Course Title:	Mathematics for Mechanical Engineering Stream-III		
Course Code:	22MATM31	**CIE Marks**	50
Course Type:	Theory	**SEE Marks**	50
		Total Marks	100
Teaching Hours/ Week (L:T:P:S)	2:2:0:0	**Exam Hours**	03
Total Hours of Pedagogy	40 hours Theory	**Credits**	03

Course objectives: The goal of the course Mathematics for Mechanical Engineering Stream-III(22MATM31)is to

Familiarize the importance of Random variable and Probability distribution essential for Mechanical engineering.
Analyze Civil engineering problems applying Statistical methods to fit a curve and understand co-variance of two variables and its correlation coefficient.
Develop the knowledge of complex variable and find the Analyticity of a function.
Apply LPP in real life example.
To develop the knowledge of functionals and variational problems.
Develop the knowledge of solving Mechanical engineering problems numerically.

Teaching-Learning Process
Pedagogy(General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.
In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop student's theoretical and applied mathematical skills.
State the need for Mathematics with Engineering Studies and Provide real-life examples.
Support and guide the students for self–study.
You will also be responsible for assigning homework, grading assignments and quizzes, and documenting student's progress.
Encourage the students for group learning to improve their creative and analytical skills.
Show short related video lectures in the following ways:
As an introduction to new topics (pre-lecture activity).
As are vision of topics (post-lecture activity).
As additional examples (post-lecture activity).
As an additional material of challenging topics (pre-and post-lecture activity).
As a model solution of some exercises (post-lecture activity).

Course outcome (Course Skill Set)

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

CO1	Knowing the random variable both discrete and continuous and their probability distribution, Mass density function and solving the problems on various engineering problems.
CO2	Apply the concept of correlation and regression lines for solving the problems and numerical techniques to solve engineering problems and fit a least squares curve to the given data.
CO3	Understand the analyticity, potential fields, residues and poles of complex potentials in field theory, electromagnetic theory and studying Bilinear transformation.
CO4	Understand what functionals are, and have some appreciation of their applications
CO5	Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained.
CO6	Demonstrate the various physical modules in Civil engineering through higher order differential equations.

Bloom's level of the course outcomes:

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

Course Articulation Matrix / Course mapping :

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

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

MODULE-1: Probability Distribution

Probability Distribution: Random variables (discrete and continuous) probability mass/density functions. Binomial distribution, Poisson distribution. Exponential and Normal distributions. Problems.

Self Study : Definition of probability , addition and multiplication rule, Bay's theorem.

(RBT Levels: L1, L2 and L3) (8 Hours)

MODULE-2: Statistical Methods

Basic Statistics: Measures of central tendency, measures of dispersion, range quartile deviation, mean deviation, standard deviation, coefficient of variation, Skewness and Kurtosis, problems.
Statistical Methods: Correlation-karl Pearson's co-efficient of correlation problems. Regression analysis lines of regression, Rank correlation (without proof)-problems.
Curve Fitting: Curve fitting by the method of least square. Fitting of the curves of the form$y = ax + b, y = ax^2 + bx + c \ \& \ y = ae^{bx}$.

Self-study: Center and circle of curvature, evolutes and involutes.
(RBT Levels: L1, L2 and L3) (8 Hours)

MODULE-3 : Complex variable-1

Complex valued function, limit, continuity, differentiability, analytic functions. Cauchy-Riemann Equation in Cartesian, Polar form. Harmonic and orthogonal property and problems on construction of Analytic function.
Self Study : Complex Trigonometry.

(RBT Levels: L1, L2 and L3) (8 Hours)

MODULE- 4: Calculus of variation

Calculus of variation - Functional; Variation of a functional and its properties; Variational problems with fixed boundaries; Euler's equation, Extremals; Functional dependent on several unknown functions and their first order derivatives; Functionals dependent on higher order derivatives; Functionals dependent on the function of more than one independent variable; Variational problems in parametric form;
Self Study : Differential equation with more than variable.

(RBT Levels: L1, L2 and L3) (8 Hours)

MODULE- 5 :Operation Research

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.
Self Study : Formulation of LPP
(RBT Levels: L1, L2 and L3) (8 Hours)

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing marks for the CIE is 45% of the maximum marks (22.5 marks out of 50). The minimum passing marks for the SEE is 35% of the maximum marks (18 marks out of 50).
A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation(CIE):

The CIE shall be conducted by the course teacher throughout the semester. The CIE marks for the theory component shall be 50 marks .

Three Tests each of 15 Marks; after the completion of the syllabus of 35-40%, 65-70%, and 90-100% respectively. Average of Best Two performances of the Internal Tests shall be considered for 15 Marks.

Session wise assignments for 25 marks
For Seminar and library work 05 marks
Attendance 5 marks (95% to 100%), 04 marks (85% to 94%)

Semester End Examination(SEE)

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
The question paper will have ten full questions carrying equal marks.
Each full question carries 20 marks.
There will be two full questions (with a maximum of three 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 five full questions, selecting one full question from each module

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)Text Books

B.S.Grewal:"Higher Engineering Mathematics", Khanna publishers, 44th Ed.,2021.
E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.

Reference Books

V. Ramana:"Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.,2017
Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics" Oxford University Press, 3rdEd., 2016.

N.P Bali and Manish Goyal: "A textbook of Engineering Mathematics" Laxmi Publications,10th Ed.,2022.
C. Ray Wylie, LouisC. Barrett:"Advanced Engineering Mathematics" McGraw–Hill Book Co., Newyork, 6thEd., 2017.
Gupta C. B, Sing S .Rand Mukesh Kumar: "Engineering Mathematic for Semester I and II" ,Mc-Graw Hill Education(India)Pvt. Ltd 2015.
H.K. Dass and Er.RajnishVerma:"Higher Engineering Mathematics" S.Chand Publication, 3rdEd. ,2014.
James Stewart:"Calculus"CengagePublications,7thEd.,2019.
David CLay:"Linear Algebra and its Applications", Pearson Publishers,4th Ed.,2018.
Gareth Williams: "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6thEd., 2017.

Additional Mathematics - I

COMMON TO ALL BRANCHES

Course Code	22MATDIP31	CIE Marks	100
Contact Hours/Week	02	SEE Marks	00
Total Hours	25	Exam Hours	00
Semester	III	Credits	00

Course Learning Objectives:

This course will enable students to:

- Acquire basic concepts of complex trigonometry, vector algebra, differential and integral calculus and vector differentiation.
- know the basic concepts of derivatives and representation of different types of polar curves Evaluation of double and triple integrals.
- know the basic concepts of partial differential equations.
- To develop the knowledge of matrices and linear algebra in compressive manner.
- To understand the essential concept of linear algebra.

Course Outcomes(COs):

After completion of course, the student will able to

CO#	Course Outcomes	POs	PSOs
CO1	Learn the representation of complex numbers in Argand diagram and understanding the vector dot product and cross product and use in finding the area, projection, etc. Also understanding the gradient, divergence and curl operators.	1, 2, 3	
CO2	Apply the knowledge of calculus to find the nth derivative and solve the problems related to polar curves and its applications in determining the bendness of a curve.	1, 2, 3	
CO3	Learn the notion of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions and solve first order linear/nonlinear differential equation analytically using standard methods.	1, 2, 3	
CO4	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.	1, 2, 3	
CO5	Make use of matrix theory for solving system of linear equations and compute Eigen values and Eigen vectors.	1, 2, 3	

Bloom's level of the course outcomes:

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

Course Articulation Matrix / Course mapping :

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

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

Module-1: Complex Trigonometry

Complex Numbers: Definition and Properties . Modulus and Amplitude of complex number, Argand's diagram , De-Moivre's theorem (without proof)
Vector Analysis : Scalar and Vectors. Vector addition and subtraction. Multiplication of vectors (Dot and Cross products) Scalar and vector triple products- simple problems, Vector Differentiation : Gradient, Divergence and Curl.

(RBT Levels: L1, L2 and L3)
5 Hours

Teaching – Learning Process	Chalk and talk method / Power Point Presentation

Module-2: Differential Calculus

Review of successive differentiation. Formulae of n^{th} derivatives of standard functions- Leibnitz's theorem (without proof).
Polar Curves: Expression for Angle between radius vector and tangent, length of perpendicular from pole to the tangent, angle between two polar curves, Pedal Equation of polar curves and problems. Taylor' and Maclaurin's series expansions.

(RBT Levels: L1, L2 and L3) 5 Hours

Teaching – Learning Process	Chalk and talk method / Power Point Presentation

Module-3: Partial Differential

Definitions of Partial Differentiation, Direct and Indirect partial derivatives, Symmetric functions, Homogeneous function and Euler's theorem on homogeneous function. Total Derivative of composite and implicit function. Jacobians.

(RBT Levels: L1, L2 and L3) 5 Hours

Teaching – Learning Process	Chalk and talk method / Power Point Presentation

Module-4: Integral Calculus

Reduction Formulae of $\int_0^{\pi/2} Sin^n x\, dx$, $\int_0^{\pi/2} Cos^n x\, dx$, and Statement of Reduction formulae $\int_0^{\pi/2} sin^m x\, cos^n x\, dx$ and Problems.

Double and Triple integral- simple problems. (RBT Levels: L1, L2 and L3) 5 Hours	
Teaching – Learning Process	Chalk and talk method / Power Point Presentation
Module-5: Linear Algebra	
Basic concepts of matrices- Rank of matrix by elementary row transformations- Echelon form. Consistency of system of Linear equations. Solution of system linear equations by Gauss Elimination method, Linear Transformation, Cayley- Hamilton theorem to compute inverse of matrix. Eigen values and Eigen vector, Largest Eigen value and corresponding Eigen vector by Reyleigh's Power method. (RBT Levels: L1, L2 and L3) 5 Hours	
Teaching – Learning Process	Chalk and talk method / Power Point Presentation
CIE + Assignments: 15+35=50 Marks There will be a 2 CIE's, the best one among 2 CIE's will be considered and there will be a 35 marks for Assignments	
Text Books: 1. B.S. Grewal : Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015. 2. E. Kreyszig : Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2016.	
Reference books: 1. C.Ray Wylie, Louis C.Barrett : "Advanced Engineering Mathematics", 6th Edition, 2. McGraw-Hill Book Co., New York, 1995. 2. James Stewart : "Calculus –Early Transcendentals", Cengage Learning India Private Ltd., 2017. 3. B.V.Ramana : "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010. 4. Srimanta Pal & Subobh C Bhunia:"Engineering Mathematics", Oxford University Press,3rd Reprint,2016. 5. Gupta C.B., Singh S.R. and Mukesh Kumar : "Engineering Mathematics for Semester I & II", Mc-Graw Hill Education (India) Pvt.Ltd., 2015.	
Web links and Video Lectures: 1. http://nptel.ac.in/courses.php?disciplineID=111 2. http://www.class-central.com/subject/math 3. http://academicearth.org.	

Engineering Thermodynamics						
Course Code	22ME32				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
Aims to provide a good platform to mechanical engineering students to understand and appreciate concept of thermodynamics involved in thermal energy transformation.
To prepare students to understand systems and properties, relationships among the thermos-physical properties, the laws of thermodynamics and applications of these basic laws in thermodynamic systems.
This course will provide the essential tools required to study thermodynamic systems in Applied Thermodynamics.
To prepare students to carry out experimental investigation and analysis at later stages of graduation.
To understand the concepts related to Refrigeration and Air conditioning.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Fundamental concepts and definitions**: Thermodynamic definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems, characteristics of system boundary and control surface, examples. Thermodynamic properties; intensive and extensive properties, specific properties, pressure, and specific volume. Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic processes, Thermodynamic equilibrium. **Temperature Measurement**: Zeroth law of thermodynamics, Concept of temperature, temperature scales, international fixed points and measurement of temperature. Constant volume gas thermometer, constant pressure gas thermometer, mercury in glass thermometer. Numerical.	10	L1,L2,L3
2	**Work and Heat** : Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work, electrical work. Other types of work. Heat; definition, units and sign convention. Numerical. **First Law of Thermodynamics**: Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy. Extension of the First law to control	10	L1,L2,L3

	volume; steady flow energy equation(SFEE), and its important applications. Numerical.		
3	**Second Law of Thermodynamics**: Limitations of first law of thermodynamics, Thermal reservoir, heat engine and heat pump: Schematic representation, efficiency and COP. Reversed heat engine, schematic representation, importance and superiority of a reversible heat engine and irreversible processes, internal and external reversibility. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements. **Carnot cycle**: Carnot cycle, Carnot theorem and its corollaries, absolute thermodynamic temperature scale, efficiency of reversible heat engine, Numerical.	10	L1,L2,L3
4	**Entropy**: Clausius inequality, Statement- proof, Entropy- definition, a property, change of entropy, entropy as a quantitative test for irreversibility, principle of increase in entropy, entropy as a coordinate. Numerical. **Pure Substances**: Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Throttling calorimeter, Separating and throttling calorimeter. Numerical.	10	L1,L2,L3
5	**Refrigeration Systems**: Air-standard Cycles - Joule Cycle. Introduction to Refrigeration Systems, Vapor compression Refrigeration Cycle, Vapor-absorption Refrigeration Cycle. Numerical. **Psychometrics and Air-conditioning Systems**: Psychometric properties of Air, Psychometric Chart, Air conditioning Processes for Heating, Cooling, Dehumidification and Humidification. Numerical.	10	L1,L2,L3

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

CO.1	Explain and apply fundamentals of thermodynamics and thermometry.
CO.2	Derive and discuss the first law of thermodynamics and evaluate energy interactions across the boundary of thermodynamic systems.
CO.3	Explain second law of thermodynamics and apply the knowledge of entropy, reversibility and irreversibility to solve numerical problems.
CO.4	Explain the concepts of thermodynamics and interpret behavior of pure substances as well as its application in practical problems.
CO.5	Understand and apply concepts of refrigeration systems.

Mapping of course outcomes with program outcomes

22ME32	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO.1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO.2	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO.3	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO.4	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO.5	3	2	1	-	-	-	-	-	-	-	-	-	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. Basic and Applied Thermodynamics - P.K.Nag, Tata McGraw Hill 2nd Edition, 2002.
2. Fundamentals of Thermodynamics – Borgnakke Sonntag, 7th Edition, Wiley Publications.

REFERENCE BOOKS:

1. Basic Thermodynamics - B.K Venkanna & Swati B. Wadavadagi PHI, New Delhi 2010.
2. Engineering Thermodynamics - B. Jones and G.A. Hawkins John Wiley and Sons.
3. Basic Thermodynamics – R K Hegde & Niranjan Murthy, Sapna Publications Ltd.
4. Thermodynamics: An Engineering Approach, Y A Cengel & M A Boles, 6th Edition, Tata McGraw-Hill.

E-RESOURCES :

NPTEL videos on thermodynamics.
2. SWAYAM videos on thermodynamics.

Manufacturing Process						
Course Code	**22ME33**				**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
Define various terms associated with casting processes.
Explain methods of construction of moulds.
Select moulding machine and moulding process based on material type
Select appropriate joining process, type of joints.
Explain different non-destructive testing method.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Casting Process** Introduction: Concept of Manufacturing process, its importance. Classification of Manufacturing processes. Introduction to Casting process & steps involved. Varieties of components produced by casting process. Advantages& Limitations of casting process. Patterns: Definition, functions, Materials used for pattern, various pattern allowances and their importance. Classification of patterns. **Sand Molding:** Types of base sand, requirement of base sand. Molding sand mixture ingredients for different sand mixtures. Method used for sand molding, such as Green sand, dry sand and skin dried molds. **Binder:** Definition, Types of binder used in molding sand. Additives: Need, Types of additives used and their properties	**08 Hours**	**L1, L2**
2	**Cores, Molding Machines, Special Molding Process** **Cores**: Definition, Need, Types. Method of making cores, Binders used, core sand molding. Concept of Gating & Risers. Principle and types. Fettling and cleaning of castings. Basic steps, Casting defects, Causes, features and remedies. **Molding Machines**: Jolt type, Squeeze type, Jolt & Squeeze type and Sand slinger. **Special Molding Process:** Study of important molding processes, No bake molds, Flask less molds, Sweep mold, CO2 mold, Shell mold, Investment mold.	**08 Hours**	**L1, L2**

3	**Metal Molds:** Gravity die-casting, Pressure die casting, Centrifugal casting, Squeeze Casting, Slush casting, Thixo-casting and Continuous Casting Processes. **Melting Furnaces:** Classification of furnaces. Constructional features &working principle of coke fired, oil fired and Gas fired pit furnace, Resistance furnace, Coreless Induction furnace, Electric Arc Furnace, Cupola furnace.	**08 Hours**	**L1, L2, L3**
4	**WELDING TECHNOLOGY** 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 processes. (AHW) **Gas Welding**: Principle, Oxy – Acetylene welding, Chemical Reaction in Gas welding, Flame characteristics. Gas torch construction &working. Forward and backward welding	**08 Hours**	**L1, L2, L3**
5	**Special types 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. **Inspection Methods:** Methods used for Inspection of casting and welding. Visual, Magnetic particle, Fluorescent particle, Ultrasonic, Radiography, Eddy current, Holography methods of Inspection.	**08 Hours**	**L1, L2, L3**

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

CO.1	Student should be able to apply the knowledge of various manufacturing processes.
CO.2	Understand and analyze foundry practices like pattern making, mold making, Core making and Inspection of defects.
CO.3	Understand the different types of metal molds and melting furnaces.
CO.4	Understand different types of welding processes.
CO.5	Understand the special types of welding and inspection methods for casting and welding

Mapping of course outcomes with program outcomes

22ME33	**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	-	1	1	1	-	-	-	-	-	-	2	-	-
CO.3	3	2	-	1	1	-	-	-	-	-	-	-	2	-	-
CO.4	3	2	-	1	-	1	-	-	-	-	-	-	2	-	-
CO.5	3	2	1	-	1	-	-	-	-	-	-	-	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:

"Manufacturing Process-I", Dr.K.Radhakrishna, Sapna Book House,5th Revised Edition 2009.
"Manufacturing & Technology: Foundry Forming and Welding",P.N.Rao, 3rd Ed., Tata McGraw
Machine tools & operations, AnupGoel, Technical publications,2nd edition 2018.
Machine tools and operations, Sagar M. Baligidad, Sunsatar publishers,1st edition 2017.

Reference Books:

1. "Process and Materials of Manufacturing", Roy A Lindberg, 4th Ed.PearsonEdu. 2006.
"Manufacturing Technology", SeropeKalpakjian, Steuen. R. Sechmid,Pearson Education Asia, 5th Ed. 2006.

Engineering Materials & Applications						
Course Code	**22ME34**				**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
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 Hours**	**L1, L2**
2	**Module 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 Hours**	**L1, L2, L3**
3	**Module 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.	**08 Hours**	**L1, L2, L3**

	Iron carbon system - The iron–iron carbide (Fe–Fe3C) phase diagram, development of microstructure in iron–carbon alloys, hypoeutectoid alloys, hypereutectoid alloys, nonequilibrium cooling, the influence of other alloying elements.		
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, Recrystallization and Grain growth, Types of annealing, Normalizing, Hardening, Tempering, Martempering, ustempering, Concept of hardenability, Factors affecting it hardenability, surface hardening methods: carburizing, cyaniding, nitriding, flame hardening and induction hardening, Age hardening of luminum-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 Hours**	**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 Hours**	**L1, L2**

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

CO.1	Explain fundamental concepts and principles of material science and metallurgy, including the properties and behavior of materials at the atomic and molecular level.
CO.2	Analyse the mechanisms of fracture and predict the strength and durability of materials.
CO.3	Analyze and interpret phase diagrams and their relationship to material properties & Develop a comprehensive understanding of the iron and iron carbon system
CO.4	Analyze heat treatment and its effect on material properties
CO.5	Analyse the properties of composite materials, shape memory alloys and nano materials and design and select them for specific applications.

Mapping of course outcomes with program outcomes

22ME34	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	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO.3	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO.4	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO.5	3	1	-	-	-	-	-	-	-	-	-	-	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. Mechanical Metallurgy/G E Dieter/ Tata McGraw-Hill/1997.
2. Introduction to Physical Metallurgy / Sidney H. Avener/3rd Edition / Tata McGraw – ill/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.

Computer Aided Machine Drawing [CAMD]						
Course Code	**22ME35**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	1	**0**	**4**	**5**		
Number of Lecture Hours	**50**				**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 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	**8**	**L1,L2**
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).	**8**	**L1,L2**
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).	**10**	**L1,L2**
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).	**10**	**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	**14**	**L4**

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

22ME35	**PO 1**	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS01**	**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 Testing Lab						
Course Code	**22MEL36**				**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

22ME12	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

Foundry And Forging Lab						
Course Code	**22MEL37**				**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.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
PART – A	**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.	**08**	**L1, L2**
PART – B	**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)	**08**	**L1, L2**
PART – C	**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.	**08**	**L1, L2**

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

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

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**
CO.1	3	2	-	-	-	-	-	-	1	1	-	-	3	-	
CO.2	3	2	-	-	-	-	-	-	2	1	-	-	3	-	
CO.3	3	3	-	-	-	-	-	-	2	1	-	-	3	-	
CO.4	3	2	-	-	-	-	-	-	2	2	-	-	2	-	
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 or Part C Model : 50 Marks
Viva –Voice : 20 Marks
Total : 100 Marks

Work Shop Practice Lab-I						
Course Code	**22MEL38**				**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	1.Demonstration on use of Hand Tools: V-block, Marking Gauge, Files, Hack Saw, Drills, Taps. Minimum three models involving Dove tail joint, Triangular joint and Semi-circular joint. 2. Sheet Metal & Soldering Work: Development & Soldering of the models: Tray, Frustum of cone, Prism (Hexagon &Pentagon), Truncated Square Pyramid, Funnel.	**12**	**L1, L2**
Part – B	3) Welding: Study of electric arc welding tools & equipment's, Models: Butt Joint, Lap Joint, and T joint & L joint. 4) Knowing Safety procedures and precautions in workshop.	**12**	**L1, L2**

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

CO.1	Demonstrate and produce different types of fitting models.
CO.2	Gain knowledge of development of sheet metal models with an understanding of their applications.
CO.3	Perform soldering and welding of different sheet metal & welded joints.
CO.4	Understand the Basics of Workshop practices.

QUESTION PAPER PATTERN:
ONE question from part -A: 30 Marks
ONE question from part B or Part C Model : 50 Marks
Viva –Voice : 20 Marks
Total : 100 Marks

Project-III						
Course Code	**22PRJ39**				**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 introduce fundamental concepts and analysis techniques in engineering to students across all disciplines.
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**

Mapping of course outcomes with program outcomes

22MEL38	**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

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).

Basic of Spread Sheets

Course Code	**22AECME311A**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**02**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students to
To introduce students to the basics to create plots, charts, etc
To enhance students technical skills in computation
To impart student knowledge of threads solutions for roots, multiple roots, optimization
To help students to gain knowledge about matrix operations

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Introduction to Excel** About Excel & Microsoft, Uses of Excel, Excel software, Spread sheet window pane, Title Bar, Menu Bar, Standard Toolbar, Formatting Toolbar, the Ribbon, File Tab and Backstage View, Formula Bar, Workbook Window, Status Bar, Task Pane, Workbook & sheets	**05**	**L1,L2**
2	**Columns & Rows** Selecting Columns & Rows, Changing Column Width & Row Height, Autofitting Columns & Rows, Hiding/Unhiding Columns & Rows, Inserting & Deleting Columns & Rows, Cell, Address of a cell, Components of a cell – Format, value, formula, Use of paste and paste special	**05**	**L1,L2**
3	**Functionality Using Ranges**. Using Ranges, Selecting Ranges, Entering Information Into a Range, Using AutoFill	**04**	**L1,L2**
4	**Creating Formulas.** Using Formulas, Formula Functions – Sum, Average, if, Count, max, min, Proper, Upper, Lower, Using AutoSum,	**05**	**L1,L2,L3**
5	**Spread sheet Charts** Creating Charts, Different types of charts, Formatting Chart Objects, Changing the Chart Type, Showing and Hiding the Legend, Showing and Hiding the Data Table	**05**	**L1,L2,L3**

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

CO.1	At the end of the course the student will be able to make his own presentation
CO.2	To create different plots and charts
CO.3	To compute different functions, conditional functions and make regression analysis
CO.4	To carryout iterative solutions for roots, multiple roots, optimization and non-linear regressionanalysis
CO.5	To carryout matrix operations

Mapping of course outcomes with program outcomes

22AECME311A	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	2	1	1	1	
CO.2	1	-	1		-	-	-	-	-	-	-	-	1	-	-
CO.3	1	-	2	1	-	-	-	-	-	-	-	-	1	-	-
CO.4	1	-	2	1	-	-	-	-	-	-	-	-	1	-	-
CO.5	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-

High-3: Medium-2: Low-1

SCHEME OF SEE EXAMINATION (50 MARKS)

SEE marks for the practical course is 50 Marks.

Evaluation of test write-up/objective type conduction procedure and result/viva will be conducted jointly by examiners. General rubrics suggested for SEE are mentioned here, Conduction procedure and result in - 70%, writeup-20%, Viva voce 10% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50.

TEXT BOOKS:

1. MyITLab with Pearson eText -- Access Card -- for Exploring Microsoft Office 2013 Pearson.
2. OPTIONAL GO GOOGLE GET START&OFF MICROSOFT 365 HOME 180DAY 2013 TRIAL PKG Pearson/Microsoft.

REFERENCE BOOKS:

1. Microsoft Excel 2016- Data Analysis and Business Modelling paperback -1May 2017 Wayne l, winston, Microsoft process
2. Microsoft Excel practice Formulae : From Basic data Analysis to Advance Formulae

E-RESOURCES

https://www.google.com/search?q=nptl+spreadsheet&rlz=1C1GCEA_enIN1047IN1047&oq=NPTL+SPREAD&gs_lcrp=EgZjaHJvbWUqCQgBECEYChigATIGCAAQRRg5MgkIARAh
https://archive.nptel.ac.in/courses/110/107/110107157/

Introduction to Gauges & Measurements

Course Code	**22AECME311B**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	1	**0**	**0**	**01**		
Number of Lecture Hours	**20**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students to
To study the gauge design and its terminology.
To gain the concept of angular measuring instruments and its parameters.
To study the alignment telescope with autocollimeter.
To study the basic concept of thread, gear, surface and roundness measurements.
To study flow measurements of force, torque, hydraulic and electrical.

MODULE NO.	**TOPICS**	**TEACHING HOURS**	**RBT LEVELS**
1	Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchange ability and selective assembly.	**04**	**L1, L2**
2	Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar.	**04**	**L1, L2**
3	Angle alignment telescope – Autocollimator – Applications. Principles and Methods of straightness – Flatness measurement.	**04**	**L1, L2, L3**
4	Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.	**04**	**L1, L2, L3**
5	Force, torque, power – mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube.	**04**	**L1, L2**

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

CO.1	To understand the gauge design and its terminology.
CO.2	To understand the concept of angular measuring instruments and its parameters.
CO.3	To understand the alignment telescope with autocollimator.
CO.4	To understand the basic concept of thread, gear, surface and roundness measurements.
CO.5	To understand flow measurements of force, torque, hydraulic and electrical.

Mapping of course outcomes with program outcomes

22AECME311B	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	1	-	-	-	-	-	1	-	-
CO.2	3	1	-	-	1	1	1	-	-	-	-	-	1	-	-
CO.3	3	1	-	-	1	1	1	-	-	-	-	-	1	1	-
CO.4	3	1	-	-	1	1	1	-	-	-	-	-	1	1	-
CO.5	3	1	-	-	1	1	1	-	-	-	-	-	1	1	-

High-3: Medium-2: Low-1

SCHEME OF SEE EXAMINATION (50 MARKS)

SEE marks for the practical course is 50 Marks.

Evaluation of test write-up/objective type conduction procedure and result/viva will be conducted jointly by examiners. General rubrics suggested for SEE are mentioned here, Conduction procedure and result in - 70%, writeup-20%, Viva voce 10% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50.

Books Recommended to Students

Textbooks:

Jain R.K. “Engineering Metrology”, Khanna Publishers.

Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005

Reference Books:

Charles Reginald Shotbolt, “Metrology for Engineers”, 5th edition, Cengage Learning EMEA,1990.

Backwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education , 2006.

Social Connect Responsibility						
Course Code	**22HSM310**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	1	**0**	**0**	**01**		
Number of Lecture Hours	**24**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students to
Enable to create of a responsible connection with society.
Provide a formal platform for students to communicate
Provide a formal platform for students to connect with their surroundings.
To alleviate the complex social problems through immersion, design & technology.

MODULE NO.	**TOPICS**	**TEACHING HOURS**	**RBT LEVELS**
1	Plantation and adoption of a tree: Plantation of a tree that will be adopted for four years by a group of B.Tech, students. They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, and its appearance in folklore and literature.	**05**	**L1, L2**
2	Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms.	**05**	**L1, L2**
3	Organic farming and waste management: usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus.	**05**	**L1, L2**
4	Water Conservation: knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices.	**05**	**L1, L2**
5	Food Walk City's culinary practices, food lore, and indigenous materials of the region used in cooking.	**04**	**L1, L2**

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

CO.1	Students will able to understand the plantation methods
CO.2	Students will able to understand our heritage
CO.3	Students will have the fundamental knowledge about the organic farming
CO.4	Students will be able to understand the techniques in water conservation
CO.5	Students can able to understand, how to reduce the problems in society through the use of technology

Mapping of course outcomes with program outcomes

22AECME311B	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	1	-	-	-	-	-	1	-	-
CO.2	3	1	-	-	1	1	1	-	-	-	-	-	1	-	-
CO.3	3	1	-	-	1	1	1	-	-	-	-	-	1	1	-
CO.4	3	1	-	-	1	1	1	-	-	-	-	-	1	1	-
CO.5	3	1	-	-	1	1	1	-	-	-	-	-	1	1	-

High-3: Medium-2: Low-1

SCHEME OF SEE EXAMINATION (50 MARKS)

SEE marks for the practical course is 50 Marks.

Evaluation of test write-up/objective type conduction procedure and result/viva will be conducted jointly by examiners. General rubrics suggested for SEE are mentioned here, Conduction procedure and result in - 70%, writeup-20%, Viva voce 10% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50.

Course Title:	Mathematics for MES - IV		
Course Code:	22MATM41	CIE Marks	50
Course Type:	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L: T:P:S)	2:2:0:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory	Credits	03

Course objectives: The goal of the course Mathematics for Mechanical Engineering Stream- IV (22MATM41) is to

- Familiarize the importance of numerical methods to solve First order ODE in Mechanical engineering.
- Introduce most commonly used analytical and numerical methods in the different engineering fields.
- Understand Joint probability distribution and stochastic processes arising in science and Mechanical engineering.
- Develop the knowledge of complex variable and discuss the various properties of it.
- To develop the knowledge of special functions like Bessel and Legendre.
  Develop the knowledge of sampling theory in day-to-day life and trace different types of curves.

Teaching-Learning Process Pedagogy (General instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching. methods may be adopted so that the delivered lessons shall develop student's theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting student's progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As are vision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Course outcome (Course Skill Set)

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

CO1	Solving the first order first degree ordinary differential equations arising in flow problems using single step and multistep numerical methods.
CO2	Use to solve Finite Difference Method and partial differential equations arising in heat, wave and Laplace Equation equations by numerical methods.
CO3	Apply Sampling Distribution to solve Engineering Problems.
CO4	Obtain the series solution of ordinary differential equations and studying special functions.
CO5	Able to Solve complex Integration Problem.

Bloom's level of the course outcomes:
Course Articulation Matrix / Course mapping:

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

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

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

MODULE-1: Numerical Methods-1

Numerical Methods: Numerical solution of ordinary differential equations of first orde r andfirst degree, Taylor's series method, modified Euler's-method Runge Kutta method of fourth order. Milne's and Adams- Bashforth predictor and corrector methods (No derivations of formulae). (5 Assignment Problem).
Self Study : Picard's method Applications of Numerical Methods:
(RBT Levels: L1, L2 and L3) (8 Hours)

MODULE-2 : Numerical Methods-2

Numerical Methods: Numerical solution of second order ordinary differential equations, Runge- Kutta Method and Milne's Method, Numerical solution of P.D.E: Numerical solution of Heat equation, Wave equation, problems. (5 Assignment Problem).
Self Study : Picard's method, Numerical solution of Laplace's equation Applications of Numerical Methods:
(RBT Levels: L1, L2 and L3) (8 Hours)

MODULE- 3: Sampling theory and curve tracing

Sampling theory : Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, Type I and Type II errors, Level of significance, confidence limits for means, one tailed and two tailed tests, student's t-distribution, Chi - square

distribution as a test of goodness of fit.

Tracing of curves: Cartesian form - Strophoid, Leminscate, Parametric form - Cycloid, Astroid,

Polar form - Cardioid, Leminscate.

Self Study :.Types of samplings, Cartesian equations and their geometrical representation Applications of Sampling theory and curve tracing:

(RBT Levels: L1, L2 and L3) (8 Hours)

MODULE- 4: Special Functions

Special Functions: Series solution of Bessel's differential equation leading to (x) −Bessel's function of first kind. Basic properties and orthogonally. Series solution of pLroegbelenmdrse's differential equation leading to (x) −Legendre polynomials. Rodrigue's formula,

Self Study : Condition for Orthogonally, Differential Equations

Applications of Special Functions:

(RBT Levels: L1, L2 and L3) (8 Hours)

MODULE- 5: Complex variable-2

Complex line Integrals: Cauchy's Integration theorem, Cauchy integral formula, Laurent's Series, types of singularities. Residue, Poles, Cauchy's Residue theorem (without proof) and Problems.

Transformations: Bilinear transformations and problems.

Self Study :Cauchy Riemann Integral, Singularity Definition. Applications of Special Functions:

(RBT Levels: L1, L2 and L3) (8 Hours)

Question Paper Pattern:

• The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

• The question paper will have ten full questions carrying equal marks.

• Each full question carries 20 marks.

• There will be two 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 five full questions, selecting one full question from each Module.

CIE + Assignments: 15+35=50 Marks

There will be a 3 CIE's, the average of best of 2 CIE's will be considered and there will be a 35 marks for Assignments

Suggested Learning Resources:

Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)Text Books

1. **B.S.Grewal**:"Higher EngineeringMathematics",Khannapublishers, 44th Ed.,2021.
2. **E. Kreyszig**: "AdvancedEngineeringMathematics", John Wiley&Sons, 10thEd., 2018.

Reference Books:

1. **V.Ramana:**"HigherEngineeringMathematics"McGraw-HillEducation,11th Ed.,2017
2. **SrimantaPal&SubodhC.Bhunia**:"EngineeringMathematics"OxfordUniversityPress,3rd Ed., 2016.
3. **N.PBali and Manish Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications,10th Ed.,2022.
4. **C.RayWylie,LouisC.Barrett:**"AdvancedEngineeringMathematics"McGraw–HillBookCo., Newyork, 6thEd., 2017.
5. **GuptaC.B,SingS.RandMukeshKumar:**"EngineeringMathematicforSemesterIandII", Mc- Graw Hill Education(India)Pvt.Ltd 2015.
6. **H.K.DassandEr.RajnishVerma:**"HigherEngineeringMathematics"S.ChandPublication,
7. **JamesStewart:"**Calculus"CengagePublications,7thEd.,2019.
8. **DavidCLay:**"LinearAlgebraandits Applications",Pearson Publishers,4th Ed.,2018.
9. **Gareth Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6thEd., 2017.

FUNDAMENTALS OF FLUID MECHANICS						
Course Code	**22ME42**				**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 basic principles and fundamental concepts of fluid mechanics.
- Make the students to understand the concept and apply the various laws solving the fluid engineering problems.
- Make the students familiar with measurements and visualization of fluid flow types, kinematics, dynamics and its analysis.
- Study the fluid dynamics through Euler's and Bernoulli's equations and Newton's momentum laws for flow systems
- Understand the concept flow of liquids through pipes and different sections and the dimensional quantities

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**
2	Fluid Statics: Hydrostatic forces on submerged horizontal plane, vertical plane and inclined plane to determine total pressure and centre of pressure in static fluid. Buoyancy, centre of buoyancy, Meta centre and Meta centric heights 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, irrotational, stream lines, path lines, streak lines, velocity components, convective and local acceleration, velocity potential, stream function, continuity equation in Cartesian co-ordinates. Types of Motion, Vorticity and Rationality; Comparison of two circular flows, rotation, Vorticity and circulation, Laplace equation in velocity potential and Poisson equation in stream function, flow net and numerical.	**08**	**L1, L2, L3**
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.	**08**	**L1, L2, L3**

	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.		
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. 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	Analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.
CO.2	Apply the concepts of fluid properties and fluid pressure to the related measurement devices.
CO.3	Visualize different types of fluid flow, and compare them based on kinematic flow descriptions.
CO.4	Apply Bernoulli's & Newton's laws to many applications.
CO.5	Apply the concept of laminar and turbulent flows for flow through pipe loses and dimensional quantities.

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

High-3: Medium-2: Low-1

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 Hill 1998.

REFERENCE BOOKS:

1. Fluid Mechanics, Pijush K. Kundu, IRAM COCHEN, ELSEVIER, 3rd Ed. 2005.
2. Fluid Mechanics and hydraulics, Dr. Jagadish lal, Metropolitan Book Co-Ltd., 1997.
3. Fluid Mechanics, John F. Douglas, Janul and M. Gasiosek and john A. Swaffield, Pearson Education Asia, 5th ed., 2006.
4. Fluid Mechanics and Fluid Power Engineering, Kumar D.S, Kataria and Sons, 2004
5. Fluid Mechanics -. Merle C. Potter, Elaine P Scott. Cengage learning.

QUESTION PAPER PATTERN FOR SEE:

- 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.

APPLIED THERMODYNAMICS						
Course Code	**22ME43**				**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

- Introduce about basic physics, chemistry behind thermodynamics and gas power cycle
- Study the basic concepts of SI and CI engine and testing the performance parameters by different methods.
- Familiarise about the application of the Rankine cycle and basics of Refrigeration and Air Conditioning.
- Study application of gas turbine used in various thermodynamic application and also the concept of rocket and jet propulsion systems.
- Understand the concept of reciprocating air compressor and their related efficiencies.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Gas power cycle:** Air Standard cycles and assumptions: Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-S diagrams, description, efficiencies and mean effective pressures: Otto, Diesel and dual cycles and related numerical problems, Comparison of Otto, Diesel and dual cycles.	**08**	**L1, L2, L3**
2	**I.C. Engine**: Introduction, Classification and application of IC engines, Combustion in SI engine, factors effecting ignition lag, flame propagation, knocking in SI engine, effects of knocking, factors affecting knocking. Rating of SI engine fuel, Combustion in CI engine, factors effecting delay period, detonation in CI engine, Rating of CI engine fuel. **Testing of IC engine:** Testing of two stroke and four stroke SI and CI engines for performance related numerical, heat balance, Motoring Method, Willian's line method, swinging field dynamometer, Morse test, related numerical.	**08**	**L1, L2, L3**
3	**Vapour Power cycles:** Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, combined cycles, and related numerical. Refrigeration and Air conditioning: Introduction, Basic definitions, Refrigerator and Heat Pump, Types of refrigerants, Properties of ideal refrigerants, Working principle of Carnot cycle, Vapour compression refrigeration system, Vapour absorption refrigeration system and difference between them. Room air conditioning.	**08**	**L1, L2, L3**
4	**Gas Turbine:** Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with inter cooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles, and related numerical.	**08**	**L1, L2, L3**

	Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine.		
5	**Compressors:** Reciprocating Air Compressor, Single stage compressor – computation of work done, isothermal efficiency, effect of clearance volume, volumetric efficiency, Free air delivery, Theoretical and actual indicator diagram. **Multistage compressors** – Constructional details of multistage compressors, Need of multistage, Computation of work done, Volumetric efficiency, Condition for maximum efficiency, Inter cooling and after cooling (numerical), Theoretical and actual indicator diagram for multi stage compressors, and related numerical.	**08**	**L1, L2, L3**

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

CO1	Impliment the basic concepts of physics and chemistry behind thermodynamics and solve introductory problems on gas cycle.
CO2	Explain and analyse SI and CI engine performance and fuel properties.
CO3	Analyase the concept of vapour power cycle and basics of refrigeration and air conditioning systems.
CO4	Apply the concept of Brayton cycle and its applications in the field of aviation propulsion.
CO5	Describe and solve problems on the single and multi-stage reciprocating compressor.

Mapping of course outcomes with program outcomes

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

High-3: Medium-2: Low-1;

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, "Dhanpat Rai & sons , 2002

REFERENCE BOOKS:

1) Basic and Applied Thermodynamics by P.K. Nag, MCGRAW HILL INDIA
2) Applied thermodynamics by Omkar Singh, New Age International
3) Applied Thermodynamics for Engineering Technologists by Eastop, PearsonEducation
4) Applied Thermodynamics by Venkanna And Swati, PHI
5) Theory of Stream Turbine by WJ Kearton

6) Gas turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Long man
7) Gas Turbine, by V. Ganeshan, Tata McGraw Hill Publishers.
8) Steam & Gas Turbine by R. Yadav, CPH Allahabad
9) Thermodynamics and Energy Systems Analysis, Borel and Favrat, CRC Press
10) Thermodynamics by Prasanna Kumar, Pearson
11) Thermal Engineering by Kulshrestha, Vikas Publishing.
12) Thermal Engg. By PL Ballaney, Khanna Publisher
13) Thermal Engg. By RK Rajput, Laxmi Publication
14) Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007
15) Arora.C.P, "Refrigeration and Air Conditioning ," Tata McGraw-Hill Publishers 1994
16) Ganesan V " Internal Combustion Engines" , Third Edition, Tata Mcgraw-Hill 2007
17) Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi,2003

DATA HANDBOOKS:

D1. Thermodynamic data hand book, B.T. Nijaguna.

D2. Thermodynamic data hand book, R K Hegde.

QUESTION PAPER PATTERN FOR SEE:

- 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.

INSTRUMENTATION AND METROLOGY						
Course Code	**22ME44**				**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	**Introduction to Metrology**: Definition, objectives and concept of metrology, Need of inspection, Principles, process, methods of measurement, accuracy, precision and errors in measurement. **Standards of measurements:** Role of standards, Subdivision of standards, Types of Standards: line Standard and End Standard characteristics, Standards of length Material Standards-International prototype meter, Imperial standard yard and Wave length standard.	**08**	**L1,L2, L3**
2	**Linear Measurement:** Slip gauges- Indian standards on slip gauge, method of selection of slip gauge, stack of slip gauge, adjustable slip gauge, wringing of slip gauge, numerical on building of slip gauges (M87, M112). **Angular measurements**- Introduction, bevel protractor, sine bar, sine center, angle gauges, optical instruments for angular measurements-autocollimator, and numerical on building angle gauges.	**08**	**L1,L2**
3	**System of Limits, Fits, Tolerance and Gauging:** Definition of tolerance, concept of interchange ability and selective assembly, concept of limits of size and tolerances. Fits: definition, types of fits and their designation, hole basis system, and shaft basis system, Gauging: Classification of gauges, brief concept on design of gauges (Taylor's principles), Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials. **Comparators: introduction to comparators**: Mechanical- Johnson Mikrokator, sigma comparators, dial indicator, electrical principles-LVDT, Pneumatic principles- solex comparators and optical principles comparators- Zeiss ultra-optimeter.	**08**	**L1,L2, L3**
4	**Advances in metrology:** interferometer, basic concept of laser, laser interferometers, Basic concepts of Coordinate Measuring Machines-	**08**	**L1,L2, L3**

	constructional features, applications, Basic concept of machine vision system, elements and applications. **Measurement systems:** Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-time delay. Errors in measurement, classification of errors.		
5	**Measurement of Force and Torque:** Introduction, Force: Direct method- Analytical Balance (Equal arm), Platform balance, proving ring, Torque: Mechanical Dynamometers, Hydraulic Dynamometer, and Eddy current Dynamometer **Measurement of Pressure and temperature:** Pressure measurement: High Pressure measurement-Bridgman Gauge, Low Pressure measurement-McLeod Gauge, Vacuum pressure-pirani gauge. Temperature measurement: Liquid in glass thermometer, bimetallic strip, resistance thermometer-Thermocouples: Laws of thermocouples, materials. Radiation Pyrometers: Total Radiation pyrometer and optical pyrometer.	**08**	**L1,L2, L3**

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

CO1	Describe what is metrology and its importance in measurements.
CO2	Make the measurements using different instruments for linear and angular objects.
CO3	Explain about the basic concepts of Limits, Fits and Tolerances and use of comparators.
CO4	Apply the techniques of measuremnets using conventional instruments and advanced measuring instruments.
CO5	Asses the techniques of torque, force, temperature and pressure measurement using different instruments.

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	P O 11	PO 12	PS0 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	1	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	1	-	-	2	-	-	-	-	-	-	-	3	-	-
CO5	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-

High-3: Medium-2: Low-1;

TEXT BOOKS:

1. I C Gupta-**Engineering Metrology**, Dhanpat Rai Publications, 7th edition, 2013.
2. R K Jain, **Engineering Metrology**, Khanna publications, 8thedition, 2002
3. **Mechanical Measurements**: Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006

Anand K Bewoor, VinayAKulkarni, **Metrology & Measurement**, McGraw-Hill,2009

REFERENCE BOOKS:

1. “Engineering Metrology–K.J.Hume, Macdonaldand Co.(publisher) London
2. The Springer hand book of metrology and Testing, Czichos (Ed),2011
3. Engineering Metrology–D.M.Anthony, Pergamon Press
4. Engineering Metrology and Measurements, Bentley, Pearson Education
5. ASME, Hand book of Industrial Metrology,1998.

E-RESOURCES:

1. NPTEL videos. https://archive.nptel.ac.in/courses/112/104/112104250/

QUESTION PAPER PATTERN FOR SEE:

- 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.

MECHANICS OF MATERIALS						
Course Code	**22ME45**				**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 study different types of stresses, strain and deformation induced in the mechanical components due to external loads.
- To study Principal stresses, strains and to predict the stress distribution in pressure vessels.
- To study the behavior of various beams under different loading conditions.
- To study behavior of structural members in Torsion.
- To understand stability of columns.

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 super position, total elongation of tapering bars of circular and rectangular cross sections. **Volumetric strain**: Expression for volumetric strain, elastic constants 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 stresses and maximum shear stresses, graphical method - Mohr's circle for plane stress. **Thick and Thin cylinders**: Stresses in thin cylinders, Lame's equation for thick cylinders subjected to internal and external pressures, Changes in dimensions of cylinder (diameter, length and volume), simple numericals.	**08**	**L1,L2, L3**
3	**Bending moment and Shear forces in beams**: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and 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	**Stress in Beams**: Pure bending, curvature of beam, Longitudinal strains in beams, Normal stresses in Beams with rectangular, circular, 'I' and 'T' cross sections, Flexure Formula, Bending Stresses. Simple numerical. **Torsion of shafts:** Assumptions in theory of pure torsion, Torsion equations, torsional rigidity and modulus of rupture, Power transmitted, Comparison of solid and hollow circular shafts. Simple numerical.	**08**	**L1,L2, L3**
5	**Elastic stability of columns:** Introduction, buckling and stability, critical load, columns with pinned ends, columns with other support conditions, Rankine's formula, Simple numerical. **Theories of Failure:** Introduction, maximum principal stress theory , Maximum shear stress theory, Failure of brittle materials, Failure of ductile materials, simple numericals.	**08**	**L1,L2, L3**

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

CO.1	To demonstrate fundamental knowledge about various types of loading and stresses induced in elastic bodies.
CO.2	To determine plane stress, principal stress and maximum shear stress using Mohr's circle & to analyse cylindrical pressure vessels under various loadings
CO.3	To Draw the SFD and BMD for different types of loads and support conditions.
CO.4	Apply the knowledge to understand the load transferring in beams and to apply basic equation of simple torsion in designing of circular shafts.
CO.5	To analyse buckling and bending phenomenon in columns.

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

High-3, Medium-2, Low-1

TEXT BOOKS:

1. Strength of Materials by S.S. Bhavikatti ,Vikas Publications House Pvt. Ltd. New Delhi,2012
2. Strength of Materials by R K Bansal, Laxmi Publication Pvt Ltd.,2016
3. Strength of Materials by R Subramanian, Oxford university press, 2010.
4. Strength of Materials by S.Ramamrutham, Dhanapath Rai Publishing Company, New Delhi,2012

REFERENCE BOOKS:

1. Mechanics of Materials by James Gere, Thomson Publication, 2010.
2. Strength of Materials by S S Rattan, McGraw Hill, 2011.
3. Mechanics of materials by Ferdinand Beer and Russell Johston , Tata McGraw Hill, 2003.

E-RESOURCES :

https://onlinecourses.nptel.ac.in/noc22_ce54/preview

QUESTION PAPER PATTERN FOR SEE:

- 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.

UNIVERSAL HUMAN VALUES						
Course Code	22UHV410				**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: Students will be taught to:

- To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Module -1	**Teaching Hours**	**RBT Level**
Introduction to Value Education: Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, **Practice Session PS1** Sharing about Oneself, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Practice Session PS2 Exploring Human Consciousness Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations, Practice Session PS3 Exploring Natural Acceptance	**08 Hours**	**L1&bL2**
Module -2		
Module 2 – Harmony in the Human Being (6 lectures and 3 tutorials for practice session), Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, Practice Session PS4 Exploring the difference of Needs of Self and Body, The Body as an Instrument of the Self**,** Understanding Harmony in the Self , Practice Session PS5 Exploring Sources of Imagination in the **Self,** Harmony of the Self with the Body, Programme to ensure self-regulation and Health**,** Practice Session PS6 Exploring Harmony of Self with the Body	**08 Hours**	**L1&bL2**
Module -3		
Harmony in the Family and Society (6 lectures and 3 tutorials for practice session) Harmony in the Family – the Basic Unit of Human Interaction**,** 'Trust' – the Foundational Value in Relationship, Practice Session PS7 Exploring the Feeling of Trust, 'Respect' – as the Right Evaluation, Practice Session PS8 Exploring the Feeling of Respect, Other Feelings, Justice in Human-to-Human Relations, Understanding Harmony in the Society, Vision for the Universal Human Order	**08 Hours**	**L1,L2 &L3**
Module -4		
Harmony in the Nature/Existence Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Exploring the Four Orders of Nature, Realizing Existence as Co-	**08 Hours**	**L1,L2&L3**

existence at All Levels, The Holistic Perception of Harmony in Existence, Exploring Co-existence in Existence		
Module-5		
Implications of the Holistic Understanding – a Look at Professional Ethics Natural Acceptance of Human Values Definitiveness of (Ethical) Human Conduct **Practice Session PS12** Exploring Ethical Human Conduct , A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Exploring Humanistic Models in Education, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession, Exploring Steps of Transition towards Universal Human Order	**08 Hours**	**L1,L2,L3**
Course Outcomes: After studying this course, students will be able to: CO-1-Present sustainable solutions to the problems in society and nature CO-2-See that these solutions are practicable and draw roadmaps to achieve them. CO-3-Grasp the right utilization of their knowledge in their streams of Technology/Engineering/Management/any other area of study to ensure mutual fulfillment. E.g. mutually enriching production system with rest of nature. CO-4-Sincerely evaluate the course and share with their friends. They are also able to suggest measures to make the course more effective and relevant. CO-5-Make use of their understanding in the course for the happy and prosperous family and society.		
Text Books: 1. The Textbook - A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1 2. The Teacher's Manual- Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53		
Reference Books: 1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999. 2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004. 3. The Story of Stuff (Book). 4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi 5. Small is Beautiful - E. F Schumacher. 6. Slow is Beautiful - Cecile Andrews 7. Economy of Permanence - J C Kumarappa 8. Bharat Mein Angreji Raj – Pandit Sunderlal 9. Rediscovering India - by Dharampal 10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi 11. India Wins Freedom - Maulana Abdul Kalam Azad 12. Vivekananda - Romain Rolland (English) 13. Gandhi - Romain Rolland (English).		

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

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

High-3, Medium-2, Low-1

QUESTION PAPER PATTERN:

SCHEME OF EVALUATION FOR CIE (50 MARKS)

- Solution of Assignment questions : 25Marks.
- Attendance : 05 marks
- seminar/library : 05 marks
- Internal Assessment test in the same pattern as that of the SEE examination : 15 marks.

QUESTION PAPER PATTERN FOR SEE:

- 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.

FLUID MECHANICS LABORATORY						
Course Code	**22MEL46**				**CIE Marks**	**50**
Number Practical Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**2**	**2**		
Number of Practical Hours	**24**				**Exam Hours**	**03**
Credits-01						

Course Objectives: This course will enable students

- To provide practical knowledge of pipe fittings and calibration of pressure gauges.
- To study the, stability of floating bodies, law of conservation of energy and flow pattern of flowing fluid
- To study the methods for finding of co-efficient of discharge for open channel and pipe flow
- To study the method of finding force on different types of vanes by a jet of water.
- To get familiarized with pipe friction for a fluid flow in a pipe.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**PART-A** 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, & L3**
2	**PART-B** 1. Hydraulic coefficients of orifices and mouth pieces under constant head method and time of emptying method. 2. Determination of the Coefficient of discharge of given Orifice meter. 3. Determination of the Coefficient of discharge of given Venturi meter. 4. Determination of the Coefficient of discharge of given V-Notch 60^0, 90^0 and Rectangular notch 5. Determination of force due to impact of jets. 6. Determination of friction factor for a given set of pipes. a) Major loss. b) Minor loss.	**12**	**L2 & L3**

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

CO1	Demonstrate the usage of various pipe fittings, water meters and to calibrate pressure gauges, also to determine metacentric height.
CO2	Explain and analyze the stability of floating bodies.
CO3	Apply the law of conservation of energy and determine type of flow based on Reynolds number.
CO4	Apply the concepts of flow measurement using Venturimeter, Orifice plates, and Notches.
CO5	Determine and analyze different types of energy losses in pipe flow.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

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

High-3, Medium-2, Low-1

SCHEME OF CIE EVALUATION (50 MARKS)

SL. No.	Components	Marks
1	Conduction of Experiments	25
2	Evaluation of Labs	15
3	Mock Evaluation / Presentation	10
	Total	**50**

SCHEME OF SEE EXAMINATION (50 MARKS)

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

INSTRUMENTATION AND MEASUREMENT LABORATORY						
Course Code	**22MEL47**				**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.

	EXPERIMENTS	TEACHING HOURS	RBT LEVELS
PART A	1. Calibration of Pressure gauge. 2. Calibration of LVDT. 3. Calibration of Thermocouples (J/K-TYPE). 4. Calibration of Load cell. 5. To determine the young's modulus of MS specimen using Strain gauges.	**12**	**L2, L3, L4**
PART B	1. Measurements using optical projector/Toolmaker's microscope 2. Measurements of angle using sine center/sine bar/bevel protractor. 3. Measurements of screw thread parameters using two wire or three wire method. 4. Measurements of alignment using autocollimator 5. Measurements of Flatness using optical flats	**12**	**L2, L3, L4**

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

CO1	Calibrate instruments using different techniques.
CO2	Make the measurements using different instruments.

Mapping of course outcomes with program outcomes

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO.1	2	2	1	1	2	-	-	-	2	-	-	2	-	3	-
CO.2	2	2	1	1	2	-	-	-	2	-	-	2	-	3	-

High-3, Medium-2, Low-1

SCHEME OF CIE EVALUATION (50 MARKS)

SL. No.	Components	Marks
1	Conduction of Experiments	25
2	Evaluation of Labs	15
3	Mock Evaluation / Presentation	10
	Total	**50**

SCHEME OF SEE EXAMINATION (50 MARKS)

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

WORKSHOP PRACTICE LABORATORY -II						
Course Code	22MEL48				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.

	EXPERIMENTS	TEACHING HOURS	RBT LEVELS
PART - A	1. **DEMONSTRATION**:Safety practice and precautions to be observed in workshop **2. WOOD WORKING (CARPENTRY):** Familiarity with different types of woods and tools used in wood working and make following joints. a) Half – Lap joint b) Mortise and Tenon joint c) Dovetail lap joint or Bridle joint.	**12**	**L1, L2, L3**
PART - B	3. **WELDING & BRAZING**: Study of Gas welding and Gas cutting: tools & equipment's, Models: Butt Joint, Lap Joint, T joint & L joint. 4. Study and Demonstration of power tools in mechanical engineering.	**12**	**L1, L2, L3**

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

CO1	Demonstrate and produce different types of fitting models.
CO2	Make sheet metal models with an understanding of their applications.
CO3	Perform soldering and welding of different sheet metal & welded joints.
CO4	Apply the Workshop practices for creating tasks.

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	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO.2	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO.3	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO.4	3	2	-	-	-	-	-	-	-	-	-	-	-	2	-

High-3, Medium-2, Low-1

SCHEME OF SEE EXAMINATION (50 MARKS)

SL. No.	Modules	Marks
1	PART-A	20
2	PART-B	20
3	VIVA-VOCE	10
	Total	**50**

PROJECT-IV						
Course Code	**22PRJ49**				**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 introduce fundamental concepts and analysis techniques in engineering to students across all disciplines.

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

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	2	-	2	2	-	-	2	2	2	2	2	-	2	-
CO.2	3	2	-	2	2	-	-	2	2	2	2	2	-	2	-
CO.3	3	3	-	2	2	-	-	2	2	2	2	2	-	2	-
CO.4	3	2	-	2	2	-	-	2	2	2	2	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).

INTRODUCTION TO GEOMETRIC DIMENSIONING AND TOLERENCiNG						
Course Code	22AECME411A				CIE Marks	50
Number Lecture Hour/Week	L	T	P	TOTAL	SEE Marks	50
	0	0	2	02		
Number of Lecture Hours	24				Exam Hours	03
Credits-1						

Course Objectives: This course will enable students to

- To gain the basic knowledge of geometric dimensioning and tolerances.
- To gain the basic concept of maximum material and minimum material conditions.
- To study the Taylors principle of gauging limits.
- To study basic features of datum and its symbols.
- To study the various modes of datum feature representation.

.	TOPICS	TEACHING HOURS	RBT LEVELS
	PART-A		
1	Introduction: Geometric product definition principles; verification of position with open setup; geometric characteristic symbols Geometric Dimensioning and Tolerancing: an explanation of tolerance zone conversion; surfaces, features, features of size, datum features, datum features of size, and datum's; tolerances.	06	L1, L2
2	MMC & LMC: Maximum Material Condition (meaning & use); Least Material Condition (meaning & use). Components common to geometrically dimensioned & toleranced drawing; fits & allowances, advantages of GD&T.	06	L1, L2, L3
	PART-B		
3	Size Control Form: The Taylors principle; Gauging size limits. Rules, concepts, Characteristics, and untoleranced Dimensions: individual or related Datum's, Material Conditions; untoleranced dimensions.	06	L1, L2
4	Datums: Datum features; oddly configured & curved surfaces as datum features; equalizing datum's; datum feature symbols; flexible parts; direct vs indirect tolerancing. MMC and its ramifications.	06	L1, L2, L3
	Modes of datum feature representation: angular orientation. Form Controls: flatness; straightness: circularity; free state variation; circularity Orientation Controls: orientation characteristics; angularity; perpendicularity Profile.		L1, L2, L3

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

CO1	Apply basic knowledge of geometric dimensioning and tolerances.
CO2	demonstrate the basic concept of maximum material and minimum material conditions.

CO3	Make use of the Taylors principle of gauging limits.
CO4	Show the basic features of datum and its symbols and describe the various modes of datum feature representation

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	-	1	2	-	-	-	-	-	-	-	-	1	-
CO2	2	1	-	1	2	-	-	-	-	-	-	-	-	1	-
CO3	2	1	-	1	2	-	-	-	-	-	-	-	-	1	-
CO4	2	1	-	1	2	-	-	-	-	-	-	-	-	1	-

High-3: Medium-2: Low-1

TEXT BOOKS:

1. Geometric Dimensioning & Tolerancing by James Meadows.
2. Fundamentals of Geometric Dimensioning & Tolerancing by Alex Krulikowski.

REFERENCE BOOKS:

1. James D Meadows, "Geometric Dimensioning and Tolerancing", Marcel Dekker, Inc.
2. James D Meadows, "Measurement of Geometric Tolerances in Manufacturing" Marcel Dekker, Inc.
3. P S Gill, "Geometric Dimensioning and Tolerancing", S K Kataria & sons, 2005-6.

SCHEME OF SEE EXAMINATION (50 MARKS)

SL. No.	Modules	Marks
1	PART-A	20
2	PART-B	20
3	VIVA-VOCE	10
	Total	**50**

ADDITIONAL MATHEMATICS –II			
COMMON TO ALL BRANCHES			
Course Code	22MATDIP41	CIE Marks	100
Contact Hours/Week	02	SEE Marks	00
Total Hours	25	Exam Hours	00
Semester	IV	Credits	00

Course Learning Objectives:

This course will enable students to:

- Solve first order differential equations. .
- Solve second and higher order differential equations.
- Understand and solve the partial differential equation.
- To acquire the knowledge of elementary probability theory.
- Know the basic concepts of evaluation of double and triple integrals.

Course Outcomes(COs):

After completion of course, the student will able to

CO#	Course Outcomes	POs	PSOs
CO1	Apply the knowledge of differential equation of first order to solve examples based on Newton's law of cooling.	1, 2, 3	
CO2	Solve second and higher order differential equations occurring in of electrical circuits , damped/un-damped vibrations. Explain the applications of Power series and obtain series solution of ordinary differential equations.	1, 2, 3	
CO3	Construct a variety of partial differential equations and solution by exact Methods / method of separation of variables.	1, 2, 3	
CO4	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.	1, 2, 3	
CO5	Apply the knowledge of Probability to solve the simple real life problems	1, 2, 3	

Bloom's level of the course outcomes:

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

Course Articulation Matrix / Course mapping :

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

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

MODULE-1: DIFFERENTIAL EQUATIONS - 1

Differential Equation-1: Solution of first order and first degree differential equations: Variable separable, Homogeneous, Exact and Reducible to exact differential equation, Linear differential equation. Applications of first order first degree differential equations: Newton's law of cooling.

(RBT Levels: L1, L2 and L3) 5 Hours

Teaching – Learning Process	Chalk and talk method / Power Point Presentation

MODULE-2: DIFFERENTIAL EQUATIONS - 2

Differential Equations-2: Solution of second & higher order Ordinary linear differential equation with constant co-efficients.Method of variation of parameters. Solution of homogeneous LDE by Power series solution Method.

(RBT Levels: L1, L2 and L3) 5 Hours

Teaching – Learning Process	Chalk and talk method / Power Point Presentation

MODULE-3: PARTIAL DIFFERENTIAL EQUATIONS (PDE's)

Partial Differential Equations(PDE's): Formation of PDE by eliminating arbitrary constant & functions, Solution of Non-homogeneous PDE by direct integration, solution of homogeneous PDE with respect to one independent variable only. Derivation of one dimensional wave equation and heat equation and Various possible solution of wave & heat equations by methods of separation of variables.

(RBT Levels: L1, L2 and L3) 5 Hours

Teaching – Learning Process	Chalk and talk method / Power Point Presentation

MODULE-4: IMPROPER INTEGRALS

Improper Integrals: Beta and gamma functions and its properties and examples.
Evaluation of double integral over a specific region, changing the order of integration , changing into polar form.

(RBT Levels: L1, L2 and L3) 5 Hours

Teaching – Learning Process	Chalk and talk method / Power Point Presentation

MODULE-5: PROBABILITY

Probability: Introduction , Sample space and Events. Axioms of Probability, Addition & Multiplication theorems. Conditional probability- illustrative examples. Baye's theorem- examples.

(RBT Levels: L1, L2 and L3) 5 Hours

Teaching – Learning Process	Chalk and talk method / Power Point Presentation

CIE + Assignments: 15+35=50 Marks
There will be a 2 CIE's Average of Best Two performances of the Internal Tests shall be considered for 15 Marks and there will be a 35 marks for Assignments

Text Books:

1. B.S. Grewal : Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.

2. E. Kreyszig : Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2016.

Reference books:

1. C.Ray Wylie, Louis C.Barrett : “Advanced Engineering Mathematics", 6th Edition,
2. McGraw-Hill Book Co., New York, 1995.
2. James Stewart : “Calculus –Early Transcendentals”, Cengage Learning India Private Ltd., 2017.
3. B.V.Ramana : "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
4. Srimanta Pal &Subobh C Bhunia:“Engineering Mathematics”, Oxford University Press,3rd Reprint,2016.
5. Gupta C.B., Singh S.R. and Mukesh Kumar : “Engineering Mathematics for Semester I & II”, Mc-Graw Hill Education (India) Pvt.Ltd., 2015.

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math
3. http://academicearth.org.

MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

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

SEMESTER-V

bject Code	**HSM51**	E Marks	
mber Lecture Hour/Week	+1T	E Marks	
mber of Lecture Hours		am Hours	

CREDITS-03

Course Objectives The objectives of the course is to enable students to:

1. Understand basic skills of Management.
2. Understand the need for Entrepreneurs and their skills.
3. Identify the Management functions and Social responsibilities.
4. Distinguish between management and administration.
5. Understand Project identification and Selection.

Module -1	**Teaching Hours**
Management: Introduction-Meaning-Nature and characteristics of management, Scope and Functional areas of management- Management as art of science, art or profession-Management & Administration-Roles of Management, Levels of Management, Development of Management Thought-Early management approaches-Modern management approaches. **Planning**: Nature, Importance and purpose of planning process objectives-types of plans (meaning only)-decision making, Importance of planning-steps in planning & planning premise- Hierarchy of plans.	08 Hours
Module -2	
Organizing and Staffing: Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalization, Committees–Meaning, Types of Committees; Centralization Vs Decentralization of Authority and Responsibility; **Staffing-**Need and Importance, Recruitment and Selection Process. **Directing:** Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory); Communication – Meaning, Importance and Purposes of Communication; Leadership-Meaning, Characteristics, Behavioral Approach of Leadership.	08 Hours
Module -3	
Coordination: Coordination-Meaning, Types, Techniques of Coordination; **Controlling** – Meaning, Need for Control System, Benefits of Control, Essentials of Effective Control System, Steps in Control Process. **Authority delegation:** Meaning, advantage of effective delegation, barriers to effective delegation, guidelines for effective delegation. Decentralization: Decentralization of authority meaning, distinction between delegation and decentralization, the trade-off of centralization and decentralization.	08 Hours
Module -4	
Entrepreneurship: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification	08 Hours

of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle. **Modern Small Business Enterprises:** Role of Small-Scale Industries, Impact of Globalization and WTO on SSIs, Concepts and definitions of SSI Enterprises, Government policy and development of the Small-Scale sector in India, Growth and Performance of Small-Scale Industries in India, Sickness in SSI sector, Problems for Small Scale Industries, Ancillary Industry and Tiny Industry (Definition only) .	
Module -5	
Projects Management: A Project. Search for a Business idea: Introduction, Choosing an Idea, Selection of product, The Adoption process, Product Innovation, Product Planning and Development Strategy, Product Planning and Development Process. Concepts of Projects and Classification: Introduction, Meaning of Projects, Characteristics of a Project, Project Levels, Project Classification, Aspects of a Project, The project Cycle, Features and Phases of Project management, Project Management Processes. Project Identification: Feasibility Report, Project Feasibility Analysis. Project Formulation: Meaning, Steps in Project formulation, Sequential Stages of Project Formulation, Project Evaluation. **Project Design and Network Analysis:** Introduction, Importance of Network Analysis, Origin of PERT and CPM, Network, Network Techniques, Need for Network Techniques, Steps in PERT, CPM, Advantages, Limitations and Differences.	08 Hours
Course Outcomes: After studying this course, students will be able to: CO-1-Understand the fundamental concepts of Management and Entrepreneurship and opportunities in order to setup a business. CO-2-Select a best Entrepreneurship model for the required domain of establishment. CO-3-Compare various types of Entrepreneurs. CO-4-Awareness about various sources of funding and institutions supporting entrepreneurs. CO-5-Analyze the Institutional support by various state and central government agencies.	
Text Books: 1. Principles of Management – P.C Tripathi, P.N Reddy, McGraw Hill Education, 6th Edition, 2017. ISBN-13:978-93-5260-535-4. 2. Entrepreneurship Development Small Business Enterprises- Poornima M Charantimath, Pearson Education 2008, ISBN 978-81-7758-260-4. 3. Dynamics of Entrepreneurial Development and Management by Vasant Desai. HPH 2007, ISBN: 978- 81-8488-801-2. 4. Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, "Entrepreneurship", 8th Edition, Tata Mc-graw Hill Publishing Co.ltd.-new Delhi, 2012	
Reference Books: 1. Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4.	

THEORY OF MACHINES						
Course Code	**22ME52**				**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 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, 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	**08**	**L1,L2**
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.	**08**	**L1,L2,L3**
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 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	**08**	**L1,L2,L3**

	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.	**08**	**L1,L2,L3**
5	**Introduction & Undamped free Vibrations:** Types of vibrations, Definitions, Simple Harmonic Motion (SHM), Work done by harmonic force, Principle of super position applied to SHM, Beats, Fourier theorem, simple numerical. **Vibration measuring instruments and Whirling of shafts**: Vibrometers, Accelerometer, Frequency measuring instruments and Problems. Whirling of shafts with and without damping, discussion of speeds above and below critical speeds and Problems.	**08**	**L1,L2,L3**

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

CO1	Construct/Compose mechanisms to provide specific motion.
CO2	To understand forces acting on the mechanisms
CO3	To understand the balancing of machineries along with force analysis.
CO4	To analyze the effect of a gyroscopic couple on Ship, Aeroplan and an Automobile and study of Governors with numerical solutions.
CO5	To understand basic of vibration for machine applications with frequency measurements.

Mapping of course outcomes with program outcomes

22ME52	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS0 1**	**PSO 2**	**PSO 3**
CO1	3	2	3	2	2	-	-	-	-	2	-	-	-	3	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	-	3	-
CO4	3	3	2	3	2	-	-	-	2	-	-	2	-	3	-
CO5	3	2	3	2	3	-	-	-	-	-	-	2	-	3	-

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. Theory of Machines Kinematics and Dynamics Sadhu Singh Pearson

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/**

TURBOMACHINES						
Course Code	**22ME53**				**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
The main objective of these specialized courses is to familiarize the students with the main theories and tools for the interpretation of numerical and experimental results and the design techniques for advanced turbomachinery 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 turbomachinery components to put the learned lessons into practice.
The targeted courses prepare the student for a position in a turbomachinery research center or the R&D department of a turbomachinery manufacturer.
To learn the working principles of Impulse and Reaction hydraulic turbines in detail.
To understand the concept of Centrifugal pumps and its construction.

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 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.	**10**	**L1,L2,L3**
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: Introduction, classification of hydraulic turbine,** 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	**10**	**L1,L2,L3**

	dimensions, Number of buckets, Jet diameter, Wheel diameter, Jet ratio, Speed ratio, Number of jets, efficiency, Power, Discharge etc.), performance characteristics of turbine. **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.		
5	**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:

CO1	Understand the working concept of turbomachine , model studies and solve numerical
CO2	**Understand the application and analyses various turbomachines**.
CO3	Understand working principle of Impulse and Reaction turbine.
CO4	Understand the concept of Centrifugal pumps and various efficiencies related to it.
CO5	Understand the concept of centrifugal and Axial compressors.

Mapping of course outcomes with program outcomes

22ME52	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS0 1	PSO 2	PSO 3
CO1	3	2	3	2	-	-	-	-	-	2	-	1	-	3	-
CO2	3	3	2	2	-	-	-	-	-	-	-	2	-	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	1	-	3	-
CO4	3	2	3	2	2	-	-	-	-	-	-	1	-	3	-
CO5	3	2	3	2	2	-	-	-	-	-	-	2	-	3	-

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:

4. J B K DAS
5. "Theory of Machines" by R.S. Khurmi and J.K. Gupta
6. Theory of Machines Kinematics and Dynamics Sadhu Singh Pearson

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 :

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

INTERNAL COMBUSTION ENGINES						
Course Code	**22ME541**				**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 various types of I.C. Engines and Cycles of operation.
• Understand normal and abnormal combustion phenomena in SI and CI engines
• Understand the effect of various operating variables on engine performance,
• To help students understand the different types of alternative fuels and their benefits, Fuel Cell Technology, Operating principles
• To deliver and discuss the about architecture, power electronics-based drive control systems, battery management systems and grid integration issues of Electric and Hybrid vehicles.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Energy Conversion:** Fundamentals of IC Engines Applications, nomenclature, engine components, Engine classification, two and four stroke cycle engines; fundamental difference between SI and CI engines; valve timing diagrams. Power Cycles: Air standard Otto, Diesel and Dual cycles; Valve timing diagrams, Fuel-Air cycles and deviation of actual cycles from ideal cycles.	**08**	L1,L2, L3
2	**Combustion:** Introduction, important qualities and ratings of SI Engines fuels; qualities and ratings of CI Engine fuels. Combustion in S.I. Engines, flame speed, ignition delay, normal and abnormal combustion, effect of engine variables on flame propagation and ignition delay, Combustion in C.I. Engines, combustion of a fuel drop, stages of combustion, ignition delay, combustion knock; types of SI and CI Engine combustion chambers.	**08**	L1, L2, L3
3	**Various Engine Systems and Engine Testing and Performance**: Starting systems, fuel supply systems, engine cooling system, ignition system, engine friction and lubrication systems, governing systems. **Engine Testing and Performance of SI engines.** Engine Testing and Performance of CI Engines Parameters, Type of tests and characteristic curves. Super charging in IC Engine: Effect of attitude on power output, turbo charging, types of supercharging. Engine Emissions and control: Pollutants from SI and CI engines and their control, emission regulations such as Bharat and Euro.	**08**	L1, L2, L3
4	**Alternate fuels:** Alternate fuels Need for alternative fuels, applications, various alternate fuels etc Gaseous Fuels, Alcohols, Biodiesels, vegetable oil extraction, Trans-esterification process, properties of alternative fuels and fuel blends. Fuel Cell Technology: Operating principles, Types, construction, working, application, advantages and limitations.	**08**	L1, L3

5	**Layout of Electric vehicle and Hybrid vehicles:** Engine electronics, Introduction to Electric and Hybrid vehicles, Layout of Electric vehicle and Hybrid vehicles, Advantages and drawbacks of electric and hybrid vehicles, System components, electronic control system –Different configurations of Hybrid vehicles, Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.	**08**	L1, L3

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

CO1	Understand various types of I.C. Engines and Cycles of operation.
CO2	Understand normal and abnormal combustion phenomena in SI and CI engines
CO3	Analyze the effect of various operating variables on engine performance
CO4	Understand the conventional and non-conventional fuels for IC engines and effects of emission formation of IC engines, its effects and the legislation standards
CO5	Analyze and model the power management systems for electric and hybrid vehicles

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	2	2	-	-	-	3	-	-	2	-	-	-	3	-
CO2	3	3	2	-	-	-	-	-	-	2	-	-	-	3	-
CO3	3	3	3	2	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	2	3	2	-	-	-	-	-	-	2	-	3	-
CO5	3	3	3	2	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. V. Ganeshan, "Internal Combustion Engines", Tata McGraw Hill Publications, New Delhi, 3rd edition.
2. J. B. Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw Hill Publications, New York, International Edition, 1988.

REFERENCE BOOKS:

1."Alternative Fuels", Dr. S. S. Thipse, Jaico publications.

2. “IC Engines”, Dr. S. S. Thipse, Jaico publications.

3. “Engine Emissions, pollutant formation”, G. S. Springer and D.J. Patterson, Plenum Press.

4. ARAI vehicle emission test manual.

5. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, “The Biodiesel Handbook”, AOCS Press

DESIGN LABORATORY						
Course Code	**22MEL56**				**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

22MEL56	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

FLUID MACHINES LABORATORY						
Course Code	**22MEL57**				**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

22MEL57	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

INTERNAL COMBUSTION ENGINES LABORATORY						
Course Code	**22MEL581**				**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

- This course will provide a basic understanding of fuel properties and its measurements using various types of measuring devices
- Energy conversion principles, analysis and understanding of I C Engines will be discussed. Application of these concepts for these
- machines will be demonstrated. Performance analysis will be carried out using characteristic curves.
- Exhaust emissions of I C Engines will be measured and compared with the standards.

PART	TOPICS	TEACHING HOURS	RBT LEVELS
A	1. Lab layout, calibration of instruments and standards to be 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. Determination of Calorific value of solid, liquid and gaseous fuels. 4. Determination of Viscosity of a lubricating oil using Redwoods, Say bolt and Torsion Viscometers. 5. Analysis of moisture, volatile matter, ash content and fixed carbon of solid and liquid fuel samples 6. Valve Timing/port opening diagram of an I.C. Engine	**12 Hours**	**L1,L2,L3**
B	1. Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiency, Volumetric efficiency, Mechanical efficiency, SFC, FP, A:F Ratio, heat balance sheet for a. Four stroke Diesel Engine b. Four stroke Petrol Engine c. Multi Cylinder Diesel/Petrol Engine, (Morse test) d. Two stroke Petrol Engine e. Variable Compression Ratio I.C. Engine. 2. Measurements of Exhaust Emissions of Petrol engine. 3. Measurements of Exhaust Emissions of Diesel engine 4. Demonstration of Pθ , PV plots using Computerized IC engine test rig.	**12 Hours**	**L1,L2,L3**

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

CO1	Perform experiments to determine the properties of fuels and oils.
CO2	Conduct experiments on engines and draw characteristics.
CO3	Test basic performance parameters of I.C. Engine and implement the knowledge in industry.
CO4	Identify exhaust emission, factors affecting them and report the remedies.
CO5	Determine the energy flow pattern through the I C Engine

Mapping of course outcomes with program outcomes

22MEL581	**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	-	-	-	-	-	-	-	2	-	-	-	3	-
CO2	3	3	2	-	-	-	-	-	-	2	-	-	-	3	-
CO3	3	3	3	2	-	-	-	-	2	2	-	-	-	3	-
CO4	3	3	2	3	2	-	-	-	-	2	-	-	-	3	-
CO5	3	2	3	2	-	-	-	-	-	2	-	-	-	3	-

High-3: Medium-2: Low-1

SCHEME FOR EXAMINATION:

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

PROJECT-V						
Course Code	**22PRJ59**				**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

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	-	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

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

SL.NO	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).

INTRODUCTION TO SAND MOULDING						
Course Code	22AECME510A				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	0	**0**	**1**	**1**		
Number of Lecture Hours	**14**				**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.**	**3**	**L1**
2	**Preparation of different types of gating system**	**3**	**L1,L2**
3	**Preparation of different types of runners and risers**	**3**	**L2**
4	**Preparation of moulds by sweep pattern , loose piece pattern & wax pattern.**	**3**	**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

22AECME510A	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS01	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

Mapping of course outcomes with program outcomes

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. Ammen The 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/)

SUPPLY CHAIN MANAGEMENT						
Course Code	**22ME551**				**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
• Understand the building blocks, major functions business process & there relative to decision in a supply Chain Management.
• Design & analyze the linkages between supply chain structures & logistical capabilitiesof a firm or supply chain.
• Develop quantitative models to ensure effective decision making by analyzing the supply chain issues.
• Demonstrate operational purchasing methods and techniques on supplier managementand supply in specific business contexts.
• To provide an insight into the role of internet technologies and electronic commerce in supply chain operations and to discuss technical aspects of key ITEC components in supply chain management.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Introduction to SCM:** Basic concepts & philosophy of SCM, essential features, decision phases – process view, supply chain framework, key issues in SCM and benefits.	**10**	**L1, L2**
2	**Designing the supply chain network**: Designing the distribution network, role of distribution, factors influencing distribution, design options, distribution networks in practice, network design in the supply chain, factors affecting the network design decisions. Designing and Planning Transportation Networks, role of transportation, modes, design options, tailored transportation.	**10**	**L2, L1**
3	**Inventory Management & Recent issues in SCM:** Concept, various costs associated with inventory, EOQ, buffer stock, lead time reduction, reorderpoint / re-order level fixation, ABC analysis, SDE/VED Analysis. **Recent issues in SCM** Role of computer/ IT in supply chain management, CRM Vs SCM, Benchmarking concept, features and implementation, outsourcing – basic concepts, value addition in SCM.	**10**	**L1,L2, L3**
4	**Purchasing and vendor management:** Centralized and decentralized purchasing, functions and purchase policies, vendor rating/ evaluation, single vendor concept, account for materials, just in time & Kanban systems of inventory management.	**10**	**L1,L2,L3**

5	**Logistics Management:** Logistics of part of SCM, logistics costs, logistics, sub-systems, inbound and out bound logistics bullwhip effects in logistics, distribution and warehousing management. Demand Management and Customer Service: Demand Management, CPFRP, customer service, expected cost of stock outs.	**10**	**L1,L2,L3**

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

CO.1	Demonstrate knowledge of the functions of logistics and supply chain management.
CO.2	To relate concepts and activities of the supply chain to actual organizations.
CO.3	Highlight the role of technology in logistics and supply chain management.
CO.4	Evaluate cases for effective supply chain management and its implementation.
CO.5	Describe the basic part of SCM and demand management

Mapping of course outcomes with program outcomes

22ME551	**PO 1**	**PO2**	**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**
CO1	3	2	2	-	-	-	-	-	-	2	-	-	-	3	-
CO2	2	3	2	2	-	-	-	-	-	2	-	-	-	3	-
CO3	3	2	3	-	-	-	-	-	-	2	-	-	-	3	-
CO4	3	3	3	3	2	-	-	-	-	2	-	-	-	3	-
CO5	3	2	2	2	3	-	-	-	-	2	-	2	-	3	-

High-3: Medium-2: Low-1

TEXT BOOKS:

1. A Logistic approach to Supply Chain Management – Coyle, Bardi, Longley, 1st Edition,Cengage Learning.
2. Supply Chain Logistics Management, Donald J Bowersox, Dand J Closs, M Bixby Coluper,2nd Edition, TMH, 2008.

REFERENCE BOOKS:

1. Supply chain management, Chopra Sunil and Peter Meindl - 3rd edition, Pearson, 2007.
2. Supply Chain Management-A Managerial Approach, Amith Sinha, Herbert, 2nd edition,TMH.

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

HEAT AND MASS TRANSFER						
Course Code	**22ME61**				**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:** 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. Fin efficiency and effectiveness. Numerical problems.	**08**	L1,L2,L3
3	**Forced Convections:** Applications of dimensional analysis for forced convection. Physical significance of Reynolds, Prandtl,	**08**	L1, L2, L3

	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.		
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 and apply Boundary conditions.
CO2	Apply variable thermal conductivity and heat generation concepts 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	2	2	-	-	-	-	-	-	-	1	3	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	2	3	-	-
CO4	3	2	3	2	-	-	-	-	-	-	-	1	3	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-

High-3: Medium-2: Low-1

SEE 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:

3. A Textbook Of Heat And Mass Transfer by R.K.Rajput, S.Chand, New Delhi.
4. Engineering heat and mass transfer. Mahesh. M. Rathore
5. 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
5. Heat Transfer Holman, J. P. Tata McGraw Hill, New York 9th Edition 20

DESIGN OF MACHINE ELEMENTS						
Course Code	**22ME62**				**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
1) Study basic principles of machine design.
2) Understand the principles involved in evaluating the dimensions of a component to satisfy functional and strength requirements.
3) Learn the use of design data book for designing specific components.
4) Design machine elements subjected to fatigue loading.
5) Design consideration of transmission drives and joints.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Introduction:** Design Process: Definition of design, phases of design, and review of engineering materials and their properties and manufacturing processes; use of codes and standards, selection of preferred sizes, factor of safety. **Fatigue loading:** Introduction to fatigue failure, Mechanism of fatigue failure, types of fatigue loading, S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit. Modifying factors: size effect, surface effect, Stress concentration effects Notch sensitivity, Soder berg and Goodman relationships, stresses due to combined loading, cumulative fatigue damage, and Miner's equation.	08	**L1 & L2**
2	**Design of Temporary Joints:** Types of temporary joints- cotter joints, knuckle joint and fasteners. Design of Cotter and Knuckle Joint. **Design of keys and couplings:** Keys: Types of keys and their applications, Design of square and rectangular sunk keys. Couplings: Rigid and flexible coupling-types and applications, design of Flange coupling, and Bush and Pin type coupling.	08	**L2 & L3**
3	**Threaded Fasteners:** Stresses in threaded fasteners, effect of initial tension, design of threaded fasteners under static, dynamic and impact loads, design of eccentrically loaded bolted joints. **Power screws:** Mechanics of power screw, stresses in power	08	**L2 & L3**

	screws, efficiency and self-locking, design of power screws.		
4	**Design of Clutches:** Necessity of a clutch in an automobile, types of clutch, friction materials and its properties. Design of single plate, multi-plate and cone clutches based on uniform pressure and uniform wear theories. **Design of Brakes:** Different types of brakes, Concept of self-energizing and self-locking of brakes. Practical examples, Design of band brakes, block brakes and internal expanding brakes.	08	**L2 & L3**
5	**Power Transmission Drives:** Introduction to power transmission drives. Types of drives: belt, rope, chain drives and gear drives. Belt drive: Materials of construction of flat and V belts, power rating of belts, concept of slip and creep, Selection of flat and V belts- length. Construction of wire ropes, stresses in wire ropes, and selection of wire ropes. **Gears:** Classification of gears, materials for gears, standard systems of gear tooth, lubrication of gears, and gear tooth failure modes. Numerical on Design of Spur gear and worm gears.	08	**L2 & L3**

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

CO1	Apply basic principles of machine design
CO2	Design of machine elements such as temporary joints and couplings.
CO3	Understand the design principles of power screws
CO4	Understand the design principles of brakes and clutches.
CO5	Design various types Drives such as belt, ropes and gears drives

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
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-

Scheme for Examination:

- Two questions to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

TEXT BOOKS:

1)"Design of Machine Elements",V.B.Bhandari., Tata McGraw Hill Publication, 3rd Edition.

2) "Machine Design", R.K.Jain, Khanna Publication.

3) "Machine Design", Pandya Shah, Charotar Publication.

4) "Design of Machine Elements", P. Kannaiah, Scitech Publication.

5) "Machine Design A Basic Approach", Dr. S.S.wadhwa S S Jolly DhanapatRai and Sons.

6) "Machine Design", U.C.Jindal, Pearson Education.

7) "Design of Machine ElementsI& II", J.B.K.Das and P.L.S. Murthy ,Sapna Publishers, 2nd Edition

REFERENCE BOOKS:

1) "Machine Design",Hall, Holowenko Laughlin, Tata McGraw Hill Publication Schaums Outline Series.

2) "Design of Machine Element", J.F. Shigley, Tata McGraw Hill Publication.

3) "Design of Machine Element" M.F.Spotts, Pearson Education Publication, 6th Edition.

4) PSG Design data Book

5) "Mechanical Analysis and Design", H.Burr and Cheatam, Prentice Hall Publication.

6) "Design of Transmission Systems", P. Kannaiah, Scitech Publication.

7) "Machine Design", P. Kannaiah, Scitech Publication, 2nd Edition.

8) "Machine Component Design",Robert C. Juvniall, Willey Ltd, 5th Edition.

AUTOMATION AND ROBOTICS						
Course Code	**22ME632**				**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 impart knowledge of Automation and different concepts of automated manufacturing Systems.
- To understand the concepts of Robotics & it's working mechanism.
- Understand the integrated parts of robots and its control systems.
- Understanding Robot navigation systems, future & its applications.
- To introduce the students to concepts of Artificial Intelligence, Knowing the importance of AI and Integrating AI with robots.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Automation**: Definition, Reasons for automation, Disadvantages of automation, Automation systems, Types of automation – Fixed, Programmable and Flexible automation, Automation strategies **Automated Manufacturing Systems:** Components, classification and overview of manufacturing Systems, Flexible Manufacturing Systems (FMS), Types of FMS, Applications and benefits of FMS.	**08**	**L1& L2**
2	**Robotics:** Definition of Robot, History of robotics, Robotics market and the future prospects, Applications, Robot Anatomy, Robot configurations: Polar, Cartesian, cylindrical and Jointed-arm configuration. Robot motions, Joints, Work volume, Robot drive systems, Precision of movement – Spatial resolution, Accuracy, Repeatability, End effectors – Tools and grippers.	**08**	**L1&L2**
3	**Controllers and Actuators** Basic Control System concepts and Models, Transfer functions, Block diagrams, characteristic equation, Types of Controllers: on-off, Proportional, Integral, Differential, P-I, P-D, P-I-D controllers. **Robot actuation and feedback components:** Position sensors – Potentiometers, resolvers, encoders, velocity sensors. Actuators - Pneumatic and Hydraulic Actuators, Electric Motors, Stepper motors, Servomotors, Power Transmission systems.	**08**	**L1&L2**
4	**Robot Sensors and Machine vision system:** Sensors in Robotics - Tactile sensors, Proximity and Range sensors, use of sensors in robotics. **Machine Vision System:** Introduction to Machine vision, the sensing and digitizing function in Machine vision, Image processing and analysis, Training and Vision systems.	**08**	**L1&L2**
5	**Robots Technology of the future:** Robot Intelligence, Advanced Sensor capabilities, Mechanical design features, Mobility, locomotion and navigation, the universal hand, system integration and networking. **Artificial Intelligence:** Introduction, Goals of AI research, AI techniques – Knowledge representation, Problem representation and problem solving, AI and Robotics, LISP in the factory.	**08**	**L1&L2**

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

CO1	Classify various types of automation &manufacturing systems.
CO2	Discuss different robot configurations, motions, drive systems and its performance parameters.
CO3	Describe the basic concepts of control systems, feedback components, actuators and power transmission systems used in robots.
CO4	Explain the working of transducers, sensors and machine vision systems.
CO5	Discuss the future capabilities of sensors, mobility systems and Artificial Intelligence in the field of robotics.

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
CO1	3	-	2	1	-	-	-	-	-	-	-	3	3	-	-
CO2	3	-	1	1	1	-	-	-	-	-	-	2	3	-	-
CO3	3	-	1	1	1	-	-	-	-	-	-	2	3	-	-
CO4	2	-	1	1	-	-	-	-	-	-	-	2	3	-	-
CO5	3	-	2	1	1	-	-	-	-	-	-	2	3	-	-

High-3: Medium-2: Low-1

Text Books

1. Automation, Production Systems and Computer Integrated Manufacturing M.P. Groover, Pearson Education.5th edition, 2009
2. Industrial Robotics, Technology, Programming and Applications by M.P. Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.

Reference Books

1. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill International, 2nd edition, 2007.
2. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 2009.
3. "Introduction to Robotics: Mechanics and Control", Craig, J. J., 2nd Ed., Addison- Wesley Publishing Company, Readong, MA, 1989.

E-Resources:

1. www.http://nptel.ac.in/courses/107106090

SEE 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.

ADDITIVE MANUFACTURING						
Course Code	**22ME641**				**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 the need, basic concepts, processes, and benefits of AM, and distinguish it from traditional manufacturing techniques like CNC machining.
• Study different AM processes including photo polymerization, powder bed fusion, printing, and sheet lamination, along with their materials, mechanisms, advantages, and applications.
• Equip students with knowledge and tools for selecting appropriate AM processes and managing CAD data, especially STL file preparation and troubleshooting.
• Explore approaches and challenges involved in using multiple materials in AM, including discrete, porous, and blended systems, and their commercial applications.
• Understand and evaluate the practical use of AM across industries such as aerospace, automotive, biomedical, and general engineering through functional models, tooling, and prototyping.

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Introduction and basic principles:** Need for Additive Manufacturing, Generic AM process, stereolithography or 3dprinting, rapid proto typing, the benefits of AM, distinction between AM and CNC machining, other related technologies- reverse engineering technology. **Development of Additive Manufacturing Technology:** Introduction, computers, computer-aided design technology , other associated technologies, the use of layers, classification of AM processes, metals Systems, hybrid systems, milestones in AM development.	**8**	**L1&L2**
2	**Photo polymerization processes:** Stereolitho graphy (SL), Materials, SL resin curing process, Micro-stereolithography, Process Benefits and Drawbacks, Applications of Photo polymerization Processes. **Powder bedfusion processes:** Introduction, Selective laser Sintering (SLS), Materials, Powder fusion mechanism, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.	**8**	**L2 &L3**
3	**Printing Processes:** Evolution of printing as an additive manufacturing process, research achievements in printing deposition, technical challenges of printing, printing process modeling, material modification methods, three-dimensional printing, advantages of binder printing **Sheet Lamination Processes:** Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications.	**8**	**L1& L2**

4	**Guidelines for Process Selection:** Introduction, selection methods for apart, challenges of selection, example system for preliminary selection, production planning and control. **Software issues for Additive Manufacturing:** Introduction, preparation of cad models – the STL file, problems with STL files, STL file manipulation.	**8**	**L1&L2**
5	**The use of multiple materials in additive manufacturing:** Introduction, multiple material approaches, discrete multiple material processes, porous multiple material processes, blended multiple material processes, commercial applications using multiple materials, future directions. **AM Applications:** Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Remanufacturing. Application: Examples for Aerospace, defense, automobile, Bio-medical and general engineering industries.	**8**	**L1,L2,&L3**

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

CO1	Understand the fundamental principles, need, and evolution of Additive Manufacturing (AM), and distinguish it from traditional manufacturing processes like CNC machining.
CO2	Analyze various additive manufacturing technologies including photo polymerization, powder bed fusion, and their applications, materials, benefits, and limitations.
CO3	Evaluate different printing and sheet lamination processes, understanding the associated technical challenges and material bonding techniques.
CO4	Develop the ability to select appropriate AM processes based on part requirements, and understand the role of CAD, STL files, and software in AM workflows.
CO5	Apply knowledge of multi-material additive manufacturing techniques and explore diverse applications of AM in industries such as aerospace, biomedical, and automotive.

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

High-3, Medium-2, Low-1

SEE 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. Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing I. Gibson l D. W. Rosen l B. Stucker Springer New York Heidelberg Dordrecht, London ISBN: 978-1- 4419-1119-3 e-ISBN: 978- 1-4419- 1120-9 DOI 10.1007/978 -1-4419-1120-9

REFERENCE BOOKS:

1. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling" D.T. Pham, S.S. Dimov Springer 2001.
2. Rapid Prototyping: Principles and Applications in Manufacturing RafiqNooran John Wiley & Sons 2006.
3. Additive Manufacturing Technology Hari Prasad, A.V.Suresh Cengage 2019.
4. Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing Andreas Gebhardt Hanser Publishers 2011.

E-RESOURCES :

1. Fundamentals of Additive Manufacturing Technologies : https://nptel.ac.in/courses/112103306

PROFESSIONAL ETHICS

[As per Choice Based Credit System (CBCS) Scheme]

SEMESTER-VI

bject Code	HSM610	E Marks	
mber of Lecture Hour/Week		.E Marks	
tal Number of Lecture Hours		am Hours	

CREDITS-01

Course Objectives:

1. To enable the students to create an awareness on Engineering Ethics and Human Values,
2. To instill Moral and Social Values and Loyalty and to appreciate the rights of others.

Module -1	**Teaching Hours**
HUMAN VALUES orals, 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 – Introduction to Yoga and meditation for professional excellence and stress management	04 Hours
Module -2	
ENGINEERING ETHICS nses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories	04 Hours
Module -3	
ENGINEERING AS SOCIAL EXPERIMENTATION Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.	04 Hours
Module -4	
SAFETY, RESPONSIBILITIES AND RIGHTS Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination	04 Hours
Module -5	
GLOBAL ISSUES Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility	04 Hours

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

CO-1- Incorporate morals, values, ethics, and personal development in the workplace to create a positive culture and contribute to societal advancement.

CO-2- Apply engineering ethics and theories to tackle moral issues and foster moral development.

CO-3- Follow ethical guidelines as responsible experimenters, ensuring accountability through codes of ethics and legal duties.

CO-4- Understand the safety, responsibilities and rights associated with professional ethics in both

the workplace and society.
CO-5- Understand and apply professional ethics to effectively navigate and address the complex challenges in modern engineering environments.

Text Books:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

ference Books:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.
6. World Community Service Centre, " Value Education", Vethathiri publications, Erode, 2011

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	PSO.3
CO1	-	-	-	-	-	3	2	2	2	3	2	3	-	-	3
CO2	-	-	-	-	-	3	2	3	3	3	2	3	-	-	3
CO3	-	-	-	-	-	2	2	3	3	3	3	3	-	-	3
CO4	-	-	-	-	-	3	2	3	3	3	3	3	-	-	3
CO5	-	-	-	-	-	3	3	3	3	3	3	3	-	-	3

HEAT AND MASS TRANSFER LABORATORY						
Course Code	**22MEL66**				**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 through experimentation.
- Understand the concepts of heat transfer through extended surfaces.
- Apply principles of heat transfer to predict heat transfer co-efficient.
- Gain knowledge about transient heat conduction through experimentation.
- 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	Demonstrate the method of finding thermal conductivity, heat transfer coefficient, and effectiveness in various systems through hands-on experiments.
CO2	Evaluate the performance of extended surfaces (fins) and analyze heat transfer mechanisms in convection and radiation.
CO3	Analyze heat exchanger performance using LMTD and effectiveness calculations.
CO4	Conduct experiments on phase change phenomena (boiling and condensation)
CO5	Assess the performance of vapor compression refrigeration and air-conditioning systems.

Mapping of course outcomes with program outcomes

22MEL66	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO	PO	PS01	PSO2	PSO3

											11	**12**			
CO1	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO3	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO4	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO5	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

High-3: Medium-2: Low-1

SEE 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

AUTOMATION AND ROBOTICS LABORATORY						
Course Code	**22MEL671**				**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 automation.
• To enhance students technical skills regarding automation and its instruments
• To understand the technical aspects of servomotors used in robotic arm.
• To make student understand the use electro-mechanical instruments like sensors/ switches, relays & transducers.
• To provide idea about principle and applications of PLC modules & batch process reactors including conveyor belts.

PART A	**EXPERIMENTS**	**TEACHING HOURS**	**RBT LEVELS**
1	Setup for study of different sensors/ switches, & relays	**12**	**L2,L3**
2	Study of LVDT setup		
3	Study of Pressure transducer		
4	Study on Strain guage		
PART B	**EXPERIMENTS**	**12**	**L3**
1	Applications on PLC working modules (Automated systems) i) Lift simulation module ii) Material stamping & rejection module iii) Washing machine module		
2	Batch Process Reactor (Including conveyor belt system)		
3	Position & Speed control by servomotors used in robots		

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

CO1	Understand and apply various sensors, transducers, switches, and relays for measurement and control.
CO2	Gain proficiency in PLC systems, and industrial automation systems.
CO3	Develop skills in servomotor control and process automation for advanced industrial applications.

Mapping of course outcomes with program outcomes

22MEL671	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	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
Avg. Mapping	**2**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**2**	**3**	**2**

QUESTION PAPER PATTERN:

SCHEME OF EVALUATION FOR CIE (50 MARKS)

(a)

Experiment no:	Experiment Executed (25 marks)	
1 to 8	Experiment Executed	25
	CIE Lab Evaluation	15
	Mock presentation	10
	Total	**50**

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.

ADDITIVE AND SUBTRACTIVE MANUFACTURING LABORATORY						
Course Code	**22MEL681**				**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 to different machine tools, accessories and attachments.
• To train students into machining operations to enrich their practical skills.
• To gain knowledge and skills related to 3D printing technologies.
• To learn the selection of material, equipment and development of a product for Industry 4.0 environment.

PART	**TOPICS**	**TEACHING HOURS**	**RBT LEVELS**
A	1. Preparation of three models on lathe involving: Plain turning, Taper turning, Step turning 2. Cutting of V Groove/ dovetail / Rectangular groove using a shaper.	**12 Hours**	**L1,L2,L3**
B	1.3D Modelling of a single component. 2. Printing of identified product on an available AM machine. 3. Inspection and defect analysis of the additively manufactured product.	**12 Hours**	**L1,L2,L3**

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

CO1	Identify the parts of machines and differentiate different types of machine and tools in machine shop.
CO2	Machine and tool setup for various machining operations.
CO3	Select a specific material for the given application.
CO4	Select a 3D printing process for an application.
CO5	Produce a product using 3D Printing or Additive Manufacturing (AM).

Mapping of course outcomes with program outcomes

22MEL681	**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	-	-	1	-	-	-	-	1	-	-	-	-	3	-
CO2	3	-	-	1	-	-	-	-	1	-	-	-	-	3	-

CO3	**3**	-	-	1	-	-	-	-	1	-	-	-	-	3	-
CO4	2	-	-	2	**3**	-	-	-	1	-	-	-	-	3	-
CO5	2	-	-	2	**3**	-	-	-	1	-	-	-	-	3	-

High-3: Medium-2: Low-1

SEE 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

PROJECT-VI						
Course Code	**22PRJ69**				**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:

CO1	To be able to apply knowledge of engineering to a logically chosen problem.
CO2	To be able to prepare complete feasibility report for practical problem
CO3	To be able to synthesize the findings to a suitable conclusion
CO4	To present the findings in the form of technical report
CO5	To Problem-Solving and Debugging Skills

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS01	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	2	-	2	-	3	-	1
CO2	3	2	-	-	-	-	-	-	2	-	2	-	3	-	1
CO3	3	3	-	-	-	-	-	-	2	-	2	-	3	-	1
CO4	3	2	-	-	-	-	-	-	2	-	2	-	2	-	1
CO5	3	2	-	-	-	-	-	-	2	-	2	-	2	-	1

High-3: Medium-2: Low-1

ASSESMENT AND EVALUATION

SCHEME OF EVALUATION FOR CIE (50 MARKS)

SL.NO	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).

BASICS OF FUEL CHARACTERISATION						
Course Code	**22AECME6112**				**CIE Marks**	**50**
Teaching Hours/Week	**L**	**T**	**P**	**Total**	**SEE Marks**	**50**
	0	**0**	**2**	**2**	**Total Marks**	**100**
Total Hours of Teaching	**24**				**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.

Part	**Topics**	**Teaching Hours**	**RBT Levels**
Part-A	**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.** An overview of the characteristics of diesel and gasoline fuels. **3. Determination of Proximate of diesel fuel through experimentation.** a. Moisture content determination b. Volatile matter determination c. Ash content determination d. Fixed carbon estimation **4. Study of Ultimate Analysis and its testing equipment.** a. Carbon, hydrogen, and nitrogen content b. Sulfur determination c. Oxygen by difference	**05**	**L1, L2, L3**

	5. Determination of the higher heating value (HHV) and lower heating value (LHV) of char coal and diesel fuel. **6.** Determination of kinematic and dynamic viscosity of liquid fuels using viscometers such as Redwood, Saybolt, or Engler viscometers.	**05**	**L1, L2, L3**
	7. Determination of specific gravity using hydrometers, pycnometers, or density meters. **8.** Distillation of liquid fuels (like petroleum) to determine the boiling range and assess volatility.	**05**	**L1, L2, L3**
Part-B	1. Conradson carbon residue test for determining carbon residue left after evaporation and pyrolysis of oil. 2. To Study of Determination of water content in liquid fuels using the **Karl Fischer titration method.**	**05**	**L1, L2, L3**
	3. **Study of** Testing and determination of **cetane number** for diesel fuels 4. **Study of** Testing and determination of **octane number** for gasoline.	**04**	**L1, L2, L3**

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	Perform proximate and ultimate analysis of diesel 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

22AECME6112	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO.1	3	2	-	2	-	-	-	-	-	-	-	-	3		
CO.2	3	3	-	2	-	-	-	-	-	-	-	-	3		
CO.3	2	3	-	2	-	-	-	-	-	-	-	-	3		
CO.4	3	2	-	2	-	-	-	-	-	-	-	-	3		
CO.5	3	2	-	2	-	-	-	-	-	-	-	-	3		

SEE QUESTION PAPER PATTERN:

- ONE question from part -A: 20 Marks
- ONE question from part B: 20 Marks
- Viva –Voice: 10 Marks
- Total: 50 Marks

PROJECT MANAGEMENT						
Course Code	**22ME652**				**CIE Marks**	**50**
Number Lecture Hour/Week	**L**	**T**	**P**	**TOTAL**	**SEE Marks**	**50**
	4	**0**	**0**	**4**		
Number of Lecture Hours	**50**				**Exam Hours**	**03**
Credits-04						

Course Objectives: This course will enable students to
• To make them understand the concepts of Project Management for planning to execution of projects.
• To focus on organization culture and creating a culture for project management.
• To make students understand the concept of resources and contacting
• To create an awareness on reporting objectives and execution process
• To make them understand the PERT & CPM tools and techniques used in projects management

MODULE NO.	TOPICS	TEACHING HOURS	RBT LEVELS
1	**Basics of Project Management:** Concepts of projects, characteristics of project, Type of projects, Roles and Responsibilities of Project Manager and his qualities, Idea generation, needs of society, Phases of project life cycle. Project Management Body of Knowledge (PMBOK), Customer needs.	**10**	L1& L2
2	**Project organization strategy:** Dedicated project organization, Influence project organization, Matrix organization, Advantages and disadvantages of project organizations, stake holder management, organization culture, creating a culture for project management, Project feasibility study.	**10**	L1& L2
3	**Resourcing projects and Contracting**: Abilities needed when resourcing projects, estimate resource needs, creating staffing management plan, project team composition issues, Budgeting Projects: Cost planning, estimating, budgeting. Establishing cost control. Contracts, Tendering and Selection of contractors.	**10**	L1& L2
4	**Project Planning:** Defining the project scope, Project scope checklist, Project priorities, Work Breakdown Structure (WBS), Integrating WBS with organization. Scheduling Projects: Purpose of a project schedule, historical development, how project schedules are limited and created,uncertainty in project schedules.	**10**	L1& L2
5	**Tools and techniques of projects management:** Bar chart (Gantt chart), bar chart for combined activates, logic diagrams and networks, project evaluation and review techniques (PERT), Budget & Cost management tools. Critical Path method, Earned	**10**	L1, L2, & L3

	Value management.		

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

CO1	Apply the concept of project management.
CO2	Impliment the organizational strategy, structure and culture.
CO3	Organize and manage the resources of project.
CO4	Ability in planning and evaluating the project.
CO5	Apply tools and techniques used in project management

SEE 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. Chaudhary S.; Project Management, Tata McGraw Hill
  2. Prasanna Chandra; Projects- Planning, Analysis, Selection, Financing, Implementation and Review', I Edition, Tata McGraw Hill, 8th Edition 2015

- **REFERENCE BOOKS:**
  1. A Guide to the Project Management Body of knowledge PMBOK Guide 6thEdition, Project Management Institute 2017.
  2. Project management a system approach to planning scheduling and controlling- Harold Kerzner, CBS Publisher and distributors, 2002.
  3. A management guide to PERT and CPM- WEIST and LEVY Eastern Economy of PH 2002.
  4. T R Banga, N K Agarwal and S C Sharma -Industrial engineering and Management Sciences, -KhannaPublishers

- **E-RESOURCES :**

1. NPTEL notes and Videos