JSS MAHAVIDYAPEETHA

JSS SCIENCE & TECHNOLOGY UNIVERSITY,MYSURU

SRI JAYACHAMARAJENDRA COLLEGE OF ENGINEERING, MYSURU

SCHEME I - VIII SEMESTER
&
SYLLABUS FOR I - IV SEMESTER

DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of Teaching and Examination for B.E (Mechanical Engineering)

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SRI JAYACHAMARAJENDRA COLLEGE OF ENGINEERING, MYSURU

DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of Teaching and Examination for B.E (Mechanical Engineering)

Semester	Credits
I	25.0
II	25.0
III	27.0
IV	27.0
V	27.0
VI	27.0
VII	19.0
VIII	23.0
Total	200

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Scheme of Teaching and Examination for BE Mechanical Engineering

SEMESTER: I/II

Sl. No.	Subject Code	Course title	Teaching Department	CREDITS				Contact hours	Marks			Exam duration in hrs
				L	T	P	Total		CIE	SEE	Total	
1	ME110/ ME210	Mechanical Engineering Science	Mechanical	4	0	0	4	4	50	50	100	03
2	ME120/ ME220	Computer Aided Engineering Graphics	Mechanical	2	0	2	4	6	50	50	100	03
3	ME16L/ ME26L	Workshop Practice	Mechanical	0	0	1.5	1.5	3	50	-	50	-
				Total Credits			**9.5**	**13**	**Total Marks**		**250**	

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Scheme of Teaching and Examination

B.E Mechanical Engineering

III Semester

Sl. No.	Course Code	Course Title	Teaching Department	CREDITS				Contact Hours	Marks			Exam duration in Hrs.
				L	T	P	TOTAL		CIE	SEE	TOTAL	
1.	**MA310**	Computational Mathematics	Mathematics	4	0	0	4	4	50	50	100	03
2.	**ME310**	Material Science & Metallurgy	Mechanical	4	0	0	4	4	50	50	100	03
3.	**ME320**	Basic Thermodynamics	Mechanical	4	0	0	4	4	50	50	100	03
4.	**ME330**	Kinematics of Machines	Mechanical	4	0	0	4	4	50	50	100	03
5.	**ME340**	Manufacturing Process – I	Mechanical	4	0	0	4	4	50	50	100	03
6.	**ME350A**	Computer Aided Machine Drawing	Mechanical	2	0	4	4	6	50	50	100	03
	ME350B	Fluid Mechanics		4	0	0		4	50	50		
7.	**ME36L**	Machine shop Practice	Mechanical	0	0	3	1.5	3	50	-	50	-
8.	**ME37L**	Foundry and Forging Laboratory	Mechanical	0	0	3	1.5	3	50	-	50	-
9.	**HU310/ HU410**	Constitution of India and Professional Ethics	Humanities	-	-	-	-	2	50	-	50	-
TOTAL							**27**	**32**	**Total Marks**		**750**	**-**

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Scheme of Teaching and Examination

B.E Mechanical Engineering

IV Semester

Sl. No.	Course Code	Course Title	Teaching Department	CREDITS				Contact Hours	Marks			Exam duration in Hrs.
				L	T	P	TOTAL		CIE	SEE	TOTAL	
1.	**MA410**	Fourier Series, Integral transforms and Applications	Mathematics	3	1	0	4	4	50	50	100	03
2.	**ME410**	Dynamics of Machines	Mechanical	4	0	0	4	4	50	50	100	03
3.	**ME420**	Manufacturing Process –II	Mechanical	4	0	0	4	4	50	50	100	03
4.	**ME430**	Metrology and Measurements	Mechanical	4	0	0	4	4	50	50	100	03
5.	**ME440**	Applied Thermodynamics	Mechanical	4	0	0	4	4	50	50	100	03
6.	**ME450A**	Computer Aided Machine Drawing	Mechanical	2	0	4	4	6	50	50	100	03
	ME450B	Fluid Mechanics		4	0	0		4	50	50		
7.	**ME46L**	Metrology and Measurements Laboratory	Mechanical	0	0	3	1.5	3	50	-	50	-
8.	**ME47L**	Basic Materials Testing Laboratory	Mechanical	0	0	3	1.5	3	50	-	50	-
9.	**HU420/HU320**	Environmental Studies	Environmental	-	-	-	-	2	50	-	50	-
TOTAL							**27**	**32**	**Total Marks**		**750**	-

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SRI JAYACHAMARAJENDRA COLLEGE OF ENGINEERING,MYSURU – 570 006

Scheme of Teaching and Examination

B.E Mechanical Engineering

V Semester

Sl. No.	Course Code	Course Title	Teaching Department	CREDITS				Contact Hours	Marks			Exam duration in Hrs.
				L	T	P	TOTAL		CIE	SEE	TOTAL	
1.	**ME510**	Management and Entrepreneurship	Mechanical	4	0	0	4	4	50	50	100	03
2.	**ME520**	Manufacturing Process –III	Mechanical	4	0	0	4	4	50	50	100	03
3.	**ME530**	Design of Machine Elements-I	Mechanical	4	0	0	4	4	50	50	100	03
4.	**ME540**	Mechatronics	Mechanical	4	0	0	4	4	50	50	100	03
5.	**ME550**	Fluid Machinery	Mechanical	4	0	0	4	4	50	50	100	03
6.	**ME56X**	Elective – I	Mechanical	4	0	0	4	4	50	50	100	03
7.	**ME57L**	Fluid Mechanics Laboratory	Mechanical	0	0	3	1.5	3	50	-	50	-
8.	**ME58L**	Energy Conversion Laboratory	Mechanical	0	0	3	1.5	3	50	-	50	-
TOTAL							**27**	**30**	**Total Marks**		**700**	**-**

LIST OF ELECTIVE I

DESIGN GROUP	
Sub code	**Subject**
ME561D	Theory of Elasticity
ME562D	Engineering System Design
THERMAL GROUP	
ME561T	Power plant Engineering
ME562T	Alternate Fuels
PRODUCTION GROUP	
ME561P	Tool Engineering Design
ME562P	Agile Manufacturing
MANAGEMENT GROUP	
ME561M	Materials Management
ME562M	Professional Communication and Report Writing

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Scheme of Teaching and Examination

B.E Mechanical Engineering

VI Semester

Sl. No.	Course Code	Course Title	Teaching Department	CREDITS				Contact Hours	Marks			Exam duration in Hrs
				L	T	P	TOTAL		CIE	SEE	TOTAL	
1.	**ME610**	Design of Machine Elements -II	Mechanical	4	0	0	4	4	50	50	100	03
2.	**ME620**	Computer Integrated Manufacturing	Mechanical	4	0	0	4	4	50	50	100	03
3.	**ME630**	Heat and Mass Transfer	Mechanical	4	0	0	4	4	50	50	100	03
4.	**ME640**	Engineering Economics	Mechanical	4	0	0	4	4	50	50	100	03
5.	**ME650**	Finite Element Methods	Mechanical	4	0	0	4	4	50	50	100	03
6.	**ME66X**	Elective –II	Mechanical	4	0	0	4	4	50	50	100	03
7.	**ME67L**	Computer Aided Modeling and Analysis Laboratory	Mechanical	0	0	3	1.5	3	50	-	50	-
8.	**ME68L**	Heat & Mass Transfer Laboratory	Mechanical	0	0	3	1.5	3	50	-	50	-
TOTAL							**27**	**30**	**Total Marks**		**700**	**-**

LIST OF ELECTIVE II

DESIGN GROUP	
Sub code	**Subject**
ME661D	Mechanics of Composite Materials
ME662D	Experimental Stress Analysis
THERMAL GROUP	
ME661T	Biomass Energy System
ME662T	Refrigeration and Air- Conditioning
PRODUCTION GROUP	
ME661P	Non Destructive Testing
ME662P	Design for Manufacturing
MANAGEMENT GROUP	
ME661M	Total Quality Management
ME662M	Statistical Quality Control

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SRI JAYACHAMARAJENDRA COLLEGE OF ENGINEERING,MYSURU – 570 006

Scheme of Teaching and Examination

B.E Mechanical Engineering

VII Semester

Sl. No.	Course Code	Course Title	Teaching Department	CREDITS				Contact Hours	Marks			Exam duration in Hrs.
				L	T	P	TOTAL		CIE	SEE	TOTAL	
1	ME710	Mechanical Vibrations	Mechanical	4	0	0	4	4	50	50	100	03
2	ME720	Hydraulics and Pneumatics	Mechanical	4	0	0	4	4	50	50	100	03
3	ME730	Operations Research	Mechanical	4	0	0	4	4	50	50	100	03
4	ME74X	Elective –III	Mechanical	4	0	0	4	4	50	50	100	03
5	ME75L	Computer Integrated Manufacturing Laboratory	Mechanical	0	0	3	1.5	3	50	-	50	-
6	ME76L	Design Laboratory	Mechanical	0	0	3	1.5	3	50	-	50	-
TOTAL							19	22	Total Marks		500	-

LIST OF ELECTIVE III

DESIGN GROUP	
Sub code	**Subject**
ME741D	Computational Fluid Dynamics
ME742D	Design Drawing and Analysis
THERMAL GROUP	
ME741T	Design of Heat Exchangers
ME742T	Non conventional Energy Resources
PRODUCTION GROUP	
ME741P	Industrial Automation and Robotics
ME742P	Additive Manufacturing
MANAGEMENT GROUP	
ME741M	Organizational Behavior
ME742M	Marketing Management and Marketing Research

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Scheme of Teaching and Examination

B.E Mechanical Engineering

VIII Semester

Sl. No.	Course Code	Course Title	Teaching Department	CREDITS				Contact Hours	Marks			Exam duration in Hrs
				L	T	P	TOTAL		CIE	SEE	TOTAL	
1.	**ME810**	Operations Management	Mechanical	4	0	0	4	4	50	50	100	03
2.	**ME820**	Automatic Control Engineering	Mechanical	4	0	0	4	4	50	50	100	03
3.	**ME83X**	Elective –IV	Mechanical	4	0	0	4	4	50	50	100	03
4.	**ME84L**	Project Work	Mechanical	0	0	3	11	-	100	-	100	03
TOTAL							**23**	**12**	**Total Marks**		**400**	**-**

LIST OF ELECTIVE IV

DESIGN GROUP	
Sub code	**Subject**
ME831D	Acoustics and Noise Control
ME832D	Fracture Mechanics
THERMAL GROUP	
ME831T	Internal Combustion Engines
ME832T	Cryogenics
PRODUCTION GROUP	
ME831P	Design of Experiments
ME832P	Product Life Cycle Management
MANAGEMENT GROUP	
ME831M	Project Management
ME832M	Supply Chain Management

Mechanical Engineering Science

Subject Code	**: ME110/210**	**No. of Credits**	**: 4 - 0 - 0**
No. of Lecture Hours / Week	**: 04**	**Exam Hours**	**: 3**
Total No. of Lecture Hours	**: 52**	**Exam Marks**	**: 100**

COURSE OBJECTIVES:

1. To explain the role of Mechanical Engineering and relate it to other fields of engineering and distinguish different forms of energy.

2. To classify and explain the working of Internal Combustion (IC) engines and calculate the performance parameters.

3. To demonstrate the principle and application of Refrigeration and Air Conditioning and recognize and practice the various metal joining processes. To identify and recognize the various engineering materials and select right material for the right application.

4. To classify, demonstrate and compare the power transmission elements and recognize the importance of lubrication.

5. To demonstrate and illustrate the working of some machine tools and explain their operations.

COURSE CONTENT

Unit – I

Energy Sources, Steam Formation, Steam Properties and Boilers: Sources and Classification of Energy Resources. Non-renewable and renewable energy resources, Brief Description and Utilization of Solar Energy, Wind Energy, Tidal Energy and Nuclear Energy. **Bio Fuels :** introduction to bio fuels, examples of various biofuels used in engineering applications, Comparison of biofuels with petroleum fuels in terms of calorific value and emission.

Steam Formation: Types of Steam, Steam Properties – Specific Volume, Enthalpy, External Work of Evaporation and Internal Energy (No Numerical Problems).

Boilers, Classification, Construction and Working of Lancashire Boiler and Babcock and Wilcox Boiler. Boiler Mountings and Accessories (No sketches for mountings and accessories) **10 Hours**

Unit - II

Steam turbines – Classification, Principle of Operation and Working of Impulse and Reaction Type Steam Turbines. Delaval's turbine & Parson's turbine (No compounding of turbines).
Gas turbines – Classification, Working Principles and Operations of Open Cycle and Closed Cycle Gas Turbines.
Water turbines –Classification, Principles and Working of Pelton wheel, Francis turbine and Kaplan turbine
Internal Combustion Engines: Classification, Two and Four Stroke Petrol and Diesel Engines. P-V Diagrams of Otto and Diesel Cycles. Comparison of Petrol and Diesel Engines. Comparison of Two and Four Stroke Engines. Advantages and Disadvantages Two and Four Stroke Engines. Simple Problems on Indicated Power, Brake Power, Mechanical Efficiency, Indicated Thermal Efficiency and Brake Thermal Efficiency. **10 Hours**

Unit – III

Refrigeration, Air conditioning, Joining Processes and Engineering materials:

Refrigeration and Air conditioning: Refrigerants, Properties of Refrigerants, List of Commonly Used Refrigerants. Refrigeration - Definitions - Refrigerating Effect, Ton of Refrigeration, Ice Making Capacity, COP, Relative COP, Unit of Refrigeration. Principle, Working and Comparison of Vapor Compression Refrigeration and Vapor Absorption Refrigeration System. Definition of Air conditioning, Principle, Working and Applications of Room Air Conditioners.

Joining Processes: Soldering, Brazing and welding
Definition of Welding, Soldering and Brazing and their Difference. Principle and Working of Arc Welding and Gas Welding (Oxy-Acetylene Welding). Types Flames and their uses in Gas Welding.

Engineering Materials: Types and application **of** Ferrous Materials and Non-Ferrous materials. 10 **Hours**

Unit – IV

Power Transmission, Lubrication and Bearings
Power Transmission: Belt Drives - Classification and applications. Definitions - Velocity Ratio, Creep and Slip. Working of Open and Crossed belt drive. Application of V-Belt and Flat Belt. (No Numerical Problems),

Gears:- Definitions, Terminology, Types of Gear Drives, Spur, Helical, Bevel, Worm and Worm Wheel and Rack and Pinion and their uses. Gear Trains, Simple and Compound Gear Trains. (No Numerical Problems).

Lubrication and Bearings: Lubricants - Classification and Properties. Lubricators - types of Lubricators, Wick and Splash Lubricators. Classification of Bearings. Pedestal Bearing, Ball and Roller Bearings and their uses. **10 Hours**

Unit - V

Machine Tools and Automation:

Lathe: Principle of Working of a Centre Lathe. Operations on Lathe - Turning, Facing, Knurling, Thread Cutting, Drilling, Taper turning by Tailstock Offset Method and Compound rest Swiveling Method.

Drilling Machine: Principle of Working of a Drilling Machine. Bench Drilling Machine and Radial Drilling Machine. Operations on Drilling Machine -Drilling, Boring, Reaming, Tapping, Counter Sinking, Counter Boring and Spot Facing.

Automation and Robotics

Automation :Definition, types –Fixed, Programmable & Flexible automation, NC/ CNC machines: Basic elements with simple block diagrams, advantages and disadvantages Robotics - Definition of Robot, applications, advantages and disadvantages of robots, Configuration of robot.

12 Hours

Text Books:

1. Elements of Mechanical Engineering - Kestoor Praveen, Ramesh M R: Interline Publishing House

Reference Books:

1. Elements of Mechanical Engineering - Hajra Choudhury & others, Media Promoters 2010

2. Elements of Mechanical Engineering Sciences – Dr. K.V.A. Balaji & K. Ramasastry, Sanguine Publications 2006.

3. The Elements of Workshop Technology - Vol I & II, S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, 11th edition 2001 others, Media Promoters and Publishers, Mumbai.

4. A Text Book of Elements of Mechanical Engineering – K.R. Gopalkrishna, Subhash Publishers, Bangalore.

Course Outcomes:
At the end of the course students should be able to:

CO1: Define, differentiate and illustrate different sources of energy and explain the methods of harnessing them. Explain the process of steam to formation by defining the types of steam and classify the steam boilers.

CO2: Distinguish prime movers and classify them based on their working fluids. Classify and explain the internal combustion engines and calculate the performance parameters. (IP, BP, FP, ME, ITE and BTE).

CO3: Demonstrate the Principle and application of Refrigeration and Air-conditioning. Recognize and practice the various metal joining processes. Identify and recognize the various engineering materials and determine the choice of right material for the right application.

CO4: Classify, demonstrate and compare the power transmission elements including belt drives, chain drives, gear drives etc., recognize the importance of lubrication and classify different types of lubricators. Describe and classify bearings and identify their application.

CO5: Demonstrate and illustrate the working of various machine tools like, lathe and drilling machine and explain the various operations performed on these machines. Describe automation and classify them. Classify and explain configuration of the robots and application of robots.

COMPUTER AIDED ENGINEERING GRAPHICS

Subject Code	**ME120/220**	**No. of Credits**	**2 - 0 - 2**
No. of Lecture Hours / Week	**02 + 04**	**Exam Hours**	**3**
Total No. of Contact Hours	**26 + 52**	**Exam Marks**	**100**

Course Objectives:

1. To apply the knowledge of using solid edge software effectively and to apply and interpret the concept of distances of points from reference planes like VP, HP and LPP/RPP and create 2D drawing.
2. To apply and interpret the concept of True length (TL) and True inclinations (TI), Apparent Length (AL) and Apparent Inclinations (AI) with reference planes.
3. To apply and interpret the concept of True shape (TS) of two dimensional objects (Plane Surfaces).
4. To interpret and analyze the drawings of 3D objects and draw/create the developments of cut or non-cut objects.
5. To apply, interpret, analyze and synthesize pictorial drawings (isometric view and perspective).

Course Content

UNIT-1

Introduction: Drawing Instruments and their uses, BIS conventions, Lettering, dimensioning computer screen, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D / 3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line conventions, material conventions and lettering.

Orthographic Projections: Introduction-quadrants, planes of projection, reference line. Projection of points located in all the four quadrants. Front view, top view and side view.

Projections of straight Lines: (Located in first quadrant only) Introduction-true length, apparent length true inclination and apparent inclination. Line inclined to both HP and VP.

18 Hrs

UNIT-2

Projections of plane surfaces Introduction- projection of plane surfaces – triangle, square, rectangle, pentagon, hexagon and circle. Planes in different positions by change of position method only (No problems on Punched holes and composite plates). **12 Hrs**

UNIT-3

Projections of Solids: Projection of right regular triangular, square, rectangular pentagonal, hexagonal prisms and pyramids, cylinders and cones, tetrahedron and hexahedron (cube) in different positions when solid rests on HP and axis inclined to both HP and VP.

18 Hrs

UNIT-4

Development of Surfaces: Introduction to sections of solids**,** Development of lateral surfaces of right regular prisms, pyramids, cylinder and cones, tetrahedron and hexahedron (Cube) resting with its base completely on HP and their frustums and truncations. **12 Hrs**

UNIT-5

Isometric Projections: Introduction: Isometric projection, Isometric view or drawing and Isometric Scale. Isometric projection of simple plane figures & solids.

Perspective Projection: Principle of perspective projection, definition of perspective elements, station point, picture plane, methods, visual ray method and vanishing point method. **(Only for Civil/CTM/Mech/IP)**

18 Hrs

Text Books:

1. Engineering Drawing, N D Bhatt & V M Panchal, 48th edition, 2005-Charotar Publishing House, Gujarat.
2. Engineering Graphics, K R Gopala krishna, 32nd Edition, 2005, Subash Publishers Bangalore.

Reference Book:

1. Fundamentals of Engineering Drawing with an introduction to Interactive. Computer Graphics for Design and production-Luzadder Warren J Duff John M Eastern Economy Edition, 2005- Prentice-Hall of India Pvt. Ltd., New Delhi.

Course Outcomes:

At the end of this course the student shall have the abilities to:

CO1	Apply the knowledge of using solid edge software effectively. Apply and interpret the concept of distances of objects from reference planes, True length (TL), True inclinations (TI), Apparent Length (AL), Apparent Inclinations (AI) and create 2D drawing.
CO2	Apply and interpret the concept of True shape (TS) of two dimensional objects (Plane Surfaces).
CO3	Interpret, analyze and read drawings of 3D objects.
CO4	Interpret cut or non- cut of 3D objects and draw/create the developments of cut or non-cut objects.
CO5	Apply, interpret, analyze and synthesize pictorial drawings (isometric view / perspective).

WORKSHOP PRACTICE

Subject Code	ME16L/ME26L	No. of Credits	0 - 0 – 1.5
No. of Practice Hours / Week	3	Exam Hours	--
Total No. of Contact Hours	39	CIE	50

Course objectives:

1. To identify tools, work material and measuring instruments useful for fitting, welding, carpentry and plumbing practice.
2. To handle tools and instruments and use them to prepare joints of specific shape and size.

Course Content

Practice sessions: **06 Hrs**
Identification of tools and equipments for bench work-practice, safety practice and general guidelines.

Fitting Practice: **03 Hrs**
Demonstration, usage of tools, finishing and sizing MS-flats.

Model-1 **03Hrs**
Cutting and Filing.
Filing, Measurement and Finishing. **03 Hrs**

Welding Practice: **03 Hrs**
Demonstration of tools and equipment for welding, safety practices and general guidelines.

Model-2 **03 Hrs**
Lap and Butt Joints.

Carpentry Practice: **03 Hrs**
Demonstration of power tools and equipment for carpentry, safety practices and general guidelines.

Model-3 **03 Hrs**
Cutting, Plaining and Sizing.
Measurement And Finishing. **03 Hrs**

Plumbing Practice : **06 Hrs**
Demonstration – plumbing tools, symbols and joints.

Model–4 **03 Hrs**
Joining GI pipes by threading, PVC pipes by gluing and cementing.

Text Books:

1. Elements of Mechanical Engineering - Hajra Choudhury & others, Media Promoters 2010.
2. The Elements of Workshop Technology - Vol I & II, S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, 11th edition 2001 others, Media Promoters and Publishers, Mumbai.

Reference Book:

1. Workshop manual prepared by Department of Mechanical Engineering.

Course outcomes:

At the end of the course students shall have the abilities:

CO1	To select suitable tools and equipment to prepare joints using bench-work tools.
CO2	To produce joints using materials of specific shape and size by a suitable set of operations and check the accuracy of shape and dimensions using instruments.

Computational Mathematics

III / IV / V Semester B.E.

MA310 Contact Hrs.: 4/Week

Credits: 4-0-0 Total Hrs.: 48 hours

Course Objective: Computational techniques will be introduced in different topics like algebra, calculus, linear algebra. (Examples will be taken keeping the branch for which the course is taught in view.)

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1. Number representation on the computer – floating point arithmetic; machine precision and errors – truncation errors and round-off errors; random number generation. **8**hrs

2. Curve fitting – Newton / Lagrange interpolation techniques, difference formulas, Bezier curves **8**hrs

3. Root finding – bisection method, method of false-position, Newton-Raphson's method, hybird method and roots of polynomials. **8**hrs

4. **Linear system of equations**: Eigen values and eigenvectors; Cayley-Hamilton theorem and applications; LU-factorisation, Gauss-Jordan elimination, Gaussian elimination; iterative methods, Jacobi's method, Gauss-Seidel method; eigen values by power method; finding inverses of matrices; application to search engines and image processing. **12**hrs

5. **Numerical differentiation and integration:** computing first and second derivatives, Richardson extrapolation; Newton-Cotes integration formulas, Trapezoidal rules, Simpson's rules; Gauss quadrature; Romberg integration; numerical methods of solving differential equations. **12**hrs

References:

1. *Applied Numerical Methods for Engineers*, Schilling and Harris
2. *Advanced Engineering Mathematics*, Kreyzig (9^{th} Edition)

Course Outcomes: Students will be able to:

1. Understand how machine computation is done and the error analysis arising out of this;
2. Interpolate the given data using appropriate techniques;
3. Obtain values of various functions arising out of engineering problems using appropriate techniques;
4. Handle matrix computations that come up in linear algebra like accurate / approximate solutions of systems of linear equations, eigen values, eigen vectors, inverses, etc.;
5. Make differential and integral calculus related computations to determine physical quantities like area, volume, velocity, acceleration, etc., and numerically solve differential equations;

MATERIAL SCIENCE & METALLURGY

Subject Code	**: ME310**	**No. of Credits**	**: 4-0-0**
No. of Lecture Hours / Week	**: 04**	**Exam Hours**	**: 3**
Total No. of Contact Hours	**: 52**	**Exam Marks**	**: 100**

COURSE OBJECTIVES:

1. **To understand the importance of materials in engineering systems and design and the scope for the applications.**
2. **To learn importance of solid solutions and also the rules for solidification and the factors which affect the process of solidification**
3. **To understand the methods of obtaining equilibrium diagrams or phase diagrams for binary ferrous and non-ferrous alloys.**
4. **To evaluate various heat treatment processes for ferrous and non-ferrous alloys.**
5. **To have basic knowledge of advanced materials and composites and non-conventional powder metallurgy process and basic information on Micro and Nano materials used in the new technology fields.**

COURSE CONTENT

UNIT – 1

Crystal Structure: Classification of Materials, crystalline and amorphous materials, aggregates. Coordination number and atomic packing factors for various types of crystal structures, crystal imperfections – point, line, surface and volume imperfections. Electron defect, Atomic diffusion: Phenomenon, Fick's laws of diffusion, factors affecting diffusion. Kirkendall effect. **10 Hours**

UNIT – 2

Deformation of Materials: Plastic deformation in metals, Types of fracture brittle and ductile fracture, Creep stages of creep, Stress Strain diagram for ferrous and non-ferrous alloys, Properties, stress concentration and relaxation. Fatigue, Types of fatigue loading with example, Mechanism of fatigue, fatigue properties, Fatigue testing and SN diagram. **10 Hours**

UNIT – 3

Solidification: Mechanism of solidification, Homogenous and Heterogeneous nucleation, Phase diagram: Solid solutions Hume-Rothary rules, Types of Solid solutions-substitutional, and interstitial solid, intermediate phases, Gibbs phase rule, construction of equilibrium diagrams, equilibrium diagrams involving different solubility, lever rule, Crystal growth – dendritic structure, Cast metal structures-zones of formation, growth of single crystal and application of single crystals.

Iron Carbon Diagram: Iron carbon equilibrium diagram description of phases, Solidification of steels and cast irons, invariant reactions. TTT curves, Continuous cooling curves. **10 Hours**

UNIT – 4

Heat Treatment of Metals: Purpose of Heat Treatment, Classification of Heat treatment processes based on body or surface treatments, Study of Heat treatment Processes: Annealing, Normalizing, Hardening and Tempering. Surface Hardening methods like Carburizing, Cyaniding, Nitriding, Phosphating, Induction and flame hardening. Applications in mechanical engineering parts. **10 Hours**

UNIT – 5

Advanced Materials: Composite materials – definition, need for composites, Classification of matrix materials & materials for reinforcements, fundamentals of production of FRPs and MMCs, advantages and application of composites, Fundamentals of production of FRP like Filament winding, and MMC like Squeeze casting, Pultrusion Techniques, Metal Injection Moulding. Introduction to Micro and Nano materials Application of Nano materials in - electronics, energy, automobiles, textile, sports, domestic appliances, bio-technology, polymer technology, medicine, space and defence. Introduction to powder metallurgy, process and application, merits and demerits. **12 Hours**

TEXT BOOKS:

1. **Materials Science and Engineering** by V. Raghavan, PHI, 5th Edition, 2006.
2. **Materials Science and Engineering** by William D. Callister Jr., John Wiley & Sons. Inc. 7th Edition, 2010.
3. **Material Science & Metallurgy For Engineers**, Dr. V.D. Kodgire& S. V. Kodgire, Everest Publication

REFERENCE BOOKS:

1. **Elements of Materials Science and Engineering** by H. Van Vlack, Addison –Wesley Edition., 5th Edition 2006.
2. **Foundations of Materials Science and Engineering** by Smith, 3rd Edition McGraw Hill, 2003.
3. **Structure and Properties of Engineering Materials** by Murthy, Tata McGraw Hill, 2003.
4. **The Science and Engineering of Materials**, Donald R. Askland and Pradeep.P. Phule, Cengage Learning, 4th Ed., 2003.
5. **Smart Materials and Structures** - M. V. Gandhi and B. So Thompson - Chapman & Hall, London; New York - 1992 (ISBN: 0412370107).

COURSE OUT COMES:

Upon completion of this course, students should be able to:

CO1 **Describe various aspects of crystal structures, with emphasis on defects in materials and their impact on engineering applications.**

CO2 **Classify and Comprehend various material testing concepts and draw and correlate different methods of deformation of materials and related failures in ferrous and non–ferrous materials.**

CO3 **Solve problems on equilibrium diagrams and analyze the process of solidification and illustrate different equilibrium diagrams for ferrous and non-ferrous alloys with a special focus on binary systems.**

CO4 **Study and evaluate the importance of heat treatment, analyze various phases in different methods attached to heat treatment processes and draw various heat treatment related diagrams.**

CO5 **Classify, analyze various composites and identify various applications of Nano-materials for mechanical engineering to develop new products.**

BASIC THERMODYANMICS

Subject Code	**: ME320**	**No. of Credits**	**: 4-0-0**
No. of Lecture Hours / Week	**: 04**	**Exam Hours**	**: 3**
Total No. of Contact Hours	**: 52**	**Exam Marks**	**: 100**

COURSE OBJECTIVES:

1. **To apply concepts of TD and Zeroth Law in solving numerical problems with relevant units.**
2. **To analyze and evaluate different forms work, heat and other properties by applying 1st Law of TD.**
3. **To evaluate COP, EER, Efficiency and entropy by applying second law of TD and its corollaries.**
4. **To explain pure substance with various diagrams, explain with sketches different calorimeters and to solve numerical problems using steam tables or fundamental equations.**
5. **To apply ideal and real gases laws in solving related numerical problems for various conditions.**

COURSE CONTENT

UNIT – 1

Fundamental Concepts & Definitions: Application of thermodynamics: microscopic and macroscopic approach, some basic definitions thermodynamics systems, processes, cycle, properties, state and equilibrium, Zeroth law of thermodynamics, Temperature; concepts, scales, international fixed points and measurement of temperature and related numerical examples.

10 Hours

UNIT – 2

Work and Heat; Mechanics concept of work and its limitations. TD concepts of work and heat, sign convention, expressions for displacement work in various TD processes through P-V diagrams, other types of works.

First Law of Thermodynamics for closed systems, work and heat during cyclic and non-cyclic processes. Specific heats, internal energy and enthalpy for ideal gases. **The first law for open systems.** The steady flow energy equation and its important application. PMM-I and related numerical examples. **12 Hours**

UNIT – 3

Second Law of Thermodynamics: Limitations of the first law of Thermodynamics - Thermal energy reservoirs, Heat engine and efficiency, Refrigerator and Heat pump and COP, The Carnot heat engines, statements of the second law of thermodynamics. Reversibility, causes of irreversibility. Thermodynamic Temperature Scale, Clausius inequality, Definition of entropy, entropy change in various processes and related numerical example. **10Hours**

UNIT – 4

Pure Substances: Definition of pure substance, P-T and P-V diagrams, triple point and critical points, concept and determination of dryness fraction and its measurement using throttling calorimeter and separating and throttling calorimeter, Thermodynamics properties of steam, Steam table and its use, related numerical examples. **10Hours**

UNIT – 5

Ideal gases: Ideal gas mixtures, Daltons law of partial pressures, Amagat's law of additive volumes, evaluation of properties of perfect and ideal gases and related numerical examples.

Real gases –Van-der Waal's Equation of state, Van-der Waal's constants in terms of critical properties, Beattie-Bridgeman equation, Law of corresponding states, compressibility factor; compressibility chart. Difference between Ideal and real gases. **10 Hours**

TEXT BOOKS:

1. **Basic and Applied Thermodynamics,**P.K.Nag, 2nd Ed., Tata McGraw Hill Pub. 2002.
2. **Thermodynamics, An Engineering Approach**, YunusA.Cengel and Michael A.Boles, Tata McGraw Hill publications, 2002.
3. **Thermal Science and Engineering**, D.S. Kumar, S.K. Kataria& Sons,2013

REFERENCE BOOKS:

1. **Engineering Thermodynamics,** R.K.Rajput, 4th Edition, Laxmi Publications.
2. **Fundamentals of Classical Thermodynamics,** G.J.VanWylen and R.E.Sonntag, Wiley Eastern.
3. **An Introduction to Thermodynamics**, Y.V.C. Rao, Wiley Eastern, 1993.
4. **Basic Thermodynamics**, B.K Venkanna, Swati B. V, PHI, New Delhi, 2010.

COURSE OUT COMES:

Upon completion of this course, students should be able to:

CO1 **Apply concepts of TD and Zeroth Law in solving numerical problems with relevant units.**

CO2 **Analyze and evaluate different forms work, heat and other properties by applying 1st Law of TD.**

CO3 **Evaluate COP, EER,Efficiency, temperature and entropy by applying second law of TD and its corollaries.**

CO4 **Illustrate problem solving procedure related to pure substances using PT, PV, TH diagrams.**

CO5 **Apply ideal and real gases laws in solving related numerical problems for various conditions.**

KINEMATICS OF MACHINES

Subject Code	**: ME330**	**No. of Credits**	**: 4 - 0 - 0**
No. of Lecture Hours / Week	**: 04**	**Exam Hours**	**: 3**
Total No. of Lecture Hours	**: 52**	**Exam Marks**	**: 100**

COURSE OBJECTIVES

1. **To provide basic concept of kinematics and kinetics of machine elements.**
2. **Ability to analyze and interpret data of degree of freedom and degree of movability of mechanisms.**
3. **To study how velocity and acceleration of linkages changes with the position with reference to change position of points by different methods.**
4. **To study basics of power transmission and different types of gears.**
5. **To study about different types of cams & followers by their working, design, construction of cam profile for different motion of the follower.**

COURSECONTENT

UNIT – 1

Introduction: Definitions motion, types of motions, Link or element, kinematic pairs, kinematic chain, Types of kinematic chain, Degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Structure, Inversion, Machine.

Kinematic Chains and Inversions: Inversions of Four bar chain; Single slider crank chain and Double slider crank chain. **Mechanisms:** Quick return motion mechanisms- Whitworth mechanism and Crank and slotted lever Mechanism. Straight line motion mechanisms Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms -Geneva wheel mechanism and Ratchet and Pawl mechanism. Toggle mechanism, Pantograph, Ackerman steering gear mechanism. **10 Hours**

UNIT – 2

Velocity and Acceleration Analysis of Mechanisms (Graphical Methods) Velocity and acceleration analysis of Four Bar mechanism, slider crank mechanism and Simple Mechanisms by vector polygons: Relative velocity and acceleration of particles in a common link, relative velocity and accelerations of coincident Particles on separate links- Coriolis component of acceleration. Angular velocity and angular acceleration of links. **10 Hours**

UNIT – 3

Klein's Construction: Analysis of velocity and acceleration of single slider crank mechanism. **Velocity Analysis by Instantaneous Center Method:** Definition, Kennedy's Theorem, determination of linear and angular velocity using instantaneous center method of four bar chain and single slider crank mechanism. **Velocity and Acceleration Analysis of Mechanisms (Analytical Method):** Analysis of four bar chain and slider crank chain using analytical expressions. (Use of complex algebra and vector algebra) **10Hours**

UNIT – 4

Spur Gears: Gear terminology, law of gearing, Characteristics of involute action, Path of contact. Arc of contact, Contact ratio of spur, helical, bevel and worm gears, Interference in involute gears. Methods of avoiding interference, Back lash. Comparison of involute and cycloidal teeth. **Gear Trains**: Simple gear trains, Compound gear trains for large speed. Revered and Epicyclic gear trains. Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains. Torque calculations in epicyclic gear trains.

12 Hours

UNIT – 5

Cams: Types of cams, Types of followers. Displacement, Velocity and, Acceleration time curves for cam profiles. Disc cam with reciprocating follower having knife-edge, roller and flat-face follower, Disc cam with oscillating roller follower. Follower motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion.

10 Hours

TEXT BOOKS:

1. "**Theory of Machines**", Rattan S.S, Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 3rd edition -2009.
2. "**Theory of Machines**", Sadhu Singh, Pearson Education (Singapore) Pvt. Ltd, Indian Branch New Delhi, 2nd Edi. 2006.

REFERENCE BOOKS:

1. "**Theory of Machines & Mechanisms**", J.J. Uicker, G.R. Pennock, J.E. Shigley. OXFORD 3rd Edition. 2009.
2. **Mechanism and Machine theory**, Ambekar, PHI, 2007.

COURSEOUTCOMES

Upon completion of this course, students should be able to:

CO1 **Illustrate various elements and components of mechanisms to provide specific motion.**

CO2 **Draw velocity and acceleration diagrams of various mechanisms by graphical method.**

CO3 **Draw velocity and acceleration diagrams of various mechanisms by Klein's, Instantaneous center and analytical method.**

CO4 **Select and analyze appropriate gear and power transmission in mechanisms.**

CO5 **Construct and analyze CAM profile for the specific follower motion.**

MANUFACTURING PROCESSES-I

Subject Code	**: ME340**	**No. of Credits**	**: 4 -0 -0**
No. of Lecture Hours / Week	**: 04**	**Exam Hours**	**: 3**
Total No. of Contact Hours	**: 52**	**Exam Marks**	**: 100**

COURSE OBJECTIVES:

1. **To define various terms associated with casting processes.**
2. **To explain methods of construction of moulds.**
3. **To introduce the types and working principle of furnaces.**
4. **To examine the principles associated with basic operations involving welding, soldering and brazing.**
5. **To appreciate the importance of non-destructive testing.**

COURSE CONTENT

UNIT– 1

Metal casting and Sand Moulding:

Concept of manufacturing process, its importance, introduction to casting process, steps involved. Varieties of components produced by casting process. Advantages & limitations of casting process. Types of sand, requirements of sand. Moulding sand mixture, ingredients for different sand mixtures. Methods used for sand moulding, such as Green sand, dry sand and skin dried moulds. **Patterns:** Definition, functions, materials for patterns, various allowances and their importance. Classification of patterns, BIS color coding of patterns. **Binder**: Definition, types of binder used in molding sand. **Additives**: Need, types of additives used and their properties. **Cores**:Definition, need, types. Methods of making cores, binders used, Core sand moulding. **Gating &Risers:** Principle and types. Casting defects, Causes, features and remedies.

12 Hours

UNIT– 2

Special moulding Process and Furnaces:

Moulding machines: Jolt type, Squeeze type, Jolt & Squeeze type and Sand slinger.

Process: Study of important moulding processes, No bake moulds, Flask-less moulds, Sweep moulding, CO_2 moulding, Shell moulding, Investment moulding.

Metal moulds: Gravity die-casting, Pressure die casting, Centrifugal casting, Squeeze Casting, Slush casting, and Continuous Casting Processes.

Classification of furnaces: Constructional features & working principle of coke fired, oil fired and gas fired pit furnace, Resistance furnace, Coreless induction furnace, Electric arc furnace and Cupola furnace. **12 Hours**

UNIT– 3

Welding process:
Definition, principles, classification, applications, advantages & limitations of welding.
Arc Welding: Principle, Metal Arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG), Submerged Arc Welding (SAW) and Atomic Hydrogen Welding processes (AHW). **Gas Welding:** Principle, Oxy – Acetylene welding, Chemical Reaction in Gas welding, Flame characteristics. Gas torch construction & working. Forward and backward welding.

Resistance welding - principles, Seam welding, Butt welding, Spot welding and Projection welding. **10 Hours**

UNIT– 4

Metallurgical aspects in welding:
Friction welding, Explosive welding, Thermit welding, Laser welding and Electron beam welding.Structure of welds, formation of different zones during welding. Heat affected zone. Parameters influencing heat affected zone. Effect of carbon content on structure and properties of steel.Shrinkage in welds & residual stresses. Electrodes, filler rod and fluxes. Welding defects – Detection, causes & remedy. **10 Hours**

UNIT– 5

Principles of soldering & brazing:
Mechanism, different types of soldering & brazing methods.
Inspection Methods – Methods used for inspection of castings and welded joints. Visual, Magnetic particle, Fluorescent, Ultrasonic, Radiography, Eddy current, Holography methods of inspection. **08 Hours**

TEXT BOOKS:

1. **Manufacturing Process-I,** Dr.K.Radhakrishna, Sapna Book House, 5th Revised.

REFERENCE BOOKS:

1. **Manufacturing & Technology:** Foundry Forming and Welding", P.N.Rao, 3rd Ed., Tata McGraw Hill, 2009.
2. **Process and Materials of Manufacturing", Roy A Lindberg, 4th Ed.PearsonEdu. 2006.**
3. **Manufacturing Technology,** Serope Kalpakjian, Steuen. R. Sechmid, Pearson Education Asia, 5th Ed. 2006.
4. **Principles of Metal Casting**, Heine, Rosenthal & others – TMH2001.

COURSE OUTCOMES:

Upon completion of this course, students should be able to:

CO1 **Describe the fundamentals of foundry and identify different types of pattern, gating systems and core making.**

CO2 **Explain basic concepts used in construction of moulds and analyze the working of various moulding machines and melting furnaces.**

CO3 **Select the appropriate welding process depending on the type of joint required to produce the desired product.**

CO4 **Recognize modern joining processes with their applications and explain core concept of Metallurgical factors affecting welding.**

CO5 **Discuss the fundamentals of soldering and brazing and realize the significance of Non-Destructive Testing's (NDT's).**

COMPUTER AIDED MACHINE DRAWING

Subject Code	**: ME350A/ME450A**	**No. of Credits**	**: 2 -0 -4**
No. of Lecture Hours / Week	**: 02 + 04**	**Exam Hours**	**: 3**
Total No. of Contact Hours	**: 26 + 52**	**Exam Marks**	**: 100**

COURSE OBJECTIVES:

1. **To apply general projection principles and draw sectional views of different solids with an emphasis and to analyze three-dimensional objects and draw two-dimensional views.**
2. **To draw various thread forms, different types of fasteners and their locking arrangements.**
3. **To draw various types of Keys, Cotters, Knuckle and Riveted joints.**
4. **To draw principal views of couplings and various components and assemble using Computer Aided Drafting (CAD).**
5. **To create3-D geometric models of machine parts including assemblies and generate 2-D production drawings.**

COURSE CONTENT

UNIT– 1

Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on axis inclinations ,spheres and hollow solids).True shape of sections.

Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine parts with and without section.(Bureau of Indian Standards conventions are to be followed for the drawings) line and material conventions.

12 Hours

UNIT– 2

Thread Forms: Thread terminology, sectional views of threads.ISO Metric(Internal & External) BSW, square, ACME and Sellers thread(American Standard thread).

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly)stud bolts with nut, wingnut, locknut. Flanged nut,slotted nut,taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.

12 Hours

UNIT– 3

Keys& Joints: Parallel key, Taper key, Feather key, Gibhead key and Woodruff key.

Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets).Cotter joint (socket and spigot),knuckle joint(pin joint) for two rods.

12Hours

UNIT– 4

Couplings: Split Muff coupling, Protected and unprotected type flanged coupling, pin(bush) type flexible coupling, Oldham's coupling and universal coupling(Hook's Joint).

12 Hours

UNIT– 5

3 D Assembly Drawings (Part drawings should be given)

1. Plummer block (Pedestal Bearing).
2. Screw jack (Bottle type).
3. Machine vice(Simple).

15 Hours

2 D Assembly Drawings (Part drawings should be given)

1. Tool Head of a shaper.
2. I C Engine connecting rod.
3. Tail stock of lathe.

15 Hours

TEXT BOOKS:

1. **Machine Drawing**, K.R.Gopalakrishna, Subhash Publications 5th Edition,2003.
2. **Machine Drawing**, K L Narayanan, PKannaiah, Venkatashiva Reddy, New age international publisher, 3rd Edition 2006.

REFERENCE BOOKS:

1. **Machine Drawing**, N. Siddeshwar, P. Kanniah, V.V.S.Sastri, Tata McGrawHill, 2006.
2. **Machine Drawing with Auto CAD**, Goutam Pohit & Goutham Ghosh, 1stIndianprintPearsonEducation, 2005.

COURSE OUTCOMES:

At the end of the course the students shall have the abilities to:

CO1 **Read engineering drawings with different views, including orthographic views, hidden lines and sectional views based on the standards of machine drawing practiced by Bureau of Indian standards (B.I.S).**

CO2 **Recognize types of thread forms and fastening systems, their basic principles, and where they may be applicable.**

CO3 **Distinguish between different types of Keys, Riveted joints and the process of riveting.**

CO4 **Classify different types of couplings and their uses in mechanical industries.**

CO5 **Draw different principal views of the equipment or machine parts and their assemblies using software.**

FLUID MECHANICS

Subject Code	**: ME350B/ME450B**	**No. of Credits**	**: 4-0-0**
No. of Lecture Hours / Week	**: 04**	**Exam Hours**	**: 3**
Total No. of Contact Hours	**: 52**	**Exam Marks**	**: 100**

COURSE OBJECTIVES:

1. **To have a working knowledge of the basic properties of fluids and understand the continuum approximation.**
2. **To develop understanding about Pascal law, hydrostatic law, forces exerted by a fluid at rest on submerged surfaces, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.**
3. **To describe the behavior of fluids in static and dynamic conditions of fluids motion and imbibe basic laws and equations used for analysis of static and dynamic fluids.**
4. **To inculcate the importance of fluid flow measurement and its applications in Industries.**
5. **To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersedbodies.**

COURSE CONTENT

UNIT – 1

Properties of Fluids: Introduction, Types of fluid, Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, thermodynamic properties, compressibility and bulk modulus- relationship between modulus and pressure of gas, surface tension, capillarity, Vapour pressure and Cavitation **10 Hours**.

UNIT – 2

Fluid Statistics and Buoyancy: Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressures, simple manometers and differential manometers. Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces, curved surface submerged in liquid. Buoyancy, center of buoyancy, conditions of equilibrium of floating and submerged bodies. **12 Hours**

UNIT – 3

Fluid Kinematicsand Fluid Dynamics: Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Co-ordinates only), velocity and acceleration, velocity potential function and stream function. Introduction equation of motion, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation. **10 Hours**

UNIT – 4

Fluid Flow Measurements and Flow through pipes: Venturimeter, orifice meter, Pitot-tube, vertical orifice, V-Notch and rectangular notches. Minor losses through pipes. Darey's and Chezy's equation for loss of head due to friction in pipes. HGL and TEL. **10 Hours**

UNIT – 5

Laminar flow, compressible flow and Flow past immersed bodies :

Reynolds's number, critical Reynolds's number, laminar flow through circular pipe-Hagen Ponselle's equation, laminar flow between parallel and stationary plates. Drag, Lift, expression for lift and drag. Introduction to compressible flow: Velocity of sound in a fluid, Mach number, Mach cone, propagation of pressure waves in a compressible fluid. **12 Hours**

TEXT BOOKS:

1. **Fluid Mechanics** (SI Units), Yunus A. Cengel John M. Cimbala, 3rd Ed., Tata McGraw Hill, 2014.
2. **Fluid Mechanics**, Dr. Bansal, R.K.Lakshmi Publications, 2004
3. **Fluid Mechanics**, F M White, McGraw Hill Publications Eighth edition. 2016

REFERENCE BOOKS:

1. **Fluid Mechanics and hydraulics,** Dr.Jagadishlal: Metropolitan Book Co-Ltd., 1997.
2. **Fundamentals of Fluid Mechanics** by Munson, Young, Okiishi&Huebsch, John Wiley Publications.7^{th} edition
3. **Fluid Mechanics,** John F.Douglas, Janul and M.Gasiosek and john A.Swaffield, Pearson Education Asia, 5th ed., 2006.
4. **Fluid Mechanics and Fluid Power Engineering**, Kumar.D.S, Kataria and Sons. 2004.
5. **Fluid Mechanics** -. Merle C. Potter, Elaine P.Scott. Cengage learning.

COURSE OUT COMES:

Upon completion of this course, students should be able to:

CO1 **Identify and calculate the key fluid properties used in the analysis of fluid behavior.**

CO2 **Understand and apply the principles of pressure, pressure measurement, fluid statics, buoyancy and floatation.**

CO3 **Understand and apply the principles of kinematics and dynamics while addressing problems of mechanical engineering.**

CO4 **Understand and apply the principle of Bernoulli's equation for fluid flow measurement and to identify the major and minor energy losses that is involved in a fluid flow and their accountability.**

CO5 **Understand and apply the concept of laminar flow, boundary layer, compressible flow and Flow past immersed bodies.**

MACHINE SHOP PRACTICE

Subject Code	**: ME36L**	**No. of Credits**	**: 0 – 0 - 1.5**
No. of Practical Hours / Week	**: 03**	**Exam Hours**	**: 03**
Total No. of Lecture/Practical Hours	**: 48**	**Exam Marks**	**: 50**

COURSE OBJECTIVE:

1. **To impart practical and working knowledge of Machine Tools and operations.**
2. **To develop machining skills with appropriate selection of tools.**

COURSE CONTENT

PART – A

Preparation of three models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.

PART – B

Cutting of V Groove/ dovetail / Rectangular groove using a shaper. Cutting of Gear Teeth using Milling Machine.

COURSE OUTCOMES:

Upon completion of this course, students should be able to:

CO1 **Demonstrate practical and working knowledge of Machine Tools and operations.**

CO2 **Demonstrate machining skills with appropriate selection of tools.**

FOUNDRY AND FORGING LABORATORY

Subject Code	: **ME37L**	**No. of Credits**	**: 0 – 0-1.5**
No. of Practical Hours / Week	**: 03**	**Exam Hours**	: **03**
Total No. of Lecture/Practical Hours	**: 48**	**Exam Marks**	: **50**

COURSE OBJECTIVE:

1. **To provide students with the knowledge and necessary skills to perform sand testing and preparation of moulds.**

2. **To provide students with the knowledge and necessary skills to perform metal forging operations and sheet metal work.**

COURSE CONTENT

UNIT-1

Testing of Moulding sand and Core sand

Preparation of sand specimen's and conduction of the following tests:

1. Compression, Shear and Tensile tests on Universal Sand Testing Machine.
2. Permeability test
3. Core hardness &Mould hardness tests.
4. Sieve Analysis to find Grain Fineness number of Base Sand
5. Clay content determinations in Base Sand

Foundry Practice

Use of foundry tools and equipment. Preparation of moulds using two moulding boxes using patterns or without patterns. (Split pattern, Match plate pattern and Core boxes). Preparation of one casting (Aluminum or cast iron-Demonstration only)

24 Hours

UNIT-2

Forging Operations:

1. Calculation of length of the raw material required to do the model.
2. Preparing minimum three forged models involving upsetting, drawing and bending operations.
3. Out of these three models, at least one model is to be prepared by using Power Hammer.

Sheet Metal Work:

Preparation of four models involving development of surfaces of regular solids, transition pieces and trays

24 Hours

COURSE OUTCOMES

Upon completion of this course, students should be able to:

CO1 **Demonstrate the knowledge and necessary skills to perform sand testing and preparation of moulds.**

CO2 **Demonstrate the knowledge and necessary skills to perform metal forging operation and sheet metal work.**

Fourier Series, Integral transforms and Applications

IV Semester B.E.

Sub. Code: MA410 Contact Hrs.: 4/Week
Credits: 3-1-0 Total Hrs.: 48 hours

Course Objective: Fourier series and Integral transforms techniques will be introduced. Applications of Integral transforms to solution of differential equations will be discussed.

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1. **Fourier series:** Introduction, Fourier series (in terms of Trigonometric as well as complex exponential functions) for even and odd functions; half-range expansions; practical harmonic analysis. **10 hrs**

2. **Fourier transforms**, finite and infinite Fourier transforms, basic properties, convolution theorem; inverse transforms; applications to solution of ordinary and partial differential equations; discrete Fourier transforms; brief introduction to wavelets. **10 hrs**

3. **Laplace transforms,** basic properties, convolution theorem; inverse Laplace transforms; applications to solution of ordinary and partial differential equations. **12 hrs**

4. P**artial Differential Equations**: Recapitulation; solution of Lagrange's linear PDE; D'Alembert's solution of wave equation; two-dimensional Laplace's equation; boundary value problems. **10 hrs**

5. **Z-transforms**: z-transforms and inverse z-transforms; solution of difference equations. **6 hrs**

For Civil / CTM / Env students sections 4 and 5 above is replaced by the following topic:

4': **Complex Analysis:** Introduction, analytic functions, Cauchy-Riemann equations; properties of analytic functions. **7 hrs**

5': **Probability:** Introduction, conditional probability and Bayes' theorem; Discrete (Binomial, Poisson) and continuous (exponential and normal) probability distributions and their characteristics. Sampling, sampling distribution, student's t-distribution; introduction to multivariate analysis. **9 hrs**

Text Books:

1. Advanced Engineering Mathematics, Erwin Kreizyg;
2. An Introduction to Laplace Transforms and Fourier Series, P P G Dyke.

Course Outcomes: Students will be able to:

1. find expansions of functions as Fourier series / half-range Fourier series in a given range of values of the variable. Obtaining the various harmonics of Fourier series expansion for the given numerical data;
2. find Fourier transforms, Fourier sine and cosine transforms of functions.

3. find Laplace transforms and inverse Laplace transforms; solve differential equations using Laplace transforms;
4. understand and solve PDEs arising in engineering applications using integral transforms techniques;
5. compute Z-transforms and inverse Z-transforms; solve difference equations using Z-transformation.
6. understand the concept and properties of analytic functions;
7. understand basic concepts of probability, probability distributions and sampling theory ideas.

DYNAMICS OFMACHINES

Subject Code	**: ME410**	**No. of Credits**	**:4-0-0**
No. of Lecture Hours / Week	**: 04**	**Exam Hours**	**: 3**
Total No. of Contact Hours	**: 52**	**Exam Marks**	**: 100**

COURSE OBJECTIVES:

1. **To analyze static and dynamic equilibrium of simple mechanisms subjected to force.**
2. **To describe friction and its effects on belt drives and bearings during power transmission.**
3. **To explain with sketches the process of static and dynamic balancing and analyze rotating and reciprocating masses.**
4. **To analyze energy storage in flywheel and flow control using governors and gyroscopic action and stability of ships, planes, two wheeled and four wheeled automobiles.**
5. **To draw the standard profiles of cams and its construction to estimate displacement, velocity and acceleration of the followers.**

COURSECONTENT

UNIT – 1

Static and Dynamic Force Analysis: Introduction: Static equilibrium. Equilibrium of two and three force members. Members with two forces and torque. Free body diagrams. Principle of virtual work. Static force analysis of four bar and slider-crank mechanisms without friction.

D'Alembert's principle, Inertia force, inertia torque. Dynamic force analysis of four-bar and slider crank mechanisms. Dynamically equivalent systems. Turning moment diagrams and flywheels. Fluctuation of Energy. Determination of size of flywheels. **12 Hours**.

UNIT – 2

Friction and Belt Drives: Definitions: Types of friction: laws of friction, Friction in pivot and collar bearings. Belt drives: Flat belt drives. Ratio of belt tensions, centrifugal tension, and power transmitted. **10 Hours**.

UNIT – 3

Balancing of Rotating and Reciprocating Masses: Static and dynamic balancing. Balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes.

Inertia effect of crank and connecting rod, single cylinder engine, balancing in multi cylinder-inline engine (primary & secondary forces), V-type engine; Radial engine – Direct and reverse crank method. **10 Hours**

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UNIT – 4

Governors: Types of governors; force analysis of Porter and Hartnell governors. Controlling force. Stability, sensitiveness. Isochronism, effort and power.

Gyroscope: Victorial representation of angular motion. Gyroscopic couple. Effect of gyroscopic couple on ship, plane disc, aero plane, stability of two wheelers and four wheelers. **10 Hours.**

UNIT – 5

Analysis of Cams: Analysis of Tangent cam with roller follower and Circular arc cam operating on flat faced followers. Undercutting in Cams. **10 Hours.**

TEXT BOOKS:

1. **Theory of Machines**, Rattan S.S. Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2009.
2. **Theory of Machines**, Sadhu Singh, Pearson Education. 2nd Edition.2007.

REFERENCE BOOKS:

1. **Theory of Machines & Mechanisms**", J.J.Uicker, G.R. Pennock, J.E. Shigley.OXFORD 3rdEdition, 2009.
2. **Mechanism and Machine theory**, A. G. Ambekar, Prentice-Hall, India, 2007
3. **Mechanism and Machine Theory;** J S Rao and Dukkipati; Wiley Eastern, New Delhi
4. **Theory of Mechanism and Machine**; Ghosh and A K Malik, East West Press (Pvt.) Ltd., New Delhi.
5. **Theory of Machines** by RS Khurmi and JK Gupta; S.Chand and Company Ltd., New Delhi.

COURSE OUTCOMES:

Upon completion of this course, students should be able to:

CO1 **Carry out graphical and analytical analysis of static and inertial force on mechanisms.**

CO2 **Design and develop power transmission system using flat belt drives considering friction. Similarly calculate the torque in bearings using friction.**

CO3 **Explain and illustrate balancing of rotating and reciprocating parts of the machinery**

CO4 **Explain with sketches functions and design of Porter and Hartnell governors. Similarly analyze effect of gyroscope on different vehicles like Air plane, ship, two and four wheeler**

CO5 **Design and develop standard cam profile to study the displacement, velocity and acceleration of the follower.**

MANUFACTURING PROCESS-II

Subject Code	**: ME420**	**No. of Credits**	**: 4-0-0**
No. of Lecture Hours / Week	**: 04**	**Exam Hours**	**: 3**
Total No. of Contact Hours	**: 52**	**Exam Marks**	**: 100**

COURSE OBJECTIVES:

1. **Understand principles of material removal by cutting, effect of material properties, tool shape on chip formation and select tool for a given set of cutting conditions and economic considerations**
2. **Learn constructional and operational features of lathe, drilling machines**
3. **Learn constructional and operational features of shaper, planer and milling machines**
4. **Classify and describe methods and applications of grinding and finishing processes and principles of various non-conventional processes**
5. **Be able to design and select appropriate jigs and fixtures necessary for producing a machine part**

COURSECONTENT

UNIT – 1

Metal cutting – Introduction, chip formation, shear zone, orthogonal and oblique cutting, shear angle and its expressions, cutting tool materials, thermal aspects, tool wear and tool life, surface finish, cutting fluids, economics.

Machine tools – Classification, generation of surfaces, basic elements of machine tools, support structures, power transmission, actuation systems, guide ways, general work holding methods.

SLA: SPT designation, combinations of tool geometry, Minimum of 5-examples of machined parts in general application, attempt to compute their production time, comparison of cost estimated with the market price.

10 Hours

UNIT – 2

Lathe – Classification, constructional features of a centre lathe, cutting tools, machining operations, taper turning methods, thread cutting. Capstan lathe, Turret lathe and Special purpose lathes.

Drilling machines - Classification, plain, radial, gang and multi-spindle drilling machines, cutting tools, machining operations.

SLA: Specifications for centre lathe and bench drilling machine. Lathe attachments for special operations. Kinematic diagram for a bench drilling machine, constructional features of spindle.

10 Hours

UNIT – 3

Reciprocating machine tools – Shaper and its operations, Planer and its operations and Slotter.

Milling machines - Classification, constructional features of horizontal and vertical milling machines, cutting tools, up milling and down milling, machining operations, tool and work holding devices. Indexing – need and methods.

Gear cutting – gear tooth nomenclature, gear manufacturing methods.

SLA: Quick return mechanisms, fast and loose pulley drive, shape of guide and guide-ways for shaper and planer. Arbor construction, Gear tooth profiles, applications, gear shaving.

12 Hours

UNIT – 4

Abrasive machining – Grinding, grinding wheel – materials, selection and designation. Traverse and plunge grinding, Grinding machines – classification, horizontal, vertical and cylindrical surface grinders. Lapping, honing, super-finishing.

Unconventional machining – Classification, USM, EDM, ECM, EBM, LBM, PAC, AJM, WJM techniques.

SLA: Grinding wheel manufacturing, wheel shapes. Tool and die-making by unconventional machining.

12 Hours

UNIT – 5

Jigs and fixtures – Introduction, functional surfaces, location principles, locating devices, clamps, jigs, fixtures.

SLA : CAD Modeling of minimum of 2-fixtures and 2-jigs for general use and find their mass properties

08 Hours

TEXT BOOKS:

1. **Manufacturing technology – Vol.II**by P N Rao, 2nd Edition, TMH 2012
2. **Fundamentals of metal machining and machine tools** – G Boothroyd, McGraw-Hill, 2008

REFERENCE BOOKS:

1. **Material and Processes in Manufacturing** by E Paul Degarmo & others, PHI-2006
2. **Production Technology** by HMT, TMH2001
3. **Manufacturing Engg., & Technology** -By SeropeKalpakjian& others PEA 4th Edition 2005
4. **Modern manufacturing processes** – Pandey& Shah ,2001
5. **Workshop Technology** by HazaraChoudhry, Vol-II, Media Promoters & Publishers Pvt. Ltd. 2004
6. **Production Technology** by R.K.Jain, Khanna Publications, 2003

COURSE OUTCOMES:

Upon completion of this course, students should be able to:

CO1 **To apply the knowledge of forces, material properties, surface generation to understand production processes by material removal, cutting conditions and tool selection criteria with due consideration to cost and time involved**

CO2 **To identify machine tools suitable for producing axi-symmetric features and sequence the operations to produce machine parts**

CO3 **To analyse production processes for cutting flat features, grooves and profiles and select appropriate machine tools with understanding of construction, tooling and operations on them**

CO4 **To select suitable finishing operations and to perform them with the help of suitable machine tools, compare conventional with non-conventional production processes and use them depending on the need**

CO5 **To design and select suitable jigs and fixtures to machine a component on a machine tool**

METROLOGY AND MEASUREMENTS

Subject Code	**: ME430**	**No. of Credits**	**: 4 - 0 - 0**
No. of Lecture Hours / Week	**: 04**	**Exam Hours**	**: 3**
Total No. of Lecture Hours	**: 52**	**Exam Marks**	**: 100**

COURSE OBJECTIVES

1. **To explain with sketches standards of measurement Limits, Fits, Tolerance and Gauging and solve related numerical problems.**
2. **To explain with sketches various types Comparator's working principles.**
3. **To describe measurement systems, errors and with sketches explain measurement of force torque and pressure.**
4. **To describe with sketches interferometer, screw thread and gear measurement.**
5. **To describe various modifying and terminating devices / transducers.**

COURSE CONTENT

UNIT – 1

Standards of measurement: Definition and Objectives of metrology, Standards of length International prototype meter, Imperial standard yard, Wave length standard, subdivision of standards, line and end standard, calibration of end bars (Numerical), Slip gauges, Wringing Phenomena, Indian Standards (M-81, M-87), Numerical problems on building of slip gauges.

Limits, Fits, Tolerance and Gauging: Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS 919-1963), hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials. **12 Hours**

UNIT – 2

Measurements and measurement systems: Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in measurement, classification of errors.

Transducers- transfer efficiency, primary and secondary transducers, electrical, mechanical, electronic transducers, advantages of each type transducers.

Measurement of force, torque and pressure: Principle, analytical balance, platform balance, proving ring. Torque measurement, Prony brake, hydraulic dynamometer. Pressure measurements, principle, use of elastic members, Bridgeman gauge, McLeod gauge, pirani gauge. **10 Hours**

UNIT - 3

Comparators Introduction to comparators, characteristics, classification of comparators, mechanical comparators-Johnson Mikrokator, sigma comparators, dial indicator, optical comparators principles- Zeiss ultra optimeter, electric and electronic comparators principles-LVDT, pneumatic comparators- back pressure gauges, solex comparators**.**

Angular measurement: Introduction to angular measurements, bevel protractor, sine principle and use of sine bars, sine center, use of angle gauges (numerical on building of angles), clinometers. **10 Hours**

UNIT – 4 Interferometer and screw thread, gear measurement: Interferometer, interferometry, autocollimator. Optical flats. Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, best size wire. Tool maker's microscope, gear tooth terminology, use of gear tooth vernier caliper and micrometer.

10 Hours

UNIT – 5 Modifying and terminating devices: Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, ballast circuit, electronic amplifiers and telemetry.

Terminating devices: Introduction to terminating devices, mechanical, cathode ray oscilloscope, oscillographs, X-Y plotters.

10 Hours

TEXT BOOKS

1. **Mechanical Measurements,** Beckwith Marangoni and Lienhard, Pearson Education, 6th Edition. 2006.
2. **Engineering Metrology,** R.K. Jain, Khanna Publishers, 1994.
3. **Mechanical Measurements and Metrology**, T Chandrasekhar, Subash Stores, 2011

REFERENCE BOOKS

1. **Engineering Metrology,** I.C. Gupta, DhanpatRai Publications, Delhi.
2. **Industrial Instrumentation,** Alsutko, Jerry. D. Faulk, Cengage Asia Pvt. Ltd. 2002.
3. **Measurement Systems Applications and Design,** Ernest O. Doebelin, 5th Ed., McGraw Hill Book Co.

COURSE OUTCOMES:

CO1: Explain standers of measurement and solve numerical problems on end bars and ship gauges. Describe with sketches limits, fits, Tolerance and Gauging.

CO2: Explain with sketches the working principles of mechanical, Electrical, Electronic and Pneumatic comparators.

CO3: Describe measurement systems, Errors and with sketches explain working principle of various devices used for Force, Torque and Pressure measurement.

CO4: Explain with sketches Interferometer, screw thread & gear measurement and various devices used for the purpose.

CO5: Describe with sketches working principles of various modifying and terminating devices.

APPLIED THERMODYNAMICS

Subject Code	**: ME440**	**No. of Credits**	**: 4-0-0**
No. of Lecture Hours / Week	**: 04**	**Exam Hours**	**: 3**
Total No. of Contact Hours	**: 52**	**Exam Marks**	**: 100**

COURSE OBJECTIVES:

1. **To understand and determine air standard cycle efficiency, work output and means effective pressure with a given set of operating parameters.**
2. **To understand the operational parameters and constraints, determine cycle efficiency, its power output, and required heat input and will be able to make modifications to improve the overall cycle efficiency for the steam power cycle**
3. **To understand and determine cycle efficiency, work output, and required heat input for a gas turbine cycle for a given set of operating parameters.**
4. **To understand and determine work required to compress the air the air for required application and optimize the work by multi staging with intercoolers**
5. **To optimize a refrigeration system given the requirements and constraints of a refrigeration system and will be able to understand and apply thermodynamic laws of air conditioning to determine the capacity requirements of it.**

COURSE CONTENT

UNIT – 1

Air standard cycles: Assumptions, network output, air standard efficiency and mean effective pressure of Carnot cycle, Otto cycle, Diesel cycle, Dual combustion cycle, Sterling cycle, Atkinson cycle. Comparison of Otto, Diesel and Dual combustion cycle. **12 Hours.**

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UNIT – 2

Vapour power cycles: Introduction, Carnot cycle, Simple Rankine cycle, Comparison of Rankine and Carnot cycle, Effect of condenser pressure, boiler pressure and super heating on simple Rankine cycle, Rankine cycle with reheat and regeneration. **10 Hours**.

UNIT – 3

Gas Turbines: Principle of working, classification of gas turbine, comparison of open and closed cycle turbines, Brayton cycle, pressure ratio for maximum output, optimum pressure ratio for maximum cycle thermal efficiency, multistage compression with inter-cooling and multistage expansion with reheating, regeneration of heat. **10 Hours.**

UNIT – 4

Reciprocating Compressors: Introduction, general description and classification, volumetric efficiency, work done, need for multi staging, optimum intermediate pressure for two stage air compressor with inter-cooling, work required for Multistage compressor and its efficiency. **10 Hours.**

UNIT – 5

Refrigeration and Air Conditioning: Introduction, cop, unit of refrigeration, air refrigeration, Carnot cycle, Bell-Coleman cycle, vapour compression refrigeration cycle, p-h chart, calculation of work and cop of vapour compression cycle, effect of operating conditions, vapour absorption cycle. Introduction to air conditioning, principle, psychometric, psychometric processes, types of air conditioning with simple numerical.

10 Hours.

TEXT BOOKS:

1. **Basic and Applied Thermodynamics** by P K Nag**,** Tata Mcgraw Hill pub. Co., 2002.
2. **Thermodynamics – An Engineering Approach** by Yunus A Cenegal and Michael A Boles, Tata McGraw Hill pub co., 2002.

REFERENCE BOOKS:

1. **Fundamental of classical Thermodynamics** by G J Van Wylen and RE Sonntag, Wiley Eastern.
2. **Internal combustion engines** by M.L. Mathur and R.P. Sharma, Dhanpatrai publications, 2003.
3. **Thermal Engineering** by B K Sarkar, Tata McGraw-Hill Education Pvt. Ltd., 2004

COURSE OUTCOMES:

Upon completion of this course, students should be able to:

CO1 **Understand and determine air standard cycle efficiency, work output and mean effective pressure with a given set of operating parameters. .**

CO2 **Understand the operational parameters and constraints, determine cycle efficiency, its power output, and required heat input and will be able to make modifications to improve the overall cycle efficiency for the steam power cycle.**

CO3 **Understand and determine cycle efficiency, work output, and required heat input for a gas turbine cycle for a given set of operating parameters.**

CO4 **understand and determine work required to compress the air the air for required application and optimize the work by multi staging with intercoolers**

CO5 **Optimize a refrigeration system given the requirements and constraints of a refrigeration system and will be able to understand and apply thermodynamic laws of air conditioning to determine the capacity requirements of it.**

COMPUTER AIDED MACHINE DRAWING

Subject Code	**: ME450A/ME350A**	**No. of Credits**	**: 2 -0 -4**
No. of Lecture Hours / Week	**: 02 + 04**	**Exam Hours**	**: 3**
Total No. of Contact Hours	**: 26 + 52**	**Exam Marks**	**: 100**

COURSE OBJECTIVES:

1. **To apply general projection principles and draw sectional views of different solids with an emphasis and to analyze three-dimensional objects and draw two-dimensional views.**
2. **To draw various thread forms, different types of fasteners and their locking arrangements.**
3. **To draw various types of Keys, Cotters, Knuckle and Riveted joints.**
4. **To draw principal views of couplings and various components and assemble using Computer Aided Drafting (CAD).**
5. **To create3-D geometric models of machine parts including assemblies and generate 2-D production drawings.**

COURSE CONTENT

UNIT– 1

Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on axis inclinations, spheres and hollow solids).True shape of sections.

Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine parts with and without section. (Bureau of Indian Standards conventions are to be followed for the drawings) line and material conventions.

12 Hours

UNIT– 2

Thread Forms: Thread terminology, sectional views of threads. ISO Metric (Internal &External) BSW, square, ACME and Sellers thread (American Standard thread).

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) stud bolts with nut, wing nut, lock nut. Flanged nut, slotted nut, taper and split pin for locking, countersunk head screw, grub screw, Allen screw.

12 Hours

UNIT– 3

Keys& Joints: Parallel key, Taper key, Feather key, Gib head key and Wood ruff key.

Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets).Cotter joint (socket and spigot),knuckle joint (pin joint) for two rods.

12 Hours

UNIT– 4

Couplings: Split Muff coupling, Protected and unprotected type flanged coupling, pin (bush) type flexible coupling, Oldham's coupling and universal coupling (Hook's Joint).

12 Hours

UNIT– 5

3 D Assembly Drawings (Part drawings should be given)

1. Plummer block(Pedestal Bearing).
2. Screw jack (Bottle type).
3. Machine vice (Simple).

15 Hours

2 D Assembly Drawings (Part drawings should be given)

1. Tool Head of a shaper.
2. I C Engine connecting rod.
3. Tail stock of lathe.

15 Hours

TEXT BOOKS:

1. **Machine Drawing**, K.R.Gopalakrishna, Subhash Publications 5th Edition, 2003.
2. **Machine Drawing**, K L Narayanan, P Kannaiah, Venkata shivaReddy, New age international publisher, 3rd Edition 2006.

REFERENCE BOOKS:

1. **Machine Drawing**, N. Siddeshwar, P. Kanniah,V.V.S.Sastri, Tata McGraw Hill, 2006.
2. **Machine Drawing with Auto CAD**, Goutam Pohit & Goutham Ghosh, 1st Indian print Pearson Education, 2005.

COURSE OUTCOMES:

At the end of the course the students shall have the abilities to:

CO1 **Read engineering drawings with different views, including orthographic views, hidden lines and sectional views based on the standards of machine drawing practiced by Bureau of Indian standards (B.I.S).**

CO2 **Recognize types of thread forms and fastening systems, their basic principles, and where they may be applicable.**

CO3 **Distinguish between different types of Keys, Riveted joints and the process of riveting.**

CO4 **Classify different types of couplings and their uses in mechanical industries.**

CO5 **Draw different principal views of the equipment or machine parts and their assemblies using software.**

FLUID MECHANICS

Subject Code	**: ME450B/ME350B**	**No. of Credits**	**: 4-0-0**
No. of Lecture Hours / Week	**: 04**	**Exam Hours**	**: 3**
Total No. of Contact Hours	**: 52**	**Exam Marks**	**: 100**

COURSE OBJECTIVES:

1. **To have a working knowledge of the basic properties of fluids and understand the continuum approximation.**
2. **To develop understanding about Pascal law, hydrostatic law, forces exerted by a fluid at rest on submerged surfaces, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.**
3. **To describe the behavior of fluids in static and dynamic conditions of fluids motion and imbibe basic laws and equations used for analysis of static and dynamic fluids.**
4. **To inculcate the importance of fluid flow measurement and its applications in Industries.**
5. **To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersedbodies.**

COURSE CONTENT

UNIT – 1

Properties of Fluids: Introduction, Types of fluid, Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, thermodynamic properties, compressibility and bulk modulus- relationship between modulus and pressure of gas, surface tension, capillarity, Vapour pressure and Cavitation **10 Hours**.

UNIT – 2

Fluid Statistics and Buoyancy: Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressures, simple manometers and differential manometers. Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces, curved surface submerged in liquid. Buoyancy, center of buoyancy, conditions of equilibrium of floating and submerged bodies.

12 Hours

UNIT – 3

Fluid KinematicsandFluid Dynamics: Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Co-ordinates only), velocity and acceleration, velocity potential function and stream function. Introduction equation of motion, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation.

10 Hours

UNIT – 4

Fluid Flow Measurements and Flow through pipes: Venturi meter, orifice meter, Pitot-tube, vertical orifice, V-Notch and rectangular notches. Minor losses through pipes. Darey's and Chezy's equation for loss of head due to friction in pipes. HGL and TEL **10 Hours**.

UNIT – 5

Laminar flow, compressible flow and Flow past immersed bodies :

Reynolds's number, critical Reynolds's number, laminar flow through circular pipe-Hagen Ponselle's equation, laminar flow between parallel and stationary plates. Drag, Lift, expression for lift and drag. Introduction to compressible flow: Velocity of sound in a fluid, Mach number, Mach cone, propagation of pressure waves in a compressible fluid. **12 Hours**

TEXT BOOKS:

1. **Fluid Mechanics** (SI Units), Yunus A. Cengel John M. Cimbala, 3rd Ed., Tata McGraw Hill, 2014.
2. **Fluid Mechanics**, Dr. Bansal, R.K.Lakshmi Publications, 2004
3. **Fluid Mechanics**, F M White, McGraw Hill Publications Eighth edition. 2016

REFERENCE BOOKS:

1. **Fluid Mechanics and hydraulics,** Dr.Jagadishlal: Metropolitan Book Co-Ltd., 1997.
2. **Fundamentals of Fluid Mechanics** by Munson, Young, Okiishi&Huebsch, John Wiley Publications.7^{th} edition
3. **Fluid Mechanics,** John F.Douglas, Janul and M.Gasiosek and john A.Swaffield, Pearson Education Asia, 5th ed., 2006.
4. **Fluid Mechanics and Fluid Power Engineering**, Kumar.D.S, Kataria and Sons. 2004.
5. **Fluid Mechanics** -. Merle C. Potter, Elaine P.Scott. Cengage learning.

COURSE OUT COMES:

Upon completion of this course, students should be able to:

CO1 **Identify and calculate the key fluid properties used in the analysis of fluid behavior.**

CO2 **Understand and apply the principles of pressure, pressure measurement, fluid statics, buoyancy and floatation.**

CO3 **Understand and apply the principles of kinematics and dynamics while addressing problems of mechanical engineering.**

CO4 **Understand and apply the principle of Bernoulli's equation for fluid flow measurement and to identify the major and minor energy losses that is involved in a fluid flow and their accountability.**

CO5 **Understand and apply the concept of laminar flow, boundary layer, compressible flow and Flow past immersed bodies.**

METROLOGY AND MEASUREMENTS LABORATORY

Subject Code	**: ME46L**	**No. of Credits**	**: 0 – 0 - 1.5**
No. of Practical Hours / Week	**: 03**	**Exam Hours**	**: 03**
Total No. of Lecture/Practical Hours	**: 48**	**Exam Marks**	**: 50**

COURSE OBJECTIVES:

1. **To provide students with the necessary skills for calibration and testing of different gauges and instruments.**
2. **To provide students with the necessary skills to collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures using various metrology instruments.**

COURSE CONTENT

UNIT-1

MECHANICAL MEASUREMENTS

1. Calibration of Pressure Gauge
2. Calibration of Thermocouple
3. Calibration of LVDT
4. Calibration of Load cell
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.

UNIT-2

METROLOGY

1. Measurements using Optical Projector / Toolmaker Microscope.
2. Measurement of angle using Sine Center / Sine bar / bevel protractor
3. Measurement of alignment using Autocollimator / Roller set
4. Measurement of cutting tool forces using
    a) Lathe tool Dynamometer
    b) Drill tool Dynamometer.
5. Measurement of Screw threads Parameters using two wire or Three-wire methods.
6. Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator
7. Measurement of gear tooth profile using gear tooth vernier /Gear tooth micrometer
8. Calibration of Micrometer using slip gauges
9. Measurement using Optical Flats

COURSE OUTCOMES:

Upon completion of this course, students should be able to:

CO1 **Demonstrate the necessary skills for calibration and testing of different gauges and instruments.**

CO2 **Demonstrate the necessary skills to collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures using various metrology instruments.**

BASIC MATERIALS TESTING LABORATORY

Subject Code	: **ME47L**	**No. of Credits**	**: 0 - 0 -1.5**
No. of Practical Hours / Week	**: 03**	**Exam Hours**	: **03**
Total No. of Lecture/Practical Hours	: **48**	**Exam Marks**	: **50**

COURSE OBJECTIVES

1. **To conduct Tension, Compression, Bending & Shear tests on UTM and evaluate material properties.**
2. **To carry out Torsion, Hardness & Impact tests and determine various moduli, hardness numbers and impact energy.**

COURSE CONTENT

1. **Hardness Test:** Estimating the Hardness of different Engineering materials using Brinell's & Rockwell Hardness Testers.
2. **Impact Test:** Determining the impact strength of a given material using Charpy & IZOD tests.
3. **Tension Tests using Universal Testing Machine :** Tension test on the given specimens (at least 2 materials for comparison) and to plot the stress strain graphs
4. **Compression Tests using Universal Testing Machine :** Compression test on the given specimens and to plot the stress strain graphs
5. **Bending and Double Shear Tests using Universal Testing Machine:** Bending test, Double Shear test on the given specimens and to plot the stress strain graphs.

COURSE OUTCOMES

Upon completion of this course, students should be able to:

CO1 Conduct Tension, Compression, Bending & Shear tests on UTM and evaluate material properties.

CO2 Conduct Torsion, Hardness & Impact tests and determine various moduli, hardness numbers and impact energy