Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar

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Curriculum for B. Tech. in Mechanical Engineering (New CBCS)

(With Effect from Academic Year 2024-25)

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

Government College of Engineering Aurangabad
(An Autonomous Institute of Government of Maharashtra)

Teaching and Evaluation Scheme from Academic Year 2024-25 as per New CBCS
Final Year B. Tech. Program in Mechanical Engineering

Semester – VII

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks				
				L	T	P		ISE I	ISE II	ISE III	ESE	Total
1.	PCC	MEPC 4001	Tool Design	3	0	0	**3**	15	15	10	60	**100**
2.	PCC	MEPC 4002	Automobile Engineering	3	0	0	**3**	15	15	10	60	**100**
3.	PCC	MEPC 4003	Mechatronics and Control System	3	0	0	**3**	15	15	10	60	**100**
4.	PEC		Professional Elective - V	2	0	0	**2**	10	10	5	25	**50**
5.	OEC		Open Elective - V	3	0	0	**3**	15	15	10	60	**100**
6.	PCC	MEPC 4007	Lab - Tool Design	0	0	2	**1**	25	-	-	25	**50**
7.	PCC	MEPC 4008	Lab - Automobile Engineering	0	0	2	**1**	25	-	-	25	**50**
8.	PCC	MEPC 4009	Lab - Mechatronics and Control System	0	0	2	**1**	25	-	-	25	**50**
9.	PEC		Lab - Professional Elective – V	0	0	2	**1**	25	-	-	25	**50**
10.	PROJ	MEPR 4013	Mini Project	0	0	6	**3**	50	-	-	50	**100**
Total				**14**	**0**	**14**	**21**	**220**	**70**	**45**	**415**	**750**

Professional Elective – V
MEPE4004 Robotics & Automation
MEPE4005 Refrigeration and air Conditioning
MEPE4006 Introduction to FEM
MEPE4010 Lab - Robotics & Automation
MEPE4011 Lab- Refrigeration and air Conditioning
MEPE4012 Lab - Introduction to FEM

Open Elective V
MEOE0050 Additive Manufacturing

Semester – VIII

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks				
				L	T	P		ISE I	ISE II	ISE III	ESE	Total
1.	PROJ	MEPR 4014	Internships in Industry/ Research organization/ Research Centre	0	0	16	**8**	100			100	**200**
Total				**0**	**0**	**16**	**8**	**100**			**100**	**200**

Approved in XXV IIIth Academic Council
Dated: 25th Jun 2024

MEPC4001: Tool Design		
Teaching Scheme	**Examination Scheme**	
Lectures: 3 Hrs. / Week	ISE I	15 Marks
Credits: 3	ISE II	15 Marks
	ISE III	10 Marks
	End Semester Examination	60 Marks

Course Description: After completing this course, students will have abroad and fundamental understanding of metal cutting theory, tool life, multi point cutting tools, die design and procedures involved in the design, construction, and use of common jigs and fixtures used in the metal working industry.

Course Objectives:

1. To provide a clear view on theory of metal cutting and tool geometry
2. To accustom with tool life
3. To acquire and apply fundamental principles of locating and clamping devices
4. To impart knowledge about jig and fixture design
5. To familiarize with concept of die design for piercing, blanking, bending and forming

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Interpret and understand the theory of metal cutting, tool life and geometry of single and multi-point cutting tool
CO2	Design jigs and fixtures for various applications.
CO3	Design of dies for piercing, blanking, bending and Drawing operations

Detailed Syllabus:

Unit 1	**Theory of Metal Cutting**: Mechanics of chip formation, Single point cutting tool, designation of cutting tool, method of machining, types of chips, determination of shear angle, determination of unreformed chip thickness, force analysis, energy consideration, oblique cutting, tool wear and tool life, economics of metal cutting, machinability, surface roughness, Cutting fluids types and characteristics, Types of Inserts
Unit 2	**Introduction to Press Tools (press tool design):** Press Operations, press tool components, press working terminology, working of cutting die, types of dies, principle of metal cutting (strip layout, clearance, land, straight, angular clearance) theory of metal cutting, cutting forces, energy, methods of reducing cutting forces, blanking and piercing die consideration
Unit 3	**Design of Drawing Die**: no. of draws, stage wise achievement of drawn component, stage wise components drawing, re-draw and inverted die, drawing radii & clearance, drawing force, **Design of Bending Die:** bending principle, bending methods, Estimation of bend radius, bend allowance, developed length, bending pressure, bottoming force, spring back effect in bending operation, spanking.

Unit 4	**Jigs & fixtures**: Principle of location, locating devices, Principle of clamping & clamping devices, force calculation, Types of bushes & their applications, Definition of drill jig, types of drill jig, chip formation in drill jig, general consideration in design of drill jigs, method of construction, indexing drill jig, drill jig and modern manufacturing method. Definition of fixture, fixture and economics, types of fixtures, milling fixture, turning fixtures, indexing fixture
Unit 5	**Multipoint cutting tools:** types of cutting tool, classification, nomenclature, geometry, force and power consumption, tooth form and cutting angle for (milling cutters, broach, drills, reamers, Taps and Hobs)

Text and Reference Books

1. Amitabh Bhattacharyya, "Metal Cutting Theory and Practice", Central Book Publication, Calcutta
2. Cyril Donaldson, "Tool Design", Tata McGraw-Hill Publishing Co. Ltd, New Delhi
3. Kempster, "Introduction to Jig and Tool Design", M. H. A. English Language Book Society
4. P.H. Joshi, "Jigs and Fixtures", Tata McGraw-Hill Publishing Co. Ltd, New Delhi
5. "Production Engineering", H.M.T. Hand-Book, Tata McGraw-Hill Publishing Co. Ltd, New Delhi
6. Wilson (Edited), "Fundamentals of Tool Design", A.S.T.M.E.
7. P.C. Sharma "Production Engineering", S. Chand Company Ltd New Delhi
8. S K Basu and S N Mukherjee, "Fundamentals of tool engineering design", Oxford and IBH publication Co. Pvt. Ltd Bombay
9. P. H. Joshi "Press Tools Design and Construction" Wheeler Publishing

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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 O1	PS O2
CO1	2	1	2		2	1						2	2	2
CO2	1		1			1						2	1	1
CO3	2	2	2	2	2	1						2	2	2

1 – Low, 2 – Medium, 3 – High

Teacher's Assessment:

Teachers Assessment of 10 marks is based on one of the/ or combination of few of following

1) Presentation of case studies
2) Question & answer/ Numerical solution
3) Design and Drawing of Jig and fixture for different automobile components
4) Design and drawing of Dies for different automobile components in CAD software

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	Class Test -I	Class Test -II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	2	2	2	10
K2	Understand	3	3	2	10
K3	Apply	5	5	3	20
K4	Analyze	5	5	3	20

MEPC4002: Automobile Engineering		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	ISE I	15 Marks
Credits: 03	ISE II	15 Marks
	ISE III	10 Marks
	End Semester Examination	60 Marks

Course description: After completing this course, students will have a broad and fundamental understanding of Automobile Engineering. Topics range from a classification of automobile to details sub systems of vehicle such as engine, clutch, gear box, transmission line, differential gear box, types of axles ,steering system, breaking system and electrical system overdrive suspension system etc. and career options available within this field

Course Objectives:

1. Understand the basics of principles of actual automobile systems.
2. To know the importance and features of different systems like axle, differential, brakes, Steering, suspension, and balancing etc
3. To interpret the working of various Automobile Systems.
4. To Compare modern trends in Automotive Vehicles.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Understand the Construction, working and other details about InternalCombustion Engines used in automobiles.
CO2	Infer Construction, working, preventive maintenance, trouble shooting anddiagnosis of various Automobile Systems.
CO3	Classify the features of different systems like axle, differential, brakes, steering, suspension, and balancing etc.
CO4	Compare the Modern technology and safety measures used in Automotive Vehicles.

Detailed Syllabus:

Unit 1	Classification of automobiles, chassis, layout types, Sub-systems of automobile Power Unit: -Functions and locations power for propulsion, Engine parts-types, construction and functions, multiple cylinder engines. General considerations of engine balance vibration, firing order road performance curves.
Unit 2	**Fuel feed systems:-** fuel feed systems for petrol engines. Fuel pumps, ,Cooling system : purpose, types of cooling system, troubles and remedies of cooling system. lubrication :- Types of lubricants, ,multi viscosity oils, chassis lubrication. Engine lubrication:-types of lubricating systems, crankcase ventilation, Engine lubrication troubles and remedies.
Unit 3	**Starter motor drive: -**Bendix drive, over running clutch drive, Solenoid switch; solenoids switch. Ignition system: - Battery coil and magneto ignition system, Ignition timing and its effect on engine performance, Ignition advance mechanisms, electronic ignition system.
Unit 4	**Transmission system:-** Construction, transmission, requirements of singleplate friction clutch and multi plate clutch, clutch adjustments, clutch troubles and remedies.

	Gear Boxes: - Sliding mesh, constant mesh and synchromesh gear box,function of over drives, trouble shooting and remedies. Propeller shaft, hotchkiss drive torque tube drive, differential, Final drive Types of rear axles
Unit 5	**Braking system: -** Mechanical, hydraulic brakes, power brakes, air brakes and vacuum brakes Fault finding and maintenance of brakes, Steering system: - Function, types of linkages, steering gears, steering gear ratio. Wheel alignment, steering geometry, & their effects, Introduction of power steering. **Suspensions:** - Types of Rigid, axle and independent suspension system, shock absorbers.

Text and Reference Books

1. Kirpal Singh, "Automobile Engineering", Vol I & II, Standard publishers Distributors, Delhi
2. Ramalingum K. K., "Automobile Engineering", Scitech publications", Chennai
3. Srinivasan S. "Automotive Engines", Tata McGraw Hill
4. Crouse W. H. "Automotive Mechanics", Tata McGraw Hill
5. Joseph Heitner, "Automotive Mechanics", East-West press Pvt. Ltd
6. T. R. Banga & Nathu Singh, "The Automobile Engineering", Khanna Publishers
7. R. K. Rajput, "Automobile Engineering", Laxmi Publication
8. K. K. Jain & R.B. Asthana. "Automobile Engineering", Tata McGraw Hill
9. S. Srinivasan, "Automotive Mechanics", Tata McGraw Hill
10. R.K. Mohanty, "Automobile Engineering", Standard Book House

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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	PSO1	PSO2
CO1	3	3			1							1	1	
CO2	3		2	1								1	1	
CO3		2											2	
CO4		2									2	1	1	

1 – Low, 2 – Medium, 3 – High

Teacher's Assessment: Teachers Assessment of 10 marks is based on one of the / or combinationof few of following

1. Presentation of case studies
2. Question & answer / Numerical solution
3. Study of Industry processes and its presentation
4. Mini project

Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ISE III	ESE
K1	Remember	03	03	02	15
K2	Understand	07	07	03	20
K3	Apply	05	05	02	15
K4	Analyze	00	00	03	10
K5	Evaluate	00	00	00	00
K6	Create	00	00	02	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1, K2	K1, K2	K3	K3, K4
	CO1	CO2	CO3	CO4
Class Test (15 Marks)	05	05	02	03
Class Test (15 Marks)	05	05	02	03
Teachers Assessment (10 Marks)	03	02	01	04
ESE Assessment (60 Marks)	17	18	12	13

MEPC4003: Mechatronics and Control System		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	ISE I	15 Marks
Credits: 03	ISE II	15 Marks
	ISE III	10 Marks
	End Semester Examination	60 Marks

Course Objectives:

1. Model and analyze mechatronic systems for an engineering application.
2. Identify sensors, transducers and actuators to monitor and control a process or product.
3. To impart knowledge about microprocessor, microcontrollers used in mechatronics.
4. Develop PLC programs for an engineering application.
5. Evaluate the performance of mechatronic systems.

Course Outcomes:

After completing the course, students will able to

Course Outcomes	
CO1	Recognize and analyze electro-mechanical systems in daily lives.
CO2	Analyze the requirements for a given industrial process and select the most appropriate sensors, actuators, and controls according to applications.
CO3	Understand the different logic gates, architecture of microprocessor and microcontroller for industrial applications.
CO4	Develop PLC Ladder programming for Industrial Applications.
CO5	Familiarity with control theory and controller design.

Detailed Syllabus:

Unit 1	**Introduction of Mechatronics** Introduction: Electro-mechanical systems; Typical applications; Examples – automobiles, home appliances, medical instruments, etc. Sensors - working characteristics and mathematical model of Thermal sensors, Pressure sensors, Strain sensors, Load cell, Motion sensor, Accelerometer, Optical sensors, Photo diode, Photo Emissive, Force sensors, Torque sensor
Unit 2	**Actuators** Pneumatic and Hydraulic actuators; Elements, Construction, Operation, Standard Symbols and Industrial Applications. Hydraulic and Pneumatic Circuits. Electric motors including DC, AC, BLDC, servo and stepper motors.
Unit 3	**Machine Controls** Digital Logic, Logic Gates, Boolean algebra. Principles of basic electronics Microprocessors / microcontroller, Industrial Applications, Hardware in mechatronics systems, Interfacing, DA and AD converters, software and hardware principles and tools to build mechatronics systems
Unit 4	**Programming Logic Controllers (PLC)** Basic structure, selection of PLCs, Ladder Programming in Industrial Applications **Advanced Applications in Mechatronics**: mechatronics control in automated manufacturing, CIM, Robot, Artificial Intelligence in mechatronics, fuzzy logic applications in mechatronics, micro sensor
Unit 5	**Control Theory and Systems** Basic control concepts; Feedback; Open and closed loop control; Concept of block

	diagrams; P, PI and PID controllers; Tuning the gain of controllers; System models, transfer functions, system response, frequency response; Root Locus method and Bode plots.

Text and Reference Books

1. Ernest O. Doeblin, "Measurement Systems Application and Design", McGraw Hill International Publication.
2. W. Bolton, "Mechatronics," Addison Wesley Longman.
3. Mahalik, "Principles, concepts and applications Mechatronics", TMH
4. Ramesh Gaonkar, "Introduction to 8085-PENRAM", International Publishing.
5. Muzumdar, "Pneumatics" –Tata McGraw-Hill Education.
6. Pipenger, "Hydraulic valves and controls", M. Dekker.
7. K. Ayala, "8051 microcontroller Architecture, programming & Application" – Penram International Publishing
8. Steward, "Hydraulics and Pneumatics for production", Audal Series.
9. "Fundamentals of Pneumatics", Festo series.
10. G.K. McMillan, "Process/Industrial Instruments and Controls Handbook," McGraw-Hill.

Online Resources:

1. https://nptel.ac.in/courses/107/106/107106090/
2. https://nptel.ac.in/courses/112/101/112101098/
3. https://nptel.ac.in/courses/112/107/112107289/
4. https://nptel.ac.in/courses/112/104/112104298/

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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 O1	PS O2
CO1	1		1			1		1						
CO2		1	2	3									1	
CO3	1			2							1			
CO4		1		2	1							1	2	

1 – Low, 2 – Medium, 3 – High

Assessment:

ISE III: Teacher's Assessment: Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1) Simulation
2) Application development
3) Presentation of case studies
4) Question & answer / Numerical solution
5) Study of Industrial processes

Assessment Table:

Assessment Tool	K1 to K4	K1 to K4	K1 to K4	K1 to K4	K1 to K4
Cos	CO1	CO2	CO3	CO4	CO5
Class Test (15 Marks)	07	08			
Class Test (15 Marks)			07	08	
Teachers Assessment (10 Marks)	02	02	02	02	02
ESE Assessment (60 Marks)	12	12	12	12	12

Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test 1**	**Test 2**	**Teachers Assessment/ Assignment**	**End Semester Examination**
K1	Remember	1	1	2	10
K2	Understand	2	2	2	10
K3	Apply	6	6	6	20
K4	Analyze	6	6		20
K5	Evaluate				
K6	Create				
Total Marks: 100		15	15	10	60

MEPE4004: Robotics and automation		
Teaching Scheme	**Examination Scheme**	
Lectures: 02Hrs. / Week	ISE I	10 Marks
Credits: 02	ISE II	10 Marks
	ISE III	05 Marks
	End Semester Examination	25 Marks

Course Objectives:

1. Understand the fundamentals of robotic systems and automation.
2. Evaluating robotic path as per need of application
3. Study robotic end effectors.
4. Familiarize with robot matching with workplace.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Understand robotics and automation terminology
CO2	Evaluate and plan robotic path.
CO3	Know various end effectors along with selection criterion
CO4	Analyze robot matching with workplace

Detailed Syllabus:

Unit 1	**Automation and robotics:** History of robotics, Robot anatomy, robot configurations, robot components, type or robot drives- pneumatic, hydraulic and electrical drive system.
Unit 2	**Transformations and kinematics:** Coordinate transformation- vector operations – Basic transformations matrices- properties of transformations matrices – Homogeneous transformation – forward solution, D H algorithm: Inverse kinematic solutions, Brief robot dynamics
Unit 3	**Control and End effectors:** Control system concepts- Analysis – control of joints- adaptive and optimal control -End effectors- classifications – Mechanical – Magnetic – Vacuum- adhesive – Drive systems and controls
Unit 4	**Robot Applications:** work cell control and interlock, robot applications in manufacturing like material transfer and machine loading/ unloading, processing operations, assembly, and inspection. **Automation:** Introduction, types of automation system, programming Logics Controllers, Emerging trends in automation

Text and Reference Books

1. Groover M.P. Weiss Mithell Nagel R.N., Odery N.G., "Industrial Robotics, Technology, Programming and Applications", McGraw Hill International Editions.
2. Klafter," Robotics Engineering", PHI Pvt. Ltd., New Delhi.
3. K S. Fu, R C. Gonzalez, CSG Lee, "Robotics", McGraw Hill International Editions.
4. Grover M.P., "Automation Production Systems, and Computer Integrated Manufacturing", fourth Edition, Pearson Education, India.
5. Groover M.P., Zimmers E.W., "CAD/CAM Computer Aided Design and Manufacturing", PHI, Pvt. Ltd., New Delhi.
6. Radhakrishnan P. Subramanian S., Raju V.," CAD/CAM/CIM", New Age International Publishers Pvt. Ltd., New Delhi, India.

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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 O1	PS O2
CO1	1													
CO2		2			1								1	
CO3	1	1												1
CO4			1				2							

1 – Low, 2 – Medium, 3 – High

Assessment: ISEI, II (Class Test, TA) & ESE
TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by the course coordinator.

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	04	04	02	10
K2	Understand	04	04	02	10
K3	Apply	02	02	01	05
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 50		10	10	05	25

Assessment table

Assessment Tool	K1 to K4	K1 to K4	K1 to K4	K1 to K4
Cos	CO1	CO2	CO3	CO4
Class Test (10Marks)	05	05		
Class Test (10Marks)			05	05
Teachers Assessment (05 Marks)	01	01	01	02
ESE Assessment (50 Marks)	12	13	12	13

MEPE4005: Refrigeration and air Conditioning		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs. / Week	ISE I	10 Marks
Credits: 02	ISE II	10 Marks
	ISE III	05 Marks
	End Semester Examination	25 Marks

Course Objectives:

1. Understand the fundamentals of refrigeration and air conditioning, Psychrometry.
2. Select appropriate method of production of cold.
3. Analyze and choose appropriate thermal systems for applications of refrigeration and air conditioning.
4. Familiarize with industrial protocols, regulations, and impact of recent other technologies in the field.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Analyze performance of various refrigeration systems.
CO2	Analyze the air conditioning processes and systems using principles of the Psychrometry.
CO3	Evaluate cooling and heating loads in air conditioning systems.
CO4	Learning impact of contemporary technologies on HVAC industry.

Detailed Syllabus:

Unit 1	Methods of Refrigeration, Vapor compression cycle, Thermodynamic analysis, effect of operating parameters, liquid-gas heat exchanger, actual vapor compression system (study with T-S & P-h planes) Flash gas removal and flash gas inter cooling, Introduction to multi-pressure system (multi-evaporator, multi compressor), multiple / individual expansion valve
Unit 2	**Introduction to non-conventional refrigeration systems:** vapor absorption refrigeration systems-Ammonia-water; Lithium-Bromide; Steam jet system, thermoelectric refrigeration system
Unit 3	**Gas cycle refrigeration:** Bell Coleman cycle, Aircraft air conditioning system, introduction to expansion devices, control devices ofVCRS Applications of refrigeration systems: Industrial, comfort, food preservation and medical
Unit 4	ASHARE nomenclature pertaining to air conditioning, psychometric processes on psychometric chart, coil bypass factor, estimation of cooling / heating load, plotting air conditioning processes for summer using ESHF concept, concept of comfort air Conditioning.
Unit 5	**Refrigerants:** desirable properties, designation, secondary refrigerants, Ozone depletion, global warming, alternate refrigerants. **Impact of other technologies:** Invertor based air conditioner, Energy star rating, screw compressor, variable frequency drive, IoT applications for RAC systems.

Text and Reference Books

1. J. L. Threlkeld, "Thermal Environmental Engineering", Prentice-Hall, vol 4
2. Anantha Narayanan, "Basic Refrigeration and Air Conditioning", Wiley-VCH VerlagGmbH, vol 3
3. Richard Charles Jordan, Gayle B. Priester, "Refrigeration and Air Conditioning", Prentice-Hall, vol 2
4. Rex Miller, Mark Richard Miller, Edwin P. Anderson, "Audel Refrigeration: Home and Commercial", Wiley publication, vol 5
5. Rex Miller, Mark Richard Miller, Edwin P. Anderson, "Audel Air Conditioning: Home and Commercial", Wiley publication, vol 5
6. ASHARE Handbook: Fundamental, ASHARE publication
7. ASHARE Handbook: Standards, ASHARE publication
8. ASHARE Handbook: System and Equipment, ASHARE publication
9. Carrier AirConditioning Handbook, Carrier publication

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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 O1	PS O2
CO1	3												3	
CO2			2		1							3	3	
CO3			2		1								2	
CO4	3										3		2	

1 – Low, 2 – Medium, 3 – High

Assessment: ISE I, II (Class Test, TA) & ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by the course coordinator.

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	04	04	02	10
K2	Understand	04	04	02	10
K3	Apply	02	02	01	05
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 50		10	10	05	25

Assessment table

Assessment Tool	K1 to K4	K1 to K4	K1 to K4	K1 to K4
Cos	CO1	CO2	CO3	CO4
Class Test (10 Marks)	05	05		
Class Test (10 Marks)			05	05
Teachers Assessment (05 Marks)	01	01	01	02
ESE Assessment (25 Marks)	07	07	07	04

MEPE4006: Introduction to FEM		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs. / Week	ISE I	10 Marks
Credits: 02	ISE II	10 Marks
	ISE III	05 Marks
	End Semester Examination	25 Marks

Course Objectives:

1. Understand the fundamental concepts of finite element method
2. Inculcate the formulation of finite element models by selecting a suitable element, developing element matrices & vectors, and incorporating boundary conditions
3. Familiarize with finite element procedures to solve structural, thermal, and fluid flow problems using commercial finite element packages

Course Outcomes:

After completing the course students will able to :

Course Outcomes	
CO1	Understand the basic finite element formulation techniques and derive equations in finite element methods for 1D problem.
CO2	Formulate equations in finite element methods for 2D and 3D problems.
CO3	Demonstrate the basic concept of Dynamic analysis and Simulation and its techniques

Detailed Syllabus:

Unit 1	**Introduction**–Finite Element Terminology (nodes, elements, domain, continuum, Degrees of freedom, loads & constraints) General FEM procedure, Applications of FEM in various fields, P & h formulation, Advantages and disadvantages of FEM. Consistent units system. Discretization of **one-Dimensional element**, matrix analysis method, Derivation of Shape functions, element stiffness matrices, global stiffness matrix, application of boundary, and force vectors. Assembly of Matrices - solution of problems in one dimensional structural analysis, Stepped and Taper Bars, Torsion of circular shaft
Unit 2	**Introduction of 2D and 3D elements**. Finite element analysis for truss element. Natural coordinates and coordinates transformations, Derivation of shape functions for triangular element. Analysis of structural vibration. Finite element formation of beams. Equations of elasticity – Plane stress, plane strain problems, Applications to free vibration problems of rod and beam. Lumped and consistent mass matrices, Jacobian matrix, stress analysis of CST element
Unit 3	**Dynamic Analysis**: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of eigen values and eigen vectors, free vibration analysis. **Simulation:** Introduction, definition, steps used in simulation, advantage and limitations, techniques of simulation**.**

Text and Reference Books

1. Chandraputla, Ashok and Belegundu, Introduction to Finite Elements in Engineering, Prentice – Hall.
2. S. S. Rao, The Finite Element Methods in Engineering, Pergamon.
3. J. N. Reddy, An Introduction to Nonlinear Finite Element Analysis, OUP.
4. C. S. Krishnamoorthy, Finite element analysis, TMH
5. J. N. Reddy, Finite element methods, McGraw Hill publication ltd.

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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 O1	PS O2
CO1	2		1		2							1		
CO2	3			2	2							1		
CO3	1				2							1		1

1 – Low, 2 – Medium, 3 – High

Assessment: ISEI, II (Class Test, TA) & ESE
TA: Students will perform one or more of the following activities

5. Surprise Test
6. Assignment
7. Quiz
8. Any other activity suggested by the course coordinator.

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	Teachers Assessment/ Assignment	End Semester Examination
K1	Remember	04	04	02	10
K2	Understand	04	04	02	10
K3	Apply	02	02	01	05
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 50		10	10	05	25

Assessment table

Assessment Tool	K1 to K4	K1 to K4	K1 to K4
Cos	CO1	CO2	CO3
Class Test (10 Marks)	05	05	
Class Test (10 Marks)		05	05
Teachers Assessment (05 Marks)	01	02	02
ESE Assessment (25 Marks)	05	10	10

MEOE0050: Additive Manufacturing		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	ISE I	15 Marks
Credits: 03	ISE II	15 Marks
	ISE III	10 Marks
	End Semester Examination	60 Marks

Course description: Additive Manufacturing (AM) is a process of joining materials to make objects from 3D model data, using y layer up on layer, as opposed to subtractive manufacturing methodologies, such as traditional machining. The basic principle of AM is that a model, initial generated using a three-dimensional Computer Aided design (3D CAD) system, can be fabricated directly. AM technologies have significantly evolved over the last decade. Because of their potential to extensively transform the nature of manufacturing process, e.g. by enabling "freedom of design" several industries have been attracted by these technologies. Using AM, manufacturing of highly complex parts can be an economical viable alternative to conventional AI manufacturing technologies.

Course Outcomes:

After completing the course, students will able to

Course Outcomes	
CO1	Understand the concept of additive manufacturing and evaluation of its process sequence
CO2	Understand the materials required for AM and its molecular structure
CO3	Apply the knowledge of software tools for additive manufacturing
CO4	Develop the 3D component using additive manufacturing process

Detailed Syllabus:

Unit 1	**Introduction to Additive Manufacturing (AM)** General overview Introduction to reverse engineering, Traditional manufacturing vis AM Computer Aided Design (CAD) and manufacturing (CAM) and AM. Different AM processes and relevant process physics AM process chain, Application Level: Direct processes – Rapid Prototyping, Rapid Tooling, Rapid manufacturing; Indirect processes - Indirect prototyping, Indirect Tooling, Indirect manufacturing
Unit 2	**Software Technologies and Tools** Design / Fabrication processes: Data Sources, Software Tools, File Formats, Model Repair and Validation, Pre- and Post-processing, Designing for Additive manufacturing
Unit 3	**Materials science for AM** Discussion on different materials used, Use of multiple materials, multifunctional and graded materials in AM, Role of solidification rate, Evolution of non-equilibrium structure property relationship, Grain structure and microstructure
Unit 4	**AM technologies** Powder-based AM processes involving sintering and melting (selective laser sintering, shaping, electron beam melting, involvement). Printing processes (droplet-based 3D Solid-based AM processes- extrusion based fused deposition modelling object Stereo lithography Micro- and non-additive

Unit 5	**Process selection planning, control for AM** Selection of AM technologies using decision methods, Additive manufacturing process plan: strategies and post processing, Monitoring and control of defects, transformation
Unit 6	**Application of AM** Applications of AM: Aerospace, Automotive, Biomedical Application of AM. Product Development, Commercialization, Trends and future directions in Additive Manufacturing

Text and Reference Books

1. Gibson, Rosen, Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer
2. Andreas Gebhhardt, Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing, Hanser Publishers
3. J Evans and W Linsay, The Management and Control of Quality, Thomson.
4. Hopkinson Hague, Dickens, Rapid Manufacturing: An Industrial Revolution for the Digital Age, Wiley.
5. J. D. Majumdar and I. Manna, Laser-assisted fabrication of materials, Springer series in Material scienc
6. Zhiqiang Fan and Frank Liou, Numerical modelling of the additive manufacturing (AM) processes of titanium alloy, InTech.

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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	PSO1	PSO2
CO1	2	3	3	3		2	1						2	
CO2	3	2	3		2	1		1						2
CO3	2	3	2	3	3	3		2	1				3	
CO4	1			3		2	1		1					

1 – Low, 2 – Medium, 3 – High

Assessment:

ISE 1: Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/Presentations/ Course Projects on First and Second unit.

ISE II: Shall be based on class test on third and fourth units.

ISE III: Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/Presentations/ Course Projects

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	3	2	2	10
K2	Understand	3	3	2	15
K3	Apply	2	3	2	10
K4	Analyze	3	2	2	10
K5	Evaluate	2	3	1	10
K6	Create	2	2	1	10
Total Marks: 100		15	15	10	60

Assessment table

Assessment Tool	K1	K2	K3	K4
	CO1	CO1/CO4	CO3	CO2/CO4
ISE I (15 Marks)	05	05	03	02
ISE II (15 Marks)	05	05	03	02
ISE III (10 Marks)	00	05	05	00
ESE Assessment (60 Marks)	05	15	20	20
Total Marks 100	15	30	31	24

MEPC4007: Lab - Tool Design	
Teaching Scheme Practical: 2 Hrs /Week Credits: 01	**Examination Scheme** ISE-I : 25 Marks End Semester Examination: 25 Marks

Course Outcome

As an outcome of completing the Laboratory course, students will able to:

CO1	Understand the geometry of single point and multipoint cutting tools and analyze tool life calculation
CO2	Participate to develop locating and clamping devices and analyze minimum force required for clamping
CO3	Design jigs for drilling and fixtures for turning and milling for particular industrial product
CO4	Select, design and draw standard dies for Piercing and Blanking operations

List of Experiments (Any Six)

No.	List of Experiment
1	Sheet No.1: Locating Devices: Drawing and Designing of various Locating systems/devices for Jigs/Fixtures
2	Sheet No.2: Clamping Devices and Drill Bushes: Drawing and Designing of various Clamping system/devices (mechanical/hydraulic/pneumatic) for Jigs/Fixtures and Drill bushes
3	Sheet No.3: Design of Drilling Jig: Design and Drawing of Drilling Jig for the given component
4	Sheet No.4: Design of Milling/Turning Fixture: Design and Drawing of Milling/Turning fixture for the job given.
5	Sheet No.5: Design of Press Tool: Design and Drawing of Blanking/Piercing press tool for the given components.
6	Sheet No.6: Multipoint Cutting Tool: Drawing of various Multipoint cutting tools e.g drill, milling cutters, reamers, broaches, taps, hobs
7	Journal Assignment on a) Tooling Materials: Tool materials and its characteristics and classification b) Single point Cutting Tool: Geometry, Tool signature, Significance of various angles, Merchant theory, factors affecting Tool life, Tool wear c) Press Working: Working, operations, classification, types of dies etc
8	Models: Preparing a model of Single Point Cutting Tool from soft/wood material Preparing one of the Multipoint cutting tool from soft/wood material

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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 O1	PS O2
CO1	3		2		1								3	
CO2	3	2						2					1	
CO3	3	2	1		1									
CO4	3	2	1		1								2	

Assessment Pattern

Assessment Pattern Level	Skill level	ISE I	ESE
S1	Imitation	05	05
S2	Manipulation	10	10
S3	Precision	10	10
S4	Articulation	00	00
S5	Naturalization	00	00
Total		25	25

Preparation (S1)	5	5
Conduct of Experiment (S2)	5	5
Observation and Analysis of Results (S3)	5	5
Record (S2)	5	5
Presentation/ Viva-Voce (S3)	5	5
Total	25	25

Assessment Table

Assessment Tool	S1	S2	S3	S4
	CO1	CO2	CO3	CO4
Term Work (25 Marks)	05	10	05	05
Practical Examination & Viva Voce (25 Marks)	05	10	05	05

MEPC4008: Lab- Automobile Engineering	
Teaching Scheme Practical: 2 Hrs /Week Credits: 01	**Examination Scheme** ISE-I : 25 Marks End Semester Examination: 25 Marks

Course Objective:

To understand and apply practical application of various systems in Automobiles

Course Outcome

As an outcome of completing the Laboratory course, students will able to:

CO1	Understand the various Chassis and construction of an Automobile.
CO2	To Know the working and constructions of transmission systems in an Automobile
CO3	Infer the working and constructions of steering, braking systems in an Automobile
CO4	Classify the working and constructions of Suspension systems in an Automobile
CO5	Summarize regarding the modern E – vehicles

List of Experiments (Any Eight)

No.	List of Experiment
1	Study of construction and working of various types of Chassis and types of an automobile
2	Study of construction and working of various types of barking systems
3	Study of construction and working of various types of Gear boxes and transmission systems in an automobile
4	Study of construction and working of various types of Suspension systems in an automobile
5	Study of construction and working of various types of Cooling and lubrication systems in an automobile
6	Study of construction and working of various types of Starting systems in an automobile
7	Industrial visit to any two industries related to Automobile components/assembly of vehicle systems
8	Industrial visit to any two industries related to Automobile vehicle Manufacturing vehicle components, manufacturing
9	Study of construction and working of various types of Chassis and types of an automobile
10.	Latest trends in automobile engineering like EV, Hydrogen Vehicle etc

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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 O1	PS O2
CO1	1		2	3									1	
CO2	1	2		3									2	
CO3	1							2	3				2	
CO4								1						
CO5	3	2			2							2		

Assessment Pattern

Assessment Pattern Level	Skill level	ISE I	ESE
S1	Imitation	05	05
S2	Manipulation	10	10
S3	Precision	10	10
S4	Articulation	00	00
S5	Naturalization	00	00
Total		**25**	**25**

Preparation (S1)	5	5
Conduct of Experiment (S2)	5	5
Observation and Analysis of Results (S3)	5	5
Record (S2)	5	5
Presentation/ Viva-Voce (S3)	5	5
Total	**25**	**25**

Assessment Table

Assessment Tool	S1	S2	S3	S4
	CO1	CO2	CO3	CO4
Term Work (25 Marks)	05	10	05	05
Practical Examination & Viva Voce (25 Marks)	05	10	05	05

MEPC4009: Lab - Mechatronics and Control System	
Teaching Scheme Practical: 2 Hrs /Week Credits: 01	**Examination Scheme** ISE-I : 25 Marks End Semester Examination: 25 Marks

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Study of sensors, Hydraulic and Pneumatic actuators and experimentation of its characterization for industrial applications
CO2	Understand the architecture of microprocessor / microcontroller
CO3	Develop pneumatic circuit / hydraulic circuit for industrial applications and measure its Performance.
CO4	Develop an understanding of PLC ladder diagram related to industrial automation systems and measure its performance.
CO5	Understand and develop Characterization of performance of PID Controller and stability of controller.

List of Experiments

The student shall perform following experiments **(Any Eight)**

Sr. No.	Details
1	Study of different sensors and perform characteristics experimentation (Any two)
2	Study of microprocessor/microcontroller
3	Pneumatic circuit design for certain industrial applications.
4	Hydraulic circuit design for certain industrial applications.
5	Development of ladder diagram/programming PLC for level control, position control or any other mechanical engineering application
6	An industrial visit to study the mechatronics system. Industrial Visit report to be submitted.
7	Determination of characteristics of ON/OFF Temperature Controller.
8	Determination of characteristics of various modes of control P, PD, PI, PID
9	An Industrial Visit to study the process control systems. Industrial Visit report to be submitted.
10.	Demonstration of IOT on any automation system
11.	Simulink modelling of HVAC system for energy efficiency analysis

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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 O1**	**PS O2**
CO1	1		2	3									2	
CO2	1	2		3										
CO3	1	1	2			2	3				3		1	
CO4	1	1	2			2	3				3		2	
CO5	1	2		3									2	

1 – Low, 2 – Medium, 3 – High

Assessment:
ISE I- Continuous Assessment of individual student in a batch during each experiment Maximum Marks-25

Assessment Pattern

Assessment Pattern Level No.	**Skill Level**	**ISE I**	**ESE**
S1	Imitation	4	4
S2	Manipulation	9	9
S3	Precision	12	12
S4	Articulation		
S5	Naturalization		
Total Marks		**25**	**25**

Skill Level	**ISE I**	**ESE**
Preparation (S1)	4	4
Conduct of Experiment (S2)	5	5
Observation and Analysis of Results (S3)	6	6
Record (S2)	4	4
Presentation/ Viva-Voce (S3)	6	6
Total Marks	**25**	**25**

Assessment Table:

Assessment Tool	**S2**	**S1**	**S1**	**S3**	**S3**
	CO1	**CO2**	**CO3**	**CO4**	**CO5**
Term Work (25 Marks)	4	4	5	6	6
Practical Examination & Viva Voce (25 Marks)	4	4	5	6	6

MEPE4010: Lab- Robotics and automation	
Teaching Scheme Practical: 2 Hrs /Week Credits: 01	**Examination Scheme** ISE-I : 25 Marks End Semester Examination: 25 Marks

Course Objectives:

1. To understand robot anatomy and kinematic and dynamic characteristics of robot
2. To know the different sensors, their selection for an application
3. To accustom with robot programming
4. To develop an automation system for an application

Course Outcomes:

After completing the course students will able to

CO1	Study robot anatomy
CO2	Study kinematics and dynamic performance of robots
CO3	Select appropriate sensor for robotic application and automation
CO4	Analise automation system performance

List of the Experiments:

The student shall perform following experiments (Any Eight):

Sr. No.	Details
1	Study of Robot Anatomy
2	Experiment on Various Robotic sensors and its use in practice
3	Developing at least one robot program for an application
4	Path planning of robotic system for an application
5	Industrial visit for robotic system used for welding operation
6	Industrial visit for robotic system used for sheet metal cutting/ painting
7	Industrial visit for study of automation system
8	Group project for designing automation system for an application
9	Demonstration of Robocon and Drone club on ongoing project in the college.

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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 O1	PS O2
CO1	1	1							2			1	1	
CO2		2							1			1	3	
CO3	1								1			1	2	1
CO4	3			1								1	3	

1 – Low, 2 – Medium, 3 – High

Assessment:
ISE I- Continuous Assessment of individual student in a batch during each experiment Maximum Marks-25

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ESE**
S1	Implementation	04	04
S2	Manipulation	07	07
S3	Precision	14	14
S4	Articulation	00	00
S5	Naturalization	00	00
Total Marks		25	25

Knowledge Level	**ISE I**	**ESE**
Preparation S1	04	04
Conduct of Experiment S2	04	04
Observation & analysis of Results S3	08	08
Record S2	03	03
Mini project/ Presentation/Viva Voce S3	06	06
Total Marks	25	25

MEPE4011: Lab- Refrigeration and Air conditioning	
Teaching Scheme Practical: 2 Hrs /Week Credits: 01	**Examination Scheme** ISE-I : 25 Marks End Semester Examination: 25 Marks

Course Objectives:

1. Study of vapor compression refrigeration system components, selection and functioning
2. Experimental analysis for performance evaluation of R and AC thermal systems
3. Exploring scope of IoT and other technologies in R and AC industry
4. Report writing of engineering system performance.

Course Outcomes:

After completing the course students will able to

CO1	Study of refrigerant compressors, expansion devices used in vapor compression refrigeration system, thermostat with range and differential setting, charging of refrigeration system
CO2	Trial on pilot ice plant to evaluate cycle performance and actual coefficient of performance
CO3	Participate in a group atmosphere for the understanding of an industrial refrigeration system.
CO4	Communicate effectively both verbally and in written form through the preparation of journal report and practical presentation.

List of the Experiments:

The student shall perform following experiments:

Sr. No.	Details
1	Study of refrigerant compressors
2	Analyzing cycle performance and actual coefficient of performance of pilot ice plant.
3	Industrial visit to understand working of water chiller plant, pasteurization heat exchangers, cold storage of a milk plant.
4	Evaluation of expansion devices in Vapor compression system.
5	Study of thermostat with range and differential setting.
6	Plotting of psychometric processes of air conditioning using air conditioning rig.
7	Study of charging of refrigeration system
8	Industrial visit to study central air conditioning plant.

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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 O1	PS O2
CO1	3												3	1
CO2		2				1							3	1
CO3	3					1							2	
CO4								3	2	1			3	

1 – Low, 2 – Medium, 3 – High

Assessment:

ISE I- Continuous Assessment of individual student in a batch during each experiment Maximum Marks-25

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ESE**
S1	Implementation	04	04
S2	Manipulation	07	07
S3	Precision	14	14
S4	Articulation	00	00
S5	Naturalization	00	00
Total Marks		25	25

Knowledge Level	**ISE I**	**ESE**
Preparation S1	04	04
Conduct of Experiment S2	04	04
Observation & analysis of Results S3	08	08
Record S2	03	03
Mini project/ Presentation/Viva Voce S3	06	06
Total Marks	25	25

MEPE4012: Lab - Introduction to FEM	
Teaching Scheme Practical: 2 Hrs /Week Credits: 01	**Examination Scheme** ISE-I : 25 Marks End Semester Examination: 25 Marks

Course Objectives:

1. To understand the concept of finite element method and develop algorithms for analysis of mechanical system.
2. To apply the knowledge of FEM for 1D stress analysis, modal analysis, and flow analysis.
3. To formulate and solve problems of trusses, beams and frames, students will also be able to use commercial packages for complex problems.
4. To develop 2-D FE formulations involving triangular, quadrilateral elements and higher order elements.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Solve 1D, 2D and 3D Structural, thermal and fluid problems using FEA software
CO2	Solve Plane truss problems, Beam problems with different boundary and loading conditions
CO3	Demonstrate Simulation and Solve Dynamic problems using FEA software.

List of the Experiments:

The student shall perform following experiments: (Any Eight)

Sr. No.	Title of the Experiments
1	Introduction to Finite Element Analysis software.
2	Solve 1D – Structural, thermal and fluid problems using FEA software
3	Solve Plane truss problems, using FEA software. Include problems with symmetry
4	Solve Beam problems with different boundary and loading conditions using FEA software.
5	Solve 2D problems using different element types in a FEA software. Also analyses effect of element formulation and number of elements.
6	Solve 3D problems using FEA software.
7	Kinematic Analysis and simulation of slider crank Mechanism.
8	Dynamic Analysis 1) Bar subjected to forcing function
9	Dynamic Analysis 2) Fixed -fixed beam for natural frequency determination
10	Thermal Analysis – 1D problems with conduction and convection boundary conditions

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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 O1	PS O2
CO1	3		2		3							1		
CO2	3		2		3							1		
CO3	2	1	2		3							1		1

1 – Low, 2 – Medium, 3 – High

Assessment:

ISE I- Continuous Assessment of individual student in a batch during each experiment Maximum Marks-25

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ESE**
S1	Implementation	04	04
S2	Manipulation	07	07
S3	Precision	14	14
S4	Articulation	00	00
S5	Naturalization	00	00
Total Marks		25	25

Knowledge Level	**ISE I**	**ISE I**
Preparation S1	04	04
Conduct of Experiment S2	04	04
Observation & analysis of Results S3	08	08
Record S2	03	03
Mini project/ Presentation/Viva Voce S3	06	06
Total Marks	25	25

MEPR4013: Mini Project	
Teaching Scheme Practical: 6 Hrs /Week Credits: 03	**Examination Scheme** ISE-I : 50 Marks End Semester Examination: 50 Marks

Course Objectives:

1. To encourage and provide opportunities for students to get professional experience through in-house or industrial projects
2. To learn and understand real life / industrial situations.
3. To provide an opportunity to analyze and discuss the results to draw conclusions.
4. To acquaint with the process of applying basic engineering fundamental in the domain of practical applications.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Identify a topic in advanced areas of Mechanical Engineering.
CO2	Review literature to identify gaps and define objectives & scope of the work..
CO3	Generate and implement innovative ideas for social benefit.
CO4	Analyze and discuss the results to draw valid conclusions
CO5	Explore the possibility of publishing papers in peer reviewed journals/conference proceedings.

Guidelines:

Students should conduct literature survey / visit industry / analyze current trends and identify the problem for Mini Project and finalize in consultation with Guide. Students should attempt solution to the problem by experimental / simulation methods. The solution to be validated with proper justification and report to be compiled in standard forma.

Mini Project work Identification:

Mini Project work shall be based on any of the following:

1. Design / Fabrication of product / testing setup of an experimentation unit / apparatus / small equipment, in a group with engineering analysis / performance analysis / modeling
2. Experimental verification of principles used in Mechanical Engineering Applications.
3. Projects having valid database, data flow, algorithm, and output reports, preferably software based.

Student may choose to undergo project at Industry/Govt. Organizations//MSME/ Innovation. Student may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo project with industry/Government organizations/Micro/Small/ Medium enterprises to make themselves ready for the industry.

Before assigning particular industry/research organization guide shall ensure compatibility of students, availability of project in the proposed organization expected minimum three skill sets. Project work identification process should be initiated before the start of 7th semester.

Project Diary/ project Workbook:

Students must maintain **Project** Diary/ **Project** Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. The diary/workbook should be signed every day by the supervisor.

Project Diary/workbook should be submitted by the students immediately after the completion of the project.
Mini Project Work Evaluation: (Assessment) Every student is required to prepare and maintain documentary proofs of the activities done by him as project diary or as workbook. The evaluation of these activities will be done by Program Head/Cell In-charge/ Project Head/ faculty mentor or Industry Supervisor based on- Overall compilation of project activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities. Assessment and Evaluation is to be done in consultation with project supervisor (Internal / and External – a supervisor from place of project). Recommended evaluation parameters- Post project Internal Evaluation -50 Marks Project Diary/Workbook and project Report / external viva- 50 Marks.

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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	PSO1	PSO2
CO1	3	1	1	2					2	2		1		
CO2	2		1	2	1				1	2	1	1		
CO3	2			2		2	2		1			1	2	
CO4	2					1		2		2	1	1		1
CO5	2			2	1	1		1	1			1		

1 – Low, 2 – Medium, 3 – High

Assessment:

ISE I- Continuous Assessment of individual student Maximum Marks-50

ESE – Viva Voce based on presentation and report Maximum Marks-50

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ESE**
S1	Implementation	08	08
S2	Manipulation	06	06
S3	Precision	28	28
S4	Articulation	08	08
S5	Naturalization	00	00
Total Marks		**50**	**50**

Knowledge Level	**ISE I**	**ESE**
Preparation S1	08	08
Articulation of problem S4	08	08
Observation S3	16	16
Record S2	06	06
Mini project/ Presentation/Viva Voce S3	12	12
Total Marks	**50**	**50**

MEPR4014: Internships in Industry/Research organization/Research Centre	
Teaching Scheme Practical: 16 Hrs /Week Credits: 08	**Examination Scheme** ISE-I : 100 Marks End Semester Examination: 100 Marks

Course Objectives:

1. To encourage and provide opportunities for students to get professional/personal experience through Internships
2. To learn and understand real life/industrial situations.
3. To provide an opportunity to analyze and discuss the results to draw conclusions.
4. To acquaint with the process of applying basic engineering fundamental in the domain of practical applications.
5. To inculcate the process of research.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Demonstrate professional competence through industry Internships.
CO2	Choose appropriate technology and tools to solve given problem.
CO3	Identify methods and materials to carry out experiments/develop code
CO4	Analyze and discuss the results to draw valid conclusions

Guidelines:

Engineering internships are intended to provide students with an opportunity to apply conceptual knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as a part of the Final Year B. Tech. (Mechanical Engineering) curriculum. Students should visit industry / Research organization / Research Centre and identify the internship area and finalize in consultation with Guide.

Duration:

The internship shall have 08 credits, minimum 16 hours per week interaction.

Internship work Identification:

Student may choose to undergo Internship at industry / Research organization / Research Centre. Student may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry / Research organization / Research centre to make themselves ready for the industry.

Student shall take guided internship in a strict supervision of Academic Guide (Preferably Mentor of Teacher Guardian Scheme) and Industrial Supervisor. The internship shall inculcate skills to the incumbent which will facilitate earning livelihood. These skill sets shall be close to vocational education level. Before assigning particular industry/research organization guide shall ensure compatibility of students, availability of internship in the proposed organization expected minimum three skill sets.

Internship work identification process should be initiated before the end of VIIth semester of Final Year B. Tech. program in coordination with training and placement cell / industry institute cell / internship cell. This will help students to start their internship work on time.

Internship Diary/ Internship Workbook:
Students must maintain Internship Diary / Internship Workbook. The main purpose of maintaining diary / workbook is to cultivate the habit of documenting. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. The training diary/workbook should be signed every day by the supervisor.
Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training.

Internship Work Evaluation:
Every student is required to prepare and maintain documentary proofs of the activities done by him as internship diary or as workbook. The evaluation of these activities will be done by Program Head / Cell In-charge / Project Head / faculty mentor or Industry Supervisor based on- Overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities.
Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External – a supervisor from place of internship). Recommended evaluation parameters- Post Internship Internal Evaluation -100 Marks + Internship Diary/Workbook and Internship Report - 100 Marks.

Feedback from internship supervisor (External and Internal)
Post internship, faculty coordinator should collect feedback about student with recommended parameters include as- Technical knowledge, Discipline, Punctuality, Commitment, Willingness to do the work, Communication skill, individual work, Team work, Leadership.

Mapping of Course outcomes with Program outcomes and Program Specific Outcomes:

Course 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 O1	PS O2
CO1	3	1	1	2					2	2		1		
CO2	2		1	2	1				1	2	1	1		
CO3	3	1		2		2	2		1			1	2	
CO4	3		2			1		2		2	1	1		1

1 – Low, 2 – Medium, 3 – High

Assessment:
ISE I- Continuous Assessment of individual student Maximum Marks-100
ESE – Viva Voce based on presentation and report Maximum Marks-100

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ESE**
S1	Implementation	16	16
S2	Manipulation	12	12
S3	Precision	56	56
S4	Articulation	16	16
S5	Naturalization	00	00
Total Marks		**100**	**100**

Knowledge Level	**ISE I**	**ESE**
Preparation S1	16	16
Articulation of problem S4	16	16
Observation S3	32	32
Record S2	12	12
Mini project/ Presentation/Viva Voce S3	24	24
Total Marks	**100**	**100**