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

Tentative Teaching and Evaluation Scheme from Academic Year 2025-26 as per NEP-2020
Third Year B. Tech. Program in Mechanical Engineering

Semester–V

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	MEPCC 3001	Machine Design-I	2	1	0	**3**	15	15	10	60	**100**
2.	PCC	MEPCC 3002	Lab Machine Design-I	0	0	2	**1**	-	-	25	25	**50**
3.	PCC	MEPCC 3003	Kinematics of Machines	2	0	0	**2**	10	10	-	30	**50**
4.	PCC	MEPCC 3004	Lab-Kinematics of Machines	0	0	2	**1**	-	-	25	25	**50**
5.	PCC	MEPCC 3005	Numerical and Computational Methods	2	0	0	**2**	10	10	-	30	**50**
6.	PCC	MEPCC 3006	Fluid Mechanics &Fluid Power	3	0	0	**3**	15	15	10	60	**100**
7.	PCC	MEPCC 3007	Lab Fluid Mechanics& Fluid Power	0	0	2	**1**	-	-	25	25	**50**
8.	PEC		Program Elective-I	3	0	0	**3**	15	15	10	60	**100**
9.	PEC		Lab Program Elective-I	0	0	2	**1**	-	-	25	25	**50**
10.	MD M		Multidisciplinary Minor	3	0	0	**3**	15	15	10	60	**100**
11.	MD M		Lab Multidisciplinary Minor	0	0	2	**1**	-	-	25	25	**50**
12.	OE		Open Elective-III	2	0	0	**2**	10	10	-	30	**50**
Total without Honor				**17**	**1**	**10**	**23**	**90**	**90**	**165**	**455**	**800**
13	*HNC	MEHNC7001/ MEHNC7006/ MEHNC7011/ MEHNC7016	Additive Manufacturing Technology/ Principles of Robotics/ Energy Audit/ Optimum Design	4	0	0	4	15	15	10	60	**100**
Total with Honor				**21**	**1**	**10**	**27**	**105**	**105**	**175**	**515**	**900**

Program Elective-I

MEPEC3001 Robotics & Automation
MEPEC3002 Lab Robotics & Automation
MEPEC3003 Tribology
MEPEC3004 Lab Tribology
MEPEC3005 Renewable Energy Engineering
MEPEC3006 Lab Renewable Energy Engineering
MEPEC3007 Mechanical Measurements
MEPEC3008 Lab Mechanical Measurements

MDM (Offered by Mechanical Department)

MEMDM5004 Energy Efficiency of Thermal Utility
MEMDM5005 Lab Energy Efficiency of Thermal Utility
MEMDM6004 Computer Aided Design
MEMDM6005 Lab Computer Aided Design

Open Elective–III (Offered by Mechanical Department)

MEOEC3010 Entrepreneurship Development/
MEOEC3011 Financial Management

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Semester–VI

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	MEPCC 3008	Heat and mass Transfer	3	0	0	**3**	15	15	10	60	**100**
2.	PCC	MEPCC 3009	Heat and mass Transfer	0	0	2	**1**	-	-	25	25	**50**
3.	PCC	MEPCC 3010	Machine Design- II	2	1	0	**3**	15	15	10	60	**100**
4.	PCC	MEPCC 3011	IC Engine & Gas Turbine	3	0	0	**3**	15	15	10	60	**100**
5.	PCC	MEPCC 3012	Lab IC Engine& Gas Turbine Lab	0	0	2	**1**	-	-	25	25	**50**
6.	PEC		Program Elective- II	3	0	0	**3**	15	15	10	60	**100**
7.	PEC		Lab Program Elective- II	0	0	2	**1**	-	-	25	25	**50**
8.	PEC		Program Elective– III	2	0	0	**2**	10	10	-	30	**50**
9.	MD M		Multidisciplinary Minor	3	0	0	**3**	15	15	10	60	**100**
10.	VSEC	MEVSE 3001	Workshop Practice-III	0	0	4	**2**	-	-	25	25	**50**
Total without Honor				**17**	**0**	**10**	**22**	**85**	**85**	**150**	**430**	**750**
11	HNC	MEHNC7002/ MEHNC7007/ MEHNC7012/ MEHNC7017	Design for Additive Manufacturing /Robot Programming and Simulation /Energy Efficient Building/ Advanced Machine Design	4	0	0	4	15	15	10	60	**100**
Total with Honor				**21**	**0**	**10**	**26**	**100**	**100**	**160**	**490**	**850**

Program Elective-II

MEPEC3009 Additive Manufacturing
MEPEC3010 Lab Additive Manufacturing
MEPEC3011 Theory of Machines
MEPEC3012 Lab Theory of Machines
MEPEC3013 Applied Thermodynamics
MEPEC3014 Lab Applied Thermodynamics
MEPEC3015 Mechatronics & Control Systems
MEPEC3016 Lab Mechatronics & Control Systems

Program Elective-III

MEPEC3017 Introduction to Composite Materials
MEPEC3018 Operation Research
MEPEC3019 Package Equipment Design
MEPEC3020 Hybrid and Electric Vehicle
MEPEC3021 Design and Analysis of Turbo machinary

MDM (Offered by Mechanical Department) MEMDM5006 Power Plant Engineering
MEMDM6006 Production Planning and Control

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Level 5.5 Exit Criteria

Mandatory Courses to be completed after Third Year for obtaining Three Year Bachelor's Degree in Vocation (B. Voc.) in Mechanical Engineering

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.	OJT	MEINT 3001	Internship	0	0	16	**8**	-	-	100	100	**200**
OR												
2.	VSEC	MEVSE 3002	Application of Solid works for Mechanical Engineering *	0	0	8	**4**	-	-	50	50	**100**
3.	VSEC	MEVSE 3003	Minor Project	0	0	8	**4**	-	-	50	50	**100**

***Equivalent online courses(NPTEL/SWAYAM/MOOC/COURSERA/OTHERS)will be approved by BoS Chairman**

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MEPCC3001: Machine Design - I		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs. / Week	**ISEI**	**15Marks**
Tutorial: 01 hrs/week	**ISEII**	**15Marks**
Credits: 03	**ISEIII**	**10Marks**
	ESE	**60Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Understand the behaviour ductile and brittle materials under loads and calculate stresses in elements in various loading conditions.
CO2	Apply the design procedures for power transmitting shafts. Keys & couplings,
CO3	Interpret low cycle and high cycle fatigue and apply design procedure for finite and infinite life of machine elements
CO4	Apply the design procedures for power screw, welded and riveted joints
CO5	Illustrate statistical considerations in design for various assembly and model the assembly by using software's

Detailed Syllabus:

Unit 1	**Introduction – Design for Static Strength** Basic procedure for machine design, Phases of Design, Design Considerations, Use of Standardization in design, Aesthetic, Ergonomic and Manufacturing considerations in design, Design for static strength, stress strain relationship for CI, MS, brass, rubber, Factor of safety, design considerations for cast and forged components, modes of failure, stresses due to bending, torsion, strain energy, eccentric loading, principal stresses, combined loading, Theories of failures, its applications and problems, Design of simple machine parts like as cotter joint and knuckle joint and parts subjected to combined loading
Unit 2	**Design of Power Transmission Shafts** Transmission Shaft material, design of shaft on strength basis, design of shaft on torsional and rigidity basis, design of shaft for lateral rigidity basis, Bending and torsional moments, ASME code for standard sizes of shaft, Effect of stress concentration, design of shaft against fluctuating loads.
Unit 3	**Design Against Fluctuating Loads** Stress concentration, stress concentration factors, reduction of stress concentration effect, fluctuating stress- fully reversed, repeated, fluctuating, Fatigue failures, mechanism of fatigue failure, Mean stress effect- master diagram for steel, ferrous and nonferrous metals, endurance limit, S-N curve, Moore's test, low cycle and high cycle fatigue, notch sensitivity, Effect of surface finish, size, reliability, temperature, surface treatment, residual stress, manufacturing process on fatigue life, design for fatigue - finite and infinite life, Soderberg's and Goodman diagrams, modified Goodman diagram, Gerber equation, ASME Elliptic criterion, combined stresses- Miner's rule
Unit 4	**Design of Power Screw, Welded & Riveted Joints** Terminology of power screw, Force analysis for square, trapezoidal thread, self-locking of screw, efficiency of square thread, collar friction, stresses in screws, Design of screw jack, introduction to differential and compound screw, re-circulating ball screw. Welded Joints: Types of welded joints, design of welded joints, weld joint design for but weld, parallel fillet, transverse fillet, symmetrical section, Unsymmetrical sections

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	eccentric loads in plane of weld by referring design data handbook. Riveted Joints: Rivet materials, types of riveted joints, Types of failures, strength equations, efficiency of riveted joints, boiler joint- longitudinal and circumferential lap joint, design of eccentrically loaded riveted joints
Unit 5	**Statistical consideration in design** Design and natural tolerances –Design for assembly**, Statistical** analysis of tolerances – Mechanical reliability and factor of safety Modeling and analysis: Modelling and Analysis and integration of Transmission Shaft, welded joints by using SOLIDWORKS software's and ANSYS the so these elements is based upon extensive application

Text Books

1. Shigley J. E.andMischkey C. R., "Mechanical Engineering Design", TMH, NewDelhi
2. Spotts M. F. and ShoupT.E., "Design of Machine Elements", Prentice Hall International
3. Hall A.S.,HolowenkoA.R.and Laughlin H.G.,"Theory and Problems of Machine Design", Schaum's outline series, Tata McGraw Hill Publication. Co. Ltd, New Delhi
4. Bhandari V. B., "Design of Machine Elements", Tata McGraw Hill Publication.Co. Ltd, New Delhi

Reference Books:

1. Black P.H. and O.E. Adam, "Machine Design", Tata McGraw Hill Publication. Co. Ltd, New Delhi
2. Burghardt M.D., "Introduction to Engineering Design and Problem Solving", McGraw Hill Publications
3. K.Lingaiah, "Machine Design Databook", Tata McGraw Hill Publication.Co. Ltd, New Delhi
4. Alfred Hall, Alfred Holowenko, Herman Laughlin, S. Somani, "Machine Design", Tata McGraw Hill Publication. Co. Ltd, New Delhi

Assessment:

ISE 1: Shall be on the basis of Class Tests on First two units or it may base on Assignments/ Quizzes/ Field visits/Presentations/ Course Mini Projects on First and Second unit.

ISE II: Shall be based on class test on third and four units or it may base on Assignments/ Quizzes/ Field visits/Presentations/ Course Mini Projects

ISE III: The design project for group of students shall be based on above mechanical elements consist of Modeling and Analysis and integration of by using SOLIDWORKS software's and ANSYS the students shall design a model use for extensive application

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Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ISE II	ESE
K1	Remember	2	-	-	10
K2	Understand	6	5	2	20
K3	Apply	7	10	4	30
K4	Analyze	-	-	-	-
K5	Evaluate	-	-	-	-
K6	Create	-	-	-	-
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K, K2 and K3	K2 and K3	K1, K2, K3	K1, K2, K3	K1, K2, K3
	Co1	C02	Co3	Co4	Co5
ISE I (15 Marks)	5	10	-	-	-
ISE II (15Marks)	-		5	10	-
ISE II (10Marks)	2	2	2	2	2
ESE (60 Marks)	10	15	15	10	10
Total Marks 100	17	27	22	22	12

Special Instruction if any: Nil

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course Outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2		2	2							2	3	
CO2	3		3		2			1					3	2
CO3	3	2	2	2	2		1		1			2	3	2
CO4	3		3		2			1					3	2
CO5	2		2		3		1			2		3	2	3

1 – Low 2- Medium 3- High

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MEPCC3002 LAB Machine Design - I		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week /Batch	**ISE III**	**25 Marks**
Credits: 01	**ESE**	**25 Marks**

Course Outcomes:

After completion of this course students will be able to:

Course Outcomes	
CO1	Design and prepare part and assembly drawings of any joints/ Couplings by using standard Parts & Design Data Book
CO2	Apply the design procedure for power screw and prepare assembly drawings
CO3	Apply the design procedure of Welded and Riveted joints for given open ended problems
CO4	Illustrate the Modeling, Analysis and integration of assembly by using software's Mini-projects/ Group projects

Practical

Practical shall consist of Two design project.

a) The design project for group of students shall be based on "Design of the given Joints/ Couplings by using Design Data Book and drafting of assembly and details drawings on A3 size drawing sheet.
b) The design project for group of students shall be based on above mechanical elements consist of Modeling and Analysis and integration of by using SOLIDWORKS software's and ANSYS the students shall design a model use for extensive application.
c) Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified so as to make it working drawing.

A design report shall prepare separately giving all necessary calculations of the design of the components and assembly shall be submitted in a separate file: Design data book shall be used extensively for the selection of standard materials and the components.

Part II One Mini Project and additional four assignments (One units of MEPCC3001)

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**End Semester Examination**
K1	Remember	05
K2	Understand	10
K3	Apply	10
K4	Analyze	
K5	Evaluate	-
K6	Create	-
Total Marks		25

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Assessment Table:

Assessment Pattern Level No.	Knowledge Level	End Semester Examination
S1	Imitation	10
S2	Manipulation	8
S3	Precision	7
S4	Articulation	
S5	Naturalization	
Total Marks		25

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2			1								1	
CO2	3	2			1								1	
CO3	2	2	1		1				2	1			1	
CO4	2	2	1	1	2				1	2			1	2

1 – Low 2- Medium 3- High

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MEPCC 3003 KINEMATICS OF MACHINES		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs. / Week	**ISEI**	**10Marks**
Tutorial: 00 hrs/week	**ISEII**	**10Marks**
Credits: 02	**ESE**	**30Marks**

After completing this course, students will be able to:

Course Outcomes	
CO1	Explain the fundamental concepts of kinematics, mechanisms, and mobility analysis based on various criteria.
CO2	Interpret velocity and acceleration in planar mechanisms using graphical method.
CO3	Design cam-follower systems, determining their motion characteristics through graphical and analytical methods

Syllabus for Kinematics of Machines

Unit No.	Topics Covered
Unit 1	**Fundamentals of Kinematics and Mechanisms** **Classification of mechanisms**: Basic kinematic concepts and definitions, Kinematic links, Kinematic pairs, Kinematic chains, planar, spherical, and spatial mechanisms, Mobility analysis: Kutzbach criteria, Grubler criteria, problems based on these criteria, Degree of freedom and Grashoff's law, Kinematic inversions of four-bar chain and slider-crank chains , Mechanical advantage and transmission angle, **Description of common mechanisms**: Quick return mechanism, straight-line generators, Universal Joint, Rocker mechanisms
Unit 2	**Kinematic Analysis – Velocity and Acceleration** **Velocity analysis of simple mechanisms**: Instantaneous centers and Arnold Kennedy's theorem, Graphical methods: Link-to-link method, line of centers method, and relative velocity method, Rubbing velocity at pin joints, **Acceleration analysis of mechanisms,** Centripetal (radial) acceleration, tangential acceleration, and total acceleration, Acceleration polygons for mechanisms, Coriolis acceleration component
Unit 3	**Cams and Follower Motion Analysis** **Classification of cams and followers,** Terminology and definitions related to cams **Displacement diagrams,** Uniform velocity, parabolic, simple harmonic motion (SHM), and cycloidal motion, **Analysis of follower motion,** Constant velocity, SHM, uniform acceleration & deceleration, cycloidal motion, polynomial motion, and derivation of displacement equations, Graphical synthesis of plate cams using knife-edge, roller followers, Determination of velocity and acceleration of the follower motion

Text and Reference Books

Shigley J. E. and Uicker J. J., "*Theory of Machines and Mechanisms*", 3rd Edition, McGraw Hill Intl, 2010.

Thomas Bevan, *Theory of Machines*, 3rd edition, CBS Publishers & Distributors, 2005.

Robert L. Norton, *Kinematics and Dynamics of Machinery*, Tata McGrawHill, 2009.

Rao J. S. &Dukkipati R. V., "*Mechanism and Machine Theory*", 2nd Edition, New AgeIntl. Publishers, 2012.

Ratan S. S., "*Theory of Machines*", 2nd Edition, Tata McGraw Hill Publishing Company Ltd, 2005.

Sharma C. S. and P. Kamlesh, "*Theory of Mechanisms and Machines*", Printice Hall of India Pvt. Ltd, 2006.

Ghosh A. and Mallick A.K., "*Theory of Mechanisms and Machines"*, Affiliated East- WestPvt. Ltd, New Delhi, 1988.

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

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https://archive.nptel.ac.in/courses/112/105/112105268/

Assessment:
ISE I: Shall be on the basis of Class Tests on First unit also Assignments/ Quizzes/ Field visits/Presentations/ Course Projects on First and Second unit.
ISE II: Shall be based on class test on Second unit and third units.

Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ESE
K1	Remember	5		8
K2	Understand	5	2	6
K3	Apply		4	8
K4	Analyze		4	8
K5	Evaluate	Nil	Nil	Nil
K6	Create	Nil	Nil	Nil
Total Marks 50		10	10	30

Assessment table:

Assessment Tool	K1, K2	K2, K3 and K4	K2, K3 and K4
	CO1	CO2	CO3
ISE I	5	3	2
ISE II	2	4	4
ESE	7	12	11
Total Marks 50	14	19	17

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02
CO1	3	2	1									1	1	
CO2	3	3	1									2	1	
CO3	2	3	1		1							2	1	

1 – Low 2- Medium 3- High

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MEPCC 3004: LAB-KINEMATICS OF MACHINES		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week /Batch	**ISEIII**	**25 Marks**
Credits: 01	**ESE**	**25 Marks**

Course Outcomes:

Course Outcomes	
CO1	Identify and classify different kinematic mechanisms and study their mobility based on fundamental kinematic concepts.
CO2	Perform velocity and acceleration analysis of simple mechanisms using graphical methods.
CO3	Design the cam-follower mechanisms for different motion requirements.

List of the Experiments

The student shall perform minimum eight experiments of the following

Sr. No.	Title of the Experiments
1	Study and classification of kinematic pairs, chains, and mechanisms
2	Mobility analysis using Grashof's law and Kutzbach criterion (Drawing Sheet-Two problems)
3	Graphical velocity analysis using Instantaneous Centers (IC) method (Drawing Sheet-two problem)
4	Velocity analysis of a four-bar mechanism and slider crank mechanism using graphical methods (Drawing Sheet-two Problems)
5	Acceleration analysis of a four-bar mechanism and slider crank mechanism using graphical methods (Drawing Sheet-two Problems)
6	Determination of Coriolis acceleration in a slider-crank mechanism (Drawing Sheet-one problem)
7	Draw sheets based on cam profiles for various follower motions (Drawing Sheet-two problem)
8	Study of Basic Mechanism Synthesis and Its Applications
9	Assignment based on cams, theory, classification, application, terminology etc

Note: Graphical and Computational Analysis of Mechanisms Using MATLAB form any of practical no 3,4,6,7.

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	End Semester Examination
K1	Remember	5
K2	Understand	10
K3	Apply	5
K4	Analyze	5
K5	Evaluate	-
K6	Create	-
Total Marks		25

Assessment Pattern Level

Assessment Pattern Level No.	Knowledge Level	End Semester Examination
S1	Imitation	10
S2	Manipulation	8
S3	Precision	7
S4	Articulation	
S5	Naturalization	
Total Marks		25

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2										1	1	
CO2	3	3	2									2	1	
CO3	2	2	2									1	1	

1 – Low 2- Medium 3- High

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MEPCC3005: NUMERICAL AND COMPUTATIONAL METHOD		
Teaching Scheme	**Examination Scheme**	
Lectures:02Hrs /Week	**ISEI**	**10Marks**
Credits:02	**ISE II**	**10 Marks**
	End Semester Examination	**30 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Estimate solutions for differential equations using numerical techniques.
CO2	Develop solution for engineering applications with numerical integration.
CO3	Design and create model using a curve fitting and regression analysis.

Detailed Syllabus:

Unit 1	**Numerical Solution of Differential Equations** **Ordinary Differential Equations [ODE]:** Taylor series method, Euler Method, Runge-Kutta 4thorder. Simultaneous equations using Runge-Kutta 2ndorder method. **Partial Differential Equations [PDE]:** Finite difference method, Simple Laplace method, PDE's Parabolic explicit solution, Elliptic explicit solution.
Unit 2	**Numerical Integration** **Numerical Integration (1D):** Trapezoidal rule, Simpson's 1/3rdRule, Simpson's3/8thRule, GaussQuadrature2-point and 3-point method. **Double Integration:** Trapezoidal rule, Simpson's 1/3rdRule.
Unit 3	**Curve Fitting and Regression Analysis** **Curve Fitting:** Least square technique- first order, power equation, exponential equation and quadratic equation. **Regression Analysis:** Linear regression, Nonlinear regression, Multiple regressions, Polynomial regression. Lagrange's interpolation, Numerical interpolation and differentiation using Newton's forward method, inverse interpolation (Lagrange's method only).

Text and Reference Books

Steven C. Chapra, 'Applied Numerical Methods with MATLAB for Engineers and Scientist', Tata Mc-Graw Hill Publishing Co. Ltd.
B. S. Grewal, 'Numerical Methods in Engineering and Science', Khanna Publication.
B. S. Grewal, 'Higher Engineering Mathematics', Khanna Publication.
Erwin Kreyszig, 'Advanced Engineering Mathematics', Wiley India
Joe D. Hoffman, 'Numerical Methods for Engineers and Scientists', CRC Press
Sheldon M. Ross, 'Introduction to Probability and Statistics for Engineers and Scientists', 5e, by Elsevier Academic Press
Deisentoth, Faisal, Ong, 'Mathematics for machine learning', Cambridge University Press.
Kandasamy, 'Numerical methods', S Chand.
Jason Brownlee, 'Statistical Methods for Machine Learning', Machine learning Mastery.

Web References:

http://nptel.ac.in/courses/111101003/
http://nptel.ac.in/courses/111105038/
http://nptel.ac.in/courses/111107063/
http://nptel.ac.in/courses/111105041/
http://nptel.ac.in/courses/111104079/
https://www.analyticsvidhya.com/

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Assessment:
ISE 1: Shall be on the basis of Class Tests on First unit or it may base on Assignments/ Quizzes/ Field visits/Presentations/ Course Mini Projects on First unit.
ISE II: Shall be based on class test on two unit or it may base on Assignments/ Quizzes/ Field visits/Presentations/ Course Mini Projects

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	End Semester Examination
K1	Remember			
K2	Understand	5	5	10
K3	Apply	5	5	20
K4	Analyze			
K5	Evaluate			
K6	Create			
Total Marks 50		10	10	30

Assessment table:

Assessment Tool	K2, K3	K2, K3	K2, K3
	CO1	CO2	CO3
ISEI(10 Marks)	10		
ISEII (10Marks)		10	
	K2 to K3	**K2 to K3**	**K2 to K3**
ESE Assessment(30Marks)	10	10	10
Total Marks 50	20	20	10

Mapping of Course outcomes with Program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2										1	1	
CO2	3	3	2									2	1	
CO3	2	2	2									1	1	

1 – Low, 2 – Medium, 3 – High

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MEPCC3006 FLUID MECHANICS AND FLUID POWER		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs / week	**ISE I**	**15 Marks**
Tutorial: 0 hrs / week	**ISE II**	**15 Marks**
Credits: 03	**ISE III**	**10 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

Course Outcomes	
CO1	Articulate the fundamental properties of fluid
CO2	Understand the concept of hydrostatics, buoyancy and flotation for identification stability of bodies in submerged and floating conditions
CO3	Distinguish various types of fluid flow and flow measuring devices
CO4	Evaluate and major and minor losses associated with pipe flow in piping networks and apply the knowledge to minimize the losses in pipes
CO5	Analyze the working of centrifugal and reciprocating pumps

Detailed Syllabus:

Unit 1.	**Fundamentals of Fluid** Introduction to fluid, Types of fluid, fluid properties such as viscosity, compressibility, surface tension and capillarity, Vapor pressure and cavitations, pressure measurement by simple and differential manometers
Unit 2.	**Hydrostatic forces: Buoyancy and Flotation** Pascal's law, Hydrostatic law, total pressure and centre of pressure for vertical, horizontal, inclined and curved surface, buoyancy and flotation, concept of Metacentre height, Equilibrium of floating and submerged bodies
Unit 3.	**Fluid Kinematics & Dynamics** Eulerian and Langragian approach of fluid flow, types of fluid flow, Continuity equation Velocity and Acceleration of fluid particles, Stream function and velocity potential function. stream, path and streak line, Equation of motion, Integration of Euler's equation as energy equation. Bernoulli's theorem, Application of Bernoulli's theorem such as venture-meter, orifice-meter, pitot tube, Moment Of Momentum Equation , practical applications, illustrative examples,
Unit 4.	**Flow through Pipes & Dimensional Analysis** Loss of energy in pipes, Darcy-Weisbach equation, major and minor losses, Hydraulic Gradient Line (HGL) and Total Energy Line (TEL), flow through series pipes, parallel pipes and branched pipes, equivalent pipe, Syphons, power transmission through pipes, condition for maximum power transmission, efficiency for maximum power transmission, water hammer in pipes, illustrative examples Dimensions of different fluid parameters, Buckingham's pie theorem, different dimensionless groups, physical meaning of dimensionless groups, types of similarities, laws of similitude
Unit 5.	**Centrifugal & Reciprocating Pumps** Introduction, types of pumps, types of impellers, types of casings, priming, various heads & efficiencies of centrifugal pump, minimum starting speed of a centrifugal pump, multistage centrifugal pump, performance of pumps, principles of similarity applied to centrifugal pump, specific speed, NPSH, cavitation in pumps,

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	illustrative examples. Introduction to main parts of Reciprocating pump, construction & working of Reciprocating pump, classification of Reciprocating pump, slip of reciprocating pump (No numerical on Reciprocating pump)

Reference and Text Books

1. Fluid Mechanics, Dr. R.K. Bansal- 9 th edition, Laxmi Publication (P) Ltd. New Delhi,2014
2. Hydraulics and Fluid Mechanics, Modi P. N. and Seth S. M, 19th edition-Standard Book House, 2012.
3. Fluid Mechanics, Cengel and Cimbla, 3 rd edition, TATA McGraw-Hill,2019. 4.Fluid Mechanics, Frank M White, 7 th edition, TATA McGraw-Hill,2011.
4. Fluid Mechanics, Kundu, Cohen, Dowling-6 th edition- Elsevier India,2000.
5. Fluid Mechanics, Chaim Gutfinger, David Pnueli-1 st edition,Cambridge University press,1997.
6. Introduction to Fluid Mechanics, Edward Shaughnessy, Ira Katz James Schaffer-1st edition, OXFORD University Press,2003.
7. Fundamentals of Fluid Mechanics- Munson, Okiishi, Huebsch, Rothmayer 7th edition, John Wiley & Sons Inc, 2004.Hill

Assessment:

ISE I: Shall be on the basis of Class Tests on First and Second unit.

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

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

Assessment Pattern:

Assessment Pattern Level	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	2	2	2	
K2	Understand	3	3	3	
K3	Apply	2	2	3	
K4	Analyze	3	3	2	
K5	Evaluate	5	5		
K6	Create				
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1 and K2	K2 and K3	K4 and K5	K1 and K2	K2 and K3	K4 and K5
	CO1	CO2	CO3	CO4	CO5	CO5
ISE I (15 Marks)	4	6	5			
ISE II (15 Marks)				4	6	5
ISEIII (10 Marks)	1	2	2	1	2	2
ESE Assessment (60 Marks)	05	10	15	05	10	15
Total Marks 100	10	18	22	10	18	22

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course Outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PS01**	**PSO2**
CO1	1	2											1	
CO2	1	2	2										1	
CO3		3	2										2	
CO4	2	3	2										1	
CO5	1	2	3										2	

1 – Low, 2 – Medium, 3 – High

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MEPCC3007 LAB FLUID MECHANICS AND FLUID POWER		
Teaching Scheme	**Examination Scheme**	
Practical: 2 Hrs/Week	**ISEII**	**25 Marks**
Credits: 1	**ESE**	**25 Marks**

Course Outcome

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

	Course Outcomes
CO1	Ability enhancement in practical determination of fluid viscosities and to decide the flow patterns.
CO2	Ability enhancement in applying Bernoulli's theorem & momentum principle to various flow pattern.
CO3	Ability enhancement in applying theoretical knowledge to find the performance of different pumps.

Minimum Eight experiments shall be performed to cover entire curriculum of course ME. List of Experiments

Sr. No.	**Details**
1.	Experiment on determination of metacentric height of a floating body
2.	Study of different manometer'
3.	Determination of coefficient of discharge for Orifice meter
4.	Determination of coefficient of discharge for Venturimeter
5.	Determination of coefficient of velocity by using Pitot tube
6.	Verification of Bernoulli's theorem.
7.	Study the type of flow by using Reynolds's apparatus.
8.	Determination of Major losses through pipes
9.	Determination of minor losses due to pipe fittings
10.	Experiment on Red wood viscometer
11.	Trial on centrifugal pump
12.	Industrial visit to hydraulic power station
13.	Industrial visit to Pump house station

Assessment:

ISEIII: Shall be on the basis of assessment of term work.
ESE: ESE will base on oral exam conducted by course coordinator and external examination.

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	End Semester Examination
K1	Remember	5
K2	Understand	10
K3	Apply	5
K4	Analyze	5
K5	Evaluate	-
K6	Create	-
Total Marks		25

Assessment Pattern Level

Assessment Pattern Level No.	Knowledge Level	End Semester Examination
S1	Imitation	10
S2	Manipulation	8
S3	Precision	7
S4	Articulation	
S5	Naturalization	
Total Marks		25

Mapping of Course outcome with Program Outcomes and Program

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	**1**	**2**											**1**	
CO2		1	**2**										**1**	
CO3		**1**	**2**										**2**	

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MEPEC3001:ROBOTICS AND AUTOMATION		
Teaching Scheme	**Examination Scheme**	
Lectures:03Hrs./Week	**ISEI**	**15Marks**
Credits:03	**ISEII**	**15Marks**
	ISEIII	**10 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Understand robotics and automation terminology
CO2	Learn robot anatomy of robot, configuration of different robots, and Describe construction and working of different types robots
CO3	Illustrate various end effectors along with selection criterion
CO4	Interpret Robot actuator and feedback components such as stepper motor, encoder, resolver
CO5	Understand fundamental aspects of automation in industries

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-adaptiveandoptimalcontrol-Endeffectors-classifications–Mechanical–Magnetic– Vacuum- adhesive – Drive systems and controls, Types of grippers & its design
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
Unit 5	**Automation:** Introduction, types of automation system, Programmable Logic Controller, Block Diagram of PLC, Ladder Programming, Emerging trends in automation , SCADA, orientation of industrial security system

Text and Reference Books

1. Groover M.P.Weiss Mithell Nagel R.N., OderyN.G.,"Industrial Robotics, Technology,Programming and Applications", McGraw Hill International Editions.
2. Klafter, "Robotics Engineering" ,PHI Pvt .Ltd., NewDelhi.
3. K S.Fu,RC. Gonzalez, CSGLee, "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. Radha Krishnan Subramanian's. ,Raju V., "CAD/CAM/CIM", New Age International Publishers Pvt. Ltd., New Delhi, India.

Assessment:

ISE I: Shall be on the basis of Class Tests on First and Second unit.
ISE II: Shall be based on class test on third, fourth units.
ISE III: Shall be on the basis of Group Assignments/ Quizzes/ Field visits/Presentations

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Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISEI	ISE II	ISE III	End Semester Examination
K1	Remember	5	5		
K2	Understand	5	5		12
K3	Apply	5	5	5	24
K4	Analyze			5	12
K5	Evaluate				
K6	Create				12
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	K2.K3	K2,K3	K3	K4	K3,K4
	CO1	CO2	CO3,CO4	CO4	CO5
ISE I(15 Marks)	7	8			
ISE II(15Marks)		5	5	5	
ISE III (10 Marks)			5	5	
ESE Assessment(60Marks)	12	12	12	12	12
Total Marks 100	19	25	22	22	12

Mapping of Course out comes with Program out comes 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	PO11	PO12	PSO1	PSO2
CO1	1	2												
CO2	2	2			1								1	
CO3	1	1			1							1		1
CO4	2	2										1		

1– Low, 2–Medium, 3 – High

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MEPEC3002 : LAB ROBOTICS AND AUTOMATION		
Teaching Scheme	**Examination Scheme**	
Practical:02hrs/week	**ISEIII**	**25 Marks**
Credits:01	**ESE**	**25 Marks**

Course Outcomes:
After completing the course students will able to

Course Outcomes:	
CO1	Study robot anatomy
CO2	Study kinematics and dynamic performance of robots
CO3	Select appropriate sensor for robotic application and automation
CO4	Analyze 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 PLC program for an application
4	Use of virtual robotics lab of IIT Kharagpur http://vlabs.iitkgp.ac.in/mvl1/exp.html
5	Industrial visit for robotic system used for welding operation/ sheet metal cutting/ painting
6	Industrial visit for robotic system used for
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.
10	Developing at least one robot program for an application

Assessment:
ISEIII: Shall be on the basis of assessment of term work.
ESE: ESE will based on oral exam conducted by course coordinator and external exam

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISEI**	**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

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Assessment Table:

Knowledge Level	**ISEI**	**ESE**
Preparation S1	04	04
Conduct of ExperimentS2	04	04
Observation & analysis of Results S3	08	08
Record S2	03	03
Mini project/Presentation/Viva VoceS3	06	06
Total Marks	25	25

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

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MEPEC3003 :TRIBOLOGY		
Teaching Scheme	**Examination Scheme**	
Lectures:03hrs./week	**ISE I**	**15Marks**
Tutorial:00hrs./week	**ISE II**	**15Marks**
Credits:03	**ISEIII**	**10Marks**
	End Semester Examination	**60Marks**

After completing the course, students will be able to:

Course Outcomes:	
CO1	Understand about tribology and friction
CO2	Provide a clear view on types of wears
CO3	Recognize lubrication and lubricants
CO4	Know fluid film lubrication
CO5	Realize application of tribology

Detailed Syllabus:

Unit1	**Introduction to Tribology** Introduction to tribology, Interdisciplinary Approach, Economic Benefits. tribology in design, tribology in industry. **Friction** Causes of Friction, Adhesion Theory, Abrasive Theory, Junction Growth Theory, Laws of Rolling Friction, Friction Instability.
Unit2	**Wear** Wear Mechanisms, Adhesive Wear, Abrasive Wear, Corrosive Wear, Fretting Wear, Wear Analysis.
Unit 3	**Lubrication and Lubricants** Importance of Lubrication, Boundary Lubrication, Mixed Lubrication, Full Fluid Film Lubrication; Hydrodynamic, Elasto hydrodynamic lubrication, Types & Properties of Lubricants, Lubricants Additives.
Unit 4	**Fluid film lubrication** Fluid mechanics concepts, Equation of Continuity & Motion, Generalized Reynolds Equation with Compressible& Incompressible Lubricants.
Unit 5	**Application of Tribology** Introduction, Rolling Contact Bearings, Gears, Journal Bearings - Finite Bearings, Air bearings and Magnetic bearings

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Text and Reference Books

1. A Text Book of"Tribology"byHgPhakatkar,RrGhorpade, 2nd revisededition, Nirali Prakashan, Pune, Aug2011.
2. A Text Bookof"Tribology"byR.B.Patil,1st edition,Tech-MaxPublications, Pune, Aug2009
3. A Text Book of "Introduction toTribology"byBharatBhushan, 2nd Edition, John Wiley and Sons Publication, NY,2013.
4. A TextbookofDesignofMachineElementsbyV.B.Bhandari,4th edition, Tata-McGraw Hill Publication Co. Ltd., Aug2016

Assessment:

ISEI: Shall be on the basis of Class Tests/Assignments/Quizzes/Field visits/Presentations/ Course Projects on first and second unit.

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

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

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISE II	ISE III	End Semester Examination
K1	Remember	5	5		
K2	Understand	5	5		12
K3	Apply	5	5	5	24
K4	Analyze			5	12
K5	Evaluate				
K6	Create				12
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K2.K3	K2,K3	K3	K4	K3,K4
	CO1	CO2	CO3,CO4	CO4	CO5
ISEI(15 Marks)	7	8			
ISEII(15Marks)		5	5	5	
ISEIII (10 Marks)			5	5	
	K2 to K4,K6	K2 to K4,K6	K2 to K4,K6	K2 to K4,K6	K2 to K4,K6
ESE Assessment(60Marks)	12	12	12	12	12
Total Marks 100	19	25	22	22	12

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Mapping of Course outcome with Program Outcomes and Program Outcomes

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1				3								1	
CO2		2		1						2				1
CO3														
CO4	3					1							1	
CO5			1											

1– Low, 2–Medium, 3 – High

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MEPEC3004:LAB TRIBOLOGY		
Teaching Scheme	**Examination Scheme**	
Practical:02hrs/week	**ISE III**	**25Marks**
Credits:01	**ESE**	**25 Marks**

Course Outcomes:

After completing the course, students will be able to:

CO1	Measure the friction and understand the wear mechanisms in case of tilting pad thrust bearing apparatus, brake line test rig , pin on disc test rig, journal bearing test rig and tribometer.
CO2	Use of scratch tester to assess material resistance
CO3	Apprehend simulation and modeling of tribo pairs to know its working

Detailed Syllabus:

Part I	**Content** **Minimum five experiments and three assignments shall be performed to cover entire curriculum of course** **Study / Demonstration on Journal Bearing apparatus.** 1. Study/Demonstration on tilting pad thrust bearing apparatus. 2. Study/Demonstration on Brake line friction test rig. 3. Measurement of wear and coefficient of friction using Pinon Disk. 4. Friction in Journal Bearing. 5. Demonstration on scratch tester 6. Demonstration on sliding wear tester by using tribometer 7. Simulation and Modelling of Tribo Pairs

Assessment:

ISEIII: Shall be on the basis of assessment of term work.

ESE: ESE will based on oral exam conducted by course coordinator and external examination.

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISEI**
S1	Imitation	5
S2	Manipulation	10
S3	Precision	10
S4	Articulation	
S5	Naturalization	
S6		
Total Marks 50		25

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Assessment table:

Assessment Tool	**S1 to S3**	**S1,S2**	**S1**
	CO1	CO2	CO3
ISEIII(25 Marks)	15	10	
ESE (25Marks)	15	5	5
TotalMarks50	30	15	5

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3								1			1	
CO2	2	3								1			1	
CO3	2	1								1			1	

1-Low 2 – Medium 3– High

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MEPEC3005 Renewable Energy Engineering		
Teaching Scheme	**Examination Scheme**	
Lectures: 3Hrs /Week	**ISEI**	**15 Marks**
Credits: 3	**ISEII**	**15 Marks**
	ISE III	**10 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

	Course Outcome
CO1	Explain the environmental aspects of renewable energy and compare them with conventional systems, identifying their prospects and limitations.
CO2	List and describe components of solar energy systems and apply their use in heating, cooling, desalination, and power generation.
CO3	Explain the principles of wind and tidal energy conversion and apply them to basic system configurations.
CO4	Apply the knowledge of biomass and green energy sources, and conversion process to find basic energy solutions.
CO5	Describe the knowledge of ocean thermal energy conversion and hydrogen energy.

Detailed Syllabus:

Unit 1	**Introduction to Renewable Energy-** Principles of renewable energy, energy and sustainable development, Worldwide and Indian renewable energy availability, Brief overview of: solar, wind, tidal, wave, ocean thermal, biomass, geothermal, oil shale, Introduction to Internet of Energy (IoE)
Unit 2	**Solar Energy:** Measurement of Solar Radiation, its geometry, and characteristics. Flat plate collectors, concentrating collectors, solar water heating, solar cookers. Basic principles, solar cells, modules, arrays, PV systems, and applications.
Unit 3	**Wind and Ocean Energy:** Wind speed, wind energy potential, Horizontal and vertical axis wind turbines, components, and performance. Factors affecting site selection and integration of wind power into the grid. **Ocean Energy:** Tidal energy, wave energy, and ocean thermal energy conversion (OTEC).
Unit 4	**Biomass Energy and Hydro- Energy:** Types of biomas and characteristics. Thermo chemical and biochemica

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	(gasification, combustion, anaerobic digestion). Production and utilization of bio-fuels. Principle of hydro-energy, Small hydro and large hydro power plants
Unit 5	**Green Energy & Hydrogen:** Introduction to Green energy, fuel cell classification (H2), operating principles, Hydrogen: zero-energy concepts, benefits, electrolysis production, storage, applications, challenges

Text and Reference Books

1. Rai, G. D. (Fourth Edition). *Non-Conventional Energy Sources*. Khanna Publishers.
2. Rao, S., & Parulekar, B. B. *Energy Technology*. Khanna Publishers.
3. Sukhatme, S. P. (1996). *Solar Energy*. 2nd Edition, Tata McGraw-Hill.
4. Culp Jr., A. W. (1996). *Principles of Energy Conversion*. McGraw-Hill.
5. Singh, Shobh Nath. (2018). *Non-Conventional Energy Resources*. Pearson.

Web References:
https://nptel.ac.in/courses/103103206
https://archive.nptel.ac.in/courses/103/107/103107157

Assessment:
ISE I: Shall be on the basis of Class Tests on First and Second unit.
ISE II: Shall be based on class test on third, fourth and fifth unit.
ISE III: Shall be on the basis of Group Assignments/ Quizzes/ Field visits/Presentations.

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember				
K2	Understand	8	8	4	20
K3	Apply	4	4	4	20
K4	Analyze	3	3	2	20
K5	Evaluate				
K6	Create				
Total Marks		15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K3	K4
ISEI(15 Marks)		8	4	3
ISEII (15Marks)		8	4	3
ISEII (10Marks)		4	4	2
	K1	**K2**	**K3**	**K4**
ESE Assessment (60 Marks)		20	20	20
Total Marks 100		**40**	**32**	**28**

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Mapping of Course outcomes with Program outcomes:

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

1 – Low, 2 – Medium, 3 – High

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MEPEC3006 Lab Renewable Energy Engineering		
Teaching Scheme	**Examination Scheme**	
Lectures: 2Hrs /batch/Week	**End Semester Examination**	**25 Marks**
Credits: 2		

Course Outcomes:

CO No	Course Outcome
CO1	Identify the key parameters of solar, wind, biomass, and hydrogen-based renewable energy systems through laboratory experiments
CO2	Study the performance of solar thermal collectors, wind turbines, and biomass gasifiers, and interpret system characteristics.
CO3	Demonstrate practical understanding of renewable energy conversion technologies and gain insights into industrial applications

List of the Experiments: The student shall perform following experiments:

Sr. No	Title of Experiment
1.	Study of Solar Radiation Measurement and Solar Geometry
2.	Study of Solar Water Heating System Performance
3.	Study of Flat Plate and Concentrating Solar Collectors
4.	Study of Wind Speed Measurement and Wind Energy Potential
5.	Study of Horizontal and Vertical Axis Wind Turbines
6.	Study of Biomass Gasification Process
7.	Study of Tidal and Wave Energy Conversion Systems
8.	Study of Hydrogen Production by Electrolysis and Fuel Cell Operation
9.	Visit to any solar /hydraulic/wind power station

Assessment Pattern:

Assessment Pattern LevelNo.	Knowledge Level	ISEI
S1	Imitation	5
S2	Manipulation	10
S3	Precision	10
S4	Articulation	
S5	Naturalization	
S6		
TotalMarks50		25

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Assessment table:

Assessment Tool	**S1 to S3**	**S1,S2**	**S1**
	CO1	CO2	CO3
ISEIII(25 Marks)	15	10	
ESE (25Marks)	15	5	5
TotalMarks50	30	15	5

Mapping of Course outcomes with Program outcomes:

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2		3	3		2				2	2	3	2
CO2	3	2	2	2	3	2	2				2	2	3	2
CO3	3		3		3	2	2	1	2	2	3	3	3	3

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MEPEC3007 : MECHANICAL MEASUREMENT		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISEI**	**15Marks**
Tutorial: 00 hrs/week	**ISEII**	**15Marks**
Credits: 03	**ISEIII**	**10 Marks**
	ESE	**60Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Understand the use and principles of measuring devices.
CO2	Know the generalized measurement system, errors, transducers, intermediate modifying and terminating devices.
CO3	To learn the working of various measuring instrument
CO4	Enable students to select particular instrument according to application.

Detailed Syllabus:

Unit 1	**Significance of Mechanical Measurements;** Classification of measuring instruments, generalized measurement system, types of inputs: Desired, interfering and modifying inputs. Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc. Error in measurement: Types of errors, Effect of component errors on comb
Unit 2	**Displacement measurement:** Transducers for displacement measurement, Potentiometers, LVDT, Capacitance type, Digital transducers (optical encoder), Nozzle flapper transducer.
Unit 3	**Measurement of angular velocity**: Tachometers, Tacho-generators, digital tachometers and stroboscopic methods Acceleration Measurement: Theory of accelerometers and vibro-meters, Practical Accelerometers, strain gauge based and piezoelectric accelerometers
Unit 4	**Pressure measurement:** Pressure standards, Elastic pressure transducers viz. Bourdon Tubes, Diaphragm, Bellows and piezoelectric pressure sensors. High−pressure measurements, Bridgman gauge Vacuum measurement: Vacuum gauges viz. McLeod gauge, Ionization and Thermal Conductivity gauges.
Unit 5	**Temperature measurement:** Resistance thermometers, Thermistors and Thermocouples, Pyrometers Strain measurement: Theory of Strain Gauges, Gauge factor, Temperature compensation, Bridge circuit, Orientation of Strain Gauges for Force and Torque measurement, Strain Gauge based Load Cells and Torque Sensors

Text and Reference Books 1. Sawhney A K, "Mechanical Measurements and Instruments", Dhanpat Rai& Sons. New Delhi. 2018

Rangan C. S, Sarma G. R.," Instrumentation Devices and Systems", Tata McGraw Hill, Delhi 2017

E. O. Doebelin, "Engineering Experimentation: planning, Execution, Reporting", McGraw Hills Int. Edition 2020

Thomas Beckwith, N. Lewis Buck, Roy Marangoni, "Mechanical Engineering Measurement", Narosa Publishing House, Bombay 2019

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Assessment:

ISE I: 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 levels no.	Knowledge levels	ISE I	ISE II	ISE III	ESE
K1	Remember	5	3		15
K2	Understand	5	7	2	15
K3	Apply	5	5	2	15
K4	Analyze			6	15
K5	Evaluate				
K6	Create				
Total Marks 100		**15**	**15**	**10**	**60**

Assessment table:

Assessment Tool	K1 and K2	K2 and K3	K2 and K3	K2 and K3
	CO1	**CO2**	**CO3**	**CO4**
ISE I (15 Marks)	7	8	-	
ISE II (15Marks)			8	7
ISE III (10Marks)	2	3	2	3
ESE (60 Marks)	10	20	15	15
Total Marks 100	**19**	**31**	**25**	**25**

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1			1	2		1	1		1	2	1
CO2	3	2	1			1	2		1	1		1	2	1
CO3	3	2	1			1	2		1	1		1	2	1
CO4	3	2	1			1	2		1	1		1	2	1

1 – Low 2- Medium 3- High

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MEPE3008 : Lab MECHANICAL MEASUREMENTS		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week /Batch	**ISE III**	**25 Marks**
Credits: 01	**End Semester Evaluation**	**25 Marks**

Course Outcomes:

After completion of this course students will be able to:

	Course Outcomes
CO1	Apply knowledge of principles of various sensors and transducers for measuring System
CO2	Explain knowledge of displacement, strain measuring instrument for practical /real life Situation and setting the instruments for zero error adjustment.
CO3	Use knowledge of Angular velocity, pressure measuring instrument for practical /real life situation and analyze its characteristics.
CO4	Understand knowledge of Temperature, acceleration measuring instrument for practical /real life situation

List of the Experiments

The student shall perform minimum five experiments of the following

Sr. No.	Title of the Experiments
1	Study and demonstration of generalized measurement system with a typical instrument
2	Measurement of displacement using any one displacement measuring instrument, setting the instruments for zero error adjustment.
3	Measurement of strain using strain gauge
4	Measurement of pressure using any one pressure measuring instrument and setting the instruments for zero error adjustment
5	Measurement of temperature using RTD/Thermocouple/pyrometer and analyzing its Characteristics
6	Measurement of optical Sensor
7	Measurement of speed using any one speed measurement instrument
8	Industrial Visit study of various measurement system

Assessment:

ISEIII: Shall be on the basis of assessment of term work.
ESE: ESE will base on oral exam conducted by course coordinator and external examination.

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE III	End Semester Examination
K1	Remember	5	5
K2	Understand	10	10
K3	Apply	5	5
K4	Analyze	5	5
K5	Evaluate	-	-
K6	Create	-	-
Total Marks		25	25

Assessment Pattern Level

Assessment Pattern Level No.	Knowledge Level	ISE III	End Semester Examination
S1	Imitation	10	10
S2	Manipulation	8	8
S3	Precision	7	7
S4	Articulation		
S5	Naturalization		
Total Marks		25	25

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2				1					2	1	
CO2	2	3	2		3					2	2			
CO3	1	2	2	3					1		2		1	
CO4						3		3	2	3		1	1	

1 – Low 2- Medium 3- High

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MEMDM5004 ENERGY EFFICIENCY OF THERMAL UTILITY		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISEI**	**15 Marks**
Tutorial: 00 hrs/week	**ISEII**	**15 Marks**
Credits: 03	**ISE III**	**10 Marks**
	ESE	**60 Marks**

Course Outcomes

	Course Outcome
CO1	Identify various thermal utilities such as boilers, furnaces, heat exchangers, compressors, pumps, fans, and HVAC systems, along with their key performance parameters. (K1)
CO2	Explain the principles, performance assessment methods, and energy efficiency factors of different thermal utilities.(K2)
CO3	Apply standard performance evaluation techniques to measure and improve the efficiency of thermal utilities.(K3)
CO4	Analyse energy performance data of thermal utilities and diagnose inefficiencies to recommend suitable optimization strategies.(K4)
CO5	Evaluate the impact of energy-efficient measures on cost savings and environmental sustainability in industrial thermal systems.(K4)

Detailed Syllabus

Unit No.	**Syllabus**
Unit 1	**Energy Efficiency of Boilers and Furnaces** Introduction to Boilers and Furnaces, Purpose of the Performance Test , Performance Terms and Definitions , Scope and Reference Standards , Boiler Efficiency Testing: Direct and Indirect Methods , Example: Boiler Efficiency Calculation , Factors Affecting Boiler Performance , Boiler Terminology , Industrial Heating Furnaces , Furnace Heat Balance Method , Example – Heat Balance of Furnace , Factors Affecting Furnace Performance , Useful Information and Data Tables
Unit 2	**Energy Efficiency of Heat Exchangers** Introduction to Heat Exchangers, Purpose of the Performance Test, Performance Terms and Definitions , Industrial Heat Exchangers , Methodology of Heat Exchanger Performance Assessment , Examples
Unit 3	**Energy Efficiency of Fans, Blowers, and Pumps** Introduction to Fans and Blowers, Purpose of the Performance Test, Performance Terms and Definitions , Scope and Reference Standards , Field Testing and Example , Introduction to Pumps , Purpose of the Performance Test , Performance Terms and Definitions, Field Testing for Determination of Pump Efficiency , Determining the System Resistance and Duty Point
Unit 4	**Energy Efficiency of Compressors** Introduction to Compressors, Purpose of the Performance Test, Performance Terms and Definitions, Field Testing, Calculation Procedure for Nozzle Method, Example, Assessment of Specific Power Requirement, Measurement of FAD by Pump Up Method
Unit 5	**Energy Efficiency of HVAC Systems** Introduction to HVAC Systems , Purpose of the Performance Test , Performance Terms and Definitions , Components of HVAC System , Procedure for Performance Evaluation of Vapour Compression Refrigeration (VCR) System , Procedure for Performance Evaluation of Vapour Absorption Refrigeration (VAR) System
Text and Reference Books	

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W. C. Turner, Energy Management Handbook, 6th ed. New York, NY, USA: John Wiley & Sons, 2004.
Smith, C. B. (2015). Energy Management Principles: Applications, Benefits, Savings. Elsevier.
Thumann, A. & Mehta, D. P. (2020). Handbook of Energy Engineering (8th ed.). Fairmont Press.
Bureau of Energy Efficiency (BEE), India. Energy Performance Assessment for Equipment & Utility Systems.
ISO 50001:2018 – Energy Management Systems.
https://beeindia.gov.in/en

Assessment:
ISE 1: Shall be on the basis of Class Tests on First Two units.
ISE II: Shall be based on class test on Third, Fourth unit.
ISE III: Teacher assessment will be based on Assignments/ Quizzes/ Field visits/Presentations/ Course Projects.

Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ESE
K1	Remember	8		10
K2	Understand	7		10
K3	Apply		7	15
K4	Analyze		8	25
K5	Evaluate			
K6	Create			
Total Marks		15	15	60

Assessment table:

Assessment Tool	K1	K2,	K3	K4	K4
	CO1	CO2	CO3	CO4	CO5
ISE I	8	7			
ISE II			5	5	5
ISE III	2	2	2	2	2
ESE	10	10	15	12	13
Total Marks 100	20	19	22	19	20

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1			2		1	2	1	2	2	1
CO2	3	3	2	2			2		1	2	1	2	3	2
CO3	3	3	3	2			3		2	2	2	3	3	3
CO4	3	3	3	3			3		2	2	2	3	3	3
CO5	3	2	3	2			3		2	2	2	3	3	3

1 – Low2- Medium 3- High

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MEMDM 5005 Lab ENERGY EFFICIENCY OF THERMAL UTILITY		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week /Batch	**ISE III**	**25 Marks**
Tutorial: 00 hrs/week	**ESE**	**25 Marks**
Credits: 01		

Course Outcomes:

Course Outcomes	
CO1	Explain the efficiency assessment methods for boilers, furnaces, heat exchangers, and HVAC systems.
CO2	Describe the performance testing procedures for industrial fans, blowers, and pumps.
CO3	Illustrate the methodology for evaluating the energy performance of compressors and refrigeration systems.

List of the Experiments

The student shall perform minimum eight experiments of the following

Sr. No.	Title of the Experiments
1	Study of Boiler Efficiency Analysis
2	Study of Heat Balance Calculation of a Furnace
3	Study of Performance Assessment of a Shell and Tube Heat Exchanger
4	Study of Energy Performance Testing of a Centrifugal Fan
5	Study of Field Testing of a Centrifugal Pump
6	Determination of Coriolis acceleration in a slider-crank mechanism (Drawing Sheet-one problem)
7	Study of Specific Power Assessment of an Air Compressor
8	Study of Determining Free Air Delivery (FAD) using Pump-Up Method
9	Study of Performance Evaluation of a Vapour Compression Refrigeration (VCR) System
10	Study of Performance Analysis of a Vapour Absorption Refrigeration (VAR) System
11	Study of System Resistance and Duty Point Determination for a Pumping System

Assessment:

ISEIII: Shall be on the basis of assessment of term work.
ESE: ESE will base on oral exam conducted by course coordinator and external examination.

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	End Semester Examination
K1	Remember	15
K2	Understand	10
K3	Apply	-
K4	Analyze	-
K5	Evaluate	-
K6	Create	-
Total Marks		25

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Assessment Pattern Level

Assessment Pattern Level No.	Knowledge Level	End Semester Examination
S1	Imitation	10
S2	Manipulation	8
S3	Precision	7
S4	Articulation	
S5	Naturalization	
Total Marks		25

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2										1	1	
CO2	3	3										2	1	
CO3	2	2										1	1	

1 – Low 2- Medium 3- High

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MEMDM6004 COMPUTER AIDED DESIGN		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISEI**	**15Marks**
Tutorial: 00 hrs/week	**ISEII**	**15Marks**
Credits: 3	**ISEII**	**10Marks**
	ESE	**60Marks**

Course Outcome

Course Outcomes	
CO1	Understand the application of computers in design
CO2	Create the various graphics modelling and transformation techniques
CO3	Explain the Computer aided drafting and documentation systems.
CO4	Describe the Graphics standards used in CAD.
CO5	Understand use of different CAD packages

	Detailed Syllabus
Unit 1	Introduction to computer technology, Introduction to CAD systems, Computer Aided Design workstation and peripherals, Graphics input/output devices. Design process and CAD models, Applications and benefits of CAD.
Unit 2	Computer graphics, Coordinate systems, 2D geometry transformations, mapping of geometry models.
Unit 3	3Dgeometry transformations. Graphics manipulation and editing. CAD software: Graphics system and functions of a graphics package. Wireframe, solid and surface modeling. Approaches to solid modeling.
Unit 4	Computer aided drafting and documentation, Principles and concepts of automated drafting, drafting packages, Data exchange standards. Graphics standards like GKS, PHIGS, OpenGL, etc.
Unit 5	Introduction of CAD packages like Auto CAD, Autodesk, Free CAD, SOLIDWORKS, CATIA, Creo, etc.

Textbooks:

1. CAD/CAMComputer-AidedDesignandManufacturing;byM.Groover,E.Zimmers(Pearson)
2. CAD/CAM Principles and Applications; by PNRao(TataMc
3. GrawHill)
4. ComputerAidedDesign&Manufacturing;byDr.SadhuSingh(KhannaPublishers)

Reference books:

1. CAD/CAM TheoryandPractice;byIbrahimZeid,RSivasubramanian(TataMcGraw Hill)
2. Computer Graphics ;by DonaldHearn,M.PaulineBaker(PearsonEducation

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Assessment:
ISE 1: Shall be on the basis of Class Tests on First two unit also Assignments/ Quizzes/ Field visits/Presentations/ Course Projects on First and Second unit.
ISE II: Shall be based on class test on third unit and fourth units.
ISE III: Teacher assessment will be based on Assignments/ Quizzes/ Field visits/Presentations/ Course Projects

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISEI**	**ISEII**	**ISE III**	**End Semester Examination**
K1	Remember	5	5		
K2	Understand	5	5		12
K3	Apply	5	5	5	24
K4	Analyze			5	12
K5	Evaluate				
K6	Create				12
TotalMarks100		15	15	10	60

Assessment table:

Assessment Tool	**K2.K3**	**K2,K3**	**K3**	**K4**	**K3,K4**
	CO1	CO2	CO3,CO4	CO4	CO5
ISEI(15 Marks)	7	8			
ISEII (15Marks)		5	5	5	
ISEIII (10 Marks)			5	5	
	K2 to K4,K6	**K2 to K4,K6**	**K2 to K4,K6**	**K2 to K4,K6**	**K2 to K4,K6**
ESE Assessment(60Marks)	12	12	12	12	12

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3							1		1			3	
CO2	3			2					1		2		2	1
CO3	3	3	1	2			2					1	3	
CO4		2	1										1	
CO5	2			1			2							2

1 – Low 2- Medium 3- High

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MEMDM6005: LAB COMPUTER AIDED DESIGN		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week /Batch	**ISEIII**	**25 Marks**
Tutorial: 02hrs/week	**ESE**	**25 Marks**
Credits: 1		

Course Outcomes:

After completion of this course students will be able to:

	Course Outcomes
CO1	Students will understand the role of CAD in mechanical component and system design by creating geometric models and engineering drawings
CO2	Operate graphics software for various Cad applications
CO3	Design3D Models on any CAD software like Solidworks, Pro/E, NX, Creo etc.

List of the Experiments

The student shall perform minimum six experiments of the following

Sr. No.	**Title of the Experiments**
1	Introduction to computer aided drafting & coordinate system.
2	The 2-dimensional drawing, orthographic views, front views, top views and side view.
3	Introduction to Solid Works and working with sketch mode.
4	To study the wireframe, surface, and solid modelling.
5	Working with the tools like Pattern, Copy, Rotate, Move and Mirror etc
6	Working with creating 3D features (Extrude & Revolve).
7	Draw the part drawing of product 2 using any 3D software
8	Make assembly by using any 3D software

Assessment:

ISEIII: Shall be on the basis of assessment of term work.
ESE: ESE will base on oral exam conducted by course coordinator and external examination.

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	End Semester Examination
K1	Remember	15
K2	Understand	10
K3	Apply	-
K4	Analyze	-
K5	Evaluate	-
K6	Create	-
Total Marks		25

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Assessment Pattern Level

Assessment Pattern Level No.	Knowledge Level	End Semester Examination
S1	Imitation	10
S2	Manipulation	8
S3	Precision	7
S4	Articulation	
S5	Naturalization	
Total Marks		25

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3							1		1			3	
CO2	3			2					1		2		2	1
CO3	3	3	1	2			2					1	3	

1 – Low 2- Medium 3- High

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MEOEC3010 : ENTREPRENEURSHIP DEVELOPMENT		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs. / Week	**ISEI**	**10Marks**
Tutorial: 00 hrs/week	**ISEII**	**10Marks**
Credits: 02	**ESE**	**30Marks**

Course Outcomes:
After completing the course students will able to

Course Outcomes	
CO1	Describe key issues faced by entrepreneurs and managers at different stages of the life-cycle of an enterprise
CO2	Explain about Making a choice to create an entrepreneurial venture, current trend of technology entrepreneurship,
CO3	Demonstrate how to start a start-up, identifying opportunities and factors driving competitive advantages,

Detailed Syllabus:

Unit 1	Incubation, acceleration, Funding new ventures – bootstrapping, crowd sourcing,angel investors, VCs, debt financing , due diligence,Legal aspects of business (IPR, GST, Labour law, factory act, environment law)
Unit 2	Cost, volume, profit and break-even analysis,Margin of safety and degree of operating leverage,Capital budgeting for comparing projects or opportunities, Product costing,Product pricing, Govt policies for Entrepreneurship
Unit 3	Funding new ventures – bootstrapping, crowd sourcing,Angel investors, VCs, debt financing, and due diligence, Incubation and acceleration, Government incentives for entrepreneurship. Project cost and Financial Closure

Text and Reference Books

1. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses , Eric Ries ,Crown Business
2. Zero to One: Notes on Startups, or How to Build the Future, Peter Thiel, Blake Masters, Crown Business
3. Shoe Dog: A Memoir by the Creator of Nike, Phil Knight, Scribner
4. The $100 Startup: Reinvent the Way You Make a Living, Do What You Love, and Create a New Future,Chris Guillebeau, Crown Business
5. Entrepreneurial Development , S. S. Khanka,Publication House: S. Chand Publishing

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Assessment:
ISE I: Shall be on the basis of Class Testson First unit
ISE II: Shall be based on class test onSecondunit.

Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ESE
K1	Remember	3	3	9
K2	Understand	3	3	9
K3	Apply	2	2	6
K4	Analyze	2	2	6
K5	Evaluate	Nil	Nil	Nil
K6	Create	Nil	Nil	Nil
Total Marks 50		10	10	30

Assessment table:

Assessment Tool	K1, K2 and K3	K1, K2 and K3	K1, K2, K3 and K4
	CO1	CO2	CO3
ISE I (10 Marks)	10	-	-
ISE II (10Marks)	-	5	5
ESE (30 Marks)	7	11	12
Total Marks 50	17	16	17

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2			2			1		1			1	
CO2	2			2	2				1		2		2	1
CO3	3	1	1	2			2					1	1	

1 – Low 2- Medium 3- High

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MEOEC3011 FINANCIAL MANAGEMENT		
Teaching Scheme	**Examination Scheme**	**Marks**
Lectures: 02Hrs/Week	**ISE I**	**10 Marks**
Credits: 02	**ISE II**	**10 Marks**
	ESE	**30 Marks**

Course Outcomes:

After completing the course students will be able to grasp-

CO1	Role, purpose and scope of Financial Management. Basic Accounting. Corporate objectives.
CO2	Time Value of money. Evaluation of different project options. Cost of capital. The relevant costs.
CO3	The Costing, Budgeting. Management of Working capital, Cash & Liquidity.

Detailed Syllabus:

Unit 1	Introduction to Financial Management – its role, purpose& importance. Corporate objectives – types, their significance, CSR. Disclosures, Statutory compliance requirements. Branches of Accounting, Difference between Financial Accounting & Cost Accounting. Book-keeping and Accounting basics – terminology, conventions &concepts.Rules of Debit & Credit, Journalizing, Posting and Financial Statements. Depreciation – concept, methods of calculation.
Unit 2	Time value of money – SI, CI. Use of CI tables for various situations (single payment, annuity/uniform series payment, sinking fund, capital recovery etc). Project evaluation techniques – Payback period, BEP, MARR, Equivalent Worth methods (Present Worth, Future Worth, Annual Worth, NPV, IRR, ERR, RoR, RoI, Benefit-Cost ratio) Cost of capital – measurement, cost of debt, cost of retained earning Relevant cost – meaning, types & examples.
Unit 3	Difference between capital & revenue expenditure. Budget – meaning, terminology, types. Financial Ratios – types, analysis, uses. Working capital, cash & liquidity management. Various cost elements, their variance, Cost accumulation & Cost allocation. Costing – Standard costing, Marginal costing Cost of capital – measurement, cost of debt, cost of retained earning, Balancing & profit & loss

Assessment:

ISE I: Class Test on unit one

ISE II: Class Test on unit two

ESE: Theory paper on full syllabus

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Assessment Pattern:

Assessment Pattern Level Number	Knowledge Level	ISE I CO1,CO2	ISE II CO2,CO3	End Semester Examination CO1,CO2,CO3
K1	Remember	2	2	10
K2	Understand	3	3	10
K3	Apply	5	5	10
Marks		10	10	30

Assessment pattern:

Assessment pattern level	Knowledge levels	ISE I	ISE II	ESE
K1	Remember	2	2	5
K2	Understand	3	2	8
K3	Apply	3	2	6
K4	Analyze	1	1	5
K5	Evaluate	1	3	6
Total Marks: 50		**10**	**10**	**30**

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

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO02
CO 1	2	2	1	2	2						1	2	1	1
CO 2	2	2	1	2	2						2	2	2	2
CO 3	2	2	1	2	2						1	2	1	1

1 – Low 2- Medium 3- High

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MEHNC7001 : ADDITIVE MANUFACTURING TECHNOLOGY		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**15 Marks**
Tutorial: ------	**ISE II**	**15 Marks**
Credits: 04	**ISE III**	**10 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Demonstrate the concept of additive manufacturing and evaluation of its process sequence.
CO2	Interpret the materials required for AM and its properties.
CO3	Explain the suitability of AM process for various applications.
CO4	Draw the 3D component using the knowledge of soft tools for additive manufacturing.
CO5	Apply the suitable process for fabricating a given product considering different real-life case studies.

Detailed Syllabus:

Unit 1	**Overview of Additive Manufacturing (AM)** AM history, process, Classification, Merits, de-merits and applications, AM v/s Conventional Manufacturing processes, CAD for Additive Manufacturing CAD Data formats, STL format (STL, AMF, IGES, STEP),. Outline on AM software. Introduction to reverse engineering, Rapid Prototyping, Rapid Tooling, Rapid manufacturing.
Unit 2	**Materials for AM** Discussion on use of multifunctional and graded materials in AM, Polymers, Metals, Non-Metals, Ceramics, Selection for Various applications. Various forms of raw material- Liquid, Solid, Wire, Powder, Powder Preparation (Powder Metallurgy) and their desired properties, Polymers and their properties. Role of solidification rate, Support Materials.
Unit 3	**AM Techniques** Process parameter, Process Selection for various applications. Liquid, Solid & Powder Based AM Techniques (Stereo lithography, FDM, LOM, Multi jet Modeling, SLS, SLM, Direct Metal Laser Sintering, 3-D Printing) Working Principles, products, materials, merits, drawbacks and applications. Direct Energy Deposition AM Process (Laser Engineered Net Shaping (LENS), Direct Metal

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	Deposition (DMD), Electron Beam based metal deposition) working principles, products, benefits and drawbacks & applications.
Unit 4	**Process selection, planning & control (Soft Tools) for AM** Design / Fabrication processes, Data Sources, Soft Tools, File Formats, 3D-Models Repair and Validation, Pre & post processing Monitoring and control, Part orientation and support generation; Design of support structure for AM, Overview on slicing methods, Tool path generation for AM, Design for Additive manufacturing. Selection of AM technologies using decision methods.
Unit 5	**Application of AM** Aerospace, Automotive, Biomedical Product Development, Commercialization, Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP, 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. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov, Springer 2001.
4. Rapid Prototyping: Theory and practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006
5. Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley & Sons, 2006
6. Laser Metal Deposition Process of Metals, Alloys, and Composite Materials, Engineering Materials and Processes, Mahamood R.M., Springer International Publishing AG 2018

Assessment: ISEI, II, III (Class Test-1, Class Test-2, TA) & ESE

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

1. Surprise Test
2. Assignment / Field visits / Presentations / Course Projects
3. Quiz
4. Any other activity suggested by course coordinator

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember				
K2	Understand	5	5	3	20
K3	Apply	5	5	5	20
K4	Analyze	5	5	2	20
K5	Evaluate				
K6	Create				
Total Marks 100		15	15	10	60

Mapping of Course outcomes with Program outcomes:

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

1 – Low, 2 – Medium, 3 – High

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MEHNC7006 : PRINCIPLES OF ROBOTICS		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs / Week	**ISE I**	**15 Marks**
Tutorial: ------	**ISE II**	**15 Marks**
Credits: 04	**ISE III**	**10 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Explain basic concept of robotics.
CO2	Demonstrate different motions in robotics to analyze instrumentation systems and their various applications.
CO3	Interpret the various end effectors along with selection criterion.
CO4	Illustrate various path planning techniques and accordingly plan robotic path matching with workplace.
CO5	Demonstrate dynamics and control in robotics industries

Detailed Syllabus:

Unit 1	**Basic Concepts** Brief history Types of Robot, Robot classifications and specifications, Robot anatomy, Robot configurations, Robot Components, Various manipulators – Sensors work cell. Types of Robot drives– pneumatic, hydraulic and electrical drive systems, design and control issues.
Unit 2	**Direct and Inverse Kinematics** Mathematical representation of Robots, Position and orientation Homogeneous transformation, and Kinematics -- Coordinate transformation -Vector operations, Basic transformations matrices, Properties of transformation matrices Representation using the DH algorithm (Denavit Hartenberg parameters) Transformations– Forward & Inverse kinematic solution, Brief Robot dynamics.
Unit 3	**Controls and End Effectors** Control system concepts - Analysis - control of joints - Adaptive and optimal control – End effectors - classification - Mechanical - Magnetic Vacuum - Adhesive - Drive systems and controls- Force analysis and Gripper design.

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Unit 4	**Path Planning** Definition-Joint Space Technique-Use of p-degree Polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths Position and orientation planning. Work cell control and interlocks, Robot applications in manufacturing like material transfer and machine loading/unloading, processing operations, assembly and inspection
Unit 5	**Dynamics and Control** Lagrangian mechanics, 2-DOF Manipulator-Lagrange Euler Formulation-Dynamic model – Manipulator control Problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.

Text and Reference Books

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
2. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw- Hill Singapore, 1996.
4. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010
5. K. K.Appu Kuttan, Robotics, I K International, 2007.
6. Klafter,"Robotics Engineering", PHI Pvt. Ltd., New Delhi.
7. Radhakrishnan P. Subramanian S., Raju V.,"CAD/CAM/CIM", New Age International Publishers Pvt. Ltd., New Delhi, India, 2008.

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Assessment: ISEI, II, III (Class Test-1, Class Test-2, TA) & ESE
TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment / Report writing on specific Automation system
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**End Semester Examination**
K1	Remember				
K2	Understand	5	5	3	20
K3	Apply	5	5	5	20
K4	Analyze	5	5	2	20
K5	Evaluate				
K6	Create				
Total Marks 100		15	15	10	60

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Mapping of Course outcomes with Program outcomes:

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

1 – Low, 2 – Medium, 3 – High

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MEHNC7011 : ENERGY AUDIT		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs / Week	**ISE I**	**15 Marks**
Tutorial: ------	**ISE II**	**15 Marks**
Credits: 04	**ISE III**	**10 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Explain different forms of energy and its quality inputs
CO2	Conduct energy audits of various facilities.
CO3	Analyze energy consumption data and identify areas for improvement.
CO4	Evaluate the financial feasibility of energy-saving projects to prepare and present energy audit
CO5	Explain present pattern of energy consumption in different cost centers

Detailed Syllabus:

Unit 1	**Energy Scenario** Introduction, energy problems, energy use trends in developing countries, prospects of changes in energy supply, strategies for sustainable development, finite fossil reserve, Energy and environment, Need for renewable and energy efficiency, Energy conservation principles.
Unit 2	**Energy Audit Process and Techniques** Gathering information on energy consumption patterns, equipment performance, and operational practices. Familiarizing with instruments used for measuring energy consumption, such as ammeters, voltmeters, watt meters, and lux meters. Understanding the principles of material and energy balances to track energy flows within a system. Evaluating the efficiency of various energy systems like boilers, pumps, and motors. Learning to use Sankey diagrams to visualize energy flows and identify areas of loss

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Unit 3	**Energy Conservation and Financial Analysis** Exploring various methods for reducing energy consumption in different sectors. Learning techniques for evaluating the economic feasibility of energy- saving projects, including simple payback period, net present value (NPV), and internal rate of return (IRR). Comparing energy performance against industry standards to identify areas for improvement.
Unit 4	**Reporting and Implementation** Understanding the structure and content of an energy audit report, including recommendations and cost-benefit analysis. Developing strategies for implementing recommendations from the energy audit report. Establishing systems for tracking energy consumption and performance after implementing energy-saving measures.
Unit 5	**Energy Conservation and Recycling** Introduction, Listing of energy conservation opportunities, Electrical ECOs, Thermodynamic ECOs, ECOs in chemical processing industries, ECOs in medium and small industries, ECOs in residential buildings, shopping complexes and in university campus, Human and animal bio-muscle energy, Waste management, Recycling of discarded materials and energy recycling, Waste recycling management.

Text and Reference Books

1. "Energy Technology", by S. Rao, Dr. B.B. Parulekar, Khanna publications, Delhi
2. A.B. Gill, "Power Plant Performance", Butterworths, 1982
3. "The Efficient use of Energy", Ed: I.G.C. Dryden, Butterworths, London, 1982
4. Wood, A.J., Wollenberg, B.F., Power generation, Operations and control, John Wiley, York, 1984

Assessment: ISEI, II, III (Class Test-1, Class Test-2, TA) & ESE

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

1. Surprise Test
2. Assignment / Prepare Energy Audit report for your college
3. Quiz
4. Any other activity suggested by course coordinator

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember				
K2	Understand	5	5	3	20
K3	Apply	5	5	5	20
K4	Analyze	5	5	2	20
K5	Evaluate				
K6	Create				
Total Marks 100		15	15	10	60

Mapping of Course outcomes with Program outcomes:

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

1 – Low, 2 – Medium, 3 – High

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MEHNC7016 : OPTIMUM DESIGN		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs / Week	**ISE I**	**15 Marks**
Tutorial: ------	**ISE II**	**15 Marks**
Credits: 04	**ISE III**	**10 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Explain the concepts of optimization in mechanical design.
CO2	Demonstrate the various optimization techniques.
CO3	Apply procedure of various optimization techniques to solve design problems.
CO4	Design and evaluate the performance of mechanical systems for optimal performance.
CO5	Demonstrate CAD/CAM/CAE software for design and analysis.

Detailed Syllabus:

Unit 1	**Introduction to Optimum Design** A review of the design process from concept to final product, including problem definition, concept generation, analysis, and evaluation. Defining what optimization means in the context of mechanical design, and why it's important. Learning how to express design problems mathematically, including defining design variables, objective functions, and constraints.
Unit 2	**Classical Optimization** Classical optimization methods (single and multi-variable). Linear and non-linear programming. Sequential unconstrained minimization techniques. Approximation techniques, Duality. Taguchi method and Design of Experiments (DOE).

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Unit 3	**Optimization Techniques** General principles of design for manufacture. Design for machining, castings, and forgings. Design for safety considering how optimization can be used to improve the manufacturability and assembly of mechanical components. Incorporating reliability and safety considerations into the optimization process.
Unit 4	**Application to Machine Elements** Applying optimization techniques to the design of shafts, springs, gears, bearings, pressure vessels and other common mechanical components.
Unit 5	**Modelling and Simulation** Mathematical modelling of mechanical systems. Simulation techniques and validation. Use of CAD/CAM/CAE software in design. Introduction to FEA software and techniques. Solid modelling and meshing. Application of boundary conditions and analysis. Post-processing of FEA results.

Text and Reference Books

1. Jasbir S. Arora, Introduction to Optimum Design, 3rd Edition, © 2012 Elsevier.
2. Rao S. S. "Engineering Optimization", John Wiley, New Delhi.
3. Paplambros P. Y. and Wilde D. J., "Principles of Optimum Design: Modeling and Computation", Cambridge University Press, UK.
4. Chandrupatla, "Optimization in Design", PHI, New Delhi.
5. Deb Kalyanmoy, "Optimization in Engineering Design", PHI, New Delhi.
6. Introduction to Optimum Design. Jasbir A. Arora. McGraw Hill.
7. Optimization for Engineering Design - K. Deb, PHI, 2005

Assessment: ISEI, II, III (Class Test-1, Class Test-2, TA) & ESE

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

1. Surprise Test
2. Assignment using Design/Modeling & analysis tools like CAD/CAM/CAE /MATLAB or similar softwares.
3. Quiz
4. Any other activity suggested by course coordinator

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I (Class Test-1)	ISE II (Class Test-2)	ISE III (TA + Surprise Test)	End Semester Examination
K1	Remember				
K2	Understand	5	5	3	20
K3	Apply	5	5	5	20
K4	Analyze	5	5	2	20
K5	Evaluate				
K6	Create				
Total Marks 100		15	15	10	60

Mapping of Course outcomes with Program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2	2							3	2	
CO2	3	3		2	3							3	2	
CO3	3	3	2	2	3							3	3	
CO4	3	2	3	2	2	2	2			2	2	3	3	2
CO5	2		2		3					2	2	3	3	2

1 – Low, 2 – Medium, 3 – High

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MEPCC3008 HEAT AND MASS TRANSFER		
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 Outcomes:

After completing the course, student should be able to:

Course Outcomes	
CO1	Understand the basic modes of heat transfer.
CO2	Compute temperature distribution in steady state and unsteady conduction and analyse heat transfer through extended surfaces
CO3	Interpret and analyze forced and free convection heat transfer
CO4	Understand the principles of radiation heat transfer
CO5	Design heat exchangers using LMTD and NTU methods

Unit 1	**Heat Conduction** Concepts and Mechanism of heat flow: Steady and unsteady state heat transfer, Modes of heat transfer, their physical mechanism. Laws of heat transfer, thermal conductivity, heat transfer coefficient, radiation heat transfer coefficient. Isotropic and an-isotropic materials, Insulation materials, Thermal resistance and thermal conductance. Generalized three dimensional heat conduction equation and reduction to Fourier, Poisson and Laplace equations, Boundary conditions, Steady state heat conduction with and without heat generation in plane wall, cylinder and sphere, electrical analogy, Thermal contact resistance, composite system, critical thickness of insulation on cylindrical bodies, illustrative examples.
Unit 2	**Unsteady State Heat Conduction and Fins** Lumped heat capacity system, Biot number, unsteady state heat transfer for lumped capacity system, Extended Surface: Types of fins, governing equation for pin fin for infinite long fin and fin with negligible heat loss, Fin performance, fin efficiency, fin effectiveness, overall fin effectiveness, approximate solution of fins. Error in temperature measurement by thermometer
Unit 3	**Convective Heat Transfer** Principle of heat convection: mechanism, natural and forced convection. Thermal boundary layer, heat transfer in flow through pipe, entry length, heat transfer in high speed flow, free and forced convection over vertical / horizontal plate, pipe/cylinder and sphere using empirical relations only, Principle of condensation and boiling (No numerical treatment)
Unit 4	**Radiation Heat Transfer** Thermal radiation: Concept, Black body radiation, Spectral and total emissive power, Stefan Boltzmann law, Radiation laws. Irradiation and radiosity, Surface absorption, reflection and transmission, emissivity. Radiation view factor, Properties of view factor, radiation heat exchange betwee

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	surface, radiation shield
Unit 5	**Heat Exchangers and Mass Transfer** Classification of heat exchangers, temperature distribution in parallel, counter flow arrangement, condenser and evaporator, Overall heat transfer coefficient, fouling factor. Log-mean temperature difference method and NTU – effectiveness method of analysis for rating and sizing of heat exchangers. Requirement of good heat exchanger and heat exchanger and design and selection, practical applications, heat pipe. Introduction to Mass transfer, Mass transfer coefficient,Fick's law of diffusion

Reference Books and Text Books:

1. Heat and Mass Transfer, R.K.Rajput, S.Chand & Company Ltd, New Delhi
2. Engineering Heat and Mass Transfer, M. M. Rathore 2nd Edition, Laxmi Publications, New Delhi.
3. Heat Transfer, J.P.Holman ,VII Edition, Mc Graw Hill, 1992
4. Heat and Mass Transfer, R.K.Rajput, Revised edition 2012, S.Chand & Company Ltd,
5. New Delhi.
6. Heat and Mass Transfer, D.S.Kumar, D.S.Kumar , 8th edition 2010,S.K.Kataria & Sons, Delhi
7. Heat Transfer, P.K.Nag, 3rd edition 2011Tata McGraw Hill Publishing Company Ltd,
8. New Delhi.
9. A Text Book on Heat Transfer,Sukhatme S.P, III rd Edition ,Orient Longmans Ltd, New Delhi, 1989.
10. A Course in Heat and Mass Transfer, Arora S.C. & Domkundwar, IVth Edition, Dhanpat Rai & Sons, 1994.
11. Heat Transfer –A Practical Approach, Yunus A. Cengel,2nd edition 2002, Tata McGraw Hill

Assessment:

ISE I: Shall be on the basis of Class Tests on Firstand Second unit.
ISE II: Shall be based on class test on third, fourth units.
ISE III: Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/Presentations

Assessment Pattern:

Assessment Pattern Level	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	2	2	2	
K2	Understand	3	3	3	
K3	Apply	2	2	3	
K4	Analyze	3	3	2	
K5	Evaluate	5	5		
K6	Create				
Total Marks 100		15	15	10	60

Assessment table:

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Assessment Tool	K1 and K2	K2 and K3	K4 and K5	K1 and K2	K2 and K3	K4 and K5
	CO1	CO2	CO3	CO4	CO5	CO6
ISE I (15 Marks)	4	6	5			
ISE II (15 Marks)				4	6	5
ISEIII (10 Marks)	1	2	2	1	2	2
ESE Assessment (60 Marks)	05	10	15	05	10	15
Total Marks 100	10	18	22	10	18	22

Mapping of Course outcome with Program Outcomes and Program
SpecificOutcomes3 – High 2 – Medium 1 - Low

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	1	2											1	
CO2	1	2	2										1	
CO3		3	2										2	
CO4	2	3	2										1	
CO5	1	2	3										2	
CO6	2	2	3										1	

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MEPCC3009 LAB HEAT AND MASS TRANSFER		
Teaching Scheme	**Examination Scheme**	
Practical: 2 Hrs/Week	Term Work	25 Marks
Credits: 1	Practical Examination & Viva Voce	25 Marks

Course Outcome

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

	Course Outcomes
CO1	Understand the basic laws of heat transfer, the fundamentals of convective heat transfer process.
CO2	Analyze problems involving steady state heat conduction in simple geometries, performance of pin fin under different tip conditions, Stefan's Boltzmann constant, emissivity of test surface, critical heat flux
CO3	Develop solutions for transient heat conduction in simple geometries, heat exchanger performance by using the method of log mean temperature difference
CO4	Calculate radiation heat transfer between black body surfaces, radiation heat exchange between gray body surfaces

Minimum Eight experiments shall be performed to cover entire curriculum of course ME. List of Experiments

Sr. No.	**Details**
1	Study the Variation of thermal conductivity with respect to temperature of given metal rod.
2	Determination of thermal conductivity of insulating powder.
3.	Determination of thermal conductivity of composite wall.
4.	Determination of heat transfer coefficient in natural convection
5.	Determination of heat transfer coefficient in forced convection.
6.	Determination of temperature distribution .fin efficiency in natural and forced convection
7.	Determination of emissivity of a test surface
8.	Determination of Stefan Boltzmann constant
9.	Study of pool boiling phenomenon and determination of critical heat flux
10.	Determination of LMTD, overall heat transfer coefficient and effectiveness of heat exchanger in parallel and counter flow arrangement
11.	Determination of heat transfer from a heat pipe.
12	Calibration of thermocouple

Assessment:

ISEIII: Shall be on the basis of assessment of term work.
ESE: ESE will base on oral exam conducted by course coordinator and external examination.

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI
S1	Imitation	5
S2	Manipulation	10
S3	Precision	10
S4	Articulation	
S5	Naturalization	
S6		
Total Marks 50		25

Assessment table:

Assessment Tool	S1 to S3	S1,S2	S1
	CO1	CO2	CO3
ISEIII(25 Marks)	15	10	
ESE (25Marks)	15	5	5
TotalMarks50	30	15	5

Mapping of Course outcome with Program Outcomes and Program

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2
CO1	**1**	**2**											**1**	
CO2		1	**2**	**2**									**1**	
CO3		**1**	**2**	**3**									**2**	
CO4		**1**	**2**	**3**									**2**	

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MEPCC 3010 MACHINE DESIGN - II		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs. / Week	**ISEI**	**15Marks**
Tutorial: 01 hrs./week	**ISEII**	**15Marks**
	ISE III	**10 Marks**
Credits: 03	**ESE**	**60Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Understand the behaviour of helical spring and apply design procedure for solving real life problems.
CO2	Apply the design procedures for Spur Gear and Helical Gear
CO3	Apply the design procedures for Bevel Gear and Worm Gear
CO4	Illustrate design considerations in rolling and sliding contact bearings and apply its design procedure
CO5	Interpret the considerations in design for assembly

Detailed Syllabus:

Unit 1	**Design of Springs:** Types of Springs, Material for Helical Springs, Standard Size of Spring Wire, Terms used in Compression Springs, Stressesin Helical Springs of Circular Wire, Deflection of Helical Springs of Circular Wire, Design procedure of helical spring, Eccentric Loading, of Springs, Buckling of Compression Springs, Surgingof Springs. Leaf Springs, Construction of Leaf Springs. Design procedure of Leaf Springs
Unit 2	**Design of spur gear**: Terminology, Force analysis, Modes of Gear tooth failures. Detail design procedure based on AGMA specifications, problems based on real conditions. Design of helical gear: Terminology, Virtual number of teeth, force analysis, Detail design procedure, problems based on real conditions
Unit 3	**Design of Bevel gears:** Terminology, Types of bevel gears, Force analysis, Beam strength of bevel gears, Wear strength of bevel gears, and effective load on gear tooth, design procedure based on AGMA specifications, Problems based on real conditions. **Design of worm gears:** Terminology, Force and efficiency analysis, Bending and surface fatigue strength, Worm gear thermal considerations, Methods of lubrications
Unit 4	**Rolling contact bearings:** Construction, Classification, static and dynamic load carrying capacity,L10 & L90 life. Load - Life relationship, Design based on manufacture's catalogue, Dynamic Load Rating for Rolling Contact Bearings under Variable Loads.. **Sliding contact bearings**: Working principle of hydrodynamic and hydrostatic bearing, Journal Bearing terminology, Hydrodynamic theory of lubrications, Bearing Design factors, Heat balance of bearing Design of hydrodynamic bearing for particular conditions.
Unit 5	Design for Assembly:

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	Design for ergonomics, Design for safety and reliability, Design for service/maintenance, Design for environment.

Text Books

. Shigley J. E.andMischkey C. R., "Mechanical Engineering Design", TMH, NewDelhi

. Spotts M. F. and ShoupT.E., "Design of Machine Elements", Prentice Hall International

Hall A.S.,HolowenkoA.R.and Laughlin H.G.,"Theory and Problems of Machine Design", Schaum's outline series, Tata McGraw Hill Publication. Co. Ltd, New Delhi

. BhandariV. B.,"DesignofMachineElements",TataMcGraw HillPublication.Co. Ltd,New Delhi

ReferenceBooks:

Black P.H. and O.E. Adam, "Machine Design", Tata McGraw Hill Publication. Co. Ltd, New Delhi

Burghardt M.D., "Introduction to Engineering Design and Problem Solving", McGraw Hill Publications

K.Lingaiah, "Machine Design Databook", Tata McGraw Hill Publication.Co. Ltd, New Delhi

Alfred Hall, Alfred Holowenko, Herman Laughlin, S. Somani, "Machine Design", Tata McGraw Hill Publication. Co. Ltd, New Delhi

Assessment:

ISE 1: Shall be on the basis of Class Tests on First two units or it may base on Assignments/ Quizzes/ Field visits/Presentations/ Course Mini Projects on First and Second unit.

ISE II: Shall be based on class test on third and four units or it may base on Assignments/ Quizzes/ Field visits/Presentations/ Course Mini Projects

ISE III: The design project for group of students shall be based on above mechanical elements consist of Modeling and Analysis and integration of by using SOLIDWORKS software's and ANSYS the students shall design a model use for extensive application

Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ISE III	ESE
K1	Remember	3	3	-	5
K2	Understand	5	5	4	25
K3	Apply	7	7	6	30
K4	Analyze	-	-	-	-
K5	Evaluate	-	-	-	-
K6	Create	-	-	-	-
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K, K2 and K3	K2 and K3	K1, K2, K3	K1, K2, K3	K1, K2, K3
	Co1	C02	Co3	Co4	Co5
ISE I (15 Marks)	5	10	-	-	-
ISE II (15Marks)	-	-	5	10	-
ISE II (10Marks)	2	2	2	2	

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ESE (60 Marks)	10	10	15	15	10
Total Marks 100	17	22	22	27	12

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											1	1
CO2	3	2	1										1	2
CO3	3	2	1										2	1
CO4	1	1	1		1								1	1

1 – Low 2- Medium 3- High

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MEPCC3011INTERNAL COMBUSTION ENGINES AND TURBINES		
Teaching Scheme	**Examination Scheme**	
Lectures: 03Hrs. / Week	**ISEI**	**15 Marks**
Tutorial: 00 hrs/week	**ISEII**	**15 Marks**
Credits: 03	**TA**	**10 Marks**
	ESE	**60Marks**

Course Outcomes:

After completing the course students will be able to:

CO1	Understand various types of I.C.Engines, Cycles of operation and Identify fuel Metering, fuel supply systems for different types of engines.
CO2	Explain combustion phenomenon SI and CI engines and Analyzed the effect of Various operating variables on engine performance.
CO3	Evaluate performance Analysis of IC Engine and Justify the suitability for different applications.
CO4	Explain the conventional and non-conventional fuels and effects of emission for of IC engines, its effects and the legislation standards.
CO5	Analyze the performance of Gas Turbine.

Detailed Syllabus

Unit 1	**I.C. Engines** Classification, selection criteria of IC engines based on application, materials and manufacturing processes of ICE components, firing order and its significance **Fuel Supply systems of SI and CI engines** – Types of carburetor (makes), Fuel supply systems for C.I.engines:Requirement of ideal injection system, types of injection systems, fuel pump sand injectors, types of nozzles,
Unit 2	**Combustion in SI engines**– stages of combustion, ignition lag,engine variable affecting flame propagation, detonation, effects of detonation & its control, octane rating, combustion chamber design principle and types.
	Combustion in CI engines– stages, delay period and it's, variable, diesel knock and its control, octane rating of fuels, different types of combustion chambers. **Comparison of SI &CI engines**– For different thermodynamics and operating characteristics
Unit 3	Testing and performance – Review of IC engine testing, and trial calculation on testing at different load characteristics, Performance characteristics such as brake ThermalefficiencyvolumetricefficiencyBSFC,Economicalrunning,Williamsline, interrelationship of various engines variables, performance graphs

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Unit 4	**Exhaust Emission**– Introduction, constituents of exhaust gas, effects on human health and causes of formation and their measurement pollution control device and EURO standards. **Alternative fuels for I C engines** like LPG, CNG, Alcohols, Hydrogen etc., their need, properties, engine modification and performance Introduction to hydrogen fuel cell engine
Unit 5	**Gas Turbine** – Theory & fundamentals of gas turbine, principle, classification, Atkinson & Joule cycle, assumption for simple gas turbine, cycle analysis, work ratio concept to f maximum and optimum pressure ratio, effect to operating variables on thermal Efficiency, Regenerative, Inter cooling and reheating their effect on performance.

Text and Reference Books

1. HeywoodJ.B.,"Internal combustion EngineFundamentals",McGrawHill,1988
2. ObertE.F.,"Internal combustion Engine and Air Pollution",Intext Educational Pub,1974
3. Mathur M.C., Sharma R.D.," Internal combustion engines",8th Ed.; Dhanpat Rai publication.,2003
4. GanesanV.,"Internal combustion Engines",6thEd.TataMcGraw Hill Publishing Co.
5. Domkundwar V.M. "Internal Combustion Engines"
6. R.K Rajput A text Book on Internal combustion Engines, Laxmi Publications P Ltd
7. PulkrabekW,"EngineeringFundamentals ofInternalCombustionEngine", Prentice Hall,1997

Assessment:

ISE I: Shall be on the basis of Class Tests/Assignments/ Quizzes on First and Second unit.

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

ISE III : Shall be based on Assignments/Quizzes/Field visits/Presentations/ Course Projects

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Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	ESE
K1	Remember	03	03	00	10
K2	Understand	05	05	05	10
K3	Apply	03	03	05	20
K4	Analyze	02	02	00	20
K5	Evaluate	03	03	00	00
K6	Create	00	00	00	00
Total Marks100		15	15	10	60

Assessment table

Assessment Tool	K1to K4	K1to K4	K1to K4	K1to K4	K1to K4
	CO1	CO2	CO3	CO4	CO5
ISE I	05	03	02	05	00
ISE II	05	03	02	00	05
ISE III	03	01	01	03	02
ESE	10	10	10	20	10

Mapping of Course outcome with program outcome

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

1– Low 2- Medium 3 –High

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MEPCC3012 : LAB INTERNAL COMBUSTION ENGINES AND GAS TURBINES		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week /Batch	**ISE III**	**25 Marks**
Credits: 01	**ESE**	**25 Marks**

Course Outcomes:

CO1	Identify the various types of I.C. Engines and Cycles of operation.
CO2	Express the effect of various operating variables on engine performance
CO3	Demonstration of fuel metering and fuel supply systems of different types of Engines
CO4	Analyze &Justify the suitability of conventional and non-conventional Fuels for IC engines
CO5	Understand the effects of emission formation of IC engines, its effects and the legislation standards

Experiments	
Term work shall consists of record of the following experiments	
1.	Trial on diesel engines for performance evaluation.
2.	Trial on petrol engines for performance evaluation.
3.	Morse test trial
4.	Assembling and disassembling of modern fuel supplying system
5.	Theoretical and Actual valve timing diagram of high/low speed engine
6.	Exhaust gas analysis of S.I./C.I. engines.
7.	Study of alternative fuel.
8.	Experiment and trail on VCR IC Engine
9	Industrial visit to minimum to two industries related to I.C. Engine manufacturing or related component

Text and Reference Books

1. Nag P.K., "*Engineering Thermodynamics*", TMH Publishing Co. New Delhi.
2. Ballaney P.L., "*Thermal Engineering*", Khanna Publications, New Delhi.
3. Rajput R.K., "*A Textbook of Engineering Thermodynamics*", Laxmi Publication, New Delhi
4. Domkundwar S, Kothandaraman C. P. &Domkundwar A., "*A Course in Thermal Engineering*", Dhanpat Rai and Co. publication, New Delhi.
5. Rao Y. V. C., "*Engineering Thermodynamics*"**,** Universities Press, Hyderabad
6. Thermodynamics: An Engineering Approach by Yunus A. Cengel (Author), Michael A. Boles (Author)Publication House: McGraw-Hill Education

Assessment:

ISEIII: Shall be on the basis of assessment of term work.

ESE:ESE will base on oral exam conducted by course coordinator and external examination.

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Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ESE
K1	**Remember**	**3**	**3**	**9**
K2	**Understand**	**3**	**3**	**9**
K3	**Apply**	**2**	**2**	**6**
K4	**Analyze**	**2**	**2**	**6**
K5	**Evaluate**	**Nil**	**Nil**	**Nil**
K6	**Create**	**Nil**	**Nil**	**Nil**
Total Marks 50		10	10	30

Assessment table:

Assessment Tool	**K1, K2 and K3**	**K1, K2 and K3**	**K1, K2, K3 and K4**
	CO1	CO2	CO3
ISE I (10 Marks)	**10**	**-**	**-**
ISE II (10Marks)	**-**	**5**	**5**
ESE (30 Marks)	**7**	**11**	**12**
Total Marks 50	17	16	17

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3			2			1		1			3	
CO2	3			2	2				1		2		2	1
CO3	3	3	1	2			2					1	3	

1 – Low 2- Medium 3- High

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MEPEC3009 ADDITIVE MANUFACTURING		
Teaching Scheme	**Examination Scheme**	
Lectures: 03hrs/week	**ISEI**	**15Marks**
Tutorial: 00hrs/week	**ISEII**	**15Marks**
Credits: 03	**ISEIII**	**10Marks**
	End Semester Examination	**60Marks**

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 structures
CO3	Apply the knowledge of software tools for additive manufacturing
CO4	Develop the 3D component using additive manufacturing process

Detailed Syllabus:

Unit1	**Introduction to Additive Manufacturing (AM)** GeneraloverviewIntroductiontoreverseengineeringTraditionalmanufacturingvisAMComputer 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
Unit2	**Software Technologies and Tools** Design/FabricationProcesses:DataSources,SoftwareTools,FileFormats,ModelRepairandValidation, Pre-&Post-processing, Designing for Additive Manufacturing
Unit3	**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
Unit4	**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 modeling object Stereolithography Micro-and Nano–additive
Unit5	**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 **Applications of AM** Applications of AM: Aerospace, Automotive, Biomedical Applications of AM. Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing.

Assessment:

ISE I: Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/Presentations/ Course Projects on first and second unit.

ISEII: 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.

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISE III	End Semester Examination
K1	Remember	5	5		
K2	Understand	5	5		12
K3	Apply	5	5	5	24
K4	Analyze			5	12
K5	Evaluate				
K6	Create				12
TotalMarks100		15	15	10	60

Assessment table:

Assessment Tool	K2.K3	K2,K3	K3	K4	K3,K4
	CO1	CO2	CO3,CO4	CO4	CO5
ISEI(15 Marks)	7	8			
ISEII (15Marks)		5	5	5	
ISEIII (10 Marks)			5	5	
	K2 to K4,K6	**K2 to K4,K6**	**K2 to K4,K6**	**K2 to K4,K6**	**K2 to K4,K6**
ESE Assessment(60Marks)	12	12	12	12	12

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1	PSO2
CO1	2	3	3	3		2	1						2		3
CO2	3	2	3		2	1		1						2	
CO3	2	3	2	3	3	3		2	1				3		
CO4	1			3		2	1		1						3

1– Low 2- Medium 3 –Hi

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MEPEC3010 LAB ADDITIVE MANUFACTURING		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week /Batch	**ISE III**	**25 Marks**
Credits: 01	**ESE**	**25 Marks**

Course Outcomes:

After completion of this course students will be able to:

	Course Outcomes
CO1	Explain different types of 3D Printing techniques
CO2	Identify parameters for powder binding and jetting process
CO3	Determine effective use of ABS material for 3D Printing model
CO4	Apply principles of mathematics to evaluate the volume of material require.
CO5	To create 3D Printing Model

List of the Experiments

The student shall perform following experiments

Sr. No.	Title of the Experiments
1	Module 01: Introduction to Prototyping, Working of 3D Printer, Types of 3D printing Machines: Exp 1: Modeling of Engineering component and conversion of STL format. Exp 2: Slicing of STL file and study of effect of process parameter like layer thickness, Orientation and infill on build time using software. Exercise 1 : Component-1 Exercise 2 : Component-2
3	Module 2: Exp1 : 3D Printing of modeled component by varying layer thickness and orientation Exp 2 : 3D Printing of modeled component by varying infill
4	Module 3: Study on effect of different materials like ABS, PLA, Resin etc, and dimensional accuracy.
5	Module 4: Identifying the defects in 3D Printed components.
6	Module 5 Exp1: Modelling of component using 3D Scanner of real life object of unknown dimension in reverse engineering. Exp 2: 3D Printing of above modeled component

Assessment:

ISEIII: Shall be on the basis of assessment of term work.

ESE: ESE will base on oral exam conducted by course coordinator and external examination.

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Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ESE
K1	**Remember**	**3**	**3**	**9**
K2	**Understand**	**3**	**3**	**9**
K3	**Apply**	**2**	**2**	**6**
K4	**Analyze**	**2**	**2**	**6**
K5	**Evaluate**	**Nil**	**Nil**	**Nil**
K6	**Create**	**Nil**	**Nil**	**Nil**
Total Marks 50		10	10	30

Assessment table:

Assessment Tool	**K1, K2 and K3**	**K1, K2 and K3**	**K1, K2, K3 and K4**
	CO1	CO2	CO3
ISE I (10 Marks)	**10**	**-**	**-**
ISE II (10Marks)	**-**	**5**	**5**
ESE (30 Marks)	**7**	**11**	**12**
Total Marks 50	17	16	17

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course Outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3		2											
CO2	3		2											
CO3	3	3	2										2	1
CO4	3		2										3	2

1- Low 2– Medium 3–High

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MEPEC3011 THEORY OF MACHINES		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISEI**	**15 Marks**
Tutorial: 00 hrs/week	**ISEII**	**15 Marks**
Credits: 3	**ISEII**	**10 Marks**
	ESE	**60 Marks**

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

	Course outcomes
CO1	Explain the principles of balancing of rotary and reciprocating masses.
CO2	Apply the principles of governor and its stabilization on various transport vehicles.
CO3	Analyze the force and power generated in brakes and dynamometer.
CO4	Evaluate static and dynamic force and design dynamically equivalent systems.
CO5	Understand the principles of vibrations.

Detailed Syllabus:

Unit1	**Balancing:** Static balancing, dynamic balancing, balancing of several masses in different planes, force balancing of linkages, balancing of reciprocating mass, balancing of locomotives, effect of partial balancing in locomotives, balancing of inline engines, balancing of V,W,V-8andV-12engines,balancingofradialengines.
Unit2	**Governor:** Introduction to centrifugal & inertia types governor, classification, Watt, porter, pro well spring loaded governor, Sensitivity & stability, Force diagram (Numerical)
Unit3	**Brake & Dynamometers:** Introduction, brake materials, types of brakes, shoe brake,pivotedshoebrake,doubleblockbrake,simpleanddifferentialblockbrake,bandandblockbrake,brakingforce,brakingtorquecalculations,internalexpanding brake, normal pressure braking force, braking torque, braking of vehicle when brake is applied on real wheel, front wheel, four wheels, Types of dynamometer, rope brake, epicyclic train, belt transmission, torsion and eddy current dynamometer, fluid coupling and dynamometer, Numerical treatment.
Unit4	**Static and Dynamic force analysis:** Static equilibrium, equilibrium of two and three force members, equilibrium of four forces and torque, force convention and free body diagrams. D'Alemberts principle, equivalent offset inertia force, dynamic analysis of four link mechanism and slider crank mechanism, Angular velocity and acceleration of connecting rod, engine force analysis.
Unit5	**Vibration:** Introduction, Definitions, Types of vibration, Basic features of vibrating system, cause effects and terminology, degree of freedom, Free longitudinal

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	vibration, displacement, velocity and acceleration, Inertia effect of the mass of spring, Damped vibration, logarithmic decrement, forced vibration, forced damped vibration, free torsional vibration (Single and Two rotor system).

Text Books

Rattan,"Theoryofmachine",TataMcGraw-HillPublishingCo.Ltd,NewDelhi
P.Ballaney,"Theory of machine",Khanna Publication, New Delhi
JagdishLal,"TheoryofmachineandMechanisms",Metropolitanpublication
Thomas Beven,"Theory of machine", CBS Publisher
K. G. Grover, "Mechanical vibration", New Chand publication, New Delhi

Reference Books

Shigley and Vicker,"Theory of machine", Mc Graw-Hill Publishing Co. Ltd ,New Delhi
J.S. Rao& R.V. Dukkipati, Mechanism & Machine Theory, New Age Publication

Assessment:

ISE I: Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/Presentations/ Course Projects on first and second unit.
ISEII: 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	03	03	00	10
K2	Understand	05	05	05	10
K3	Apply	03	03	05	20
K4	Analyze	02	02	00	20
K5	Evaluate	03	03	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table

Assessment Tool	K1	K2	K3	K4	K3
	CO1	CO2	CO3	CO4	CO5
ISE I (15Marks)	05	03	02	05	00
ISE II (15Marks)	05	03	02	00	05
ISE III (10 Marks)	03	01	01	03	02
ESE Assessment (60 Marks)	10	10	10	20	10

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Mapping of Course outcome with Program Outcomes

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

1– low 2 – Medium 3– high

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MEPEC3012 LAB THEORY OF MACHINES		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week /Batch	**ISE III**	**25 Marks**
Credits: 01	**ESE**	**25 Marks**

Course Outcomes:

	Course Outcomes
CO1	Explain the effects of forces in static and dynamic balancing
CO2	Express the effect of various forces, Speed, and acceleration analysis of various governors
CO3	Analysis and evaluation of braking force ,torque of brakes and Dynamometer
CO4	Analyze& Justify the suitability of conventional and non-conventional fuels for IC engines
CO5	Understand various types of vibrational principles

List of Experiments	
Term work shall consists of record of the following experiments	
1.	To draw, solve and calculate the force analysis of static force analysis/ balancing of rotating masses (Min. four problems)
2.	To draw, solve and calculate the force analysis of dynamic force analysis/reciprocating masses/V,W,V-8 and V-12 (Min. four problems).
3.	Trial on any two types of governors
4.	To understand the working and design principle Solve the problems on various types of brakes
5.	To understand the working and design principle Solve the problems on various types of Dynamometers
6.	To Solve the problems on static and dynamics force analysis of various machine parts (Min Five)
7.	To perform any three practical based on vibration like Simple/.compound pendulum/whirling speed of shaft, torsional vibration/damping vibration etc

Assessment:

ISE III: Shall be on the basis of assessment of term work.

ESE: ESE will based on oral exam conducted by course coordinator and external examination.

Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ESE
K1	**Remember**	**3**	**3**	**9**
K2	**Understand**	**3**	**3**	**9**
K3	**Apply**	**2**	**2**	**6**
K4	**Analyze**	**2**	**2**	**6**
K5	**Evaluate**	**Nil**	**Nil**	**Nil**
K6	**Create**	**Nil**	**Nil**	**Nil**
Total Marks 50		10	10	30

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Assessment table:

Assessment Tool	K1, K2 and K3	K1, K2 and K3	K1, K2, K3 and K4
	CO1	CO2	CO3
ISE I (10 Marks)	**10**	**-**	**-**
ISE II (10Marks)	**-**	**5**	**5**
ESE (30 Marks)	**7**	**11**	**12**
Total Marks 50	17	16	17

Mapping of Course outcome with program outcome

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**												1	
CO2		**2**											1	
CO3	**2**												1	1
CO4	**2**												1	
CO5						**2**	**3**						1	

1- Low 2- Medium 3- High

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MEPEC3013 APPLIED THERMODYNAMICS		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISEI**	**15 Marks**
Tutorial: 00 hrs/week	**ISEII**	**15 Marks**
Credits: 03	**ISE III**	**10 Marks**
	ESE	**60 Marks**

Course Outcomes

After completion of the course student will be

	Course Outcome
CO1	Define fundamental thermodynamic principles related to compressors, vapour power cycles, boilers, and cooling systems.(K1)
CO2	Explain the working of compressors, steam turbines, nozzles, and condensers with thermodynamic analysis.(K2)
CO3	Identify and describe different vapour power cycles and their performance parameters used in power plants.(K2)
CO4	Apply thermodynamic laws to calculate boiler efficiency, nozzle flow, and cooling tower performance through problem-solving.(K3)
CO5	Solve numerical problems related to compressors, vapour power cycles, and draught systems. (K3)

Detailed Syllabus

Unit No	**Detailed Syllabus**
Unit 1	**Compressors** Introduction to Compressors, Reciprocating Compressors: Thermodynamic analysis, Actual indicator diagram, Multistage compression, Control of reciprocating compressors, Reciprocating air motor. Rotary Compressors: Centrifugal compressors, Axial flow compressors, Surging and choking, Stalling. Compressor Characteristics: Centrifugal compressor characteristics, Axial flow compressor characteristics. Comparative Study of Compressors Numerical on the Above Topics
Unit 2	**Vapour Power Cycles** Introduction to Vapour Power Cycles:Thermodynamic Cycles: Carnot vapour power cycle, Rankine cycle, Desired thermodynamic properties of working fluids. Performance Enhancement Techniques: Parametric analysis for Rankine cycle improvement, Reheat cycle, Regenerative cycle, Binary vapour cycle, Combined cycle, Combined Heat and Power (CHP) systems. Different Steam Turbine Arrangements. Numerical on the Above Topics
Unit 3	**Steam Nozzles** Flow of Steam through Nozzles and Diffusers:Maximum discharge and critical pressure ratio, Effect of friction on nozzle performance, Determination of throat and exit areas, Nozzle efficiency. Concept of Super-Saturated Flow and Wilson Line. Numerical on the Above Topics
Unit 4	**Boilers and Boiler Draught** Introduction to Boilers in Thermal Power Plants - Boiler Components: Boiler mountings and accessories, Devices for improving boiler efficiency. Boiler Performance Analysis: Boiler

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	rating, Boiler power, Equivalent evaporation, Boiler efficiency, Effect of accessories on boiler efficiency, Heat balance. Boiler Draught: Types of draught, Expression for chimney diameter and height, Condition for maximum discharge, Chimney efficiency, Causes of draught loss. Numerical on the Above Topics
Unit 5	**Condensers and Cooling Towers** Introduction to Condensers: Need and types of condensers, Quantity of cooling water required. Thermodynamic Analysis: Dalton's law of partial pressure, Condenser efficiency, Vacuum efficiency. Air in Condensers: Sources of air, Effects on performance, Condensate pumps, Air extraction pumps, Air ejectors. Cooling Water Systems: Cooling ponds, Spray tanks, Cooling towers (Natural and mechanical wet type). Numerical on the Above Topics

Text and Reference Books

Engineering Thermodynamics, P.K. Nag, McGraw Hill Education (India) Pvt. Ltd.
Applied Thermodynamics, R.K. Rajput, Laxmi Publications Pvt. Ltd.
Fundamentals of Thermodynamics, Richard E. Sonntag, Claus Borgnakke, Gordon J. Van Wylen, John Wiley & Sons.
Applied Thermodynamics for Engineering Technologists, T.D. Eastop and A. McConkey, Pearson Education Limited.
Thermodynamics: An Engineering Approach, Yunus A. Çengel, Michael A. Boles, McGraw Hill Education (India) Pvt. Ltd.
Advanced Engineering Thermodynamics, Adrian Bejan, John Wiley & Sons.
A Heat Transfer Textbook, John H. Lienhard IV, John H. Lienhard V, Dover Publications.
Applied Thermodynamics, Onkar Singh, New Age International Publishers.

Assessment:

ISE 1: Shall be on the basis of Class Tests on First Two units.
ISE II: Shall be based on class test on Third and Fourth.
ISE III: Teacher assessment will be based on Assignments/ Quizzes/ Field visits/Presentations/ Course Projects.

Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ISE III	ESE
K1	Remember	8		3	9
K2	Understand	7	7	3	23
K3	Apply		8	4	28
K4	Analyze	Nil	Nil	Nil	Nil
K5	Evaluate	Nil	Nil	Nil	Nil
K6	Create	Nil	Nil	Nil	Nil
Total Marks		15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K2	K3	K3
	CO1	CO2	CO3	CO4	CO5
ISE I	8	7			
ISE II		3	4	4	4
ISE III	3	2	1	2	2
ESE	9	8	15	14	14
Total Marks 100	20	20	20	20	20

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Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

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

1 – Low 2- Medium 3- High

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MEPEC3014 LAB APPLIED THERMODYNAMICS		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week /Batch	**ISE III**	**25 Marks**
Credits: 01	**ESE**	**25 Marks**

Course Outcomes:

Course Outcomes	
CO1	Define fundamental thermodynamic principles related to compressors, vapour power cycles, boilers, and cooling systems. (K1)
CO2	Explain the working of compressors, steam turbines, nozzles, and condensers with thermodynamic analysis. (K2)
CO3	Apply thermodynamic laws to evaluate the performance of boilers, nozzles, and cooling towers using experimental data. (K3)
CO4	Analyze the efficiency and performance characteristics of compressors, condensers, and vapour power cycles through experimental and computational methods. (K4)

List of the Experiments

The student shall perform minimum eight experiments of the following

Sr. No.	Title of the Experiments
1	Performance Testing of a Two-Stage Reciprocating Air Compressor
2	Performance Analysis of a Coal-Fired Power Plant using Open-Source Dataset
3	Estimation of Condenser Vacuum Efficiency from Historical Data using Python coding.
4	Thermal Power Plant Emission Analysis and Its Effect on Performance
5	Cooling Tower Performance Prediction Using Regression Models
6	Study of Rotary Compressors
7	Study of Cooling Tower and its Performance Parameters
8	Study of Draught System in Boilers
9	Study of Condensers and its Performance Parameters
10	Assignment on Heat Balance Sheet Numerical

Assessment:

ISE III: Shall be on the basis of assessment of term work.

ESE: ESE will based on oral exam conducted by course coordinator and external examination

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	End Semester Examination
K1	Remember	2
K2	Understand	3
K3	Apply	10
K4	Analyze	10

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K5	Evaluate	-
K6	Create	-
Total Marks		25

Assessment Pattern Level:

Assessment Pattern Level No.	**Knowledge Level**	**End Semester Examination**
S1	Imitation	10
S2	Manipulation	8
S3	Precision	7
S4	Articulation	
S5	Naturalization	
Total Marks		25

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1										1		
CO2	3	2	1									1		
CO3	3	3	2	1								1	1	
CO4		2	3	3	2							1		

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MEPEC3015: MECHATRONICS AND CONTROL SYSTEM		
Teaching Scheme	**Examination Scheme**	
Lectures:03Hrs./Week	**ISEI**	**15 Marks**
Credits:03	**ISEII**	**15 Marks**
	ISEIII	**10 Marks**
	End Semester Examination	**60 Marks**

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 PLCL adder 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, Introduction to IoT
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

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Text and Reference Books

Ernest O. Doeblin, “Measurement Systems Application and Design”, McGraw Hill International Publication.
W.Bolton, “Mechatronics,”AddisonWesleyLongman.
Mahalik, “Principles,concepts and applications Mechatronics”,TMH
Ramesh Gaonkar,“Introduction to8085-PENRAM”,International Publishing.
Muzumdar, “Pneumatics”–TataMcGraw-HillEducation.
Pipenger,“ Hydraulic valves and controls”,M.Dekker.
K.Ayala,“8051microcontroller Architecture, programming & Application”– Penram International Publishing
Steward, “Hydraulics and Pneumatics for production”,Audal Series.
“Fundamentals of Pneumatics”,Festo series.
G.K.McMillan,“Process/IndustrialInstrumentsandControlsHandbook,”McGraw- Hill.

Online Resources:

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

Assessment:

ISEIII: Teacher’s Assessment:

ISE I: Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/Presentations/ Course Projects on first and second unit.
ISEII: Shallbe based onclass test on third and fourth units.
ISE III: Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/Presentations/ Course Project

Assessment Table:

Assessment Tool	K1 to K4	K1 to K4	K1 to K4	K1 t oK4	K1 to K4
Cos	CO1	CO2	CO3	CO4	CO5
Class Test (15Marks)	07	08			
Class Test (15Marks)			07	08	
Teachers Assessment (10 Marks)	02	02	02	02	02
ESE Assessment (60 Marks)	12	12	12	12	12

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Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test1	Test2	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

Mapping of Course out comes with Program out comes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

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MEPEC3016: LAB MECHATRONICS AND CONTROL SYSTEM		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week /Batch	**ISE III**	**25 Marks**
Credits: 01	**ESE**	**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 modeling of HVAC system for energy efficiency analysis

Assessment:

ISE III: Shall be on the basis of assessment of term work.

ESE: ESE will based on oral exam conducted by course coordinator and external examination

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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 (25Marks)	4	4	5	6	6
Practical Examination & Viva Voce (25 Marks)	4	4	5	6	6

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MEPEC3017 INTRODUCTION TO COMPOSITE MATERIAL		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs. / Week	**ISEI**	**10Marks**
Tutorial: 00 hrs/week	**ISEII**	**10Marks**
Credits: 02	**ESE**	**30Marks**

Course Outcomes	
CO1	Recognise composite materials and its advantages and limitations
CO2	Relate to the production process of composite material
CO3	Appraise the design of the various types of composite materials

Detailed Syllabus:

Unit 1	Classifications of composites, general properties, application of composites in engineering, Advantages and Limitations, mechanical properties of composites.
Unit 2	Rule of mixtures equation of composites, strengths of orthotropic lamina, analysis of Laminated Composites, stress strain variations in laminates
Unit 3	Polymer matrix materials, metal matrix materials, ceramic matrix materials, carbon materials, glass materials, fiber reinforcements, types of fibers, whiskers, laminar composites, filled composites, particulate reinforced composites, dental composites

Text and Reference Books

1.S Mileiko, "Metal and Ceramic Based Composites", Pub. Elsevier, 1st Edition,
2. V Raghavan, "Physical Metallurgy: Principles and Practice", Pub. PHI Learning, 2nd Edition
3. Chawla, Krishan K., "Composite Materials", Pub. Springers
4. Roman Pampuch, "An Introduction to Ceramics", Pub. Springers

Assessment:
ISE I: Shall be on the basis of Class Tests on First unit
ISE II: Shall be based on class test on Second unit

Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ESE
K1	Remember	3	3	9
K2	Understand	3	3	9
K3	Apply	2	2	6
K4	Analyze	2	2	6
K5	Evaluate	Nil	Nil	Nil
K6	Create	Nil	Nil	Nil
Total Marks 50		10	10	30

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Assessment table:

Assessment Tool	**K1, K2 and K3**	**K1, K2 and K3**	**K1, K2, K3 and K4**
	CO1	CO2	CO3
ISE I (10 Marks)	10	-	-
ISE II (10Marks)	-	5	5
ESE (30 Marks)	7	11	12
Total Marks 50	17	16	17

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2			2			1		1			1	
CO2	2			2	2				1		2		2	1
CO3	3	1	1	2			2					1	1	

1 – Low 2- Medium 3- High

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MEPEC3018 OPERATION RESEARCH		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs. / Week	**ISEI**	**10 Marks**
Tutorial: 00 hrs/week	**ISEII**	**10 Marks**
Credits: 02	**ESE**	**30 Marks**

Course Outcome:

Up on the completion of course, the student will be able to:

	Course Outcome
CO1	Identify and develop operational research models from the verbal description of the real system.
CO2	Understand the mathematical tools that are needed to solve optimisation problems.
CO3	Use mathematical software to solve the proposed models
CO4	Analyse the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.

Detailed Syllabus

Unit	Details
Unit 1	**Introduction:** Origin of Operation Research, Historical Standpoint, Methodology, Different Phases, Characteristics, Scope and Application of Operations Research. **Linear Programming (LP):** Concepts, Formulation of model, Graphical solution, Maximization / Minimization – Simplex Algorithm, Use of slack / surplus / artificial variables, Big M and Two phase method – Nature & type of solutions, Interpretation of optimal solution. Dual problem – relation between primal and dual.
Unit 2	**Transportation& Assignment problems:** Concepts, formulations of models, Solution procedures, Optimality checks, Balanced/Unbalanced, Maximum/Minimum problems, Prohibited case –degeneracy **Queuing Models:** Basis of Queuing theory, elements of queuing theory, Kendall's Notation, Operating characteristics of a queuing system, Classification of Queuing models.
Unit 3	**Replacement Models:** Introduction, Replacement of capital equipment which depreciated with time, replacement by alternative equipment, Group and individual replacement policy. **Decision Theory:** Introduction, Decision under certainty, Decision under risk, Decision under uncertainty: Laplace criterion, Mini Max criterion, savage Mini Max regret criterion, hurwicz criterion, Decision tree.

Text Books & Reference Books:

1	Quantitative Techniques in management, N.D. Vora–Tata McGraw Hill
2	Operations Research –An Introduction –Fifth edition by Hamdy A Taha- Prentice Hall of India, New Delhi.

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3	PrinciplesofOperationsResearch:WithApplicationstoManagementDecisions,Wagner,H. M.,Prentice-HallofIndia,NewDelhi, 1982.
4	HillierF.S. and Lieberman ,G.J. OperationsResearch,HoldDayInc.,SanFrancisco,1974.
5	Littlechild,S.C.(ed),OperationalResearch for Managers,PhilipAllan,Oxford,1977.
6	Mitchell,G.H.(ed),OperationalResearchTechniquesandexamples,TheEnglishUniversities Press Ltd., London, 1972. Moder, J.J. and Elmaghraby, S.E. (ed.),
7	Handbook of Operations Research:ModelsandApplications,VanNostrandReinholdCo.,NewYork,1987.

Assessment:
ISE I: Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/Presentations/ Course Projects on first unit.
ISEII: Shall be based on class test on second units.

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISEI**	**ISEII**	**ISE III**	**End Semester Examination**
K1	Remember	5	5		
K2	Understand	5	5		12
K3	Apply	5	5	5	24
K4	Analyze			5	12
K5	Evaluate				
K6	Create				12
TotalMarks100		15	15	10	60

Assessment table:

Assessment Tool	**K2.K3**	**K2,K3**	**K3**	**K4**	
	CO1	CO2	CO3,CO4	CO4	
ISEI(10 Marks)	4	6			
ISEII (10Marks)		0	5	5	
	K2 to K4,K6	**K2 to K4,K6**	**K2 to K4,K6**	**K2 to K4,K6**	
ESE Assessment(30Marks)	8	8	7	7	

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Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

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

1 – Low 2- Medium 3- High

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MEPEC-3019 PACKAGED EQUIPMENT DESIGN		
Teaching Scheme	**Examination Scheme**	**Marks**
Lectures: 02 Hrs/Week	**ISE I**	**10 Marks**
Credits: 02	**ISE II**	**10 Marks**
	ESE	**30 Marks**

Course Outcomes:

After completing the course students will be able to grasp -

	Course Outcomes
CO1	The concept & need for a packaged solution to a process plant / facility requirement. Design standards & Codes. Basic process control.
CO2	Various options available in the market for designing the solutions as above.
CO3	Provide a holistic design of the Packaged Equipment as per Client's requirement.

Detailed Syllabus:

Unit 1	Concept of Modular design and Packaged Equipment. The need to design & build a packaged solution for the process plants & facilities. Area classification (hazardous, non-hazardous) National & international design standards (e.g. IS, ASTM, API, ASME) for pressure vessels, storage tanks, heat exchangers, pumps, compressors, valves, motors etc. Basics of process control – Control loops for pressure, temperature, volume. Devices used in control loops such as sensors, switches, transmitters, transducers, controllers, positioners, actuators, control valves, gauges, NRV/check valves, basic Motor Control Circuit.
Unit 2	Application based types of – pumps, compressors, diesel engines, petrol engines, gas turbines, fans, blowers, electrical motors, bearings, couplings, belts, gear boxes, chain drives, fasteners, washers, valves, mountings, enclosures, silencers, electrical starters, air filtration systems, exhausts, air/gas dehydration systems, material handling systems (Cranes, Conveyors), safety valves. Fire & Gas detection system – detector types, permissible LEL levels. Types of Ingress Protection. Capacity control in different types of Air/Gas compressors.
Unit 3	Selection of package components based on Client's complete Scope of Work, includes - Boundary/battery limits, Site Conditions (Soil, land/marine, Wind speed, ambient temperature etc), Area classification on the master layout, Enclosure, HSE requirement of the client and local law, Operating parameters, Designed life, Performance parameters/limits, Permissible downtime for planned maintenance (MTBO), Reliability, Redundancy, Maintenance space and special tools requirement, Hook-up points, Packing for transportation and handling. Preparation of Process Flow Chart and P&I Diagram. Getting approval from the Client. Mutual agreement on Quality tests, performance tests at Factory and at Site. Designing the Package as per approved specifications and drawings. Preparation of O&M manual containing specification sheet for each component, Dos & Don'ts. Introduction to Packaged equipment performance simulation packages.
	(**The syllabus does not include** - Fabrication of the Module/Packaged Equipment, Hook-up, Pre-commissioning & Commissioning of the Module/Package at site)

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Assessment:

ISE I: Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/Presentations/ Course Projects on first unit.
ISEII: Shall be based on class test on second units

Assessment pattern:

Assessment pattern level	**Knowledge levels**	**ISE I**	**ISE II**	**ESE**
K1	Remember	2	3	9
K2	Understand	4	3	7
K3	Apply	3	4	10
K4	Analyze	1	0	4
Total Marks: 50		**10**	**10**	**30**

Assessment table:

Assessment Tool	K1, K2	K1, K2	K2, K3
	CO1	CO2	CO3
ISE I	6	4	
ISE II		4	6
ESE	10	10	10
Total Marks 50	16	18	16

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

Course outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**
CO1	3	2	3			3					3		3	3
CO2	3	3	3			3					2		3	3
CO3	3	3	3			3					2		3	3

1- Low 2- Medium 3- High

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MEPEC3020 - HYBRID AND ELECTRIC VEHICLE		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs. / Week	**ISEI**	**10Marks**
Tutorial: 00 hrs/week	**ISEII**	**10Marks**
Credits: 02	**ESE**	**30Marks**

After completing this course, students will be able to

	Course Outcomes
CO1	Describe the fundamental concepts of hybrid and electric vehicle technology, including historical development, hybridization types, and energy storage systems. (K1, K2)
CO2	Explain the working principles of different drive systems, energy storage methods, and the role of IoT in modern electric vehicles. (K1, K2)
CO3	Compare various energy storage and management strategies for hybrid and electric vehicles, considering real-world applications and Indian infrastructure. (K2, K3)

Detailed Syllabus

Unit No.	**Topics Covered**
Unit 1	**Introduction to Hybrid Electric Vehicles** Overview of Hybrid Electric Vehicles (HEVs), Historical Development of Automobiles and the Invention of Hybrid Vehicles, Evolution of Hybrid Technology: Modern Developments, Economic and Environmental Impact of Hybrid Electric Vehicles, Hybridization in E-Vehicles: Types and Concepts **Key Concepts:** Ragone Plot: Theory and Application, Hybridization with IC Engines and Batteries (Various Types) ,Integration of Solar and Other Non-Conventional Energy Sources with Batteries , Current Scenario in India: Availability and Usage of Different Battery Technologies in E-Vehicles
Unit 2	**Drive Systems for E-Vehicles** Introduction to Drive Systems in Electric Vehicles,Types of Motors: Selection, Sizing, and Classification - General Characteristics, Operation Principles, and Performance of Motor Drives ,Mechanical and Electrical Connections in Motor Systems. **Advancements in E-Vehicles:** Integration of IoT in Electric Vehicles, Wireless Sensor Networks and the Role of IoT, Intelligent Transport Systems (ITS)
Unit 3	**Energy Storage and Management Strategies** **Energy Storage:** Energy Storage Requirements for Hybrid and Electric Vehicles **Types of Energy Storage Systems:** Battery-Based Storage: Analysis and Performance, Fuel Cell-Based Storage: Functionality and Applications, Super capacitor-Based Storage: Efficiency and Uses, Flywheel Energy Storage: Principles and Advantages, Hybrid Energy Storage: Combining Different Technologies, Battery Degradation, Disposal, and Recycling Practices, Fast and Efficient Charging Methods, Availability of Charging Stations in India and Related Infrastructure, Standardization and Safety Regulations for E-Vehicle Energy Systems. **Energy Management Strategies:** Overview of Energy Management Strategies in

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	Hybrid and Electric Vehicles, Classification and Comparison of Various Energy Management Approaches, Implementation Challenges in Energy Management

Text and Reference Books

Advances in Battery Technologies for Electric Vehicles – Bruno Scrosati, Jürgen Garche, and Werner Tillmetz (Woodhead Publishing Series in Energy: Number 80)

Behaviour of Lithium-Ion Batteries in Electric Vehicles: Battery Health, Performance, Safety, and Cost – Gianfranco Pistoia, Boryann Liaw

Fundamentals and Applications of Lithium-Ion Batteries in Electric Drive Vehicles – Jiuchun Jiang and Caiping Zhang (Beijing Jiaotong University, Wiley Publications)

Electric Motor Drives – Modelling, Analysis & Control – R. Krishnan (PHI India, Ltd.)

Modern Electric, Hybrid Electric, and Fuel Cell Vehicles (Third Edition) – Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz M. Ebrahimi

Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design – Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali

Web link: https://emobility.araiindia.com/standards.

https://archive.nptel.ac.in/courses/108/103/108103009/#

Assessment:

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

ISE II: Shall be based on class test on Second unit.

Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ESE
K1	Remember	6		10
K2	Understand	4	4	10
K3	Apply		6	10
K4	Analyze	Nil	Nil	Nil
K5	Evaluate	Nil	Nil	Nil
K6	Create	Nil	Nil	Nil
Total Marks 50		10	10	30

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Assessment table:

Assessment Tool	K1, K2	K1, K2	K2, K3
	CO1	CO2	CO3
ISE I	6	4	
ISE II		4	6
ESE	10	10	10
Total Marks 50	16	18	16

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1				2					2	3	1
CO2	3	3	2				2					3	1	2
CO3	2	3	3				3					3	1	3

1 – Low 2- Medium 3- High

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MEPEC3021 – Design and Analysis of Turbomachines [		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs. / Week	**ISEI**	**10 Marks**
Tutorial: 00 hrs/week	**ISEII**	**10 Marks**
Credits: 02	**ESE**	**30 Marks**

	Course Outcomes
CO1	To understand the working principles and classifications of turbomachines.
CO2	To analyses performance and mechanical stress in turbomachine components.
CO3	To apply CFD and FEA tools for simulation-based design and evaluation using Siemens software. [or Ansys]
CO4	To develop mini projects based on industrial case studies involving design validation.

Unit No.	**Topics Covered**
Unit 1	**Fundamentals of Turbomachines Classification:** Hydraulic, Steam, Gas, Air Compressors, Energy transfer: Euler's equation, velocity triangles, Impulse vs. reaction machines, Efficiencies: isentropic, mechanical, volumetric, Performance characteristics: specific speed, unit quantities
Unit 2	**Structural and Flow Analysis of Turbomachine Components** Stress in rotating disks and blades, Blade loading: centrifugal, thermal, and pressure stresses, Fatigue, creep, and failure theories, Governing equations for fluid flow: Navier-Stokes, continuity, Flow separation and boundary layers in turbomachines
Unit 3	**Application of CFD and FEA using Siemens Tools** Introduction to Siemens tools: Simcenter, [else Ansys or Comsol] CAD modelling of blades and impellers, Meshing and simulation: steady/transient flow, thermal and stress simulation. Case Studies: Gas turbine blade stress under high-temperature flow, Pump impeller cavitation and pressure distribution, Fan/Compressor efficiency analysis Microproject: Design, analyze of a turbomachine component using Siemen

Text and Reference Books

• S.L. Dixon and C.A. Hall, Fluid Mechanics and Thermodynamics of Turbomachinery, 7th Edition, Elsevier, 2014.
• S.S. Rattan, Strength of Materials, 3rd Edition, McGraw-Hill Education, 2011.
• H.K. Versteeg and W. Malalasekera, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, 2nd Edition, Pearson Education, 2007.
• https://onlinecourses.nptel.ac.in/noc21_me127 • https://onlinecourses.nptel.ac.in/noc24_ae23
• https://onlinecourses.nptel.ac.in/noc20_me64

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Assessment:
ISE 1: Shall be on the basis of Class Tests on First and Second unit or Assignments/ Quizzes/ Field visits/Presentations/ Course Projects on First unit and Second Unit
ISE II: Shall be based on class test on Third and Fourth Unit.

Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ESE
K1	Remember			
K2	Understand	6		10
K3	Apply	4	4	10
K4	Analyze		6	10
K5	Evaluate			
K6	Create			
Total Marks 50		10	10	30

Assessment table:

Assessment Tool	K1, K2	K2, K3	K3, K4	K2, K3
	CO1	CO2	CO3	CO3
ISE I	5	5		
ISE II			5	5
ESE	5	5	10	10
Total Marks 50	10	10	15	15

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1				2					2	3	1
CO2	3	3	2				2					3	1	2
CO3	2	3	3				3					3	1	3
CO4	3	2	1				2					2	3	1

1 – Low 2- Medium 3- High

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MEMDM5006 POWER PLANT ENGINEERING		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISEI**	**15 Marks**
Credits: 03	**ISEII**	**15 Marks**
	ESE	**60Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Understand the energy demand of Nation
CO2	Understand the various types of power plant, components, performance and concept of base load and peak load
CO3	Aware of Pros and Cons of various power plants.
CO4	Recognize the importance of secondary energy source.

Detailed Syllabus:

Unit 1	**Introduction:** Sources of Energy- Resources and Development of Power in India. Layouts of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants - Combined Power Cycles - Comparison and Selection. Power Plant Economics and Environmental Considerations: Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve. Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor - Tariff - Related Exercises. Effluents from Power Plants and Impact on Environment - Pollutants and Pollution Standards - Methods of Pollution Control. Inspection And Safety Regulations.
Unit 2	**Steam Power Plant:** Modern High Pressure and Super Critical Boilers-Analysis of Power Plant Cycles-Modern Trends in Cycle Improvement-Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipment, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems. Steam Power Plant: Combustion Process: Properties of Coal-Overfeed and Under Feed Fuel Beds, Traveling Grate Stokers, Spreader Stokers, Retort Stokers, Pulverized Fuel Burning System and Its Components, Combustion Needs and Draught System, Cyclone Furnace, Design and Construction, Dust Collectors, Cooling Towers and Heat Rejection. Analysis of Pollution from Thermal Power Plants -PollutionControls.CO_2 Recorders
Unit 3	**Diesel Power Plant: Introduction**–IC Engines, Types, Construction-Plant Layout with Auxiliaries -Fuel Storage GASTURBINEPLANT: Introduction- Classification- Construction- Layout with Auxiliaries-Principles of Working Closed and Open Cycle as Turbines. Advantages And Disadvantages Combined Cycle Power Plants.
Unit 4	**Hydro Electric Power Plant:** Waterpower – Hydrological Cycle / Flow Measurement –Drainage Area Characteristics-Hydrographs-Storage and Pondage -Classification of Dams and Spill Ways. Hydro Projects And Plant: Classification-Typical Layouts-Plan Plant Operation Pumped Storage Plants.

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Unit 5	**Power from Non-Conventional Sources:** Utilization of Solar Collectors-Principle of its Working, Wind Energy - Types of Turbines - HAWT & VAWT-Tidal Energy. MHD power Generation. Nuclear Power Station: Nuclear Fuel -Nuclear Fission, Chain Reaction, Breeding and Fertile Materials-Nuclear Reactor-Reactor Operation. Types Of Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding-RadioactiveWasteDisposal.

Text and Reference Books

1. Power plantEngineering,P.K. Nag, TMH,3rdEdition,2013.
2. AcourseinpowerplantEngineering,AroraandS.Domkundwar, charotar publications
3. ATextBookofPowerPlantEngineering,Rajput,LaxmiPublications,4thedition,2012.
4. PowerplantEngineering,Ramalingam,Scie-techPublishers
5. Powerplant engineeringP.C. Sharma, S.K.KatariaPublications,2012.

Useful Links

- http://www.nprcet.org/e%20content/Misc/e-Learning/EEE/II%20YEAR/EE2252%20-%20Power%20Plant%20Engineering.pdf

Assessment:

ISE I: Shall be on the basis of Class Tests on First unit &Second unit

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

ISE III: Assignments/ Quizzes/ Field visits/Presentations/ Course Projects

Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ISE3	ESE
K1	Remember	5	5	3	12
K2	Understand	5	5	3	12
K3	Apply	3	3	2	12
K4	Analyze	2	2	2	12
K5	Evaluate	Nil	Nil	Nil	12
K6	Create	Nil	Nil	Nil	Nil
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1, K2 and K3	K1, K2 and K3	K1, K2, K3 and K4	K1, K2 and K3	K1, K2 and K3
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	5	10			
ISE II (15Marks)			5	10	
ISEIII(10Marks)				5	5
ESE (60 Marks)	12	12	12	12	12
Total Marks 100	17	22	17	27	17

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Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

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

1 – Low 2- Medium 3- High

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MEMDM6006: PRODUCTION PLANNING AND CONTROL		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISEI**	**15 Marks**
Tutorial: 00 hrs/week	**ISEII**	**15 Marks**
Credits: 03	**ISEIII**	**10 Marks**
	ESE	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Define key terminology related to production planning and control, such as 'master production schedule, 'material requirements planning,' and 'capacity planning.'"
CO2	Explain the relationship between demand forecasting and production scheduling.
CO3	Apply Material Requirements Planning (MRP) principles to calculate net material requirements for a given product
CO4	Analyze different production planning strategies (e.g., make-to-stock, make-to-order) and compare their suitability for various manufacturing environments
CO5	Evaluate the effectiveness of a production control system by assessing its ability to minimize inventory costs and meet customer delivery deadlines.

Detailed Syllabus:

Unit 1	Introduction to PPC, System approach, Type of manufacturing systems,Factors affecting manufacturing systems,functional aspects, operationalaspects, durability and dependability, aesthetic aspects, economicanalysis, profit and competitiveness, the three S's, break evenanalysis, economics of a new design, production aspects.
Unit 2	Forecasting Introduction, Demand patterns, Factors affecting demand, Subjectiveforecasting methods, Casual forecasting methods, Time seriesforecasting methods, Routine short term forecasting methods,Selection of forecasting model.
Unit 3	CPM/PERT Introduction, Project scheduling with CPM, Project scheduling with PERT. Loading and SchedulingGeneral scheduling problem, Significance of loading and scheduling,Factors affecting scheduling, Scheduling system, Flow shop Scheduling, Job shop scheduling, Sequencing, Line balancing.
Unit 4	Inventory Management Introduction, Inventory related costs, EOQ model, EPO model, inventory models allowing shortages, Inventory models allowing pricediscounts, Inventory model under risk conditions, Inventory control systems: continuous review, periodic review, optional replenishment, JIT , LIFO, FIFO,etc., Inventory classification systems: ABC, FMS, VED etc, MRP.
Unit 5	Capacity Planning Introduction, measures of capacity, capacity strategies, A systematic approach for capacity decisions, Long range capacity planning and control, Medium range capacity planning and control, Short range capacity planning and control.

Text and Reference Books

Production Planning and Control: Text and Cases, S. K. Mukhopadhyay,PHI Learning
Production Planning and Control: A Comprehensive Approach, D.R. Kiran, Butterworth-Heinemann / BS Publications / BSP Books
Fundamentals of Production Planning and Control, Simy Joy ,Payal Ana Rajeev, Pearson.

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Production Planning and Control,Dr.V.Jayakumar, Lakshmi Publications.

Assessment:
ISE I: Shall be on the basis of Class Tests on First unit &Second unit
ISE II: Shall be based on class test on third unit and fourth units.
ISE III: Assignments/ Quizzes/ Field visits/Presentations/ Course Projects

Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ISE3	ESE
K1	Remember	5	5	3	12
K2	Understand	5	5	3	12
K3	Apply	3	3	2	12
K4	Analyze	2	2	2	12
K5	Evaluate	Nil	Nil	Nil	12
K6	Create	Nil	Nil	Nil	Nil
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1, K2 and K3	K1, K2 and K3	K1, K2, K3 and K4	K1, K2 and K3	K1, K2 and K3
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	5	10			
ISE II (15Marks)			5	10	
ISEIII(10Marks)				5	5
ESE (60 Marks)	12	12	12	12	12
Total Marks 100	17	22	17	27	17

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2			2			1		1			1	
CO2	2			2	2				2		3		2	1
CO3	1	1	1	2			2					1	1	
CO4					3	2				1		2		
CO5	2	2	1	2										

1-Low 2- Medium 3- High

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MEVSE3001 Workshop Practice-III		
Teaching Scheme	**Examination Scheme**	
Practical : 4 hrs. per week	**ISE III**	**25 Marks**
Credit : 02	**End Semester Examination**	**25 Marks**

Course Outcomes:
After completing the course students will able to

CO1	Prepare CAD models with slicing software for additive manufacturing on 3D Printer
CO2	Perform robotic welding operations including equipment setup, seam tracking, and quality control.
CO3	Design and generate toolpaths using ArtCAM and operate CNC wood routers effectively.
CO4	Operate laser cutting machines for non-metal sheets using integrated design tools.
CO5	Integrate 3D printing, robotic welding, CNC, and laser cutting skills in a project with safety and quality standards.

Detailed Syllabus:

Unit No.	Topics Covered
Unit 1	**3D Printing** Fundamentals of additive manufacturing and 3D printing technologies; types of 3D printers and materials; CAD model preparation using software like Fusion 360 or Tinker CAD; slicing and G-code generation using Cura; printer setup, operation, and troubleshooting; safety measures and hands-on practice on 3D printers.
Unit 2	**Robotic Welding** Fundamentals of robotic welding (TIG, MIG); equipment setup, seam tracking, and quality control; hands-on welding practice with robotic systems, assembly, review of fixture system.
Unit 3	**CNC Wood Router & Art CAM** CNC router components and tooling; Introduction to Art CAM for design and tool path generation; programming and hands on CNC wood router.
Unit 4	**Laser Cutting (Non-metal Sheets)** Principles of laser cutting technology; machine operation and parameter settings; design integration using CorelDraw, AutoCAD, and hands on laser cutting system etc.
Unit 5	**Project-Based Integration** Applying combined skills in robotics, CNC, and laser; project planning, execution, and evaluation; safety practices and quality assessment.

Text a/ **Reference Books**

1. Elements of Workshop Technology: Hajra Choudhury
2. CNC Programming Handbook: Peter Smid
3. Laser Cutting Guide for Manufacturing: Charles Caristan
4. **Web References:** Art CAM official site, Autodesk resources, Robotics industry tutorials

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Assessment:

Assessment Tool	Marks	Cognitive Levels Assessed
ISE I (Internal Assessment)	10	K2 – Understand, K3 – Apply
ISE II (Internal Assessment)	10	K2 – Understand, K3 – Apply
End Semester Examination	30	K2 – Understand, K3 – Apply
Total	**50**	

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	End Semester Examination
K1	Remember	-	-	-
K2	Understand	2	2	10
K3	Apply	4	4	10
K4	Analyze	4	4	10
K5	Evaluate	-	-	-
K6	Create	-	-	-
Total Marks		10	10	30

Assessment Pattern:

Assessment Tool	**K2, K3**	**K2, K3**	**K2, K3**
ISEI(10 Marks)	10		
ISEII (10Marks)		10	
	K2 to K3	**K2 to K3**	**K2 to K3**
ESE Assessment (30Marks)	10	10	10
Total Marks 50	20	20	10

Mapping of Course outcomes with Program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	1	1	1	1	1	-	1	1	**1**
CO2	2	1	2	-	-	1	1	1	1	1	-	1	**1**	**1**
CO3	2	2	3	1	2	1	1	2	2	1	-	1	1	**1**
CO4	2	2		2	-	3	1	2	1	1	-	1	1	**1**
CO5	3	3	3	3	2	1	1	2	2	1	-	1	1	**1**

1 – Low, 2 – Medium, 3 – High

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MEHNC7002: DESIGN FOR ADDITIVE MANUFACTURING		
Teaching Scheme	**Examination Scheme**	
Lectures: 4Hrs / Week	**ISE I**	**15 Marks**
Credits: 04	**ISE II**	**15 Marks**
	ISE III	**10 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:
After completing the course students will able to

Course Outcomes	
CO1	Explain design for additive manufacturing
CO2	Develop mathematical models to represent synthetic curves and surfaces
CO3	Demonstrate design constraints and choose a polymer and metal AM process
CO4	Develop lattice structures using topology optimization
CO5	Apply design for additive manufacturing guidelines in design analysis

Detailed Syllabus:

Unit 1	Introduction to Design for Additive Manufacturing (DAM): Introduction to geometric modelling, Modelling of Synthetic curves like Hermite, Bezier and B-spline, Parametric Representation of freeform surfaces, Design freedom with AM, Need for Design for Additive Manufacturing (DfAM), CAD tools vs. DfAM tools, Requirements of DfAM methods, General, Guidelines for DfAM, The Economics of Additive Manufacturing, Design to Minimize Print Time, Design to Minimize Post-processing.
Unit 2	Design Guidelines for Part Consolidation: Design for Function, Material Considerations, Number of Fasteners, Knowledge of Conventional DFM/DFA, Assembly Considerations, Moving Parts, Part redesign, Opportunities for part consolidation, challenges with part consolidation
Unit 3	Design for Improved Functionality: Multi scale design for Additive manufacturing, Mass customization, Biomimetics, Generative design, Design of multi-materials and functionally graded materials
Unit 4	Design for Minimal Material Usage: Topology Optimization, Modelling of Design space, defining design and manufacturing constraints, performing analysis for weight reduction, maximize stiffness, minimize displacement, Post-processing and Interpreting Results, Applications of TO, TO tools, Design of cellular and lattice structures, Design of support structures.
Unit 5	Computational Tools for Design Analysis: Considerations for Analysis of AM Parts, Material Data, Surface Finish, Geometry, Simplifying Geometry, Mesh-Based Versus Parametric Models, Build Process Simulation: Model Slicing, Contour Data Organization, Layer-by-Layer Simulation, Hatching Strategies, Scan Pattern Simulation and Tool Path Generation.

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Textbooks

1. A Practical Guide to Design for Additive Manufacturing, Diegel, Olaf, Axel Nordin, and Damien Motte, Springer, 2020.
2. The 3D Printing Handbook: Technologies, Design and Applications, Redwood, Ben, Filemon Schoffer, and Brian Garret, 3D Hubs, 2017

Reference Books:

1. Design for Advanced Manufacturing: Technologies and Process, Laroux K, Gillespie, McGrawHill, 2017.
2. Additive Manufacturing Technologies, Gibson, Ian, David W. Rosen, Brent Stucker, and Mahyar Khorasani, Springer, 2021.
3. Laser-Induced Materials and Processes for Rapid Prototyping, L.Lu, J. Y. H. Fuh and Y.S. Wong, Springer, 2001.
4. Rapid Prototyping: Laser-based and Other Technologies, Patri K. Venuvinod and Weiyin Ma, Springer, 2004.
5. Mathematical Elements for Computer Graphics, David F. Rogers, J. A. Adams, TMH,2008.
6. Geometric Modeling, Michael E.Mortenson, Tata McGrawHill, 2013

Web References:

1. https://courses.gen3d.com/courses/enrolled/988400
2. https://markforged.com/resources/blog/design-for-additive-manufacturing-dfam
3. https://www.hubs.com/knowledge-base/how-design-parts-metal-3d-printing/
4. https://www.rapidmade.com/design-for-additive-manufacturing
5. https://all3dp.com/1/design-for-additive-manufacturing-dfam-simply-explained /#where- to-learn-dfam

Assessment:

ISE I: Shall be on the basis of Class Tests on First and Second unit.
ISE II: Shall be based on class test on third, fourth unit.
ISE III: Shall be on the basis of Group Assignments/ Quizzes/ Field visits/Presentations.

Assessment pattern:

Assessment pattern levels no.	Knowledge levels	ISE I	ISE II	ISE3	ESE
K1	Remember				
K2	Understand	5	5	3	20
K3	Apply	5	5	5	20
K4	Analyze	5	5	2	20
K5	Evaluate				
K6	Create				
Total Marks 100		15	15	10	60

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Assessment table:

Assessment Tool	K1, K2 and K3	K1, K2 and K3	K1, K2, K3 and K4	K1, K2 and K3	K1, K2 and K3
	CO1	**CO2**	**CO3**	**CO4**	**CO5**
ISE I (15 Marks)	5	5	5		
ISE II (15Marks)		3	5	4	3
ISE3(10Marks)				5	5
ESE (60 Marks)	12	12	12	12	12
Total Marks 100	**17**	**20**	**22**	**21**	**20**

Mapping of Course outcomes with Program outcomes:

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3		3	2	2					2	3	
CO2	3	3	2	2	3							2	2	
CO3	2	2	3		2	2	2					2	3	
CO4	3	2	3	2	3							3	2	
CO5	3	3	3	2	3	2	2					3	3	2

1 – Low, 2 – Medium, 3 – High

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MEHNC7007 : ROBOTICS PROGRAMMING & SIMULATION		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**15 Marks**
Tutorial:	**ISE II**	**15 Marks**
Credits: 04	**ISE III**	**10 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Explain the Basic principles of robots.
CO2	Demonstrate fundamental robot programming concepts.
CO3	Apply procedure of advanced robot programming techniques.
CO4	Develop robot programs for industrial applications.
CO5	Explain program robots using different methods

Detailed Syllabus:

Unit 1	**Basics of Robotics** Definition, functions, advantages, disadvantages, applications of robots. Robot Anatomy: Classification (SCARA, Cartesian, Articulated etc.), components (manipulator, end-effector, controller, sensors, actuators). Robot Specifications, Work envelope, payload capacity, repeatability, degrees of freedom.
Unit 2	**Robot Programming Fundamentals** Lead-through programming, teach pendant, offline programming, and text-based programming. Robot Programming Concepts, Motion control commands (MOVE, WAIT, SIGNAL, DELAY), subroutines, branching, error handling. Robot Programming Languages: Generations of robot languages, introduction to specific languages (e.g., VAL, RAIL, AML) and modern trends (Python, ROS).
Unit 3	**Advanced Robot Programming Techniques** Tactile, position, velocity, and force sensors for robot interaction and feedback. Techniques for generating smooth robot motion paths between programmed points. Introduction to robot vision systems, image processing basics for object recognition and grasping. Safety Programming: Emergency stop procedures, safety interlocks, robot programming considerations for safe operation.
Unit 4	**Robot Programming Applications** Programming examples for common industrial applications (e.g., welding, painting, material handling, assembly). Simulation and Offline Programming: Utilizing robot simulation software to create, test, and debug robot programs. Troubleshooting and Maintenance: Identifying and resolving common robot programming errors, basic

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	robot maintenance procedures. Future Trends in Industrial Robotics: Advanced programming techniques, collaborative robots (cobots), and the integration of artificial intelligence (AI).
Unit 5	**Robot Simulation** The Robot drive mechanism, Mathematical modeling of the robot, Robot kinematics Concepts of ROS and Gazebo MATLAB and Simulink for mathematical modeling, simulation, and control design. Simulation Software SolidWorks, ADAMS, etc.

Text and Reference Books

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
2. Hughes Cameron, "Robot Programming", Pearson Publishers, 2016
3. J. Srinivas, "Robotics: Control and Programming", Narosa Publication, 2009
4. Lentin Joseph, "Learning Robotics Using Python", Second Edition Design, simulate, program, and prototype an autonomous mobile robot using ROS, OpenCV, PCL, and Python, Packt Publishing Paperback – 1 January 2018
5. Staple Danny, "Learn Robotics Programming", Packt Publishing Limited, Feb 2021

Assessment: ISEI, II, III (Class Test-1, Class Test-2, TA) & ESE

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

1. Surprise Test
2. Assignment / prepare simulation of robot for specific application.
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE I**	**ISE II**	**ISE III**	**End Semester Examination**
K1	Remember				
K2	Understand	5	5	3	20
K3	Apply	5	5	5	20
K4	Analyze	5	5	2	20
K5	Evaluate				
K6	Create				
Total Marks 100		15	15	10	60

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Mapping of Course outcomes with Program outcomes:

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

1 – Low, 2 – Medium, 3 – High

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MEHNC7012 : ENERGY EFFICIENT BUILDINGS		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs / Week	**ISE I**	**15 Marks**
Tutorial:	**ISE II**	**15 Marks**
Credits: 04	**ISE III**	**10 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Illustrate the concept and theoretical background of low energy building design.
CO2	Explain key factors that need to be considered while designing day lighting.
CO3	Demonstrate low or net zero energy building design to provide natural lighting, cooling and heating in buildings.
CO4	Explain standard sustainable materials for energy-efficient building
CO5	Apply procedure energy efficiency regulations to ensure buildings meet specific performance requirements.

Detailed Syllabus:

Unit 1	**Introduction to energy efficient buildings** Building physics, heat gains in the building, Psychometric analysis, Weather analysis Energy use in buildings, Energy Supply in Buildings, Heating, Ventilating, and Air Conditioning (HVAC) Systems, Heating and cooling loads.
Unit 2	**Day lighting and artificial lighting** Day lighting and artificial lighting, relationship between daylight and human health and benefits of day lighting) Sky condition models and their characteristics Parameters for day lighting design (critical indoor illuminance, critical outdoor illuminance level, daylight factor distribution and glare) Parameters affecting day lighting factor (room depth, height of the window head, shading devices, glazing type, reflectance of room surfaces) Day lighting components (intermediate light spaces, interior light spaces, lateral pass-through components, zenithal pass-through components, global pass-through components) Control elements.
Unit 3	**Passive/low energy heating & Cooling systems** Principle of passive heating, Types of passive heating systems. Building design strategies to reduce cooling demand Types of passive cooling systems (evaporative cooling, indirect evaporative cooling and earth cooling systems)

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Unit 4	**Sustainable Materials and Construction** Selection of sustainable and low-embodied energy materials. Life cycle assessment of building materials. Waste management and recycling in construction. Case Studies and Practical Applications, Analysis of successful energy-efficient building designs. Real-world examples of sustainable building practices. Application of energy-efficient design principles to specific building types.
Unit 5	**Building Performance analysis and Modelling** Thermal modelling, ventilation modelling, heat flow analysis Weather simulation and analysis tool (Climate Analysis, Solar Exposure analysis, and Passive strategies through psychometric chart), Energy Codes, Guidelines and Standards. Energy efficiency policies and incentives, and Net-zero energy buildings

Text and Reference Books

1. Crosbie, M.J., 1998. The Passive Solar Design and Construction Hand Book, John Wiley & Sons Inc., New York.
2. Ed. Baker, N., Fanchiotti, A. And Steemers, K., 1993. Daylighting in Architecture: A European Reference Book, James & James (Science Publishers) Ltd., London.
3. Givoni, B., 1994. Passive and Low Energy Cooling of Buildings, John Wiley & Sons Inc., New York.
4. Givoni, B., 1998. Climatic Consideration in Building and Urban Design, John Wiley & Sons, Inc., Canada.
5. Gregg D Ander, 2003. Daylighting Performance and Design Second Edition, John Wiley & Sons, Inc., New Jersey.
6. Guzowski, M., 2000. Daylighting for Sustainable Design, McGraw-Hill, New York.
7. Nayak ,J.K.andPrajapati, J.A., 2006. Handbook on Energy Conscious Buildings, Prepared under the interactive R & D Project No. % (03) 99 - SEC between Indian Institute of Technology, Bombay and Solar Energy Centre, Ministry of New and Renewable Energy, India.
8. Santamouris, M., 1996. Passive Cooling of Buildings, James & James (Science Publishers) Ltd., London.

Assessment: ISEI, II, III (Class Test-1, Class Test-2, TA) & ESE

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

1. Surprise Test
2. Assignment / Case Study/Design Problem
3. Quiz
4. Any other activity suggested by course coordinator

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember				
K2	Understand	5	5	3	20
K3	Apply	5	5	5	20
K4	Analyze	5	5	2	20
K5	Evaluate				
K6	Create				
Total Marks 100		15	15	10	60

Mapping of Course outcomes with Program outcomes:

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

1 – Low, 2 – Medium, 3 – High

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MEHNC7017 : ADVANCED MACHINE DESIGN		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs / Week	**ISE I**	**15 Marks**
Tutorial: ------	**ISE II**	**15 Marks**
Credits: 04	**ISE III**	**10 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Explain the advances in Mechanical Design.
CO2	Illustrate functional and non-functional requirements, and translate them into design specifications.
CO3	Apply design procedure for different failure criteria.
CO4	Predict fracture, fatigue and creep strength, Evaluate fatigue life of mechanical components for ductile and brittle materials.
CO5	Illustrate value engineering techniques to optimize design and reduce costs while maintaining functionality.

Detailed Syllabus:

Unit 1	**Advances in machine design** Design Philosophies, Defining design, creativity, invention and innovation, design methodology, patterns of evaluation, design patents, functional approach, performance specifications, Quality Function, problem definition, objective, top down and bottom up approaches, creative problem solving, inventive principle, evaluation of ideas or concepts, selection of best design, Understanding of static failure for ductile and brittle materials Significance of the theories of failure Importance of factor of safety in design.
Unit 2	**Introduction to product design** Various design models-Shigley model, Asimov model and Norton model, Need analysis, design for safety and Reliability. Statistical Considerations in Design, relationship between actual load and load capability, Prototype and Component Testing, Service Experience. Product strategies, value, planning and specification, concept generation, concept selection, concept testing.

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Unit 3	**Material selection for design** Engineering Design process and the role of materials, Materials classification and their properties, Types of Material Failure – Elastic & Plastic Deformation, Design and Materials Selection – Iterative and Stepwise nature design, Examples of material selection for typical applications,
Unit 4	**Fracture, Fatigue and Creep** Introduction to fatigue, Fatigue failure models, Fatigue life, Fatigue failure theories, harmful and beneficial residual stresses, factors affecting fatigue behaviour, Fundamentals of Fracture mechanics - Cleavage fracture, Ductile fracture and Inter-granular fracture; Griffiths theory; Orowan theory, Fundamentals of degradation, Creep phenomenon, Temperature dependence of creep, Creep Curve, Creep parameters, Stress relaxation. Stress-Strain-Time relation.
Unit 5	**Economic Factors Influencing Design** Economic analysis, Break-even analysis, Human engineering considerations, Ergonomics, Design of controls, Design of displays. Value engineering, Material and process selection in value engineering, and Modern approaches in design.

Text and Reference Books

1. Mechanical properties of engineered materials, Wolé Soboyejo, Marcel Dekker, Inc., 2002
2. Karl T. Ulrich and Steven D. Eppinger, Product design and development, 3rd edition, Tata McGraw Hill.
3. Elements of Fracture Mechanics Prashant Kumar McGraw-Hill.
4. Metal Fatigue in Engineering R I Stephens, A Fatemi, R R Stephens and H O Fuchs. John-Wiley.
5. Mechanical Engineering Design, Richard G. Budynas, J Keith Nisbett, Shigley's Mc Graw Hill, Ninth edition, 2011.
6. J.E. Shigley and L.D. Mitchell, Mechanical Engineering Design, McGraw Hill International Book Company, New Delhi.
7. Metal Fatigue in Engineering, R I Stephens, A Fatemi, R R Stephens, H O Fuchs, John Wiley
8. Economics by Design: Principles and Issues" by Robert Collinge
9. Materials Selection in Design, Ashby, M.F., Butterworth-Heinemann, 4/e, 2010

Assessment: ISEI, II, III (Class Test-1, Class Test-2, TA) & ESE

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

1. Surprise Test
2. Assignments / Mini Design Exercise
3. Quiz
4. Any other activity suggested by course coordinator

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember				
K2	Understand	5	5	3	20
K3	Apply	5	5	5	20
K4	Analyze	5	5	2	20
K5	Evaluate				
K6	Create				
Total Marks 100		15	15	10	60

Mapping of Course outcomes with Program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2		2							2	3	
CO2	3	2	3		2							2	2	2
CO3	3	3	3	2	2							2	3	2
CO4	3	3	2	3	2							2	3	
CO5	3		2	2	2					2		2	3	2

1 – Low, 2 – Medium, 3 – High

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LEVEL 5.5 EXIT CRITERIA

MEINT 3001:Internship		
Teaching Scheme	**Examination Scheme**	
Practical: 16 Hrs. / Week /Student	**ISE III**	**100 Marks**
Credits: 08	**ESE**	**100 Marks**

Course Outcomes:

Course Outcomes	
CO1	**Understand and explain** the fundamental concepts, processes, and professional practices in an industrial or research environment, demonstrating awareness of industry standards and workplace ethics.
CO2	**Apply** technical and managerial skills gained during the internship to solve real-world engineering problems, showcasing hands-on experience with tools, technologies, and methodologies.
CO3	**Analyze** industrial or research challenges by systematically collecting data, evaluating processes, and identifying areas for improvement based on practical exposure and feedback.
CO4	**Evaluate** and demonstrate professional competencies such as communication, teamwork, leadership, discipline, and commitment through documented evidence in the Internship Diary/Workbook and feedback from supervisors.
CO5	**Create and Develop** innovative solutions, entrepreneurial ideas, or research-based findings that contribute to technological advancement, skill development, and career readiness.

Important Points in Internship

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

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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 center 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

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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

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 III**	**ESE**
K1	Remember	16	16
K2	Understand	16	16
K3	Apply	32	32
K4	Analyze	12	12
K5	Evaluate	12	12
K6	Create	12	12
Total Marks		**100**	**100**

Assessment Pattern Level

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

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Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

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

1 – Low, 2 – Medium, 3 – High

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MEVSE 3002 Application of Solidworks for Mechanical Engineering		
Teaching Scheme	**Examination Scheme**	
Lectures: 00 Hrs. / Week	**ISEIII**	**25 Marks**
Practical: 08 hrs/week	**ESE**	**25 Marks**
Credits: 4		

Course Outcome:

Upon the completion of course, the student will be able to:

	Course Outcome
CO1	Draw the 3-D geometric information of machine components including assemblies, and automatically generate 2-D production drawings.
CO2	Understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program
CO3	Improvevisualizationabilityofmachinecomponentsandassembliesbeforetheiractual fabrication through modelling
CO4	Apply animation, shading, rendering, lighting and colouring
CO5	Model complex shapes including freeform curves and surfaces.

Content:

Sr. No.	Content
1	**Module 1 Review of Drafting Package:** **Expt. 1**: Basic Sketch command–Line, Circle, Rectangle, Arc, Polygon, Spline. **Expt. 2**: Drafting the Orthographic views of Mechanical components.
2	**Module 2 Exercise in Solid modeling software (SOLIDWORKS):** **Expt. 1:** Introduction & Basic Create command, Extrude, Revolve, Sweep, Loft, Rib, Web, Box, Cylinder, and Modifying command i.e. Fillet, Chamfer, Shell, Split Body. **Expt. 2.** Modeling of Simple Mechanical Components, Modeling of components with sweep and loft feature, Modeling of temporary fasteners.
3	**Module 3 Exercise of Parametric drawing:** **Expt.3**: Parametric drawing of components.
4	**Module 4 Exercise on assembly of components:** **Expt. 1:** Assembly of components, Conversion of 3D to 2D and mass property calculations, **Expt. 2:** Assembly Drawing for Screw jack, Assembly Drawing for Connecting rod, Working Drawing for tolerances in Part and Assembly drawing.
5	**Module 5 Production drawing:** **Expt. 1** Generating the Bill of material, Seat size and manufacturing settings, Industry drawing layout.

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Assessment:
ISE III: Shall be on the basis of assessment of term work.
ESE: ESE will base on oral exam conducted by course coordinator and external examination

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISE III	End Semester Examination
K1	Remember	5	5		
K2	Understand	5	5		12
K3	Apply	5	5	5	24
K4	Analyze			5	12
K5	Evaluate				
K6	Create				12
Total Marks100		15	15	10	60

Assessment table:

Assessment Tool	K2.K3	K2,K3	K3	K4	K3,K4
	CO1	CO2	CO3,CO4	CO4	CO5
ISEI(15 Marks)	7	8			
ISEII (15Marks)		5	5	5	
ISEIII (10 Marks)			5	5	
	K2 to K4,K6	**K2 to K4,K6**	**K2 to K4,K6**	**K2 to K4,K6**	**K2 to K4,K6**
ESE Assessment (60 Marks)	12	12	12	12	12

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

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

1 – Low, 2 – Medium, 3 – High

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MEVSE 3003: Minor Project		
Teaching Scheme	**Examination Scheme**	
Practical: 8 Hrs. / Week /Student	**ISE III**	**50 Marks**
Credits: 04	**ESE**	**50 Marks**

Course Outcomes:

Course Outcomes	
CO1	**Identify and comprehend** fundamental principles of Mechanical Engineering by conducting literature surveys, industry visits, and trend analysis to define the project problem statement.
CO2	**Apply** engineering knowledge and problem-solving techniques to design, fabricate, or analyze a product, testing setup, or software-based system through experimental or simulation-based approaches.
CO3	**Analyze and interpret** experimental/simulation data to validate the proposed solution with appropriate justifications, ensuring technical and scientific accuracy.
CO4	**Synthesize project** findings into a structured report following standard documentation formats, effectively presenting project outcomes through technical writing and oral presentations.
CO5	**Demonstrate innovation and entrepreneurial skills** by developing industry-ready solutions, incorporating sustainability, ethical considerations, and multidisciplinary approaches to address real-world engineering challenges.

Important Points in Minor Project

Guidelines: Students should conduct literature survey / visit industry / analyze current trends and identify the problem for Minor 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 format.
Minor Project work Identification: Minor 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

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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/In house/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 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 dayto-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.
Minor 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..

Assessment:

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

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

Assessment Pattern:

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Assessment Pattern Level No.	Knowledge Level	ISE III	ESE
K1	Remember	8	8
K2	Understand	8	8
K3	Apply	16	16
K4	Analyze	6	6
K5	Evaluate	6	6
K6	Create	6	6
Total Marks		**50**	**50**

Assessment Pattern Level

Assessment Pattern Level No.	Knowledge Level	ISE III	ESE
S1	Imitation	8	8
S2	Manipulation	6	6
S3	Precision	23	23
S4	Articulation	8	8
S5	Naturalization	00	00
Total Marks		**50**	**50**

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

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

1 – Low, 2 – Medium, 3 – High

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