BASIC THERMODYNAMICS						
Course Code	**21ME32**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	3	**1**	**0**	**4**		
Number of Lecture Hours	**50**				**Exam Hours**	**03**
Credits-04						

Course Objectives: This course will enable students to
• Learn about thermodynamic systems and boundaries
• Study the basic laws of thermodynamics including, conservation of mass, conservation of energy or first law
• Understand various forms of energy includingsecond law.
• Analyze displacement work for a part of system boundary & whole systemClausiustheorem.
• Identify various types of properties, Use tables, equations, and charts, in evaluation of thermodynamic properties,pure substance.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Fundamental Concepts, Definitions, Work and Heat:** Thermodynamic definition and scope, Microscopic and Macroscopic approaches.Some practical applications of engineering thermodynamic Systems.Thermodynamic systems and control volume with examples. Thermodynamic properties, states, processes and cycles, reversible and irreversible process, quasi-static process. Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall,thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics, Temperature; concepts, scales, internationalfixed points and measurement of temperature, simple problems on temperature concept. Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, signconvention, Point and path function.Displacement work in quasi static process, other modes of work, Heat Transfer and Compression of heat and work.	**10**	**L1,L2,L3**
2	**First Law of Thermodynamic:** Joules experiments, equivalence of heat and work, Statement of the First law of thermodynamics, energy as a property, modes of energy, Different forms of stored energy, Corollaries of first law, Specific heat at constant volume and constant pressure, application of first law to a closed system (Non Cyclic Processes), Steady and Unsteady flow process, Steady Flow Energy Equation (SFEE), Application of steady flow energy equation - work absorbing system, work developing system and non-work absorbing and non-work developing systems, related numerical problems.	**10**	**L1,L2,L3**

3	**Second law of Thermodynamic:**Introduction and limitation of First law, Heat engine, Heat pump and Reversed Heat Engine, Energy Reservoirs kelvin – plank statement of second law, Clausius statement of second law, Equivalence of the two statements, Perpetual motion machine of second kind, Reversibility and Irreversibility Processes, Carnot cycle, Numerical Problems.	**10**	**L1,L2,L3**
4	**Entropy:** Entropy and its Definition, two reversible adiabatic lines cannot intersect each other, Clausius theorem and Clausius inequality, Entropy is a point function, T- S Diagram, principle of increase in entropy, Application of Entropy Principal, Entropy using T-ds relation, Entropy Change for Ideal gas and numerical problems.	**10**	**L1,L2,L3**
5	**Pure substance , available and irreversibility, Ideal gases and real gases:** Introduction, P-T-V of a pure substance, P-T Diagram, triple point and critical points, Enthalpy of steam, Latent heat, External work done, Internal energy of a system, state changes of system involving a pure system, dryness fraction, saturated vapors, two phase mixture, vapour phase, steam table, formation of steam at constant pressure, Measurement of dryness fraction of steam, Throttling calorimeter, separating and throttling calorimeter and numerical problems. Definition, Daltons law of partial pressures, Amagat's law of additive volumes, Internal energy and specific heats of an ideal gas mixture, enthalpy of ideal gas mixture,entropy of ideal gas's mixture, Van-der Waal's Equation of state, Van-der Waal\'sconstants in terms of critical properties, Beattie-Bridgeman equation, compressibility factor; compressibility chart.Difference between Ideal and real gases.	**10**	**L1,L2,L3**

COURSE OUTCOMES: At the end of the course the student will be able to:

21ME32.1	Explain thermodynamic systems, properties, Zeroth law of thermodynamics, temperature scales and energy interactions.
21ME32.2	Determine heat, work, internal energy, enthalpy for flow &non flow process using First Law of Thermodynamics.
21ME32.3	Determine heat, work, internal energy, enthalpy for flow &non flow process using Second Law of Thermodynamics.
21ME32.4	Determine change in internal energy, change in enthalpy and change in entropy using TD relations for ideal gases.
21ME32.5	Interpret behavior of pure substances and its applications to practical problems. Calculate Thermodynamics properties of real gases at all ranges of pressure, temperatures using modified equation of state including Vander Waals equation and Beattie Bridgeman equation.

Mapping of course outcomes with program outcomes

21ME32	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
21ME32.1	3	2	-	-	-	-	-	-	-	-	-	1	2	1	1

21ME32.2	3	2	-	1	-	-	-	-	-	-	-	1	2	1	1
21ME32.3	1	2	2	1	-	-	-	-	-	-	-	1	2	1	1
21ME32.4	1	1	1	1	-	-	-	-	-	-	-	1	2	1	1
21ME32.5	2	1	1	1	-	-	-	-	-	-	-	1	2	1	1
Avg. Mapping	2	1.6	0.8	0.8								1	2	1	1

High-3: Medium-2 : Low-1

QUESTION PAPER PATTERN:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module

TEXT BOOKS:

1. 1. Basic Engineering Thermodynamics, A.Venkatesh, Universities Press, 2008
2. Basic thermodynamic, R K Hegde, Sapna publication.
3. Basic and Applied Thermodynamics, P.K.Nag, 2nd Ed., Tata McGraw Hill Pub. 2002

REFERENCE BOOKS:

1. 1. Thermal Engineering, Dr C P Kothandaraman, Dhanpatrai& CO (P) LTD, Eductional&TechnicalPublishers
2. Thermal Engineering, R K Rajput, Laxmi Publication LTD
3. Thermodynamics, An Engineering Approach, YunusA.Cenegal and Michael A.Boles, Tata McGraw Hill publications, 2002
4. Engineering Thermodynamics, J.B.Jones and G.A.Hawkins, John Wiley and Sons.
5. An Introduction to Thermodynamics, Y.V.C.Rao, Wiley Eastern, 1993,
6. B.K Venkanna, Swati B. Wadavadagi “Basic Thermodynamics, PHI, New Delhi, 2010

DATA HANDBOOKS:

1. Thermodynamic data hand book, B.T. Nijaguna.
2. Properties of Refrigerant & Psychometric (tables & Charts in SI Units),Dr. S.S. Banwait, Dr. S.C. Laroiya, Birla Pub. Pvt. Ltd., Delhi, 2008.
3. Thermodynamic data hand book R K Hegde.
4. Thermodynamic data hand book R S Khrumi.

E-RESOURCES

https://nptel.ac.in/courses/112105123

MANUFACTURING PROCESS						
Course Code	**21ME33**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	3	**0**	**0**	**3**		
Number of Lecture Hours	**40**				**Exam Hours**	**03**
Credits-03						

Course Objectives: This course will enable students to
• To provide detailed information about the molding processes
• Understand the knowledge of various casting process in manufacturing
• To impart knowledge of various joining process used in manufacturing
• To build adequate knowledge of quality test methods conducted on welded
• Understand different non-destructive testing method

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**INTRODUCTION& BASIC MATERIALS USED IN FOUNDRY:** **Introduction:** Definition, Classification of manufacturing processes. Metals cast in the foundry-classification, factors that determine the selection of a casting alloy. Introduction to casting process & steps involved. Patterns: Definition, classification,	**08**	**L1, L2**

	materials used for pattern, various pattern allowances and their importance. **Sand molding:** Types of base sand, requirement of base sand. Binder, Additives definition, need and types. **Preparation of sand molds:** Molding machines- Jolt type, squeeze type and Sand slinger. Study of important molding process: Green sand, core sand, dry sand, sweep mold, CO2 mold, shell mold, investment mold, plaster mold, cement bonded mold. Cores: Definition, need, types. Method of making cores, concept of gating (top, bottom, parting line, horn gate) and rise ring (open, blind) Functions and types.		
2	**MELTING & METAL MOLD CASTING METHODS: Melting furnaces:** Classification of furnaces, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace,constructional features & working principle of cupola furnace. **Casting using metal molds:** Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixocasting, and continuous casting processes.	**08**	**L1, L2,**
3	**SOLIDIFICATION &NON-FERROUS FOUNDRY PRACTICE:** **Solidification**: Definition, Nucleation, solidification variables, Directional solidification-need and methods. Degasification in liquid metals-Sources of gas, degasification methods. **Fettling and cleaning of castings:** Basic steps involved. Sand Casting defects- causes, features and remedies. Advantages & limitations of casting process **Nonferrous foundry practice**: Aluminum castings - Advantages, limitations, melting of aluminum using lift-out type crucible furnace. Hardeners used, drossing, gas absorption, and fluxing and flushing, grain refining, pouring temperature. Stir casting set up, procedure, uses, advantages and limitations.	**08**	**L1, L2,**
4	**WELDING PROCESS: Welding process:** Definition, Principles, Classification, Application, 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 (AHW). **Special type of welding:** Resistance welding principles, Seam welding, Butt welding, Spot welding and Projection welding. Friction welding, Explosive welding, Thermit welding, Laser welding and electron beam welding.	**08**	**L1, L2,**

5	**SOLDERING, BRAZING AND METALLURGICAL ASPECTS IN WELDING:** Structure of welds, Formation of different zones during welding, Heat Affected Zone (HAZ), Parameters affecting HAZ. Effect of carbon content on structure and properties of steel, Shrinkage in welds& Residual stresses, Concept of electrodes, filler rod and fluxes. Welding defects-Detection, causes & remedy. **Soldering, brazing, gas welding:** Soldering, Brazing, Gas Welding: Principle, oxy-Acetylene welding, oxy-hydrogen welding, air-acetylene welding, Gas cutting, powder cutting. **Inspection methods:** Methods used for inspection of casting and welding. Visual, magnetic particle, fluorescent particle, ultrasonic. Radiography, eddy current, holography methods of inspection.	**08**	**L1, L2**

COURSE OUTCOMES: At the end of the course the student will be able to:

21ME33.1	Student should be able to apply the knowledge of various manufacturing processes.
21ME33.2	Understand and analyze foundry practices like pattern making, mold making, Core making and Inspection of defects.
21ME33.3	Understand the solidification of castings and finishing process of casted parts.
21ME33.4	Understand different types of welding processesused in manufacturing.
21ME33.5	Understand the different metal joining processes and to study about the inspection of joints.

Mapping of course outcomes with program outcomes

21ME33	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
21ME33.1	3	1	-	-	-	-	-	-	-	-	-	-	1	1	2
21ME33.2	3	1	-	-	-	-	-	-	-	-	-	-	1	1	2
21ME33.3	3	1	-	-	-	-	-	-	-	-	-	-	1	1	2
21ME33.4	3	1	-	-	-	-	-	-	-	-	-	-	1	1	2
21ME33.5	3	1	-	-	-	-	-	-	-	-	-	-	1	1	2
Avg. Mapping	3	1	-	-	-	-	-	-	-	-	-	-	1	1	2

QUESTION PAPER PATTERN:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module

TEXT BOOKS:

1. "Manufacturing Process-I", Dr.K.Radhakrishna, Sapna Book House,5th Revised Edition 2009.
2. "Manufacturing & Technology: Foundry Forming and Welding",P.N.Rao, 3rd Ed., Tata McGraw
3. Machine tools & operations, AnupGoel, Technical publications,2nd edition 2018.
4. Machine tools and operations, Sagar M. Baligidad, Sunsatar publishers,1st edition 2017.
5. Metal cutting and machine tool engineering, Pakirappa, Durga publishing house, 3rd edition 2015
6. Manufacturing process-2, Kestoor Praveen, Suggi publishing,5th edition 2013.

REFERENCE BOOKS:

1. "Process and Materials of Manufacturing", Roy A Lindberg, 4th Ed.PearsonEdu. 2006.
2. "Manufacturing Technology", SeropeKalpakjian, Pearson Education Asia, 5th Ed. 2006.
3. "Principles of metal casting", Rechard W. Heine, Carl R. LoperJr., Philip C. Rosenthal, Tata McGraw Hill Education Private Limited Ed.1976
4. Fundamental of Machining and Machine Tools, Geoffrey Boothroyd and Winston A. Knight, CRC Taylor& Francis, Third Edition.
5. All about Machine Tools, Heinrich Gerling, New Age revised 2nd Edition, 2006
6. Metal cutting principles, Milton C. Shaw, Oxford University Press, Second Edition,2005.

E-RESOURCES :

1. https://onlinecourses.nptel.ac.in/noc24_me48/preview
2.https://www.pdfdrive.com/metal-shaping-processes-casting-and-molding-particulate-processing-deformation-processes-and-metal-removal-d175278664.html

MATERIAL SCIENCE						
Course Code	**21ME34**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	3	**0**	**0**	**3**		

Number of Lecture Hours	40	Exam Hours	03
Credits-03			

Course Objectives: This course will enable students.
• Exemplify different engineering materials and their metallurgical properties.
• Interpret different alloy phase diagrams, particularly Iron-Iron Carbide phase diagram
• Distinguish different ferrous and non-ferrous metals based on their microstructure.
• Summarize different properties and applications of ceramics, polymers, composites and advanced materials.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Basics, Mechanical Behavior, Failure of Materials:** **Structure of Metals:** Simple Cubic, BCC, FCC and HCP Structures, Coordination number, atomic Packing Efficiency, Crystal imperfections – point, line, surface and volume imperfections, Atomic Diffusion: Phenomenon, Fick's laws of diffusion; Factors affecting diffusion. **Mechanical Behavior**: Concepts of stress and strain: tension test, compression tests, shear and torsion tests, elastic deformation stress–strain behavior, elasticity, elastic properties of materials, plastic deformation: tensile properties, ultimate tensile strength, ductility, resilience, toughness, true stress and strain, and elastic recovery after plastic deformation.	08	L1, L2
2	**Fracture, Fatigue, Creep and Mechanisms of strengthening in metals: Fracture:** Fundamentals of fracture, ductile fracture, brittle fracture, ductile-to-brittle transition **Fatigue:** Types of fatigue loading with examples, Mechanism of fatigue, Fatigue properties, S-N diagram, Fatigue testing **Creep:** Description of the phenomenon with examples, three stages of creep, creep properties, Stress relaxation. Concept of fracture toughness. **Mechanisms of strengthening in metals:** Strengthening by grain size reduction, solid-solution strengthening, strain hardening, Recovery, re-crystallization, and grain growth.	08	L1, L2, L3
3	**Alloys, Phase diagrams and Iron-carbon diagram: Alloys:** Concept of formation of alloys, Types of alloys, solid solutions, factors affecting solid solubility (Hume Rothery rules), Binary phase diagrams: Eutectic, and Eutectoid systems, Lever rule. **Phase Diagrams:** Definitions and basic concepts: solubility limit, phases, microstructure, phase equilibria, one-component (or unary) Phase diagrams. **Iron carbon system** - The iron–iron carbide ($Fe–Fe_3C$) phase diagram, development of microstructure in iron–carbon alloys, hypoeutectoid alloys, hypereutectoid alloys, nonequilibrium cooling, the influence of other alloying elements.	08	L1, L2, L3

4	**Heat treatment, Ferrous and Non-ferrous materials: Heat treatment of metals:** Heat treating of metals: Time-Temperature-Transformation (TTT) curves, Continuous Cooling Transformation (CCT) curves, Annealing: Recovery, Re-crystallization and Grain growth, Types of annealing, Normalizing, Hardening, Tempering, Mar tempering, austempering, Concept of hardenability, Factors affecting it harden ability, surface hardening methods: carburizing, cyaniding, nitriding, flame hardening and induction hardening, Age hardening of aluminum-copper alloys and PH steels. **Ferrous materials:** Properties, Compositions and uses of Grey cast iron, white cast iron, Malleable iron, SG iron and steel. **Non-ferrous Metals and Alloys**: Structure and properties of copper and its alloys, Aluminum and its alloys, Al-Cu phase diagram, Titanium and its alloys.	**08**	**L1, L2, L3**
5	**Advanced Materials: Composite materials:** **Composite materials** - Definition, classification, types of matrix materials & reinforcements, Metal Matrix Composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs), Particulate-reinforced and fiber-reinforced composites, Fundamentals of production of composites, Processes for production of composites. **Other materials:** Smart materials, shape Memory alloys and nano-material properties and applications.	**08**	**L1, L2**

COURSE OUTCOMES: At the end of the course the student will be able to:

21ME34.1	To know the atomic structure, crystal imperfections & mechanical behavior of metals.
21ME34.2	Describe the mechanical properties of metals, their alloys and various modes of failure. Also, Various modes of strengthening mechanism.
21ME34.3	Understand the microstructures of ferrous and non-ferrous materials to mechanical properties.
21ME34.4	Describe the concept of heat treatment upon various ferrous & Non-ferrous alloys.
21ME34.5	Know about composite materials, smart materials, shape memory alloys and Nano materials and their processing as well as applications.

Mapping of course outcomes with program outcomes

21ME34	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
21ME34.1	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
21ME34.2	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
21ME34.3	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
21ME34.4	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1

21ME34.5	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
Avg. Mapping	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1

QUESTION PAPER PATTERN:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TEXT BOOKS:

1. Mechanical Metallurgy/G E Dieter/ Tata McGraw-Hill/1997.
2. Introduction to Physical Metallurgy / Sidney H. Avener/3rd Edition / Tata McGraw – hill/2012.

REFERENCE BOOKS:

1. Material Science and Metallurgy for Engineers/ Kodgire V. D / Everest Publishing House/2011.
2. Science of Engineering Materials / B.K. Agarwal/ Tata McGraw –Hill/1988.
3. Materials Science and engineering / William and collister/8th Edition/ Wiley.

E-RESOURCES

https://archive.nptel.ac.in/courses/112/108/112108150/

Computer Aided Machine Drawing [CAMD]						
Course Code	**21MEL35**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	1	**0**	**4**	**5**		
Number of Lecture Hours	**40**				**Exam Hours**	**03**
Credits-03						

Course Objectives: This course will enable students.
To introduce students to the basics of standards of engineering drawing related to machine components.
To enhance students' technical skills regarding orthographic views conversion, part modeling and assembly
To impart student knowledge of threads forms, fasteners, riveted joints and shaft joints
To make student understand the use of limits, fits and tolerances pertaining to machine drawing in industries.
To help students to gain knowledge about CAD software in drafting, modeling and assembly of machine components.

MODULE NO.	**TOPICS**	**TEACHING HOURS**	**RBT LEVELS**
1	**Sections of Solids**: Sections of Pyramids, Prisms, Cubes, Cones and Cylinders resting only on their bases. (No problems	**06**	**L1,L2,L3**

	on axis inclination, hollow solids and spheres), True shape of the sections. **Orthographic views**: Conversion of pictorial views into orthographic projections of simple machine parts without section		
2	**Thread forms**: Thread terminology, sectional views of threads, ISO Metric (Internal & External), BSW, American Standard thread, Square, Acme thread, Buttress thread **Fasteners:** Hexagonal headed bolt and nut with washer (assembled view), square headed bolt and nut with washer (assembled view).	**06**	**L1,L2,L3**
3	**Riveted joints:** Single and double riveted lap joints, Butt joints with single/double cover straps (Chain and zigzag using snap head rivets) **Shaft joints:** Cotter joint (socket and spigot), Knuckle joint (pin joint).	**08**	**L1,L2,L3**
4	**Keys:** Parallel key, Taper key, Feather key, Gib-head key and Woodruff key. **Couplings:** Split muff coupling, protected type flange coupling, Universal coupling (Hook's Joint).	**08**	**L1,L2,L3**
5	**Assembly Drawings:** **Limits, Fits and Tolerances**: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, Types of fits with symbols and applications, Geometrical tolerances on drawings, Standards followed in industry. **Assembly Drawings: (Part drawings shall be given)** 1. Screw Jack (Bottle type) 2. Plummer block (Pedestal Bearing) 3. Machine vice 4. Gland and Stuffing box	**12**	**L1,L2,L3**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	Students will able to understand sectional views of solid objects and also understand the conversion of 3-Dimentional model into 2-Dimensional drawings
CO.2	Students will able to understand and draw three views of bolt and nut with standard proportions, and also able to recognize the various profiles of thread forms used on the bolt and nut
CO.3	Students will be able to understand and draw the assembled two views of riveted joints, knuckle joint and cotter joint with standard proportions
CO.4	Students will have the fundamental knowledge about the basic concepts of Limits, Fits and Tolerances and also able to understand and draw the assembled two views of couplings.
CO.5	Students can able to understand and ability to re-create detailed part drawings and assembly of Screw jack, Plummer Block, Machine vice, Gland and stuffing box

Mapping of course outcomes with program outcomes

21MEL35	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS0 1**	**PSO 2**	**PSO 3**
CO.1	2	1	2	-	2	-	-	-	-	2	-	2	2	2	-
CO.2	2	1	2	-	2	-	-	-	-	2	-	1	2	2	-
CO.3	2	1	2	-	2	-	-	-	-	2	-	1	2	2	-

CO.4	1	1	2	-	2	-	-	-	-	2	-	1	2	2	-
CO.5	2	2	3	-	1	-	-	-	-	2	-	2	2	3	-

High-3: Medium-2: Low-1

QUESTION PAPER PATTERN:

SCHEME OF EVALUATION FOR CIE (50 MARKS)

Class work (Sketching and Computer drawing printouts in A4 sheets): 35Marks.

(b) Internal Assessment test in the same pattern as that of the main examination: 15 marks.

SCHEME OF SEE EXAMINATION (50 MARKS)

Student has to solve three questions; pattern of questions are as follows

Question no	Modules	Marks
Q1	Module 01 OR Module 02	25
Q2	Module 03 OR Module 04	25
Q3	Module 5(Assembly) Or Module 5 (Assembly)	50
Total		**100**

NOTE:

1. No restriction of timing for sketching/ computerization of solutions. The total duration is 3 hours.
2. It is desirable to do sketching of all the solutions before computerization.
3. Drawing instruments may be used for sketching.
4. For Q1, and Q2, 2D drafting environment should be used.
5. For assembly 3D part modeling and assembly should be used and extract 2D views.
6. Evaluation is to be done on 40:60 basis (40% sketching, 60% Computerization)

TEXT BOOKS:

"A Text Book of Computer Aided Machine Drawing", S. Trymbakaa Murthy, CBS Publishers, New Delhi, 2007.

'Machine Drawing', N.Siddeshwar, P.Kannaih, V.V.S. Sastri, published by Tata Mc.Grawhill, 2006.

REFERENCE BOOKS:

'Machine Drawing', N.D.Bhat&V.M.Panchal, Published by Charotar Publishing House, 1999.

2. 'Machine Drawing', K.R. Gopala Krishna, Subhash publication.

E-RESOURCES:

NPTEL videos.

MATERIAL SCIENCE LAB						
Course Code	**21MEL36**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students to
To learn the concept of the preparation of samples to perform characterization such as microstructure, volume fraction of phases and grain size.
Calculate the various Mechanical properties of materials such as tensile, flexural, compression Strength and Hardness.
To learn material failure modes and the different loads causing failure.
To learn the concepts of improving the mechanical properties of materials by different methods like heat treatment, surface treatment etc.

MODULE NO.	**TOPICS**	**TEACHING HOURS**	**RBT LEVELS**
PART – A	1. Preparation of specimen for Metallographic examination of different engineering materials. To report microstructures of (a) plain carbon steel, (b) tool steel, (c) gray C.I, (d) SG iron, (e) Brass, (f) Bronze (g) composites. 2. Brinell hardness test on metals 3.Rockwell hardness test on metals 4. Vickers's Hardness test on metals	**12**	**L1, L2**
PART – B	1. Tensile, shear and compression tests of metallic and wooden material specimens using Universal Testing Machine. 2. Bending Test on wooden specimen. 3. Torsion Test on steel bar. 4. Izod and Charpy Tests on Mild steel specimen. 5. Fatigue Test (Demonstration only).	**12**	**L1, L2**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	Acquire experimentation skills in the field of material testing.
CO.2	Develop theoretical understanding of the mechanical properties of materials by performing experiments.
CO.3	Apply the knowledge to analyze a material failure and determine the failure inducing agent/s.
CO.4	Apply the knowledge of testing methods in related areas.
CO.5	Know how to improve structure/behavior of materials for various industrial applications.

Mapping of course outcomes with program outcomes

21MEL36	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	3	2	-	-	-	-	-	-	1	1	-	-	-	-	2
CO.2	3	2	-	-	-	-	-	-	2	1	-	-	-	-	2
CO.3	3	3	-	-	-	-	-	-	2	1	-	-	-	-	1
CO.4	3	2	-	-	-	-	-	-	2	2	-	-	-	-	3
CO.5	3	1	-	-	-	-	-	-	1	2	-	-	-	-	2

High-3: Medium-2: Low-1

QUESTION PAPER PATTERN:
ONE question from part -A: 30 Marks
ONE question from part -B: 50 Marks
Viva -Voice: 20 Marks
Total: 100 Marks

WORK SHOP PRACTICE LAB						
Course Code	**21MEL37**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students to
• To impart knowledge and skill to use tools, machines, equipment, and measuring instruments.
• Also Educate students of Safe handling of machines and tools.

MODULE NO.	**TOPICS**	**TEACHING HOURS**	**RBT LEVELS**
	PART - A	**12**	**L1, L2**
1. Demonstration on use of Hand Tools: V-block, Marking Gauge,Files, Hack Saw, Drills, Taps. (Minimum three models involving Dovetail joint,Triangular joint and semicircular joint) 2. Sheet Metal & Soldering Work: Development & Soldering of the models: Tray, Frustum of cone, Prism (Hexagon &Pentagon), Truncated Square Pyramid, Funnel.			
	PART - B	**12**	**L1, L2**
1. Welding: Study of electric arc welding tools &equipment's,Models: Butt Joint, Lap Joint, and T joint &L joint. 2. Knowing Safety procedures and precautions in workshop.			

COURSE OUTCOMES: At the end of the course the student will be able to:

21MEL37.1	Fabricate different types of fitting models and sheet metal models
21MEL37.2	Gain knowledge of joining process through welding

Mapping of course outcomes with program outcomes

22MEL37	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS0 1**	**PSO 2**	**PSO 3**
22MEL37.1	3	2	-	-	1	-	-	-	-	1	-	-	2	1	1
22MEL37.2	3	2	-	-	1	-	-	-	-	2	-	-	2	1	1
Avg. Mapping	3	2	-	-	1	-	-	-	-	1	-	-	2	1	1

Text book:

1. Elements of Workshop Technology: VolI: Manufacturing Processes, S K Hajra.Choudhury, A K. Hajra Choudhury,15th Edition Reprinted 2013, Media Promoters &Publishers Pvt Ltd., Mumbai.

Reference Book:

1. A Textbook of Workshop Technology: Manufacturing Processes by R S Khurmi, 16th edition, S. Chand Publishing.

2. Workshop Technology Part 1: volume 1 fifth edition, W. A. J. Chapman, Published January 1st 1972 by Elsevier Science.

3. Introduction to Basic Manufacturing Process & Workshop Technology Singh, Rajender, 2nd edition, new age international, Jan,2010.

Scheme of SEE Examination:

Questions	Marks
ONE model from part –A	15
ONE model from part -B	25
Viva -Voice:	10
Total:	50

PROJECT-III						
CourseCode	**21MEMP38**				**CIE Marks**	**50**
NumberLecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
NumberofLectureHours	**24**				**ExamHours**	**03**
Credits-01						

CourseObjectives: Thiscoursewill enablestudents to

1.To introduce fundamental concepts and analysis techniques in engineering to students across all disciplines.
2.UNDERSTAND the "Product Development Cycle", through Mini Project.
3. PLAN for various activities of the project and distribute the work amongst team members.
4. LEARN budget planning for the project.
5. Preparation for Industrial Challenges

Projectwork:

Basedontheability/abilitiesofthestudent/sandrecommendationsofthementor,asingledisciplineora multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than4 students.

COURSEOUTCOMES: Attheend ofthe coursethe student willbe ableto:

CO.1	Tobeableto applyknowledgeofengineering toalogicallychosen problem.
CO.2	Tobeabletopreparecompletefeasibilityreportforpracticalproblem
CO.3	To beable to synthesizethefindings to asuitableconclusion
CO.4	Topresent thefindings inthe formoftechnical report
CO.5	To Problem-Solving and Debugging Skills

Mappingofcourseoutcomeswithprogram outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	3	2	-	-	-	-	-	-	2	-	2	-	3	-	1
CO.2	3	2	-	-	-	-	-	-	2	-	2	-	3	-	1
CO.3	3	3	-	-	-	-	-	-	2	-	2	-	3	-	1
CO.4	3	2	-	-	-	-	-	-	2	-	2	-	2	-	1
CO.5	3	2	-	-	-	-	-	-	2	-	2	-	2	-	1

High-3:Medium-2:Low-1

ASSESMENTAND EVALUATION

SCHEMEOFEVALUATIONFORCIE (50MARKS)

SL.NO	Modules	Marks
1	Designandfabricationof thesystem/project	25
2	Evaluationofprojectreportbythedepartment	15
3	Mockevaluation/presentation	10
Total		**50**

SCHEMEOFSEEEXAMINATION(50MARKS)

Studenthasto solvethreequestions; patternofquestions areasfollows

Questionno	Modules	Marks
Q1	Designandfabricationof thesystem/project	25
Q2	Evaluationofprojectreportbythedepartment	15
Q3	Mockevaluation/presentation	10
Total		**50**

NOTE:

- TheSEEfortheProjectshallbeevaluated bytwo examinersjointlyandtheevaluation shallbebasedonvariouscomponentssuchas,WritingofAbstract,Projectreport,Oral Presentation, Demonstration and Viva-voce.
- Projectreporthas tobepreparedas pertheuniversityguidelines (outline).

FUNDAMENTALS OF FLUID MECHANICS						
Course Code	**21ME42**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	2	**1**	**0**	**3**		
Number of Lecture Hours	**40**				**Exam Hours**	**03**
Credits-03						

Course Objectives: This course will enable students to
• To understand the basic principles and fundamental concepts of fluid mechanics, also to understand concept of pressure and its measurement
• To make the students understand the concept and apply the various laws solving the fluid engineering problems
• To make the students familiar with measurements and visualization of fluid flow, kinematics.
• To understand various laws governing fluiddynamics and their applications.
• To understand the concept of dynamic similarity and experimental modeling.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	Basics concepts and definitions: Introduction, Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapour pressure, compressibility and bulk modulus. Concept of continuum, types of fluids, pressure at a point in the static mass of fluid, variation of pressure, Pascal's law, absolute, gauge, atmospheric and vacuum pressures. Pressure measurement by simple, differential manometers, mechanical gauges and numerical.	**08**	**L1,L2,L3**
2	Fluid Statics: Hydrostatic forces on submerged horizontal plane, vertical plane and inclined planet determine total pressure and center of pressure in static fluid. Buoyancy, center of buoyancy, meta center and metacentric height its application in shipping, stability of floating bodies.	**08**	**L1,L2,L3**
3	Fluid Kinematics: Types of flows -steady, unsteady, uniform, non-uniform, laminar, turbulent, one-two and three dimensional, compressible, incompressible, rotational, irrational, stream lines, path lines, streak lines, velocity components, convective and local acceleration, velocity potential, stream function, continuity equation in Cartesian co-ordinates.	**08**	**L1,L2,L3**

	Types of Motion, vorticity and rotationality; comparison of two circular flows, rotation, vorticity and circulation, Laplace equation in velocity potential and Poisson's equation in stream function, flow net and numerical.		
4	Fluid Dynamics: Introduction to conservation of mass equation of motion, Euler's equation of motion, Bernoulli's equation, Bernoulli's theorem, application of Bernoulli's theorem on venture meter, orifice meter, rectangular and triangular notch, pitot tube, orifices and limitations and numerical. Momentum equation for flow systems: Newton's laws and conservation of momentum; choosing a control volume; forces acting on a control volume; the linear momentum equation and its application on force on pipe bend and numerical.	**08**	**L1,L2,L3**
5	Flow through pipes: Minor losses through pipes. Darcy's and Chezy's equation for loss of head due to friction in pipes. Hydraulic Gradient Line and Total Energy Line. Laminar flow and viscous effects: Reynolds number, critical Reynolds number, laminar flow through circular pipe, Hagen-Poiseuille equation, laminar flow between parallel and stationary plates. Dimensional Analysis: Introduction, dimensions of physical quantities, dimensional homogeneity, Buckingham Pi-theorem, dimensionless numbers, similitudes, Reynolds model law, Mach model law.	**08**	**L1,L2,L3**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	To analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.
CO.2	To understand fluid properties and their significance, concept of fluid pressure and related measurement devices there by solving some related numerical.
CO.3	To visualize different types of fluid flow, and compare them based on kinematic flow descriptions.
CO.4	To understand how mass and momentum is conserved based on Bernoulli's & Newton's laws, its applications and solve some simple numerical.
CO.5	To understand the concept of laminar and turbulent flows, flow through pipe quantity head losses for flow through pipes and also understand and solve numerical on modeling.

Mapping of course outcomes with program outcomes

21ME42	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS0 1**	**PSO 2**	**PSO 3**

21ME42.1	3	2	1	1	-	-	-	-	-	-	-	1	2	2	1
21ME42.2	3	2	2	1	-	-	-	-	-	-	-	1	2	2	1
21ME42.3	3	2	2	1	-	-	-	-	-	-	-	1	2	2	1
21ME42.4	3	2	2	1	-	-	-	-	-	-	-	1	2	2	2
21ME42.5	3	2	2	1	-	-	-	-	-	-	-	1	2	2	2

QUESTION PAPER PATTERN:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module

TEXT BOOKS:

1.Fluid Mechanics(SI units),Yunus A Cengel John M.Cimbala,2nd Ed,Tata McGraw Hill
2.Fluid Mechanics, Dr.Bansal,R.K. Lakshmi Publications,2004
3.Streeter V L,Benjamin Wylie E,Bedford K W Fluid Mechanics,WCB/Mcgraw Hill1998.

REFERENCE BOOKS:

1.Fluid Mechanics, Oijus.K.Kundu,IRAM COCHEN, Elsevier, 3rd
2.Fluid Mechanic,John F, Douglas, Janul and M.Gasiosek and john A.Swaffield, Pearson Education Asia, 5th Ed, 2006.
3. Fluid Mechanics and Fluid Power Engineering, Kumar.D.S, Kataria and Sons,2004
4.Fluid Mechanics- Merle C,.Potter, Elaine P.Scott. Cengage learning

E-RESOURCES :

1. https://archive.nptel.ac.in/courses/112/105/112105269/
2. Unacademy.com/content/gate/study-material/civil-engineering/fluid-mechanics/

APPLIED THERMODYNAMICS						
Course Code	**21ME43**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	3	**1**	**0**	**4**		
Number of Lecture Hours	**50**				**Exam Hours**	**03**
Credits-4						

Course Objectives: This course will enable students to
• To introduce student about application of thermodynamics using gas power cycles.
• To study basic concepts of combustion of fuels and performance of SI, CIengine
• To study the basics of rankings cycle applied to steam turbines and also the concept of refrigeration and usage of psychrometric charts.
• To study the basics of velocity diagram for different kinds of steam turbines
• To study the different kindsof compressors and their related efficiency

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Gas power cycle:** Air Standard cycles and assumptions: Carnot, Otto, Diesel, Dual and Stirlingcycles,P-Vand T-S diagrams, description, efficiencies, related numerical problems. Mean effective pressures: Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto,Diesel and Dual cycles, related numerical problems.	**10**	**L1, L2, L3**
2	**Fuels & Combustion of Fuels:**Introduction to fuels, types of fuel, calorific value of fuels, Bomb Calorimeter, combustion of fuels, Theoretical (Stoichiometric) amount of Oxygen / Air required for complete combustion of fuel, Air-Fuel ratio, Excess air, percentage of excess air, mass balance, conversion of volumetric analysis to mass analysis and vice-versa**(No Numerical Treatment on fuels and combustion, only basic definitions and terminologies to be covered)** **I.C. Engine**: Introduction, classification and application I C engine, combustion in S.I. engine, factor effecting ignition lag, flame propagation, detonation or knocking in S I engine, effects of knocking, factor effecting knocking, rating of S I engine fuel, combustion in C.I. engine, delay period, knocking, rating of C I engine fuels, Testing of two stroke and four stroke SI and CI engines for performance relatednumerical problems (engine performance parameters), heat balance, Motoring Method, Willian's line method, Morse test, related numerical problems.	**10**	**L1, L2, L3, L4**

3	**Vapor Power cycles:** Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters (open and closed), Combined cycles, numerical problems. **Refrigeration and Psychometry:** Introduction, COP, unit of refrigeration and performance factor, refrigerator and heat pump, required properties of ideal refrigerant, important of refrigerants, Air refrigeration: Carnot cycle, bell-Coleman cycle. Introduction, psychrometry and psychrometric properties, psychometric relation, chart, and psychometric process**. (simple problems on refrigeration and psychrometry)**	**10**	**L1, L2, L3, L4**
4	**Impulse Turbines:** Principles of operation, Classification, Impulse and reaction steam turbine, compounding of steam turbines, Velocity diagrams, Work done, Efficiencies, End thrust, Blade friction, Influence of ratio of blade speed to steam speed on efficiency of single turbines and its condition curve and reheat factors. related numerical problems. **Reaction Turbines** Flow through impulse reaction blades, Velocity diagram, and degree of reaction, Parson's reaction turbine, Performance of steam turbines, related numerical problems.	**10**	**L1, L2, L3, L4**
5	**Compressors**: Introduction, working of reciprocating air compressor, air compressor terminology, Application of SFEE, work done by compressor with and without clearance, isothermal efficiency, volumetric efficiency, multi stage compressor, condition for minimum work, numerical problems. **Rotary Air Compressors**- Classification, Working and constructional centrifugal compressor and axial flow compressor.	**10**	**L1, L2, L3, L4**

COURSE OUTCOMES: At the end of the course the student will be able to:

21ME43.1	To identify and formulate power production based on the fundamental's laws of thermal engineering.
21ME43.2	Understand and analyze the cycles of internal combustion engines in order to perform heat, work and efficiency calculations.
21ME43.3	Understand concept of vapour power cycle and solve introductory problems on various cycle and also the concept of refrigeration and psychometric process.
21ME43.4	Understand, apply and analysis steam turbine velocity diagrams in order to determine stage calculations mathematically and graphically.
21ME43.5	Apply and analyze the single and multi-stage reciprocating air compressor cycles in order

	to carry out calculations on machine performance

Mapping of course outcomes with program outcomes

21ME43	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
21ME43.1	3	3	1	-	-	-	-	-	-	-	-	1	-	2	1
21ME43.2	3	3	1	-	-	-	-	-	-	-	-	1	-	2	1
21ME43.3	3	3	1	-	-	-	-	-	-	-	-	1	-	2	1
21ME43.4	3	3	1	-	-	-	-	-	-	-	-	1	-	2	1
21ME43.5	3	3	1	-	-	-	-	-	-	-	-	1	-	2	1
Avg. Mapping	3	3	1	-	-	-	-	-	-	-	-	1	-	2	1

QUESTION PAPER PATTERN:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module

TEXT BOOKS:

1. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2000
2. Kothandaraman.C.P, Domkundwar. S,Domkundwar. A.V., "A course in thermal Engineering",Fifth Edition," DhanpatRai& sons, 2002

REFERENCE BOOKS:

1. Basic and Applied Thermodynamics by P.K. Nag, MCGRAW HILL INDIA
2. Applied thermodynamics by Onkar Singh, New Age International
3. Applied Thermodynamics for Engineering Technologists by Eastop, PearsonEducation
4. Applied Thermodynamics by Venkanna And Swati, PHI

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/103/112103307/
2. https://unacademy.com/course/applied-thermodynamics-gate-mechanical/2824SZLX

INSTRUMENTATION AND METROLOGY						
Course Code	**21ME44**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	3	**0**	**0**	**3**		
Number of Lecture Hours	**40**				**Exam Hours**	**03**
Credits-03						

Course Objectives: This course will enable students.
• To introduce students to the basics of standards of engineering metrology
• To enhance students' technical skills regarding measurements and its instruments
• To understand the basic principles of linear and angular measurements.
• To make student understand the use of limits, fits and tolerances.
• To provide idea about principle and applications of devices for measurement of force, torque, pressure, flow and temperature.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Basics Of Metrology:** 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.	**06**	**L1,L2,L3**
2	**Linear And Angular Measurements**: 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 sine bar – Angle alignment telescope – Autocollimator – Applications.	**08**	**L1,L2,L3**
3	**Advances In Metrology**: Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.	**08**	**L1,L2,L3**
4	**Form Measurement**: Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.	**08**	**L1,L2,L3**

5	**Measurement Of Power, Flow and Temperature**: Force, torque, power – mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturi meter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration – Readability and Reliability.	**10**	**L1,L2,L3**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	Describe the concepts of measurements to apply in various metrological instruments.
CO.2	Outline the principles of linear and angular measurement tools used for industrial applications.
CO.3	Explain the procedure for conducting computer aided inspection.
CO.4	Demonstrate the techniques of form measurement used for industrial components.
CO.5	Discuss various measuring techniques of mechanical properties industrial applications.

Mapping of course outcomes with program outcomes

22ME44	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS0 1**	**PSO 2**	**PSO 3**
21ME44.1	2	1	-	1	1	-	-	-	-	1	-	2	1	2	1
21ME44.2	2	1	-	2	1	-	-	-	-	1	-	2	1	1	1
21ME44.3	2	2	-	1	2	-	-	-	-	1	-	2	1	2	1
21ME44.4	2	1	-	1	1	-	-	-	--	1	-	2	1	1	1
21ME44.5	2	1	-	1	1	-	-	-	-	1	-	2	1	2	1

QUESTION PAPER PATTERN:

SCHEME OF EVALUATION FOR CIE (50 MARKS)

(a) Solution of Assignment questions : 35Marks.

(b) Internal Assessment test in the same pattern as that of the SEE examination: 15 marks.

QUESTION PAPER PATTERNFOR SEE (50 MARKS)

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module

TEXT BOOKS:

1. Jain R.K. “Engineering Metrology”, Khanna Publishers.
2. Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005.

REFERENCE BOOKS:

1. Charles Reginald Shotbolt, “Metrology for Engineers”, 5th edition, Cengage Learning EMEA,1990.
2. Backwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education , 2006.

E-RESOURCES:

1. https://nptel.ac.in/courses/112106179

FLUID MECHANICS LAB						
Course Code	**21MEL45**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students to
• The students will be able to have hands on experience in flowmeasurements using different devices
• Also perform calculation related to losses in pipeperform characteristicvarious study of pumps, turbines etc

	PART A	**TEACHING HOURS**	**RBT LEVELS**
1	1) Study of taps, valves, pipe fittings, gauges, pitot tubes, water meters and current meters. 2) Calibration of Pressure gauges 3) Determination of metacentric height and radius of gyration of floating bodies. 4) Verification of Bernoulli's theorem 5) Reynolds experiment	**12**	**L1,L2**
	PART B		
2	6) Hydraulic coefficients of orifices and mouth pieces under constant head method and time of emptying method. 7) Determination of the Coefficient of discharge of given Orifice meter. 8) Determination of the Coefficient of discharge of given Venturi meter. 9) Determination of the Coefficient of discharge of given V-Notch 60^0, 90^0 and rectangular notch 10) Determination of force due to impact of jets. 11) Determination of friction factor for a given set of pipes. a) Major loss. b) Minor loss.	**12**	**L1,L2**

COURSE OUTCOMES: At the end of the course the student will be able to:

21MEL45.1	Ability to use the measurement equipment's for flow measurement.
21MEL45.2	The students will be able to understand the different flow measurement equipment's and their procedures

Mapping of course outcomes with program outcomes

21MEL45	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS0 1**	**PSO 2**	**PSO 3**

21MEL45.1	3	3	1	-	-	-	-	-	-	-	-	1	-	2	1
21MEL45.2	3	3	1	-	-	-	-	-	-	-	-	1	-	2	1
Avg. Mapping	3	3	1	-	-	-	-	-	-	-	-	1	-	2	1

Scheme of SEE Examination:

Questions	**Marks**
ONE model from part –A	15
ONE model from part -B	25
Viva -Voice:	10
Total:	50

E-RESOURCES:

1. https://archive.nptel.ac.in/courses/112/106/112106311/

INSTRUMENTATION AND MEASUREMENTS LABORATORY						
Course Code	**21MEL46**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students.
• To introduce students to the basics of conducting experiment in metrology
• To enhance students' technical skills regarding measurements and its instruments
• To understand the technical aspects of experiment.
• To make student understand the use instruments.
• To provide idea about principle and applications of devices for measurement of force, torque, pressure, flow and temperature.

PART A	**EXPERIMENTS**	**TEACHING HOURS**	**RBT LEVELS**
	Calibration of Pressure gauge	**12**	**L3,L4**
	Calibration of LVDT		
	Calibration of Thermocouples		
	Calibration of Load cell		
	Determination of modulus of elasticity of a mild steel specimen using strain gauges		
PART B	**EXPERIMENTS**	**12**	**L2,L3**
	Measurements using optical projector/Toolmaker's microscope		
	Measurements of angle using sine center/sine bar/bevel protractor		
	Measurements of alignment using Autocollimator / Roller set		
	Measurements of cutting tool forces using a) Lathe tool Dynamometer b) Drill tool Dynamometer.		
	Measurements of screw thread parameters using two wire or three wire method		
	Measurements of Surface roughness Using Tally surf / Mechanical Comparator		
	Measurements of gear tooth profile using gear tooth vernier.		
	Calibration of micrometer using slip gauges		

	Measurements of Flatness using optical flats		

COURSE OUTCOMES: At the end of the course the student will be able to:

21MEL46.1	Students will able to understand how to calibrate instruments using different techniques
21MEL46.2	Students will able to understand and make the measurements using different instruments

Mapping of course outcomes with program outcomes

21MEL46	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS01	PSO 2	PSO 3
21MEL46.1	2	2	1	1	2	-	-	-	2	-	-	2	2	3	2
21MEL46.2	2	2	1	1	2	-	-	-	2	-	-	2	2	3	2
Avg. Mapping	**2**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**2**	**3**	**2**

QUESTION PAPER PATTERN:

SCHEME OF SEE EXAMINATION (50 MARKS)

Student has to execute the experiment

Question no	Modules	Marks
Q1	PART-A	15
Q2	PART-B	25
Q3	VIVA-VOCE	10
	Total	**50**

Reference: LAB MANUAL

NOTE:

1. No restriction of timing for execution of experiment and calculation. The total duration is 3 hours.
2. It is desirable to write observations and procedures before conducting experiment.
3. Students need to follow all the safety measures.

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FOUNDRY AND FORGING LAB						
Course Code	**21MEL47**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students to
• To provide an insight into different sand preparation and foundry equipment's.
• To provide an insight into different forging tools and equipment's.
• To provide training to students to enhance their practical skills.
• To practically demonstrate precautions to be taken during casting and hot working.
• To develop team qualities and ethical principles.

	TOPICS	**TEACHING HOURS**	**RBT LEVELS**
	PART - A	**12**	**L1, L2**
Testing of Molding sand and Core sand Preparation of sand specimens and conduction of the following tests: 1. Compression, Shear and Tensile tests on Universal Sand Testing Machine. 2. Permeability test 3. Sieve Analysis to find Grain Fineness Number (GFN) of Base Sand 4. Clay content determination in Base Sand.			
	PART - B	**12**	**L1, L2**
2. Foundry Practice 1. Use of foundry tools and other equipment's. 2. Preparation of molding sand mixture. 3. Preparation of green sand molds using two molding boxes kept ready for pouring. • Using patterns (Single piece pattern and Split pattern) • Without patterns. • Preparation of one casting (Aluminum or cast iron-Demonstration only)			
	PART - C	**12**	**L1, L2**
3. Forging Operations: Use of forging tools and other equipment's • Calculation of length of the raw material required to prepare the model considering scale loss. • Preparing minimum three forged models involving upsetting, drawing and bending operations. • Demonstration of forging model using Power Hammer.			

COURSE OUTCOMES: At the end of the course the student will be able to:

21MEL47.1	Students enhance the skills of various skills of sand preparation, molding, & testing
21MEL47.2	Students able to understand foundry tools and Moulding sand mixture.
21MEL47.3	Students able to understand the forging tools and its models.
21MEL47.4	Students able to understand casting and hot working precautions
21MEL47.5	Students should have Ethical principles & qualities process

Mapping of course outcomes with program outcomes

21MEL47.1	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS0 1**	**PSO 2**	**PSO 3**
21MEL47.1	3	2	-	-	-	-	-	-	1	1	-	-	3	2	1
21MEL47.2	3	2	-	-	-	-	-	-	2	1	-	-	3	2	1
21MEL47.3	3	3	-	-	-	-	-	-	2	1	-	-	3	2	1
21MEL47.4	3	2	-	-	-	-	-	-	2	2	-	-	2	2	1
21MEL47.5	3	1	-	-	-	-	-	-	1	2	-	-	2	2	1
Avg. Mapping	3	2	-	-	-	-	-	-	1.6	1.4	-	-	2.6	2	1

Scheme of SEE Examination:

Questions	**Marks**
ONE model from part –A	15
ONE model from part –B or Part-C	25
Viva -Voice:	10
Total:	50

Reference: Lab Manual

PROJECT-IV						
Course Code	**21MEMP48**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**02**
Credits-01						

Course Objectives: This course will enable students.
• To study and apply the fundamental concepts of engineering.
• To enhance the innovative ideas based on engineering knowledge

	Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.	**24**	**L2,L3**
	Student can make projects based on single disciple or interdisciplinary with the suggestions from the guides allocated		

COURSE OUTCOMES: At the end of the course the student will be able to:

21MEMP48.1	Students will be able to know the emerging concepts.

Mapping of course outcomes with program outcomes

21MEMP 48	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
21MEMP 48.1	2	1	2	-	2	-	-	-	-	2	-	2	2	2	1
Avg. Mapping	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**2**	**1**

ASSESMENT AND EVALUATION

SCHEME OF EVALUATION FOR CIE (50 MARKS)

	Modules	Marks
1	Design and fabrication of the system/project	25
2	Evaluation of project report	15
3	Mock presentation	10

Total	50

SCHEME OF SEE EXAMINATION (50 MARKS)

- Student has to solve three questions; pattern of questions are as follows

Question no	Modules	Marks
Q1	Design and fabrication of the system/project	25
Q2	Evaluation of project report	15
Q3	Presentation-VIVA VOICE	10
	Total	50

NOTE:

- The SEE for the Project shall be evaluated by two examiners jointly and the evaluation shall be based on various components such as, Writing of Abstract, Project report, Oral Presentation, Demonstration and Viva-voce.
- Project report has to be prepared as per the university guidelines (outline).

NANO MATERIALS						
Course Code	**21AEC49B**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**00**
	1		**0**	**1**		
Number of Lecture Hours	**24**				**Exam Hours**	**00**
Credits-01						

Course Objectives: This course will enable students to
• In this course students will learn about the basics of nanoscale science
• In this course students will learn about the types of materials
• In this course students will learn about the engineering applications
• In this course students will learn about the hazards.
• In this course students will learn about the properties of nano materials

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	INTRODUCTIONTO NANOSCIENCE ANDNANOTECHNOLOGY History, background and interdisciplinary nature of nanoscience and nanotechnology, challenges of Rechard Feynman, scientific revolutions, nanosized effects surface to volume ratio, examples of surface to volume ratio, atomic structure, Bohr atomic model, molecules and phases,importance of nanoscale materials and their devices.	**05**	**L1,L2,L3**
2	CLASSIFICATION OF NANOSTRUCTURES Zero dimensional, one-dimensional and two-dimensional nanostructure materials - classification of solids: conductor, semiconductors, insulator, types of semiconductors, doping, diodes, current flow in semiconductors, ceramics and nanocomposites, quantum size effect(QSE) in 1D, 2D, 3D nanomaterials, quantum dots, nanowires, nanotubes, nanosheets, top down and bottom-up approach.	**05**	**L1,L2,L3**
3	INTRODUCTION TO NANOMATERIALS AND DEVICES Types of nanomaterials: Metal nanoparticles Eg Au, Ag, Cu, Pt and their application as FETs. Metal oxide nanoparticles TiO2, ZnO, SnO2 and their application in solar cells, MEMS based gas sensors, Semiconducting Cadmium and Selenide quantum dots bio imaging, Carbon based nanomaterials and their applications.	**05**	**L1,L2,L3**
4	INTRODUCTION TO NANOTOXICOLOGY:	**05**	**L1,L2,L3**

	Nanomaterials pollution – Nanomaterials in Environment - Toxicology of Airborne – Effect of Nanomaterials in the environment. Safety and pollution Control techniques-handling, storage, packaging, transportation and disposal.		
5	MECHANICAL PROPERTIES OF NANOMATERIALS Mechanical Stress- Strain curve, True Stress True strain, Hardness, compressive & tensile strengths, Fracture toughness Fatigue, Creep and other elastic properties of materials, Deformation behavior of Nanomaterials	**04**	**L1,L2,L3**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	Describe fundamentals of nanoscience and nanotechnology
CO.2	nano-structures
CO.3	Develop smart materials
CO.4	Explain nano toxicology
CO.5	Mechanical properties of Nano Materials

Mapping of course outcomes with program outcomes

21 AEC49B	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS0 1**	**PSO 2**	**PSO 3**
21AEC49B.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-	1
21AEC49B.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-	1
21AEC49B.3	2	1	-	-	-	-	-	-	-	-	-	-	1	-	1
21AEC49B.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-	1
21AEC49B.5	2	1	-	-	-	-	-	-	-	-	-	-	1	-	1

QUESTION PAPER PATTERN (ONLY CIE):

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module

TEXT BOOKS:

1. D. John Thiruvadigal, S. Ponnusamy, C. Preferencial Kala, M. Krishna Mohan, "Material Science" Vibrant Publications, 2014

2. Fundamentals of Material Science, Prasad Puthiyillam, Savitha Prasad, NarayanaHebbar, LAP-Lamber Academic Publishing, Mauritius, 2018. ISBN: 978-3-659-93009-6

REFERENCE BOOKS:

1.. Donald Askeland, PradeepFulay, Wendelin Wright, The Science & Engineering of Materials, 6 th Ed., Cengage Learning, 2011

2. Raghavan V. "Materials Science & Engineering – A First Course", 5th edition, Prentice Hall of India, New Delhi, 2005

E-RESOURCES:

1. https://nptel.ac.in/courses/118102003

PROJECT-IV						
CourseCode	**21MEMP48**				**CIE Marks**	**50**
NumberLecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
NumberofLectureHours	**24**				**ExamHours**	**03**
Credits-01						

CourseObjectives: Thiscoursewill enablestudents to

1.To introduce fundamental concepts and analysis techniques in engineering to students across all disciplines.
2.UNDERSTAND the "Product Development Cycle", through Mini Project.
3. PLAN for various activities of the project and distribute the work amongst team members.
4. LEARN budget planning for the project.
5. Preparation for Industrial Challenges

Projectwork:

Basedontheability/abilitiesofthestudent/sandrecommendationsofthementor,asingledisciplineora multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than4 students.

COURSEOUTCOMES: Attheend ofthe coursethe student willbe ableto:

CO.1	Tobeableto applyknowledgeofengineering toalogicallychosen problem.
CO.2	Tobeabletopreparecompletefeasibilityreportforpracticalproblem
CO.3	To beable to synthesizethefindings to asuitableconclusion
CO.4	Topresent thefindings inthe formoftechnical report
CO.5	To Problem-Solving and Debugging Skills

Mappingofcourseoutcomeswithprogram outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	3	2	-	-	-	-	-	-	2	-	2	-	3	-	1
CO.2	3	2	-	-	-	-	-	-	2	-	2	-	3	-	1
CO.3	3	3	-	-	-	-	-	-	2	-	2	-	3	-	1
CO.4	3	2	-	-	-	-	-	-	2	-	2	-	2	-	1
CO.5	3	2	-	-	-	-	-	-	2	-	2	-	2	-	1

High-3:Medium-2:Low-1

ASSESMENTAND EVALUATION

SCHEMEOFEVALUATIONFORCIE(50MARKS)

SL.NO	Modules	Marks
1	Designandfabricationof thesystem/project	25
2	Evaluationofprojectreportbythedepartment	15
3	Mockevaluation/presentation	10
Total		**50**

SCHEMEOFSEEEXAMINATION(50MARKS)

Studenthasto solvethreequestions; patternofquestions areasfollows

Questionno	**Modules**	**Marks**
Q1	Designandfabricationof thesystem/project	25
Q2	Evaluationofprojectreportbythedepartment	15
Q3	Mockevaluation/presentation	10
Total		**50**

NOTE:

- TheSEEfortheProjectshallbeevaluated bytwo examinersjointlyandtheevaluation shallbebasedonvariouscomponentssuchas,
- WritingofAbstract,Projectreport,Oral Presentation, Demonstration and Viva-voce.
- Projectreporthas tobepreparedas pertheuniversityguidelines (outline).

ManagementAndEntrepreneurship Development						
Course Code	**21HSMC51**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	3	**0**	**0**	**3**		
Number of Lecture Hours	**40**				**Exam Hours**	**03**
Credits-03						

Course Objectives: This course will enable students to
Explainfundamentalsmanagementfunctionsof a manager.Alsoexplainplanninganddecision-makingprocesses.
Explaintheorganizationalstructure,staffingand leadershipprocess.
Describetheunderstandingofmotivation anddifferentcontrol systemsinmanagement.
Explainunderstandingof EntrepreneurshipsandEntrepreneurshipdevelopmentprocess. IllustrateSmallScaleIndustries,varioustypesofsupportingagencies andfinancingavailable foranentrepreneur
IllustrateSmallScaleIndustries,varioustypesofsupportingagencies andfinancingavailable foranentrepreneur.
Summarizethepreparationofprojectreport,needsignificanceof report.

MODULE NO.	**TOPICS**	**TEACHING HOURS**	**RBT LEVELS**
1	**Introduction to Management and Entrepreneurship** - Meaning, nature and characteristics of management, scope and Functional areas of management, goals of management, levels of management, brief overview of evolution of management theories, Planning- Nature, importance, types of plans, steps in planning, Organizing- nature and purpose, types of Organization, Staffing- meaning, process of recruitment and selection.	**8 HOURS**	**L1 & L2**
2	**Organizing and Staffing:**Meaning of entrepreneur, characteristics of entrepreneurs, classification and types of entrepreneurs, various stages in entrepreneurial process,role of entrepreneurs in economic development, entrepreneurship in India and barriers to entrepreneurship. Identification of business opportunities, market feasibility study, technical feasibility study, financial feasibility study and social feasibility study.	**8 HOURS**	**L2 & L1**
3	**Social Responsibilities of Business**Meaning of project, project identification, project selection, project report, need and significance of project report, contents, formulation, guidelines by planning commission for project report, ERP and Functional areas of Management – Marketing / Sales- Supply ChainManagement –	**8 HOURS**	**L3 & L1**

	Finance and Accounting – Human Resources – Types of reports and methods of report generation.		
4	**Modern Small Business Enterprises:**Meaninganddefinition(evolution)Roleandimportance, PoliciesgoverningSMEsOrganizationalstructureStepsinsettingupas mallunit, SME funding. Requirements of capital (fixed and working), Factors determining capital requirements, Importance of fixed and working capital, Working capital management, Sources of finance for SME'S. Taxation benefits. SIDBI and SISI – Their role in the development of SMEs. Taxation benefits SIDBI and SISI – Their role in the development of SMEs. Marketing mechanism in SMEs Problems of SMEs and prospects Turnaround strategies for SMEs.	**8 HOURS**	**L2 & L3**
5	**Project Management:**Social Responsibility, Social Responsibility and Economic Performance, The Greening of Management – Social Obligation, Social Responsiveness and Social Responsibility, Value Based Management, Managerial Ethics, Different NGOs, Social Responsibility and Ethics Issues in Today's World.	**8 HOURS**	**L3 & L1**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	Define management, organization, entrepreneur, planning, staffing, ERP and outline their importance in entrepreneurship
CO.2	Utilize the resources available effectively through ERP
CO.3	Explain the organizational structure, staffing and leadership processes
CO.4	Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur
CO.5	Understands the Social Responsibility and Economic Performance

Mapping of course outcomes with program outcomes

21HSMC51	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO.2	1	2	-	2	2	2	-	-	-	-	-	-	-	1	-
CO.3	1	2	-	-	2	-	-	-	-	-	2	-	2	1	-
CO.4	1	2	-	-	-	-	-	-	-	-	-	2	2	1	-
CO.5	1	2	-	-	-	2	-	-	2	2	-	-	2	2	-

High-3: Medium-2: Low-1

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module

Text books:

1. Small scale industries and entrepreneurship, Dr. Vasant Desai, Himalayan Publishing House.
2. Principles of Management – P. C. Tripathi, P.N. Reddy – Tata McGraw Hill.
3. Dynamics of Entrepreneurial Development & Management-Vasant Desai , Himalaya Publishing House.
4. Entrepreneurship Development – Poornima. M. Charantimath, Small Business Enterprises – Pearson Education - 2006 (2 & 4).

Reference books:

1. Management Fundamentals - Concepts, Application, Skill Development – Robers Lusier, Thomson.
2. Entrepreneurship Development - S. S. Khanka, S. Chand & Co. New Delhi.
3. Management - Stephen Robbins, Pearson

E-Resources :

1. https://youtu.be/Tzzfd6168jk?si=0gKqxGZgfnpGM3U9
2. https://www.youtube.com/watch?v=Y5ZK97ggp20

V Semester: *Scheme 2021*

Theory Of Machines						
Course Code	**21ME52**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	3	**0**	**0**	**3**		
Number of Lecture Hours	**40**				**Exam Hours**	**03**
Credits-03						

Course Objectives: This course will enable students to
To provide detailed information about the basic's mechanisms and knowledge of various forces acting on mechanisms
To impart knowledge of velocity and acceleration analysis by different methods.
To impart the knowledge of static force analysis along with balancing of masses in different planes.
To provide basic knowledge of governors and gyroscope and its applications
To impart knowledge of vibrations and its applications

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Introduction**: Definitions: Link, kinematic pairs, kinematic chain, mechanism, structure, degrees of freedom, Classification links, Classification of pairs based on type of relative motion, Grubler's criterion, mobility of mechanism, Groshoff's criteria. **Mechanisms**: Quick return motion mechanisms-Drag link mechanism, 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, Ratchet and Pawl mechanism, toggle mechanism, pantograph, Ackerman steering gear mechanism, condition for correct steering	**8**	**L1**
2	**Velocity Analysis by Instantaneous Center Method**: Definition, Kennedy's theorem, Determination of linear and angular velocity using instantaneous center method. **Klein's Construction**: Analysis of velocity and acceleration of single slider crank mechanism.	**8**	**L1**
3	**Static force Analysis**: Static equilibrium. Equilibrium of two and three force members. Members with two forces and torque, free body diagrams, Static force analysis of four bar mechanism	**8**	**L3**

	and Slider-crank mechanism. **Balancing of Rotating 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		
4	**Governors**: Types of governors, force analysis of Porter and Hartnell governors. Controlling force, Stability, Sensitiveness, Isochronism, Effort and Power. Gyroscope: Vectorial representation of angular motion, **Gyroscopic couple**. Effect of gyroscopic couple on plane disc, aero plane, ship, stability of two wheelers and four wheelers, numerical problems.	**8**	**L1,L2**
5	**Introduction & Undamped free Vibrations (Single Degree of Freedom)**: Types of vibrations, Definitions, Simple Harmonic Motion (SHM), Work done by harmonic force, Principle of super position applied to SHM. Derivations for spring mass systems, Natural frequencies of simple systems, springs in series and parallel, Tensional and transverse vibrations, Effect of mass of spring and problems. **Vibration measuring instruments**: Sesmi instruments, Vibrometers, Accelerometer, Frequency measuring instruments, and simple numerical.	**8**	**L1,L2**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	Construct/Compose mechanisms to provide specific motion.
CO.2	To understand forces acting on the mechanisms
CO.3	To understand the balancing of machineries along with force analysis.
CO.4	To analyze the effect of a gyroscopic couple on Ship, Aeroplane and an Automobile.and study of Governors with numerical solutions.
CO.5	To understand basic of vibration for machine applications with frequency measurements.

Mapping of course outcomes with program outcomes

21ME52	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO.2	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO.3	3	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO.4	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO.5	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-

High-3: Medium-2: Low-1

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module

Text Books:

1. J B K DAS
2. "Theory of Machines" by R.S. Khurmi and J.K. Gupta
3. SADHU SINGH

Reference Books:

1. "Theory of Machines and Mechanisms" by John J. Uicker Jr., Gordon R. Pennock, and Joseph E. Shigley
2. R S KHRUMI
3. C S SHARMA
4. THOMAS BEVEN

E-Resources :

1. **https://archive.nptel.ac.in/courses/112/106/112106270/**

Turbo Machines						
Course Code	**21ME53**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	3	**1**	**0**	**4**		
Number of Lecture Hours	**50**				**Exam Hours**	**03**
Credits- 04						

Course Objectives: This course will enable students to
To familiarize the students with the main theories and tools for the interpretation of numerical and experimental results and the design techniques for advanced turbo machinery components.
The first part provides the basis for the more specialized studies in turbines or compressors in the second part of this course program. The formal lectures are completed with the aero design of advanced turbo machinery components to put the learned lessons into practice.
The targeted courses prepare the student for a position in a turbo machinery research centre or the R&D department of a turbo machinery manufacturer.
To learn the working principles of Impulse and Reaction water turbines and also to study its velocity triangles. To study design parameters related to Turbines
To understand the concept of Centrifugal pumps and its construction. To understand MPSH and NPSH terms related to centrifugal pumps.

MODULE NO.	**TOPICS**	**TEACHING HOURS**	**RBT LEVELS**
1	**Introduction**: Fluid machines, classification of fluid machines, Definition of turbomachine, parts of turbomachines, Classification of turbomachine, Comparison with positive displacement machines, Dimensional analysis, Application of dimensional analysis to a general fluid flow, significance of Pie terms, Effect of Reynold's number, Unit quantities, Hydraulic model analysis, Application of first and second laws of thermodynamics to turbomachines, Efficiencies of turbomachines. Problems.	**10**	**L1,L2,L3**
2	**Energy exchange in Turbomachines** : Euler's turbine equation, Alternate form of Euler's turbine equation, components of energy transfer, General Analysis of turbines (PGT): impulse, and reaction turbine, degree of reaction(R), efficiency and utilization factor, relation between degree of reaction and utilization factor. Power absorbing turbomachine (PAT): Axial flow machine (axial flow compressor, blower, pumps) energy transfer, Degree	**10**	**L1,L2,L3**

	of reaction (R), Radial Flow Machine (Centrifugal pumps, compressor, blowers) energy transfer, Degree of reaction (R), H-Q curve, types of centrifugal pump impeller, numerical.		
3	**Steam Turbines:** Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor for two stage, numerical problems. Reaction turbine – Parsons's turbine, condition for maximum utilization factor, reaction staging, problems.	**10**	**L1,L2,L3**
4	**Hydraulic Turbines:** Heads and efficiencies of hydraulic turbines, Pelton wheel: its velocity triangles, construction, working, work done and proportions of Pelton wheel, numerical problems (Calculation of bucket dimensions, Number of buckets, Jet diameter, Wheel diameter, Jet ratio, Speed ratio, Number of jets, efficiency, Reaction Turbine: (Francis and Kaplan turbine): its velocity triangles, construction, working, work done and proportions of reaction turbine, Draft tube, types of draft tube, numerical problem (calculation of various efficiencies, Power, Discharge, Blade angles, Runner dimensions etc.). Power, Discharge etc.), performance characteristics of turbine.	**10**	**L1,L2,L3**
5	**Centrifugal Pumps and Centrifugal Compressors:** Centrifugal Pumps: Introduction, types, construction and working of pump, velocity triangle, terminology of centrifugal pump, pump losses and efficiencies, work done by centrifugal pump, pre-rotation, slip and slip coefficient, minimum starting speed, Multistage pumps, casing of centrifugal pump, Cavitation, Maximum permissible suction head (MPSH) and Net positive suction head (NPSH). Priming. Methods of priming, performance characteristics of pumps. Centrifugal Compressors: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency, Chocking, Stalling, surging and problems. Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and Problems.	**10**	**L1,L2,L3**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	Understand the working concept of turbomachine and model studies
CO.2	Understand the application and analysis of turbine
CO.3	Understand working principle of impulse and reaction turbine
CO.4	Understand the concept of centrifugal pumps and various efficiencies related to it
CO.5	Understand the concept of centrifugal and axial compressors

Mapping of course outcomes with program outcomes

21ME53	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	2	1	-	-	1	-	-	-	-	-	-	-	1	-	-
CO.2	2	-	-	1	-	-	-	-	-	-	1	-	1	-	-
CO.3	2	-	1	-	-	-	-	-	-	-	-	-	1	-	-
CO.4	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO.5	2	-	-	-	-	-	-	-	1	-	-	-	1	-	-

High-3: Medium-2: Low-1

Question Paper Pattern:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module

Text Books:

1. **"**Turbo machines", S.M. Yahya, Tata Mc Graw Hill, 2005
2. "Fans, compressor and turbine", S. M. Yahya, Tata Mc Graw Hill, 2005

Reference Books:

1. Hydraulic Machines", V.P. Vasantdani, Khanna Publishers, 1996.2. "Fluid flow machines", N.S. Govind Rao, Tata McGraw-Hill,1983.
2. "Steam and gas Turbines", R. Yadav, Central Publishing House, Allahabad, 6th Edition, 1997.
3. "Gas Turbines", V. Ganeshan, Published by TMH Education Pvt. Ltd. , 3rd Edition.
4. "Thermal Engg.", Kumar vasantdani, Khanna publisher
5. "Thermal Engg.", P.L. Balleny, Khanna publisher. , 20th Edition
6. "Gas turbines and Compressor", Cohen and Rogers, Saravanamutto Publisher
7. "Thermodynamics and Heat Engines", R. Yadav, Vol-II, Central Publishing House.

E-Resources :

1. **https://archive.nptel.ac.in/courses/112/104/112104305/**

V Semester: *Scheme 2021*

Alternate Fuels & Hybrid Systems						
Course Code	**21ME542**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	3	**0**	**0**	**3**		
Number of Lecture Hours	**40**				**Exam Hours**	**03**
Credits-03						

Course Objectives: This course will enable students
To introduce students about the various alternative fuel sources.
To understand the conversion of vegetable oils into biodiesel and testing in the IC engine.
To understand the properties of Hydrogen and its performance in the IC engine.
To understand the properties of gaseous fuels and its performance in the IC engine.
To understand the technical knowledge about advanced vehicles and fuel cells.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Introduction to alternative fuels**: Need for alternative fuels, classification of fuels, characteristics of alternative fuels like ethanol, methanol, CNG, LPG, biodiesels for SI and CI engines. **Alcohols as fuels:** Introduction of alcohols as fuels**,** Production methods of alcohols, Chemical-Combustion and emission characteristics of alcohols, performance of alcohols in engine, fuel and engine modifications.	**08**	L1, L2,L3
2	**Vegetable oils and biodiesel:** Introduction of vegetable oils, types of vegetable oils and their important properties, methods of conversion of vegetable oils into biodiesel -micro emulsification, pyrolysis, transesterification, factors effecting transesterification process, engine modifications and performance of vegetable oils in engine.	**08**	L1, L2, L3
3	**Hydrogen as fuel:** Introduction to hydrogen, Production methods of hydrogen, combustive properties of hydrogen. Problems associated with hydrogen as fuel and solutions, Hydrogen storage-safety aspects of hydrogen. Engine modifications, performance and emissions characteristics of hydrogen as fuel in IC engine.	**08**	L1, L2, L3
4	**Biogas fuels:** Introduction to Biogas**,** Production methods (hydrolysis-fermentation-methane formation), properties of biogas, engine modifications, and performance and emissions	**08**	L1, L2, L3

	characteristics of biogas in IC engines. **LPG, CNG as fuel:** Introduction to LPG and CNG fuel, properties of LPG and CNG fuel, Engine modifications, performance and emissions characteristics of LPG, CNG fuel in IC engine**.**		
5	**Advanced vehicles: Electric drives vehicles (EV):** Components and layout of an Electric Vehicle- batteries, chargers, drives, and transmission and power devices. Hybrid electric Vehicle (HEV): System components, electronic control system – Different configurations of Hybrid vehicles. Power split devices. **Fuel Cells and Dual Fuel Technology (DFT):** Fuel Cells- Alkali, Molten Carbonate, Phosphoric Acid, Proton Exchange Membrane and Solid Oxide fuel cell fuel cell production, storage and applications, History of dual fuel technology, Applications of DFT. Dual fuel engine operation. Advantages and disadvantages of dual fuel technology.	**08**	L1, L2

COURSE OUTCOMES: At the end of the course,

CO.1	Students will able to understand nature of alternative fuels.
CO.2	Students will be able to understand extraction of fuel from vegetable oils.
CO.3	Students will be able to know, how hydrogen is used as fuel.
CO.4	Students will be able to understand the techniques in production of biofuels.
CO.5	Students can able to understand modern transport systems.

Mapping of course outcomes with program outcomes

21ME542	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO.1	3	1	-	-	1	1	-	-	-	-	-	-	1	-	-
CO.2	3	1	-	-	1	1	1	-	-	-	-	-	1	-	-
CO.3	3	1	-	-	1	1	1	-	-	-	-	-	1	-	-
CO.4	3	1	-	-	1	1	1	-	-	-	-	-	1	-	-
CO.5	3	1	-	-	1	1	1	-	-	-	-	-	1	-	-

High-3: Medium-2: Low-1

QUESTION PAPER PATTERN:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.

- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TEXT BOOKS:

1. Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer Verlag London Limited 2008, ISBN-13: 9781846289941.
2. Alternate Fuels by Dr. S. Thipse, Jaico Publications.

REFERENCE BOOKS:

1. Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.
2. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
3. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, N 0-76-80-0052-1.

E-RESOURCES:

NPETL videos and notes: https://archive.nptel.ac.in/course.html

Fluid Machines Lab						
Course Code	**21MEL56**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students to
To gain knowledge in performance testing of Hydraulic Turbines and Hydraulic Pumps at constant speed and Head.
To provide practical knowledge in verification of principles of fluid flow.
Enrich the concept of fluid mechanics and hydraulic machines.
Demonstrate the classical experiments in fluid mechanics and hydraulic machinery.
Discuss the performance characteristics of turbines and pumps.

UNIT		**TEACHING HOURS**	**RBT LEVELS**
PART-A	• To determine total head, pump output, overall efficiency and pump efficiency of Gear Pump Test Rig. • To determine total head, pump output, overall efficiency and pump efficiency of the submersible pump of Submersible Pump Test Rig • To find out discharge of useful water and waste water. To find out the efficiency of the Hydraulic ram of Hydraulic Ram Test Rig • To determine total head, pump output, overall efficiency and pump efficiency of the Jet pump • Pipes in Parallel and series, to study the pipes in parallel and series.	**12**	**L1,L2,L3**
PART-B	**Performance on hydraulic Turbines** • Pelton wheel • Francis Turbine • Kaplan Turbines **Performance hydraulic Pumps** • Single stage and Multi stage centrifugal pumps • Reciprocating pump • Performance test on a two stage Reciprocating Air Compressor • To show the velocity and pressure variation with radius in a forced vortex flow	**12**	**L1,L2,L3**

Course Outcomes: At the end of the course the student will be able to:

CO.1	Ability to use the measurement equipment's for flow measurement.
CO.2	The students will be able to understand the performance of hydraulic turbine and pumps under different working conditions
CO.3	Able to develop the skill of experimentation techniques for the study of flow phenomena in channels/pipes.
CO.4	To provide the students' knowledge in calculating performance analysis in turbines and pumps and can be used in power plants.
CO.5	Students can able to understand to analyze practical problems in all power plants and chemical industries

Mapping of course outcomes with program outcomes

21MEL56	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-
CO.2	1	1	-	-	-	-	-	-	-	-	-	-	-	1	-
CO.3	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-
CO.4	1	-	1	-	-	-	-	-	-	-	-	-	1	-	-
CO.5	-	-	-	-	-	1	1	-	-	-	-	-	-	-	1

High-3: Medium-2: Low-1

Question Paper Pattern:

- ONE question from part -A: 30 Marks
- ONE question from part B: 50 Marks
- Viva –Voice: 20 Marks
- Total : 100 Marks

V Semester: *Scheme 2021*

Machine Shop Lab						
Course Code	**21MEL57**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits- 1						

Course Objectives: This course will enable students to
To provide an insight to different machine tools, accessories and attachments.
To train students into machining operations to enrich their practical skills.
To inculcate team qualities and expose students to shop floor activities.
To educate students about ethical, environmental and safety standards.

	TOPICS	**TEACHING HOURS**	**RBT LEVELS**
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 .	**12**	**L1,L2,L3**
PART-B	Cutting of V Groove/ dovetail / Rectangular groove using a shaper. Cutting of Gear Teeth using Milling Machine.	**12**	**L1,L2,L3**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	Identify the parts of machines and differentiate different types of machine and tools in machine shop.
CO.2	Machine and tool setup for various machining operations.
CO.3	Perform various machining operations to change the shape of a given workpiece-Facing, drilling, turning, threading cutting knurling etc.
CO.4	Understand the safety precautions during machining processes.
CO.5	Perform operations on lathe, milling and shaper for various engineering applications.

Mapping of course outcomes with program outcomes

21MEL57	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-
CO.2	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-
CO.3	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-

CO.4	-	-	-	-	-	1	-	1	-	-	-	-	1	-	-
CO.5	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-

High-3: Medium-2: Low-1

QUESTION PAPER PATTERN:

- ONE question from part -A: 30 Marks
- ONE question from part B: 50 Marks
- Viva –Voice: 20 Marks
- Total : 100 Marks

Design Lab / Machine Dynamics Lab						
Course Code	**21MEL58**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits- 01						

Course Objectives: This course will enable students to
To understand the natural frequency, logarithmic decrement, damping ratio and damping.
To understand the balancing of rotating masses.
To understand the concept of the critical speed of a rotating shaft.
To understand the concept of stress concentration using Photo elasticity.
To understand the equilibrium speed, sensitiveness, power and effort of Governor.

UNIT		**TEACHING HOURS**	**RBT LEVELS**
PART-A	1. Determination of natural frequency, logarithmic decrement, damping ratio and damping Co- efficient in a single degree of freedom vibrating systems (longitudinal and torsional) 2. Determination of critical speed of rotating shaft. 3. Balancing of rotating masses. 4. Determination of fringe constant of Photo-elastic material using Circular disk subjected diametric compression, Pure bending specimen (four-point bending) 5. Determination of stress concentration using Photo elasticity for simple components like Plate with hole under tension or bending, circular disk with circular hole under compression, 2-d crane Hook	**12**	**L1,L2,L3**
PART-B	1. Determination of equilibrium speed, sensitiveness, power and effort of Porter/ Proel / Hartnell Governor. (at least one) 2. Determination of principle stresses and strain in a member subjected to combined loading using strain rosettes. 3. Determination of stresses in curved beam using strain gauge 4. Experiments on Gyroscope Experiment on Journal bearing ((Demonstration only)	**12**	**L1,L2,L3**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	To understand the working principles of machine elements such as Governors, Gyroscopes etc.,
CO.2	To identify forces and couples in rotating mechanical system components.
CO.3	To identify vibrations in machine elements and design appropriate damping methods and to determine the critical speed of a rotating shaft.
CO.4	To measure strain in various machine elements using strain gauges.
CO.5	To determine the minimum film thickness, load carrying capacity, frictional torque and pressure distribution of journal bearing.

Mapping of course outcomes with program outcomes

21MEL58	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO.3	2	-	1	-	-	-	-	-	-	-	-	-	1	-	-
CO.4	2	-	-	1	-	-	-	-	-	-	-	-	1	-	-
CO.5	2	-	1	-	-	-	-	-	-	-	-	-	1	-	-

High-3: Medium-2: Low-1

Question Paper Pattern:

- ONE question from part -A: 30 Marks
- ONE question from part B: 50 Marks
- Viva –Voice: 20 Marks
- Total : 100 Marks

PROJECT-V						
Course Code	**21PRJ59**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits- 01						

Course Objectives: This course will enable students to
To study and apply the fundamental concepts of engineering.
To enhance the innovative ideas based on engineering knowledge

TOPICS	TEACHING HOURS	RBT LEVELS
Mini-project work Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.	**24**	**L2,L3**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	To be able to apply knowledge of engineering to a logically chosen problem.
CO.2	To be able to prepare complete feasibility report for practical problem
CO.3	To be able to synthesize the findings to a suitable conclusion
CO.4	To present the findings in the form of technical report

Mapping of course outcomes with program outcomes

22MEL58	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO.2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO.3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO.4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-

High-3: Medium-2: Low-1

ASSESMENT AND EVALUATION
SCHEME OF EVALUATION FOR CIE (50 MARKS)

	Modules	Marks
1	Design and fabrication of the system/project	25
2	Evaluation of project report by the department	15
3	Mock evaluation/presentation	10
	Total	50

SCHEME OF SEE EXAMINATION (50 MARKS)

- Student has to solve three questions; pattern of questions are as follows

Question no	Modules	Marks
Q1	Design and fabrication of the system/project	25
Q2	Evaluation of project report by the department	15
Q3	Mock evaluation/presentation	10
	Total	50

NOTE:

- The SEE for the Project shall be evaluated by two examiners jointly and the evaluation shall be based on various components such as, Writing of Abstract, Project report, Oral Presentation, Demonstration and Viva-voce.
- Project report has to be prepared as per the university guidelines (outline).

V Semester: *Scheme 2021*

Introduction to Sand Moulding						
Course Code	**22AME551A**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**1**	**1**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students to
To provide students with the knowledge of sand properties
To provide students with the knowledge and necessary skills to perform gating system
To provide students with the knowledge and necessary skills to perform runner
To provide students with the knowledge and necessary skills to perform sand preparation of pattern.
To provide students with the knowledge and necessary skills to perform sand preparation of moulds.

Unit	TOPICS	TEACHING HOURS	RBT LEVELS
1	**To demonstrate the types of moulds and Moulding sand properties.**	**2**	**L1**
2	**Preparation of different types of gating system**	**2**	**L1,L2**
3	**Preparation of different types of runners and risers**	**2**	**L2**
4	**Preparation of moulds by sweep pattern ,loose piece pattern & wax pattern.**	**2**	**L2**
5	**Preparation of bench and Floor moulding**	**2**	**L2**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	Demonstrate the knowledge and necessary skills to understand properties of sand
CO.2	Demonstrate the knowledge and necessary skills to perform gating system
CO.3	Demonstrate the knowledge and necessary skills to perform runners and risers
CO.4	Demonstrate the knowledge and necessary skills to perform patterns
CO.5	Demonstrate the knowledge and necessary skills to perform mouldings

Mapping of course outcomes with program outcomes

22AME551A	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	2	-	1	-	-	-	-	-	-	-	-	-	1	-	1
CO.2	2	-	1	-	-	-	-	-	-	-	-	-	1	-	1
CO.3	2	-	1	-	-	-	-	-	-	-	-	-	1	-	1
CO.4	2	-	1	-	-	-	-	-	-	-	-	-	1	-	1
CO.5	2	-	1	-	-	-	-	-	-	-	-	-	1	-	1

QUESTION PAPER PATTERN:

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Vivavoce 20% of maximum marks.
- SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours

➢ TEXT BOOKS:

1. C. W. AmmenThe Complete Handbook of Sand Casting,By C. W. Ammen

2. Ghosh, A. and Mallik, A. K., (2017), Manufacturing Science, East-West Press

➢ REFERENCE BOOKS:

1. Little R. L. – 'Welding and Welding Technology' – Tata McGraw Hill Publishing Company Limited, New Delhi – 1989

E-RESOURCES :

1. https://archive.nptel.ac.in/courses/112/107/112107083/
2. (Link:http://www.springer.com/us/book/9781447151784http://nptel.ac.in/courses/112 105127/)

MECHANICSOFMATERIALS						
CourseCode	**21ME61**				**CIEMarks**	**50**
NumberLectureHour/Week	**L**	**T**	**P**	**TOTAL**	**SEEMarks**	**50**
	3	**0**	**0**	**3**		
NumberofLectureHours	**40**				**ExamHours**	**03**
Credits-03						

CourseObjectives: Thiscoursewillenablestudentsto

- Tostudydifferenttypesofstresses,strainanddeformationinducedinthemechanical componentsdue to external loads.
- TostudyPrincipalstresses,strainsandtopredictthestressdistributioninpressurevessels.
- Tostudythebehaviourofvariousbeamsunderdifferentloadingconditions.
- Tostudybehaviourofstructuralmembers in Torsion.
- Tounderstandstabilityofcolumns.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Simple Stress and Strain**: Introduction, Properties of Materials, stress, strain, Hook's law, Poisson's Ratio, Stress-Strain diagrams, Principles of superposition, totalelongation oftaperingbarsofcircularand rectangular cross sections. **Volumetricstrain**:Expressionforvolumetricstrain,elasticconstants relationship among Elastic constants, thermal stresses including compound bars.	**08**	**L1,L2,L3**
2	**Bi-axial Stress system**: Introduction, plane stress, stresses on inclined sections,principal stressesandmaximumshearstresses,graphicalmethod -Mohr'scircleforplane stress. **ThickandThincylinders**:Stressesinthincylinders, Lame'sequationfor thick cylinders subjected to internal and external pressures, Changes in dimensionsofcylinder(diameter,lengthandvolume),andsimple numerical.	**08**	**L1,L2,L3**
3	**Bending moment and Shear forces in beams**: Definition of beam – Typesofbeams– Conceptofshearforceandbendingmoment–S.Fand B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads – Point of contra flexure	**08**	**L1,L2,L3**

4	**StressinBeams**:Purebending,curvatureofbeam,Longitudinalstrain sin beams, Normal stresses in Beams with rectangular, circular, 'I' and 'T' cross sections, Flexure Formula, Bending Stresses. Simple numerical. **Torsionofshafts:**Assumptionsintheoryofpuretorsion,Torsion equations, torsional rigidity and modulus of rupture, Power transmitted, Comparison of solid and hollow circular shafts. Simple numerical.	**08**	**L1,L2,L3**
5	**Elasticstabilityofcolumns:**Introduction,bucklingandstability,criti cal load,columnswithpinnedends,columnswithothersupportconditions, Rankine'sformula,Simplenumerical. **Theories of Failure:** Introduction, maximum principal stress theory, Maximumshearstresstheory,Failureofbrittlematerials,Failureofdu ctile materials, simple numerical.	**08**	**L1,L2,L3**

COURSEOUTCOMES:Attheendofthecoursethestudentwillbeableto:

CO.1	Todemonstratefundamentalknowledgeaboutvarioustypesofloadingandstressesinducedin elasticbodies.
CO.2	Todetermineplanestress,principalstressandmaximumshearstressusingMohr'scircle&to Analysecylindricalpressurevesselsundervariousloadings.
CO.3	ToDrawtheSFDandBMDfordifferenttypesofloadsandsupport conditions.
CO.4	Applytheknowledgetounderstandtheloadtransferringinbeamsandtoapplybasicequationof simpletorsionindesigningofcircularshafts.
CO.5	ToAnalysebucklingandbendingphenomenonincolumns.

Mappingofcourseoutcomeswithprogramoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO.2	1	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO.3	1	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO.4	1	2	-	1	-	-	-	-	-	-	-	-	-	1	-
CO.5	1	2	-	-	-	-	-	-	-	-	-	-	-	1	-

High-3,Medium-2,Low-1

QUESTIONPAPERPATTERN:

- Thequestionpaperwillhavetenquestions.
- EachfullQuestionconsistingof20marks
- Therewillbe2fullquestions(withamaximumoffoursubquestions)fromeachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule

TEXTBOOKS:

1. StrengthofMaterialsbyS.S.Bhavikatti, VikasPublications House Pvt. Ltd. New Delhi 2012
2. StrengthofMaterialsbyRKBansal,LaxmiPublicationPvtLtd.,2016
3. StrengthofMaterialsbyRSubramanian,Oxforduniversitypress,2010.
4. StrengthofMaterialsbyS.Ramamrutham,DhanapathRaiPublishingCompany,NewDelhi,2012

REFERENCEBOOKS:

1. MechanicsofMaterialsbyJamesGere,ThomsonPublication,2010.
2. StrengthofMaterialsbySSRattan,McGrawHill,2011.
3. MechanicsofmaterialsbyFerdinandBeerandRussellJohston,TataMcGrawHill,2003.

DESIGNOFMACHINEELEMENTS						
CourseCode	**21ME62**				**CIEMarks**	**50**
NumberLectureHour/Week	**L**	**T**	**P**	**TOTAL**	**SEEMarks**	**50**
	3	**0**	**0**	**3**		
NumberofLectureHours	**40**				**ExamHours**	**03**
Credits-03						

CourseObjectives: Thiscoursewillenablestudentsto

- Studybasicprinciplesofmachinedesign.
- Understandtheprincipalsinvolvedinevaluatingthedimensionsofacomponenttosatisfy functional and strength requirements.
- Learnuseofcataloguesanddesigndatabook.
- Designmachineelementssubjectedtofluctuating loading.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Fundamentals of Machine Design**: Concept of Machine design, Types of loads, Factor of safety- its selection and significance, Review of theories of elastic failure and their applications, Basic procedure of design of machine elements, **Review and selection of various engineering material** properties and I.S. coding for ferrous materials, Factors governing selection of Engineering materials.	**08**	**L1, L2**
2	**Designofmachineelementsunderstaticloading**:Knucklejoint,Turn buckle and bell crank Lever. **TypesofCouplings**DesignofMuff,RigidCoupling,flexiblebushed pin type flanged coupling.	**08**	**L1, L2**
3	**DesignofPulleyandSelectionofBelts**DesignofPulley-flatandVbelt pulley,Selectionofflatbelt,Vbeltasperthestandardmanufacturer's catalogue, Introduction to timing belts.	**08**	**L1,L2, L3**
4	**IntroductiontoGearsGearterminology**:Materialselection,Types of gearfailure.SpurGeartoothloads,No.ofteeth,Facewidth,Strengthof gear teeth, Static beam strength (Lewis'sequation) Barth equation, Dynamic toothload(spot'sequationandBuckinghamequation),Wearstrength (Buckingham'sequation),Estimationofmodulebasedonbeamstrength and wear strength. Gear design for maximum power transmission capacity, **Helical Gears** Formative number of teeth in helical gears, Force analysis, Beamandwearstrengthofhelicalgears,Effectiveloadanddesignof helical gear.	**08**	**L1,L2, L3**
5	**BevelGear**Straighttoothbevelgearterminologyandgeometricalrelations, Guidelinesforselectionofdimensionsandminimumnumberofteeth,Force analysis, Beamandwearstrength,Dynamictoothload,Designofstraighttooth bevel gears based on beam and wear strength, **Worm Gears** Terminology and geometrical relations. Standard	**08**	**L1,L2, L3**

	dimensions and recommendation of worm gearing, Force analysis, Friction, Efficiency, ofwormgeardrive,Designofwormdrivebased onbeamstrengthandwear strength rating, Thermal consideration in worm drive.		

COURSEOUTCOMES:Attheendofthecoursethestudentwillbeableto:

CO.1	Applybasicprinciplesofmachinedesign
CO.2	Designmachineelementssubjectedtofluctuatingloading.
CO.3	Designmachineelementsonthebasisofstrengthconcept.
CO.4	SelectmachineelementsfromManufacturer'scatalogue.
CO.5	Designvarioustypesofgearssuchasspur,helical,bevelandwormgear.

Mappingofcourseoutcomeswithprogramoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS01	PSO 2	PSO 3
CO.1	3	2	2	-	-	-	-	-	-	-	-	-	3	1	-
CO.2	3	2	2	-	-	-	-	-	-	-	-	-	3	1	-
CO.3	3	2	1	-	-	-	-	-	-	-	-	-	3	1	-
CO.4	3	2	2	-	-	-	-	-	-	-	-	-	3	1	-
CO.5	3	2	1	-	-		-	-	-	-	-	-	3	1	-

High-3:Medium-2:Low-1

TEXTBOOKS:

1) "DesignofMachineElements",V.B.Bhandari.,TataMcGrawHillPublication,3rdEdition.
2) "MachineDesign",R.K.Jain,KhannaPublication.
3) "MachineDesign",PandyaShah,CharotarPublication.
4) "DesignofMachineElements",P.Kannaiah,ScitechPublication.
5) "MachineDesignABasicApproach",Dr.S.S.wadhwaSSJollyDhanapatRaiandSons.
6) "MachineDesign",U.C.Jindal,PearsonEducation.
7) "DesignofMachineElementsI&II",J.B.K.DasandP.L.S.Murthy,SapnaPublishers,2ndEdition

REFERENCEBOOKS:

1) "MachineDesign",Hall,HolowenkoLaughlin,TataMcGrawHillPublicationSchaumsOutlineSeries.
2) "DesignofMachineElement",J.F.Shigley,TataMcGrawHillPublication.
3) "DesignofMachineElement"M.F.Spotts,PearsonEducationPublication,6thEdition.
4) PSGDesigndataBook
5) "MechanicalAnalysisandDesign",H.BurrandCheatam,PrenticeHallPublication.
6) "DesignofTransmissionSystems",P.Kannaiah,ScitechPublication.
7) "MachineDesign",P.Kannaiah,ScitechPublication,2ndEdition.

QUESTIONPAPERPATTERN:

- Thequestionpaperwillhavetenquestions.
- EachfullQuestionconsistingof20marks
- Therewillbe2fullquestions(withamaximumoffoursubquestions)fromeachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.

FINITEELEMENTMETHODS						
CourseCode	**21ME631**				**CIEMarks**	**50**
NumberLectureHour/Week	**L**	**T**	**P**	**TOTAL**	**SEEMarks**	**50**
	3	**0**	**0**	**03**		
NumberofLectureHours	**40**				**ExamHours**	**03**
Credits-03						

CourseObjectives: Thiscoursewillenablestudentsto

- TounderstandtheimportanceofFEM anditsapplicationinsolidmechanics.
- Interpretthevariousmethodsinassemblingthestiffness equations.
- Tounderstandand applyFiniteelementsolutionstoStructural,dynamicproblems.
- Tosolvetemperatureand heattransferproblems.
- TounderstandtheimportanceofFEM anditsapplicationinsolidmechanics.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**INTRODUCTION:**IntroductiontoFiniteElementMethod,Equilibrium equationsinelasticitysubjectedtobodyforce,tractionforces,stress-strain relations, Plain stress and Plain strain conditions. Convergence criteria, Discretization process, Node numbering, Location of nodes, half band width. Application and limitations. **MATHEMATICAL PRELIMINARIES:** Principle of virtual work, principleofminimumpotentialenergy,Raleigh'sRitzmethod,Galerkin's method. Direct approach for stiffness matrix formulation of bar element. Numerical problems.	**08**	**L1,L2**
2	**INTERPOLATION MODELS:** Interpolation polynomials-Linear, quadratic and cubic. Simplex, complex and multiplex elements. 2D Pascal's triangle. CST elements-Shape functions and Nodal load vector, Strain displacement matrix and Jacobian matrix for triangular and rectangular element. **SOLUTION OF 1-D BARS:** Solutions for displacements of 1D Straight bar,steppedbarsandtaperedbars,reactionsandstressesbyusingpenalty approach and elimination approach, Gauss Elimination Methods	**08**	**L1,L2,L3**

3	**HIGHER ORDER ELEMENTS:** Langrange's interpolation, higher order one dimensional elements-Quadratic and cubic element and their shape functions. Shape function of 2-D quadrilateral element-linear, quadric element Isoperimetric, Sub parametric and Super parametric elements. **ANALYSIS OF TRUSSES:** Stiffness matrix of Truss element, Numerical problems.	**08**	**L1,L2,L3**
4	**BEAMS:** Hermite shape functions for beam element, Derivation of stiffness matrix. Numerical problems of beams carrying concentrated, UDL and linearly varying loads. **TORSION OF SHAFTS:**Finite element formulation of shafts, determinationofstressandtwistsincircularshafts.	**08**	**L1,L2,L3**
5	**HEAT TRANSFER:** Basic equations of heat transfer:Energy balance equation,Rate equation:conduction, convection, radiation, energy, generated in solid, energy stored in solid, 1D finite element formulation using variational method. Problems with temperature gradient and heat fluxes, heat transfer in composite sections, straight fins. **AXISYMMETRIC SOLID ELEMENTS**: Derivation of stiffness matrix ofaxisymmetricbodieswithtriangularelements,Numerical solutionofaxisymmetrictriangularelement(s)subjectedtovariousforces	**08**	**L1,L2,L3**

COURSEOUTCOMES:Attheendofthecoursethestudentwillbeableto:

CO.1	Analyzethebasicproceduresinvolvedinfiniteelement method.
CO.2	Analyzeawiderangetwo-dimensionalfieldproblemusingfiniteelementtechniquesandsolve1D bar problems.
CO.3	UsehigherorderelementsinFEMandsolveplanetruss problems.
CO.4	ApplyFEMtechniquesandsolveproblemsinvolvingstructureslikeBeams andShafts.
CO.5	ApplyFEMtechniquesandsolveproblemsinvolvingheattransferandaxisymmetricsolid elements.

Mappingofcourseoutcomeswithprogram outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS0 1**	**PSO 2**	**PSO 3**
CO.1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO.2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO.3	3	2	-	1	-	-	-	-	-	-	-	-	3	2	-
CO.4	3	2	-	1	-	-	-	-	-	-	-	-	3	2	-
CO.5	3	2	-	1	-		-	-	-	-	-	-	3	2	-

High-3:Medium-2:Low-1

TEXTBOOKS:

1. TheFiniteElementMethodinEngineeringbySBHaleshFirstEditionFeb2018,SapnaBookHoiuse (P) Ltd.
2. FiniteElementAnalysisbyBhavikatti,SSNewageInternational,3rdEdition2015
3. FiniteElementMethodbyJNReddy,TMH.

REFERENCEBOOKS:

1. IntroductiontoFiniteElementsinEngineeringbyTirupathi R.ChandrupatlaandAshok D.Belegundu, Pearson Education, 4th Edition 2012.
2. AFirstCourseintheFiniteElementMethodbyDarylL.Logan,CengageLearning,5thEdition2012.
3. TextbookofFiniteElementAnalysisbySeshuP,PrenticeHallofIndia
4. ConceptsandApplicationsofFiniteElementAnalysisbyCookRD,MalkusDS,PleshaME,John Wiley Sons.
5. FiniteElementMethodsbyRDhanrajandKPrabhakaranNair,OxfordUniversityPress.

QUESTIONPAPERPATTERN:

- Thequestionpaperwillhavetenquestions.
- EachfullQuestionconsistingof20marks
- Therewillbe2fullquestions(withamaximumoffoursubquestions)fromeachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.

SOLIDWASTEMANAGEMENT

[AsperChoiceBasedCreditSystem(CBCS)scheme]

SEMESTER – VI

SubjectCode	21CV651	CIE	50
NumberofLectureHour/Week	3L+1T	SEE	50
TotalNumberofLecture Hours	52	Exam Hours	03

CREDITS– 04

Courseobjectives: Thiscoursewillenablestudentsto

1. Understandingofproblemsofmunicipalwaste,biomedicalwaste,hazardouswaste,e-waste,industrialwasteetc.
2. Knowledgeoflegal,institutionalandfinancialaspectsofmanagementofsolidwastes.
3. BecomeawareofEnvironmentandhealthimpactsofsolidwastemismanagement

4:Identifyingrecyclingandreuseoptions(composting,sourceseparation,andre-useofshreddedtires,recycledglass, fly ash, etc.)

5.evaualtedifferentprocessingmethods

CourseOutcomes(COs):

*Oncompletionofthiscourse,*thestudentwillbeableto

CO#	CourseOutcomes	POs	PSOs
CO1	anunderstandingofthenatureandcharacteristicsofmunicipalsolid wastes.		
CO2	Acquireknowledge on the regulatory requirements regarding municipal solid waste management.		
CO3	abilitytoplanwasteminimizationanddesignstorage,collection, transport, processing and disposal of municipal solid waste.		
CO4	Identifying(composting,sourceseparation,andre-useofshreddedtires, recycled glass, fly ash, etc		
CO5	Thestudentswillbeabletoutilizethewastebymaterialrecoverysheet		

Bloom'sleveloftheCourseoutcomes:

CO#	Bloom'sLevel					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√	√	√		
CO2	√	√	√			
CO3		√	√	√		
CO4		√			√	√
CO5		√	√			

CourseArticulationMatrix/Coursemapping:

CO#	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	2		2		1	2			
CO2	3		2		1		2	2	1			2			
CO3	2	1	2	2		2	3		2		1	2			
CO4	3		2		1		2	2	1		1	2			
CO5	2	1					3		2		1	2			

	Teaching Hours	RBT Level

Module-1		
SOURCES AND TYPES 8 Sources and types of municipal solid wastes-waste generation rates-factors affecting generation, characteristics-methods of sampling andcharacterization;EffectsofimproperdisposalofsolidwastesPublichealthand environmental effects. Elements of solid waste management –Social and Financial aspects – Municipal solid waste (M&H) rules – integrated management-Public awareness; Role of NGO's.	12Hours	L1,L2,
Module-2		
ON-SITE STORAGE AND PROCESSING. On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health andeconomicaspectsofopenstorage–wastesegregationandstorage–casestudies under Indian conditions – source reduction of waste – 3R system	8Hours	L1,L2,
Module-3		
COLLECTIONANDTRANSFER8MethodsofResidentialandcommercialwaste collection – Collection vehicles – Manpower– Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems resolving	10Hours	L1 L2,L4
Module-4		
OFF-SITE PROCESSING Objectives of waste processing – Physical Processing techniquesandEquipment's;Resourcerecoveryfromsolidwastecompostingand biomethanation;Thermalprocessingoptions–casestudiesunderIndianconditions.	12Hours	L1 L2,
Module-5		
Landdisposalofsolidwaste;Sanitarylandfills–siteselection,designandoperation of sanitary landfills – Landfill liners – Management of leachate and landfill gas-Landfillbioreactor–DumpsiteRehabilitation.Dumpsitelandreclaim	10Hours	L1 L2,

Questionpaperpattern:

- Thequestionpaperwillhavetenquestions.
- Eachfullquestionconsistsof10marks.
- Therewillbe2fullquestions(withamaximumoffoursubquestions)fromeach module.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestionfromeach module.

TextBooks:

1. Tchobanoglous,G.,Theisen,H.M.,andEliassen,R."Solid.Wastes:EngineeringPrinciplesandManagement Issues". McGraw Hill, New York, 1993.
2. Vesilind, P.A. and Rimer, A.E., "Unit Operations in Resource Recovery Engineering", Prentice Hall, Inc., 1981
3. PaulTWillams,"WasteTreatmentandDisposal",JohnWileyandSons,2000

ReferenceBooks:

1. GovernmentofIndia,"ManualonMunicipalSolidWasteManagement",CPHEEO,MinistryofUrban Development, New Delhi, 2000.

2. BhideA.D.andSundaresan,B.B."SolidWasteManagementCollection",ProcessingandDisposal, 2001

3. ManserA.G.R.andKeelingA.A.,"PracticalHandbookofProcessingandRecyclingofMunicipalsolid Wastes", Lewis Publishers, CRC Press, 1996

4. GeorgeTchobanoglousandFrankKreith"HandbookofSolidwasteManagement",McGrawHill,New York, 2002

5.Sasikumar.K,SanoopGopiKrishna,"SolidWasteManagement",PHIlearning,NewDelhi,2009

AIRPOLLUTION&CONTROL

[AsperChoiceBasedCreditSystem(CBCS)scheme]

SEMESTER – VI

SubjectCode	21CV652	CIE	50
NumberofLectureHour/Week	3L+1T	SEE	50
TotalNumberofLecture Hours	52	Exam Hours	03

CREDITS– 04

Courseobjectives: Thiscoursewillenablestudentsto
Studythesourcesandeffectsofairpollution.
Learnthemeteorologicalfactorsinfluencing air pollution.
Analyzeairpollutantdispersion models.
Illustrateparticularandgaseouspollutioncontrolmethods.
toimprovethe knowledgeonemerging trends

CourseOutcomes(COs):

*Oncompletionofthiscourse,*thestudentwillbeableto

Bloom'slevelofthecourseoutcomes:

CourseArticulationMatrix/Coursemapping:

CO#	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	1	2	1	1		1	2	1	2	1	1		1	2	1
CO2	2	2	1	1	1	1	2	1	2	1	1		1	1	1
CO3	2	2	1	1	1	1	2	1	1	1	1				
CO4	1	1	1	1		2	2	2	2	1	1		1	1	1
CO5	1	2	1	1		2	2	2	2	1	1		2	1	2

	Teaching Hours	**RBTLevel**

Module-1		
Introduction:Definition,Sources,classificationandcharacterization of air pollutants. Effects of air pollution on health, vegetation & materials. Types of inversion, photochemical smog.	10Hours	L1,L2,L3,L4
Module-2		
Meteorology: Temperature lapse rate & stability, wind velocity & turbulence, plume behavior, measurement of meteorological variables, wind rose diagrams, Plume Rise, estimation of effective stack height and mixing depths.	12Hours	L1,L2,L3

CO#	CourseOutcomes	POs	PSOs
CO1	Identifythemajorsourcesofairpollutionandunderstandtheir effects on health and environment.		
CO2	Evaluate the dispersion of air pollutants in the atmosphere and todevelop air quality models		
CO3	Ascertainandevaluatesamplingtechniquesforatmosphericand stack pollutants.		
CO4	Chooseanddesigncontroltechniquesforparticulateandgaseous emissions		
CO5	Ability to justify the use of pollution control equipment and theredesign.		

CO#	Bloom'sLevel					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1	√	√	√	√		
CO2	√	√	√			
CO3		√	√	√		
CO4		√			√	√
CO5		√	√			

Module-3

Sampling:Sampling of particulate and gaseous pollutants (Stack, Ambient & indoorairpollution),Monitoringandanalysisofairpollutants(PM2.5,PM10, SOX, NOX, CO, NH3)	12Hours	L2,L3,L4
Module-4		
ControlTechniques:Particulatematterandgaseouspollutants-settling chambers, cyclone separators, scrubbers, filters & ESP.	8Hours	L2,L4,L5
Module-5		
Airpollutionduetoautomobiles,standardsandcontrolmethods.Noise pollution causes, effects and control, noise standards. Environmental issues, global episodes, laws, acts, protocols	10Hours	L2,L3

Questionpaperpattern:

- Thequestionpaperwillhavetenquestions.
- Eachfullquestionconsistsof10marks.
- Therewillbe2fullquestions(withamaximumoffoursubquestions)fromeachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestionfromeachmodule.

TextBooks:

1. M.N.RaoandHVNRao,"Airpollution",TataMc-G rawHill Publication.
2. H.C.Perkins,"Airpollution".TataMcGrawHill Publication
3. MackenzieDavisandDavidCornwell,"IntroductiontoEnvironmental Engineering" McGraw-Hill Co.

ReferenceBooks:

1. NoelDeNevers, "AirPollutionControlEngineering",WavelandPrInc.
2. AnjaneyuluY,"TextbookofAirPollutionandControlTechnologies",Allied Publishers.

INTRODUCTIONTODRONETECHNOLOGY

[As perNEP, Outcome based Education (OBE), andChoiceBased Credit System (CBCS) Scheme]
SEMESTER-VI

CourseCode	21EC652	CIEMarks	50
NumberofLecture Hour/Week	2L+1L	SEEMarks	50
NumberofLectureHours	50	ExamHours	03

CREDITS-04

Course Objectives: Studentswillbe taughtto:

- To makethestudentsto understandthebasicconceptsofUAV drone systems.
- TointroduceDesignofUAVdronesystem.
- Tointroducethestabilityandcontrolof anaircraft.
- Tointroduce UAVdroneintegration/installation/configuration.

Module-1	**Teaching Hours**
IntroductiontoDrones:IntroductiontoUnmanned AircraftSystems,History ofUAV drones, classification of drones, System Composition, applications, DGCA regulations	10 Hours
Module-2	
Design of UAVDrone Systems: Basicprinciplesofflightmechanics, Introduction to Designand SelectionoftheSystem,AerodynamicsandAirframeConfigurations,CharacteristicsofAircraft Types,DesignStandardsandRegulatoryAspects-India Specific,DesignforStealth	10 Hours
Module-3	
Avionics Hardware of Drones: Flight controller board, Autopilot, AGL-pressure sensors servos-accelerometer–gyros-actuators-powersupply-processor,integration,installation,configuration.	10 Hours
Module-4	
Communication,PayloadandControlDispensableandNon-Dispensablepayloads–Control ofHTOL,VTOL,ControlofPayloadsandSensors-Communicationmedia, Radiocommunication.Factorsaffectingdroneflightperformance andefficiency	10 Hours
Module-5	
NavigationandTesting: PS,Waypointsnavigation,groundcontrolsoftware,SystemGround Testing, System In-flight Testing, Future Prospects and Challenges	10 Hours

CourseOutcomes: After studyingthiscourse, studentswillbe ableto:

CO1:AbilitytodesignUAV dronesystem

CO2: To understandworkingofdifferenttypesofenginesanditsarea ofapplications.

CO3: Tointegrate,installandconfiguretheUAV

CO4: Tounderstandstaticanddynamicstabilitydynamicinstabilityandcontrolconcepts

CO5: Toknowtheloadstakenbyaircraftandtypeofconstructionandalsoconstructionmaterialsinthem.

TextBooks:

1. RegAustin“UnmannedAircraftSystemsUAVdesign,developmentanddeployment”,Wiley, 2010.
2. RobertC.Nelson,FlightStabilityandAutomaticControl,McGraw-Hill,Inc, 1998.
3. KimonP.Valavanis,“AdvancesinUnmannedAerialVehicles:StateoftheArtandtheRoad to Autonomy”, Springer, 2007

4. PaulGFahlstrom,ThomasJGleason,"IntroductiontoUAVSystems",UAVSystems,Inc,1998
5. Dr.ArmandJ.Chaput,"DesignofUnmannedAirVehicleSystems",LockheedMartin Aeronautics.

COURSEOUTCOMEANDPROGRAMMEOUTCOMEMAPPING(1/2/3):

Note:1-Low,2-Medium,3-High

CO/PO	PO.1	PO.2	PO.3	PO.4	PO.5	PO.6	PO.7	PO.8	PO.9	PO.10	PO.11	PO.12	PSO.1	PSO.2
CO1	-	-	3	-	-	-	-		-	-	-	2	2	3
CO2	3	-	-	-	-	-	-	-	-	-	-	2	3	3
CO3	-		-	-	-	-	-	-	-	-	-	2	3	-
CO4	-	-	-	-	-	-	-	-	-	-	-	2	3	-
CO5	-	-	-	-	-	-	-	-	-	-	-	2	3	-

ENERGYCONVERSIONLAB						
CourseCode	**21MEL66**				**CIEMarks**	**50**
NumberLectureHour/Week	**L**	**T**	**P**	**TOTAL**	**SEEMarks**	**50**
	0	**0**	**3**	**3**		
NumberofLectureHours	**24**				**ExamHours**	**03**
Credits-01						

CourseObjectives: Thiscoursewillenablestudentsto

1. Thiscoursewillprovideabasicunderstandingoffuelpropertiesanditsmeasurementsusingvarioustypes of measuring devices
2. Energyconversionprinciples,analysisandunderstandingofICEngineswillbediscussed.Applicationof these concepts for these
3. machineswillbedemonstrated.Performanceanalysiswillbecarriedoutusingcharacteristiccurves.
4. ExhaustemissionsofICEngineswillbemeasuredandcomparedwiththestandards.

MODULE NO.	TOPICS	TEACHING HOURS	RBTLEVELS
Part-A	1. Lablayout,calibrationofinstrumentsandstandardstobe discussed. 2. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Marten's (closed) / Cleveland's (Open Cup) Apparatus. 3. DeterminationofCalorificvalueofsolid,liquidandgaseous fuels. 4. Determination of Viscosity of a lubricating oil using Redwoods, Sayboltand Torsion Viscometers. 5. Analysisofmoisture,volatilematter,ashcontentandfixedcarbon ofsolid and liquid fuel samples 6. ValveTiming/portopeningdiagramofanI.C. Engine	**12 HOURS**	**L2,L3**
Part B	7. PerformanceTestsonI.C.Engines,CalculationsofIP,BP,Thermal efficiency,Volumetricefficiency,Mechanicalefficiency,SFC,FP,A:FRatio,heatbalancesheet for a. FourstrokeDieselEngine b. FourstrokePetrol Engine c. MultiCylinderDiesel/PetrolEngine,(Morse test) d. TwostrokePetrol Engine e. VariableCompressionRatioI.C. Engine. 8. MeasurementsofExhaustEmissionsofPetrolengine. 9. MeasurementsofExhaustEmissionsofDieselengine. 10. Demonstrationofpθ,pVplotsusingComputerizedICenginetestrig.	**12 HOURS**	**L2,L3**

COURSEOUTCOMES:Attheendofthecoursethestudentwillbeableto:

CO.1	Performexperimentstodeterminethepropertiesoffuelsand oils.

CO.2	Conductexperimentsonenginesanddrawcharacteristics.
CO.3	TestbasicperformanceparametersofI.C.Engine andimplementtheknowledgeinindustry.
CO.4	Identifyexhaustemission,factorsaffectingthemandreporttheremedies.
CO.5	DetermineheenergyflowpatternthroughtheIC Engine

Mappingofcourseoutcomeswithprogramoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	3	2	2	-	2	-	-	-	-	-	-	-	2	-	-
CO.2	3	2	2	-	2	-	-	-	-	-	-	-	2	-	-
CO.3	3	2	2	-	2	-	-	-	-	-	-	-	1	-	-
CO.4	3	2	2	-	2	-	-	-	-	-	-	-	1	-	-
CO.5	3	2	2	-	2		-	-	-	-	-	-	2	-	-

High-3,Medium-2,Low-1

SCHEMEOFCIEEVALUATION(50MARKS)

SL.No.	Components	Marks
1	ConductionofExperiments	25
2	EvaluationofLabs	15
3	MockEvaluation/Presentation	10
	Total	**50**

SCHEMEOFSEEEXAMINATION(50MARKS)

SL.No.	Modules	Marks
1	PART-A	15
2	PART-B	25
3	VIVA-VOCE	10
	Total	**50**

COMPUTERAIDEDMODELLINGANALYSISLABORATORY						
CourseCode	**21MEL671**				**CIEMarks**	**50**
NumberLectureHour/Week	**L**	**T**	**P**	**TOTAL**	**SEEMarks**	**50**
	0	**0**	**3**	**3**		
NumberofLectureHours	**24**				**ExamHours**	**03**
Credits-01						

CourseObjectives: Thiscoursewillenablestudentsto

1. ToacquirebasicunderstandingofModelingandAnalysis software
2. Tounderstandthedifferentkindsofanalysisandapplythebasicprinciplestofindoutthestress and other related parameters of bars, beams loaded with loading conditions.
3. Toleantoapplythebasicprinciplestocarryoutdynamicanalysistoknowthenaturalfrequency of different kind of beams.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
Part-A	1. Barsofconstantcrosssectionarea,taperedcrosssectionareaand stepped bar 2. Trusses–(Minimum2exercisesofdifferent types) 3. Beams–Simplysupported,cantilever,beamswithpointload, UDL,beams withvaryingload etc (Minimum6 exercisesdifferentnature)	**12HOURS**	**L3, L4**
Part B	4. ThermalAnalysis(Minimum4exercisesofdifferent types) 5. DynamicAnalysisto find a) Fixed–fixedbeamfornaturalfrequency determination. b) Bar subjected to forcing function. c) Fixed – fixed beam subjected to forcing function 6. Stressanalysisofarectangularplatewithacircular hole	**12HOURS**	**L3, L4**

COURSEOUTCOMES:Attheendofthecoursethestudentwillbeableto:

CO.1	Demonstratethebasicfeaturesofananalysispackage.
CO.2	Usethemoderntoolstoformulatetheproblem,andabletocreategeometry,discretize,apply boundary condition to solve problems of bars, truss, beams, plate to find stress with different loading conditions. different loading conditions.
CO.3	Demonstratethedeflectionofbeamssubjectedtopoint,uniformlydistributedandvaryingloads furthertousetheavailableresultstodrawshearforceandbendingmoment diagrams.
CO.4	Analyzethegivenproblembyapplyingbasicprincipletosolveanddemonstrate1Dand2Dheat transferwithconductionandconvectionboundaryconditions.
CO.5	Carryoutdynamicanalysisandfindingnaturalfrequenciesforvariousboundaryconditionsandalso analyze with forcing function.

Mappingofcourseoutcomeswithprogramoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	3	2	2	-	2	-	-	-	-	-	-	-	2	-	-
CO.2	3	2	2	-	1	-	-	-	-	-	-	-	2	-	-
CO.3	3	2	2	-	2	-	-	1	-	-	-	-	1	-	-
CO.4	3	2	2	-	1	-	-	-	-	-	-	-	1	-	-
CO.5	3	2	2	-	2		-	-	-	-	-	-	2	-	-

High-3,Medium-2,Low-1

SCHEMEOFCIEEVALUATION(50MARKS)

SL.No.	Components	Marks
1	ConductionofExperiments	25
2	EvaluationofLabs	15
3	MockEvaluation/Presentation	10
	Total	**50**

SCHEMEOFSEEEXAMINATION(50MARKS)

SL.No.	Modules	Marks
1	PART-A	15
2	PART-B	25
3	VIVA-VOCE	10
	Total	**50**

PROJECT-VI						
CourseCode	**21PRJ68**				**CIEMarks**	**50**
NumberLectureHour/Week	**L**	**T**	**P**	**TOTAL**	**SEEMarks**	**50**
	0	**0**	**1**	**1**		
NumberofLectureHours	**24**				**ExamHours**	**03**
Credits-01						

CourseObjectives: Thiscoursewillenablestudentsto

- Tostudyandapplythefundamentalconceptsofengineering.
- Toenhancetheinnovativeideasbasedonengineering knowledge

TOPICS	TEACHING HOURS	RBT LEVELS
Mini-projectwork	**24**	**L2,L3**
Basedontheability/abilitiesofthestudent/sandrecommendationsofthementor, a single discipline or a multidisciplinary Mini- project can be assignedto an individual student or to a group having not more than 4 students.		

COURSEOUTCOMES:Attheendofthecoursethestudentwillbeableto:

CO.1	Tobeabletoapplyknowledgeofengineeringto a logicallychosen problem.
CO.2	Tobeabletopreparecompletefeasibilityreportforpracticalproblem
CO.3	Tobeabletosynthesizethefindingstoasuitable conclusion
CO.4	Topresentthefindings intheformoftechnical report

Mappingofcourseoutcomeswithpogramoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	3	2	1	1	1	1	-	1	2	-	2	-	3	-	-
CO.2	3	2	1	1	1	1	-	1	2	-	2	1	3	-	-
CO.3	3	3	1	1	1	1	-	1	2	2	2	-	3	-	-
CO.4	3	2	1	1	1	1	-	1	2	2	2	-	2	-	-

High-3:Medium-2:Low-1

ASSESMENT AND EVALUATION
SCHEMEOFEVALUATIONFORCIE(50MARKS)

	Modules	Marks
1	Designandfabricationofthesystem/project	25
2	Evaluation ofprojectreportbythedepartment	15
3	Mockevaluation/presentation	10
	Total	50

SCHEMEOFSEEEXAMINATION(50MARKS)

- Studenthastosolvethreequestions;patternofquestionsareasfollows

Questionno	Modules	Marks
Q1	Designandfabricationofthesystem/project	25
Q2	Evaluation ofprojectreportbythedepartment	15
Q3	Mockevaluation/presentation	10
	Total	50

NOTE:

- TheSEEfortheProjectshallbeevaluatedbytwoexaminersjointlyandtheevaluationshall be based on various components such as, Writing of Abstract, Project report, Oral Presentation, Demonstration and Viva-voce.
- Projectreporthastobepreparedaspertheuniversityguidelines(outline).

PROFESSIONALETHICS						
CourseCode	**21HSM69**				**CIEMarks**	**50**
NumberLectureHour/Week	**L**	**T**	**P**	**TOTAL**	**SEEMarks**	**50**
	1	**0**	**0**	**1**		
NumberofLectureHours	**20**				**ExamHours**	**03**
Credits-01						

CourseObjectives: Thiscoursewillenablestudents to

- ToenablethestudentstocreateanawarenessonEngineeringEthicsandHumanValues,
- ToinstillMoralandSocialValuesandLoyaltyandtoappreciatetherightsofothers.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**HUMANVALUES**	**04 Hours**	**L1 &L2**
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy–Self-confidence–Character–Spirituality–IntroductiontoYogaandmeditationforprofessional excellence and stress management.			
2	**ENGINEERINGETHICS**	**04 Hours**	**L2 &L3**
Sensesof,,EngineeringEthics"–Varietyofmoralissues–Typesofinquiry–Moraldilemmas–Moral Autonomy–Kohlberg'stheory–Gilligan'stheory–ConsensusandControversy–Modelsofprofessional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories			
3	**ENGINEERINGASSOCIALEXPERIMENTATION**	**04 Hours**	**L1,L2& L3**
Engineering as Experimentation – Engineers asresponsible Experimenters – Codes of Ethics – A BalancedOutlook on Law.			
4	**SAFETY, RESPONSIBILITIESANDRIGHTS**	**04 Hours**	**L1,L2&L3**
SafetyandRisk–AssessmentofSafetyandRisk–RiskBenefitAnalysisandReducingRisk-RespectforAuthority–Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination			
5	**GLOBALISSUES**	**04 Hours**	**L1,L2& L3**
MultinationalCorporations–EnvironmentalEthics–ComputerEthics–WeaponsDevelopment–Engineers asManagers–ConsultingEngineers–Engineers asExpertWitnessesand Advisors–MoralLeadership–Code of Conduct – Corporate Social Responsibility.			

COURSEOUTCOMES:Attheendofthecoursethestudentwillbeableto:

CO.1	Understandthefundamentalconceptsofmorals,values,andethics,andtheirapplicabilityinboth personal and professional contexts.
CO.2	Demonstrate a commitment to integrity, honesty, and courage in their decision-making processes and professional conduct.
CO.3	Developinterpersonalskillssuchasempathy,respectforothers,andcooperation,fostering collaborative and inclusive work environment.
CO.4	Applytechniquessuchasservicelearning.
CO.5	Cultivateastrongpersonalcharacter,spirituality,andself-confidence,enablingthemtonavigate challenges with resilience

Mappingofcourseoutcomeswithprogramoutcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	2	-	-	-	-	2	-	2	1	-	-	-	1	1	-
CO.2	2	-	-	-	-	2	-	2	1	-	-	-	1	1	-
CO.3	2	-	-	-	-	2	-	2	1	-	-	-	1	1	-
CO.4	2	-	-	-	-	2	-	2	1	-	-	-	1	1	-
CO.5	2	-	-	-	-	2	-	2	1	-	-	-	1	1	-

QUESTIONPAPERPATTERN:

- Thequestionpaperwillhavetenquestions.
- EachfullQuestionconsistingof20marks
- Therewillbe2fullquestions(withamaximumoffoursubquestions)fromeachmodule.
- Eachfullquestionwillhavesubquestionscoveringallthetopicsunderamodule.
- Thestudentswillhavetoanswer5fullquestions,selectingonefullquestionfromeach module.

TEXTBOOKS:

1. MikeW.MartinandRolandSchinzinger,“EthicsinEngineering”,TataMcGrawHill,New Delhi, 2003
2. GovindarajanM,NatarajanS,SenthilKumarV.S,“EngineeringEthics”,PrenticeHallof India, New Delhi, 2004.

REFERENCEBOOKS:

1. CharlesB.Fleddermann,“EngineeringEthics”,PearsonPrenticeHall,NewJersey,2004.
2. CharlesE.Harris,MichaelS.PritchardandMichaelJ.Rabins,“EngineeringEthics–
3. ConceptsandCases”,CengageLearning,2009
4. JohnRBoatright,“EthicsandtheConductofBusiness”,PearsonEducation,NewDelhi,
5. 2003
6. EdmundGSeebauerandRobertLBarry,“FundametalsofEthicsforScientists

E-RESOURCES :

1.https://www.coursera.org/courses?query=ethics

INTRODUCTIONTOGEOMETRICDIMENSIONING&TOLERENCES						
CourseCode	**21AECME6101**				**CIEMarks**	**50**
NumberLectureHour/Week	**L**	**T**	**P**	**TOTAL**	**SEEMarks**	**50**
	0	**0**	**2**	**2**		
NumberofLectureHours	**24**				**ExamHours**	**03**
Credits-01						

CourseObjectives: Thiscoursewillenablestudentsto

- Togainthebasicknowledgeofgeometricdimensioningandtolerances.
- Togainthebasicconceptofmaximum materialandminimummaterialconditions.
- TostudytheTaylorsprincipleofgauginglimits.
- Tostudybasicfeaturesofdatum anditssymbols.
- Tostudythevarious modesofdatum featurerepresentation

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	Introduction: Geometric product definition principles; verification of position with open setup; geometric characteristic symbols Geometric DimensioningandTolerancing:anexplanationoftolerancezone conversion; surfaces, features, features of size, datum features, datum features of size, and datum's; tolerances	**05**	**L1,L2**
2	MMC&LMC:MaximumMaterialCondition(meaning&use);Least Material Condition (meaning & use). Componentscommontogeometricallydimensioned&tolerancedrawing; fits & allowances, advantages of GD&T	**05**	**L1,L2**
3	SizeControlForm:The Taylorsprinciple;Gaugingsizelimits. Rules, Concepts,Characteristics,andintoleranceDimensions:individualor related Datum's, Material Conditions, intolerance dimensions.	**04**	**L1,L2**
4	Datums:Datumfeatures;oddlyconfigured&curvedsurfacesasdatum features;equalizingdatum's;datumfeaturesymbols;flexibleparts; direct vs indirect tolerancing. MMC and its ramifications	**05**	**L1,L2,L3**
5	Modes of datum feature representation: angular orientation. Form Controls: flatness; straightness: circularity; free state variation; circularity Orientation Controls: orientation characteristics; angularity; perpendicularity Profile.	**05**	**L1,L2,L3**

COURSEOUTCOMES:Attheendofthecoursethestudentwillbeableto:

CO.1	Tounderstandthebasicknowledgeofgeometric dimensioningand tolerances
CO.2	Tounderstandthebasicconceptofmaximummaterialandminimummaterialconditions.
CO.3	TounderstandtheTaylorsprincipleofgauginglimits
CO.4	Tounderstandthebasicfeaturesofdatumanditssymbols
CO.5	Tounderstandthevariousmodesofdatumfeaturerepresentation

Mappingofcourseoutcomeswithprogram outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

						6									
CO.1	3	2	1	1	1	-	-	-	-	-	-	-	2	1	-
CO.2	3	2	1	1	-	-	-	-	-	-	-	-	1	1	-
CO.3	3	1	2	1	1	-	-	-	-	-	-	-	1	1	-
CO.4	3	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO.5	3	2	1	1	1.		-	-	-	-	-	-	2	1	-

High-3,Medium-2,Low-1

TEXTBOOKS:

1. GeometricDimensioning&TolerancingbyJamesMeadows.
2. FundamentalsofGeometricDimensioning&TolerancingbyAlexKrulikowski.

REFERENCEBOOKS:

2. JamesDMeadows,"GeometricDimensioningandTolerancing",MarcelDekker,Inc.
3. JamesDMeadows,"MeasurementofGeometricTolerancesinManufacturing"MarcelDekker,Inc.
4. PSGill,"GeometricDimensioningandTolerancing",SKKataria&sons,2005-6

HYDRAULICS& PNEUMATICS						
Course Code	**21ME71**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	2	**1**	**0**	**3**		
Number of Lecture Hours	**40**				**Exam Hours**	**03**
Credits-03						

Course Objectives: This course will enable students to

- To provide student with knowledge on the application of fluid power in process,construction and manufacturing industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system.
- To develop a measurable degress of competence in the design, construction and operation of fluid power circuits.
- To develop a measurable degree of competence in the design, construction and operaion of fluid power circuits.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS** Introduction to Fluid power — Advantages and Applications — Fluid power systems—Types of fluids — Properties of fluids and selection — Basics of Hydraulics — Pascal?s Law — Principles of flow — Friction loss — Work, Power and Torque Problems, Sources of Hydraulic power: Pumping Theory— Pump Classification — Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary — Fixed and Variable displacement pumps — Problems.	**08**	**L1,L2**
2	**HYDRAULIC ACTUATORS AND CONTROL COMPONENTS** Hydraulic Actuators: Cylinders—Types and construction, Application, Hydraulic cushioning — Hydraulic motors — Control Components : Direction Control, Flow control and pressure control valves—Types,Construction& Operation— Servo and Proportional valves—Applications—Accessories : Reservoirs, Pressure Switches —Applications—Fluid Power ANSI Symbols — Problems.	**08**	**L1,L2**
3	**HYDRAULIC CIRCUITS AND SYSTEMS** Accumulators, Intensifiers, Industrial hydraulic circuits — Regenerative, Pump Unloading, Double- Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.	**08**	**L2,L3**
4	**PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS** Properties of air — Perfect Gas Laws — Compressor — Filters,	**08**	**L2,L3**

	Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit — Cascade method — Electro Pneumatic System — Elements — Ladder diagram — Problems, Introduction to fluidics and pneumatic logic circuits.		
5	**TROUBLE SHOOTING AND APPLICATIONS** Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools — Low cost Automation — Hydraulic and Pneumatic power packs.	**08**	**L1,L2**

COURSE OUTCOMES: At the end of the course the student will be able to:

C01	Explain the fluid power and operation of different types of pumps.
C02	Summarize the features and function of hydraulic motors,actuatorsand flow control valves
CO3	Expalin the different types of hydraulic circuits and systems
CO4	Explain the working of different pneumatic circuits and systems.
CO5	Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems,

Mapping of course outcomes with program outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS 01**	**PS O2**	**PS O3**
CO1	2	2	-	1	-	-	-	-	-	-	-	-	1	-	-
CO2	2	2	-	1	-	-	-	-	-	-	-	-	1	-	-
CO3	2	2	-	1	-	-	-	-	-	-	-	-	1	-	-
CO4	2	2	-	1	-	-	-	-	-	-	-	-	1	-	-
CO5	2	2	-	1	-	-	-	-	-	-	-	-	1	-	-

Text Books:

1. Anthony Esposito, " Fluid Power with Applications" , Pearson Education 2005.
2. Pneumatics and Hydraulics Andrew Parr Jaico Publishing Co
3. Majumdar S.R. " Oil Hydraulics Systems-Princples and maintenance ", Tata McGraw-Hill,2001.

Reference Books

1. AnthonuLal, " Oil Hydraulics in the service of industry ", Allied publishers,1982.
2. Dudelyt, A.pease and John T.Pippenger, " Basic Fluid Power", Prentice Hall, 1987.
3. Majumdar S.R. " Pneumatic systems- Principles and maintenance ", Tata Mc Graw Hill, 1995
4. Michael J, Prinches and ashby J.G. " Power Hydraulics " Prentice Hall 1989
5. Shanmugasundaram.K, " Hydraulic and Pneumatic Controls", Chand & Co,2006

HEAT AND MASS TRANSFER

Course Code	**21ME72**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	2	**1**	**0**	**3**		
Number of Lecture Hours	**40**				**Exam Hours**	**03**
Credits-03						

Course Objectives: This course will enable students to
• Study the modes of heat transfer
• Learn how to formulate and solve 1-D heat conduction problems
• Apply empirical correlations for fully-developed laminar, turbulent internal flows and external flows
• Study the basic principles of heat exchanger analysis and concepts of Boiling and Condensation
• Understand the principles of radiative heat transfer and Mass transfer.

MODULE NO.	**TOPICS**	**TEACHING HOURS**	**RBT LEVELS**
1	**Introductory Concepts and Definitions:**Introductory Concepts and Definitions: Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer; combined heat transfer mechanism. Boundary conditions of 1st, 2nd and 3rd kind Conduction. One dimensional heat conduction equation. Derivation of three-dimensional heat conduction equation in cartesian coordinates only. Discussion of three-dimensional Heat Conduction Equation in (ii) Polar and (iii) Spherical Co-ordinate Systems. **Steady-state one-dimensional heat conduction problems in Cartesian System:** Steady-state one-dimensional heat conduction problems (i) without heat generation and (ii) constant thermal conductivity in Cartesian system with various possible boundary conditions.	**08**	L1, L2,L3
2	**Variable Thermal Conductivity:**Brief Introduction to variable thermal conductivity and heat generation [No numerical on variable thermal conductivity and heat generation] Thermal Resistances in Series and in Parallel. Critical thickness of Insulation in cylinder and spheres Concept. **Extended Surfaces or Fins:** Heat transfer in extended surfaces of uniform cross-section without heat generation, long fin, short fin with insulated tip and without insulated tip and fin connected between two heat sources.	**08**	L1,L2,L3

	Fin efficiency and effectiveness. Numerical problems.		
3	**Forced Convections:** Applications of dimensional analysis for forced convection. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro dynamically and thermally developed flows inside a duct, use of correlations for flow over a flat plate, over a cylinder and sphere. Numerical problems. **Free convection:** Laminar and Turbulent flows, Vertical Plates, Vertical Tubes and Horizontal Tubes, Empirical solutions.	**08**	L1, L2, L3
4	**Heat Exchangers:** Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD, Effectiveness-NTU methods of analysis of heat exchangers. Numerical problems. **Condensation and Boiling**: Types of condensation (discussion only) Nusselt's theory for laminar condensation on a vertical flat surface; use of correlations for condensation on vertical flat surfaces, horizontal tube and horizontal tube banks; Reynolds number for condensate flow; regimes of pool boiling, pool boiling correlations.	**08**	L1,L2,L3
5	**Radiation Heat Transfer:** Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-Boltzmann law, Kirchoff's law, Planck's law and Wein's displacement law. Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle; Lambert's law; radiation heat exchange between two finite surfaces-configuration factor or view factor. Numerical problems. **Mass Transfer:** 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.	**08**	L1,L2,L3

COURSE OUTCOMES: At the end of the course the student will be able to:

CO1	Demonstrate a thorough understanding of the basic concepts and laws governing heat transfer, including conduction, convection, and radiation, and apply these principles to

	derive heat conduction equations in various coordinate systems.
CO2	Solve steady-state one-dimensional heat conduction problems under different boundary conditions and analyze heat transfer in extended surfaces (fins), including their efficiency and effectiveness, through numerical problem-solving.
CO3	Analyze forced and free convection heat transfer processes for laminar and turbulent flows over various geometries, interpret dimensionless numbers, and apply empirical correlations to solve practical problems.
CO4	Classify heat exchangers, analyze their performance using LMTD and effectiveness-NTU methods, and apply condensation and boiling heat transfer mechanisms.
CO5	Perform calculations involving surface exchanges and radiation shields, and apply mass transfer fundamentals, including diffusion and convective correlations, using heat, momentum, and mass transfer analogies.

Mapping of course outcomes with program outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS 01**	**PS O2**	**PS O3**
CO1	3	3	-	-	-	-	-	-	-	-	-	1	3		
CO2	3	3	2	-	-	-	-	-	-	-	-	2	3		
CO3	3	3	3	2	-	-	-	-	-	-	-	2	3		
CO4	3	2	3	-	-	-	-	-	-	-	-	1	3		
CO5	-	3	-	3	-	-	-	-	-	-	-	2	3		

High-3: Medium-2: Low-1

QUESTION PAPER PATTERN:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module

TEXT BOOKS:

1. A Textbook Of Heat And Mass Transfer by R.K.Rajput, S.Chand, New Delhi.
2. Engineering heat and mass transfer. Mahesh. M. Rathore
3. Heat transfer, a practical approach Yunus A. Cengel Tata Mc Graw Hill Fifth edition Reference Books.

REFERENCE BOOKS:

1. Heat and mass transfer Kurt C, Rolle Cengage learning second edition.
2. Principals of heat transfer Frank Kreith, Raj M. Manglik, Mark S. Bohn Cengage learning Seventh Edition 2011.
3. Heat Transfer A Basic Approach M. NecatiOzisik McGraw Hill, New York 2005.
4. Fundamentals of Heat and Mass Transfer Incropera, F. P. and De Witt, D. P John Wiley and Sons, New York 5th Edition 2006

Heat Transfer Holman, J. P. Tata McGraw Hill, New York 9th Edition

OPERATIONS RESEARCH						
Course Code	**21ME73**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	2	**1**	**0**	**3**		

Number of Lecture Hours	**40**	**Exam Hours**	**03**
Credits-03			

Course Objectives: This course will enable students to
• Understand the methodology of OR problem solving and formulate linear programming problem.
• Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.
• Develop formulation skills in transportation & assignment models and finding solutions
• To know how project management techniques help in planning and scheduling a project
• Propose the best Strategy using Decision making methods under Uncertainty

MODULE NO.	**TOPICS**	**TEACHING HOURS**	**RBT LEVELS**
1	**Introduction**: Evolution of OR, Definitions of OR, Scope of OR, Applications of OR, Phases in OR study. Characteristics and limitations of OR, models used in OR. **Linear Programming Problem (LPP):** Generalized LPP- Formulation of problems as L.P.P.Solutions to LPP by graphical method (Two Variables).	**08**	**L1,L2,L3**
2	**LPP by Simplex method**: Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method and Two Phase Simplex Method, Degeneracy in LPP. **Concept of Duality**: writing Dual of given LPP. Solutions to L.P.P by Dual Simplex Method.	**08**	**L1,L2,L3**
3	**Transportation Problem**: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution (MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, applicationoftransportationproblem. **Assignment Problem**- Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment problems. Travelling Salesman Problem (TSP). Difference between assignment and T.S.P. Numerical Problems	**08**	**L1,L2,L3**
4	**Network analysis**: Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, AON and AOA diagrams; Critical path method to find the expected completion time of a project, determination of floats in networks, PERT networks,	**08**	**L1,L2,L3**

	determining the probability of completing a project, predicting the completion time of project; Cost analysis in networks. Crashing of networks-Problems. **Queuing Theory**: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), Kendall & Lee's notation of Queuing, empirical queuing models – Numerical on M/M/1 and M/M/C Queuing models.		
5	**Sequencing**: Basic assumptions, Johnson's algorithm, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing of 2 jobs on 'm' machines using graphical method. **Decision Theory:** Introduction, Decision under certainty, Decision under risk, Decision under uncertainty: Laplace criterion, MaxiMin criterion, MiniMax criterion, savage MiniMax regret criterion, hurwicz criterion, Decision tree.	**08**	**L1,L2,L3**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	Recognize the importanceof techniques of operations research.To formulate a given problem, then to solve either by Graphical/Simplex method.
CO.2	Formulate as L.P.P and derive optimal solutions to linear programming problems by graphical method, Simplex method, Big-M method and Dual Simplex method.
CO.3	Formulate as Transportation and Assignment problems and derive optimum solutions for transportation, Assignment and travelling salesman problems.
CO.4	Construct network diagrams and determine critical path, floats for deterministic and PERT networks including crashing of Networks.Solve waiting line problems for M/M/1 and M/M/K queuing models.
CO.5	Determine minimum processing times for sequencing of n jobs-2 machines, n jobs-3machines,n jobs-m machines and 2 jobs-n machines using Johnson's algorithm.

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO.2	1	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO.3	1	-	2	-	-	-	-	-	-	-	-	-	-	1	-
CO.4	1	-	-	1	-	-	-	-	-	-	-	-	-	1	-
CO.5	1	-	-	-	1	-	-	-	-	-	-	1	-	1	-

High-3,Medium-2,Low-1

QUESTION PAPER PATTERN:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.

- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module

TEXT BOOKS:

1. Operations Research- An Introduction by Hamdy A. Taha-Pearson Education Edition.
2. Operations Research- A.P.Verma, S.K.Kataria& Sons, Third edition, 2007
3. Operations Research-S.D. Sharma, Kedarnath Ramnath and Co, 4th edition, 2012
4. Operations Research- Kalavathy.S, Vikas Publishing House, 4th edition 2013
5. Operations Research- R.Panneerselvam, PHI Learning, 2019

REFERENCE BOOKS:

1. Operations Research, Theory and Applications, Sixth Edition, J K Sharma, Trinity Press,Laxmi Publications Pvt. Ltd. 2016.
2. Operations Research, Paneerselvan, PHI.
3. Operations Research, A M Natarajan, P Balasubramani, Pearson Education, 2005.
4. Introduction to Operations Research, Hillier and Lieberman, 8th Ed., McGraw Hill.

E-RESOURCES :

1. http://www.digimat.in/nptel/courses/video/112106134/L04.html
2. https://nptel.ac.in/courses/111104027
3. https://www.digimat.in/nptel/courses/video/112106134/L16.html
4. http://www.nitttrc.edu.in/nptel/courses/video/111104079/L34.html
5. http://www.digimat.in/nptel/courses/video/110104073/L21.html

MECHATRONICS						
Course Code	**21ME742**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	2	**1**	**0**	**3**		
Number of Lecture Hours	**40**				**Exam Hours**	**03**
Credits-03						

Course Objectives: This course will enable students to
• To acquire a strong foundation in science and focus in mechanical, electronics, control, software, and computer engineering, and a solid command of the newest technologies.
• To understand the evolution and development of Mechatronics as a discipline.
• To substantiate the need for interdisciplinary study in technology education
• To understand the applications of microprocessors in various systems and to know the functions of each element.
• To demonstrate the integration philosophy in view of Mechatronics technology

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1		**08 Hours**	**L1, L2**
Introduction: Scope and elements of mechatronics, mechatronics design process, measurement system, requirements and types of control systems, feedback principle, Basic elements of feedback control systems, Classification of control system. Examples of Mechatronics Systems such as Automatic Car Park system, Engine management system, Antilock braking system (ABS) control, Automatic washing machine. **Transducers and sensors:** Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, LVDT, Capacitance sensors, force and pressure sensors, Strain gauges, temperature sensors, proximity switches and Hall Effect sensors.			
2		**08Hours**	**L1, L2, L3**
Signal Conditioning: Introduction – Hardware – Digital I/O, Analog to digital conversions, resolution, Filtering Noise using passive components – Registers, capacitors, amplifying signals using OP amps. Data acquisition systems (DAQS), data loggers, Supervisory control and data acquisition (SCADA), Communication methods. **Electro Mechanical Drives:** Relays and Solenoids – Stepper Motors – DC brushed motors – DC brushless motors – DC servo motors –PWM's – Pulse Width Modulation.			
3		**08 Hours**	**L1, L2, L3**
Microprocessor & Microcontrollers: Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers. **Microprocessor Architecture:** Microprocessor architecture and terminology-CPU, memory and address, I/O andPeripheraldevices,ALU,InstructionandProgram,Assembler,DataRegisters,ProgramCounter,Flags,Fetch cycle, write cycle, state, bus interrupts.			
4		**08 Hours**	**L1, L2, L3**

Programmable Logic Controller: Introduction to PLCs, Basic structure of PLC, Principle of operation, input and output processing, PLC programming language, ladder diagram, ladder diagrams circuits, selection of PLC for application. **Application of PLC control:** Extending and retracting a pneumatic piston using latches, control of twopneumatic pistons, control of process motor, control of vibrating machine, control of process tank, control of conveyer motor etc.			
5		**08 Hours**	**L1, L2**
Robotics: Robotic configuration, robot anatomy and related attributes, robot control systems, end effectors, sensors in robotics, industrial robot applications, robot accuracy and repeatability, different types of robots, degrees of freedom **Mechatronics Design process:** Stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Automatic car park barrier.			

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	Illustrate various components of Mechatronics systems.
CO.2	Assess various control systems used in automation.
CO.3	Design and conduct experiments to evaluate the performance of a mechatronics system or component with respect to specifications, as well as to Analyse and interpret data.
CO.4	Apply the principles of Mechatronics design to product design.
CO.5	Explain the basic principles of Robotic technology, configurations & control.

Mapping of course outcomes with program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS0 1**	**PSO 2**	**PSO 3**
CO.1	3	-	-	-	1	-	-	-	-	-	-	-	-	-	1
CO.2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	1
CO.3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	1
CO.4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO.5	3	-	-	-	2	-	-	-	-	-	-	-	-	-	2

QUESTION PAPER PATTERN:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

- **TEXT BOOKS:**

1. Mechatronics, R. Ravi Kumar, Sunstar Publishers.
2. Mechatronics-Principles Concepts and Applications, NitaigourPremchandMahalik, Tata McGraw Hill,
3. Mechatronics–Electronic Control Systems in Mechanical and Electrical Engineering, W.Bolton, Pearson Education

- **REFERENCE BOOKS:**

1. Mechatronics, HMT Ltd, Tata Mc Graw Hill, 1st Edition
2. Mechatronics: Integrated Mechanical Electronic Systems, K.P. Ramachandran, G.K. Vijayaraghavan, M.S. Balasundaram, Wiley India Pvt. Ltd. New Delhi
3.Introduction to Robotics: Analysis, Systems, Applications, Saeed B. Niku, Person Education

OPERATION MANAGEMENT						
Course Code	**21ME751**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	3	**1**	**0**	**4**		
Number of Lecture Hours	**50**				**Exam Hours**	**03**
Credits-04						

Course Objectives: This course will enable students to

- To study fundamentals of production and operations management and decision making.
- To study forecasting and its approaches.
- To understand locations planning and its capacity.
- To understand **Aggregate Planning & Master Scheduling.**
- To study an overview of **Material Requirement Planning.**

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Production and Operations Management:**Introduction, Functions within business organizations, the operation management function, Classification of production systems, Productivity, factors affecting productivity, contemporary issues and development. Decision Making: The decision process, characteristics of operations decisions, use of models, decision making environments, graphical linear programming, analysis and trade-offs.	**10**	**L1, L2**
2	**Forecasting:** Steps in forecasting process, approaches to forecasting, forecasts based on judgment and opinion, analysis of time series data, accuracy and control of forecasts, choosing a forecasting technique, elements of a good forecast.	**10**	**L1, L2**
3	**Capacity & Location Planning:** Importance of capacity decisions, defining and measuring capacity, determinants of effective capacity, determining capacity requirement, developing capacity alternatives, evaluating alternatives, Need for location decisions, nature of locations decisions, general procedure for making locations decisions, evaluating locations decisions, facilities layout – need for layout decisions, types of processing.	**10**	**L1, L2**
4	**Aggregate Planning & Master Scheduling:** Aggregate planning – Nature and scope of aggregate planning, strategies of aggregate planning, techniques for aggregate planning – graphical and charting techniques, mathematical techniques. The master production schedule, Master scheduling process, Master scheduling methods.	**10**	**L1, L2**
5	**Material Requirement Planning (MRP):** Dependent versus independent demand, an overview of MRP – MRP inputs and outputs, MRP processing, ERP capacity requirement planning, benefits and limitations of MRP. **Purchasing and Supply Chain Management (SCM):** Introduction, Importance of purchasing and SCM, the procurement process, Concept of tenders, Approaches to SCM, Vendor development.	**10**	**L1,L2**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	Explain the concept and scope of operations management in a business context.

CO.2	Recognize the role of Operations management among various business functions and its role in the organizations' strategic planning and gaining competitive advantage.
CO.3	Analyze the appropriateness and applicability of a range of operations management systems/models in decision making.
CO.4	Assess a range of strategies for improving the efficiency and effectiveness of organizational operations.
CO.5	Evaluate a selection of frameworks used in the design and delivery of operations

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	3	-	-	1	-	1	-	-	-	-	-	-	1	-	-
CO.2	3	-	-	1	-	1	-	-	-	-	-	-	1	1	-
CO.3	3	-	-	1	-	1	-	-	-	-	-	-	1	-	-
CO.4	3	-	-	1	-	1	-	-	-	-	-	-	1	-	-
CO.5	3	-	-	1	-	1	-	-	-	-	-	-	1	-	-

High-3: Medium-2: Low-1

TEXT BOOKS:

1. "Operation Management, Author- Joseph G Monks McGrew Hill Publication, International Edition-1987.
2. "Production and Operation Management" ,Author-Pannerselvam R. PHI publications, 2nd edition
3. "An Introductory book on lean System, TPS Yasuhiro Modern.

REFERENCE BOOKS:

1. "Production and Operation Management" Chary S. N. TataMcGrew Hill 3rd edition.
2. "Production and Operations Management", Everett E. Adams, Ronald J. Ebert, Prentice Hall of India Publications, Fourth Edition.
3. Modern Production/Operations Management, Buffia, Wiely India Ltd 4th Edition.

QUESTION PAPER PATTERN:

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

HYDRAULICS AND PNEUMATICS LAB						
Course Code	**21MEL76**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students to
• To understand the use of hydraulic and pneumatic systems in automation.
• Study of working principle of various components used in hydraulic and pneumatic systems.
• To understand different components used in hydraulic and pneumatic systems.
• To learn the design of hydraulic and pneumatic circuits.
• Understand industrial applications of hydraulic and pneumatic circuits

PART	TOPICS	TEACHING HOURS	RBT LEVELS
A	1.Study the fundamental principal of hydraulics and its application 2.Operation of double acting cylinder using 4/3 hand lever valve 3. Study of actuator speed control circuits a) meter-in circuit b) meter-out circuit 4. Control of double acting cylinder by using 4 by 2-way direction control valve 5. Study operation of pilot operated check valve.	**08 Hours**	**L1,L2,L3**
B	1. Study of self-reciprocation of single acting cylinder by using electric limit switch. 2. Study of self-reciprocation of double acting cylinder by using proximity switch 3. Study of operation of double acting cylinder by using 5/2 single sided solenoid valve 4. Study of operation of 3/2 single pilot operated valve and 3/2 hand lever valve.	**08 Hours**	**L1,L2,L3**
C	**For Demonstration purpose only** 1. Study of AND gate valve. 2. Study of shuttle valve 3. Study of quick exhaust valve 4. Study of operation of 3/2 hand lever valve 5. Study of operation of 5/2 push button valve. 6. Study of operation of time delay valve. 7. Study of operation of pressure sequencing valve	**08 Hours**	**L1,L2,L3**

	8. Study of flow control valve and pneumatic motor		

COURSE OUTCOMES: At the end of the course the student will be able to:

CO1	Identify the components of hydraulic and pneumatic systems.
CO2	Classify the applications of hydraulic and pneumatic system
CO3	Demonstrate the various hydraulic and pneumatic components and systems.
CO4	Design hydraulic and pneumatic circuits for various applications
CO5	Conduct the troubleshooting of hydraulic and pneumatic systems.

Mapping of course outcomes with program outcomes

21MEL76	**PO 1**	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS0 1**	**PSO 2**	**PSO 3**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
Avg. Mapping	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-

High-3: Medium-2: Low-1

SCHEME OF EXAMINATION:

Perform any two experiments
One Question from Part A – 20 Marks
One Question from Part B/Part C– 20 Marks
Viva-Voce – 10 Marks

HEAT AND MASS TRANSFER LAB						
Course Code	**21MEL77**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students to

- Know the basics of modes of heat and mass transfer.
- Understand the concepts of heat transfer through extended surfaces.
- Apply principles of heat transfer to predict heat transfer co-efficient.
- Understand and analyze the functioning of vapor compression refrigeration system.

PART	TOPICS	TEACHING HOURS	RBT LEVELS
A	1. Determination of Thermal Conductivity of a Metal Rod. 2. Determination of Overall Heat Transfer Coefficient of a Composite wall. 3. Determination of Effectiveness on a Metallic fin. 4.Determination of Heat Transfer Coefficient in free Convection 5.Determination of Heat Transfer Coefficient in a Forced Convention. 6. Determination of Emissivity of a Surface.	**12 Hours**	**L1,L2,L3**
B	1. Determination of Stefan Boltzmann Constant. 2. Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers. 3. Experiments on Boiling of Liquid and Condensation of Vapor. 4. Performance Test on a Vapor Compression Refrigeration. 5. Performance Test on a Vapor Compression Air – Conditioner. 6. Experiment on Transient Conduction Heat Transfer.	**12 Hours**	**L1,L2,L3**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO1	Classify different modes of heat transfer and demonstrate the concepts of heat transfer through conduction.

CO2	Conduct experiments on fins and Analyse experimental data to draw meaningful conclusions for developments of heat exchanging device
CO3	Perform experiments on heat transfer through Convection, Radiation and analyse with meaningful data.
CO4	Apply and demonstrate heat exchangers.
CO5	Apply the concepts for design and maintenance of vapor compression refrigeration system.

Mapping of course outcomes with program outcomes

21MEL77	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**	**-**									**2**		
CO2	**3**	**2**	**1**	**-**									**2**		
CO3	**3**	**2**	**1**	**-**									**3**		
CO4	**3**	**2**	**1**	**-**									**1**		
CO5	**3**	**2**	**2**	**2**									**2**		

High-3: Medium-2: Low-1

SCHEME OF EXAMINATION:

Perform any two experiments
One Question from Part A – 20 Marks
One Question from Part B – 20 Marks
Viva-Voce – 10 Marks

CONTROL ENGINEERING VIRTUAL LAB						
Course Code	**21MEL781**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits- 01						

Course Objectives: This course will enable students to
• Understanding Control Concepts: Gain a basic understanding of control ideas and principles through interactive simulations and virtual experiments.
• Component Characteristics: Study and verify the various characteristics of control system components using virtual tools.
• System Development: Build a virtual control system and compute its transfer function using simulation software.
• Stability Analysis: Analyze the stability of the developed virtual control system through computational methods.

PART		**TEACHING HOURS**	**RBT LEVELS**
PART-A	1. Pole-zero plot 2. First order unity feedback 3. Second order unity feedback system 4. Type zero-one-Two System 5. Study the effect of addition of zeros to the forward path transfer function of a closed loop system.	**12**	**L1,L2,L3**
PART-B	6. Study the effect of addition of poles to the farward path transfer function of a control system. 7. To obtain root locus for a given transfer function of the system 8. To obtain bode plot for a given transfer function of the system 9. Nyquist plot of a second order system 10. To study the effect of PI, PD and PID controller on a control system	**12**	**L1,L2,L3**

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	To understand concept of pole-zero plot and first order unity feed back
CO.2	To study the second order unity feedback system and type zro-one-two system.
CO.3	To study the effect of addition of zeros to the forward path transfer function of a closed loop system.
CO.4	To measure root locus and bode plot for a given transfer function
CO.5	To determine PI, PD and PID controller on a control system.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO.1	2	2	1	1	1	-	-	-	-	-	-	-	2	-	-
CO.2	2	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO.3	2	2	1	1	1	-	-	-	-	-	-	-	1	1	-
CO.4	2	2	1	1	1	-	-	-	-	-	-	-	2	-	-
CO.5	2	2	1	1	1	-	-	-	-	-	-	-	1	-	-

High-3: Medium-2: Low-1

QUESTION PAPER PATTERN:

- ONE question from part -A: 30 Marks
- ONE question from part B: 50 Marks
- Viva –Voice: 20 Marks

Total : 100 Marks

MechatronicsLab						
CourseCode	**21MEL782**				**CIE Marks**	**50**
NumberLectureHour/Week	**L**	**T**	**P**	**TOTAL**	**SEEMarks**	**50**
	0	**0**	**2**	**2**		
NumberofLectureHours	**24**				**Exam Hours**	**03**
Credits-01						

CourseObjectives: Thiscoursewillenablestudents.
• Tointroduce studentstothe basicsofconductingexperimentinmechatronics.
• Toenhance students'technicalskillsregardingmechatronicsandits instruments
• Tounderstandthetechnicalaspectsofexperiment.
• Tomake studentunderstandtheuseelectro-mechanicalinstrumentslike switches,relays& transducers.
• Toprovideideaaboutprincipleandapplicationsofdataacquisitionsystem,PLCmodules&batchprocess reactors.

PARTA	**EXPERIMENTS**	**TEACHING HOURS**	**RBT LEVELS**
1	Setupfor studyof differentswitches&Relays	**12**	**L2,L3**
2	StudyofLVDTsetup		
3	StudyofPressure transducer		
4	Studyon Straingauge		
5	DataAcquisitionSystem		
PARTB	**EXPERIMENTS**	**12**	**L3**
1	ApplicationsonPLCprogrammingworking modules i) Liftsimulationmodule ii) Materialstamping&rejectionmodule iii) Washingmachine module		
2	BatchProcessReactor		
3	Position&Speedcontrolusing servomotors		

COURSEOUTCOMES:Atthe endof the coursethe studentwillbe ableto:

CO.1	Understandandapplyvarioussensors,transducers,switches,andrelaysformeasurementand control.

CO.2	Gainproficiencyindataacquisition,PLCprogramming,andindustrialautomation systems.
CO.3	Developskillsinservomotorcontrolandprocessautomationforadvancedindustrial applications.

Mappingofcourseoutcomeswith program outcomes

21MEL782	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO.1	2	2	1	1	2	-	-	-	2	-	-	2	2	3	2
CO.2	2	2	1	1	2	-	-	-	2	-	-	2	2	3	2
CO.3	2	2	1	1	2	-	-	-	2	-	-	2	2	3	2

QUESTIONPAPERPATTERN:

SCHEMEOFEVALUATION FORCIE(50 MARKS)

(a)

Experimentno:	ExperimentExecuted(25marks)	
1to8	ExperimentExecuted	25
	CIELab Evaluation	15
	Mockpresentation	10
	Total	**50**

SCHEMEOFSEE EXAMINATION(50 MARKS)

Studenthasto executetheexperiment

Questionno	Modules	Marks
Q1	PART-A	15
Q2	PART-B	25
Q3	VIVA-VOCE	10
	Total	**50**

Reference:LABMANU

AL NOTE:

1. Norestrictionoftimingforexecutionofexperimentandcalculation.The totaldurationis3hours.

2. Itisdesirable towriteobservationsandproceduresbeforeconducting experiment.

3. Studentsneedtofollowallthesafetymeasures.

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Project-VII						
Course Code	**21PRJ79**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students to

1. To introduce fundamental concepts and analysis techniques in engineering to students across all disciplines.
2. UNDERSTAND the "Product Development Cycle", through Mini Project.
3. PLAN for various activities of the project and distribute the work amongst team members.
4. LEARN budget planning for the project.
5. Preparation for Industrial Challenges

Project work:

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

COURSE OUTCOMES: At the end of the course the student will be able to:

CO.1	To be able to apply knowledge of engineering to a logically chosen problem.
CO.2	To be able to prepare complete feasibility report for practical problem
CO.3	To be able to synthesize the findings to a suitable conclusion
CO.4	To present the findings in the form of technical report
CO.5	To Problem-Solving and Debugging Skills

Mapping of course outcomes with program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS0 1**	**PSO 2**	**PSO 3**
CO.1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO.2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO.3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO.4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO.5	3	2	-	-	-	-	-	-	2	-	2	-	2	-	1

High-3: Medium-2: Low-1

Assessment And Evaluation

Scheme of Evaluation for CIE(50 Marks)

	Modules	Marks
1	Design and fabrication of the system/project	25
2	Evaluation of project report by the department	15
3	Mock evaluation/presentation	10
Total		50

Scheme of See Examination (50 MARKS)

Student has to solve three questions; pattern of questions are as follows

Question no	Modules	Marks
Q1	Design and fabrication of the system/project	25
Q2	Evaluation of project report by the department	15
Q3	Mock evaluation/presentation	10
Total		50

NOTE:

The SEE for the Project shall be evaluated by two examiners jointly and the evaluation shall be based on various components such as, Writing of Abstract, Project report, Oral Presentation, Demonstration and Viva-voce.

Project report has to be prepared as per the university guidelines (outline).

INDUSTRIAL PSYCHOLOGY AND ORGANISATIONAL BEHAVIOUR

[As per NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme]

SEMESTER-VII

Subject Code	21HSM710	CIE Marks	50
Number of Lecture Hour/Week	1L	SEE Marks	50
Total Number of Lecture Hours	20	Exam Hours	03

CREDITS-01

Course Objectives: This course will enable students to:

1. Relating human psychology to science
2. Understand the human psychology
3. Understand the nature of organization and organization models
4. Understand the human social communication
5. Understand the leadership qualities

Modules	**Teaching Hours**
Module -1	
Introduction to I/O psychology: Major fields of I/O psychology, brief history of I/O psychology, employment of I/O psychology, ethics in I/O psychology. (Chapter-1)	**3 Hours**
Module -2	
Organisational communication: Types of organizational communication, interpersonal communication, improving employee communication skills. (Chapter-11)	**3 Hours**
Module -3	
Leadership: Introduction, personal characteristics associated with leadership, interaction between the leadership and the situation specific leader skills, leadership where we are today. (Chapter-12)	**5 Hours**
Module -4	
Group behaviour- teams and conflicts Group dynamics, factors affecting group performance, individual versus group performance, group conflicts. (Chapter-13)	**5 Hours**
Module-5	
Stress management: Dealing with the demands of life and work, stress defined, predisposition to stress,	**4 Hours**

sources of stress, consequences of stress, stress reduction intervention related to life /work issues. (Chapter-15)	

Course Outcomes: At the end of this course, students would be able to

CO-1-Comprehend the knowledge and concepts of human psychology

CO-2-know the importance of communication in organization.
CO-3-have insight into individual, group behavior and leadership skills.
CO-4-deal with people in better way by knowing their behavior.
CO-5-Dealing with stress and work issues.

Text Book: MichaelG.Aamodt, Industrial/Organizational Psychology: An Applied Approach, 6th Edition, Wadsworth Cengage Learning, ISBN: 978-0-495-60106-7.

Reference Books:

1. Blum M.L. Naylor J.C., Horper& Row, Industrial Psychology, CBS Publisher, 1968

2. Luthans, Organizational Behaviour, McGraw Hill, International, 1997

3. Morgan C.t., KingR.A., JohnRweisz&JohnSchoples, Introduction to Psychology, McHraw Hill, 1966

4. SchermerhornJ.R.Jr., Hunt J.G &Osborn R.N., Managing, Organizational Behaviour, John Willy

COURSE OUTCOME AND PROGRAMME OUTCOME MAPPING (1/2/3):

Note:1-Low, 2-Medium, 3-High

CO/PO	PO.1	PO.2	PO.3	PO.4	PO.5	PO.6	PO.7	PO.8	PO.9	PO.10	PO.11	PO.12	PSO.1	PSO.2
CO1	-	-	-	-	-	**2**	-	-	**3**	-	-	**2**	-	-
CO2	-	-	-	-	-	**2**	-	-	**3**	**3**	-	**2**	-	-
CO3	-	-	-	-	-	**2**	-	-	**3**	-	-	**2**	-	-
CO4	-	-	-	-	-	**2**	-	-	**3**	-	-	**2**	-	-
CO5	-	-	-	-	-	**2**	-	-	**3**	-	-	**2**	-	-

BASICS OF FUEL CHARACTERIZATION						
Course Code	**21AECME711A**				**CIE Marks**	**50**
Teaching Hours/Week	**L**	**T**	**P**	**Total**	**SEE Marks**	**50**
	0	**0**	**1**	**1**	**Total Marks**	**100**
Total Hours of Teaching	**14**				**Exam Hours**	**03**
Credits-01						

Course Category: Foundation

Preamble: Fuel characterization is a critical field in mechanical and energy engineering. Understanding the properties and behaviors of different fuels is fundamental to optimizing engine performance, ensuring fuel efficiency, and reducing emissions. This course provides in-depth knowledge on the classification of fuels, their calorific values, viscosity, specific gravity, and other vital properties. It emphasizes laboratory experimentation to practically understand how fuels behave under different conditions.

Pre-requisite, if any: Knowledge of fuels and chemical properties.

Course Objectives:

- To provide an understanding of various types of fuels and their properties.
- To enable students to determine essential characteristics such as calorific value, viscosity, specific gravity, and combustion properties of fuels.
- To provide hands-on experience in laboratory testing for analyzing fuel properties.
- To understand the methods used to measure the performance characteristics of fuels.
- To learn the significance of fuel analysis in optimizing engine performance and complying with environmental standards.

MODULE NO.	**TOPICS**	**TEACHING HOURS**	**RBT LEVELS**
1	**Introduction of fuels**	**3 Hours**	**L1,L2,L3**
Lab Activity: 1. Study of Classification of fuels, and basic properties of fuels such as Calorific value, specific gravity, viscosity, flash point, fire point, and cetane/octane number.			
2	**Calorific Value Measurement, Bomb Calorimeter Experiment, Viscosity Measurement.**	**3 Hours**	**L1, L2, L3**

Lab Activity:

1. Determination of the higher heating value (HHV) and lower heating value (LHV) of char coal and diesel fuel.
2. Determination of kinematic and dynamic viscosity of liquid fuels using viscometers such as Redwood, Saybolt, or Engler viscometers.

3	**Density, and Specific Gravity of Fuels.**	**3 Hours**	**L1, L2, L3**

List Activityl:

1. Determination of specific gravity using hydrometers, pycnometers, or density meters.

4	Study of distillation and d**etermination of Carbon Residue and Water Content in Fuels**	**3 Hours**	**L1, L2, L3**

Lab activity: Study of distillation of liquid fuels (like petroleum) to determine the boiling range and assess volatility.Determination of Carbon Residue and Water Content in Fuel.

5	**Study of determination of Cetane and Octane Number.**	**2 Hours**	**L1, L2, L3**

List of Lab Activities:

1. Study of Testing and determination of cetane number for diesel fuels
2. Study of Testing and determination of octane number for gasoline.

COURSE OUTCOMES: At the end of the course the student will be able to:	
CO.1	Identify and classify various types of fuels based on their physical and chemical properties.
CO.2	Measure and analyze the calorific value, viscosity, and specific gravity of fuels using laboratory methods.
CO.3	Determine density and specific gravity of fuels.
CO.4	Analyse the significance of carbon residue and water content in fuels.
CO.5	Determine cetane and octane numbers and their impact on fuel performance in engines

Mapping of the Course Outcomes for Course Code 21AECME711A to Program Outcomes

21AECME711A	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO.1	3	2	-	1	-	-	-	-	-	-	-	-	3	3	-
CO.2	3	3	-	1	-	-	-	-	-	-	-	-	3	3	-
CO.3	2	3	-	1	-	-	-	-	-	-	-	-	3	3	-
CO.4	3	2	-	1	-	-	-	-	-	-	-	-	3	3	-
CO.5	3	2	-	1	-	-	-	-	-	-	-	-	3	3	-

QUESTION PAPER PATTERN:

- ONE question from part -A: 30 Marks
- ONE question from part B : 50 Marks
- Viva –Voice : 20 Marks

Total : 100 Marks

RESEARCH PROJECT/FIELD PROJECT-VIII			
[As per Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme] SEMESTER-VIII			
Subject Code	21PRJ81	CIE Marks	50
Total No. of implementation weeks	16P	SEE Marks	50
		Exam Hours	03
CREDITS-8			

Course Objectives: Students will be Guided to:

1. Understanding about the Project and its components.
2. Introduction of the project selected.
3. Detailed literature survey of the project and understand concepts of problem identification.
4. Design and development of Proposed Methodology.
5. Implementation of the proposed methodology and thesis document preparation.

STUDENTS WILL BE GIVEN AnOPEN-ENDED PROBLEM OF THE SOCIETY AND ASKED TO SOLVE BY DESIGNING AND IMPLEMENTING THE SYSTEM INDIVIDUALLY

Course outcomes: After studying this course, students will be able to:

CO-1- Apply the knowledge of electronics hardware and software components to solve the real time problems of the society.

CO2. Analyze the various existing solutions available to solve the real time problem and propose the best solution.

CO-3-Design and development of proposed methodology based on the societal needs, environmentally friendly.

CO-4-Use the modern tool available like advanced hardware and software tools to implement the proposed methodology and make it use for society and prepare a document and submit.

CO-5-Publish the proposed work in the peer reviewed Journal

COURSE OUTCOME AND PROGRAMME OUTCOME MAPPING (1/2/3):

Note: 1-Low, 2-Medium, 3-High

CO/PO	**PO.1**	**PO.2**	**PO.3**	**PO.4**	**PO.5**	**PO.6**	**PO.7**	**PO.8**	**PO.9**	**PO.10**	**PO.11**	**PO.12**	**PSO.1**	**PSO.2**
CO1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**
CO2	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**
CO3	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**
CO4	**-**	**-**	**3**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO5	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**-**	**2**	**-**	**-**

INTERNSHIP [As per Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme] SEMESTER-VIII			
Subject Code	21MEI82	CIE Marks	50
Total No. of implementation/training weeks	12P	SEE Marks	50
		Exam Hours	03

CREDITS-06

Course Objectives: Students will be taught to:

1. Learn to appreciate work and its function in the economy.
2. Develop work habits and attitudes necessary for job success.
3. Develop communication, interpersonal and other critical skills in the job interview process.
4. Build a record of work experience.
5. Acquire employment contacts leading directly to a full-time job following graduation from college.

Students has to carry out the internship OF 16 weeks in the industry.

Course outcomes: After studying this course, students will be able to:

CO1. Apply the knowledge of electronics hardware and software components to solve the real time problems of the society.

CO2. Analyze the various existing solutions available to solve the real time problem and propose the best solution.

CO3. Design and implement the system to solve the real time problem of the society.

CO4.Conduct investigations on the output and prepare the technical documentation of the designed system in a team.

CO5.Use the modern tool available like advanced hardware and software tools.

COURSE OUTCOME AND PROGRAMME OUTCOME MAPPING (1/2/3):

Note: 1-Low, 2-Medium, 3-High

CO/PO	**PO.1**	**PO.2**	**PO.3**	**PO.4**	**PO.5**	**PO.6**	**PO.7**	**PO.8**	**PO.9**	**PO.10**	**PO.11**	**PO.12**	**PSO.1**	**PSO.2**
CO1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**
CO2	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**
CO3	**-**	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**
CO4	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**3**
CO5	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**3**