaf springs- elliptical and semi elliptical type- applications.

UNIT-IV	Deflection	9

Computation of slopes and deflections of determinate beams by Double integration method -Macaulay's Method- Area moment method, Columns and struts– Euler equation and its limitations –Rankine's formula for columns and struts.

UNIT-V	Analysis of Stresses In Two Dimensions	9

State of stress at a point –normal and tangential stresses on a given plane, principal stresses, principal stresses and their planes, planes of maximum shear stress, analytical method and Mohr's circle method. Stresses in thin cylindrical and spherical shells under internal pressure-changes in dimensions and volume.

Total hours	**45**

Outcome(s)	**After successful completion of the course, the student would be able to:** • Explain the Basic concepts of stress and strain in of solids. • Analyze beams to determine shear forces, bending moments and axial forces and also they will be in a position to assess the behavior of columns, beams and failure of materials. • Design shafts to transmit required power and springs for its maximum energy storage capacities. • Evaluate the slope and deflection of beams and buckling loads of columns under different boundary conditions. • Analysis of Stresses in two dimensions in principal stresses, principal strains and Stresses in thin cylindrical and spherical shells under internal pressure.

TEXT BOOK :

1.	Bansal R.K. "A Text Book of Strength of materials, Laxmi Publications (P), New Delhi, 6th Edition, 2022.
2.	Ferdinand Beer, E. Johnston, John DeWolf and David Mazurek Mechanics of Materials", McGraw-Hill Book Co, Eight Edition, 2020

3.	R.K.Rajput, ,"Strength of Materials",S.Chand Publications,2015.
4.	Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2012.
REFERENCES:	
1.	Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 2015.
2.	Strength of materials by S.Ramamrutham, Dhanpat Rai & Co. (P) Ltd, 2014.
3.	Subramanian R, "Strength of materials", Oxford University Press, New Delhi, 2nd Edition 2011

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14304	Engineering Thermodynamics	3	0	0	3	100

Objective(s)	• To understand principles of thermodynamics and to use it in accounting for the bulk behavior of the simple physical systems. • To provide an in-depth study of thermodynamic principles, thermodynamics of state, basic thermodynamic relations, Principle of Psychometric and Properties of pure substances. • To enlighten the basic concepts of vapour power cycles. • To understand the various gas laws and equations of state and apply them to solve problems of gas mixtures in estimating enthalpy, entropy, internal energy and heat transfer.

UNIT-I	**Basic Concept and First Law**	**9**

Basic concepts - Thermodynamic systems - closed, open and isolated. Property, point and path function. Zeroth law of thermodynamics. Law of conversion of energy. – Concept of temperature and heat. Molar specific heat of a gas. First law of thermodynamics – application to closed and open systems, steady flow process with reference to various. Limitations of first law of thermodynamics.

UNIT-II	**Second Law**	**9**

Second law of thermodynamics – Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot theorem, Carnot cycle, reversed Carnot cycle, efficiency, COP, concept of entropy, entropy of ideal gas.

UNIT-III	**Properties of Pure Substance and Steam Power Cycle**	**9**

Properties of pure substances – Thermodynamic properties of pure substances liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done through a non- flow processes. Standard Rankine cycle and Reheat cycle.

UNIT-IV	**Ideal and Real Gases and Thermodynamic Relations**	**9**

Gas mixtures – properties ideal and real gases, equation state, Avogadro's Law, Vander Waal's equation of state, compressibility factor– Dalton's law of partial pressure, T-D relations, Maxwell's relations, Clausius Clapeyron equations, Joule –Thomson coefficient.

UNIT-V	**Psychrometry**	**9**

Psychrometry and psychometric charts, property calculations of air vapour mixtures. Psychometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling

Total hours	**45**

Outcome(s)	• Describe the basic concepts of thermodynamic processes and first law of thermodynamics. • Solve the problems by using the second law of thermodynamics. • Calculate the thermodynamic properties of pure substances using the steam table. • Distinguish the behavior of real & ideal gases and derive the thermodynamic relations. • Apply the psychometric concepts in various processes.

TEXTBOOK:

1	P.K.Nag, "Engineering Thermodynamics", TMH, New Delhi, 2013
2	R.K.Rajput, "Engineering Thermodynamics" Laxmi Publications, New Delhi,2010
3	Yonus A Cengel and Michale A Boles, Thermodynamics: An Engineering Approach, McGraw Hill, 2002

REFERENCES:

1	Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 1995.
2.	Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
3	Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24CY11001	Environmental Science and Sustainability	2	0	0	0	100

Objective(s)	To make the students familiar with : • The importance of Environment and Ecosystem. • The basic concepts of biodiversity and emphasize on the biodiversity of India and its conservation. • The causes, effects and prevention measures of environmental pollution. • The social issues of the environment and National laws for environment protection. • The concept of sustainable development goals and appreciate the inter dependence of economic and social aspects of sustainability, recognize and analyze.

UNIT-I	**Environment & Ecosystem**	**9**
Definition, Scope and Importance of Environment – Need for public awareness – Ecosystem: concept of an ecosystem – structure and function of an ecosystem – energy flow in the ecosystem - Introduction, types, characteristic features, structure and function of the terrestrial (Forest and Grass land) ecosystem.		
UNIT-II	**Biodiversity and Its Conservation**	**9**
Biodiversity: Introduction – definition - genetic, species and ecosystem diversity - Value of biodiversity – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity – Field visit to local area.		
UNIT-III	**Environmental Pollution**	**9**
Definition – causes, effects and control measures of: (a) Air, (b) Water, (c) Soil, (d) Noise pollution– solid waste management: causes, effects and control methods of municipal solid wastes – E-waste and plastic waste: recycling and reuse - role of an individual in prevention of pollution – pollution case studies (vizag gas leakage)		
UNIT-IV	**Social Issues & Environmental Impact Assessment**	**9**
Social issues – Climate change, global warming, acid rain, ozone layer depletion, case studies (Global warming). – EPA: Environment protection act - EIA: EIA structure- methods of baseline data acquisition. Planning and management of impact studies - operational aspects of EIA - methods for impact identification.		
UNIT-V	**Sustainability and Management**	**6**
Development , GDP ,Sustainability- concept, needs and challenges - economic, social and aspects of sustainability - from unsustainability to sustainability - millennium development goals, and protocols- Sustainable Development Goals - targets, indicators and intervention areas.		
	Total hours	**45**

Outcome(s)	At the end of the course the student will be able to • Explain the importance of Environment and types of Ecosystem. • Classify the biodiversity and measure the variety of animals, plants and microbial species. • Identify the different types of Pollution and be familiar with control measures • List out the environmental issues and essential legislation on environmental laws. • Recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

TEXT BOOK :

1	Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press (2015)
2	Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2017.
3	Dr.A.Ravikrishnan, "Environmental Science and Engineering" , Sri Krishna Hi-tech Publishing Company Pvt. Ltd.

	Chennai, 2014.
4	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
REFERENCES:	
1	R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
2	Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 3nd Edition, Pearson Education, 2023.
3	Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi, 2007.

CO MAPPING WITH POs AND PSOs

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

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24ME24301	**Strength of Materials Laboratory**	0	0	3	1.5	**100**

Objective(s)	• To supplement the theoretical knowledge gained in Mechanics of materials with practical testing for determining the strength of materials under externally applied loads. This would enable the student to have a clear understanding of the design for strength and stiffness. • 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 a mild steel rod
2	Double shear test on mild steel
3	Torsion test on mild steel rod
4	Impact test on metal specimen
5	Hardness test on metals - Brinnell and Rockwell Hardness
6	Deflection test on cantilever beam
7	Deflection test on simply supported beam.
8	Compression test on open coiled helical springs
9	Compression test on closed coil helical springs
10	Test on Cement
11	Verification of Maxwell's reciprocal theorems.
	Total hours **45**

LIST OF EQUIPMENTS

1	Universal Tensile Testing machine with double Shear attachment –1 No
2	Torsion Testing Machine -1 No.
3	Impact Testing Machine -1 No.
4	Brinell Hardness Testing Machine -1 No.
5	Rockwell Hardness Testing Machine -1 No.
6	Spring Testing Machine for tensile and compressive loads - 1 No.
7	Le Chatelier's apparatus -1 No.
8	Vicat's apparatus -1 No.
9	Mortar cube moulds- 5 Nos.

Outcome(s)	• The students will have the required knowledge in the area of testing of materials and components of structural elements experimentally.

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME24302	Computer Aided Machine Drawing Laboratory	1	0	2	2	100

Objectives	• To make the students understandable on drawings of machine components as per standard. • To familiarize the students with Indian standards on drawing practices of engineering components. • To gain practical experience in 3D part, assembly modeling and drafting using design tool.

UNIT-I	**Introduction to machine drawing**	**4**
Conventional representation of common machine elements such as screws, bolts, nuts, keys, gears, bearings, couplings, webs, ribs etc., Types of sections – Parts not usually sectioned.		
UNIT-II	**Production Drawing**	**4**
Understand Machine Components and Assemblies; Fasteners and Joints. Bolts & Nuts, Cotter joints and couplings. Assemblies – Bearings, Tool and Work holding devices, IC Engines Components.		
UNIT-III	**Two Dimensional Drafting**	**7**
Two dimensional modeling and drafting.		
UNIT-IV	**Three Dimensional Modeling**	**15**
Three Dimensional Modeling of Bearings, Tool and Work holding devices.		
UNIT-V	**Three Dimensional Modeling**	**15**
IC Engines Components and Assemblies.		
	Total hours	**45**

Outcomes	Upon completion of this course, the students will be able to • Demonstrate the drawing standards, limits, fits and tolerances. • Design the part drawings, sectional views of machine components as per standards. • Design the part, assembly modeling and drafting of engineering components as per standards.

LIST OF EQUIPMENTS (for a batch of 30 students)

1. Hardware with graphics facility - 30 No.
2. Drafting and Modeling software - 30 users
3. Laser Printer or Plotter to print / plot drawings - 1 No

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24MA12405	Statistics And Numerical Methods (Chemical & Mechanical Engineering)	3	1	0	4	100

Objective(s)	To enable students to • Study the types of small sample tests. • Acquire the knowledge of design of experiment. • Understand the solution of algebraic and transcendental equations and study the methods to solve linear system of equations by direct and iterative methods. • Interpolate the values of a function using Lagrange's, Newton's and cubic spline polynomial approximations. • Evaluate the derivatives using finite differences and evaluate single and double integrals by numerical integration methods.

UNIT-I	**Testing of Hypothesis**	**9+3**

Probability-Axiom of probability- Conditional probability-Statistics – Definition, Types of variables – Organizing data – Measures of Central tendency: Mean Median and Mode Sampling distributions –Test for single mean, proportion and difference of means (Large and small samples) – Test for single variance and equality of variances - Chi-Square Test for goodness of fit and independents of attributes.

UNIT-II	**Design of Experiments**	**9+3**

Completely Randomized Design – Randomized Block Design – Latin Square Design – 2^2 &2^3-Factorial Design – Taguchi Design

UNIT-III	**Numerical Solution Of Equations**	**9+3**

Solution of Algebraic and transcendental equation – Iteration method and Newton - Raphson method – Solution of linear system of equations -Gaussian elimination and Gauss-Jordon method– Iterative method –Gauss Jacobi and Gauss-Seidel methods – Matrix inversion by Gauss Jordon method

UNIT-IV	**Interpolation and Approximation**	**9+3**

Review of difference operators – Lagrange's and Newton's divided difference interpolation - Newton's forward and backward difference interpolation – Interpolating with a cubic spline.

UNIT-V	**Numerical Differentiation and Integration**	**9+3**

Differentiation using Newton's forward and backward interpolation formula –Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Two and Three point Gaussian quadrature formulae – Double integrals using trapezoidal and Simpson's rules.

Total hours	**60**

Outcome(s)	At the end of the course the students will be able to • Analyze testing of hypothesis. • Solve the problems involving design of experiments. • Compute the solution of algebraic and transcendental equations and system of linear equations numerically. • Apply the concepts of numerical methods to solve ordinary differential equations. • Solve numerical differentiation and integration using finite differences.

TEXT BOOK :

1	Grewal, B.S. and Grewal,J.S.," Numerical methods in Engineering and Science",Khanna Publishers, New Delhi, 2015.
2	Johnson, R.A., Miller, J.S., "Numerical Methods in Engineering and Statistics for Engineers", Pearson Education, 2015.

REFERENCES:	
1	Gupta S.C. and Kapoor V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons, New Delhi, 2020.
2	Veerarajan.T, and Ramachandran, T., “ Numerical Methods with programming in C” , Tata McGraw Hill, 2007.
3	Chapra, S. C and Canale, R. P. “Numerical Methods for Engineers”, Tata McGraw-Hill, New Delhi, 2015.

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14303	Fluid Mechanics and Machinery	3	0	0	3	100

Objective(s)	• To discuss the properties and characteristics of the fluids both in static and dynamic mode • To discuss the basic concept of boundary layer thickness and find the major & minor losses in flow through the pipes • To understand the importance of dimensional analysis • To understand the concepts of pumps and their applications • To enumerate the fundamental knowledge on design aspects of hydraulic turbines.

UNIT-I	**Fluid Properties and Flow Characteristics**	**9**
Units and dimensions. Properties of fluids – specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws -capillarity and surface tension. flow characteristics: concepts of system and control volume.-application of control volume to continuity equation- Euler and Bernoulli's equations – application of Bernoulli's equation – discharge measurement and velocity measurement (orifice, venturimeter and pitot tube).		
UNIT-II	**Flow Through Circular Conduit**	**9**
Laminar flow though circular conduits and circular annuli. Turbulent flow - Darcy –weisbach's equation. friction factor and moody diagram. Boundary layer concepts – types of boundary layer thickness. Major & minor losses- series and parallel connections in flow through pipes. Equivalent pipes, power transmission - hydraulic and energy gradient lines in flow through pipes.		
UNIT-III	**Dimensional Analysis**	**9**
Dimension and units: Buckingham's Π theorem- dimensionless parameters. types of similitude, models and similitude analysis– applications of dimensionless parameters. need for dimensional analysis – methods of dimensional analysis.		
UNIT-IV	**Pumps**	**9**
Types of pump and category -classification of centrifugal pump, working principles, velocity triangles, work done, performance characteristic curves - working of reciprocating pumps, discharge, slip, percentage of slip, Indication diagrams, work saved by air vessels. theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles.		
UNIT-V	**Turbines**	**9**
Classification of turbines – Impulse and reaction turbines, pelton wheel, francis turbine and kaplan turbine – working principles, velocity triangles, work done, efficiencies, hydraulic design, heads and draft tube. specific speed - unit quantities – performance curves for turbines –governing of turbine.		
	Total hours	**45**

Outcome(s)	• Determine properties and characteristics of fluids • Estimate the flow rates, pressure changes, minor and major head losses for flows through pipes • Discuss the importance of dimensional and model analysis • Estimate the efficiency of different pumps with the study of characteristics curves. • Apply mathematical knowledge on performance of turbines.

TEXT BOOK :

1	Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", Ninth edition, Laxmi Publications (P) Ltd., New Delhi. 2015.
2	R.K. Rajput "A text book of Fluid Mechanics and Hydraulic Machines", 5th Edition, S.Chand & Company (Ltd), New Delhi, 2009.
3	R.S .Kurumay, Fluid Mechanics and Hydralic Machines, S.Chand & Co. Ltd. Edition, 2015.

REFERENCES:	
1	D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering", 2nd Edition, SK. Katania and Sons, New Delhi, 2010
2	Pijush K Kundu , Irq M Cohen , Fluid Mechanics , Academic Press-2008.
3	Kumar. K.L., "Engineering Fluid Mechanics", 14th Edition, Eurasia Publishing House (P) Ltd., New Delhi, New Edition -2016.
4	Ramamrutham. S, "Fluid Mechanics, Hydraulics and Fluid Machines", Dhanpat Rai & Sons, Delhi, 2005.
5	Som, S.K., and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", by S K Som; G Biswas. Print book. English. 2004. 2nd Edition. New Delhi, India: Tata McGraw-Hill.

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14402	Metrology and Measurements	3	0	0	3	100

Objective(s)	• To describe the basics of standards and measurement system. • To illustrate various length and angle measuring instruments. • Knowledge of computer aided inspection helps the modern day automation requirements/applications. • This course offers a platform for the design and implementation of SQC system. • This course provides a comprehensive knowledge of transducers used in engineering field.

UNIT-I	**Basics of Metrology**	**9**
Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment –their effect on Precision and Accuracy–Errors–Errors in Measurements–Types–Control–Types of standards.		
UNIT-II	**Linear and Angular Measuring Instruments**	**9**
Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design –terminology –procedure– concepts of interchange ability and selective assembly–Angular measuring instruments–Types– Bevel protractor, clinometers, angle gauges, spirit levels and sine bar–Angle alignment telescope–Autocollimator–Applications.		
UNIT-III	**Advances in Metrology**	**9**
Computer aided and laser metrology: Co-ordinate measuring machine–applications; laser micrometer, laser interferometer, laser scanning gauge, non-contact and in- process inspection, vision system. Length bar measuring machine, Optical projection comparator, Tool makers microscope.		
UNIT-IV	**Statistical Quality Control**	**9**
Introduction - Definition of Quality - Chance Causes and assignable Causes - SQC Benefits and Limitations. Control Charts for Variables - X bar and R charts, Standard deviation charts - run up - run down – Process capability studies. Control Charts for attributes-Fraction defectives-And number of defects-chart sensitivity- Control charts for Non Conformities- C and U chart.		
UNIT-V	**Transducers**	**9**
Introduction to Transducers - Classification - Primary - Secondary and Tertiary - Mechanical - Bellows - Bourdon's Tube - Springs - Proving Rings - Diaphragm - Monometer - Bimetals - Electrical- Resistance - Inductance and Capacitance - Strain Gauges and its Orientation for Measurement - Vibration and Acceleration Measurement - Advantages and Limitation. Measurement of Force – Torque - Power - Temperature.		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Discuss the measurement standards and measuring systems • Explain the various linear and angular measurements • Describe the advanced and computerized measuring systems • Analyze using statistical control tools to understand their applications • Elucidate the application of various transducers

TEXTBOOK:

1	JainR.K.," Engineering Metrology", Khanna Publications,2010
2	M.S.Mahajan," Statistical Quality Control", Dhanpat Rai&Co,2013

REFERENCES:

1	I.C Gupta," Engineering Metrology ",Dhanpat Rai Publications,2004.
2	Dale H. Besterfield,"Quality Control"8th Edition, Pearson Prentice Hall2008.

CO Mapping with POs and PSOs

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

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
24HS11006	UNIVERSAL HUMAN VALUES -II	2	1	0	3	100

(Mandatory Credit Course to All UG Programmes to be offered in III / IV Semester)

Pre-requisites: Universal Human Values 1 (Induction Programme) (desirable)

The foundation course "H-102 Universal Human Values: "Understanding Harmony" may be covered in III or IV semester. This course discusses the role of human beings in their family. It also touches issues related to their role in the society and the nature. During the Induction Program, students would get an initial exposure to human values through Universal Human Values 1. This exposure is to be augmented by this compulsory full semester foundation course. The Course has 5 Modules (5 Units): 30 Lectures and 15 Practice sessions (Tutorials).

1. COURSE OBJECTIVES:

The objectives of the course are:

(i). Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.

(ii). Understanding (or developing clarity) the harmony in the human being, family, society and nature/existence

(iii). Strengthening of self-reflection for harmonious relationship in family, society

(iv). Development of commitment and courage to act as human being in ensuring harmony in nature for co-existence.

(v). Development of holistic principles of harmony and professional ethics for natural acceptance of human values and observe ethical human conduct.

2. COURSE OUTCOMES:

Upon completion of the Course the Learner will be able to:

- Distinguish between values and skills, and highlight the need for Universal Human Values.
- Describe the need for Harmony and distinguish between happiness and accumulation of physical facilities, etc.
- Relate the value of harmonious relationship in family, society based on trust and respect for happiness and prosperity in their life and profession.
- Outline the role of a human being in ensuring harmony in nature for co-existence.
- Apply the holistic principles of Harmony and Professional Ethics for natural acceptance of human values and observe Ethical Human Conduct.

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

L 1. Purpose and motivation for the course, recapitulation from Universal Human Values-I (Induction Programme).

L 2. Self-Exploration–what is it? Its content and process; 'Natural Acceptance' and Experiential Validation-as the process for self-exploration.

L 3. Continuous Happiness and Prosperity - A look at basic Human Aspirations.

L 4. Right understanding, Relationship and Physical Facility - the basic requirements for fulfillment of aspirations of every human being with their correct priority.

L 5. Understanding Happiness and Prosperity correctly - A critical appraisal of the current scenario.
L 6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

3 Practice sessions *(T1 to T3) - To discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.*

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!
L 7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
L 8. Understanding the needs of Self ('I') and 'Body'- happiness and physical facility
L 9. Understanding the Body as an instrument of 'I'(I being the doer, seer and enjoyer)
L 10.Understanding the characteristics and activities of 'I' and harmony in 'I'
L 11.Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
L 12.Programs to ensure Sanyam and Health.

3 Practice sessions *(T4 to T6) - To discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.*

Module 3: Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship
L 13. Understanding values in human-human relationship; meaning of Justice (Nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.
L 14. Understanding the meaning of Trust; Difference between intention and competence.
L 15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.
L 16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.
L 17. Visualizing a universal harmonious order in Society-Undivided Society, Universal Order-from family to world family.

3 Practice sessions *(T7 to T9): Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education, etc. Discuss Gratitude as a universal value in relationships, scenarios. Elicit examples from students' lives.*

Module4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence
L 18. Understanding the harmony in the Nature.
L 19. Interconnectedness and mutual fulfillment among the four orders of nature - recyclability and self-regulation in nature.
L 20. Understanding Existence as Co-existence of mutually interacting units in all - pervasive space.
L 21. Holistic perception of harmony at all levels of existence.
2 Practice sessions *(T10 to T11): Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology, etc.*

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics
L 22. Natural acceptance of human values.

L 23. Definitiveness of Ethical Human Conduct.
L 24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
L 25. Competence in professional ethics: (a). Ability to utilize the professional competence for augmenting universal human order (b). Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, (c). Ability to identify and develop appropriate technologies and management patterns for above production systems.
L 26. Case studies of typical holistic technologies, management models and production systems.
L 27. Strategy for transition from the present state to Universal Human Order: (a). At the level of individual: as socially and ecologically responsible engineers, technologists and managers (b). At the level of society: as mutually enriching institutions and organizations.
L 28. Definition of Morals, Values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully.
L 29. Importance of Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality.
L 30. Introduction to Yoga and meditation for professional excellence and stress management. *Sum up.*

4 Practice sessions *(T12 to T15) - Include Practice Exercises and Case Studies which will be taken up in Practice (Tutorial) Sessions.*
eg. To discuss the conduct as an Engineer or Scientist, etc.

Total hours = 45

3. READINGS:

3.1 Textbook

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

3.2 Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of My Experiments with Truth -by Mohandas Karamchand Gandhi
4. Small is Beautiful - E. F Schumacher.
5. Slow is Beautiful - Cecile Andrews.
6. Economy of Permanence - J C Kumarappa.
7. Bharat Mein Angreji Raj - Pandit Sunderlal.
8. Rediscovering India by Dharampal.
9. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi.
10. India Wins Freedom - Maulana Abdul Kalam Azad.
11. Vivekananda - Romain Rolland (English).
12. Mika Martin and Roland Scinger, 'Ethics in Engineering', Pearson Education/Prentice Hall, New York 1996.

CO Mapping with POs and PSOs

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

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24ME24401	**Fluid Mechanics and Machinery Laboratory**	0	0	3	1.5	**100**

Objective(s)	• Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,

LIST OF EXPERIMENTS

1	Determination of the Coefficient of discharge of given Orifice meter.
2	Determination of the Coefficient of discharge of given Venturi meter.
3	Calculation of the rate of flow using Rota meter.
4	Determination of friction factor for a given set of pipes
5	Conducting experiments and drawing the characteristic curves of centrifugal pump
6	Conducting experiments and drawing the characteristic curves of submergible pump
7	Conducting experiments and drawing the characteristic curves of reciprocating pump.
8	Conducting experiments and drawing the characteristic curves of Gear pump.
9	Conducting experiments and drawing the characteristic curves of Pelton wheel
10	Conducting experiments and drawing the characteristics curves of Francis turbine
	Total hours **45**

LIST OF EQUIPMENTS (for a batch of 30 students)

1	Orifice meter setup -1 No.
2	Venturi meter setup-1 No.
3	Rotameter setup-1 No.
4	Pipe Flow analysis setup-1 No.
5	Centrifugal pump-1 No.
6	Submergible pump setup-1 No.
7	Reciprocating pump setup-1 No.
8	Gear pump setup-1 No.
9	Pelton wheel setup-1 No.
10	Francis turbine setup -1 No.

Outcome(s)	• Ability to use the measurement equipments for flow measurement • Ability to do performance trust on different fluid machinery

CO MAPPING WITH POs AND PSOs

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

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22ME24701	**Metrology and Measurements Laboratory**	0	0	3	1.5	**100**
Objective(s)	• This course provides the practical knowledge behind the various measurements like linear, angular measurements. • To demonstrate the optical measuring instruments. • To explain the importance for handling the instruments.					
LISTOFEXPERIMENTS						
1	Calibration of Vernier/ Micrometer/ Dial gauge.					
2	Checking Dimensions of part using slip gauges.					
3	Measurements of Gear Tooth Dimensions using Gear Tooth Vernier.					
4	Measurement of Angle using sine bar/sine center/ Bevel Protractor .					
5	Measurement of thread parameters using Toolmakers Microscope/Floating carriage Micrometer.					
6	Checking the limits of dimensional tolerances using comparators (Mechanical).					
7	Measurement of Temperature using Thermocouple.					
8	Measurement of Displacement using LVDT.					
9	Measurement of Force using Load Cell.					
10	Measurement of taper angle using profile projector.					
	Total hours				**45**	
LIST OF EQUIPMENTS						
1	Tool Maker’s Microscope–1No.					
2	Comparator- 2No.					
3	SineBar-2No.					
4	Gear Tooth Vernier Caliper-1No.					
5	Floating carriage Micrometer-1No.					
6	Temperature measurement setup -1No.					
7	Load Cellsetup-1No.					
8	Profileprojector-1No.					
9	BevelProtractor-1 No.					
10	Slip gaugeset-4No.					
11	Verniercaliper–4No.					
12	Micrometer-4 No.					
13	Surfaceplate–6No.					
Outcome(s)	At the end of the course, the students will be able to • Use the measuring instruments and measure the dimension of various components. • Determine the characteristics of measuring instruments. • Manipulate the measurement of various physical quantities.					

CO Mapping with POs and PSOs

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	3	-	-	1	3	-	-	-	1	-	-
CO2	3	-	-	-	3	-	-	1	3	-	-	-	1	-	-
CO3	3	-	-	-	3	-	-	1	3	-	-	-	1	-	-

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24HS21002	**Professional Communication Skills** (Common to all B.E./B.Tech. Degree Programmes)	0	1	2	2	**100**
Objectives	• To familiarize students with the stage dynamics • To help the learners to improve their creative skills • To make them acquire the ability to speak effectively in real life situations					

LIST OF EXPERIMENTS

1	Introduction to Professional Communication and SWOT Analysis
2	Soft Skills (Goal Setting, Empathy, Stress Management, Emotional Intelligence, Conflict Resolution)
3	Building Vocabulary (Intermediate Level)
4	Welcome Address and Vote of Thanks
5	Stage Dynamics (Body Language and Paralanguage – Individual Presentation for 3 minutes)
6	Framing Questions (WH Questions & 'Yes' or 'No' Questions)
7	Narrative Techniques - Narrating the Experience
8	Master of Ceremony Skills
9	Picture Description
10	Impromptu Speech (Just a Minute)
	Total hours **30**
Outcome(s)	At the end of the course, the learners will be able to : • Apply suitable vocabulary in academic and workplace contexts • Demonstrate communication skills effectively in both oral and written formats • Create documents professionally and make presentations effectively

TEXTBOOK:

1	Joshi, Manmohan, *Soft Skills*, 1st Edition. Bookboon, 2017

REFERENCE BOOKS:

1	Muralikrishna, & Sunita Mishra, *Communication Skills for Engineers*. Pearson, New Delhi, 2011.
2	Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, New Delhi, 2011

WEBSITES

1	https:// www.ted.com/talks
2	https://joshtalks.com
3	https://quizziz.com
4	www.pdfdrive.com
5	www.talking books.com

CO Mapping with POs and PSOs

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	2	3	3	3	2	2	3	3	-	-	-
CO2	2	-	-	-	2	3	3	3	2	2	3	3	-	-	-
CO3	2	-	-	-	2	3	3	3	2	2	3	3	-	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14501	Thermal Engineering	3	0	0	3	100

Objective(s)	• To understand fundamental concept on gas power cycles and its applications. • To describe the steam nozzles and turbines for determining the efficiency of the systems. • To understand the basic concepts of air compressors and to find the various efficiencies of the system • To understand the knowledge on refrigeration and air conditioning for identifying the performance of the systems • To enumerate the performance and emission characteristics on internal combustion engines.

UNIT-I	**Gas Power Cycles**	**9**

Otto, Diesel, Dual and Brayton cycles, calculation of mean effective pressure, and air standard efficiency - actual and theoretical P-V diagram of four stroke and two stroke engines.

UNIT-II	**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 of turbine, velocity diagram, speed regulations –governors.

UNIT-III	**Air Compressors**	**9**

Classification and working principle of various types of compressors, work of compression with and without clearance, volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, multistage air compressor with and without inter cooling.

UNIT-IV	**Refrigeration and Air Conditioning Systems**	**9**

Refrigerants - vapour compression refrigeration cycle - working principle of vapour absorption system, air conditioning system - types and working principles - concept of room sensible heat factor, grand sensible heat factor, effective sensible heat factor, Introduction to mobile air conditioning and refrigeration.

UNIT-V	**Internal Combustion Engines**	**9**

Classification - Components and their function - Comparison of two stroke and four stroke engines – Fuel injection system - Comparison of petrol and diesel engines - Lubrication systems and Cooling systems - Battery and Magneto Ignition Systems – Performance calculation- Exhaust gas analysis, Pollution control norms. Pollution control methods – Catalytic converters, EGR and SCR

Total hours	**45**

Outcome(s)	Upon completion of this course, the students can able to • Apply the different gas power cycles and use in internal combustion engine. • Understand the working of different types of steam nozzles and its applications, conditions for maximum discharge of steam through it. • Evaluate the performance of air compressors under the given operating conditions. • Design refrigeration and air-conditioning system for a particular application • Get an insight of various components and principles of internal combustion engine

TEXT BOOKS:

1	Rajput. R. K., "Thermal Engineering" S. Chand Publishers , Eleventh Edition, 2020
2	Sarkar B K, "Thermal Engineering" *Tata McGraw-Hill Publishers*, New Delhi · 2022.
3	Vijayaraghavan.G.K and Vishupriyan, "Thermal Engineering" A.R.Publications, Channai-600100, Tenth Edition-2015.

REFERENCES:	
1	R.S.Khurmi and J.K.Gupta “Thermal Engineering” S.Chand & Company Ltd, 2020
2	Ganesan V.” Internal Combustion Engines” 4th Edition, Tata McGraw-Hill 2017.
3	Apora C P, Refrigeration And Air Conditioning, Tata Mcgraw Hill -2015.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14502	**Design of Machine Elements** (Use of P S G Design Data Book is permitted in the End Semester examination)	3	0	0	3	100

Objective(s)	• To understand machine members subjected to steady and variable loads. • To understand the design of shafts and couplings for various applications. • Learn how to design both temporary and permanent joints under various load conditions. • To understand the design procedure for helical, leaf springs, and flywheels for various applications. • To Design and select sliding and rolling contact bearings.

UNIT-I	**Steady Stresses and Variable Stresses In Machine Components**	**9**

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

UNIT-II	**Shafts and Couplings**	**9**

Design of solid and hollow shafts based on strength, rigidity– Keys- different types of keys- Design Keys, keyways and splines, failures of keys-Couplings - Rigid coupling- flexible coupling.

UNIT-III	**Temporary and Permanent Joints**	**9**

Threaded fasteners- stress in screwed threads, Bolted joints including eccentric loading, Knuckle joints, Cotter joints–Welded joints, and Riveted joints for structures.

UNIT-IV	**Energy Storing Elements and Engine Components**	**9**

Functions of springs-applications- spring materials-Design of helical springs and leaf spring- Flywheels considering stresses in rims and arms for engines -Connecting rod and Crankshaft.

UNIT-V	**Bearings**	**9**

Sliding contact and rolling contact bearings (antifriction bearing)-Hydrodynamic journal bearings, Sommerfeld Number, Selection of ball and rolling contact bearings.

Total hours	**45**

Outcome(s)	Upon completion of this course the students must be able to: • Apply the principle of solid mechanics to design machine member under variable loading. • Calculate the diameter of shafts based on strength, rigidity and design various types of coupling based on application. • Discus the design Parameters of permanent and temporary joint on various loading application. • Calculate the design parameter for energy storage element and engine components. • Compute the design parameters of various types of bearings.

TEXT BOOK :

1	R.S.Khurmi&J.K.Ghupta"A Textbook of Machine Design" S.Chand & CompanyLtd.,2005
2	Bhandari V,"Design of Machine Elements",3rd Edition,TataMcGraw-HillBookCo,2010.
3	S.Md Jalaludeen "Machine Design Volume –I Design of Machine Elements", 4th edition, Anuradha Publications, 2014.Chennai.

REFERENCES:

1	Joseph Shigley,Charles Mischke,Richard Budynas and Keith Nisbett "Mechanical Engineering Design",8th Edition,Tata McGraw-Hill,2008.
2	Sundararajamoorthy, T.V. and Shanmugam, N., Machine Design, Anuradha Publications Agencies, , Chennai 2015.
3	Robert C.Juvinal and Kurt M.Marshek,"Fundamentals of Machine Design", 4 th Edition,Wiley,2005

4	Norton R.L, “Design of Machinery”, Tata McGraw-Hill Book Co., 2004.
5	Spotts M.F, Shoup T.E., “Design and Machine Elements”, Pearson Education, 2004.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14503	Manufacturing Technology	3	0	0	3	100

Objective(s)	• To understand the working principles of conventional reciprocating and rotary machine tools. • To explore various abrasive machining and gear cutting techniques. • To study CNC machine tools, their components, and part programming methods. • To examine mechanical and electrical energy-based non-traditional machining processes. • To learn chemical and electrochemical machining principles and their industrial applications.

UNIT-I	**Reciprocating machine tools**	**9**

Reciprocating machine tools: shaper, planer, slotter - Milling : types, milling cutters, operations - Hole making : drilling - Quill mechanism , Reaming, Boring, Tapping - Sawing machine: hack saw, band saw, circular saw; broaching machines: broach construction – push, pull, surface and continuous broaching machines

UNIT-II	**Abrasive Processes and Gear Cutting**	**9**

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding – honing, lapping, super finishing, polishing and buffing, abrasive jet machining - Gear cutting, forming, generation, shaping, hobbing.

UNIT-III	**CNC Machine Tools and Part Programming**	**9**

Numerical control (NC) machine tools – CNC: types, constructional details, special features – design considerations of CNC machines for improving machining accuracy – structural members – slide ways –linear bearings – ball screws – spindle drives and feed drives. Part programming fundamentals – manual programming – computer assisted part programming.

UNIT-IV	**Mechanical Energy and Electrical Energy Based**	**9**

Abrasive Jet Machining – Water Jet Machining – Ultrasonic Machining. (AJM, WJM and USM). Working Principles – equipment used – Process parameters – MRR-Variation in techniques used – Applications. Electric Discharge Machining (EDM)- working Principles-equipments-Process Parameters-MRR electrode / Tool – Power Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

UNIT-V	**Chemical and Electro-Chemical Energy Based Processes**	**9**

Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants-maskanttechniques of applying maskants-Process Parameters – MRR-Applications. Principles of ECM-equipments-MRR-Electrical circuit-Process Parameters-ECG and ECH Applications.

Total hours	**45**

Outcome(s)	• Identify and explain the operation of shaper, planer, slotter, milling, and drilling machines. • Select appropriate abrasive tools and processes for precision finishing tasks. • Develop CNC part programs and understand machine design considerations. • Analyze the principles and applications of AJM, WJM, USM, and EDM processes. • Evaluate CHM and ECM processes, including MRR, etchants, maskants, and hybrid methods.

TEXT BOOK :

1	Hajra Choudry, “Elements of Work Shop Technology – Vol. II”, Media Promoters. 2002
2	M.P.Groover and Zimers Jr., ‘CAD/CAM’ Prentice Hall of India Ltd., 2004.
3	Anand Pandey, “Modern Machining Processes”, Ane Books Pvt. Ltd., New Delhi, India, 2019.

REFERENCES:	
1	Rajput R.K, 'Atext book of Manufacturing Technology', Lakshmi Publications, 2007.
2	Mikell P.Groover, 'Fundamentals of Modern Manufacturing,Materials, Processes and Systems', John Wiley and Sons, 9th Edition,2007.
3	Jagadeesha T., "Non-Traditional Machining Processes", I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017
4	Carl Sommer, "Non-Traditional Machining Handbook", Advance Publishing., United States, 2000

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24HS11004	Constitution of India	3	0	0	3	100

Objective(s)	• To know about the salient features of the Constitution of India. • To gain knowledge about structure and functions of Union Government. • To learn about the structure and functions of State Government. • To understand about amendments in Indian Constitution, Judicial review. • To study in detail about the Indian society.

UNIT-I	**Introduction About Indian Constitution**	**9**
Historical Background – Constituent Assembly of India – Role and salient features - Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.		
UNIT-II	**Structure and Function of Union Government**	**9**
Parliamentary system – Legislature, Executive. Union Government – Structures of the Union Government. Functions and Responsibilities of President – Vice President – Prime Minister – Cabinet – Council of Ministers, Union Territories.		
UNIT-III	**Structure and Function of State Government**	**9**
State Legislature - State Government – Structure and Functions – Governor – Chief Minister – Cabinet – Special Provisions (Article 370. 371, 371J) for some States. Judicial System in States – High Courts and other Subordinate Courts, Judicial review.		
UNIT-IV	**Constitution Functions, Amendments And Review**	**9**
Indian Federal System – Centre-State Relations – President's Rule – Assessment of working of the Parliamentary System in India - Constitutional Amendments – Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44, 61, 73, 74, 75, 86, and 91, 94, 95, 100, 101, 118. Savior of the Constitution – The Supreme Court of India – The Hon'ble Chief Justice of India and Hon'ble Judges of the Supreme Court. Judicial Review of Parliamentary and Executive functions.		
UNIT-V	**Indian Society**	**9**
Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections - Special Constitutional Provisions for SC & ST, OBC, Special Provision for Women, Children & Backward Classes.		
	Total hours	**45**

Outcome(s)	**On completion of the course, the learners should be able to:** • Summarize the features of the Indian Constitution and observe the fundamental duties, rights and responsibilities. • Explain the functioning of Indian parliamentary system at the Center and the responsibilities of important functionaries. • Describe the functioning of State Government and important functionaries. • Recognize Amendments in Indian Constitution and Judicial review. • Illustrate the composition and features of Indian society.

TEXT BOOK :

1	Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi
2	R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.

REFERENCES:	
1	Sharma, Brij Kishore, “Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
2	Maciver and Page, “ Society: An Introduction Analysis “, Mac Milan India Ltd., New Delhi.
3	K.L.Sharma, (1997) “Social Stratification in India: Issues and Themes”, Jawaharlal Nehru University, New Delhi.
4	U.R.Gahai, “Indian Political System “, New Academic Publishing House, Jalaendhar
5	R.N. Sharma, “Indian Social Problems “, Media Promoters and Publishers Pvt. Ltd.

CO Mapping with POs and PSOs

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

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24HS21003	**Interview Skills and Soft Skills** (Common to all B.E./B.Tech. Degree Programmes)	0	1	2	2	**100**
Objectives	• To improve the learners reading fluency skills through extensive reading • To help the learners obtain speaking skills in both formal and informal situation. • To make them acquire presentation skills and interview skills to face challenges in the career aspects					

LIST OF EXPERIMENTS

1	Employability Skills (Interpersonal, Intrapersonal, Leadership, Decision Making and Problem Solving)
2	Building Vocabulary (Advanced level)
3	Short Conversations (Situation Based Dialogues)
4	Art of Storytelling
5	Professional E-mail Writing
6	Preparing One Page Resume
7	Interview Skills (Mock Interview & Interview Etiquette)
8	Professional Etiquette (Polite Expressions, Telephone Etiquette, Online Etiquette)
9	Group Discussion
10	Public Speaking
	Total hours **30**
Outcome(s)	At the end of the course, the learners will be able to : • Analyse the content and apply knowledge and skills efficiently wherever necessary. • Create profile and other essential documents. • Demonstrate soft skills effectively at the time of interview and workplace.

TEXTBOOK

1	Joshi, Manmohan, Soft Skills, 1st Edition. Bookboon, 2017

REFERENCE BOOKS

1	Raman, Meenakshi & Sangeeta Sharma, *Technical Communication: Principles and Practice*, Ed.III, Oxford University Press, New Delhi. 2015.
2	Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, New Delhi, 2011

ONLINE WEBSITES

1	https:// www.ted.com/talks
2	https://www.joshtalks.com
3	https://quizziz.com
4	www.pdfdrive.com
5	www.talking books.com

CO MAPPING WITH POs AND PSOs

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

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24ME24501	**Thermal Engineering Laboratory**	0	0	3	1.5	**100**

Objective(s)	• To integrate the concepts, laws and methodologies from the first course in Thermodynamics into the analysis of cyclic process. • To apply the thermodynamic concepts into various thermal application like I.C engines, Steam turbines, Compressors and Refrigeration and Air conditioning Systems.

LIST OF EXPERIMENTS

1	Valve Timing and Port Timing Diagrams
2	Performance Test on 4-Stroke Diesel Engine
3	Heat Balance Test on 4-Stroke Diesel Engine
4	Morse Test on Multi-Cylinder Petrol Engine
5	Retardation Test to find Frictional Power of a Diesel Engine
6	Determination of Viscosity by Red Wood Viscometer
7	Determination of Flash Point and Fire Point
8	Performance and Energy Balance Test on a Steam Generator
9	Performance and Energy Balance Test on Steam Turbine
10	Performance test on Two Stage Air Compressor
11	Determination of COP of a refrigeration system
12	Determination of COP of air-conditioning system
	Total hours **45**

LIST OF EQUIPMENTS

1	I.C Engine – 2 stroke and 4 stroke model -1 each
2	Red Wood Viscometer- 1 No.
3	Apparatus for Flash and Fire Point -1 No each
4	4-stroke Diesel Engine with mechanical loading- 1 No.
5	4-stroke Diesel Engine with electrical loading- 1 No.
6	Multi-cylinder Petrol Engine -1 No.
7	Single cylinder Petrol Engine -1 No.
8	Steam Boiler with turbine setup.
9	Refrigeration test rig-1No.
10	Air-Conditioning test rig-1No.

Outcome(s)	• Identify and explain the different parts of petrol and diesel engines, and to draw valve timing diagrams. • Explain and differentiate various types of boilers and identify and selection of required its mounting and accessories. • To Evaluate the Heat Balance Sheet of IC engine

CO MAPPING WITH POs AND PSOs

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

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24ME24502	Manufacturing Laboratory	0	0	3	1.5	100

Objective(s)	• To impart hands-on experience in basic manufacturing processes such as pattern making, moulding, gear cutting, and thread cutting using conventional machine tools. • To familiarize students with the working principles, setup, and operations of machines including lathe, milling, grinding, shaping, and slotting machines. • To develop practical skills in precision machining and tooling processes used in production environments, including surface finishing and tool grinding techniques.

LIST OF EXPERIMENTS

1	Prepare a mould using solid/split patterns in Foundry.
2	Thread cutting operation in centre lathe
3	Exercise on capstan Lathe and Turret lathe
4	Spur Gear cutting using Milling machine
5	Centre less grinding
6	Cylindrical grinding
7	Round to square machining using shaper machining
8	Tool and cutter grinding machine
9	Internal keyway slotting in slotting machine
10	Surface grinding
	Total hours **45**

LIST OF EQUIPMENTS

1	Standard molding tool setup -4Nos.
2	Centre lathe -7 Nos.
3	Turret Lathe -1No.
4	Capstan Lathe -1No
5	Horizontal Milling Machine -1No
6	Surface Grinding Machine -1No
7	Cylindrical Grinding Machine -1No
8	Shaper -1No
9	Slotter -1No
10	Drilling Machine -1No
11	Tool and Cutter grinder -1No
12	Centreless grinding machine -1No
Outcome(s)	• Ability to use different machine tools for finishing operations • Ability to use different machine tools to manufacturing gears. • Ability to manufacture tools using cutter grinder

CO MAPPING WITH POs AND PSOs

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

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24ME25501	**Internship**	0	0	2	1	**100**

Objective(s)	• Students shall develop the habit to work in a group. • To provide opportunities for students to apply their knowledge in a real world environment. • To expose students to industrial working environment.

Industrial case study should be based on the study of some specific case / issue/ problem related to any Industry. Data should be collected from Industry with the objective of studying some specific case / issue / problem. The Collected data should be analysed using knowledge gained in the curriculum. The Result should be worked out and conclusion should be drawn. A group of maximum of four students may be formed for one case study.

Note: Students have to undergo two weeks internship in an industry between 4^{th} and 5^{th} semester. A report consisting of the problem / issues identified methodology of data collection, method of analysis, results and conclusion should be submitted in the prescribed format at the end of the industrial training and the evaluation will be done by a committee constituted by the HOD. Minimum two presentations should be made as a part of internal evaluation. Each student/group of students must present a PPT for about 30 minutes. The presentation of industrial case study in conferences will be encouraged.

Total hours	**30**

Outcome(s)	At the end of the course, the student will be able to: • Use of acquired techniques, skills, and modern engineering tools necessary for engineering practice • Understand their professional and ethical responsibilities. • Understanding the impact of engineering solutions in a global, economic, environmental, and societal context

CO MAPPING WITH POs AND PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14601	Theory of Machines	3	0	0	3	100

Objective(s)	• To understand the concepts of kinematic linkages and their motion analysis in the assembly of a system/machine. • To understand the concepts on kinematic analysis of gears and gear train, the role of friction in screw jack, clutches and brakes. • To understand the dynamic force analysis, method of static and dynamic balancing of machines. • To study the undesirable effects of unbalances in rotors and engines. • To understand the principles of governors and gyroscopes.

UNIT-I	**Basics of Mechanisms and Kinematic Analysis**	**9**

Definitions – Link, Kinematic pair, Kinematic chain, Mechanism, and Machine. –Degree of Freedom – Mobility - Kutzbach criterion (Gruebler's equation) -Grashoff's law- Kinematic Inversions of four-bar chain and slider crank chain - Mechanical Advantage- Transmission angle.
Analysis of simple mechanisms (four bar mechanism and Single slider crank mechanism) - Graphical Methods for displacement, velocity and acceleration; – Coriolis components of acceleration.

UNIT-II	**Gears and Gear Trains**	**9**

Classification of gears – Gear tooth terminology - Fundamental Law of toothed gearing and involute gearing – Length of path of contact and contact ratio - Interference and undercutting - Gear trains – Simple, compound and Epicyclic gear trains - Differentials.

UNIT-III	**Friction and Dynamic Force Analysis**	**9**

Dry friction – Friction in screw jack – Pivot and collar friction - Plate clutches - Block brakes, band brakes.
D'Alembert's principle –Dynamic analysis of four bar mechanism – Dynamic Analysis of reciprocating engines – Piston effort, Crank effort, Turning moment on crankshaft.

UNIT-IV	**Balancing and Free Vibration**	**9**

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder Engine – Primary and secondary unbalanced forces.
Basic features of vibratory systems – Free vibration – Equations of motion – natural frequency – Types of Damping – Damped free vibration – Whirling of shafts and critical speed.

UNIT-V	**Forced Vibration and Mechanisms for Control**	**9**

Response to periodic forcing – Harmonic Forcing – Forced vibration caused by unbalance-Vibration isolation.
Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors-– Effect of friction. Gyroscopes –Gyroscopic couple.

Total hours	**45**

Outcome(s)	Upon the completion of this course the students will be able to • Calculate the displacement, velocity and acceleration of simple and inversions of mechanisms using analytical or graphical method. • Compute significant terminology of gears and gear trains using design theories. • Apply the concepts of friction and dynamic force analysis on rotating and reciprocating machine members as per design theories. • Compute the magnitude and direction of rotating and reciprocating machine parts balancing and vibrations. • Apply the concepts of effects of centrifugal, gravity, spring, friction and couple forces in the control mechanisms of governors and gyroscopes. • Analyze the balancing and vibration of rotating and reciprocating machine parts.

TEXT BOOK :	
1	Khurmi, R.S., and Gupta, J.K., "Theory of Machines", 14th Edition S.Chand & Company, Ltd., New Delhi, 2005
2	Ambekar A. G., Mechanism and Machine Theory, Prentice Hall of India, New Delhi, 2007.
3	S.S. Rattan, "Theory of Machines", Third Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2009.
REFERENCES:	
1	V.P.Singh, "Theory of Machines", 7th Edition Dhanpat Rai & co. Ltd., New Delhi, 2009.
2	Ramamurti, V.,' Mechanism and Machine Theory", Second Edition, Narosa Publishing House, 2005.
3	Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 1995.
4	Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 2005.
5	Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East- West Press Pvt. Ltd., New Delhi, 1994.
6	Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory ", Wiley-Eastern Limited, New Delhi, 1992.
7	Sadhu Singh, "Theory of Machines" Pearson Education, 2002.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14602	Heat and Mass Transfer	3	0	0	3	100

Objective(s)	• To introduce the various modes of heat transfer and to develop methodologies for solving a wide variety of practical heat transfer problems. • To understand the concepts of heat transfer through extended surfaces. • To provide useful information concerning the performance and design of simple heat transfer Systems. • To learn the thermal analysis and design of heat exchangers and to understand the basic concept of mass transfer.

UNIT-I	**Conduction**	**9**
Fourier law of Heat Conduction– Cartesian Coordinates – One Dimensional Steady State Heat Conduction – Plane and Composite Systems – Extended Surfaces –Heat flow in semi-infinite solids– Lumped Analysis.		
UNIT-II	**Convection**	**9**
Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders, Internal flow through tubes.		
UNIT-III	**Heat Transfer and Heat Exchangers**	**9**
Boiling – Pool boiling and Film boiling – Condensation – Dropwise and Film-wise Condensation –Correlations in boiling and condensation Parallel flow, counter flow; evaporator and condensers, overall heat transfers coefficient, fouling factors, long-mean temperature difference (LMTD), method of heat exchanger analysis, effectiveness of heat exchanger, NTU method.		
UNIT-IV	**Thermal radiation**	**9**
Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, Planck's distribution law, radiation from real surfaces; radiation heat exchange between black and gray surfaces, shape factor, analogical electrical network, 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 hours	**45**

Outcome(s)	• Understand the basic modes of heat transfer and compute temperature distribution in steady and unsteady state heat transfer through conduction • Interpret and analyze free and forced convection • Design and analysis of heat exchanger • Understand the Principle of Radiation, Evaluation of heat transfer by radiation between different Geometries and basic of Mass Transfer • Apply diffusive and convective mass transfer equations and correlations for different applications.

TEXT BOOK :

1	R.C. Sachdeva, "Fundamentals of Engineering Heat and Mass transfer", New Age International Publishers, 2010
2	Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5thEdition -2013

REFERENCES:

1	Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010
2	Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012
3	Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 2013.

4	S.P. Venkateshan, “Heat Transfer”, Ane Books, New Delhi, 2014
5	Frank P. Incropera and David P. Dewitt, “Fundamentals of Heat and Mass Transfer”, John Wiley and Sons, 7th Edition, 2014.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14603	**Design of Transmission Systems** (Use of PSG Data book is permitted)	3	0	0	3	100

Objective(s)	• To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components. • To understand the standard procedure available for Design of Transmission of Mechanical elements spur gears and parallel axis helical gears. • To learn the design bevel, worm and cross helical gears of Transmission system. • To learn the concepts of design multi and variable speed gear box for machine tool applications. • To learn the concepts of design to cams, brakes and clutches

UNIT-I	**Design of Flexible Drives**	**9**
Selection and design of Flat belts and pulleys – Selection and design of V belts and pulleys – Selection and design of Chain drives and sprockets		
UNIT-II	**Design of Spur Gears and Parallel Axis Helical Gears**	**9**
Gear Terminology-Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Module and Face width-power rating calculations based on strength and wear considerations - Parallel axis Helical Gears – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces and stresses. Estimating the size of the helical gears.		
UNIT-III	**Design of Bevel and Worm Gears**	**9**
Straight bevel gear: Tooth terminology- Design of pair of straight bevel gears – Tooth forces and stresses. Worm Gear: Merits and demerits- Terminology. Thermal capacity, Design of the worm and gear – Forces and stresses, efficiency		
UNIT-IV	**Design of Gear Boxes**	**9**
Calculation of gear forces for spur and helical gear. Geometric progression - Standard step ratio – Ray diagram, kinematics layout –Design of reduction gearbox- design of multispeed machine tool gearbox		
UNIT-V	**Design of Clutches and Brakes**	**9**
Design of plate clutches – Axial clutches-Cone clutches-Internal expanding rim clutches –Design of brakes – Internal and external shoe brakes.		
	Total hours	**45** periods

Outcome(s)	Upon completion of this course, the Learners will be able to : • Apply the concepts of design to belts, chains drives. • Apply the concepts of design to spur, helical gears. • Apply the concepts of design to worm and bevel gears. • Apply the concepts of design to gear boxes. • Apply the concepts of design to brakes and clutches

TEXT BOOK :

1	Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2010.
2	Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.

REFERENCES:

1	Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.
2	Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
3	C.S.Sharma, Kamlesh Purohit, "Design of Machine Elements", Prentice Hall of India, Pvt. Ltd., 2003.

4	Bernard Hamrock, Steven Schmid, Bo Jacobson, "Fundamentals of Machine Elements", 2nd Edition, Tata McGraw-Hill Book Co., 2006.
5	Gitin Maitra, L. Prasad "Hand book of Mechanical Design", 2nd Edition, Tata McGraw-Hill, 2001.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME16601	Principles of Management	3	0	0	3	100

Objective(s)	To enable the students to: • To understand and the evolution and functions of Management • To learn the principles of management • To illustrate the principles, concepts and importance of planning, organizing, directing and controlling • To learn the importance of the principles of management in an organization

UNIT-I	**Introduction to Management and Organizations**	**9**
Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers -managerial roles and skills – Evolution of Management – Scientific, human relations ,system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.		
UNIT-II	**Planning**	**9**
Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.		
UNIT-III	**Organising**	**9**
Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.		
UNIT-IV	**Directing**	**9**
Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership –communication – process of communication – barrier in communication – effective communication – Communication and IT.		
UNIT-V	**Controlling**	**9**
System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.		
	Total hours	**45**

Outcome(s)	At the end of the course the students will be able to: • Describe the evolution and functions of management • Illustrate the planning process in the organization • Explain the organizing and recruitment process in the organization. • Discuss the motivational and leadership theories for effective direction of organization • Summarize the budgetary and non-budgetary control techniques

TEXT BOOK :

1	Stephen P. Robbins & Mary Coulter, ―Management‖, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.
2	JAF Stoner, Freeman R.E and Daniel R Gilbert ―Management‖, Pearson Education, 6th Edition, 2004

REFERENCES:	
1	Stephen A. Robbins & David A. Decenzo & Mary Coulter, ―Fundamentals of Management‖ Pearson Education, 7th Edition, 2011.
2	Robert Kreitner & Mamata Mohapatra, ― Management‖, Biztantra, 2008.
3	Harold Koontz & Heinz Weihrich ―Essentials of management‖ Tata McGraw Hill,1998
4	Tripathy PC & Reddy PN, ―Principles of Management‖, Tata McGraw Hill, 1999

CO Mapping with POs and PSOs

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	3	2	2	2	3	3	2	-	3	-
CO2	2	2	2	3	3	3	2	2	2	3	3	2	-	3	-
CO3	2	2	2	2	3	3	2	2	2	3	3	2	-	3	-
CO4	2	2	2	3	3	3	2	2	2	3	3	2	-	3	-
CO5	2	2	2	2	3	3	2	2	2	3	3	2	-	3	-

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24ME24601	**Theory of Machines Laboratory**	0	0	3	1.5	**100**
Objective(s)	• To supplement the principles learnt in kinematics and Theory of Machines. • To understand how certain measuring devices are used for dynamic testing. • To understand techniques of vibration control.					

LIST OF EXPERIMENTS

1	Kinematics of 4 bar mechanisms – Slider crank and Crank Rocker Mechanism - Determination of velocity and acceleration
2	Kinematics of Universal Joints – Determination of velocity and acceleration
3	Kinematics of Epi-cyclic Gear Trains – Determination of velocity ratio and Torque.
4	Governors - Determination of sensitivity, effort, etc. for any one of Governors -Watt, Porter, Proell
5	Motorized Gyroscope-Verification of laws -Determination of gyroscopic couple.
6	Whirling of shaft-Determination of whirling / critical speed of shaft in transverse vibration.
7	Dynamic balancing of rotating masses in different planes.
8	Determination of radius of gyration and moment of inertia of I.C. engine connecting rod using oscillation method.
9	Vibrating system – Determination of natural frequency of spring mass system without damper.
10	Determination of natural frequencies of compound pendulum using oscillation method.
	Total hours | **45**

LIST OF EQUIPMENTS

1	Kinematic Models to study various mechanisms – 1No.
2	Universal joint apparatus– 1No.
3	Gear train Model– 1No.
4	Governor apparatus – Watt or Porter or Proell– 1No.
5	Motorised gyroscope– 1No.
6	Whirling of shaft apparatus– 1No.
7	Dynamic balancing machine– 1No.
8	Connecting rod– 1No.
9	Vibration test facilities apparatus– 1No.
10	Compound pendulum apparatus– 1No.
Outcome(s)	At the end of the course, the student will be able to: • Analysis the kinematics of different mechanisms. • Determine the radius of gyration and moment of inertia of systems. • Calculate the vibration parameters in single degree of freedom systems.

CO MAPPING WITH POs AND PSOs

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

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24ME24602	Heat Transfer Laboratory	0	0	3	1.5	100

Objective(s)	• To study the heat transfer phenomena and to predict the relevant coefficient using implementation • To study the performance of refrigeration cycle / components.

LIST OF EXPERIMENTS

1	Thermal conductivity measurement using guarded plate apparatus.
2	Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
3	Determination of heat transfer coefficient under natural convection from a vertical cylinder.
4	Determination of heat transfer coefficient under forced convection from a tube.
5	Heat transfer from pin-fin apparatus (natural & forced convection modes)
6	Determination of Stefan – Boltzmann constant.
7	Determination of emissivity of a grey surface.
8	Effectiveness of Parallel / Counter flow heat exchanger.
9	Determination of COP of a refrigeration system
	Total hours 45

LIST OF EQUIPMENTS

1	Guarded plate apparatus – 1No.
2	Lagged pipe apparatus – 1No.
3	Natural convection-vertical cylinder apparatus – 1 No.
4	Forced convection inside tube apparatus – 1No.
5	Pin-fin apparatus – 1 No.
6	Stefan-Boltzmann apparatus – 1 No.
7	Emissivity measurement apparatus – 1 No.
8	Parallel/counter flow heat exchanger apparatus – 1No.
9	Refrigeration test rig – 1No.
Outcome(s)	• Calculate the overall heat transfer coefficient by using of forced and natural convection modes. • Determine the Stefan-Boltzmann constant • Examine the COP of the Refrigeration

CO MAPPING WITH POs AND PSOs

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	-	-	-	-	-	2	-	-	3
CO2	2	3	-	-	-	2	-	-	3	-	-	2	-	-	3
CO3	2	3	-	-	-	2	-	-	3	-	-	2	-	-	3

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24ME36601	**Design and Fabrication Project**	0	0	4	2	**100**
Objective(s)	• The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.					
Outcome(s)	Upon the completion of this course the students will be able to • Design and fabricate the machine element or the mechanical product. • Demonstrate the working model of the machine element or the mechanical product.					

Guideline for Review and Evaluation

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Total hours	**45**

CO Mapping with POs and PSOs

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	2	3	2	2	1	1	3	3	2	1
CO2	3	3	2	3	2	2	3	2	2	1	1	3	3	2	1

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14701	Industrial Automation	3	0	0	3	100

Objective(s)	• To define automation and Control and explain the differences in the sense of the terms. • To provide knowledge on actuators and industrial controllers. • To understand about the material handling devices in automation. • To underline the basic objectives of a manufacturing industry and explain how automation and control technologies relate to these.

UNIT-I	**Introduction to Automation**	**9**

Definition and fundamentals of automation, reasons for Automating, basic elements of an automated system: Power, Program and control system Advanced automation functions: safety, maintenance & repair diagnosis, error detection and recovery levels of automation.

UNIT-II	**Pneumatics and hydraulics**	**9**

Hydraulic and pneumatic devices-Different types of valves , Actuators and auxiliary elements in Pneumatics & hydraulics , their applications and use of their ISO symbols Synthesis and design of circuits (up to 3 cylinders)-pneumatic, electro pneumatics and hydraulics Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves; with and without grouping.

UNIT-III	**Sensors and Transducers**	**9**

Introduction to Mechatronics Systems – Measurement Monitoring Systems Automation – Control Systems – Microprocessor based Controllers. Sensors and Transducers – Performance Terminology –Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors – Selection of Sensors.

UNIT-IV	**Robots and their applications**	**9**

Introduction to robots, Types, Classifications, Selection of robots, Robot Degrees of freedom, Robot configuration, Accuracy and repeatability, Specification of a robot, Robot feedback controls: Point to point control and Continuous path control, Control system for robot joint, Adaptive control, Drives and transmission systems, End effectors, Industrial robot applications of robots.

UNIT-V	**Introduction to IOT and Applications**	**9**

Introduction to IoT – Meaning and features – Basic components – Sensors, connectivity, data processing – IoT protocols – Security and privacy – Applications in smart homes, healthcare, industry, agriculture – Benefits and challenges of IoT.

Total hours	**45**

Outcome(s)	• Describe the automation components and systems application. • Explain automated controls using Pneumatic and hydraulic systems. • Evaluate the feedback control systems in automated system. • Elucidate the application of Industrial robotics. • Apply IOT concepts in smart and automated systems.

TEXT BOOK :

1	Mechatronics – W.Bolton, Pearson Education India, New Delhi 2007.
2	A. K. Gupta, S. K. Arora, "Industrial Automation and Robotics" Laxmi Publications, New Delhi 2009
3	M.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing, Pearson Education, New Delhi,Fourth Edition,2016.
4	Geoffrey Boothroyd, Peter Dewhurst and Winston A. Knight, "Product Design for manufacture and Assembly", CRC Press,Thied Edition,2010.
5	M.P. Groover, M. Weiss, R.N. Nagel, and N.G. Odrey, "Industrial Robotics Technology programming and Applications", McGraw-Hill, Second Edition,2017.

REFERENCES:

1	HMT, "Mechatronics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
2	Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991, First Indian print 2010.
3	Devdas shetty, Richard A. Kolk, "Mechatronics System Design", 2nd Edition, Cengag Learning 2011.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14701	Finite Element Analysis	3	0	0	3	100

Objective(s)	• Mathematical formulation and solution for engineering problem • Fundamentals of 1D Finite elements for structural analysis • Fundamentals of 2D Finite elements for Vector analysis. • Fundamentals of 2D Finite elements for structural analysis and Axisymmetric • Need for Isoparametric formulation and numerical integration

UNIT-I	**Introduction**	**9**
Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.		
UNIT-II	**One-Dimensional Problems**	**9**
One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.		
UNIT-III	**Two Dimensional Scalar Variable Problems**	**9**
Second Order 2D Equations involving Scalar Variable Functions– Variational formulation–Finite Element formulation– Triangular elements–Shape functions and element matrices and vectors.		
UNIT-IV	**Two Dimensional Vector Variable Problems**	**9**
Vector Variable problems– Elasticity equations– Plane Stress, Plane Strain and Axisymmetric problems– Formulation– element matrices– Assembly– boundary conditions and solutions, Examples		
UNIT-V	**Isoparametric Formulation**	**9**
Natural co-ordinate systems – Isoperimetric elements – Shape functions for iso parametric elements One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.		
	Total hours	**45**

Outcome(s)	• Develop mathematical models for boundary value problems and their numerical solution • Apply the concepts of Finite Element Analysis to solve one dimensional problem in structural analysis • Apply the concepts of Finite Element Analysis to solve two dimensional problems in scalar analysis • Apply the concepts of Finite Element Analysis to solve two dimensional problems in structural analysis • Analyze the Isoparametric transformation and the use of numerical integration

TEXT BOOK :

1	Reddy.J.N.,"An Introduction to the Finite Element Method",3rd Edition, Tata McGraw-Hill.2019.
2	Seshu,P,"Text Book of Finite Element Analysis",Prentice-Hall of India Pvt.Ltd., New Delhi.2018.
3	Chandrupatla & Belagundu,"Introduction to Finite Elements in Engineering",3rd Edition,Prentice HallCollege Div,2019.

REFERENCES:

1	Rao,S.S.,"The Finite Element Method in Engineering",3rd Edition, Butterworth Heinemann, 2018
2	Logan,D.L.,"A first course in Finite Element Method",Thomson Asia Pvt.Ltd.,2017.
3	Robert D.Cook, David S.Malkus, Michael E.Plesha, Robert J.Witt, "Concepts and Applicationsof Finite Element Analysis", 4th Edition,Wiley Student Edition,2017

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME14703	Operations Research	3	0	0	3	100

Objective(s)	• To understand the concepts of linear programming models to optimize the problem solutions at dissimilar circumstances. • To find the optimized solutions at a range of conditions using transportation and assignment models. • To understand the concepts of game theory and sequencing models to optimize the significant production processes. • To determine the optimum lot size of inventories and replacement of items under diverse conditions. • To understand the concepts of Project management and Queuing models to obtain optimized planning, control and queue systems.

UNIT-I	**Linear Programming Models**	**9**

Introduction: Basics of Operation Research, OR Models and types, advantages and limitations.
Linear Programming: Introduction & Scope, Problem formulation, Graphical Method -The standard form of linear programming problems – Basic feasible solutions – unrestricted variables – simplex algorithm – artificial variables.

UNIT-II	**Transportation and Assignment Models**	**9**

Transportation Problem: Basic solutions - North West corner Rule, least cost method and Vogel's approximation method – MODI method to find optimal solution- degeneracy in transportation problems- unbalanced Transportation Problem.
Assignment problem – Hungarian Method- Maximization problem.

UNIT-III	**Game Theory and Sequencing**	**9**

Game Theory: Two person Zero sum game, Solution with/without saddle point, dominance rule, different methods like Algebraic, Graphical and game problem as a special case of Linear Programming.
Sequencing: Basic assumptions, n Jobs through 2-3 machines, 2 Jobs on m machines.

UNIT-IV	**Inventory control and Replacement Models**	**9**

Inventory control: Introduction, types of inventories, costs associated with inventories, the concept of EOQ, deterministic inventory problems with no shortages, with shortages.
Replacement Problems: Introduction, replacement of items that deteriorate gradually, replacement of items that fails suddenly.

UNIT-V	**Project Management and Queuing Models**	**9**

Project management: Basic Concept of network Scheduling, Rules for drawing network diagram, Applications of CPM and PERT techniques in Project planning and control; crashing of operations; resource allocation.
Queuing models: Characteristics of Queuing Model, M/M/1 and M/M/S system, cost consideration.

Total hours	**45**

Outcome(s)	Upon completion of this course, the students will able to; • Apply the concepts of linear programming models to obtain the optimum solutions under dissimilar circumstances. • Calculate the optimal solution of given minimization problems using transportation and assignment Models. • Determine the optimum solution from the solutions of given problem and improve the processing time using game theory and sequencing. • Compute the economic order quantities of inventories and solutions of replacement of items using inventory control and replacement models. • Apply the concepts of network scheduling and effective queue systems using project management and queuing models.

TEXT BOOK :	
1	Operations Research - An Introduction, by- Hamdy A. Taha, Pearson India, 9th Edition, 2014.
2	Operations Research- A.P. Verma, S.K. Kataria and Sons, 7th Edition, New Delhi, 2013.
3	Operations Research- S. Kalavathy, Vikas Publishing House Private Limited, 4th Edition, New Delhi, 2013.
4	Operations Research- R. Panneerselvam, PHI Learning Private Limited, New Delhi, 2nd Edition, 2012.
5	Problems in Operations Research by- Prem Kumar Gupta & D.S. Hira, S. Chand Publications,2010.
REFERENCES:	
1	Operations Research: Concepts and Cases" by Hillier and Liberman, McGraw-Hill, 10th Edition, 2017.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME24701	Industrial Automation Laboratory	0	0	3	1.5	100

Objective(s)	• To gain knowledge in basic electrical, hydraulic, and pneumatic systems for automatic control in single and double-acting cylinders. • To know the concept of PLC and Micro-processer in automation applications. • To understand the electromechanical devices and stepper motor principles in automatic control systems.

LIST OF EXPERIMENTS

1. Design and testing of direction control circuit using single and double acting cylinder and to demonstrate the working of the circuit.
2. Design and testing of pneumatic circuit with double acting cylinder using multiple sequences and to demonstrate the working of the circuit.
3. Design and testing of pneumatic circuit with double acting cylinder using push button in electro pneumatic trainer kit and to demonstrate the working of the circuit.
4. Design a circuit using timer for controlled retracted motion of a double acting cylinder and to demonstrate the working of the circuit.
5. Design and testing of hydraulic circuit with single acting and double acting cylinder using Hydraulic trainer kit to demonstrate the working of the circuit.
6. Speed control of a stepper motor with half step and full step resolution.
7. Design and demonstrate the sequential circuit using PLC.
8. Control the speed of PMDC motor using PID controller interfacing.

Total hours	**45**

LIST OF EQUIPMENTS

1. Basic Pneumatic Trainer Kit with Manual controls – 1 No
2. Basic Pneumatic Trainer Kit with Electrical and PLC Control -1 No
3. Basic Hydraulic Trainer Kit- 1No
4. Programmable Logic Controller unit-1 No

Outcome(s)	Upon completion of the course, students shall be able to: • Design the automatic control of single and double acting cylinders using electrical, hydraulic and pneumatic systems. • Design the PLC and micro controller circuit for automation applications. • Demonstrate the electromechanical devices and stepper motor principles in automatic control systems.

CO Mapping with POs and PSOs

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	-	2	1	-	1	-	-	-	1	-	3	-
CO2	2	2	3	-	2	1	-	1	-	-	-	1	-	3	-
CO3	2	2	3	-	2	1	-	1	-	-	-	1	-	3	-

CourseCode	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24ME24702	**Simulation Laboratory**	0	0	3	1.5	**100**
Objective(s)	• To expose the students to the techniques of CNC programming and cutting tool path generation through CNC simulation software by using G-codes and M-codes. • To educate the students on the usage of CAM packages and cutting parts on a virtual CNC machine simulator • To make the students understand the importance of automation in industries and advanced manufacturing systems					

LIST OF EXPERIMENTS	
CNC SIMULATION	
(i) Simulation of - CNC Lathe Operations	
a)	Facing Cycle ,Turning Cycle, Step Turning &Taper Turning
b)	Threading & Grooving
(ii) Simulation of - CNC Milling Operations	
a)	Linear and Circular interpolation
b)	Mirroring and Circular Pocketing
CAE ANALYSIS	
1.	Stress analysis of a plate with a circular hole
2.	Stress analysis of rectangular L bracket.
3.	Stress analysis of beams (Cantilever, Simply supported, Fixed ends).
4.	Thermal stress analysis of a 2D component.
5.	Conductive heat transfer analysis of a 2D component.
6.	Convective heat transfer analysis of a 2D component.
Total hours	**45**

Outcome(s)	• Develop the tool path layout. • Construct and simulate the part programming. • Conduct static and thermal analysis for engineering components.

CO Mapping with POs and PSOs

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	3	1	-	1	3	1	-	1	-	-	3
CO2	1	2	-	-	3	1	-	1	3	1	-	1	-	-	3
CO3	1	2	-	-	3	1	-	1	3	1	-	1	-	-	3

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
24ME36701	**Project Work (Phase- I)**	0	0	6	3	**100**
Objective(s)	• To practice the steps involved for the selection, execution, and reporting of the project. • To train the students for group activities to accomplish an engineering task.					
Outcome(s)	• The students involves in identifying right project work, acquiring knowledge on thatarea, making preliminary works towards phase II of the project work.					

The project work shall be an experimental / design and fabrication project on any of the topics of Mechanical engineering interest. The head of the department will decide the framing of the project batches. Each of the batches shall consist a minimum of four students. The topic of the project should be different from his/her mini project. A faculty member will always be supervising each group as an internal guide. In case an industrial project is selected by a batch, in addition to the internal guide, there should be an external guide from the industry.

During this semester, each group is required to select a topic for the project. A project evaluation committee will be constituted by head of the department at the beginning of the semester. A brief report of the chosen project should be submitted before the committee within two weeks from the beginning of the VII semester. The committee will give permission for the project after examining the feasibility. In the event of rejection of the topic by the committee, the students should resubmit a new project topic within one week, and get it approved by the committee. After getting the permission, they have to conduct a detailed literature survey, and collect sufficient information and necessary data.

25% of the total work to be done for the project work has to be completed by end of 7^{th} semester. The same team of faculty will evaluate the project phase-I report. This evaluation will form 50% of the internal assessment mark. The remaining 50% of the internal assessment mark will be given at the end of the 8th semester, at the time of completing the project work.

Total hours	**45**

CO Mapping with POs and PSOs

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	2	3	2	2	3	3	3	2

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15101	Renewable Energy	3	0	0	3	100

Objective(s)	• To understand the various solar energy systems. • To understand the application of wind energy and wind energy conversion system. • To understand the Bio energy sources • To study the utilization of renewable energy sources for both domesticsand industrial applications. • To understand the various types of renewable energy sources.

UNIT-I	**Solar Energy**	**9**
Solar radiation its measurements and prediction - solar thermal flat plate collectors concentrating collectors – applications - heating, cooling, desalination, power generation, drying, cooking etc - principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. Photovoltaic applications: battery charger, domestic lighting, street lighting, and water pumping, power generation schemes. Cost Estimation and Payback Calculations.		
UNIT-II	**Wind Energy**	**9**
Resource assessment - types of wind turbines - selection of components - blade materials - power regulation - various methods of control - wind farms - site selection - off shore wind farms – Solar Wind Hybrid energy systems.		
UNIT-III	**Bio Energy Sources**	**9**
Energy through various processes - Energy through fermentation - Gasification - various types of gasifiers -Pyrolysis - Fixed bed and fast Pyrolysis - Bio energy through digestion - Types of Digesters- Factors affecting the yield of products.		
UNIT-IV	**Hydrogen and Fuel Cells**	**9**
Thermodynamics and electrochemical principles - basic design, types, and applications - production methods - Biophotolysis: Hydrogen generation from algae biological pathways - Storage gaseous, cryogenic and metal hydride and transportation. Fuel cell – principle of working - various types - construction and applications.		
UNIT-V	**Other Types of Energy**	**9**
Hybrid Systems-Ocean energy resources - principles of ocean thermal energy conversion systems - ocean thermal power plants - principles of ocean wave energy conversion and tidal energy conversion – hydropower – site selection, construction, environmental issues - geothermal energy - types of geothermal energy sites, site selection, and geothermal power plants.		
	Total hours	**45**

Outcome(s)	Upon completion of the course, students shall be able to: • Explain the various solar energy applications • Analyze the performance of wind mills • Design a bio-gas digester • Explain the construction and working of electrochemical cells • Explain various methods for harvesting the ocean energy

TEXT BOOK :

1	D.P. Kothari K. C. Singal, Rakeshranjan, "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt. Ltd, 2011.
2	Rai G D , "Non-Conventional Sources of Energy", 6th Edition, Khanna Publishers, New Delhi, 2017.

REFERENCES:

1	Sukhatme S.P., "Solar Energy", Tata McGraw Hill, 2008.
2	Khandelwal K.C, Mahdi S.S., "Biogas Technology" - A Practical Handbook, Tata McGraw Hill, 1986.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15102	Gas Dynamics and Jet Propulsion	3	0	0	3	100

Objective(s)	• To understand the basic concept and importance of gas dynamics • To understand the basic difference between incompressible and compressible flow. • To understand the basic concept for constant area duct with friction and heat transfer. • To understand the phenomenon of shock waves and its effect on flow properties. • To understand the Rocket engines and space flight.

UNIT-I	**Fundamental of Gas Dynamics**	**9**
Energy and momentum equations of compressible fluid flows -Stagnation states and Stagnation Properties, Bulk Modulus of Elasticity, Sound Velocity. Mach waves and Mach cone – Bernoulli's Equation Effect of Mach number on compressibility – Use of Gas tables.		
UNIT-II	**Isentropic Flow With Variable Area**	**9**
Comparison between Isentropic and Adiabatic Processes- Mach Number Variation- Stagnation and Critical StatesArea Ratio as a Function of Mach Number- Impulse Function- Mass Flow Rate- Flow through Nozzles- Flow through Diffusers .		
UNIT-III	**Fanno and Rayleigh Flow**	**9**
Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties – Use of tables and charts – Generalized gas dynamics.		
UNIT-IV	**Flow With Normal Shocks**	**9**
Governing equations – Variation of flow parameters across the normal shocks – Prandtl – Meyer relations – flow in convergent and divergent nozzle with shock, Normal shock in Fanno and Rayleigh flows -Use of table and charts		
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 hours	**45**

Outcome(s)	Upon the completion of this course the students will be able to • Explain basic concepts of gas dynamics and describe the basic fundamental equations of one dimensional fluid flows. • Analyze the flow through constant area duct with friction and heat transfer. • Compute the flow characteristics using Rayleigh and Fanno flow • Calculate the flow parameters across normal shock wave • Apply gas dynamics principles in the jet and space propulsion

TEXT BOOK :

1	S.M. Yahya, fundamentals of Compressible Flow, New Age International (P) Limited, New Delhi, 6 th Ed., 2019.
2	Anderson, J.D., Modern Compressible flow, McGraw Hill, 3 rd Edition, 2003.

REFERENCES:

1	PR.S.L. Somasundaram, Gas Dynamics and Jet Propulsions, New Age International Publishers, 1996.
2	H. Cohen, G.E.C. Rogers and Saravanamutto, Gas Turbine Theory, Prentice Hall., 2001.
3	V. Ganesan, Gas Turbines, Tata McGraw Hill Publishing Co., New Delhi, 7 th Reprint 2006.
4	V. Babu, Fundamentals of Gas Dynamics, ANE Books India, 2008

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15103	Power Plant Engineering	3	0	0	3	100

Objective(s)	• To understand the basic working of various power generation units and steam cycles. • To learn the concepts of steam generators, combustion and firing methods in order to make the fullest use of thermal power potentialities of the country. • To understand the concepts of fuel combustion and pollution management systems. • To impart knowledge on nuclear, gas turbine, hydro and diesel power plants which play an important role in power generation. • To understand the concept of power from the renewable sources.

UNIT-I	**Introduction to Power Plants**	**9**
Power plants-Features - Components and layouts-Working principle of Steam - Hydro -Nuclear - Gas Turbine and Diesel power plants-Selection of site-Analysis of steam cycles-Rankine cycle-Reheating and Regenerative cycles		
UNIT-II	**Steam Generators**	**9**
Boiler classification-Types of Boiler-Fire tube and Water tube boilers-High pressure and Supercritical boilers-Positive circulation boilers-Fluidized bed boiler-Waste heat recovery boiler-Feed water heaters-Super heaters-Reheaters-Economiser-Condenser-Cooling tower-Feed water treatment-Air heaters		
UNIT-III	**Fuel Combustion and Pollution Management**	**9**
Coal handling and preparation-Combustion equipment and firing methods-Mechanical stokers Pulverized coal firing systems-Cyclone furnace-Ash handling systems-Electrostatic preceptor-Fabric filter and Bag house-Forced draft and Induced draft fans-Chimney- ISO and Statutory Requirement.		
UNIT-IV	**Nuclear and Gas Turbine Power Plants**	**9**
Principles of nuclear energy-Energy from nuclear reactions-Energy from fission and fuel Burn up-Decay rates and Half-Lives-Boiling water reactor-Pressurized water reactor- Pressurized Heavy Water Reactor-Gas cooled reactor-High temperature gas cooled reactor- Pebble bed reactor-Fast breeder reactor-Liquid metal fast breeder reactor-reactor materials-Radiation shielding-Waste disposal-Gas turbine power plant-Open and closed cycles-Intercooling - Reheating and Regenerating-Combined cycle power plant		
UNIT-V	**Power From Renewable Energy**	**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, Geo Thermal, Biogas and Fuel Cell power systems.		
	Total hours	**45**

Outcome(s)	Student will be able to • Discuss the layout of thermal power plant and working principle of various types of boilers. • Explain the concepts of steam generators, combustion and firing methods in order to make the fullest use of thermal power plants. • Describe the fuel combustion and pollution management systems. • Discuss the various types of nuclear reactors used in nuclear power plant. • Summarize the principles and working of various renewable energy power plants.

TEXT BOOK :

1	P. K. Nag, 2001, Power Plant Engineering: Steam and Nuclear, Tata McGraw-Hill Publishing Company Ltd., Second Edition.
2	K.K.Ramalingam, ―Power Plant Engineering, Scitech Publications (India) Pvt Ltd., 2002.

REFERENCES:	
1	M. M. El-Wakil, 2002, Power Plant Technology, McGraw-Hill International Editions
2	Black and Veatch, 2005, Power Plant Engineering, CBS Pub and Distributors, New Delhi.
3	G.R. Nagpal, ―Power Plant Engineering, Khanna Publishers, 2002.
4	R. K. Rajput, 2005, A Text Book of Power Plant Engineering, Laxmi Publications (P) Ltd.

CO Mapping with POs and PSOs

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

Course code	Course name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
24ME15104	Refrigeration and Air Conditioning	3	0	0	3	100

Objectives	• To understand various concepts and fundamentals of refrigeration. • To discuss about the vapor compression cycle and its working principle. • To learn the overall attributes of cold storage applications in food industries. • To describe food freezing and equipment involved in freezing process. • To learn the concept of cold chain management in small and large scale refrigerators

UNIT-I	**Introduction to Refrigeration**	**9**
Refrigeration – Ton of refrigeration, refrigeration cycles, Refrigerants, characteristics of different refrigerants, net refrigerating effect -Components of a Refrigeration system: Compressor, condenser, Evaporator, Expansion valves piping and different controls- COP - Representation of cycle on T-S and p-h charts effect of sub cooling and super heating. Applications of refrigeration in different food products.		
UNIT-II	**Vapour Compression & Absorption System**	**9**
Vapour compression refrigeration - working principle and essential components of the plant – simple Vapour compression refrigeration cycle - Vapor Absorption System - description and working of NH3 - water system and Li Br - water System - Principle of operation Three Fluid absorption system, salient features.		
UNIT-III	**Psychometry**	**9**
Psychometric Properties & Processes- Characterization of Sensible and latent heat loads - Need for Ventilation, Consideration of Infiltration - Load concepts of RSHF, GSHF- Problems, Concept of ESHF and ADP. Air conditioning Load Calculations.		
UNIT-IV	**Air Conditioning Systems**	**9**
Air Conditioning systems: Summer and Winter Air conditioning. Classification of equipment- filters grills and registers fans and blowers. Heat Pump - Heat sources - different heat pump circuits. Applications include Cold storage and mobile transfer systems. Requirements of Industrial air conditioning-Automobile.		
UNIT-V	**Cold Storage and Management**	**9**
Insulation, properties of insulating materials, air diffusion equipment, Cold load estimation; prefabricated systems, walk-in-coolers, and Refrigerated container trucks: Freezer Storages, Freezer room Temperatures, Cooling towers: introduction, Construction and Working; Cold Storage practice, Stacking and handling of materials.Supply chain system - Important Factors to consider- logistic supply- Protocols for Domestic, Sea and Air freight- Traceability and barcode – Product Temperature and Moisture monitoring.		
	Total hours :	**45**

Outcomes	At the end of the course the students will be able to: • Illustrate the fundamental principles and applications of refrigeration system. • Select the properties, applications and environmental issues of different refrigerants • Describe the utility of different Air conditioning systems for different applications. • Demonstrate the predictive modeling for shelf life assessment of foods • Examine the Industrial application aspects in industrial refrigeration systems.

TEXT BOOK

1	Arora, C.P., Refrigeration and Air Conditioning, McGraw Hill, 3rd ed, New Delhi, 2010.
2	Sun, Da-Wen. "Advances in Food Refrigeration". Leatherhead Publishing, 2001.
3	James, S.J. and C. James. "Meat Refrigeration". CRC / Woodhead Publishing, 2002.

REFERENCES	
1	Roy J. Dossat, Principles of Refrigeration, Pearson Education Asia, 4th Edition, 2009.
2	Stoecker, W.F. and Jones J. W., Refrigeration and Air Conditioning, McGraw Hill, New Delhi, 1986.
3	Jones W.P., Air conditioning engineering, Elsevier Butterworth-Heinemann, 5th Edition,2001
4	Refrigeration commissioning guide for commercial and industrial systems, 2013.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15105	Heating Ventilation and Air Conditioning	3	0	0	3	100

Objective(s)	• To inculcate techniques of estimating building envelop load. • To understand the recent Air Conditioning systems • To provide the knowledge of basic concepts of ventilation, infiltration and space distribution techniques. • To understand the effect of solar radiation and internal heat sources on heating load calculation. • To identify trouble shooting of HVAC systems.

UNIT-I	**Building Survey**	**9**
Building Survey; Heating and dehumidifying coils and air washers. Cooling by dry and wet coils. Building Aesthetics and Thermal infiltration, Periodic heat flow through building elements for weather conditions all round the year, tropical conditions. Heating and cooling load calculations. Energy-efficient and cost effective measures for building envelope. Standard codes(ASHRAE) for building survey.		
UNIT-II	**Introduction to Air Conditioning Systems**	**9**
Psychrometric; Properties of moist air and psychrometric processes –Dry bulb temperature, dew point temperature, humidity ratio, degree of saturation and enthalpy. Classification of air conditioning systems –Summer, winter and year round air conditioning systems. Selection of air conditioning equipments for cooling and dehumidification processes. Advanced air conditioning systems. Thermal storage air conditioning system.		
UNIT-III	**Ventilation System**	**9**
Introduction; Fundamentals of good indoor air quality need for building ventilation. Types of ventilation system. Supply system; Air inlet system, Filtering, heating and cooling equipment- Fans, Duct, Grills, Diffusers for distribution of air. Exhaust system; General exhaust system, local exhaust system and air cleaning devices. Ventilation of commercial and residential buildings.		
UNIT-IV	**Heating System**	**9**
Solar radiation, Heat gain through fenestrations, Space load characteristics, cooling load and coil load calculations. Heat losses through structure-heat losses due to infiltration. Effects of solar radiation and internal heat sources on heating load calculation. Thermal resistance of various building materials. Heat transfer through building structures - Air heating system-Hot water heating system.		
UNIT-V	**Industrial Applications OF HVAC Systems**	**9**
Integration of IoT in HVAC –Real time monitoring-Preventive maintenance-Remote diagnostics-Building inter-operability-Improvement in efficiency of system. Trouble shooting of HVAC systems; A general guide lines to HVAC troubleshooting-diagnostic tools, sequence of operation and general trouble shooting procedure.		
	Total hours	**45**

Outcome(s)	On completion of the course, students will be able to • Estimate heat transfer through building structures with the environment. • Illustrate the various methods of Air Conditioning systems. • Develop the ventilation and infiltration provisions at appropriate space. • Estimate the energy requirements for heating load calculations. • Understand the ways of improvement in efficiency of HVAC system

TEXT BOOK :

1	Arora C P, Refrigeration and Air Conditioning, Tata Mc Graw Hill.
2	Manohar Prasad, Refrigeration and Air-conditioning, Wiley Eastern Limited, 2016.

REFERENCES:

1	ASHRAE Handbook (HVAC Equipments).

2	HVAC Fundamentals Volume-l / James E. Brumbou / Audel / 4th Edition.
3	Fundamentals of HVAC Systems / Robert Mcdowall / Academic Press / 2016.
4	Home Heating & Air Conditioning systems / James Kittle / MGH.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15106	Computational Fluid Dynamics	3	0	0	3	100

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

UNIT-I	**Introduction**	**9**
Basics of Computational Fluid Dynamics – Governing equations– Continuity, Momentum and Energy equations – Boundary conditions & Types– Time-averaged equations for Turbulent Flow – Classification and Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations, comparison between Analytical, Experimental and Numerical techniques, Techniques of Discretisation and Numerical errors		
UNIT-II	**Finite Difference and Finite Volume Methods for Diffusion**	**9**
Derivation of finite difference equations– General Methods for first and second order accuracy – Finite volume formulation for steady and transient diffusion 1D and 2D problems – Use of Finite Difference and Finite Volume methods, Accuracy of solution, optimum step-size, Euler, Crank-Nickolson, and pure implicit methods, stability of schemes.		
UNIT-III	**Finite Volume Method for Convection Diffusion**	**9**
Steady one-dimensional convection and diffusion – Central, upwind differencing schemes, properties of discretization schemes, Hybrid, Power-law, QUICK Schemes, Computation of Boundary layer flow, von Neumann stability analysis.		
UNIT-IV	**Flow Field Analysis**	**9**
Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms, Computation of internal and external thermal boundary layer.		
UNIT-V	**Turbulence Modeling**	**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 hours	**45**

Outcome(s)	On completion of the course, students will be able to : • Apply the fundamentals of CFD, and develop case specific governing equations. • Discuss finite difference and finite volume based analysis for steady and transient diffusion problems. • Implement various mathematical schemes under finite volume method for convention diffusion. • Solve complex problems in the field of fluid flow and heat transfer with the support of high speed computers. • Apply the various discretization methods, solution procedure and the concept of turbulence modelling.

TEXT BOOK :

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	Suhas V, Patankar, "Numerical Heat transfer and Fluid flow", Taylor & Francis, 2009.
3	Yogesh Jaluria & Kenneth E. Torrance, "Computational Heat Transfer", CRC press, 2002.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15201	Design of Jigs, Fixtures and Press Tools (Use of P S G Design Data Book is Permitted)	3	0	0	3	100

Objective(s)	• To understand the functions and design principles of jigs, fixtures and press tools. • To understand the basics of Jigs • To understand the basics of fixtures. • To understand bending and drawing operations • To understand the development of required views of the final design.

UNIT-I	**Introduction**	**9**
Function and advantages of Jigs and fixtures - Basic elements - principles of location - Locating methods and devices - Redundant Location - Principles of clamping - Mechanical actuation - pneumatic and hydraulic actuation Standard parts - Drill bushes and Jig buttons - Tolerances and materials used.		
UNIT-II	**Jigs**	**9**
Design and development of jigs for given component - Types of Jigs - Post, Turnover, Channel, latch, box, pot, angular post jigs - Indexing jigs.		
UNIT-III	**Fixtures**	**9**
Design and development of fixtures for given component-General principles of milling, Lathe, boring, broaching and grinding fixtures - Assembly, Inspection and Welding fixtures - Modular fixturing systems-Quick change fixtures.		
UNIT-IV	**Bending and Drawing Dies**	**9**
Difference between bending and drawing - Blank development for above operations - Types of Bending dies - Press capacity - Spring back - knockouts - direct and indirect - pressure pads -Ejectors - Variables affecting Metal flow in drawing operations - draw die inserts - draw beads - ironing.		
UNIT-V	**Forming Techniques and Evaluation**	**9**
Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies - recent trends in tool design- computer Aids for sheet metal forming Analysis - basic introduction - tooling for numerically controlled machines - setup reduction for work holding - Single minute exchange of dies.		
	Total hours	**45**

Outcome(s)	Upon completion of the course, students shall be able to: • Summarize the different methods of locating jigs and fixtures and clamping principles • Design and develop jigs for given component • Design and develop fixtures for given component • Distinguish between bending and drawing dies • Discuss the different types of forming techniques

TEXT BOOK :

1	Joshi, P.H. "Jigs and Fixtures", Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.
2	Joshi P.H "Press tools -Design and Construction", S. Chand & Co Ltd, 2001.
3	Kempster, "Jigs and Fixture Design", Third Edition, Hoddes and Stoughton, 1974.
4	Donaldson, "Lecain and Goold Tool Design", 5th Edition, Tata McGraw Hill, 2017.

REFERENCES:

1	K. Venkataraman, "Design of Jigs Fixtures & Press Tools", Anne Publications, 2015.
2	"ASTME – "Fundamentals of tool design"-Prentice Hall of India pvt. Ltd New Delhi 1984.
3	"Design Data Hand Book", PSG College of Technology, Coimbatore, 2013.
4	V.Balachandran, "Design of Jigs Fixtures & Press Tools", Notion Press, 2015.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15202	Process Planning and Cost Estimation	3	0	0	3	100

Objective(s)	• To provide the necessary knowledge for the planning of manufacturing processes for new industrial products. • To know the different steps involved in process planning. • To Estimate costs for new products. • To understand the machining time calculation for different manufacturing methods.

UNIT-I	**Introduction to Process Planning**	**9**
Aims and objectives- methods of process planning-drawing interpretation-dimensional tolerances in manufacturing process-steps in process selection-production equipment and tooling selection.		
UNIT-II	**Process Planning Steps**	**9**
Design of a process plan – selection of production processes, tools and process parameters- positioning and work holding devices-selection of inspection devices and tools-documenting the process plan-simple case studies-computer-aided process planning (CAPP).		
UNIT-III	**Introduction to Cost Estimation**	**9**
Importance of costing and estimation-methods of costing-elements of cost estimation-types of estimates-Estimating procedure-Estimation labor cost, material cost-allocation of overhead charges-calculation of depreciation cost- Break-even analysis.		
UNIT-IV	**Production Cost Estimation**	**9**
Estimation of different types of jobs– estimation of forging shop, welding shop, foundry shop.		
UNIT-V	**Machining Time Calculation**	**9**
Estimation of machining time–importance of machine time calculation-calculation of machining time for lathe, drilling, boring, milling, shaping, planning and grinding.		
	Total hours	**45**

Outcome(s)	Upon completion of the course, students shall be able to: • Describe the process planning techniques in different industrial processes. • Prepare process planning activity chart. • Compute the direct and indirect product costing. • Find the production cost for manufacturing processes. • Calculate the machining time for machining operations.

TEXT BOOK :

1	Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.
2	Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995.
3	Gideon Halevi, "Process and operation planning", Kluwer academic Publishers (Printede-book), 2003.

REFERENCES:

1	Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2011.
2	Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9 th Edition, John Wiley, 1998.
3	Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003
4	Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2001.
5	K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers 1990.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15203	Geometric Dimension, Tolerance and Modeling	2	0	2	3	100

Objective(s)	• To understand the concepts on steps involved in Design Process. • To get idea of drawing standards, fits and tolerances in design and drafting. • To gain knowledge on integration of design tool in computers to obtain 2D and 3D modeling. • To obtain basic concepts on geometric modeling methods for design and drafting in mechanical systems. • To gain practical experience in handling 2D sketches and 3D solid modeling using appropriate design tool.

	Examination Pattern: Theoretical Mode	
UNIT-I	**Introduction to design, Limits, Fits and Tolerance**	**9**
Overview of the design process - Selection of materials dependent on mechanical characteristics - Preferred numbers. Tolerances – Types – Drawing's representation – Tolerance data sheet –Geometric tolerance-computation of fundamental deviations. Fits – Types of fits – Allocation of fits for different machine components.		
UNIT-II	**Geometric Modeling and Methods**	**9**
GEOMETRIC MODELLING- Curves representation - Hermite curve- Bezier curve- B-Spline curves-rational curves- Surface modeling techniques – surface patch- Coons and bicubic patches- Bezier and B-Spline surfaces. Solid modeling techniques- CSG and B-rep.		
	Examination Pattern: Practical Mode	
UNIT-III	**Geometric Graphics and Representation**	**9**
Computer aided design –CAD system architecture- Computer graphics –coordinate systems – Sketching -Clipping- hidden surface removal, reflection, shading and generation of characters. Transformation in graphics -2D and 3D transformations homogeneous coordinates.		
UNIT-IV	**Part Modeling of Engineering Components**	**9**
Preparation of part drawings from the given detailed views (orthographic views) of Lock clamp, Bracket, Gearbox cover, Pump housing, Stop valve body, Piston Head, hydraulic fittings, journal Bearing.		
UNIT-V	**Assembly and Cross Sections**	**9**
Preparation of assembly drawings and cross sections from the given detailed views (orthographic views) of Swivel bearing, Stuffing box, Steam stop valve, Hydraulic cylinder, Hydraulic pump.		
	Total hours	**45**

Outcome(s)	At the end of the course student will be able to • Describe the various steps involved in the Design Process. • Apply the drawing standards, fits and tolerances in design and drafting. • Comprehend the concept of computer aided design and geometric modeling. • Develop 2D models using modeling software. • Develop part, assembly modeling and drafting with all dimensional particulars.

TEXT BOOKS :

1. Ibrahim Zeid "Theory and Practice" Tata McGraw-Hill Publishing Co., 2nd Edition 2009.
2. P. Radhakrishan, S. Subramanyan, V. Raju, "CAD/CAM/CIM". New Age International Publishers, 4th Edition 2018.
3. Bhandari V, "Introduction To Machine Design", 2nd Edition, Tata McGraw- HillBookCo, 2013.

REFERENCES:

1. M. M. M. Sarcar, Computer Aided Design and Manufacturing, Prentice Hall of India, New Delhi, 2008.

2.	Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice", 2nd Edition, Pearson Education -2007.
SOFTWARE:	
1.	High-end Integrated Modeling CAD software – 30 Users.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15204	Value Engineering	3	0	0	3	100

Objective(s)	• To study the value engineering process and able to identify its functions within the process. • To determine the appropriate value engineering methodology for a given project and propose appropriate training to centralized and decentralized modes. • To learn various decision-making processes and cost evaluation models and apply them in appropriately in the product development life-cycle. • To explore in-depth understanding of various value engineering applications in human resources, manufacturing and marketing. • To demonstrate to implement value engineering solutions and propose to perfect them.

UNIT-I	**Value Engineering Basics**	**9**
Origin of value engineering - Meaning of value engineering - Definition of value engineering and Value analysis- Value Management - Value Analysis Versus Value Engineering - Value Analysis versus Traditional cost reduction techniques - Types of Value function – Basic and Secondary functions - concept of cost and worth - creativity In Value Engineering - uses, applications, advantages and limitations of Value analysis.		
UNIT-II	**Value Engineering Job Plan And Process**	**9**
Seven phases of job plan - FAST Diagramming as Value Engineering Tool - Behavioral and organizational aspects of Value Engineering - Ten principles of Value analysis - Benefits of Value Engineering.		
UNIT-III	**Value Engineering Techniques**	**9**
Creativity - Brain storming - Gordon technique - Morphological Analysis - ABC Analysis- Probabilistic approach - Make or Buy decisions – Function cost worth analysis (FCWA) - Function Analysis System technique (FAST) - Break Even Analysis - Life cycle cost(LCC)		
UNIT-IV	**Worksheets and Guidelines**	**9**
Preparation of worksheets - general and information phase - Function Classification, relationship and summary - Meaningful costs - Cost analysis - idea listing and comparison - Feasibility ranking - Investigator phase, study summary - guidelines for writing value engineering proposal - Financial aspects - List cycle cost analysis - Oral presentation - Audit - Case studies and Discussion.		
UNIT-V	**Versatility of Value Engineering**	**9**
Value engineering operation in maintenance and repair activities - value engineering in non hardware projects - Initiating a value engineering programme Introduction - training plan - career development for value engineering specialties.		
	Total hours	**45**

Outcome(s)	Upon completion of the course, students shall be able to: • Estimate a product cost based on value engineering principles in terms of its values, functions and worthiness. • Discuss the product and articulate it in various phases of value engineering • Discuss and select appropriate methods, standards and apply them on value engineering project and propose appropriate training • Apply querying theory and FAST to prefect a value engineering project implementation. • Develop various case studies related to value engineering project implementation.

TEXT BOOK :

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.

REFERENCES:

1	Del L. Younker., "Value Engineering: analysis and methodology", CRC Press, 2003.
2	Lawrence D. Miles., "Techniques of Value Analysis and Engineering", Lawrence D. Miles Value Foundation, 3rd Edition, 2015.

CO Mapping with POs and PSOs

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	-	-	-	-	-	-	3	3	2	-
CO2	3	2	3	2	2	-	-	-	-	-	-	3	3	2	-
CO3	3	2	3	2	3	-	-	-	-	-	-	3	3	2	-
CO4	3	2	3	2	3	-	-	-	-	-	-	3	3	2	-
CO5	3	2	3	2	3	-	-	-	-	-	-	3	3	2	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15205	Additive Manufacturing and Wireframe Modeling	2	0	4	3	100

Objective(s)	• To understand the principles and processes involved in additive manufacturing. • To familiarize with wireframe modeling techniques for 3D object representation. • To apply modeling techniques for preparing designs suitable for additive manufacturing. • To enable hands-on experience with slicing, printing, and post-processing in AM. • To develop skills in transforming wireframe into solid models for AM-ready files.

UNIT-I	Fundamentals of Additive Manufacturing	9

Introduction to Manufacturing Processes - Classification of AM Processes: Material Extrusion (FDM), Vat Photopolymerization (SLA), Powder Bed Fusion (SLS, SLM) - Materials for AM (Polymers, Metals, Composites)- Applications: Prototyping, Medical, Aerospace, Automotive Limitations and Future Trends.

UNIT-II	Introduction to Wireframe Modeling and Its Role in AM	9

CAD Modeling Fundamentals - Wireframe Modeling: Concepts and Techniques, 2D & 3D wireframe entities (Lines, Arcs, Circles, Splines), Coordinate systems - Models - Application of Wireframe in STL file creation - Wireframe to Surface/Solid.

List of Experiments	27

1. Introduction to Additive Manufacturing Lab & Safety
2. Basic CAD Drawing and 2D Wireframe Creation
3. 3D Wireframe Modeling Techniques
4. Conversion from Wireframe to Solid Model
5. STL File Generation and Mesh Checking
6. Slicing and Support Generation
7. Material Setup and Print Bed Calibration
8. 3D Printing of a Wireframe-based Solid Model
9. Post-Processing of Printed Components
10. Project: AM Component from Concept to Product

Total hours	45

Outcome(s)	• Understand the principles and classifications of additive manufacturing processes. • Apply CAD techniques and wireframe modeling for AM file preparation. • Construct accurate 3D wireframe and solid models using CAD tools. • Prepare STL files, slice models, and execute FDM printing tasks. • Demonstrate complete workflow from modeling to post-processing of printed parts.

TEXT BOOK :

1	Zeid, Ibrahim - *CAD/CAM Theory and Practice*, McGraw-Hill Education, 2nd Edition, 2008

REFERENCES:

1	Gibson, I., Rosen, D. W., & Stucker, B. - Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Springer, 2nd Edition, 2015.
2	Chua, C. K., Leong, K. F., & Lim, C. S. - Rapid Prototyping: Principles and Applications, World Scientific Publishing, 5th Edition, 2019.
3	Andreas Gebhardt - Understanding Additive Manufacturing: Rapid Prototyping - Rapid Tooling - Rapid Manufacturing, Hanser Publishers, 2011.
4	Ian Stroud - Boundary Representation Modelling Techniques, Springer, 2006.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15206	Computational Solid Mechanics	3	0	0	3	100

Objective(s)	• To study the definition and basics on theory of elasticity • To learn finite element method and procedure for static linear elasticity • To study the Non Linear and History depend problems • To study time dependent and dynamic problems of Small and large strain viscoplasticity • To study Structural Elements & Interfaces and contact using penalty method.

UNIT-I	**Basic on Theory of Elasticity**	**9**

Definitions- notations and sign conventions for stress and strain, Equations of equilibrium. Strain – displacement relations, Stress – strain relations, Lame's constant –cubical dilation, Compressibility of material, bulk modulus, Shear modulus, Compatibility equations for stresses and strains, Principal stresses and principal strains, Mohr's circle, Saint Venant's principle.

UNIT-II	**Finite Element Method for Static Linear Elasticity**	**9**

Derivation and implementation of a basic 2D FE code with triangular constant strain elements. Generalization of finite element procedures for linear elasticity: interpolation and numerical integration in 1D, 2D and 3D. Deriving finite element equations - constructing variational forms; mixed methods. Accuracy and convergence; the Patch test.

UNIT-III	**Non Linear and History Depend Problems**	**9**

Small strain hypo-elastic materials - Small strain visco-plasticity - Large strain elasticity -Large strain visco-plasticity.

UNIT-IV	**Time Dependent And Dynamic Problems**	**9**

First-order systems - the diffusion equation - Explicit time integration – the Newmark method - Implicit time integration - Modal analysis and modal time integration.

UNIT-V	**Structural Elements & Interfaces and Contact**	**9**

Continuum Beams – Shells – Cohesive Zones - Enforcing constraints using penalty methods and Lagrange Multipliers - Contact elements (in two dimensions)

Total hours	**45**

Outcome(s)	Upon completion of the course, students shall be able to: • Discuss the definition and basics on theory of elasticity • Derive the finite element method for static linear elasticity, solve problems. • Discuss the Non Linear and History depend problems, Solve problems. • Discuss time dependent and dynamic problems solve problems. • Discuss Structural Elements & Interfaces and contact, solve problems.

TEXT BOOK :

1	L.S.Srinath, Advanced Mechanics Of Solids, 3rd Edition 2008
2	J.N.Reddy, Introduction To Finite Element Method, 4th Edition 2020.
3	S.Timoshenko, Theory of Elasticity, McGraw-Hill Education (India) Pvt Limited, 2010.

REFERENCES:

1	The Mechanics of Solids and Structures - Hierarchical Modeling and the Finite Element Solution (Computational Fluid and Solid Mechanics)by Miguel Luiz Bucalem and Klaus- Jurgen Bathe 25 February 2013
2	The Finite Element Analysis of Shells - Fundamentals (Computational Fluid and Solid Mechanics)by Dominique Chapelle and Klaus-Jurgen Bathe 27 January 2013

CO Mapping with POs and PSOs

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	2	2	-	-	-	3	3	2	3
CO2	3	3	3	3	3	3	2	2	-	-	-	3	3	2	3
CO3	3	3	3	3	3	3	2	2	-	-	-	3	3	2	3
CO4	3	3	3	3	3	3	2	2	-	-	-	3	3	2	3
CO5	3	3	3	3	3	3	2	2	-	-	-	3	3	2	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15301	Composite Materials, Processing and Application	3	0	0	3	100

Objective(s)	• To study the basics and types of composite materials. • To understand polymer, metal, and ceramic matrix composites and their manufacturing processes. • To understand the properties and uses of different composite materials. • To study advanced composites like carbon–carbon composites and their aerospace applications. • To understand about the testing and characterization of composites.

UNIT-I	**Introduction to composites**	**9**

Fundamentals of composites – Definition – classification– based on Matrix – based on structure – Advantages and applications of composites – Reinforcement – whiskers – glass fiber – carbon fiber – Aramid fiber – ceramic fiber – Properties and applications.

UNIT-II	**Polymer matrix composites**	**9**

Polymers – Polymer matrix materials – PMC processes – hand layup process – spray up process – resin transfer moulding – Pultrusion – Filament winding – Auto clave based methods – Injection moulding – sheet moulding compound – properties and applications of PMC's.

UNIT-III	**Metal matrix composites**	**9**

Metals – types of metal matrix composites – Metallic Matrices. Processing of MMC – Liquid state processes – solid state processes – In-situ processes. Properties and applications of MMC's.

UNIT-IV	**Ceramic matrix composites**	**9**

Ceramic matrix materials – properties – processing of CMCs – Sintering – Hot pressing – Infiltration – Lanxide process – In-situ chemical reaction techniques – sol-gel polymer pyrolysis – SHS – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). Properties and Applications of CCMs.

UNIT-V	**Advance in composites**	**9**

Advantages of carbon matrix – limitations of carbon matrix carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Properties and applications of Carbon–carbon composites. Composites for aerospace applications. Characterization of composite materials – Mechanical Properties, Thermal Properties.

Total hours	**45**

Outcome(s)	• Identify and classify different types of composite materials. • Explain the processes used to make polymer, metal, and ceramic matrix composites. • Describe the properties and applications of various composites. • Recognize the advantages and limitations of advanced composites. • Understand how to test and characterize composite materials.

TEXT BOOK :

1	Chawla K.K., Composite materials, 2/e, Springer – Verlag, 1998.
2	Daniel Gay, Suong V. Hoa & Stephen W. Tsai – Analysis and Performance of Fiber Composites, 2nd edition 2003
3	M.S. Shukla (Editor) – Mechanics of Composite Materials and Structures: With Personal Computers, 2nd edition 2022

REFERENCES:

1	H K Shivanand, B V Babu Kiran, Composite Materials, ASIAN BOOKS, 2011.

2.	A.B. Strong, Fundamentals of Composite Manufacturing, SME, 1989.
3.	S.C. Sharma, Composite materials, Narosa Publications, 2000.
4.	Maureen Mitton, Hand Book of Bioplastics & Bio-composites for Engineering applications, John Wiley publications, 2011

CO Mapping with POs and PSOs

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	2	-	-	-	-	-	3	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	3	-
CO3	3	2	-	-	-	2	3	-	-	-	-	-	3	2	-
CO4	3	2	-	-	-	-	2	-	-	-	-	-	3	2	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-	3	2	2

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15302	Computer Integrated Manufacturing	3	0	0	3	100

Objective(s)	• To study the overview of evolution of automation, CIM and its principles. • To study the various Automation tools, include various materials handling system. • To understand the group technology and FMS. • To understand the computer aided process planning in manufacturing. • To understand the basics of data transaction, information integration and control of CIM.

UNIT-I	**Introduction**	**9**
Introduction to CAD, CAM, CAD/CAM and CIM - Evolution of CIM – CIM wheel and cycle – Production concepts and mathematical models – Simple problems in production models – CIM hardware and software – Major elements of CIM system – Three step process for implementation of CIM – Computers in CIM – Computer networks for manufacturing – The future automated factory – Management of CIM – safety aspects of CIM– advances in CIM		
UNIT-II	**Automated Manufacturing Systems**	**9**
Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly – Overview of material handling equipments – Consideration in material handling system design – The 10 principles of Material handling. Conveyor systems – Types of conveyors – Operations and features. Automated Guided Vehicle system – Types &applications – Vehicle guidance technology – Vehicle management and safety. Storage system performance – storage location strategies – Conventional storage methods and equipments – Automated storage/Retrieval system and Carousel storage system Deadlocks in Automated manufacturing systems – Petrinet models – Applications in Dead lock avoidance – smart manufacturing – Industry 4.0 - Digital manufacturing – Virtual manufacturing		
UNIT-III	**Group Technology And FMS**	**9**
Part families – Visual – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies. FMS – Components – workstations – FMS layout configurations – Computer control systems – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – Machine cell design – Composite part concept, Holier method, Key machine concept – Quantitative analysis of FMS – Bottleneck model – Simple and complicated problems – Extended Bottleneck model - sizing the FMS ─ FMS applications, Benefits.		
UNIT-IV	**Process Planning**	**9**
Process planning – Activities in process planning, Informations required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes – Sequencing of operations according to Anteriorities – various examples – forming of Matrix of Anteriorities – case study. Typical process sheet – case studies in Manual process planning. Computer Aided Process Planning – Process planning module and data base – Variant process planning – Two stages in VPP – Generative process planning – Flow chart showing various activities in generative PP – Semi generative process planning- Comparison of CAPP and Manual PP.		
UNIT-V	**Process Control and Data Analysis**	**9**
Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control – Sequence control and PLC& SCADA. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control - Overview of Automatic identification methods – Bar code technology –Automatic data capture technologies.- Quality management (SPC) and automated inspection		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Discuss the basics of computer aided engineering. • Choose appropriate automotive tools and material handling systems. • Discuss the overview of group technology, FMS and automation identification methods.

	• Design using computer aided process planning for manufacturing of various components • Explain computer process control techniques.
TEXT BOOK :	
1	Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016.
2	Mikell P. Groover, Automation, Production system and Computer integrated Manufacturing, Prentice Hall of India Pvt. Ltd., 4th Edition, 2014.
REFERENCES:	
1	Alavudeen and Venkateshwaran, Computer Integrated Manufacturing‖, PHI Learning Pvt. Ltd., New Delhi, 2013.
2	Radhakrishnan P, Subramanian S and Raju V, CAD/CAM/CIM, New Age International Publishers, 3rd Edition, 2008.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
24ME15303	Engineering Economics and Cost Analysis	L	T	P	C	100
		3	0	0	3	

Objective(s)	• To understand the cost estimation of component • To evaluate value engineering and time value of money. • To study the decision and risk analysis • To analyze replacement and maintenance • To analyze depreciation and evaluation of public alternatives

UNIT-I	**Introduction to Economics**	**9**
Introduction to Economics - Flow in an economy, Law of supply and demand, Concept of Engineering Economics - Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis - V ratio, Elementary economic Analysis - Material selection for product Design selection for a product, Process planning		
UNIT-II	**Value Engineering**	**9**
Make or buy decision, Value engineering - Function, aims, and Value engineering procedure. Interest formulae and their applications - Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor.		
UNIT-III	**Decision and Risk Analysis**	**9**
Overview of project risk - Introduction to probability concepts for investment decisions - Probability distribution for NPW decision - Comparing mutually exclusive risky alternatives - Overview of risk simulation - Overview of decision tree analysis in investment decisions		
UNIT-IV	**Replacement and Maintenance Analysis**	**9**
Replacement and Maintenance analysis - Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset - capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.		
UNIT-V	**Depreciation**	
Depreciation - Introduction, Straight line method of depreciation, declining balance method of depreciation Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation - Evaluation of public alternatives - introduction, Examples, Inflation adjusted decisions - procedure to adjust inflation.		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Describe the basic terminologies and concepts of Engineering Economics. • Apply the techniques Value Engineering and Time Value of Money. • Discuss the concepts for investment decisions • Determine the economic life of an asset. • Apply the Depreciation methods for Individual/Industrial/Public Alternatives.

TEXT BOOK :

1	Panneer Selvam, R, Engineering Economics, Prentice Hall of India Ltd, New Delhi, 2012.
2	Smith, G.W., "Engineering Economy", Lowa State Press, 1987.
3	James L Riggs, David D. Bedworth, "Engineering Economics", Tata McGraw Hill, 1998.
4	Prasanna Chandra, "Projects", Tata McGraw Hill, 2009.

REFERENCES:

1	Chan S.Park, Contemporary Engineering Economics, Prentice Hall of India, 2022.
2	Newman, D.G. and Lavelle, J.P., "Engineering Economics and Analysis", Engineering Press, 2022.

3	Samuelson P A and Nordhaus W D, "Economics", Tata McGraw Hill, 2010.
4	Patel Bhavesh. M, "Project Management, Strategic Financial Planning Evaluation and Control", Vikas Publishing House, New Delhi, 2010.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15304	Smart Materials And Applications	3	0	0	3	100

Objective(s)	• To introduce the fundamentals and biological interactions of intelligent and bio-compatible materials. • To classify and understand the behavior of various active and passive smart materials. • To explore the principles, characteristics, and applications of electro-rheological and piezoelectric materials. • To study the properties, mechanisms, and applications of shape memory alloys and polymers. • To examine the real-world applications of smart materials across engineering, biomedical, and industrial domains.

UNIT-I	**Introduction**	**9**
Intelligent / Smart materials – Functional materials – Poly functional materials – Structural materials, Electrical materials, bio-compatible materials. – Intelligent biological materials – Biomimetics – Wolff's Law – Biocompatibility – Material response: swelling and leaching, corrosion and dissolution, deformation and failure, friction and wear – host response: the inflammatory process – coagulation and hemolysis – in vitro and in vivo evaluation of biomaterials		
UNIT-II	**Classification of Smart Materials**	**9**
Types-.Active smart materials – passive smart materials-Piezoelectric materials.-Shape memory materials.- Chromoactive materials.- Magneto-rheological materials.-Photoactive materials- Magneto restrictive materials- classification - Active smart materials – passive smart materials.		
UNIT-III	**Electro-Rheological and Piezoelectric Materials**	**9**
The principal ingredients of smart materials –micro-sensors- hybrid smart materials – an algorithm for ynthesizing smart materials – active, passive reactive actuator based smart structures- suspensions 2nd electro-rheological fluids – Bingham body model – principal characteristics of electro-rheological fluids – charge migration mechanism for the dispersed phase – electro- rheological fluid domain – fluid actuators- design parameter – application of Electo-rheological fluids – Basics, Principles and instrumentation and application of Magneto-rheological fluids – Piezoelectric materials: polymers and ceramics, mechanism, properties and application. Introduction to electro-restrictive and magneto-restrictive materials		
UNIT-IV	**Shape Memory Materials**	**9**
Nickel – Titanium alloy (Nitinol) – Materials characteristics of Nitinol – martensitic transformations – austenitic transformations – thermoelastic martensitic transformations– classification of SMA alloys- mechanism of magnetic SMA – applications of SMA – continuum applications of SMA fasteners – SMA fibers – reaction vessels, nuclear reactors, chemical plant, etc. – micro robot actuated by SMA – SMA memorization process (Satellite Antenna Applications) SMA blood clot filter – Impediments to applications of SMA – Shape memory polymers– mechanism of shape memory-Primary moulding – secondary moulding – types and applications.		
UNIT-V	**Applications**	**9**
Fiber optic-actuators-sensor-Micro Electro Mechanical Systems (MEMSs), vibration control, sound control, shape control, product health or lifetime monitoring, cure monitoring, intelligent processing, active and passive controls, Structural Health Monitoring-self-repair - artificial organs, novel indicating device-Field of Defense and Space-Nuclear Industries-Structural Engineering-Biomedical Applications-Reducing Waste-Reducing Food Waste-Health Ageing Population.		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Illustrate the fundamental concepts and biological responses related to intelligent and bio-compatible materials. • Classify and explain the properties of various active and passive smart materials. • Analyze the working principles and applications of electro-rheological and piezoelectric materials. • Evaluate the behavior, transformation mechanisms, and uses of shape memory alloys and polymers. • Apply smart materials in advanced engineering, biomedical, and industrial applications.

TEXT BOOK :	
1	Sujata V., Bhat., "Biomaterials", Narosa Publication House, New Delhi, 2002.
2	M. V. Gandhi and B. S. Thompson, "Smart Materials and Structures", Chapman and Hall ,London, First Edition, 1992.
3	Inderjit Chopra and Jayant Sirohi, Smart Structures Theory, Cambridge University Press, 2014
REFERENCES:	
1	Melton, K. N, Stockel, D. and Wayman, C.M., "Engineering aspects of Shapememory Alloys", Butterworth – Heinemann, 1990.
2	Rogers, C. A., Smart Materials, "Structures and Mathematical issues", Technomic Publishing Co., U.S.A, 1989.
3	Mohsen Shahinpoor and Hans-Jo¨rg Schneider "Intelligent Materials", RSC Publishing, 2008
4	Mel Schwartz (Ed), Encyclopaedia of Smart Materials" Volume –I and II, John Wiley & Sons, Inc.2002

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15305	Non-Destructive Testing	3	0	0	3	100

Objective(s)	• To understand different surface NDE techniques. • To acquire familiarity with Liquid Penetrate Testing • To understand the basic principles underlying each NDT techniques • To know the advantages and limitations of each techniques and equipments. • To understand the common types of tests and defects arising in different types of manufactured products

UNIT-I	**Visual Testing**	**9**
Fundamentals of and introduction to destructive and non-destructive testing. Scope and limitations of NDT, Visual examination methods, Different visual examination aids-computer enhanced system-Standards and Specifications (ASME, ASTM,AWS etc.)		
UNIT-II	**Liquid Penetrant Testing**	**9**
Principles – types and properties of liquid penetrants – developers – advantages and limitations of various methods - Preparation of test materials – Application of penetrants to parts, removal of excess penetrants, post cleaning – Control and measurement of penetrant process variables – selection of penetrant method - fluorescent penetrant testing method – solvent removable.		
UNIT-III	**Magnetic Particle Testing and Equipments**	**9**
Theory of magnetism – ferromagnetic, paramagnetic materials – characteristics of magnetic fields – – Depth of penetration factors – Magnetic Bharkhausen Noise Analysis (MBN) – advantages and limitations- magnetic particle inspection of castings and welding – Dry continuous method and wet residual method		
UNIT-IV	**Radiography and Ultrasonic testing**	**9**
X-ray and Gamma-Ray radiography, Their principles, methods of generation, Industrial radiography techniques, inspection techniques, applications, limitations- Basic principles of sound propagation, types of sound waves, Principle of UT, methods of UT, their advantages and limitations, Piezoelectric Material, Various types of transducers/probe- defects in welded products by UT and Thickness determination by ultrasonic method		
UNIT-V	**Leak and pressure testing and Eddy current testing**	**9**
Definition of leak and types, Principle, Various methods of pressure and leak testing, Application and limitation- Eddy current testing: Principle, instrument , techniques, sensitivity, application, limitation Thermal methods of NDT		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Discuss the surface NDE techniques and with the established procedures • Discuss the methods of liquid penetrant testing methods • Differentiate various defect types and select the appropriate NDT methods for better evaluation. • Discuss the radiography techniques with applications • Discuss the testing and evaluation of the results for further analysis

TEXT BOOK :

1	Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition, 2002.
2	J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGrawHill Education, 2nd edition, 2011.
3	Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.

REFERENCES:	
1	Chuck Hellier, “Handbook of Nondestructive Evaluation”, Mc Graw Hill, 2012.
2	ASM Metals Handbook, V-17, "Nondestructive Evaluation and Quality Control", American Society of Metals, USA, 2001.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15306	Supply Chain Management	3	0	0	3	100

Objective(s)	• Understand the basics of Supply Chain Management • Learn about Supply Chain Network Design and Demand Management • Understand Supply Chain Planning, implementation and order processing with Information Technology • Learn application of Supply Chain Planning and Strategies. • Understand Location and Transportation Strategy in Supply Chain

UNIT-I	**Introduction to SCM**	**9**
Meaning, Importance, Overview, Objective, Process Overview, Process tools, Supply chain dynamics, A model of SCM, Focus areas in SCM, Change Drivers, Evolution of SCM, Types of Cargoes. Cross docking warehousing, Agile SCM, Green SCM, Maritime SCMs. Case studies on SCM.		
UNIT-II	**Supply Chain Network Design and Demand Management**	**9**
Logistics and SCM Network design, Integrated SCM Planning, Strategic Importance of Logistics/SCM network planning, Factors influencing network design decisions, Major Locational determinants, Framework - Design, and Functions. Demand Management, Relationship between customer service and demand management, Performance measures for customer service. Demand management process, The Role of forecasting and production, Nature of forecasting, Basic approach to demand forecasting, collaborative planning.		
UNIT-III	**Supply Chain Planning, implementation and order processing with IT**	**9**
Aggregate planning in a supply chain, Aggregate planning strategies, Planning supply and demand in a supply chain, Planning and managing inventories in a supply chain, Planning for optimal level of product availability, Sourcing/source management, Strategic sourcing management / Transportation management The customer order cycle, Order management system, Order and replenishment cycles, Order processing categories, The logistics information system, The order management system, The warehouse management system, The transportation management system		
UNIT-IV	**Supply Chain Planning and Strategies**	**9**
Supply chain strategies, Strategy classification, Corporate strategy, Logistics strategies, Strategic fit, Achieving strategic fit, Supply chain strategies, Supply chain strategy framework, Supply chain relationships, Customer relationship management, Supply chain integration, Push, Pull and Push Pull systems, Demand-driven strategies, Distribution strategies, Centralised control strategy versus decentralized control strategy.		
UNIT-V	**Location and Transportation Strategy in Supply Chain**	**9**
The need for long range planning, Major locational determinants, Historical perspectives on location problems, Single facility versus multi facility location, Methods of evaluating location alternatives. The role of transportation in a supply chain, Traffic and transportation strategy, Carrier selection decision, Intermodel transportation, Transport documentation, Transportation economics and pricing costing of transportation services, Rate and rating, Transportation management strategy, Transportation Management System (TMS).		
	Total hours	**45**

Outcome(s)	Students will be able to: • Describe the basics of Supply Chain Management • Discuss and apply the Supply Chain Network Design and Demand Management • Demonstrate Supply Chain Planning, implementation and order processing with Information Technology • Apply the Supply Chain Planning and Strategies • Demonstrate Location and Transport Strategy in Supply Chain

TEXT BOOK :

1	K. Shridhara Bhat, Supply Chain Management Himalaya Publishing House

2	Sunil Chopra, Peter Meindl, Dharam Vir Kalra, Supply Chain Management, Strategy, Planning and Operation Pearson
REFERENCES:	
1	Sarika Kulkarni, Ashok Sharma ,Supply Chain Management, Creating Linkages for Faster Business Turnaround, Tata McGraw-Hill Publishing Company Ltd
2	James B. Ayers, Supply Chain Project Management, A Structured Collaborative and Measurable Approach, CRC Press

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15401	Maintenance Engineering	3	0	0	3	100

Objective(s)	• To understand the fundamental principles and objectives of maintenance planning and organization. • To identify and compare different categories and methods of maintenance including preventive and TPM. • To explore condition monitoring techniques and associated tools used in modern maintenance systems. • To examine failure modes and develop methods for logical and sequential fault detection in machinery. • To apply suitable repair methods and digital tools for efficient maintenance and documentation.

UNIT-I	**Principles and Practices of Maintenance Planning**	**9**
Basic Principles of maintenance planning - Objectives and principles of planned maintenance activity Type of maintenance - Benefits of sound Maintenance systems - Reliability and machine availability – MTBF, MTTR, MTTF and FIT– Factors of availability – Maintenance organization – Maintenance economics.		
UNIT-II	**Maintenance Policies – Preventive Maintenance**	**9**
Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.		
UNIT-III	**Condition Monitoring**	**9**
Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis.		
UNIT-IV	**Repair Methods for Basic Machine Elements**	**9**
Repair methods for beds, slide ways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.		
UNIT-V	**Repair Methods for Material Handling Equipment**	**9**
Repair methods for Material handling equipment - Equipment records –Job order systems -Use of computers in maintenance.		
	Total hours	**45**

Outcome(s)	• Explain the objectives, types, and economic principles of maintenance systems and their impact on equipment availability. • Differentiate among various maintenance strategies and evaluate preventive and TPM techniques. • Apply condition monitoring methods using appropriate tools and interpret test results for maintenance planning. • Analyze common mechanical failures and develop logical procedures for fault diagnosis. • Demonstrate repair procedures for industrial equipment and utilize computerized systems for maintenance management.

TEXT BOOK :

1	Sushil Kumar Srivastava, Maintenance Engineering Principles, Practices & Management, S. Chand & Co, 2nd Edition, 2010
2	Venkataraman, “Maintenance Engineering & Management”, PHI Learning, 2009.
3	B. S. Dhillon, Engineering Maintenance: A Modern Approach, CRC Press, 2019

REFERENCES:	
1	B. S. Dhillon Maintainability, Maintenance, and Reliability for Engineers,CRC Press,2006
2	Garg M.R., "Industrial Maintenance", S. Chand & Co., 3rd edition 2012.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15402	Digital Manufacturing and IOT	3	0	0	3	100

Objective(s)	• To study the various aspects of digital manufacturing. • To inculcate the importance of DM in Product Lifecycle Management and Supply chain Management • To formulate of smart manufacturing systems in the digital work environment • To interpret IoT to support the digital manufacturing • To elaborate the significance of digital twin

UNIT-I	**Introduction**	**9**
Introduction – Need – Overview of Digital Manufacturing and the Past – Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management – Practical Benefits of Digital Manufacturing – The Future of Digital Manufacturing.		
UNIT-II	**Digital Life Cycle & Supply Chain Management**	**9**
Collaborative Product Development, Mapping Requirements to specifications – Part Numbering, Engineering Vaulting, and Product reuse – Engineering Change Management, Bill of Material and Process Consistency – Digital Mock up and Prototype development – Virtual testing and collateral. Overview of Digital Supply Chain - Scope& Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM		
UNIT-III	**Smart Factory**	**9**
Smart Factory – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT- Key Principles of a Smart Factory – Creating a Smart Factory – Smart Factories and Cyber security		
UNIT-IV	**Industry 4.0**	**9**
Introduction – Industry 4.0 –Internet of Things – Industrial Internet of Things – Framework: Connectivity devices and services – Intelligent networks of manufacturing – Cloud computing – Data analytics –Cyber physical systems –Machine to Machine communication – Case Studies.		
UNIT-V	**Study of Digital Twin**	**9**
Basic Concepts – Features and Implementation – Digital Twin: Digital Thread and Digital Shadow- Building Blocks – Types – Characteristics of a Good Digital Twin Platform – Benefits, Impact & Challenges – Future of Digital Twins		
	Total hours	**45**

Outcome(s)	• Discuss the various elements in the digital manufacturing. • Differentiate the concepts involved in digital product development life cycle process and supply chain management in digital environment. • Select the proper procedure of validating practical work through digital validation in Factories. • Implementation the concepts of IoT and its role in digital manufacturing. • Analyse and optimize various practical manufacturing processes through digital twin.

TEXT BOOK :

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

REFERENCES:	
1	Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital Manufacturing, SpringerVerlag 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

CO Mapping with POs and PSOs

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	-	-	-	-	-	2	2	3	-
CO2	3	2	3	2	3	-	-	-	-	-	-	2	2	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	3	-
CO4	3	2	3	2	3	-	-	-	-	-	-	3	2	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	3	2	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15403	Manufacturing Information Systems	3	0	0	3	100

Objective(s)	• To introduce the role and components of information systems in manufacturing. • To provide an understanding of database design and management for manufacturing operations. • To explain ERP and MES systems used in planning, execution, and monitoring. • To expose students to decision support tools and emerging digital technologies. • To develop skills in applying MIS concepts to real-world manufacturing problems.

UNIT-I	**Introduction to Manufacturing Information Systems**	**9**
Role of MIS in manufacturing, Types of manufacturing systems and their information needs, Components of MIS: Hardware, Software, Procedures, People, Data, Introduction to System Development Life Cycle (SDLC), Business process flow and mapping, Importance of information in decision making and control.		
UNIT-II	**Database Management for Manufacturing**	**9**
Basics of data and databases, Entity Relationship (ER) modeling, Introduction to Relational Databases and SQL Database design: normalization and schema development, Manufacturing data types: inventory, process data, BOMs, Database applications in production and inventory control		
UNIT-III	**ERP and MES Systems**	**9**
Introduction to ERP (Enterprise Resource Planning), ERP modules: Production, Inventory, HR, Finance, etc. MRP vs MRP-II vs ERP, Benefits and challenges of ERP in manufacturing, Introduction to MES (Manufacturing Execution Systems),Integration of ERP and MES with shop-floor control		
UNIT-IV	**Decision Support and Monitoring Tools**	**9**
Decision Support Systems (DSS) and their use in manufacturing, Performance measures: OEE, lead time, cycle time, uptime, Basic forecasting techniques: moving averages, exponential smoothing, Real-time monitoring and control, Introduction to SCADA and sensors, Role of dashboards and KPIs in production management		
UNIT-V	**Smart Manufacturing and Emerging Trends**	**9**
Industry 4.0 and the role of information systems, Smart factories and digital twins, Internet of Things (IoT) in manufacturing, Basics of cloud computing and cyber security, Case studies on ERP/MES/IoT in real-world factories, Future trends: AI in manufacturing, data analytics, sustainable MIS		
	Total hours	**45**

Outcome(s)	Students will be able to: • Describe the components and functions of MIS in a manufacturing setup. • Design simple databases to manage manufacturing-related data. • Explain and compare ERP and MES systems and their integration. • Apply basic decision support and performance monitoring tools. • Understand and evaluate the impact of Industry 4.0 on MIS.

TEXT BOOK :

1	D. Kiran, Manufacturing Information and Systems
2	Alexis Leon, Enterprise Resource Planning, 4th Edition, Tata McGraw-Hill, 2019.

REFERENCES:

1	F. Robert Jacobs, William L. Berry, D. Clay Whybark, Thomas E. Vollmann , Manufacturing Planning and Control for Supply Chain Management: The CPIM Reference 3rd Edition, McGraw-Hill, 2024
2	Stanley B. Gershwin , Manufacturing Systems Engineering, Prentice-Hall; 2005.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15404	Industrial Safety	3	0	0	3	100

Objective(s)	• To study the fundamental concept and principles of industrial safety • To study the principles of maintenance engineering. • To analyzing the wear and its reduction. • To study the faults in various tools, equipments and machines. • To study the periodic maintenance procedures in preventive maintenance.

UNIT-I	**Introduction**	**9**
Evolution of modern safety concepts - Fire prevention - Mechanical hazards - Boilers, Pressure vessels, Electrical Exposure.		
UNIT-II	**Chemical Hazards**	**9**
Chemical exposure - Toxic materials - Ionizing Radiation and Non-ionizing Radiation - Industrial Hygiene - Industrial Toxicology.		
UNIT-III	**Environmental Control**	**9**
Industrial Health Hazards - Environmental Control - Industrial Noise - Noise measuring instruments, Control of Noise, Vibration - Personal Protection.		
UNIT-IV	**Hazard Analysis**	**9**
System Safety Analysis - Techniques - Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment		
UNIT-V	**Safety Regulations**	**9**
Explosions - Disaster management - catastrophe control, hazard control, Safety education and training - Factories Act, Safety regulations Product safety.		
	Total hours	**45**

Outcome(s)	• Explain the evolution of safety concepts and identify mechanical and fire-related hazards. • Analyze chemical hazards and evaluate industrial toxicology and hygiene practices. • Assess industrial environmental hazards and apply appropriate control and personal protection methods. • Apply hazard analysis techniques such as FTA, FMEA, HAZOP, and risk assessment. • Interpret safety regulations and develop strategies for disaster management and safety training.

TEXT BOOK :

1.	R.K.Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi 2006.
2.	John V.Grimaldi, Safety Management, AITB S Publishers, 2003.
3.	Safety Manual, EDEL Engineering Consultancy, 2000.
4.	David L.Goetsch, Occupational Safety and Health for Technologists, 5th Edition, Engineers and Managers, Pearson Education Ltd., 2005.

REFERENCES:

1.	Slote.L,Handbook of Occupational Safety and Health, John Willey and Sons, NewYork .
2.	Frank P Lees - Loss of prevention in Process Industries, Vol. 1 and 2, Butterworth- Heinemann Ltd., London 1991.
3.	Frank Lees, " Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control", 2012.
4.	Ralph W. King and J. Majid, "Industrial Hazard and Safety Handbook", 1979.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15405	Plant Layout and Material Handling	3	0	0	3	100

Objective(s)	• To study the various types of plant layouts. • To study the plant layouts for different type of industries • To understand the importantance of material handling in the overall production cost • To understand the bottlenecks in material handling systems • To understand various safety measures to be taken in material handling systems.

UNIT-I	**Introduction**	**9**
Classification of Layout, Advantages and Limitations of different layouts, Layout design procedures. Overview ofthe plant layout. Process layout & Product layout: Selection, specification. Implementation and follow up. Comparison of product and process layout		
UNIT-II	**Heuristics for Plant Layout**	**9**
Heuristics for Plant layout - ALDEP. CORELAP, CRAFT, Group Layout, Fixed position layout- Quadratic assignment model. Branch and bound method.		
UNIT-III	**Introduction to Material Handling systems**	**9**
Introduction, Material Handling systems. Material handling principles. Classification of Material Handling Equipment. Relationship of material handling to plant layout.		
UNIT-IV	**Basic Material Handling systems:**	**9**
Basic Material Handling systems: Selection, Material Handling method- path, Equipment, function oriented systems.		
UNIT-V	**Analysis of Material Handling**	**9**
Methods to minimize cost of material handling- Maintenance of Material Handling Equipment's, Safety in handling Ergonomics of Material Handling equipment. Design, Miscellaneous equipment's.		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Discuss the various types of plant layouts. • Explain the Plant Layouts for various types of industries. • Design material handling in production • Estimate the bottlenecks in material handling systems. • Discuss the ergonomics of material handling systems.

TEXT BOOK :

1.	Plant Layout and Material Handling, by- James M. Apple, John Wiley & Sons.
2.	Facility Layout and Location: An Analytical Approach, by Richard L, Francis, Pearson India.
3.	Plant Layout and Material Handling, by- B. K. Aggarwal, Jain Brothers.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
24ME15406	Industrial Engineering and Management	L	T	P	C	100
		3	0	0	3	

Objective(s)	• To understand the technique and procedures of work study • To understand the plant layout and materials handling systems • To study the motivation theories • To study the planning procedures Human effectiveness • To understand the methods of wage payment

UNIT-I	**Work Measurement and Work Study**	**9**

Work measurement, Techniques- Production study, Time study, Standard time-Rating factors- Work sampling, Work study, Techniques- Human factors- Work study and productivity-method study, Techniques and procedures- charging Techniques- Motion economy principles- SIMO chart-Ergonomics' and Industrial design.

UNIT-II	**Plant Layout and Material Handling**	**9**

Plant location, site selection- Plant layout types, need, factors influencing the layout - Tools and techniques for developing layout, process chart, flow diagram, string diagram, Template and Scale models- Layout Planning procedure- Assembly line balancing. Material Handling, scope and importance- Types of material handling systems-factors influencing material handling- methods of material handling.

UNIT-III	**Motivation Theories and Leadership**	**9**

Definition, Meaning and Types of Motivation – Theories of Motivation Douglas Mc Gregor Theory X and Theory Y, Mayo's Hawthorne Experiment- Herzberg two factor theory of motivation, Maslow's hierarchy of human needs Leadership: Definition, Meaning, Features and Types of Leadership

UNIT-IV	**Productivity Planning And Implementation**	**9**

Need for Productivity Planning – Short term and long term productivity planning – Productivity improvement approaches, Principles - Productivity Improvement techniques – Technology based, Material based, Employee based, Product based techniques – Managerial aspects of Productivity Implementation schedule, Productivity audit and control

UNIT-V	**Wages and Incentives**	**9**

Wages and salary administration- Meaning principles- Techniques of wage fixation- Job evaluation- Merit rating- Methods of wage payment. Incentive scheme, Types, Advantages and disadvantages-Productivity base incentives, Case Example- Evaluation of incentive scheme.

Total hours	**45**

Outcome(s)	• Discuss the principles and techniques of work measurement, work study, and ergonomics to enhance productivity. • Apply plant layout tools and material handling methods to design efficient manufacturing systems. • Analyze various motivation theories and leadership styles to improve employee performance. • Evaluate different productivity improvement techniques and develop implementation plans. • Design wage and incentive schemes using job evaluation and merit rating to optimize workforce motivation.

TEXT BOOK :

1	Khanna O. P., Industrial Engineering and Management, Khanna publishers, New Delhi, 1999
2	K.C.Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers, (1990) reprint 2002

REFERENCES:

1	Martand Telsang, "Industrial Engineering and Production Management", S. Chand and Company, Second Edition, 2006.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15501	Automobile Engineering	3	0	0	3	100

Objective(s)	• To make wider the understanding of students in the structure of vehicle chassis and engine components. • To understand the concepts of engine, ignition and fuel supply system and its modifications in automobiles. • To study the Constructional and theoretical concepts of transmission systems. • To understand the concepts of vehicle sub systems like Steering, Braking, Suspension and Structural Systems of Automobiles. • To know the safety, security in Automotive Electrical and Electronics systems.

UNIT-I	**Introduction To Vehicle Structure , Engine Components**	**9**
Vehicle construction - Chassis and body - Specifications - Engine - Types - Construction - Location of engines - Cylinder arrangement - Construction details - Cylinder block - Cylinder head - Cylinder liners - Piston – piston rings - Piston pin - Connecting rod - Crankshaft - Valves. Lubrication system - Types - Oil pumps - Filters - Cooling system - Types - Water pumps – Radiators – Electronic Engine Management System.		
UNIT-II	**Ignition, Fuel Supply and Emission Control System**	**9**
Ignition system - Coil and Magneto - Spark plug - Distributor – Electronic ignition system - Fuel system - Carburetor - Fuel pumps - Fuel injection systems - Mono point and Multi point – Unit injector – Nozzle types - Electronic Fuel Injection system (EFI) – GDI, MPFI, DTSI-Automobile Emissions – Source of formation – Effects on human health and environment - Control techniques - Engine Emission Control by 3–Way Catalytic Controller –.Exhaust Gas Recirculation (EGR).		
UNIT-III	**Transmission System**	**9**
Clutches - Function - Types - Single plate, Multiple plate and Diaphragm Clutch – Fluid coupling - Gearbox - Manual - Sliding - Constant - Synchromesh - Overdrive – Automatic transmission - Torque converter - Epicylic and Hydromatic transmission – Continuously variable transmission - Universal joint - Propeller shaft - Hotchkiss drive – Final drive - Rear axle assembly – Types of Differential– Differential locks - Four wheel drive.		
UNIT-IV	**Steering, Suspension, Braking System, Wheels & Tyres**	**9**
Principle of steering - Steering Geometry and wheel alignment - Steering linkages –Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers – Wheel sand Tires - Construction - Types and specifications - Tire wear and causes - Brakes - Needs –Classifications –Drum and Disc Mechanical system- Hydraulic and pneumatic - Vacuum assisted –Retarders – Anti-lock Braking System (ABS), Types of Wheels -Wheel Balancing. Types & constructional details of tyres-Types of Tyre wear & their causes.		
UNIT-V	**Automotive Electrical Systems, Instrumentation and Their Advancements**	**9**
Battery-General electrical circuits-Dash board instrumentation - Passenger comfort – Safety and security - HVAC (Heating, Ventilation, and Air Conditioning) - Seat belts - Air bags - Automotive Electronics - Electronic Control Unit (ECU) - Variable Valve Timing (VVT) - Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program(ESP) Traction Control System (TCS) - Global Positioning System (GPS) - Hybrid vehicle.		
	Total hours	**45**

Outcome(s)	• Explain the fundamental components and construction of vehicle structures, engine parts, lubrication, and cooling systems. • Describe ignition, fuel supply systems, and emission control techniques for automotive engines. • Discuss the types and working principles of transmission systems including clutches, gearboxes, and drives. • Discuss steering, suspension, braking systems, wheels, and tires used in vehicles.

	• Explain automotive electrical systems, instrumentation, and recent advancements in vehicle electronics and safety features.

TEXT BOOKS :	
1	Devaradjane. Dr. G., Dr. M. Kumaresan, "Automobile Engineering", AMK Publishers, 2013.
2	Kirpal Singh Vol. I & II "Automobile Engineering", Standard Publishers, New Delhi, 2011.
3	Srinivasan.S, ― Automotive Mechanics, 2nd edition, Tata McGraw-Hill, 2003.
REFERENCES:	
1	Srinivasan S, "Automotive Mechanics" Tata McGraw-Hill Publications, 2011.
2	Kapil Dev, "Automobile Engineering Theory ", Asian Books Pvt. Ltd, 2001.
3	Joseph Heitner, "Automotive Mechanics: Principles and Practices" East - West Press publications, 2001.
4	William H., Crouse & Donald L Anglin, "Automotive mechanics",10th Edition Tata McGraw Hill Publishing Company Ltd., 2007.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15502	Conventional and Futuristic Vehicle Technology	3	0	0	3	100

Objective(s)	• To study the advanced engine technologies • To understand various advanced combustion technologies and its benefits • To understand the methods of using low carbon fuels and its significance • To understand the hybrid and electric vehicle configurations • To study the application of fuel cell technology in automotives

UNIT-I	**Advanced Engine Technology**	**9**
Gasoline Direct Injection, Common Rail Direct Injection, Variable Compression Ratio Turbocharged Engines, Electric Turbochargers, VVT, Intelligent Cylinder De-activation, After Treatment Technologies, Electric EGR, Current EMS architecture.		
UNIT-II	**Combustion Technology**	**9**
Spark Ignition combustion, Compression Ignition Combustion, Conventional Dual Fuel Combustion, Low Temperature Combustion Concepts– Controlled Auto Ignition, Homogeneous Charge Compression Ignition, Premixed Charge Compression Ignition, Partially Premixed Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition.		
UNIT-III	**Low Carbon Fuel Technology**	**9**
Alcohol Fuels, Ammonia Fuel and Combustion, Methane Technology, Dimethyl Ether, Hydrogen Fuel Technology, Challenges, and way forward		
UNIT-IV	**Hybrid And Electric Vehicle**	**9**
Conventional Hybrids (Conventional ICE + Battery), Modern Hybrids (RCCI/GDCI Engine + Battery), Pure Electric Vehicle Technology – Challenges and Way forward		
UNIT-V	**Fuel Cell Technology**	**9**
Fuel cells for automotive applications - Technology advances in fuel cell vehicle systems - Onboard hydrogen storage - Liquid hydrogen and compressed hydrogen - Metal hydrides, Fuel cell control system - Alkaline fuel cell - Road map to market.		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Discuss the latest trends in engine technology • Discuss the need of advanced combustion technologies and its impact on reducing carbon foot-print on the environment. • Analyzing the basic characteristics of low carbon fuels, its impact over conventional fuels and in achieving sustainable development goals. • Discuss the working and energy flow in various hybrid and electric configurations. • Analyzing the need for fuel cell technology in automotive applications.

TEXT BOOK :

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

REFERENCES:

1	Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2	James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15503	Renewable Powered Off Highway Vehicles and Emission Control Technology	3	0	0	3	100

Objective(s)	• To study the low and zero carbon fuels suitability and methods of use in off-road vehicles. • To understand the green energy production methodologies and its use in off-road vehicle categories. • To understand the various fuel cell types and its suitability in off-highway vehicles applications • To understand the impact of in-cylinder technologies on engine out emissions control. • To study the existing after-treatment technologies used in off-highway vehicle applications.

UNIT-I	**Low and Zero Carbon Fuels Powered Off-Highway Vehicles**	**9**
Ethanol, Methanol, Butanol, Biodiesel, CNG, LNG, DME, Polyoxymethylene Dimethyl Ether (PODE), Ammonia and Hydrogen Fuels suitability, methods, and technologies for powering off-road vehicles.		
UNIT-II	**Green Energy Powered Off-Highway Vehicles**	**9**
Solar Technology for Green Electricity, Green Electricity for Hydrogen Production, Hydrogen Smart Grid Technologies, Hydrogen to ICE powered vehicles, Hydrogen to Fuel Cell Powered Vehicles.		
UNIT-III	**Fuel Cell Powered Off-Highway Vehicles**	**9**
Fuel Cell, Types, Applications, Fuel Cell Requirement, Sizing and Design for Off-Highway applications, Merits and Demerits, Pathway to overcome the limitations. Scope of the fuel cell research on Off-road vehicle applications.		
UNIT-IV	**In-Cylinder Treatment Technologies**	**9**
Low temperature Combustion Modes - Homogeneous Charge Compression Ignition, Premixed- Charge Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition, Water Injection Technologies.		
UNIT-V	**After Treatment Technologies**	**9**
Diesel Oxidation Catalyst, Diesel Particulate Filter, Selective Catalytic Reduction, Ammonia slip / clean up catalyst. CO2 absorption techniques, Waste Heat Recovery and Organic Rankine Cycle.		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Evaluate the availability, suitability, and its role in off-road vehicle categories in reducing the carbon footprint on the environment. • Discuss the various green energy production methods and its impact on meeting energy demand of off-road vehicle applications. • Develop the working of fuel cell, various fuel cell types, and its design for off-road vehicle applications. • Discuss the various in-cylinder low temperature combustion technologies and its key role in controlling the engine-out emissions. • Explain the working of various existing after treatment systems in controlling the engine out emissions.

TEXT BOOK :

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

REFERENCES:

1	Daniel J Holt. Fuel Cell Powered Vehicles: Automotive Technology of the Future. Society of Automotive Engineers, 2001 - Technology & Engineering,
2	Toward Zero Carbon: The Chicago Central Area DeCarbonization Plan by Adrian Smith and Gordon Gill 2011

CO Mapping with POs and PSOs

CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	3	3	-	-	-	2	2	-	-	3
CO2	3	2	2	2	2	3	3	-	-	-	2	2	-	-	3
CO3	3	3	3	2	3	2	3	-	-	-	2	2	-	-	3
CO4	3	3	2	3	2	2	3	-	-	-	2	2	-	-	3
CO5	3	3	2	2	2	2	3	-	-	-	2	2	-	-	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15504	Vehicle Health Monitoring Maintenance and Safety	3	0	0	3	100

Objective(s)	• To understand the principles, functions and practices adapted in maintenance activities of vehicles. • To study the powertrain maintenance, fault diagnosis, maintenance of Batteries • To develop vehicle system maintenance and service of clutch, brake. • To study the concepts of vehicle safety and regulations. • To study and understand the simulation of safety concepts

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**
Exhaust emission test of petrol and diesel engine; - Electronic fuel injection and engine management service - fault diagnosis- OBD-III and scan tool, identifying DTC and servicing emission controls, Maintenance of Batteries, Starting System, Charging System and Body Electrical -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. Maintenance and Service of McPherson strut, coil spring. tyre wear, measurement of read depth and tyre rotation, Computerized wheel balancing & wheel alignment, Maintenance and Service of steering linkage, steering column, Rack and pinion steering		
UNIT-IV	**Vehicle Safety**	**9**
Concepts of vehicle safety -Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, air bags, electronic system for activating air bags, bumper design for safety, Active Safety - ABS, EBD, CSC, Traction control system, Modern electronic features in vehicles like tyre pressure monitoring, Automatic headlamp ON, Rain sensing wipers.		
UNIT-V	**Simulation of Safety Concepts**	**9**
Active safety: driving safety, conditional safety, perceptibility safety, operating safety passive safety: exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact. Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system Interactions.		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Discuss the vehicle health monitoring, maintenance and safety. • Explain the maintenance of power train. • Discuss the maintenance of Vehicle system. • Explain and awareness of vehicle safety. • Explain the simulation of safety concepts.

TEXT BOOK :

1	Ed May, "Automotive Mechanics Volume One" and Two, Mc Graw Hill Publications, Tenth edition, 2018
2	Jack Erjavek, “A systems approach to Automotive Technology”, Cengage Learning, 5th Edition, 2012

REFERENCES:

1	William H. Crouse and Donald L. Anglin, “Automotive Mechanics”, Tata McGraw Hill, 10thEdition, 2004.
2	Vehicle Service Manuals of Reputed Indian Manufacturers

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15505	CAE and CFD Approach in Future Mobility	3	0	0	3	100

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

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 modeling 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 modeling curves and surfaces, Wire frame models, Parametric representations, Parametric curves and surfaces, Solid modeling: Fundamentals of solid modeling, Different solid representation schemes, Boundary representation (B-rep), Constructive solid geometry (CSG). Mechanism design and assembly. CAD/CAM Data Exchange Formats: Types of file formats & their exchange, Graphics standards. CAD Data and Programming Techniques for RP: Transformations, Solid modeling for RP, Surface modeling, STL file generation, Defects in STL files and repairing algorithms, Interface formats		
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, Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices - Solution of static problems and case studies in stress analysis of mechanical components using 2D and 3D elements		
UNIT-IV	**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. Conservation form of the equations, shock fitting and shock capturing, Time marching and space marching. 3-D structured and unstructured grid generation, mesh smoothing and sensitivity checks		
UNIT-V	**Problem Solving Using CFD**	**9**
Turbulence Modeling, different turbulent modeling scheme. Incompressible Viscous Flows:, Applications to internal flows and boundary layer flows. Eddy viscosity and non-eddy viscosity models; Vehicle Aerodynamic Simulation Wind tunnel and on-road simulation of vehicles; Simulation of Ahmed and Windsor bodies; Vorticity based grid-free simulation technique; simulation in climatic and acoustic wind tunnels; velocity vector and pressure contour simulation		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Discuss the basic concept of the CAE /CFD • Develop the computer aided design and rapid prototyping. • Discuss the basic concept of Finite Element methods. • Discuss the concepts of computational fluid dynamics • Discuss the simulation using computational fluid dynamics.

TEXT BOOK :

1	Groover, M. P., CAD/CAM: Computer-Aided Design and Manufacturing, Pearson Education, 2008
2	TirupathiR.Chandrupatla and Ashok D.Belegundu, "Introduction to Finite Elements in Engineering", International Edition, Pearson Education Limited, 2014.

3	Applied Computational Fluid Dynamics by S. C. Gupta
REFERENCES:	
1	Dhanaraj. R and Prabhakaran Nair. K, "Finite Element Analysis", Oxford Publications, 2015.
2	Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15506	Hybrid and Electric Vehicle Technology	3	0	0	3	100

Objective(s)	• To introduce the concept of hybrid and electric drive trains. • To elaborate on the types and utilisation of hybrid and electric drive trains. • To expose on different types of AC and DC drives for electric vehicles. • To learn and utilise different types of energy storage systems • To introduce concept of energy management strategies and drive sizing

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	**Drive Sizing and Energy Management Strategies**	**9**
Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selection of appropriate energy storage technology, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification, and comparison of energy management strategies, Implementation issues.		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Discuss Characterise and configure hybrid drivetrains requirement for a vehicle • Design and apply appropriate hybrid and electric drive trains in a vehicle • Design and install suitable AC and DC drives for electric vehicles. • Discuss arrive at a suitable energy storage system for a hybrid / electric vehicle • Apply energy management strategies to ensure better economy and efficiency

TEXT BOOK :

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

REFERENCES:

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	Hybrid, Electric and Fuel-Cell Vehicles, International Edition by Jack Erjavec 6 June 2012

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15601	Industrial Robotics	3	0	0	3	100

Objective(s)	• Mention the need and knowledge of robot in industrial application • Describe the importance's of kinematics and dynamics in robotic • Identify the select the suitable type of gripping mechanism and driving system used in robot • Discuss the importance of machine vision and the various types of sensors • Identify the various application of robotics and robot economics

UNIT-I	**Introduction**	**9**
Definition need and scope of industrial robots- Coordinate Systems Classification of Robot- Robotic System & Anatomy Classification, Automation & robotics, Future Prospects, Machine loading & unloading, Processing operations, Material transfer, Assembly & Inspectors, comparison of Electric, Hydraulic and Pneumatic types		
UNIT-II	**Robot Kinematics**	**9**
End Effecters - types, Mechanical & other grippers, Tool as end effecter Coordinate Frames, Rotations, Homogeneous Coordinates, Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load. Arm Equation of Planer Robot, Four axis SCARA Robot, TCV, Inverse Kinematics of Planer Robot, Four Axis SCARA Robot.		
UNIT-III	**Robot Drives and Control**	**9**
Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – D.C. Servo Motors, Stepper Motors, A.C. Servo Motors- Designing of end effectors – Vacuum, magnetic and air operated grippers		
UNIT-IV	**Machine Vision and control & sensors**	**9**
Introduction, Low level & High level vision, Sensing &Digitizing, Image processing & analysis, Segmentation, Edge detection, Object description& recognition, Interpretation, Noises in Image, Application of imaging for Product Segregation. Poka yoke. , Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors		
UNIT-V	**Implementation and Robot Economics**	**9**
Implementation of Robots in Industries –Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Interpret the various degrees of freedom of motion of robots • Design appropriate end effectors for various applications and analyze kinematics of various manipulator configurations • Select the suitable sensors and drive for real time working of the robotic arm. • Compute required trajectory planning & drives for the given task • Specify various types of Robots for industrial applications

TEXT BOOK :

1	Mikell,P.Groover, Mitchell Weis, Roger N.Nagel, Nicholas Odrey "Industrial Robotics Technology, Programming and Applications", McGraw Hill, Int., 1986
2	D. Richard, Klafter, A. Thomas, Chmielewski and Michael Negin, Robotics Engineering – An Integrated Approach, Prentice Hall of India, New Delhi, 2001
3	Yoram Koren, "Robotics for Engineers", McGraw-Hill Book Co., 2001
4	Janakiraman.P.A., "Robotics and Image Processing", Tata McGraw-Hill, 2005

REFERENCES:

1	Introduction to Robotics Analysis, Systems, Applications, Niku, S. B., Pearso Education, 2008

2	Introduction to Robotics: Mechanica and Control, Craig, J. J., 2nd :J?:dition, Addison-Welsey, 1989
3	Fu.K.S. Gonzalz.R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 2008
4	Yoram Koren, "Robotics for Engineers", McGraw-Hill Book Co., 2001

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15602	Hydraulics and Pneumatics Systems	3	0	0	3	100

Objective(s)	• To understand the basics of hydraulics and pneumatics. • To study the hydraulic pumps and compressor power packs. • To understand the utilization of cylinders, accumulators, valves and variouselectrical and electronic control components. • To understand the fluid power circuits • To study the fluid power condition monitoring, maintenance and troubleshooting.

UNIT-I	**Introduction to fluid power**	**9**

Hydraulics Vs Pneumatics, Pascal's Law, Bernoulli's equation, Torricelli's theorem, Basic properties of and nomenclature of standard hydraulic fluids, Basic principles of Pneumatics, Properties of air, Gas laws, ANSIsymbols for circuit components.

UNIT-II	**Fluid Power drives**	**9**

Hydraulic power supply-Types, construction and selection of Hydraulic pumps and motors, Pneumatic power supply source – Types, construction and selection of Compressors and air motors, conditioning of air and its distribution, Selection of prime mover.

UNIT-III	**Fluid Power Control Components**	**9**

Valves – Pressure, direction and flow control valves, proportional and servo valves, Accumulators, Filter Regulator Lubricator (FRL), Actuators-Linear and rotary.

UNIT-IV	**Basic Fluid Power Circuits ,Electronic and Electrical Controls**	**9**

Fail safe circuits, Regenerative circuits, Meter in and Meter out circuits, Accumulator circuits, Pressure intensifier circuit, Counter balance circuit, Multi cylinder sequencing circuits, Electro pneumatic & Electro hydraulic components- solenoids, relays, proximity sensors, Programmable Logic Controllers, Ladder diagram, Timers and Counters.

UNIT-V	**Fluid Power Circuit Design, Applications ,maintenance and troubleshooting of fluid power systems**	**9**

Travel step diagram, cascade and Karnaugh – Veitch map method, Bottling and Packaging Industry, Material handling and assembly applications and maintenance and condition monitoring, troubleshooting of fluid powersystems.

Total hours	**45**

Outcome(s)	Upon successful completion of the course the students will be able to • Select and identify fluid power components • Describe the function and operation of fluid power systems • Apply multi actuator fluid power system for various purposes in industry. • Design and Develop fluid power multi actuation circuits • Explain the various control components and accessories used in fluid powersystems

TEXT BOOK :

1	Anthony Esposito, Fluid Power Systems, Pearson New International edition, 2013.
2	James R.Daines, Hydraulics and Pneumatics, 2nd Edition, The Goodheart-Willcox Company, Inc., 2013.

REFERENCES:

1	W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering, PerasonEducation, 2013.
2	Andrew Parr, Hydraulics and Pneumatics, Butterworth and Heinmann, 2011.

3	Festo, Basic Pneumatic, Electro pneumatic, Hydraulic text and work books, 2015.
4	John Pippenger, Fluid Power Controls, Literary Licensing LLC, 2012.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15603	Sensors and Instrumentation	3	0	0	3	100

Objective(s)	• To understand the concepts of measurement technology. • To understand the various sensors used to measure various physical parameters. • To study the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development • To study the optical, pressure and temperature sensor • To understand the signal conditioning and DAQ systems

UNIT-I	**Introduction**	**9**
Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.		
UNIT-II	**Motion, Proximity and Ranging Sensors**	**9**
Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).		
UNIT-III	**Force, Magnetic and Heading Sensors**	**9**
Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.		
UNIT-IV	**Optical, Pressure and Temperature Sensors**	**9**
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors		
UNIT-V	**Signal Conditioning And DAQ Systems**	**9**
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multichannel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Explain various calibration techniques and signal types for sensors. • Describe the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducers. • Apply the various sensors and transducers in various applications • Select the appropriate sensor for different applications. • Discuss the Acquire the signals from different sensors using Data acquisition systems.

TEXT BOOK :

1	Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2	Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, Dhanpat Rai & Co, 12th edition New Delhi, 2013.

REFERENCES:

1	C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons,
2	Hans Kurt Tönshoff (Editor), Ichiro, “Sensors in Manufacturing” Volume 1, Wiley-VCH April 2001.
3	Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15604	Embedded Systems and Programming	3	0	0	3	100

Objective(s)	• To study the architecture and fundamental units of microcontroller. • To study the microcontroller programming methodology and to acquire the interfacing skills and data exchange methods using various communication protocols. • To design the interface circuit and programming of I/O devices, sensors and actuators. • To understand ARM processor architecture and its functions to meet out the computational and interface needs of growing mechatronic systems. • To understand real time embedded operating system for advanced system developments.

UNIT-I	**Introduction to Microcontroller**	**9**
Fundamentals Functions of ALU - Microprocessor - Microcontrollers – CISC and RISC – Types Microcontroller - 8051 Family - Architecture - Features and Specifications - Memory Organization - Instruction Sets – Addressing Modes.		
UNIT-II	**Programming and Communication**	**9**
Fundamentals of Assembly Language Programming – Instruction to Assembler – Compiler and IDE - C Programming for 8051 Microcontroller – Basic Arithmetic and Logical Programming - Timer and Counter - Interrupts – Interfacing and Programming of Serial Communication, I^2C, SPI and CAN of 8051 Microcontroller – Bluetooth and WI-FI interfacing of 8051 Microcontroller.		
UNIT-III	**Peripheral Interfacing**	**9**
I/O Programming – Interfacing of Memory, Key Board and Displays – Alphanumeric and Graphic, RTC, interfacing of ADC and DAC, Sensors - Relays - Solenoid Valve and Heater - Stepper Motors, DC Motors - PWM Programming – Closed Loop Control Programming of Servomotor – Traffic Light		
UNIT-IV	**ARM Processor**	**9**
Introduction ARM 7 Processor - Internal Architecture – Modes of Operations – Register Set – Instruction Sets – ARM Thumb - Thumb State Registers – Pipelining – basic programming of ARM 7 - Applications.		
UNIT-V	**Single Board Computers and Programming**	**9**
System on Chip - Broadcom BCM2711 SoC – SBC architecture - Models and Languages – Embedded Design – Real Time Embedded Operating Systems - Real Time Programming Languages – Python for Embedded Systems- GPIO Programming – Interfacing		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Explain the various functional units of microcontroller, processors and system-on-chip based on the features and specifications. • Discuss the role of each functional units in microcontroller, processors and systemon- chip based on the features and specifications. • Discuss the Interface the sensors, actuators and other I/O's with microcontroller, processors and system on chip based interfacing • Design the circuit and write the programming microcontroller, processors and system on chip • Develop the applications using Embedded system.

TEXT BOOK :

1	Frank Vahid and Tony Givagis, "Embedded System Design", 2011, Wiley.
2	Kenneth J. Aylala, "The 8051 Microcontroller, the Architecture and Programming Applications", 2003

REFERENCES:

1	Muhammad Ali Mazidi and Janice GillispicMazdi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2006.

2	Simon Monk, Programming the Raspberry Pi, Second Edition: Getting Started with Python McGraw Hill TAB; 2nd edition,2015
3	James W. Stewart, "The 8051 Microcontroller Hardware, Software and Interfacing", Regents Prentice Hall, 2003.
4	John B. Peatman, "Design with Microcontrollers", McGraw Hill International, USA, 2005.

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15605	Smart Mobility and Intelligent Vehicles	3	0	0	3	100

Objective(s)	• To understand the various technologies and systems used to implement smart mobility and intelligent vehicles. • To study the Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems and other sensors for automobile vision system. • To study the Basic Control System Theory applied to Autonomous Automobiles. • To study the various driving functions, connecting the automobile system • To understand the autonomous vehicle technology.

UNIT-I	**Introduction to Automated, Connected, and Intelligent Vehicles**	**9**
Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles		
UNIT-II	**Sensor Technology for Smart Mobility**	**9**
Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems		
UNIT-III	**Connected Autonomous Vehicle**	**9**
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 hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Explain the cyber-physical control systems and their application to collision avoidance and autonomous vehicles • Discuss the remote sensing and the types of sensor technology needed to implement remote sensing • Discuss the fully autonomous vehicles • Apply the basic concepts of wireless communications and wireless data networks • Analyze the concept of the connected vehicle and its role in automated vehicles

TEXT BOOK :

1	Intelligent Transportation Systems and Connected and Automated Vehicles", 2016, Transportation Research Board
2	Radovan Miucic, "Connected Vehicles: Intelligent Transportation Systems", 2019, Springer

REFERENCES:

1	Tom Denton, "Automobile Electrical and Electronic systems, Roultedge", Taylor & Francis Group,5th Edition,2018

CO Mapping with POs and PSOs

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

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
24ME15606	Electrical Drives and Actuators	3	0	0	3	100

Objective(s)	• To study the relay and power semiconductor devices • To understand the drive characteristics • To understand the DC motors and drives. • To understand the AC motors and drives. • To understand the Stepper and Servo motor.

UNIT-I	**Relay and Power Semi-Conductor Devices**	**9**
Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits		
UNIT-II	**Drive Characteristics**	**9**
Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor.		
UNIT-III	**DC Motors and Drives**	**9**
DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications		
UNIT-IV	**AC Motors and Drives**	**9**
Introduction – Induction motor drives – Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control – Static rotor resistance control – Slip power recovery control.		
UNIT-V	**Stepper And Servo Motor**	**9**
Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation- Drive System-Logic Sequencer - Applications. Servo Mechanism – DC Servo motor-AC Servo motor – Applications.		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Explain the principles and working of relays, drives and motors. • Explain the working and characteristics of various drives and motors. • Apply the solid state switching circuits to operate various types of Motors and Drivers • Discuss the performance of Motors and Drives. • Discuss the Motors and Drivers for given applications.

TEXT BOOK :

1	Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012.
2	Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2016.

REFERENCES:

1	Gobal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House, New Delhi, 2001.
2	Theraja B.L. &Theraja A.K., "A Text Book of Electrical Technology", 2nd Edition, S.Chand & Co. Ltd., New Delhi, 2012.
3	Singh M.D. &Kanchandhani K.B., "Power Electronics", McGraw Hill, New Delhi, 2007

CO Mapping with POs and PSOs

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