MAHENDRA ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University Chennai | NAAC Accredited with 'A' Grade & NBA Tier-I (WA) UG: CSE, ECE, EEE)

Namakkal-637503, Tamil nadu.

DEPARTMENT OF MECHANICAL ENGINEERING

B.E. Mechanical Engineering Choice Based

Credit System (CBCS)

R 2022 Curriculum and Syllabi from 2023 Batch

MAHENDRA ENGINEERING COLLEGE
(Autonomous)

DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2022

I Semester (from 2023 Batch)

Sl. No.	Course code	Course Title	L	T	P	C	Cate-gory
THEORY							
1	22EN11001	Communicative English	3	0	0	3	HS
2	22MA12101	Engineering Mathematics- I	3	1	0	4	BS
3	22CY12001	Chemistry for Engineering	3	0	0	3	BS
4	22GE13001	Engineering Graphics and Design	3	0	2	4	ES
5	22EE13102	Fundamentals of Electrical and Electronics Engineering	3	0	0	3	ES
6	22HS1100l	Heritage of Tamils	1	0	0	1	HS
7		Induction Program	-	-	-	-	MC
PRACTICAL							
8	22CY22001	Chemistry Laboratory	0	0	3	1.5	BS
9	22EE23101	Fundamentals of Electrical and Electronics Engineering Laboratory	0	0	3	1.5	BS
10	22EN21001	Personality Development Practice Laboratory	0	0	2	1	HS
		TOTAL	**16**	**1**	**10**	**22**	

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DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2022

II Semester(from 2023 Batch)

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	22PY12101	Engineering Physics	3	0	0	3	BS
2	22MA12201	Engineering Mathematics - II	3	1	0	4	BS
3	22CS13001	Problem Solving Techniques in C	3	0	0	3	ES
4	22GE13201	Engineering Mechanics	3	0	0	3	ES
5	22ME14201	Manufacturing Process	3	0	0	3	PC
6	22HS11002	Tamils and Technology	1	0	0	1	HS
PRACTICAL							
7	22PY22001	Physics Laboratory	0	0	3	1.5	ES
8	22CS23001	Problem Solving Techniques Using C Lab	0	0	3	1.5	ES
9	22ME24201	Workshop Practices Laboratory	0	0	3	1.5	PC
		TOTAL	**16**	**1**	**9**	**21.5**	

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DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2022

III Semester(from 2023 Batch)

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	22MA12304	Numerical Methods and Statistics	3	1	0	4	BS
2	22ME14301	Materials Engineering	3	0	0	3	PC
3	22ME14302	Thermodynamics	3	0	0	3	PC
4	22ME14303	Fluid Mechanics and Machinery	3	0	0	3	PC
5	22SH11006	Universal Human Values	3	0	0	3	HS
6		Open Elective- I	3	0	0	3	OE
PRACTICAL							
7	22ME24301	Fluid Mechanics and Machinery Laboratory	0	0	3	1.5	PC
8	22ME24302	Computer Aided Machine Drawing Laboratory	1	0	2	2	PC
		TOTAL	**19**	**1**	**5**	**22.5**	

MAHENDRA ENGINEERING COLLEGE
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DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2022

IV Semester (from 2023 Batch)

Sl. No.	Course code	Course Title	L	T	P	C	Category
THEORY							
1	22ME14401	Thermal Engineering	3	0	0	3	PC
2	22ME14402	Manufacturing Technology	3	0	0	3	PC
3	22ME14403	Strength of Materials	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	22CY11001	Environmental Science	3	0	0	0	MC
PRACTICAL							
8	22ME24401	Manufacturing Technology Laboratory	0	0	3	1.5	PC
9	22ME24402	Strength of Materials Laboratory	0	0	3	1.5	PC
10	22EN60001	Professional Communication Skills	0	1	2	2	HS
		TOTAL	**21**	**1**	**8**	**23**	

MAHENDRA ENGINEERING COLLEGE
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DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2022

V Semester (from 2023 Batch)

Sl. No.	Course code	Course Title	L	T	P	C	Category
	THEORY						
1	22ME14501	Kinematics and Theory of Machines	3	0	0	3	PC
2	22ME14502	Design of Machine Elements	3	0	0	3	PC
3	22MBAT6S06	Managerial Skills Project and Quality Management	3	0	0	3	EEC
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
	PRACTICAL						
7	22ME24501	Thermal Engineering Laboratory	0	0	3	1.5	PC
8	22ME24502	Dynamics Laboratory	0	0	3	1.5	PC
9	22ME25501	Summer Internship Evaluation	0	0	2	1	EEC
10	22EN60002	Interview Skills and Soft Skills	0	1	2	2	HS
		TOTAL	**18**	**1**	**10**	**24**	

MAHENDRA ENGINEERING COLLEGE
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DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2022

VI Semester (from 2023 Batch)

Sl. No.	Course code	Course Title	L	T	P	C	Category
	THEORY						
1	22ME14601	Finite Element Analysis	3	1	0	4	PC
2	22ME14602	Heat and Mass Transfer	3	0	0	3	PC
3	22ME14603	Design of Transmission System	3	0	0	3	PC
4		Professional Elective- V	3	0	0	3	PE
5		Professional Elective- VI	3	0	0	3	PE
6		Professional Elective- VII	3	0	0	3	OE
7	22MC60001	Constitution of India	3	0	0	0	MC
	PRACTICAL						
8	22ME24601	Simulation Laboratory	0	0	3	1.5	PC
9	22ME24602	Heat Transfer Laboratory	0	0	3	1.5	PC
10	22ME36601	Design and Fabrication Project	0	0	4	2	EEC
		TOTAL	**21**	**1**	**10**	**24**	

MAHENDRA ENGINEERING COLLEGE
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DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2022

VII Semester(from 2023 Batch)

Sl. No.	Course code	Course Title	L	T	P	C	Category
	THEORY						
1	22ME14701	Industrial Automation	3	0	0	3	PC
2	22ME14702	Engineering Economics and Cost Analysis	3	0	0	3	PC
3	22ME14703	Metrology and Measurements	3	0	0	3	PC
4	22ME14704	Automobile Engineering	3	0	0	3	PC
5		Professional Elective-VIII	3	0	0	3	PE
6		Professional Elective-IX	3	0	0	3	PE
	PRACTICAL						
7	22ME24701	Metrology and Measurements Laboratory	0	0	3	1.5	PC
8	22ME24702	Automation Laboratory	0	0	3	1.5	PC
9	22ME36701	Project Work- Phase I	0	0	6	3	EEC
		TOTAL	**18**	**0**	**12**	**24**	

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DEPARTMENT OF MECHANICAL ENGINEERING

CBCS - Regulation 2022

VIII Semester(from 2023 Batch)

Sl. No.	Course code	Course Title	L	T	P	C	Category
	PRACTICAL						
1	22ME36801	Project Work –Phase II	0	0	12	6	EEC
		TOTAL	**6**	**0**	**12**	**06**	

Total Credit: 167

Subject Category	Credits per semester								Credit total	% of Credits (Actual Credits / Total Credits)
	I	II	III	IV	V	VI	VII	VIII		
HS	5	1	3	2	2	-	-	-	13	7.8
BS	10	7	4	-	-	-	-	-	21	12.6
ES	7	9	-	-	-	-	-	-	16	9.6
PC		4.5	12.5	12	9	16	15		69	41.3
PE				6	6	6	6		24	14.3
OE			3	3	3				9	5.4
EEC					4	2	3	6	15	9.0
MC	0			0		0			0	0
Total Credits	22	21.5	22.5	23	24	24	24	6	167	100.0

Thermal Engineering	Design Engineering	Manufacturing and Materials Engineering	Industrial System and Design	Mobility System	Robotics and Automation
22ME15101 Renewable Energy	22ME15201 Design of Jigs, Fixtures and Press Tools	22ME15301 Composite Materials and Mechanics	22ME15401 Maintenance Engineering	22ME15501Automotive Materials, Components, Design & Testing	22ME15601 Industrial Robotics
22ME15102 Gas Dynamics and Jet Propulsion	22ME15202 Process Planning and Cost Estimation	22ME15302 Computer Integrated Manufacturing	22ME15402 Digital Manufacturing and IoT	22ME15502 Conventional and Futuristic Vehicle Technology	22ME15602 Hydraulics and Pneumatics System
22ME15103 Power Plant Engineering	22ME15203 Geometric Dimension, Tolerance and Modeling	22ME15303 Manufacturing Guidelines for Product Design	22ME15403 Operations Research	22ME15503 Renewable Powered Off Highway Vehicles and Emission Control Technology	22ME15603 Sensors and Instrumentation
22ME15104 Refrigeration and Air Conditioning	22ME15204Value Engineering	22ME15304 Smart Materials And Applications	22ME15404 Industrial Safety	22ME15504 Vehicle Health Monitoring, Maintenance and Safety	22ME15604 Embedded Systems and Programming
22ME15105 Heating Ventilation and Air Conditioning	22ME15205 Optimization Method in Engineering Design	22ME15305 Non-Destructive Testing	22ME15405 Plant Layout and Material Handling	22ME15505 CAE and CFD Approach in Future Mobility	22ME15605 Smart Mobility and Intelligent Vehicles
22ME15106 Computational Fluid Dynamics	22ME15206 Computational Solid Mechanics	22ME15306 Additive Manufacturing	22ME15406 Industrial Engineering and Management	22ME15506 Hybrid and Electric Vehicle Technology	22ME15606 Electrical Drives and Actuators

Course Code	Course Name	Hours / Week			Credit	Maximum Marks
		L	T	P	C	
22EN11001	**Communicative English** (Common to all B.E/B.Tech Degree Programmes)	3	0	0	3	100

Objectives	• 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
Outcomes	At the end of the course, the learners will be able to • Recognize and comprehend the professional materials in English • Develop vocabulary skills and use words appropriately in different academic contexts. • Analyze and interpret the data with correct usage of grammar • Acquire effective LSRW skills with emerging technology • Demonstrate strong communication skills in both personal and professional life

UNIT I	**9 Hrs**

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 Hrs**

Listening – Listening to Telephonic Conversations
Speaking –Greetings and Welcome Address
Reading – Predicting the Content of a Given Article – Newspaper Articles
Writing- Recommendations, Composing E-Mail, Letter Writing- Invitation letter
Grammar & Vocabulary – Sentence Pattern, Tenses, British Terms and American Equivalents

UNIT III	**9 Hrs**

Listening - Listening to 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 –If Conditionals, Abbreviations and Acronyms

UNIT IV	**9 Hrs**

Listening - Listening to Situation Based Dialogues
Speaking – Talking part in Casual Conversation
Reading - Reading Advertisements
Writing – Paragraph Writing, and Job Application
Grammar & Vocabulary – Concord, Gerunds and Infinitives, Synonyms and Antonyms

UNIT V	9 Hrs
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** – Modal Verbs, Voice- Active Voice, Passive Voice and Impersonal Passive, Question tags and Nominal Compounds	
Total hours	**45**

Textbook:	
1	N.P.Sudharshana and C.Savitha, *English For Technical Communication*, Cambridge University Press, New Delhi, 2016
2	Murphy, Raymond, *English Grammar in Use*, Fifth Edition. Cambridge University Press, New Delhi, 2019
References:	
1	Meenakshi Raman and Sangeeta Sharma., *Technical Communication: Principles and Practice*, *Third Edition*. OUP, New Delhi, 2015.
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. 1998
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	
22MA12101	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, which is applied in electrical andcommunication branch engineering. • Define the geometric aspects of curvature, radius of curvature, evolutes and envelopesas application of differential calculus. • Explain different types of higher order ordinary differential equationswith variable coefficients and various methods to solve the equations. • Learn the double and triple integrals and give their representation as area and volume.
Outcome(s)	At the end of the course the students will be able to: • Solve the system of equations and determine rank, eigen values, eigen vectors andinverse of a given matrix and diagonalize symmetric matrix by orthogonal transformations. • Illustrate maxima and minima functions of several variables. • Apply the concepts of differential calculus in physical problems. • Solve the higher order differential equations with variable coefficients. • Compute the area and volume by using multiple integrals.

UNIT-I	**Matrices**	**9+3**
Matrix and its types – Rank of matrix - Characteristic equation - Eigen values and Eigen vectors 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	**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-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.		
	Total hours	**(L:45+T:15): 60 Hrs**

TEXT BOOK :	
1	T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2019.
2	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
3	G.Balaji, Engineering Mathematics – I, G.Balaji Publication, 3rd Edition, 2015.
REFERENCES:	
1	Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2016.
2	G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint,2002.
3	Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2016.
4	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, 9th Edition, 2014.

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	
22CY12001	Chemistry For Engineering	3	0	0	3	100
Objective(s)	To make the students familiar with: • The treatment of water for potable and industrial purposes. • Provides students with an opportunity to identify different types of polymers in our surroundings. • The basic principles and preparatory method of Nanomaterial • Different types of batteries with Construction and application. • The principles of corrosion and control techniques.					
Outcome(s)	At the end of the course the student will be able to • Explain the basic principles of water quality parameters, their analysis and various water treatments Process for domestic and industrial applications. • Classify the reaction mechanism, synthesis and application of polymers. • Develop the basic concepts of nanoscience and nanotechnology in designing the nanomaterial for Engineering and Technology. • Compare the working principles of batteries and Supercapacitors with recycling methods. • Inspect the principles of corrosion in metals with control measures.					
UNIT-I	**Water Technology**					9 Hrs
Water: Sources and impurities - Water quality parameters - Definition and significance of - colour, odour, turbidity, pH, hardness, alkalinity, flouride and arsenic - 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) – WHO and BIS guidelines for drinking water.						
UNIT-II	**Polymer Chemistry**					9 Hrs
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 - Properties of polymers: Tg, Tacticity, Molecular weight - weight average, number average and polydispersity index - Preparation, properties & applications of selected commodity and engineering polymers (Polystyrene, Teflon, Bakelite and Epoxy resin).						
UNIT-III	**Nanochemistry**					9 Hrs
Introduction: Basics - difference 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, Chemical vapour deposition, electro deposition, precipitation, hydrothermal - Applications (Medicine, Agriculture and Electronics).						
UNIT-IV	**Energy Storage Device**					9 Hrs
Types of batteries - Primary battery - dry cell - Secondary battery - lead acid battery and Lithium ion batteries- Fundamentals, Construction and application - Thin Film solid state batteries – Recycling of Na-Air batteries – Battery used in EV application - Super Capacitors(Storage principle and types).						
UNIT-V	**Corrosion & Its Control**					9 Hrs

Corrosion: Chemical corrosion – Pilling Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion - Vapour Deposition Techniques - Physical and Chemical Vapour Deposition – factors influencing corrosion – corrosion control – sacrificial anode and impressed cathodic current methods – corrosion Inhibitors.	
Total hours	45

TEXT BOOK :	
1	Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2018
2	Dr.C.K.Charles and Dr.G.Ramachandran, "Applied Chemistry", CARS Publishers,Chennai,2015
3	David Linden and Thomas B. Reddy "Handbook of Batteries", Third Edition McGraw-Hill New York.
REFERENCES:	
1	Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2018
2	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.
3	Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2019
4	T.R. Crompton "Battery Reference Book" Third Edition, British Library Cataloguing in Publication Data, 2000.

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	-	-	-

SEMESTER-I/ II						
Course Code	**Course Name**	Hours / Week			Credit	**Maximum marks**
		L	T	P	C	**100**
24GE33201	**Engineering Graphics and Design**	3	0	2	4	

Objective(s)

- To understand engineering drawings using standard graphical conventions, symbols, and projections.
- To develop skills in freehand sketching and visualizing engineering components.
- To draw accurate orthographic, sectional, and isometric drawings using conventional and Computer-Aided Design (CAD) methods.
- To apply CAD software in developing engineering graphics.
- To understand the application of solid modeling and surface development techniques through practical CAD exercises.

Examination Pattern: Theoretical Mode

UNIT I Plane Curves and Free Hand Sketching — **HOURS** 15

Curves used in engineering practices:

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves. **Free hand sketching:** Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT II Projection of Points, Lines and Plane Surfaces — **HOURS** 15

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

Examination Pattern: Practical Mode

UNIT III Projection of Solids — **HOURS** 6

Projection of solids: prisms, pyramids, cylinders, cones (axis inclined to one plane).

Experiments using CAD

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

UNIT IV Section of Solids and Development of Surfaces — **HOURS** 12

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.

Experiments using CAD

- 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.

UNIT V Isometric and Perspective Projections — **HOURS** 12

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

Experiments using CAD;

- Isometric projection of a cylinders and cones

TEXT BOOKS:	
1.	N S Parthasarathy and Vela Murali, "Engineering Drawing" Oxford University Press 2015.
2.	K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited, 2011
3.	K. V. Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2012
4.	M.S. Kumar, "Engineering Graphics", D.D. Publications, 2010.
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.
Outcome(s)	• Interpret technical drawings using conventions, notations, graphical standards and orthographic projections. • Demonstrate freehand sketching skills for two-dimensional engineering objects. • 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

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

TOTAL HOURS	**60**

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	-	-	-	-	-	1	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	1	-	-	-	-	3	-	-
CO3	3	3	-	-	3	-	-	1	-	-	-	-	3	-	-
CO4	3	3	-	-	3	-	-	1	-	-	-	-	3	-	-
CO5	3	3	-	-	3	-	-	1	-	-	-	-	3	-	-

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22EE13102	**Fundamentals Of Electrical And Electronics Engineering** (Integrated Course)	3	0	2	4	**100**
Objective	• To learn the concepts of DC circuits and wiring connections. • To understand the basic concepts of Semiconductor Device • To develop skills to interface I/O devices such as keyboard, display, Traffic light, Programmable Interrupt Controller, ADC and DAC with 8051					
Outcomes	• Illustrate the concepts of DC circuits to compute Voltage, Current and Resistance • Describe the constructional features and working principle of Electrical machines • Discuss the characteristics and control schemes of Electrical drives • Explain the functions of semiconductor devices and microcontrollers • Design the microcontroller based systems for practical applications					
UNIT I	**Basic Circuits and Domestic Wiring**					**9**
Electrical circuit elements (R, L and C)-Dependent and independent sources – Ohm's Law- Kirchhoff's laws - mesh current and node voltage methods (Analysis with only independent source) - Phasors – RMS-Average values-sinusoidal steady state response of simple RLC circuits. Types of wiring- Domestic wiring - Specification of Wires-Earthing-Methods-Protective devices.						
UNIT II	**Electrical Machines and Drives**					**9**
DC generator Constructional details – EMF equation- Methods of excitation- Principle of operation of D.C. motor – Back EMF and torque equation – Starting of D.C. motors – Three phase and Single phase induction motors(only qualitative treatment)- Types of Electric Drives- Speed-Torque characteristics of various types of load and drive motors- Speed Control Of Electrical Drives(Qualitative Approach Only)						
UNIT III	**Semiconductor Devices and Microcontrollers**					**9**
Basic Electronic Components: Resistance - Inductor - Capacitor -Types, Functions, Symbols - Color coding of Resistance – Review of insulator, conductor and semiconductor -Semiconductor types – Drift and Diffusion Currents - Study of CRO- Construction of PN junction diode- V-I characteristics of PN junction diode- Zener diode as voltage regulator – Biasing LED- Switch mode Power Supply-8051 Architecture and Programming- PIC Microcontroller						
LIST OF EXPERIMENTS						
1	Assembly Language Programming for arithmetic operations using 8051					**18**
2	Assembly Language Programming for control instruction (Increment/Decrement, Ascending/ Descending order) using 8051					
3	Traffic Light Interface					
4	Keyboard Interface					
5	Display Interface					
6	Stepper motor controller interface					
	Total hours					**45**
Text Books:						
1	Charles K. Alexander and Mathew N.O. Sadiku, Fundamentals of Electric Circuits, 5th edition, McGraw-Hill,2019.					
2	Joseph Edministor and Nahvi (Mohmood), 'Theory & Problems of Electric Circuits', 5th edition, McGraw Hill, 2020.					
3	V.K Mehta and Rohit Mehta, 'Principle of Electrical Engineering' S Chand & Company,					

	2008.
4	Rajkamal, "Microcontrollers Architecture, Programming Interfacing,& System Design",Pearson,2012
References	
1	Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7th Edition, 2006.
2	J. Millman & Halkins, Satyebranta Jit, "Electronic Devices & Circuits", Tata McGraw Hill, 2nd Edition, 2008.
3	John Iovine, 'PIC Microcontroller Project Book ', McGraw Hill 2000

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	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	2	-	-	-	-	-	-	-	-	-	-
CO5	3	-	3	2	3	-	-	-	-	1	-	1	-	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22HS11001	Heritage of Tamils	1	0	0	1	100
UNIT-I	**Language and Literature**					**3**
Language Families in India - Dravidian Languages – Tamil as aClassical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.						
UNIT-II	**Heritage - Rock Art Paintings To Modern Art – Sculpture**					**3**
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.						
UNIT-III	**Folk and Martial Arts**					**3**
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, 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**

MAHENDRA ENGINEERING COLLEGE

(Autonomous)

Accredited by NAAC 'A' Grade & NBA Tier-I(WA) UG: CSE,ECE,EEE

Mahendhirapuri, Mallasamudram, Namakkal Dt. - 637 503.

Regulations 2022

Batch 2022-2023 - II Semester
Batch 2023-2024 onwards - I Semester
(Common to all B.E./B.Tech. Programmes)

Course Code	Course Name	Periods/Week			Credit	Maximum Marks
		L	T	P	C	
22HS11001	தமிழர் மரபு	1	0	0	1	100

அலகு 1 மொழி மற்றும் இலக்கியம் 3

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

அலகு 2 மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை 3

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

அலகு 3 நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3

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

அலகு 4 தமிழர்களின் திணைக் கோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும் விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும் கல்வியும் – சங்ககால நகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு 5 இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு 3

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

TOTAL – 15 PERIODS

TEXT BOOK AND REFERENCE BOOKS	
1.	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.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) (Published by: The Author)
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code	Course Name	HOURS/WEEK			CREDIT	Maximum Marks
22CY22001	Chemistry Laboratory	L	T	P	C	100
		0	0	3	1.5	
Objectives	• Educate the theoretical concepts experimentally • To impart skills in measurements. • To design and plan the experimental procedure and to record and process the results. • To reach non trivial conclusions of significant of the experiments.					
Outcomes	On completion of this course, students will have the knowledge in • Demonstrate laboratory practices, handling glassware, equipment, and chemical reagents. • Experiment with different types of instruments for analysis of materials using small quantities. • Analyze different types of titrations for estimation of materials using more quantities involved for good results.					
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 Rate of Corrosion of Mild steel by Weight loss method.					
6.	Determination of molecular weight of polyvinyl alcohol using Viscometry.					
7.	Estimation of Iron content of the given solution using Potentiometry.					
8.	Determination of strength of given hydrochloric acid using pH meter.					
9.	Conductometric titration a strong acid vs strong base.					
10.	Determination of strength of acids in a mixture using Conductometry.					
11.	Estimation of sulphate in a solution using Conductometry.					
12.	Estimation of iron content of the water sample using Spectrophotometry. (1,10- phenanthroline / thiocyanate method) – (**DEMO ONLY**)					
TEXT BOOK						
1.	Chemistry lab Manual, Department of Chemistry, Mahendra Engineering College, Mallasamudram, 2019.					
2.	Chemistry lab Manual, Department of Chemistry, Mahendra Engineering College, Mallasamudram, 2017.					
REFERENCES						
1.	Applied chemistry theory and practice by O. P. Vermani and A. K. Narula, second edition.					
2.	Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore (1996).					
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	-	-	-	-	-	1	-	-	-
CO2	2	1	-	-	-	1	-	-	-	-	-	1	-	-	-
CO3	3	-	-	-	-	1	-	-	-	-	-	1	-	-	-

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22EE13102	**Fundamentals Of Electrical And Electronics Engineering** (Integrated Course)	3	0	2	4	**100**
Objective	• To learn the concepts of DC circuits and wiring connections. • To understand the basic concepts of Semiconductor Device • To develop skills to interface I/O devices such as keyboard, display, Traffic light, Programmable Interrupt Controller, ADC and DAC with 8051					
Outcomes	• Illustrate the concepts of DC circuits to compute Voltage, Current and Resistance • Describe the constructional features and working principle of Electrical machines • Discuss the characteristics and control schemes of Electrical drives • Explain the functions of semiconductor devices and microcontrollers • Design the microcontroller based systems for practical applications					
UNIT I	**Basic Circuits and Domestic Wiring**					**9**
Electrical circuit elements (R, L and C)-Dependent and independent sources – Ohm's Law- Kirchhoff's laws - mesh current and node voltage methods (Analysis with only independent source) - Phasors – RMS-Average values-sinusoidal steady state response of simple RLC circuits. Types of wiring- Domestic wiring - Specification of Wires-Earthing-Methods-Protective devices.						
UNIT II	**Electrical Machines and Drives**					**9**
DC generator Constructional details – EMF equation- Methods of excitation- Principle of operation of D.C. motor – Back EMF and torque equation – Starting of D.C. motors – Three phase and Single phase induction motors(only qualitative treatment)- Types of Electric Drives- Speed-Torque characteristics of various types of load and drive motors- Speed Control Of Electrical Drives(Qualitative Approach Only)						
UNIT III	**Semiconductor Devices and Microcontrollers**					**9**
Basic Electronic Components: Resistance - Inductor - Capacitor -Types, Functions, Symbols - Color coding of Resistance – Review of insulator, conductor and semiconductor -Semiconductor types – Drift and Diffusion Currents - Study of CRO-Construction of PN junction diode- V-I characteristics of PN junction diode- Zener diode as voltage regulator – Biasing LED- Switch mode Power Supply-8051 Architecture and Programming- PIC Microcontroller						
LIST OF EXPERIMENTS						
1	Assembly Language Programming for arithmetic operations using 8051					**18**
2	Assembly Language Programming for control instruction (Increment/Decrement, Ascending/ Descending order) using 8051					
3	Traffic Light Interface					
4	Keyboard Interface					
5	Display Interface					
6	Stepper motor controller interface					
	Total hours					**45**
Text Books:						
1	Charles K. Alexander and Mathew N.O. Sadiku, Fundamentals of Electric Circuits, 5th edition, McGraw-Hill,2019.					
2	Joseph Edministor and Nahvi (Mohmood), 'Theory & Problems of Electric Circuits', 5th edition, McGraw Hill, 2020.					
3	V.K Mehta and Rohit Mehta, 'Principle of Electrical Engineering' S Chand & Company, 2008.					
4	Rajkamal, "Microcontrollers Architecture, Programming Interfacing,& System Design",Pearson,2012					
References						

1	Robert T. Paynter, “Introducing Electronics Devices and Circuits”, Pearson Education, 7th Edition, 2006.
2	J. Millman & Halkins, Satyebranta Jit, “Electronic Devices & Circuits”, Tata McGraw Hill, 2nd Edition, 2008.
3	John Iovine, ‘PIC Microcontroller Project Book ’, McGraw Hill 2000

CO MAPPING WITH POs AND PSOs

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

COURSE CODE	COURSE NAME	HOURS/WEEK			CREDIT	MAXIMUM MARKS
22PY12101	**Engineering Physics** (For All Branches)	**L**	**T**	**P**	**C**	**100**
		3	0	0	3	

Objective(s)	• To provide students with a fundamental knowledge of physics, together with problem-solving skills • Understanding of Basics of Physics about lasers, Acoustics, Properties of matter, Semiconductor Physics and Quantum Physics. How these are used in information and communication technology.
Outcome(s)	After completing the course the students • Describe the basics of Laser, Fiber Optics and its types with its applications in various fields. • Explain the concept of Acoustics and Ultrasonic's and their applications in various engineering fields. • Illustrate the concept on Properties of engineering materials and their uses. • Explain the basic concepts of Quantum Physics and their Applications. • Describe the basics of semiconducting materials and their applications in Solar Power.

UNIT I	**Laser and Fiber Optics**	9 (Hrs)

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 and Acoustics**	(9 Hrs)

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.

Classification of sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies.

UNIT-III	**Properties of Matter**	(9 Hrs)

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 Hrs)

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	**Semiconductor Physics**	(9 Hrs)

Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier Concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors. Photo current in a P- N diode – solar cell –photo detectors - LED – Organic LED – Laser diodes.-Photovoltaic applications: domestic lighting, street lighting, water pumping etc -solar PV power plant.

Total hours	(45 Hrs)

	Text book :
1.	Dr. Palanisamy P.K, “Engineering Physics”, Scitech Publications, Chennai, 2010.
2.	Dr.G.Senthil kumar - Engineering Physics-VRB Publication & Co, Chennai- Latest edition 2019.
3.	Wahab, M.A. ―Solid State Physics: Structure and Properties of Materials. Narosa Publishing House, 2009
REFERENCES	
1.	Pillai S O, “Engineering Physics”, New Age International Publishers, New Delhi, 2005.
2.	Satyaprakash-Engineering Physics-Pragati Prakashan,Meerut-I Edition 2003
3.	Dr.M.Arumugam-Engineering Physics - Anuradha Agencies, Kumbakonam-III Revised Edition 2002.
4.	D. Halliday, R. Resnick and J. Walker, Fundamentals of Physics, 6th Edition, John Wiley and Sons, 2001.

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	-	-	-
CO2	3	-	-	-	-	1	1	-	-	-	-	1	-	-	-
CO3	3	-	-	-	-	1	1	-	-	-	-	1	-	-	-
CO4	3	-	-	-	-	1	1	-	-	-	-	1	-	-	-
CO5	3	-	-	-	-	1	1	-	-	-	-	1	-	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
22MA12201	Engineering Mathematics - II (Common to all Branches)	L	T	P	C	100
		3	1	0	4	

Objectives	To enable the students to: • To define vector function, operators and working procedure to evaluate line , surface and volume integrals. • To learn Laplace transform, inverse Laplace transform and its properties to solve differential equations. • To learn Fourier transforms, inverse Fourier transform and its properties and apply convolution theorem and Parseval's identity to various functions • To understand the functions of a complex variable, properties and problems involving conformal mapping. • To understand the Taylor's and Laurent's series expansion of complex functions and the process of evaluating complex integrals.
Outcomes	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. • Describe Laplace transform and its properties inverse Laplace transform and the solution of linear differential equation using Lpaplace transform techniques. • Compute Fourier transforms , inverse Fourier transform and its properties and apply convolution theorem and Parseval's identity to various functions • Predict analytic functions, harmonic functions, conformal mapping and its applications. • Expand the functions as Taylor's and Laurent's series and evaluate the 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	**Laplace Transform**	**9+3**

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

UNIT-III	**Fourier Transforms**	**9+3**

Fourier integral theorem (statement only)-Fourier transform pair (infinite) - Sine and cosine transforms-Properties-Transform of simple functions-Convolution theorem- Parseval's idendity.

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	**(L:45+T:15): 60**

TEXT BOOK :	
1	Veerarajan T & Dr.K.Kannan., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2019.
2	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
REFERENCES:	
1	Erwin kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2018.
2	V. Krishnamurthy, V. P. Mainra and J. L. Arora, " An introduction to Linear Algebra" , Affiliated East-West press, 2005.
3	Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4.	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Ninth Edition,2014.

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	-	-	-	1	-	-	-	-	-	1	-	-	-
CO2	2	3	-	-	-	1	-	-	-	-	-	1	-	-	-
CO3	2	3	-	-	-	1	-	-	-	-	-	1	-	-	-
CO4	2	3	-	-	-	1	-	-	-	-	-	1	-	-	-
CO5	2	3	-	-	-	1	-	-	-	-	-	1	-	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22CS13001	**Problem Solving Techniques In C** (I Semester for all circuit branches and II Semester for all non-circuit branches)	3	0	0	3	100

Objectives	**To enable the students to:** • Understand the basics of algorithmic problem solving • Understand the basic concepts of C Programming. • Learn the arrays and functions in C • Be familiar with pointers and structures in C • Understand the file handling techniques and preprocessors in C
Outcomes	**At the end of the course the students will be able to:** • Develop Algorithms for real time problems through various Problem solving techniques • Define the syntax of C Programming • Summarize the use of functions and pointers in programming in C programming concepts • Apply the concepts of pointers and structure • Describe the fundamental concepts of files and preprocessors in C

UNIT-I	**Problem Solving Aspects**	**9**
Problem Solving Aspects: Algorithms Pseudo code, Flowchart- Steps In Problem Solving-simple strategies for developing algorithms (iteration, recursion)- Programming methodologies - Illustrative problems: Exchanging The Values-Counting-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 – operators – Input and Output operations – Decision Making and Branching – Looping statements- Programming Examples		
UNIT-III	**Arrays and Functions**	**9**
Arrays: Introduction – One-Dimensional Arrays - Two-Dimensional Arrays - Multidimensional Arrays - Strings: Operations of Strings. Function – definition of function – Declaration of function – Function prototype – Types of functions – Pass by value – Pass by reference – Recursion - Programming Examples		
UNIT-IV	**Pointers and Structures**	**9**
Pointers - Definition – Initialization - Pointers and arrays- Introduction to Structure – Structure definition – Structure declaration – Structure within a structure- Unions – Storage classes		
UNIT-V	**File Processing and Preprocessors**	**9**
Files: File modes - File functions - File operations - Text and Binary files, Command Line arguments – C Preprocessor directives: Macros – Definition - types of Macros - Creating and implementing user defined header files.		
	Total hours	**(L:45): 45**

TEXT BOOK :

1. Anita Goel and 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	3	2	-	-	-	1	-	-	-	-	1	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22GE13201	**Engineering Mechanics** (Common to Non Circuit Branches)	3	0	0	3	100

Objective(s)	• To understand the basic concepts required for analyzing static structures model problems using free-body diagrams and accurate equilibrium equations. • To calculate the reactive forces on the structural members. • To know the geometric properties of the different cross sections on the structural members. • To get the exposure on laws of mechanics, work energy and momentum methods for finding the motion parameters.

UNIT-I	**Statics of Particle**	**9**

Introduction to Mechanics – Fundamental Principles – Laws of Mechanics, 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 - Principle of transmissibility - 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 and perpendicular axis theorem – Product of inertia of plane areas – Polar moment of inertia – Principal axes.

UNIT-IV	**Dynamics of Particles**	**9**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies- Impact - direct and central impact – coefficient of restitution. D'Alembert's principle.

UNIT-V	**Friction**	**9**

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction - Rolling resistance. Applications of screw jacks and belts.

Total hours	**45**

Outcome(s)	At the end of this course, Student will be able to • Analysis 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. • Realize about the friction using simple mechanisms.

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	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME14201	Manufacturing Processes	3	0	0	3	100

Objective(s)	• To understand the concepts of basic manufacturing processes • To acquire knowledge in metal casting processes • To expose the students to the principles of the various metal joining methods • To understand as metal cutting and metal forming process • To acquire the basics concept of metal cutting

UNIT-I	**Metal Casting**	**9**
Introduction- Molding tools- Patterns- Pattern materials, types of patterns, pattern allowances-Types of molding sand and its properties- Cores and its types - Gating and risering system- Melting furnaces-Special casting processes: Investment casting process- Die casting process-Shell molding process- Centrifugal casting process-Solidification and cooling-Casting cleaning and casting defects- Inspection methods.		
UNIT-II	**Metal Joining**	**9**
Introduction-Classification of welding process, Filler, flux, Electrodes. Gas welding- Principles and applications-Oxy-acetylene gas welding, Tungsten Inert Gas (TIG) welding, Metal Inert Gas (MIG) welding. Arc welding-Principles and applications - Gas metal arc welding (GMAW), Plasma arc welding (PAW), Submerged arc welding (SAW). Resistance welding- Principles and applications- Butt resistance welding, Spot resistance welding, Seam resistance welding.		
UNIT-III	**Metal Forming**	**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	**Metal Cutting**	**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.		
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 fabricationprocess • Illustrate the metal forming and rolling processes • Choose appropriate cutting tools and cutting fluids for machining processes • 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.

REFERENCES:

1	Rao P.N., Manufcturing 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	2	-	-	-	1	-	-	-	-	-	1	-	3	-
CO2	3	-	-	-	-	1	-	-	-	-	-	1	-	3	-
CO3	3	-	-	-	-	1	-	-	-	-	-	1	-	3	-
CO4	3	2	-	-	-	1	-	-	-	-	-	1	-	3	-
CO5	3	-	-	-	-	1	-	-	-	-	-	1	-	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22HS11002	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	**Design and Construction Technology**					**3**
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.						
UNIT-III	**Manufacturing Technology**					**3**
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel -Copper and goldCoins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.						
UNIT-IV	**Agriculture and Irrigation Technology**					**3**
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society						
UNIT-V	**Scientific Tamil & Tamil Computing**					**3**
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.						
					Total hours	**15**

MAHENDRA ENGINEERING COLLEGE

(Autonomous)
Accredited by NAAC 'A' Grade & NBA Tier-I(WA) UG: CSE,ECE,EEE
Mahendhirapuri, Mallasamudram, Namakkal Dt. - 637 503.

Regulations 2022

Batch 2022-2023 - III Semester
Batch 2023-2024 onwards - II Semester
(Common to all B.E./B.Tech. Programmes)

Course Code	Course Name	Periods/Week			Credit	Maximum Marks
		L	T	P	C	
22HS11002	தமிழரும் தொழில்நுட்பமும்	1	0	0	1	100

அலகு 1	நெசவு மற்றும் பானைத் தொழில்நுட்பம்	3

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

அலகு 2	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ–சாரோசெனிக் கட்டிடக் கலை.

அலகு 3	உற்பத்தித் தொழில்நுட்பம்	3

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

அலகு 4	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்	3

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

அலகு 5	அறிவியல் தமிழ் மற்றும் கணித்தமிழ்	3

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

TOTAL – 15 PERIODS

TEXT BOOK AND REFERENCE BOOKS	
1.	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2.	கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3.	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.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) (Published by: The Author)
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

COURSE CODE	COURSE NAME	HOURS/WEEK			CREDIT	MAXIMUM MARKS
		L	T	P	C	
22PY22001	**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.
OUTCOMES	• 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.

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 – Poiseuille‟s 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)

REFERENCES

1.	Physics Laboratory Manual (2019), Department of Physics, Mahendra Engineering College, Namakkal.
2	Geeta Sanon, BSc Practical Physics, 1st Edn. (2007), R. Chand & Co.
3	B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.
4	Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.
5	D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, 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	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	1	3	1	-	-	-	-	-	-	-	-	-	-	-	-

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Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22CS23001	**Problem Solving Techniques using C Laboratory** (I Semester for all circuit branches and II Semester for all non-circuit branches)	**0**	**0**	**3**	**1.5**	**100**
Objectives	To enable the students to: • Understand interfacing components of PC Motherboard. • Expertise in developing applications using Office Packages. • Formulate problems and implement algorithms using Raptor tool. • Make use of loops and functions in C. • Understand different types of statements, structures, unions and files.					
Outcomes	At the end of the course the students will be able to: • Identify the interfacing components of PC • Demonstrate the applications of Office Packages • Obtain solutions for the real world problems using Raptor Tool and • Develop programs using decision making statements, loops and functions • Apply structures, unions and files various types of statements for problem solving in C					

LIST OF EXPERIMENTS

1	Study and Identification of PC Motherboard and its Interfacing Components - https://www.youtube.com/watch?v=b2pd3Y6aBag
2	Prepare a Bio-data using Word Processor with Appropriate age, text and Table formatting options and send the same to recipients using Mail Merge
3	Create budget planning of your family with cell referencing, formulae, conditional formatting using Excel
4	Create a program flow to illustrate the use of Variables and Constants using Scratch Tool
5	Construct flowchart to find the Factorial for a given number using Raptor
6	Students mark generation using decision statements
7	Calculator using switch statement
8	Prime number generation and to check whether the number is Armstrong or not using looping
9	Greatest number using array (one dimensional)
10	Matrix addition / multiplication using array (two dimensional)
11	String functions
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**

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	1	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	1	1	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	1	1	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	1	1	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	1	1	-	-	-	-	-	-	-	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
22ME24201	Workshop Practices Laboratory	L	T	P	C	100
		0	0	3	1.5	

Objective(s)	• To introduce the students to the concepts of basic manufacturing processes • To identify the hand tools and instruments • To teach students how to perform simple welding, sheet metal and mouldingoperation • To help students perform some simple exercises on facing, turning, step turning and drilling

LIST OF EXPERIMENTS

1. Planning and cutting of wood.
2. Making of carpentry joints(T-joint, Lap- joint, Dovetail Joint)
3. Basic pipe connections and Mixed pipe material connection and Pipe connections with different joining components.
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
8. Mould with solid , split patterns and loose-piece pattern
9. Basic Study: Gas cutting and gas welding
10. Demonstration on: Injection moulding

LIST OF EQUIPMENTS

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. - 5 Nos
2. Carpentry vice (fitted to work bench) - 5 Nos
3. Standard woodworking tools- 5 Nos
4. Centre Lathe with accessories - 5 Nos
5. Arc welding machine - 4 Nos
6. Gas welding machine - 2 Nos
7. Sheet Metal Work facility- 3 Nos
8. Hand Shear 300mm- 2 Nos
9. Bench vice set up- 2 Nos
10. Standard tools and calipers for sheet metal work set up-2 Nos
11. Moulding Table- 4 Nos
12. Moulding boxes, tools and patterns- 4 Nos
13. Injection Moulding- for demonstration purpose-1 No

Total hours: 45

Outcome(s)	• Fabricate the models of sheet metal and welding joints • The students will acquire knowledge about moulding. • Perform facing, plain turning, step turning and drilling.

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	3	-	-	-	1	1	-	-	-	-	-	1	-	3	-
CO3	3	-	-	-	1	1	-	-	-	-	-	1	-	3	-

<table>
<tr><th>Course code</th><th>Course Name</th><th colspan="3">Hours / Week</th><th>Credit</th><th>Maximum marks</th></tr>
<tr><td rowspan="2">22MA12304</td><td rowspan="2">Numerical Methods and Statistics</td><td>L</td><td>T</td><td>P</td><td>C</td><td rowspan="2">100</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Objectives</td><td colspan="6">To enable the students to,
Learn about the solution of algebraic and transcendental equations and study the methods to solve linear system of equations by direct and iterative methods.
Gain the knowledge to solve ordinary differential equations by single step and multi-step methods.
Evaluate the derivatives from finite differences and evaluate single and double integrals by numerical integration methods.
Study the types of small sample tests.
Familiarize the students with design of experiments, correlation and regression analysis.</td></tr>
<tr><td>Outcomes</td><td colspan="6">At the end of the course the students will be able to
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.
Analyze testing of hypothesis of small samples.
Solve the problems involving design of experiments , correlation and regression analysis.</td></tr>
<tr><td>UNIT-I</td><td colspan="5">Numerical Scheems of Solving Equations</td><td>9+3</td></tr>
<tr><td colspan="7">Solution of equation – Iteration method and Newton - Raphson method – Solution of linear system by Gaussian elimination and Gauss-Jordon method– Iterative method –Gauss Jacobi method and Gauss-Seidel method – matrix inversion by Gauss Jordon method .</td></tr>
<tr><td>UNIT-II</td><td colspan="5">Initial Value Problems for Ordinary Differential Equations</td><td>9+3</td></tr>
<tr><td colspan="7">Single step methods: Taylor series method – Euler’s method and Modified Euler method for first order equation – Fourth order Runge – Kutta method for solving first order equations – Multistep method: Milne’s predictor and corrector methods.</td></tr>
<tr><td>UNIT-III</td><td colspan="5">Numerical Differentiation And Integration</td><td>9+3</td></tr>
<tr><td colspan="7">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 Simpsons’s rules.</td></tr>
<tr><td>UNIT-IV</td><td colspan="5">Testing of Hypothesis, Correlation & Regression</td><td>9+3</td></tr>
<tr><td colspan="7">Measures of Central Tendency, Sampling distributions, Small Sample Test: Test for single mean and difference of mean, F – test for equality of variances - Chi-Square Test for goodness of fit and independents of attributes. Correlation analysis and Estimation of Regression lines.</td></tr>
<tr><td>UNIT-V</td><td colspan="5">Design of Experiments</td><td>9+3</td></tr>
<tr><td colspan="7">Completely randomized design – Randomized block design – Latin square design - 2^2 -factorial design. Box-Behnken design.</td></tr>
<tr><td colspan="5">Total hours</td><td colspan="2">(L:45+T:15): 60</td></tr>
</table>

TEXT BOOK	
1.	Veerarajan.T, and Ramachandran, T., "Numerical Methods with programming in C" , Second Edition, Tata McGraw Hill, (2007).
2.	R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th edition, 2015.
REFERENCES	
1.	Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th Edition, 2007.
2.	Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., (2011).
3.	Sankara Rao K, "Numerical Methods for Scientisits and Engineering", 3rd Edition, Printice Hall of India Private Ltd, New Delhi, 2007
4.	Gerald, C.F.and Wheatley, P.O., " Applied Numerical Analysis", 6th Edition, Pearson Education, Asia, New Delhi, 2006.

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	-	-	-	-	-	1	-	-	-
CO2	3	3	-	2	-	1	-	-	-	-	-	1	-	-	-
CO3	3	2	-	2	-	1	-	-	-	-	-	1	-	-	-
CO4	3	3	-	2	-	1	-	-	-	-	-	1	-	-	-
CO5	3	3	-	2	-	1	-	-	-	-	-	1	-	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME14301	Materials Engineering	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 treatment processes. • 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, 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 Al_2O_3, SiC, Si_3N_4, 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	3	-	-	-	1	1	-	-	-	-	1	-	3	-
CO2	3	3	-	-	-	1	1	-	-	-	-	1	-	3	-
CO3	3	3	-	-	-	1	1	-	-	-	-	1	-	3	-
CO4	3	2	-	-	-	1	1	-	-	-	-	1	-	3	-
CO5	3	2	-	-	-	1	1	-	-	-	-	1	-	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME14302	Thermodynamics	3	0	0	3	100

Objective(s)	• To understand the important concepts of first and second laws of thermodynamics • To describe the concept of entropy, enthalpy, reversibility and irreversibility • To illustrate the basic concepts and properties of vapour power cycles and pure substances • To discuss the fundamental concepts of ideal, real gases and thermodynamic relations • To enumerate in depth knowledge on principle of psychometric processes.

UNIT-I	**Basic Concept and First Law**	**9**
Basic concepts - concept of continuum, macroscopic approach, thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, zeroth law of thermodynamics – concept of temperature and heat. concept of ideal and real gases. first law of thermodynamics – application to closed and open systems, steady flow process with reference to various thermal equipments.		
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, coefficient of performance. clausius inequality, concept of entropy, entropy of ideal gas.		
UNIT-III	**Properties of Pure Substance and Steam Power Cycles.**	**9**
Properties of pure substances – thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, and thermodynamic properties of steam. Calculations of work done and heat transfer in no flow and 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, compressibility chart – 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)	• Understand the concept of continuum, system, control volume, thermodynamic properties, thermodynamic equilibrium, work and heat • Apply the laws of thermodynamics to analyze heat engine, heat pumps, refrigerators, compressors and nozzles • Evaluate the performance of steam power cycles • Apply the concept of enthalpy, entropy, heat, work and other important thermodynamic properties for various ideal gas processes • Use psychromertic charts and estimate various essential properties related to psychrometry and processes.

Text books:

1	P.K.Nag, "Engineering Thermodynamics", TMH, New Delhi, 2016.
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, 2005.
REFERENCES:	
1	Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 1995.
2	Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
3	Irving Granet, Maurice Bluestein, Thermodynamics and Heat Power, Pearson Education Asia, 8th Edition-2014.

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	-	-	-	1	1	-	-	-	-	1	-	-	3
CO2	3	3	-	-	-	1	1	-	-	-	-	1	-	-	3
CO3	3	3	-	-	-	1	1	-	-	-	-	1	-	-	3
CO4	3	3	-	-	-	1	1	-	-	-	-	1	-	-	3
CO5	3	3	-	-	-	1	1	-	-	-	-	1	-	-	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME14303	Fluid Mechanics and Machinery	3	0	0	3	100

Objective(s)	• To study about mechanics of fluids and their properties. • To understand the losses in flow through pipes. • To understand the importance of dimensional analysis. • To impart knowledge on various types of flow in pumps. • To understand the importance of various types of flow in 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)	At the end of the semester the student will be able to • Describe and characterize the fluid flow. • Compute losses in circular conduits using conservation laws. • Apply dimensional analysis for fluid problems based on Buckingham's Π Theorem • Explain the performance of pumps with suitable applications. • Discuses elaborately the performance of hydraulic machines with relative applications.

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	3	-	-	-	1	1	-	-	-	-	1	-	-	3
CO2	3	3	-	-	-	1	1	-	-	-	-	1	-	-	3
CO3	3	3	-	-	-	1	1	-	-	-	-	1	-	-	3
CO4	3	3	-	-	-	1	1	-	-	-	-	1	-	-	3
CO5	3	3	-	-	-	1	1	-	-	-	-	1	-	-	3

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22SH11006	Universal Human Values	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:

Textbook

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

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

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

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22ME24301	**Fluid Mechanics and Machinery Laboratory**	0	0	3	1.5	**100**

Objective(s)	• To familiarize students with the principles and working of flow measuring devices such as orifice meter, venturi meter, and rotameter, and to experimentally determine flow parameters. • To develop an understanding of friction losses in pipes and enable students to determine friction factors through hands-on experimentation. • To provide practical exposure to the operation and performance testing of various hydraulic pumps and turbines, and to analyze their characteristic curves under different operating conditions.

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)	• Determine the discharge coefficients and flow characteristics of flow measuring devices • Analyze and evaluate the performance of various hydraulic machines • Examine and interpret the operational behavior of hydraulic turbines

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	-	-	-	1	1	-	-	-	-	-	-	-	3
CO2	3	3	-	-	-	1	1	-	-	-	-	-	-	-	3
CO3	3	3	-	-	-	1	1	-	-	-	-	-	-	-	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME24302	Computer Aided Machine Drawing Laboratory	1	0	2	2	100

Objectives	• To make the students understand and interpret drawings of machine components • To familiarize the students with Indian standards on drawing practices and standard components • To gain practical experience in handling 2D drafting and 3D modeling software systems

UNIT-I	**GD&T**	**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. Fits – Types of fits – Allocation of fits for various machine parts – Tolerances – Types – Representation on the drawing – Tolerance data sheet – Geometric tolerance .		
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)

Better hardware, with suitable graphics facility -30 No

Licensed software for Drafting and Modeling. - 30 Licenses

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	3	2	3	-	-	1	1	-	-	-	-	1	3	-	-
CO2	3	2	3	-	-	1	1	-	-	-	-	1	3	-	-
CO3	3	2	3	-	-	1	1	-	-	-	-	1	3	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME14401	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 enumerate the performance and emission characteristics on internal combustion engines. • To understand the knowledge on refrigeration and air conditioning for identifying the performance of the systems.

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, velocity diagram for simple and multi-stage turbines, 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 and inter cooling –work of multistage air compressor		
UNIT-IV	**Refrigeration and Air Conditioning Systems**	**9**
Refrigerants - vapour compression refrigeration cycle- super heat; sub cooling – performance calculations - working principle of vapour absorption system, ammonia –water, lithium bromide – water systems (Description only) air conditioning system - processes, 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 , 2010
2	Sarkar B K, "Thermal Engineering" Tata Mcgraw Hill, 1998
3	Vijayaraghavan.G.K and Vishupriyan, "Thermal Engineering" A.R.Publications, Channai-600100, Tenth Edition-2015.
REFERENCE BOOKS:	
1	R.S.Khurmi and J.K.Gupta "Thermal Engineering" S.Chand & Company Ltd, 2010`
2	Ganesan V." Internal Combustion Engines" , 3rd Edition, Tata McGraw-Hill 2007.
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

<table>
<tr><th>Course code</th><th>Course Name</th><th colspan="4">Hours/week</th><th>Credit</th><th>Maximum marks</th></tr>
<tr><td rowspan="2">22ME14402</td><td rowspan="2">Manufacturing Technology</td><td>L</td><td>T</td><td>P</td><td>C</td><td rowspan="2">100</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Objective(s)</td><td colspan="6">• To introduce the students to the concepts of basic manufacturing technology
• To impart knowledge on working of standard machine tools
• To understand and appreciate the abrasive processing
• To understand the basic concepts of computer numerical control machine tool.
• To learn about various unconventional machining processes, the various process parameters and their applications</td></tr>
<tr><td>UNIT-I</td><td colspan="5">Machine Tools</td><td>9</td></tr>
<tr><td colspan="7">Milling: Types, milling cutters, indexing, operations- Reciprocating machine tools: shaper, planer, and slotter. Sawing machine: Hack saw, band saw, circular saw- Broaching machines: Broach construction, push, pull, surface
and continuous broaching machines.</td></tr>
<tr><td>UNIT-II</td><td colspan="5">Abrasive Processes</td><td>9</td></tr>
<tr><td colspan="7">Abrasive processes: Introduction- Grinding wheel, designations and selection, types of grinding machines, cylindrical grinding, surface grinding, centre less grinding– Grinding process parameters- honing, lapping, super
finishing, polishing and buffing.</td></tr>
<tr><td>UNIT-III</td><td colspan="5">CNC Machine Tools and Part Programming</td><td>9</td></tr>
<tr><td colspan="7">Numerical control (NC) machine tools- Introduction 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.</td></tr>
<tr><td>UNIT-IV</td><td colspan="5">Electrical and Mechanical Energy Based Processes</td><td>9</td></tr>
<tr><td colspan="7">Unconventional machining process- Electrical Discharge Machining (EDM)- Abrasive Jet Machining (AJM)-
Water Jet Machining (WJM)- Ultrasonic Machining (USM)- Working principles, equipment used- process parameters- applications, advantages and limitations.</td></tr>
<tr><td>UNIT-V</td><td colspan="5">Electro Chemical and Thermal Energy Based Processes</td><td>9</td></tr>
<tr><td colspan="7">Electro Chemical Machining (ECM)- Electro Chemical Grinding(ECG)- Laser Beam machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (EBM)- Working principles, equipment used- process parameters- applications, advantages and limitations.</td></tr>
<tr><td colspan="6">Total hours</td><td>45</td></tr>
<tr><td>Outcome(s)</td><td colspan="6">• Perform various machining operations and various machine tools
• Apply the appropriate abrasive machining processes for making components
• Select the CNC machining processes for industrial applications
• The students can able to demonstrate different unconventional machining processes
• The students will identify and suggest the suitable manufacturing process for advanced materials</td></tr>
</table>

TEXT BOOK :	
1	C.Elanchezhian and M.Vijayan, "Manufacturing Technology-II", Anuradha Publication, 2010.
2	S Senthil, "Unconventional Machines Process" ARS Publication Binding, 2017.
3	RAO.P.N, "Manufacturing Technology, Metal cutting and Machine tools", 2nd Edition, Tata McGraw– Hill, 2007.
4	Hajra Choudhury S.K. and Hajra Choudhury A.K., "Element of Manufacturing Technology Vol. I", Media Publications, 2013.
REFERENCES:	
1	H M T, "Production Technology" Tata McGraw-Hill Education, 2001.
2.	V.K Jain, "Advanced Machining Processes" Allied publications, 2018.
3	Rajput,R.K., "A textbook of Manufacturing Technology", Laxmi Publications (P) Ltd., New Delhi, 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	-	3	-
CO2	3	2	-	-	-	1	-	-	-	-	-	1	-	3	-
CO3	3	2	-	-	2	1	-	-	-	-	-	1	-	3	-
CO4	3	2	-	-	-	1	-	-	-	-	-	1	-	3	-
CO5	3	2	-	-	-	1	-	-	-	-	-	1	-	3	-

<table>
<tr><td>Department</td><td colspan="3">Mechanical Engineering</td><td colspan="2">Programme Code</td><td colspan="2">1081</td></tr>
<tr><td>Course code</td><td colspan="3">Course Name</td><td colspan="2">Hours/week</td><td>Credit</td><td>Maximum marks</td></tr>
<tr><td rowspan="2">22ME14403</td><td colspan="3" rowspan="2">Strength of Materials</td><td>L</td><td>T</td><td>P</td><td>C</td><td rowspan="2">100</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Objective(s)</td><td colspan="8">• To teach students the principles of Mechanics of Materials and to develop engineering problem solving skills in stress/strain/deflection analysis through application of these principles.
• To learn and understand the axially loaded members; torsion in circular shafts, principle stresses; and maximum shear stress; Response in thin walled pressure vessels.</td></tr>
<tr><td>UNIT-I</td><td colspan="6">Stress, Strain and Deformation of Solids</td><td colspan="2">9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>UNIT-II</td><td colspan="6">Transverse Loading on Beams and Stresses in Beams</td><td colspan="2">9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>UNIT-III</td><td colspan="6">Torsion</td><td colspan="2">9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">Deflection</td><td colspan="2">9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>UNIT-V</td><td colspan="6">Analysis of Stresses in Two Dimensions</td><td colspan="2">9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td colspan="6">Total hours</td><td colspan="3">45</td></tr>
<tr><td>Outcome(s)</td><td colspan="8">After successful completion of the course, the student would be able to:
• Know the fundamentals concepts of stress and strain in mechanics of solids and structures.
• 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
• Design springs for its maximum energy storage capacities.
• Analysis of Stresses in two dimensions in principal stresses , principal strains and Stresses in thin cylindrical and spherical shells under internal pressure.</td></tr>
</table>

TEXT BOOK :	
1.	Rajput, R. K, "A Textbook of Strength of Materials", S. Chand, 2007
2.	Subramanian R, "Strength of materials", Oxford University Press, New Delhi, 2nd Edition 2011
3.	Mechanics of Materials by Ferdinand P. Beer, E. Russell Johnston Jr., , John T. Dewolf,, David F. Mazurek, Sanjeev Sanghi) Publisher: McGraw Hill India, Edition: 7, 2016
4.	Mechanics of Materials by Sesha Prakash M N; Suresh G S, published by PHI Learning, 2011
5.	S.Senthil"Strength of materials" Lakshmi Publications 1st Edition 2015
REFERENCES:	
1.	Bansal R.K. "A Text Book of Strength of materials, Laxmi Publications (P), New Delhi, 6th Edition, 2015.
2.	Strength of materials by S.Ramamrutham, Dhanpat Rai & Co. (P) Ltd, 2014.
3.	Mechanics of Material, 7th Edition James M. Gere
4.	Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 1998
5.	Nash W.A, "Theory and problems in Strength of Materials", Schaum's Outline Series, McGraw-Hill Book Co, New York, 1995.
6.	Singh D.K "Mechanics of Solids" 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	-	-	1	-	-	-	-	-	1	3	-	-
CO2	3	3	2	-	-	1	-	-	-	-	-	1	3	-	-
CO3	3	3	2	-	-	1	-	-	-	-	-	1	3	-	-
CO4	3	3	2	-	-	1	-	-	-	-	-	1	3	-	-
CO5	3	3	2	-	-	1	-	-	-	-	-	1	3	-	-

<table>
<tr><th>COURSE CODE</th><th>COURSE NAME</th><th colspan="3">HOURS/WEEK</th><th>CREDIT</th><th>MAXIMUM MARKS</th></tr>
<tr><td rowspan="2">22CY11001</td><td rowspan="2">Environmental Science and Engineering</td><td>L</td><td>T</td><td>P</td><td>C</td><td rowspan="2">100</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Objectives</td><td colspan="6">To make the students familiar with :
The importance of Ecosystem and Natural resources.
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 influence of societal use of resources on the environment and introduce the legal provisions,
National and International laws and conventions for environmental protection.
The effect of population dynamics on human and environmental health and inform about human
right, value education and role of technology in monitoring human and environmental issues.</td></tr>
<tr><td>Outcomes</td><td colspan="6">At the end of the course the student will be able to
Explain basic knowledge about the importance of environment, ecosystem and Natural resources.
Classify the biodiversity and measure the variety of animals, plants and microbial species.
Identify the awareness about the different types of Pollution and know about control
measures.
Organize the environmental impacts related to the society through WHO.
Explore the awareness about population explosion, human welfare and role of information technology in environment.</td></tr>
<tr><td>UNIT-I</td><td colspan="5">Environment, Ecosystem and Natural Resources</td><td>12 Hrs</td></tr>
<tr><td colspan="7">Definition, scope and importance of environment – Need for public awareness – Concept of an ecosystem – Structure and function of an ecosystem – Energy flow in the ecosystem – Ecological succession – food chains, food webs and ecological pyramids –Natural resources –Types and associated problems (Forest, Water, Food, Mineral and Energy resources).</td></tr>
<tr><td>UNIT-II</td><td colspan="5">Biodiversity & Conservation</td><td>6 Hrs</td></tr>
<tr><td colspan="7">Introduction to biodiversity 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.</td></tr>
<tr><td>UNIT-III</td><td colspan="5">Environmental Pollution</td><td>9 Hrs</td></tr>
<tr><td colspan="7">Definition – causes, effects and control measures of: (a) Air, (b) Water, (c) Soil, (d) Noise, (e) Thermal pollution– solid waste management: causes, effects and control measures of municipal solid wastes – disaster management: floods, earthquake and landslides– role of an individual in prevention of pollution – pollution case studies (vizag gas leakage) – Field visit to local polluted area.</td></tr>
<tr><td>UNIT-IV</td><td colspan="5">Social Issues and The Environment</td><td>9 Hrs</td></tr>
<tr><td colspan="7">From unsustainable to sustainable development – water conservation strategy – Feature of LARR Act - Rights of a property holder - role of nongovernmental organizations- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies (Global warming). – Wasteland reclamation – consumerism and waste products – environment protection act.</td></tr>
<tr><td>UNIT-V</td><td colspan="5">Human Population and The Environment</td><td>9 Hrs</td></tr>
<tr><td colspan="7">Definition – Population growth - variation among nations – population explosion – family welfare program - women and child welfare – environment and human health – human rights – value education – HIV /AIDS – role of information</td></tr>
</table>

technology in environment and human health.	
Total hours	**45**
Text books :	
1.	Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 3nd Edition, Pearson Education, 2023.
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.	Anubha Kaushik, C. P. Kaushik "Perspectives in Environmental Studies", 7th Edition, NEW AGE International Publishers, 2021.
REFERENCES	
1.	R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
2.	Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press (2015)
3.	Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, 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	2	–	–	–	–	2	2	2	–	–	–	1	–	–	–
CO2	2	–	–	–	–	2	2	2	–	–	–	1	–	–	–
CO3	2	–	–	–	–	2	3	2	–	–	–	1	–	–	–
CO4	1	–	–	–	–	2	3	3	–	–	–	1	–	–	–
CO5	1	–	–	–	-	2	2	3	–	–	–	2	–	–	–

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22ME24401	**Manufacturing Technology Laboratory**	0	0	3	1.5	**100**
Objective(s)	• To Study and acquire knowledge on various basic machining operations in special purpose machines and its applications in real life manufacture of components in the industry					
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					

LIST OF EXPERIMENTS	
1	Exercise on capstan Lathe
2	Exercise on Turret lathe
3	Spur Gear cutting using Milling machine
4	Centre less grinding
5	Cylindrical grinding
6	Round to square machining using shaper machining
7	Tool and cutter grinding machine
8	Internal keyway slotting in slotting machine
9	Surface grinding
10	Demonstration on: Electric Discharge Machines
	Total hours **45**
LIST OF EQUIPMENTS (for a batch of 30 students)	
1	Turret Lathe -1No.
2	Capstan Lathe -1No
3	Horizontal Milling Machine -1No
4	Surface Grinding Machine -1No
5	Cylindrical Grinding Machine -1No
6	Shaper -1No
7	Slotter -1No
8	Drilling Machine -1No
9	Tool and Cutter grinder -1No
10	Centreless grinding machine -1No
11	Electric Discharge Machine

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	-	3	-
CO2	3	3	-	-	1	1	-	-	-	-	-	1	-	3	-
CO3	3	3	-	-	1	1	-	-	-	-	-	1	-	3	-

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22ME24402	**Strength of Materials Laboratory**	0	0	3	1.5	**100**

Objective(s)	• To provide hands-on experience in conducting fundamental mechanical tests such as tension, torsion, impact, hardness, and compression to evaluate material properties. • To develop skills in analyzing structural behavior through deflection tests on beams and verifying theoretical concepts like Maxwell's reciprocal theorem. • To enable students to understand the mechanical performance of metals, springs, and construction materials through standardized testing methods.

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)	• Perform and analyze results from mechanical tests including tension, torsion, double shear, impact, and hardness testing. • Conduct deflection tests on beams and compression tests on helical springs to evaluate structural behavior and spring properties. • Verify theoretical concepts such as Maxwell's reciprocal theorem and carry out material tests on metals and cement accurately.

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	-	-	-	-	-	1	3	-	-
CO2	3	3	-	-	-	1	-	-	-	-	-	1	3	-	-
CO3	3	3	-	-	-	1	-	-	-	-	-	1	3	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
22EN60001	**Professional Communication Skills** (Common to all B.E./B.Tech. Degree Programmes)	**L**	**T**	**P**	**C**	**100**
		0	1	2	2	
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					
Outcomes	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					

LIST OF EXERCISES

1	Introduction to Professional Communication and SWOT Analysis
2	Reading Comprehension
3	Listening Comprehension
4	Stage Dynamics (Body Language and Paralanguage - Presentation)
5	Framing Questions (WH Questions & 'Yes' or 'No' Questions)
6	Narrative Techniques (Structure, Grammar & Vocabulary- Narrating the Experience)
7	Master of Ceremony Skills (Practice)
8	Picture Description
9	Creative Writing
10	Extempore Speech

Total hours : 30

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

Online 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	-	-	-	-	1	-	-	-	3	3	1	1	-	-	-
CO2	-	-	-	-	1	-	-	-	3	3	1	1	-	-	-
CO3	-	-	-	-	1	-	-	-	3	3	1	1	-	-	-

<table>
<tr><th>Course code</th><th>Course Name</th><th colspan="4">Hours/week</th><th>Credit</th><th>Maximum marks</th></tr>
<tr><td rowspan="2">22ME14501</td><td rowspan="2">Theory of Machines</td><td>L</td><td>T</td><td>P</td><td>C</td><td rowspan="2">100</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Objective(s)</td><td colspan="7">• 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.</td></tr>
<tr><td>UNIT-I</td><td colspan="6">Basics of Mechanisms and Kinematic Analysis</td><td>9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>UNIT-II</td><td colspan="6">Gears and Gear Trains</td><td>9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>UNIT-III</td><td colspan="6">Friction and Dynamic Force Analysis</td><td>9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">Balancing and Free Vibration</td><td>9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>UNIT-V</td><td colspan="6">Forced Vibration and Mechanisms for Control</td><td>9</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td colspan="7">Total hours</td><td>45</td></tr>
<tr><td>Outcome(s)</td><td colspan="7">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</td></tr>
</table>

	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	-	-	1	-	-	-	-	-	1	3	2	-
CO2	3	3	2	-	-	1	-	-	-	-	-	1	3	2	-
CO3	3	3	2	-	-	1	-	-	-	-	-	1	3	2	-
CO4	3	3	2	-	-	1	-	-	-	-	-	1	3	2	-
CO5	3	3	2	-	-	1	-	-	-	-	-	1	3	2	-

Course code	Course Name	Hours/week			Credit	Maximum marks
22ME14502	**Design of Machine Elements** (Use of P S G Design Data Book is permitted in the End Semester examination)	**L**	**T**	**P**	**C**	**100**
		3	**0**	**0**	**3**	

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, 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: • Compute the steady and variable stresses induced in machine elements. • Determine the diameter of shafts based on design parameters for various types of couplings. • Design of permanent and temporary joints for different loading applications. • Develop energy storage element and engine components for real- time applications. • Describe the types of bearings and analyze their applications.

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	3	3	3	2	-	-	-	-	-	-	-	1	3	2	-
CO2	3	3	3	2	-	-	-	-	-	-	-	1	3	2	-
CO3	3	3	3	2	-	-	-	-	-	-	-	1	3	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	1	3	2	-
CO5	3	3	3	2	-	-	-	-	-	-	-	1	3	2	-

<table>
<tr><th>Course code</th><th>Course Name</th><th colspan="4">Hours/week</th><th>Credit</th><th>Maximum marks</th></tr>
<tr><td rowspan="2">22MBAT6S06</td><td rowspan="2">Managerial Skills, Project and Quality Management</td><td>L</td><td>T</td><td>P</td><td>C</td><td rowspan="2">100</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Objective(s)</td><td colspan="6">This course is designed to:
Develop knowledge and skills needed for the successful managerial performance.
Develop team building and communication skills in learners for working in multi-disciplinary teams.
Enable the learners to plan, schedule and manage projects.
Facilitate budgeting and finance, and evaluate projects
Understand the importance of quality concepts and principles.</td></tr>
<tr><td>UNIT-I</td><td colspan="5">Introduction to Managerial Skills</td><td>9</td></tr>
<tr><td colspan="7">Introduction to Self Awareness – Self Portrait – Self Assessment – Life-long learning. Definition of Life Skills and Managerial Skills – Need and Importance of Skills. Decision Making and Problem Solving: Problem Analysis –Techniques – Steps; Problem solving: Characteristics of Complex problems – Problem Solving Strategies – Barriers.; Lateral thinking Need and Importance of Lateral Thinking; Logic and Rationality – Functions – Personal and Work ethics-Case study</td></tr>
<tr><td>UNIT-II</td><td colspan="5">Team Building and Effective Communication</td><td>9</td></tr>
<tr><td colspan="7">Team Building: Developing teams and team work, advantages of team, leading team, team membership, traits of working in multi-disciplinary teams. Effective Communication: Need and Importance – Techniques and Types - Verbal and Non-Verbal Communication - Barriers to communication – Overcoming barriers – Multiple Intelligences – 360 degree evaluation, Case Study.</td></tr>
<tr><td>UNIT-III</td><td colspan="5">Project Management</td><td>9</td></tr>
<tr><td colspan="7">Project: Meaning and Importance of terms ‘Event’, Activity’. ‘Time”. Identification of project opportunities, Screening of Project Ideas. Criteria for project selection, Project planning and scheduling – Application of CPM and PERT – Examples and case studies.</td></tr>
<tr><td>UNIT-IV</td><td colspan="5">Budgeting and Finance</td><td>9</td></tr>
<tr><td colspan="7">Introduction to Budgeting and Finance, kinds of Project Evaluation, Evaluation Techniques – Non-discounted cash flow methods, Discounted cash flow Methods, Evaluation of Project cost, Capital budgeting and its methods. Financial management of Projects. Project Risk and its mitigation – Examples and case studies.</td></tr>
<tr><td>UNIT-V</td><td colspan="5">Quality Concepts and Principles</td><td>9</td></tr>
<tr><td colspan="7">Introduction - Need for Quality - Evolution of Quality - Definition of Quality - Dimensions of Manufacturing Quality and Service Quality. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward Performance appraisal - Continuous process improvement, 6σ, 5s, Kaizen - Case Study.</td></tr>
<tr><td colspan="6">Total hours</td><td>45</td></tr>
<tr><td>Outcome(s)</td><td colspan="6">Upon completion of this course, the Learners will be able to :
Demonstrate applicable knowledge and skills needed for managerial effectiveness.
Demonstrate team building and communication skills for working in multi-disciplinary teams.
Plan, schedule and manage projects
Plan budgeting, manage finance and evaluate projects
Summarize the quality concepts and principles.</td></tr>
</table>

TEXT BOOK :	
1	David A.Whetten and Kim S.Cameron, Developing Management Skills, – PHI, 2011.
2	Harper, Nancy Life Skills: Essential for Personal Growth on the Ever Changing Road of Life. Bloomington, IN: Author House, 2011.
3	Adair, J. Decision Making and Problem Solving. UK: Kogan Page Publishers.2013.
4	James R Evans, Quality Management, Cengage Learning India Private Limited 2010.
5	Janakiraman. B and Gopal .R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
6	Prasanna Chandra "ProjectPlanning, Analysis, Selection, Financing, Implementation and Review, Tata Mcgraw-Hill, 2002.
REFERENCES:	
1	Kallet, Michael Think Smarter: Critical Thinking to Improve Problem-Solving and Decision Making Skills. New Jersey: John Wiley & Sons, 2014.
2	Adair, J. & Allen, M. Time Management and Personal Development. London: Hawksmere, 1999.
3	Hattie, John Self-Concept. New York: Psychology Press, 2014.
4	Mcgrath E.H., S.J., Basic Managerial Skills for all, 9th Edition, PHI, 2012
5	Amitava Mitra, Fundamentals of Quality Control & Improvement, Wiley Publications, 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	3	-	3	2	-	-	-
CO2	-	-	-	3	-	-	-	3	3	-	3	2	-	-	-
CO3	-	-	-	3	-	-	-	3	3	-	3	2	-	-	-
CO4	-	-	-	3	-	-	-	3	3	-	3	2	-	-	-
CO5	-	-	-	3	-	-	-	3	3	-	3	2	-	-	-

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22ME24501	**Thermal Engineering Laboratory**	0	0	3	1.5	**100**

Objective(s)	• Understand and analyze the performance characteristics of various internal combustion engines and steam turbines through practical experiments. • Apply principles of thermodynamics and fluid mechanics to determine heat balance, frictional losses, and energy efficiency in thermal systems. • Evaluate the operational parameters and performance of refrigeration and air-conditioning systems using experimental methods.

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)	• Perform and interpret valve and port timing diagrams and analyze the performance of 4-stroke diesel and petrol engines through tests like heat balance, Morse test, and retardation test. • Determine fluid properties such as viscosity, flash point, and fire point, and analyze the performance and energy balance of steam generators and steam turbines. • Evaluate the performance and coefficient of performance (COP) of refrigeration, air-conditioning systems, and air compressors using standard experimental procedures.

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	1	-	-	-	-	1	-	-	3
CO2	3	3	-	-	-	1	1	-	-	-	-	1	-	-	3
CO3	3	3	-	-	-	1	1	-	-	-	-	1	-	-	3

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22ME24502	**Dynamics 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 ofvelocity 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 EQUIPMENT (for a batch of 30 students)

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

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

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22ME25501	Summer Internship Evaluation	0	0	3	1.5	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	**45**

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	3	3	2	-	-	2	2	2	2	1	2	2	2	2	2
CO2	3	3	2	-	-	2	2	2	2	1	2	2	2	2	2
CO3	3	3	2	-	-	2	2	2	2	1	2	2	2	2	2

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22EN60002	**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
Outcomes	**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.

LIST OF EXERCISES

1.	Introduction to Employability Skills
2.	Reading Comprehension
3.	Listening Comprehension
4.	Professional Email Writing
5.	Preparing One Page Resume
6.	Interview Skills (Mock Interview & Interview Etiquette)
7.	Corporate Skills (Polite Expressions, Telephone Etiquette, Online Etiquette & PPT Presentation)
8.	Group Discussion
9.	Soft Skills (Interpersonal, Intrapersonal, Leadership, Decision Making and Problem Solving)
10	Public Speaking

Total hours : 30

Textbook:

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

Reference Books:

Raman, Meenakshi & Sangeeta Sharma, *Technical Communication: Principles and Practice,* Ed.III, Oxford University Press, New Delhi. 2015.

Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, New Delhi, 2011

Online Websites:

https:// www.ted.com/talks

https://www.joshtalks.com

https://quizziz.com

www.pdfdrive.com

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	-	1	2	3	2	1	2	3	-	-	-
CO2	-	-	-	2	-	1	2	3	2	1	2	3	-	-	-
CO3	-	-	-	2	-	1	2	3	2	1	2	3	-	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME14601	Finite Element Analysis	3	1	0	4	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**
SecondOrder 2D Equations involving Scalar Variable Functions–Variationalformulation– FiniteElement 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	3	3	3	2	-	-	-	-	-	-	-	1	3	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	1	3	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	1	3	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	1	3	-	-
CO5	3	3	3	2	-	-	-	-	-	-	-	1	3	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME14602	**Heat and Mass Transfer** (Use of HMT Data Book is permitted in the End Semester examination)	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	**Phase Change Heat Transfer and Heat Exchangers**	**9**
Boiling – Pool boiling and Film boiling – Condensation – Dropwise and Film-wise Condensation – Correlations in boiling and condensation Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis – LMTD method - NTU method. Theory of Compact Heat Exchangers.		
UNIT-IV	**Radiation**	**9**
Basic laws of radiation – Concept of Black body – Absorptivity, Reflectivity and Transmissivity – Emissivity – Grey body radiation –Shape Factor – Radiosity and Irradiation –Electrical Analogy for parallel plates – Radiation Shields –Introduction to Gas Radiation		
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)	Upon completion of this course, the Learners will be able to : • Apply the concept of one dimensional steady state and transient heat conduction through various systems. • Discuss the concept of convection with the flow of fluids in heat exchangers. • Associate the significance of phase change with heat exchangers. • Discuss the concept of radiation and application in heat transfer systems. • 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	3	3	-	-	1	1	-	-	-	-	1	-	-	3
CO2	3	3	3	-	-	1	1	-	-	-	-	1	-	-	3
CO3	3	3	3	-	-	1	1	-	-	-	-	1	-	-	3
CO4	3	3	3	-	-	1	1	-	-	-	-	1	-	-	3
CO5	3	3	3	-	-	1	1	-	-	-	-	1	-	-	3

Course code	Course Name	Hours/week			Credit	Maximum marks
22ME14603	**Design of Transmission Systems** (Use of PSG Data book is permitted)	**L**	**T**	**P**	**C**	**100**
		3	**0**	**0**	**3**	

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 andstresses, 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**
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	3	3	3	-	-	1	-	-	-	-	-	1	3	-	-
CO2	3	3	3	-	-	1	-	-	-	-	-	1	3	-	-
CO3	3	3	3	-	-	1	-	-	-	-	-	1	3	-	-
CO4	3	3	3	-	-	1	-	-	-	-	-	1	3	-	-
CO5	3	3	3	-	-	1	-	-	-	-	-	1	3	-	-

Course code	Course Name	Periods/week			Credit	Maximum marks
		L	T	P	C	
22MC60001	Constitution of India	3	0	0	0	100

Objectives	• 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**

	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.

Outcomes	• 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.
TEXTBOOKS:	
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	-	-	-	-	-	-	3	3	2	-	2	3	-	-	-
CO2	-	-	-	-	-	-	3	3	2	-	2	3	-	-	-
CO3	-	-	-	-	-	-	3	3	2	-	2	3	-	-	-
CO4	-	-	-	-	-	-	3	3	2	-	2	3	-	-	-
CO5	-	-	-	-	-	-	3	3	2	-	2	3	-	-	-

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22ME24603	Heat Transfer Laboratory	0	0	3	1.5	100

Objective(s)	• Understand and experimentally determine thermal conductivity and heat transfer coefficients under various modes such as conduction, natural convection, and forced convection using standard apparatus. • Evaluate radiative heat transfer parameters including Stefan-Boltzmann constant and surface emissivity through laboratory experiments. • Analyze the performance of heat exchangers and refrigeration systems by conducting experiments to calculate effectiveness and coefficient of performance (COP).

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 EQUIPMENT

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)	• Perform and interpret experiments to measure thermal conductivity and heat transfer coefficients for different materials and geometries using guarded plate, lagged pipe, vertical cylinder, tube, and pin-fin apparatus. • Determine radiative heat transfer properties such as the Stefan-Boltzmann constant and emissivity of surfaces, applying concepts of thermal radiation in practical scenarios. • Calculate and analyze the effectiveness of heat exchangers and the COP of refrigeration systems, enabling performance evaluation and design optimization in thermal engineering applications.

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	1	-	-	-	-	1	-	-	3
CO2	3	3	-	-	-	1	1	-	-	-	-	1	-	-	3
CO3	3	3	-	-	-	1	1	-	-	-	-	1	-	-	3

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22ME24601	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

Stress analysis of a plate with a circular hole

Stress analysis of rectangular L bracket.

Stress analysis of beams (Cantilever, Simply supported, Fixed ends).

Thermal stress analysis of a 2D component.

Conductive heat transfer analysis of a 2D component.

Convective heat transfer analysis of a 2D component.

Simulation of Air conditioning system with condenser temperature and evaporator Temperatures as input to get COP using C/MAT Lab.

Total hours **45**

LIST OF EQUIPMENT (for a batch of 30 students)

1.	Computer Work Station - 30
2.	Laser Printer - 01
3.	CNC Lathe - 01
4.	CNC Milling Machine – 01
5.	NX CAM Software for machining centre and turning centre-15 users (CNC Programming and tool path simulation for FANUC controller-for Demonstration only) and physical experiments using machines.
6.	Ansys 15.0 Software – 30 Users
7.	MATLAB Software -30 users.

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	3	3	-	-	-	1	-	-	-	-	-	1	3	-	-
CO2	3	3	-	-	-	1	-	-	-	-	-	1	3	-	-
CO3	3	3	-	-	-	1	-	-	-	-	-	1	3	-	-

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22ME36601	**Design and Fabrication Project**	0	0	2	1	**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	2	3	2	3	2	1	1	2	2	3	3	3	2	2
CO2	3	2	3	2	3	2	1	1	2	2	3	3	3	2	2

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME14701	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 Automation principles and strategies: USA principle, ten strategies of automation and production system, automation migration strategy		
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	**Case studies**	**9**
Case studies of automation systems- Pick and Place Robot- Car Park Barriers, Car Engine Management, Washing Machine and Automatic Camera.		
	Total hours	**45**

Outcome(s)	Learner will be able to • 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. • Identify suitable industrial automation hardware and its application.

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	-	-	-	-	-	1	-	3	-
CO2	3	2	-	-	2	1	-	1	-	-	-	1	-	3	-
CO3	3	2	-	-	2	1	-	1	-	-	-	1	-	3	-
CO4	3	2	-	-	2	1	-	1	-	-	-	1	-	3	-
CO5	3	2	-	-	2	1	-	1	-	-	-	1	-	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
22ME14702	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	-	-	-	1	1	1	1	-	-	2	-	3	-
CO2	3	2	-	-	-	1	1	1	1	-	-	2	-	3	-
CO3	3	2	-	-	-	1	1	1	1	-	-	2	-	3	-
CO4	3	2	-	-	-	1	1	1	1	-	-	2	-	3	-
CO5	3	2	-	-	-	1	1	1	1	-	-	2	-	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME14703	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	-	3	-
CO2	3	2	-	-	-	1	1	-	-	-	-	1	-	3	-
CO3	3	2	-	-	-	1	1	-	-	-	-	1	-	3	-
CO4	3	2	-	-	-	1	1	-	-	-	-	1	-	3	-
CO5	3	2	-	-	-	1	1	-	-	-	-	1	-	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME14704	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)	• Student will be able to demonstrate vehicle chassis and engine management system. • Student can apply the concepts to demonstrate the vehicle components and engine emission control systems. • Students can demonstrate the conventional and automatic transmission system and find the appropriate applications in an automobile sector. • Students can apply concepts of various sub systems (steering, braking and suspension) and

	demonstrate their components in an automobile. • Students can demonstrate the practice of Electrical vehicles / Hybrid vehicles and power Plants.

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	-	-	-	1	-	1	-	-	-	1	-	3	-
CO2	3	2	-	-	-	1	-	1	-	-	-	1	-	3	-
CO3	3	2	-	-	-	1	-	1	-	-	-	1	-	3	-
CO4	3	2	-	-	-	1	-	1	-	-	-	1	-	3	-
CO5	3	2	-	-	-	1	-	1	-	-	-	1	-	3	-

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	2	-	-	-	1	1	-	-	-	-	1	-	3	-
CO2	3	2	-	-	-	1	1	-	-	-	-	1	-	3	-
CO3	3	2	-	-	-	1	1	-	-	-	-	1	-	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME24702	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

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 by 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 (for a batch of 30 students)

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)

- Design and analyze pneumatic and hydraulic circuits using single and double-acting cylinders for various industrial applications.
- Implement and test electro-pneumatic and PLC-based control circuits including timers, sensors, and actuators.
- Interface and control electrical actuators like stepper and PMDC motors using advanced controllers such as PID and evaluate their performance.

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	-	3	-
CO2	3	2	-	-	-	1	1	-	-	-	-	1	-	3	-
CO3	3	2	-	-	-	1	1	-	-	-	-	1	-	3	-

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22ME36701	**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 that area, 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	3	2	2	1	2	3	3	3	3	3	3	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15101	Renewable Energy	3	0	0	3	100

Objective(s)	• To understand the various 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	2	-	-	-	1	1	-	-	-	2	-	-	3
CO2	3	3	2	-	-	-	1	1	-	-	-	2	-	-	3
CO3	3	3	2	-	-	-	1	1	-	-	-	2	-	-	3
CO4	3	3	2	-	-	-	1	1	-	-	-	2	-	-	3
CO5	3	3	2	-	-	-	1	1	-	-	-	2	-	-	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15102	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	-	-	-	1	-	1	-	-	-	1	-	-	3
CO2	3	3	-	-	-	1	-	1	-	-	-	1	-	-	3
CO3	3	3	-	-	-	1	-	1	-	-	-	1	-	-	3
CO4	3	3	-	-	-	1	-	1	-	-	-	1	-	-	3
CO5	3	3	-	-	-	1	-	1	-	-	-	1	-	-	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15103	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 precipator-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	2	-	-	-	-	1	1	-	-	1	1	-	-	3
CO2	3	2	-	-	-	-	1	1	-	-	1	1	-	-	3
CO3	3	2	-	-	-	-	1	1	-	-	1	1	-	-	3
CO4	3	2	-	-	-	-	1	1	-	-	1	1	-	-	3
CO5	3	2	-	-	-	-	1	1	-	-	1	1	-	-	3

<table>
<tr><th>Course code</th><th>Course name</th><th colspan="3">Hours/Week</th><th>Credit</th><th>Maximum Marks</th></tr>
<tr><td rowspan="2">22ME15104</td><td rowspan="2">Refrigeration and Air Conditioning</td><td>L</td><td>T</td><td>P</td><td>C</td><td rowspan="2">100</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Objectives</td><td colspan="6">• 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</td></tr>
<tr><td>UNIT-I</td><td colspan="5">Introduction to Refrigeration</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT-II</td><td colspan="5">Vapour Compression & Absorption System</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT-III</td><td colspan="5">Psychrometry</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT-IV</td><td colspan="5">Air Conditioning Systems</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT-V</td><td colspan="5">Cold Storage and Management</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td colspan="6">Total hours :</td><td>45 Hrs</td></tr>
<tr><td>Outcomes</td><td colspan="6">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.</td></tr>
</table>

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	-	-	-	1	-	1	-	-	-	2	-	-	3
CO2	3	3	-	-	-	1	-	1	-	-	-	2	-	-	3
CO3	3	3	-	-	-	1	-	1	-	-	-	2	-	-	3
CO4	3	3	-	-	-	1	-	1	-	-	-	2	-	-	3
CO5	3	3	-	-	-	1	-	1	-	-	-	2	-	-	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15105	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	-	-	1	1	-	1	-	-	-	1	-	-	3
CO2	3	3	-	-	1	1	-	1	-	-	-	1	-	-	3
CO3	3	3	-	-	1	1	-	1	-	-	-	1	-	-	3
CO4	3	3	-	-	1	1	-	1	-	-	-	1	-	-	3
CO5	3	3	-	-	1	1	-	1	-	-	-	1	-	-	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15106	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 Modelling**	**9**
Turbulence model requirement and types, mixing length model, Two equation (k-Є) models – High and low Reynolds number models, LES, DNS, Mesh Generation and refinement Techniques-software tools, Stability of solver, Courant Fredrick Levy number, relaxation factor, and grid independence test.		
	Total 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	-	-	-	-	-	-	1	-	1	-	-	3
CO2	3	3	3	2	2	-	-	-	-	1	-	1	-	-	3
CO3	3	3	3	2	2	-	-	-	-	1	-	1	-	-	3
CO4	3	3	3	2	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	
22ME15201	**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 opertations • 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, broachingand 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	-	-	1	-	-	-	1	2	3	-
CO2	3	2	2	-	2	-	-	1	-	-	-	1	2	3	-
CO3	3	2	2	-	2	-	-	1	-	-	-	1	2	3	-
CO4	3	2	2	-	2	-	-	1	-	-	-	1	2	3	-
CO5	3	2	2	-	2	-	-	1	-	-	-	1	2	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15202	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	-	1	-	1	-	2	2	3	-
CO2	3	3	2	-	-	2	-	1	-	1	-	2	2	3	-
CO3	3	3	2	-	-	2	-	1	-	1	-	2	2	3	-
CO4	3	3	2	-	-	2	-	1	-	1	-	2	2	3	-
CO5	3	3	2	-	-	2	-	1	-	1	-	2	2	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15203	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	-	-	1	1	-	2	3	2	-
CO2	3	2	3	-	-	2	-	-	1	1	-	2	3	2	-
CO3	3	2	3	-	-	2	-	-	1	1	-	2	3	2	-
CO4	2	2	2	-	-	2	-	-	1	1	-	2	3	2	-
CO5	3	2	3	-	-	2	-	-	1	1	-	2	3	2	-

Course code	Course Name	Hours/week			Credit	Maximum marks
22ME15204	Value Engineering	L	T	P	C	100
		3	0	0	3	

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.

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	-
CO2	3	2	3	-	2	-	-	-	-	-	-	3	3	2	-
CO3	3	2	3	-	2	-	-	-	-	-	-	3	3	2	-
CO4	3	2	3	-	2	-	-	-	-	-	-	3	3	2	-
CO5	3	2	3	-	2	-	-	-	-	-	-	3	3	2	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15205	Optimization Method In Engineering Design	3	0	0	3	100

Objective(s)	• Earn how MSDO can support the product development process of complex, multidisciplinary engineered systems • Learn how to rationalize and quantify a system architecture or product design problem by selecting appropriate objective functions, design parameters and constraints • Subdivide a complex system into smaller disciplinary models, manage their interfaces and reintegrate them into an overall system model

UNIT-I	**Optimization problem formulation**	**9**
Optimization problem formulation: Design variables, constraints, objective function and variable bounds, classification of optimization problems.		
UNIT-II	**Single Variable Optimization Algorithm**	**9**
Single Variable Optimization Algorithm: Bracketing methods (Exhaustive Search Method and Bounding Phase Method) Region Elimination Methods (Fibonacci Search method and Golden Section search method) Gradient based methods (Newton-Raphson method, Bisection Method, Secant Method).		
UNIT-III	**Multivariable Optimization Algorithms**	**9**
Multivariable Optimization Algorithms: Direct search methods (Hooke- Jeeves pattern search method), Gradient based methods (Cauchy's steepest descent method, Newton's method, Marquardt's method).		
UNIT-IV	**Constrained Optimization Algorithms**	**9**
Constrained Optimization Algorithms: Kuhn-Tucker conditions, Penalty function method, Method of multipliers, Cutting plane method, Generalized Reduced Gradient method, Integer programming		
UNIT-V	**Nature Inspired Algorithms**	**9**
Nature Inspired Algorithms: global optima, genetic algorithm, simulated annealing		
	Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Enumerate the necessity of optimization in engineering design. • Identify the various optimization techniques pertaining to design oriented problems. • Solve problems with single and multi – variable. • Formulate constrained optimization problems. • Distinguish between integer and geometric specialized algorithm

TEXT BOOK :

1	Deb, Kalyanmoy, Optimization for Engineering Design, Prentice - Hall, 1995.
2	Rao. S.S., Optimization Theory and Applications, Wiley Eastern Ltd., 1998.

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	-
CO2	3	3	2	-	2	-	-	-	-	2	-	2	3	3	-
CO3	3	3	2	-	2	-	-	-	-	2	-	2	3	3	-
CO4	3	3	2	-	2	-	-	-	-	2	-	2	3	3	-
CO5	3	3	2	-	2	-	-	-	-	2	-	2	3	2	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15206	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
3	Inelastic Analysis of Solids and Structures (Computational Fluid and Solid Mechanics)by M. Kojic and Klaus-Jurgen Bathe 22 October 2010
4	High-Resolution Methods for Incompressible and Low-Speed Flows (Computational Fluid and Solid Mechanics)by D. Drikakis and W. Rider 22 October 2010

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	
22ME15301	Composite Materials and Mechanics	3	0	0	3	100

Objective(s)	• To understand the properties and design of composite materials • To understand the manufacturing methods for composites • To study the behaviour of composite materials • To investigate the failure modes of composite materials. • To understand joining and manufacturing

UNIT-I	**Introduction**	**9**
Definition – Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Fiber surface treatments, Fillers and additives, Fiber content, density and void content.		
UNIT-II	**Manufacturing Methods**	**9**
Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes – Quality Inspection methods. Processing of MMC –diffusion bonding – stir casting – squeeze casting		
UNIT-III	**Mechanical Properties**	**9**
Static Mechanical Properties – Fatigue and Impact Properties – Environmental effects – Long term properties, Fracture Behavior and Damage Tolerance.		
UNIT-IV	**Laminates**	**9**
Rule of mixture -volume and mass fractions – density - void content, Evaluation of four elastic moduli based on strength of materials approach and Semi-Empirical model-Longitudinal Young's modulus-transverse Young's modulus–major Poisson's ratio-In-plane shear modulus, Ultimate strengths of a unidirectional lamina. Characteristics of Fiber-reinforced lamina–laminates–lamination theory, Inter laminar stresses		
UNIT-V	**Joining Methods and Failure Theories**	**9**
Failure Predictions and Repair, Laminate Design Consideration-design criteria-design allowable -design guidelines, Joint design-Bolted and Bonded Joints, Design Examples-Design of a tension member – design of a compression member – design of a beam-design of a torsional member, Application of FEM for design and analysis of laminated composites		
	Total hours	**45**

Outcome(s)	Upon completion of the course, students shall be able to: • Explain various types of composite materials • Explain various methods manufacturing the composite materials • Design and manufacture composite materials for various applications • Conduct mechanical testing of composite structures. • Explain the relevance joining methods and failure theories

TEXT BOOK :

1	Mallick, P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", 3rd Edition Marcel Dekker Inc, 2013. ISBN-13: 9780824777968
2	Autar K. Kaw, "Mechanics of Composite Materials", 2nd Edition, CRC Press, 2006 ISBN: 9780849313431.

REFERENCES:

1	M.R. Piggott, (1998), Load Bearing Fibre Composites, Pergamon press, Oxford.
2	F. Ashby and D.R.H. Jones, (1999), Engineering Materials, Pergamon press
3	R.W. Davidge and A. Kelly, (1999), Mechanical behavior of ceramics, Cambridge university press
4	Ronald Gibson, "Principles of Composite Material Mechanics", 3rd Edition, Tata McGraw Hill, 1994.

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	-	2	3	2	-
CO2	3	3	2	-	2	-	-	-	-	2	-	2	2	3	-
CO3	3	3	2	-	3	-	-	-	-	3	-	3	3	3	-
CO4	3	3	2	-	2	-	-	-	-	2	-	3	2	2	-
CO5	3	3	2	-	2	-	-	-	-	2	-	2	3	2	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15302	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 chartshowing 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	-	-	-	1	-	1	-	1	-	2	2	3	-
CO2	3	2	-	-	-	1	-	1	-	1	-	2	2	3	-
CO3	3	2	-	-	-	1	-	1	-	1	-	2	2	3	-
CO4	3	2	-	-	-	1	-	1	-	1	-	2	2	3	-
CO5	3	2	-	-	-	1	-	1	-	1	-	2	2	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
22ME15303	Manufacturing Guidelines for Product Design	L	T	P	C	100
		3	0	0	3	

Objective(s)	• To understand the manufacturing process and selection of materials • To understand the Roust design and the product design for manual assembly • To understand design guide lines for various process • To understand various assembly process • To understand the design for environment

UNIT-I	**Product Design**	**9**

Basics, Introduction of Manufacturing Processes, Manufacturing Processes : Advantages and Limitations-I, Manufacturing Processes : Advantages and Limitations-II, Process Capabilities: Basics.
Engineering Materials, Properties of Materials, Selection of Materials – I, Selection of Materials – II, Applications of Engineering Material.

UNIT-II	**Robust Design**	**9**

Robust Design, Design for X, Product Design for Manual Assembly, DFMA Guidelines, Ergonomics in Product Design.
Selection of Processes-I, Selection of Processes-II, Process Capabilities, Design Guidelines for Sand Casting, Design Guidelines for Die Casting Process.

UNIT-III	**Product Design Guidelines**	**9**

Compression Molding and Extrusion, Design Guidelines for Extrusion and Injection Molding, Design Guidelines for Sheet Metal Working, Design Guidelines for Machining, Design Guidelines for Powder Metal Processing.

UNIT-IV	**Assembly Processes**	**9**

Introduction, Adhesive Joining: Guidelines, Design Guidelines for Mechanical Fasteners, Design Guidelines for Welding, Design Guidelines: Brazing and Soldering.
Induction Welding: Plastics, Ultrasonic Welding: Plastics, Vibration and Spin Welding: Plastics, Microwave Joining, Hole Making : Guidelines.

UNIT-V	**Design for Environment**	**9**

Design for Environment, Design for Environment: Steps, Product Architecture, Rapid Prototyping, Product Design : Manufacturing Perspective.

Total hours	**45**

Outcome(s)	Upon completion of this course, the Learners will be able to : • Explain the manufacturing process and selection of materials • Discuss the Roust design and the product design for manual assembly • Explain the design guide lines for various process • Explain the various assembly process • Explain the design for environment

REFERENCES:

1	Product Design for Manufacture and Assembly, G. Boothroyd, P. Dewhurst, W. Knight, Marcel Dekker, University of Rhode Island Kingston, New York, USA.
2	Product Design and Development, Karl T. Ulrich, Steven D. Eppinger, McGraw-Hill companies, New York, USA.
3	Design for Manufacturability Handbook, James G. Bralla, McGraw-Hill companies, New York, USA.
4	Manufacturing Processes: Casting, Forming and Welding: H. S. Shan, Cambridge University Press.
5.	http://digimat.in/nptel/courses/video/112107258/L01.html

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	2	-	2	3	3	-
CO2	3	3	2	-	2	-	-	-	1	2	-	2	3	3	-
CO3	3	3	2	-	2	-	-	-	1	2	-	2	3	3	-
CO4	3	3	2	-	2	-	-	-	1	2	-	2	3	3	-
CO5	2	2	2	-	2	-	-	-	1	2	-	2	3	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15304	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.- Magnetorheological 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 –microsensors- 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 Magnetorheological 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	3	3	-	2	2	2	-	-	-	-	2	2	2	2
CO2	3	3	3	-	2	2	2	-	-	-	-	2	2	2	2
CO3	3	3	3	-	2	2	2	-	-	-	-	3	2	2	2
CO4	3	3	3	-	2	2	2	-	-	-	-	3	2	2	2
CO5	3	3	3	-	2	2	2	-	-	-	-	3	3	2	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15305	Non-Destructive Testing	3	0	0	3	100

Objective(s)	• To understand different surface NDE techniques. • To acquire familiarity with Liquid Penetrant 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	Non-Destructive Examination and Quality Control, ASM International, Vol.17, 9th edition (1989)
2	J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition (2011).
3	B. Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3 rd edition (2002).
4	T. Tangachari, J. Prasad, and B.N.S. Murthy, Treatise on non-destructive testing and

	evaluation,Navbharath Enterprises, Vol.3, (1983).
REFERENCES:	
1	C. Hellier, Handbook of Non Destructive Evaluation, McGraw-Hill Professional, 1st edition (2001).
2	J. Thomas Schmidt, K. Skeie and P. Maclntire, ASNT Non Destructive Testing Handbook: Magnetic Particle Testing, American Society for Nondestructive Testing, American Society for Metals, 2nd edition (1989).
3	Practical Non-destructive Testing – Baldev Raj, T. Jayakumar & M. Thavasimuthu, Norosa Publishing House, New Delhi.
4	Treaties on Non-destructive testing, Vol. 1,2 & 3 Edited by Dr. E.G. Krishnadas Nair, NDT Centre, Hal, Bangalore

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	1	1	-	-	-	2	-	3	-
CO2	3	3	-	-	-	1	1	1	-	-	-	2	-	3	-
CO3	3	3	-	-	-	1	1	1	-	-	-	2	-	3	-
CO4	3	3	-	-	-	1	1	1	-	-	-	2	-	3	-
CO5	3	3	-	-	-	1	1	1	-	-	-	2	-	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15306	Additive Manufacturing	3	0	0	3	100

Objective(s)	• To provide comprehensive knowledge of the wide range of additive manufacturing processes, capabilities and materials. • To study the software tools and techniques used for additive manufacturing. • To learn liquid and solid based Additive manufacturing systems and its applications • To understand physical objects that facilitates product development/prototyping requirements • To explain Design and production Bio-Additive Manufacturing

UNIT-I	**Introduction**	**9**
Overview – History - Need-Classification -Additive Manufacturing Technology in product development- Materials for Additive Manufacturing Technology – Tooling - Applications.		
UNIT-II	**CAD & Reverse Engineering**	**9**
Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.		
UNIT-III	**Liquid Based and Solid Based Additive Manufacturing Systems**	9
Classification – Liquid based system – Stereo lithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing		
UNIT-IV	**Powder Based Additive Manufacturing Systems**	
Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, Three Dimensional Printing - Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.		
UNIT-V	**Medical and Bio-Additive Manufacturing**	**9**
Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies		
	Total hours	**45**

Outcome(s)	• Demonstrate appropriate level of understanding on principles of additive manufacturing processes and Choose appropriate materials for additive manufacturing processes • Demonstrate a basic technical understanding of the physical principles, materials, and operation of the types of Additive Manufacturing processes. • demonstrate the ability to identify characteristics of parts that are fabricated by liquid and solid based Additve Manufacturing • To educate students on how to demonstrate on 3D prining Additive Manufacturing and enhance the knowledge in Laser printing. • Use the techniques, skills, and design and fabrication of Bio-Additive manufacturing with case studies. for engineering practice

TEXT BOOK :

1	Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2	Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

REFERENCES:	
1	Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2007.
2	Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
3	Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC

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	-	1	-	-	-	1	-	3	-
CO2	3	3	-	-	-	1	-	1	-	-	-	1	-	3	-
CO3	3	3	-	-	-	1	-	1	-	-	-	1	-	3	-
CO4	3	3	-	-	-	1	-	1	-	-	-	1	-	3	-
CO5	3	3	-	-	-	1	-	1	-	-	-	1	-	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15403	Operation 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 – Basic concepts of artificial variables – Big M and two phase method.

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.
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 to be taught	**45 PERIODS**

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	
22ME15404	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	-	-	-	1	2	1	-	-	-	1	-	3	-
CO2	3	3	-	-	-	1	2	1	-	-	-	1	-	3	-
CO3	3	3	-	-	-	1	2	1	-	-	-	1	-	3	-
CO4	3	3	-	-	-	1	2	1	-	-	-	1	-	3	-
CO5	2	2	-	-	-	1	2	1	-	-	-	1	-	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15405	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 of the 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 to be taught	**45 PERIODS**

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	-	-	-	-	1	1	-	-	1	2	-	3	-
CO2	3	2	-	-	-	-	1	1	-	-	1	2	-	3	-
CO3	3	2	-	-	-	-	1	1	-	-	1	2	-	3	-
CO4	3	2	-	-	-	-	1	1	-	-	1	2	-	3	-
CO5	3	2	-	-	-	-	1	1	-	-	1	2	-	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15406	Industrial Engineering and Management	3	0	0	3	100

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 enhance productivity. • Apply plant layout tools and material handling methods to design efficient manufacturi systems. • Analyze various motivation theories and leadership styles to improve employ performance. • Evaluate different productivity improvement techniques and develop implementation plan • Design wage and incentive schemes using job evaluation and merit rating to optimi 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	-	-	-	1	-	1	1	-	2	2	-	3	-
CO2	3	3	-	-	-	1	-	1	1	-	2	2	-	3	-
CO3	3	3	-	-	-	1	-	1	1	-	2	2	-	2	-
CO4	3	3	-	-	-	1	-	1	1	-	2	2	-	3	-
CO5	3	3	-	-	-	1	-	1	1	-	2	2	-	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15501	Automotive materials, components, design and testing	3	0	0	3	100

Objective(s)	• To study the functional requirements of engine components and suitable materials • To learn to design of cylinder and piston components • To learn to design of connecting rod and crank shaft • To learn to design of flywheel and valve train • To study the Engine Testing cycles, Emission measurement technologies

UNIT-I	**Functional Requirements of Engine Components and Suitable Materials**	**9**
Functional requirements of engine components – Piston, piston pin, cylinder liner, connecting rod, crank shaft, valves, spring, engine block, cylinder head, and flywheel. Suitable materials for engine components.		
UNIT-II	**Design of Cylinder and Piston Components**	**9**
Design of cylinder, cylinder head, piston, piston rings and piston pin – more details in necessary		
UNIT-III	**Design of Connecting Rod and Crank Shaft**	**9**
Design of connecting rod – Shank design – small end design – big end design – bolts design. Design of overhang crank shaft under bending and twisting – Crank pin design – Crank web design – Shaft design.		
UNIT-IV	**Design of Flywheel and Valve Train**	**9**
Design of valve – inlet valve – exhaust valve - Valve springs – tappet – rocker arm. Determination of mass of flywheel for a given coefficient of fluctuation of speed. Design of flywheel - rim - hub - arm.		
UNIT-V	**Engine Testing**	**9**
Engine test cycles – WLTC – WHSC – WHVC – NRTC – ISO 8178. Dynamometer - Chassis dynamometer - transient dynamometer. Emission measurement technologies and instruments - NOX – Smoke – Particulate matter – CO – CO_2 - HC.-Particle counter		
	Total hours	**45**

Outcome(s)	At the end of the course the students would be able to • Discuss the requirements of engine components and select suitable materials. • Apply the concept of design to cylinder and piston components and solve problems. • Apply the concept of design to Connecting rod and crank shaft and solve problems. • Apply the concept of design to flywheel and valve train and solve problems. • Discuss engine test cycles, dynamometer and emission measurement technologies and instruments

TEXT BOOK :

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

REFERENCES:

1	Hiroshima Yamagata, "The science and technology of materials in automotive engines", Woodhead Publishing Limited, Cambridge, England
2	Jain.R.K, "Machine Design", Khanna Publishers, New Delhi, 2005.
3	Manufacturing Automotive Components from Sustainable Natural Fiber Composites (SpringerBriefs in Materials) by Lobna A. Elseify, Mohamad Midani, et al.
4	Mechanical and Materials Engineering of Modern Structure and Component Design (Advanced Structured Materials Book 70) by Andreas Öchsner and Holm Altenbach

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	-	-	-	2	3	-	-
CO2	3	2	2	-	-	1	-	1	-	-	-	2	3	-	-
CO3	3	2	2	-	-	1	-	1	-	-	-	2	3	-	-
CO4	3	2	2	-	-	1	-	1	-	-	-	2	3	-	-
CO5	2	2	2	-	-	1	-	1	-	-	-	3	3	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15502	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	2	-	2	1	-	1	-	-	-	2	-	2	3
CO2	3	2	2	-	2	1	-	1	-	-	-	2	-	2	3
CO3	3	2	2	-	2	1	-	1	-	-	-	2	-	2	3
CO4	3	2	2	-	2	1	-	1	-	-	-	2	-	2	3
CO5	3	2	2	-	2	1	-	1	-	-	-	2	-	2	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15503	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 1 June 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	3	2	-	-	1	-	1	-	-	-	2	-	-	3
CO2	3	3	2	-	-	1	-	1	-	-	-	2	-	-	3
CO3	3	3	2	-	-	1	-	1	-	-	-	2	-	-	3
CO4	3	3	2	-	-	1	-	1	-	-	-	2	-	-	3
CO5	3	3	2	-	-	1	-	1	-	-	-	2	-	-	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15504	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	3	2	-	1	-	-	1	-	-	-	2	3	2	-
CO2	3	3	2	-	1	-	-	1	-	-	-	2	3	2	-
CO3	3	3	2	-	1	-	-	1	-	-	-	2	3	2	-
CO4	3	3	2	-	1	-	-	1	-	-	-	2	3	2	-
CO5	3	3	2	-	1	-	-	1	-	-	-	2	3	2	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15505	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 Modelling 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 modelling and simulation. CFD as a design and research tool, Applications of CFD in mobility engineering		
UNIT-II	**CAD and Rapid Prototyping**	**9**
Curves and Surfaces: Geometric modelling curves and surfaces, Wire frame models, Parametric representations, Parametric curves and surfaces, Solid modelling: Fundamentals of solid modelling, 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 modelling for RP, Surface modelling, 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 Modelling, different turbulent modelling scheme. Incompressible Viscous Flows:, Applications to internal flows and boundary layer flows. Eddy viscosity and non-eddy viscosity models; Vehicle Aerodynamic Simulation Wind tunnel and on-road simulation of vehicles; 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	3	2	-	2	1	-	1	-	-	-	1	3	2	2
CO2	3	3	2	-	2	1	-	1	-	-	-	1	3	2	3
CO3	3	3	2	-	2	1	-	1	-	-	-	1	3	2	2
CO4	3	3	2	-	2	1	-	1	-	-	-	1	3	2	3
CO5	3	3	2	-	2	1	-	1	-	-	-	1	3	3	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15506	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	-	-	2	-	2	1	-	-	1	3	3	3
CO2	3	3	2	-	2	2	-	2	1	-	-	1	3	3	3
CO3	3	3	2	-	2	2	-	2	1	-	-	1	3	3	3
CO4	3	3	2	-	2	2	-	2	1	-	-	1	3	3	3
CO5	3	3	2	-	2	2	-	2	1	-	-	1	3	3	3

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15601	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	3	2	-	2	-	-	1	2	-	-	1	3	2	-
CO2	3	3	2	-	2	-	-	1	2	-	-	1	3	2	-
CO3	3	3	2	-	2	-	-	1	2	-	-	1	3	2	-
CO4	3	3	2	-	2	-	-	1	3	-	-	1	3	2	-
CO5	3	3	2	-	2	-	-	1	2	-	-	1	3	2	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15602	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, ANSI symbols 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 power systems.		
	Total hours	**45** periods

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, Perason Education, 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	-	-	1	-	-	2	3	-	-
CO2	3	2	2	-	-	1	-	-	1	-	-	2	3	-	-
CO3	3	2	2	-	-	1	-	-	1	-	-	2	3	-	-
CO4	3	2	2	-	-	1	-	-	1	-	-	2	3	-	-
CO5	3	2	2	-	-	1	-	-	1	-	-	2	3	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15603	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	2	-	2	1	-	1	-	-	-	2	3	-	-
CO2	3	2	2	-	2	1	-	1	-	-	-	2	3	-	-
CO3	3	2	2	-	2	1	-	1	-	-	-	2	3	-	-
CO4	3	2	2	-	2	1	-	1	-	-	-	2	3	-	-
CO5	3	2	2	-	2	1	-	1	-	-	-	2	3	-	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15604	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	-	1	-	-	-	2	3	2	-
CO2	3	2	2	-	-	1	-	1	-	-	-	2	3	2	-
CO3	3	2	2	-	-	1	-	1	-	-	-	2	3	3	-
CO4	3	2	2	-	-	1	-	1	-	-	-	2	3	3	-
CO5	3	2	2	-	-	1	-	1	-	-	-	2	3	3	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15605	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	1	-	1	-	-	-	1	3	2	-
CO2	3	2	2	-	2	1	-	1	-	-	-	1	3	2	-
CO3	3	2	2	-	2	1	-	1	-	-	-	1	3	2	-
CO4	3	2	2	-	2	1	-	1	-	-	-	1	3	2	-
CO5	3	2	2	-	2	1	-	1	-	-	-	1	3	2	-

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22ME15606	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	-	-	-	1	-	1	-	-	-	2	3	2	-
CO2	3	2	-	-	-	1	-	1	-	-	-	2	3	2	-
CO3	3	2	-	-	-	1	-	1	-	-	-	2	3	2	-
CO4	3	2	-	-	-	1	-	1	-	-	-	2	3	2	-
CO5	3	2	-	-	-	1	-	1	-	-	-	2	3	2	-