

Government College of Engineering, Aurangabad
(An Autonomous Institute)
 Teaching and Evaluation Scheme from year 2022-23
Second Year B. Tech. Program in Mechanical Engineering
Semester III

Sr No	Category	Course Code	Course Title	Hours per week			Credits	Continuous Evaluation in terms of Marks				Total
				L	T	P		ISE I	ISE II	ISE III	ESE	
1.	BSC	MABS2001	Engineering Mathematics III	3	0	0	3	15	15	10	60	100
2.	PCC-I	MEPC2001	Engineering Thermodynamics	3	0	0	3	15	15	10	60	100
3.	PCC-III	MEPC2002	Manufacturing Processes	3	0	0	3	15	15	10	60	100
4.	PCC-IV	MEPC2003	Mechanisms of Machine	3	0	0	3	15	15	10	60	100
5.	ESC	MEES2004	Materials Science and Metallurgy	3	0	0	3	15	15	10	60	100
6.	PCC-ILC	MEPC2005	Lab- Engineering Thermodynamics	0	0	2	1	25			25	50
7.	PCC-IIIILC	MEPC2006	Lab-Manufacturing Processes (Workshop Practice II)	0	0	2	1	25			25	50
8.	PCC-IVLC	MEPC2007	Lab- Mechanisms of Machine	0	0	2	1	25			25	50
9.	ESC-LC	MEES2008	Lab - Materials Science and Metallurgy	0	0	2	1	25			25	50
10.	OEC-I		Open Elective-I	3	0	0	3	15	15	10	60	100
11.	MC-II	EEMC2010	Environmental Studies	3	0	0	0	15	15	10	60	100
Total				21	0	8	22	205	105	70	520	900
Open Elective-I MEOE0010 Total Quality Management												

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Semester IV

Sr No	Category	Course Code	Course Title	Hours per week			Credits	Continuous Evaluation in terms of Marks				Total
				L	T	P		ISE I	ISE II	ISE III	ESE	
1.	PCC-V	MEPC2010	Applied Thermodynamics	3	0	0	3	15	15	10	60	100
2.	PCC-II	MEPC2011	Machine Drawing	3	0	0	3	15	15	10	60	100
3.	PCC-VII	MEPC2012	Strength of Materials	2	0	0	2	10	10	5	25	50
4.	PCC-VIII	MEPC2013	Metrology & Quality Control	3	0	0	3	15	15	10	60	100
5.	PEC-I		Professional Elective-I	3	0	0	3	15	15	10	60	100
6.	PCC-VLC	MEPC2016	Lab- Applied Thermodynamics	0	0	2	1	25			25	50
7.	PCC-IILC	MEPC2017	Lab-Machine Drawing	0	0	2	1	25			25	50
8.	PCC-VII – LC	MEPC2018	Lab – Strength of Materials	0	0	2	1	25			25	50
9.	PCC-VIII LC	MEPC2019	Lab- Metrology & Quality Control	0	0	2	1	25			25	50
10.	PEC-I	MEPE2020	Lab- Professional Elective- I (Workshop Practice III)	0	0	2	1	25			25	50
11.	OEC-II		Open Elective II	3	0	0	3	15	15	10	60	100
Total				17	0	10	22	210	85	55	450	800
Professional Elective-I MEPE2014 Machine Tools MEPE2015 Production Processes				Open Elective II MEOE1020 Automation Engineering								


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MABS2001: Engineering Mathematics-III (For Civil, Mechanical)	
Teaching Scheme	Examination Scheme
Lectures : 2Hrs/Week	ISE-I : 15 Marks
Tutorial : 1Hr/Week	ISE-II : 15 Marks
Total Credits 3	ISE-III : 10Marks
	End Semester Exam : 60 Marks

Course description:

MABS 2001 Engineering Mathematics-III is a compulsory course to second year engineering students of Civil and Mechanical of the institute in the Semester –III and is a continuation of previous year courses viz. MABS1001: Engineering Mathematics-I and MABS1002: Engineering Mathematics-II. This course intends to provide engineering students a coherent and balanced account of major mathematical techniques and tools.

Course Objective:

This course intends to provide an overview of analytical and numerical techniques to solve ordinary and partial differential equations, which we apply to solve many engineering problems.

Course Outcomes:

After completing the course, students will be able to:

CO1	Define linear differential equations (LDE), Cauchy's and Legendre's differential equations, first order partial differential equations, Lagrange's equation
CO2	Summaries the solution of LDE with constant and variable coefficients, solution of homogeneous and non-homogeneous PDE,
CO3	Find approximate solution of ordinary differential equations of first order
CO4	Solve linear differential equations with constant and variable coefficients, first order linear and nonlinear partial differential equations, second order homogeneous and non-homogeneous linear partial differential equations.
CO5	Apply knowledge of linear differential equations to civil engineering problems, electrical circuits and Spring-Mass system, partial differential equations to wave equations and heat equations.


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Detailed syllabus:

Unit-I	The approximation for the solution of first order Ordinary Differential Equations: Taylor series method, Euler's method, Euler's modified method, Runge-Kutta fourth order method, Milne's Predictor-Corrector method.	06 L+ 03T
Unit-II	Linear Differential Equations (LDE): Linear differential equations (LDE) with constant coefficients, method of variation of parameters second order linear differential equations with variable coefficients, Cauchy's and Legendre's differential equations.	06 L+ 03T
Unit-III	Applications of Linear Differential Equations (LDE): Bending of beams, spring-mass system.	02 L+ 01T
Unit-IV	Partial Differential Equations (PDE): first order linear/nonlinear partial differential equation, Lagrange's equation, solution to homogenous and non-homogenous linear partial differential equations of second and higher order by complimentary function and particular integral method.	06 L+ 03T
Unit-V	Applications of Partial Differential Equations: Method of separation of variables, solutions of one-dimensional wave equation, one-dimensional heat equation, steady state solution of two-dimensional heat equation.	04 L+ 02T

Text and Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Willey Eastern Ltd. Mumbai.
2. B. S. Grewal, "Higher Engineering Mathematics" Khanna publication, New Delhi.
3. Ravish R Singh, Mukul Bhatt, "Engineering Mathematics-A Tutorial Approach"
4. H. K. Dass, "Advanced Engineering Mathematics" S. Chand and Sons.
5. G. B. Thomas and R. L. Finney, "Calculus", Addison- Wesley, 1996
6. I.N. Sneddon, "Elements of Partial Differential Equation"
7. Boyce & DiPrima, "Elementary Differential Equations and Boundary Value Problems"

Mapping of Course outcome with Program Outcomes (Civil Engineering)

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


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Mapping of Course outcome with Program Outcomes (Mechanical Engineering)

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

3 – High, 2 – Medium, 1 - Low

Teaching Strategies:

The teaching strategy planned through the lectures, and team-based homework . Exercises assigned weekly to stimulate the students to actively use and revise the learned concepts, which also help the students to express their way of solving the problems fluently in written form. Most critical concepts and mistakes emphasized

Teacher's Assessment: Teacher's assessment of 10 marks based on the following.

- 1) Home assignments
- 2) Surprise tests with multiple choice question

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 on Fifth unit.

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	01	02		
K2	Understand	14	13	10	60
K3	Apply				
K4	Analyze				
K5	Evaluate				
K6	Create				
Total Marks 100		15	15	10	60


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MEPC2001: ENGINEERING THERMODYNAMICS		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs./ week	ISE I	15 Marks
Tutorial: 00 hrs./ week	ISE II	15 Marks
Credits: 03	ISE III	10 Marks
	End Semester Examination	60 Marks

Prerequisites: PHBS1001 Engineering physics, CHBS 1001 Engineering Chemistry, MABS 1001 Engineering Mathematics, MEES1003 Basics of Mechanical Engineering

Course description: This course consists of basic understanding and application of laws of engineering thermodynamics to the various practical engineering applications like engines, power plants, heat exchangers, pumps etc. Basic understanding of steam formation, steam properties and use of steam tables and Mollier diagram is included in this course. Theoretical analysis of various air standard cycles is covered in this course. This course includes theoretical and practical analysis of fuels and products of combustion process.

Course Outcomes:

After completing the course, students will be able to:

Course Outcomes	
CO1	Study thermodynamic systems by applying laws of thermodynamics
CO2	Define state of steam and perform steam property calculations
CO3	Analyze thermodynamic cycle performance
CO4	Analyze combustion of fuels and product of combustion

Detailed Syllabus:

Unit 1	<p>First Law applied to Steady Flow Processes steady flow processes, SFEE, modification of SFEE for different engineering devices such as nozzles, blowers, I.C. Engines, Compressors, Pumps, Turbines, throttling devices (Numerical Treatment)</p> <p>Second Law of Thermodynamics Limitations of first law of thermodynamics, Kelvin Planks, Clausius statement and their equivalence, PMM2, thermodynamic temperature scale, Energy, Energy as property of system, Entropy, entropy as a property, reversible process and irreversible process, (Numerical Treatment)</p>
Unit 2	<p>Properties of steam and pure substances Phase transformation, p-v phase diagram, critical point, Triple point, Enthalpy and Entropy of steam, steam tables, processes of steam, Enthalpy- Entropy diagram, steady flow process and determination of dryness fraction of steam (Numerical Treatment)</p>


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Unit 3	Power cycles Definition of cycles, power producing cycles and power consuming cycles, Air standard cycles, air standard efficiency, Carnot cycle, Otto cycles, Diesel cycles, Dual combustion cycles, Comparison of Otto, Diesel and dual combustion cycles, Fuel air cycle, Brayton cycles (Numerical Treatment)
Unit 4	Fuels and Combustion classification of fuels, calorific value (C.V.) of fuels, Determination of C.V. of fuels: Dulong's formula, Bomb calorimeter and Boys Gas Calorimeter, Orsat apparatus and determination of minimum air required for combustion. Conversion of volumetric analysis to mass analysis, (Numerical Treatment)

Text and Reference Books

1. Nag P.K., "*Engineering Thermodynamics*", Fourth Edition, TMH Publishing Co. New Delhi, 2008
2. Ballaney P.L., "*Thermal Engineering*", Khanna Publications, New Delhi, 2014
3. Rajput R.K., "*A Textbook of Engineering Thermodynamics*", Third Edition, Laxmi Publication, New Delhi 2007
4. Domkundwar S, Kothandaraman C. P. & Domkundwar A., "*A Course in Thermal Engineering*", Dhanpat Rai and Co. publication, New Delhi, 2004
5. Rao Y. V. C., "*Engineering Thermodynamics*", Universities Press, Hyderabad 2014

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

3 – High 2 – Medium 1 - Low

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	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

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 on Fifth unit.

Assessment Pattern:


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Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	5	5		10
K2	Understand	5	5	3	20
K3	Apply	5	5	2	20
K4	Analyze			5	10
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 (15 Marks)			8	7
ISE III (10 Marks)	2	2	3	3
ESE Assessment (60 Marks)	20	20	20	20
Total Marks 100	29	30	31	30

Special Instructions if any: Nil

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MEPC2002 : MANUFACTURING PROCESSES		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs/ week	ISE I	15 Marks
Tutorial: 00 hrs/ week	ISE II	15 Marks
Credits:03	ISEIII	10 Marks
	ESE	60 Marks

Prerequisites: ME 1001 Basics of Mechanical Engineering

Course description:

After completing this course, students will have a broad and fundamental understanding of the concepts of moulding in practice, knowledge of pattern making and related concepts, concept of plastic processing, knowledge of hot and cold working processes, concept of sheet metal and joining process.

Course Outcomes:

After completing the course, students will be able to:

	Course Outcomes
CO1	Interpret foundry practices like pattern making and core making.
CO2	Interpret foundry practices like moulding.
CO3	Classify different plastic molding processes, fabricating methods of plastic, lamination and joining of plastic.
CO4	Differentiate various metal forming processes such as Hot and Cold working, Rolling, Forging, Extrusion and Drawing Processes.
CO5	Identify appropriate Joining Processes to join work piece.

Detailed Syllabus:

Unit 1	Pattern Making Introduction, pattern materials, factors affecting selection of pattern materials, master patterns, pattern allowances, types of patterns and their applications, core, core print, core boxes.
Unit 2	Mould Making Introduction, moulding sands, types of moulding sand, grain shape and size of sand, sand additives, properties of moulding sand, moulding processes, moulding processes based on sand used, making a green sand mould, typical moulding problems, machine moulding, cleaning of casting


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Unit 3	<p>Casting</p> <p>Design considerations of castings, Various types of castings such as sand casting permanent mould or gravity die casting, semi-permanent mould casting, slush casting pressed casting, die casting, centrifugal casting, investment of lost wax casting, plaster mould casting, antioch casting, continuous casting, chill casting, malleable casting and their industrial applications, casting defects.</p>
Unit 4	<p>Plastics and Their Processing</p> <p>Plastic, its advantages and disadvantages. Thermoplastic and thermosetting plastics. Plastic processing methods such as compression moulding, transfer moulding, injection moulding, extrusion, casting, slush moulding and calendaring. Plastic fabricating methods such as blow moulding and forming. Lamination of plastics. Joining of plastics. Industrial applications of various plastic processes.</p>
Unit 5	<p>Mechanical Working of Metals</p> <p>Introduction to hot working. Hot working processes such as hot rolling, types of hot rolling mills, piercing of seamless tubing, drawing, deep drawing, hot spinning, cold working, cold rolling, cold drawing, cold bending, cold spinning. Industrial applications of various hot working and cold working processes.</p> <p>Introduction, forging materials, forging processes, hand forging, power forging, impression die forging, drop hammers, press forging, roll die forging press versus hammer forging, machine or upset forging, high energy rate forging, effects of forging, defects in forging, advantages and disadvantages.</p>

Text and Reference Books

1. DeGarmo, Black Konser, "Materials and Processes in Manufacturing", PHI, New Delhi 2008.
2. Schey J. A., "Introduction to Manufacturing processes", Mc Graw Hill, New Delhi 1999.
3. Lindberg A., "Processes and Materials of Manufacturing", Lindberg 1998.
4. Raghuvanshi B.S., "Workshop Technology", Vol I, Asia Publishing House 2008.
5. Hazra Choudhary, "Elements of Workshop Technology", Vol. I, Khanna Publishers 2008.
6. Bawa H.S., "Workshop Technology", Vol. I Mc Graw Hill, New Delhi, 2010.
7. Chapman W A J, "Workshop Technology", Taylor and Francis pub, Vol.1 and Vol. 2, Ed.5th, 2015

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 on Fifth unit


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Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

3 – High 2 – Medium 1 - Low

Course outcome	P O1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	3										3	1	3	
CO2	1	3										3	1	3	
CO3	1	3										3	1	3	
CO4	1	3										3	1	3	
CO5	1	3										3	1	3	

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	ESE
K1	Remember	5	5	2	20
K2	Understand	5	5	3	20
K3	Apply	5	5	2	10
K4	Analyze			3	10
K5	Evaluate				
K6	Create				
Total Marks 50		15	15	10	60

Assessment table:

Assessment Tool	K3				
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	7	8			
ISE II (15 Marks)			7	8	
TA (10 Marks)	2	2	2	2	2
ESE (60 Marks)	20	10	10	10	10
Total Marks 100	29	20	19	20	12

Special Instructions if any: Nil


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MEPC2003 : MECHANISMS OF MACHINES		
Teaching Scheme	Examination Scheme (Semester – I) Theory	
Lectures: 03 hrs/ week	ISE I	15 Marks
Tutorial: 0 hrs/ week	ISE II	15 Marks
	ISE III	10 Marks
Credits:03	End Semester Examination	60 Marks

Pre-requisites: MA1001: Engineering Mathematics I, ME1001: BME, MA1002: Engineering Mathematics II.

Course Description:

The course is aimed at giving the fundamentals and application of kinematics in the analysis and synthesis of linkages, cams and gear trains. The design process is introduced and used to solve unstructured design problems in linkage, cam design and gear trains. Algebraic and graphical techniques to analyze the displacement, velocity and acceleration of linkages and cams are developed. Design considerations in mechanism synthesis.

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

CO1	Understand kinematics, kinematics links and its applications and apply concepts to analyze various types of linkage mechanisms used in obtaining specific motion
CO2	Apply the knowledge of velocity and acceleration analysis of linked mechanisms to formulate, understand motion to analyze and solve practical problem.
CO3	Understand the cam mechanism, its motions and accelerations and the geometry of cam profiles for analysis of engineering problems related to cam mechanisms
CO4	Apply knowledge of gears, gearing action in practice to analyze various motion transmission elements like gears, gear trains.

Detailed Syllabus:

Unit 1	Kinematics: Classification of mechanisms- Basic kinematic concepts and definitions Kinematic links, Kinematic pairs, Kinematic chains, planar, spherical, and spatial mechanisms, mobility, kutzbach criteria, Grubler criteria, problems based on above criterion Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angle Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms
Unit 2	Velocity analysis of simple mechanisms: Graphical velocity analysis using instantaneous centers, Arnold Kennedy's theorem, method of determining linear velocity of a point on a link, angular velocity of a link: link to link method, line of centers method. Linear and angular velocities using Relative velocity method, rubbing velocity at a pin Joint

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Unit 3	Acceleration Analysis: Centripetal or radial acceleration, tangential acceleration, total acceleration of a point on link, method to obtain acceleration polygon for a mechanism, angular acceleration of link, acceleration of intermediate and offset points, slider crank mechanism, Coriolis acceleration component, crank and slotted lever mechanism Short cut methods for kinematic analysis of mechanism: Klein's construction, Ritterhaus's construction, Bennett's construction modified Kleins construction for four bar mechanism.
Unit 4	Cams: Classification of cams and follower, Terminology and definitions- Displacement Diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions, Analysis of follower motion: constant/uniform velocity, SHM, constant/uniform acceleration & deceleration/retardation, cycloidal, polynomial motion & derivation, graphical synthesis of plate cams using knife edge, roller follower, radial / off-set follower, translating / oscillating motion of follower, determination of velocity & acceleration for this motion.
Unit 5	Gears: Gear terminology, types, field of application, Spur gear: condition for correct gearing, conjugate profiles, Involute and cycloidal gear profiles, gear parameters, Comparison Between Involute and Cycloidal Gears. Fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting, methods of eliminating interference, determination of length of path of contact, length of path and arc of approach and recess, helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics
Text and Reference Books	
<ol style="list-style-type: none"> 1. Shigley J. E. and Uicker J. J., "<i>Theory of Machines and Mechanisms</i>", 3rd Edition, McGraw Hill Intl, 2010. 2. Thomas Bevan, <i>Theory of Machines</i>, 3rd edition, CBS Publishers & Distributors, 2005. 3. Robert L. Norton, <i>Kinematics and Dynamics of Machinery</i>, Tata McGrawHill, 2009. 4. Rao J. S. & Dukkupati R. V., "<i>Mechanism and Machine Theory</i>", 2nd Edition, New AgeIntl. Publishers, 2012. 5. Ratan S. S., "<i>Theory of Machines</i>", 2nd Edition, Tata McGraw Hill Publishing Company Ltd, 2005. 6. Sharma C. S. and P. Kamlesh, "<i>Theory of Mechanisms and Machines</i>", Printice Hall of India Pvt. Ltd, 2006. 7. Ghosh A. and Mallick A.K., "<i>Theory of Mechanisms and Machines</i>", Affiliated East-WestPvt. Ltd, New Delhi, 1988. 	

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 on Fifth unit.

Mapping of Course outcome with Program Outcomes

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

CO3	2	3	2	3		3						2	
CO4	3	1	2	1		3					3		

3 – High 2 – Medium 1 – Low

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	2.5	2.5	00	10
K2	Understand	05	05	05	25
K3	Apply	7.5	7.5	05	25
K4	Analyze	00	00	00	00
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100					

Assessment table:

Assessment Tool	K3				
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	05	05	05	00	
ISE II (15 Marks)	00	05	05	05	
ISE III (10 Marks)	02	03	02	03	
ESE Assessment (60 Marks)	15	15	15	15	
Total Marks 100	22	28	27	23	

Special Instructions if any:


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MEPC2004 : MATERIAL SCIENCE AND METALLURGY		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs./ week	ISE I	15 Marks
Tutorial: 0 hrs./ week	ISE II	15 Marks
Credits: 3	ISE III	10 Marks
	End Semester Examination	60 Marks

Prerequisites: NIL

Course Description: After completion of the course, students will be able to learn about the materials and its composition. Students will have basic and fundamental knowledge in the field of Material Science. They will be able to understand the effect of different metallurgical processes on the properties of materials. Students will get exposure to various Heat treatments and understanding the concept of Nonferrous Alloys and Bearing Materials.

Course Outcomes:

After completing the course, students will be able to:

Course Outcomes	
CO1	Explain the importance of materials properties and identify the material for specific applications. Understand distinguish microstructure and analyze the effect of Crystalline nature of metals.
CO2	Explain the construct Iron-Iron carbide equilibrium diagram and analyze microstructure, general properties.
CO3	Identify and understand different types of steel and its application. Heat treatment practices of commercial steels and alloy steels.
CO4	Analyze and implement suitable heat treatment processes.
CO5	Identify and analyze different cast iron and non-ferrous alloys according to their properties.

Detailed Syllabus:

Unit 1	Introduction to materials & Metallography: - Classification of materials. Properties and applications of materials, Evaluation of tensile and hardness, Classification of metallurgy as Ferrous and Non-Ferrous Metallurgy, Crystal System, Bravais Lattices and Crystal Imperfection, Alloys and solid solutions, types, and their formations, Hume-Rothery's rules, modified Gibbs's phase rule, Metallography, specimen preparation, optical metallurgical microscope.
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Unit 2	Equilibrium Diagrams for systems like isomorphous, eutectic, peritectic. Lever rule for phase mixtures and their application in system. Types of cooling curves. Iron-Iron carbide equilibrium diagram, Allotropy, cooling curve of pure iron, Critical temperatures. Microstructure of slowly cooled steels. Estimation of carbon from microstructures; Property variation with microstructure.
Unit 3	Steel & Alloy steel: -Classification and application of plain carbon steels. Classification and applications of steels. Specification of steels, Effect of alloying elements. Examples of alloy steel such as Hadfield Manganese Steel, ball Bearing Steels, etc. Tool Steels – Classification, composition, application and commercial heat treatment practices for HSS. Stainless steels Classification, composition, application
Unit 4	Necessity of Heat Treatment: - Transformations of steels during heating and cooling, non-equilibrium cooling and transformation products of austenite, TTT diagrams, different hardening methods, quenching media, tempering of plain carbon steels and its effects. Other H.T like annealing, normalizing. Concept of hardenability, critical diameter, end quench test, surface/ case hardening, Flame and induction hardening, solid, liquid and gas carburizing, nitriding, carbonitriding, Relative merits and demerits.
Unit 5	Cast Iron – Classification, Various types of cast iron, properties and applications. Non-Ferrous Alloys – Study of non-ferrous alloys such as Brass, Bronze, Aluminium & its alloys , Nickel & its alloy, Bearing materials with their properties and applications. Composite Materials- Introduction, classification, Particle-reinforced composites, Fibre-reinforced composites, Fibre glass- reinforced composite, Structural composites, protective coatings.

Text and Reference Books

1. V.Raghvan, "Material Science and Engineering," PHI Publication, 2015.
2. V.D Kodgire, "Metallurgy and Material Science," Everest Publication, 2011.
3. S.Avner, "Physical Metallurgy," McGraw Hill Publication, 2017.
4. Callister, "Material science and Engineering," Wiley Publication, 2014.
5. Dieter, "Mechanical Metallurgy," McGraw Hill Publication, 2017.
6. ASM Handbook Vol. 12 Material Characteristics
7. ASM Handbook Vol. 12 Properties and Selection, 2017.
8. Dr. B. K. Agrawal, "Introduction to Engineering Metallurgy," Tata McGraw-Hill, 21st revised edition, 2007.

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 on Fifth unit

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes3 – High

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2 – Medium 1 - Low

Course outcome	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2											
CO2		3				2								
CO3	3				2							1	1	
CO4													3	3
CO5	3			1		2						1	2	

Assessment Pattern:

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

Assessment table:

Assessment Tool	K3				
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	7	8			
ISEII (15 Marks)			7	8	
ISEIII (10 Marks)	2	2	2	2	2
ESE Assessment (60 Marks)	12	12	12	12	12
Total Marks 100	21	22	21	22	14

Special Instructions if any:


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MEPC2005 : LAB- ENGINEERING THERMODYNAMICS		
Teaching Scheme	Examination Scheme	
Practical: 2Hrs/Week	ISE I	25 Marks
Credits:01	End Semester Evaluation	25 Marks

Course Outcomes:

After completion of this course students will be able to:

	Course Outcomes
CO1	Understand the function of boiler and its mountings and accessories
CO2	Experimentally measure the calorific value and exhaust gas analysis
CO3	Experimentally measure the dryness fraction of steam using calorimeter
CO4	Communicate effectively by preparing laboratory and industry visit report

List of the Experiments

The student shall perform minimum eight experiments of the following

Sr. No.	Title of the Experiments	Skill / Knowledge Level	CO
1	Study of any two boilers: a) Babcock and Wilcox boiler and Benson boiler.	K2	CO1 and CO4
2	Study of mountings and accessories of boilers.	K2	CO1 and CO4
3	Study and determination of C.V. of solid fuel using Bomb Calorimeter.	K3	CO2 and CO4
4	Study and determination of C.V. of gaseous fuels using Boy's Gas calorimeter	K3	CO2 and CO4
5	Analysis of exhaust gases using NDIR apparatus.	K3	CO2 and CO4
6	Determination of dryness fraction of steam using tank calorimeter.	K3	CO3 and CO4
7	Determination of dryness fraction of steam using separating and throttling calorimeter.	K3	CO3 and CO4
8	Visit to industry related to thermodynamics (e.g., power plant, milk processing plant , cold storage)	K2	CO4

Assessment: ISE I

The ISE I will consist of submitting a file for all the experiments with neatly written records of the study and diagrams.

The term work will be assessed by the course coordinator

End Semester Evaluation

The End Semester Evaluation will comprise of viva voce on the conducted practicals. The End Semester Evaluation will be done by two examiners, one will be the course coordinator and other will be examiner appointed by DSB

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
K1	Remember	05	5
K2	Understand	10	10
K3	Apply	10	10
K4	Analyze		
K5	Evaluate		
K6	Create		
Total Marks		25	25

Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
S1	Imitation	5	10
S2	Manipulation	10	8
S3	Precision	10	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					3	3		1	1	3	3	1	2
CO2	1	1				2	3		1	1	3	3	1	2
CO3	1	1				2	3		1	1	3	3	1	2
CO4	3	2				3	3	3	1	1	2	1	1	2


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MEPC2006 : WORKSHOP PRACTICE- II		
Teaching Scheme	Examination Scheme	
Practical: 4Hrs/Week	ISE I	50 Marks
Credits:02	End Semester Evaluation	50 Marks


Course Outcomes:

After completion of this course students will be able to:

Course Outcomes	
CO1	Acquiring the skills in machining operations like turning, milling, welding and black smithy.

List of the Experiments

Sr. No.	Title of the Experiments	Skill / Knowledge Level	CO
1	Foundry Shop: Sand moulding, types of sands, preparing sand for moulding, equipment, sand moulds (cope, drag, check etc.), safety precaution etc. Job: preparing sand moulds for single, multi-piece pattern in at least two- or multi--piece moulding boxes and details like runners, risers, gates etc. mould cavity finishing, demonstration of casting using ferrous of non-ferrous metal. precaution etc.	S2	CO1
2	Welding Shop: Different welding machines and equipment, types of welding and welded joints, used in fabrication, preparation for weld joints, joint finishing, different tools, types of electrodes, angle cutters, portable grinder, drills, safety precautions etc. Job: Preparing a job individually or in a group of students of any useful item of daily use using various welding operations Introduction and demonstration of robotic welding.	S3	CO1
3	Industrial Visit to any plastic manufacturing industry	S4	CO1
4	Industrial visit to any sheet metal working industry and study its process.	S5	CO1


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Assessment:**ISE I**

The ISE I will consist of submitting job of the sections with neatly written records of the study and diagrams. The term work will be assessed by the course coordinator

End Semester Evaluation

The End Semester Evaluation will comprise of viva voce by conducting practical exam. The End Semester Evaluation will be done by two examiners, one will be the course coordinator and other will be examiner appointed by DSB

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
K1	Remember	5	5
K2	Understand	5	5
K3	Apply	5	5
K4	Analyze	2	2
K5	Evaluate	3	3
K6	Create	5	5
Total Marks		25	25

Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
S1	Imitation	5	5
S2	Manipulation	5	5
S3	Precision	5	5
S4	Articulation	5	5
S5	Naturalization	5	5
Total Marks		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
CO1	1	2	2		3					

3 – High 2 – Medium 1 - Low

Special Instructions if any: Nil


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MEPC2007 : LAB - MECHANISMS OF MACHINES		
Teaching Scheme	Examination Scheme	
Practical: 2Hrs/Week	ISE I	25 Marks
Credits:01	End Semester Evaluation	25 Marks

Course Outcomes: After completion of this course students will be able to:

	Course Outcomes
CO1	Develop conceptual knowledge of Kinematics of Mechanisms and study appropriate application about mechanisms
CO2	Draw velocity and acceleration diagrams of various mechanism through graphical and analytical methods
CO3	Draw cam profiles for Graphical synthesis of cams
CO4	Generate gear tooth profiles

List of the Experiments

The student shall perform minimum eight experiments of the following, for Drawing sheets (soft tools can be used)

Sr. No.	Title of the Experiments	Skill / Knowledge Level	CO
1	Demonstration of Kinematics of Mechanisms and Machines	S1	CO1
2	Demonstration of Lower Pair Mechanism, such as Straight-line generators, Pantograph, Steering Mechanism, Hooks joint	S2	CO1
3	Draw sheets based on Velocity of Simple Mechanisms by instantaneous center method (Three or four Problems)	S3	CO2
4	Draw sheets based on Velocity analysis by relative velocity method problems (Three or four Problems)	S4	CO2
5	Draw sheets based on Acceleration analysis (Three or four Problems)	S5	CO2
6	Draw sheets based on Kinematic analysis – Short cut methods (Three or four Problems)	S1	CO2
7	Assignment based on Theory synthesis of cams, theory, classification, application, terminology etc	S4	CO3


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8	Draw sheet to generate Involute tooth profile with the help of a rack on gear blank	S5	CO4	05
9	Demonstration of interference and undercutting for gear	S5	CO4	05

Assessment:

ISE I

The ISE I will consist of submitting a file for all the experiments with neatly written records of the study and diagrams.

The term work will be assessed by the course coordinator

End Semester Evaluation

The End Semester Evaluation will comprise of viva voce on the conducted practical's.

The End Semester Evaluation will be done by two examiners, one will be the course coordinator and other will be examiner appointed by DSB

Assessment Pattern: Use the relevant table for assessment pattern.

Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
K1	Remember	05	2.5
K2	Understand	5	2.5
K3	Apply	05	5
K4	Analyze	10	5
K5	Evaluate		5
K6	Create		5
Total Marks			50

Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
S1	Imitation	05	2.5
S2	Manipulation	05	2.5
S3	Precision	05	5
S4	Articulation	05	5
S5	Naturalization	05	5
Total Marks			50


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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	PS O1	PS O2	PS O3
CO1	3	1	3							1					
CO2	3	1	2							1			3		
CO3	2	2	2							1			3		
CO4	1	3	3							1					

Special Instructions if any:


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MEES2008: Lab-MATERIAL SCIENCE & METALLURGY		
Teaching Scheme	Examination Scheme	
Practical: 2Hrs/Week	ISE I	25 Marks
Credits: 01	End Semester Evaluation	25 Marks

Course Outcomes:

After completion of this course students will be able to:

Course Outcomes	
CO1	Understand different crystal systems and various calculation included in the study of crystal system.
CO2	Use of metallurgical microscope to observe the microstructures
CO3	Understand the significance of observation of microstructure of plain carbon steels / Alloy steels.
CO4	Interpret and observe microstructure of Cast Iron/ Non Ferrous Alloys.
CO5	Study the change in mechanical properties due to heat treatment
CO6	Study of change in structure due to surface/ case hardening of steels.

List of the Experiments

The student shall perform minimum seven experiments of the following

Sr. No.	Title of the Experiments	Skill / Knowledge Level	CO
1	Study & Observation of the different Crystal Systems.	K2	CO1
2	Study & Operation of Metallurgical Microscope.	K2	CO2
3	Study & Observation of Microstructure of the Plain Carbon Steels.	K3	CO3
4	Study & Observation of Microstructure of Alloy Steels.	K3	CO3
5	Study & Observation of Microstructure of Cast Iron.	K2	CO4
6	Study & Observation of Microstructure of the Non Ferrous alloys.	K2	CO4
7	Study of changes in the mechanical properties due to heat treatment.	K2	CO5
8	Study of the change in the structure due to surface/ case hardening of steels.	K2	CO6

Assessment:

ISE I

The ISE I will consist of submitting a file for all the experiments with neatly written records of the study and diagrams. The term work will be assessed by the course coordinator.

End Semester Evaluation

The End Semester Evaluation will comprise of viva voce on the conducted practicals.

The End Semester Evaluation will be done by two examiners, one will be the course coordinator and other will be examiner appointed by DSB

Assessment Pattern:

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

Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
S1	Imitation	10	10
S2	Manipulation	10	8
S3	Precision	5	7
S4	Articulation		
S5	Naturalization		
Total Marks		25	25

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	PSO 1	PSO 2
CO1	3					3	3		1	1	3	3	1	2
CO2	1	1				2	3		1	1	3	3	1	2
CO3	1	1				2	3		1	1	3	3	1	2
CO4	3	2				3	3	3	1	1	2	1	1	2
CO5	3					3	3		1	1	3	3	1	2
CO6	1	1				2	3		1	1	3	3	1	2

1-High 2- Medium 3- Low


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MEOE0010 : TOTAL QUALITY MANAGEMENT		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs/ week	ISE I	15 Marks
Tutorial: 00 hrs/ week	ISE II	15 Marks
Credits: 03	ISE III	10 Marks
	End Semester Examination	60 Marks

Course description: After completing this course, students will have a broad and fundamental understanding of Quality. Students will have knowledge of different definitions of quality. Students will understand different quality control tools. Students will be able to understand concepts quality circles, kaizen, 5s etc. Students will understand and acquire knowledge of different ISO standardization series Students will be able to understand concepts of Just In Time (JIT) and Business Process Reengineering (BPR).

Course Objectives:

- To understand the importance of quality in modern business scenarios to individuals, organizations, customers, suppliers, and society.
- To understand E +4xcellence and Best Value
- To understand the Implication of Quality on Business.
- To understand the process of managing quality and managing services.
- To illustrate the use of total quality control tools

Course Outcome

After completing the course, students will be able to:

CO1	Define quality and discuss obstacles of quality management.
CO2	Use TQM improvement tools to enhance customer satisfaction and improve processes within their organization
CO3	Use quality management methods analyzing and solving problems of organization
CO4	Recognize the role of attitudes, beliefs, behaviors, and ethics in what we know and what we do.

Detailed Syllabus:

Unit 1	<p>TQM Premises</p> <p>Concept of Quality, Different definitions of Quality by various thinkers, Concept of Brand, Different Parameters for ascertaining quality, Dimensions of product and service in quality, Customer orientation, continuous improvement, Cost of Quality, Productivity and flexibility, approaches and philosophies of TQM,</p>
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Unit 2	Tools of TQM Basic Analytical tools-check sheets, Histograms, Pareto charts, Cause and Effect diagrams, flow charts, scatter diagrams, run charts, Cost of Quality; Quality cost measurement, Reliability and failure analysis
Unit 3	Quality Circles Introduction, implementation, formation, intangible impact of quality circle, inhibiting factors, Kaizen: Introduction, the Japanese style of management & Kaizen implementation, modeling kaizen process and benefit
Unit 4	Just in Time concept and TQM Introduction and Concept of JIT, Relevance & advantages, approach to quality, importance of KANBAN in JIT, Introduction to ISO series of Quality Standard, Certification Requirements, Evolving Standards
Unit 5	Latest Trends Concept of six sigma, and Japanese 5S principle, Implementation in manufacturing and service sector, Leadership issues, Quality, vision mission and policy statements
Text and Reference Books	
<ol style="list-style-type: none"> Deming W. Edward, '<i>Out of crisis</i>', MIT publishing, 1982. Ishikawa & Lu, '<i>What is Total Quality Control? The Japanese way</i>', PrenticeHall, 1988 Tally D. J., '<i>Total Quality Management</i>', ASQC Quality Press A. V. Feigenbaum, '<i>Total Quality Control</i>', McGraw Hill International, 6th Editions, USA, 2009. Juran J.M., '<i>Quality Control Handbook</i>', McGrawHillBookCompany 5th edition, USA, 2009. Masaaki Imai, '<i>Kaizen: The key to Japan's Competitive Success</i>', McGraw Hill International Editions, and USA, 1986. Al Endres, Wiley, '<i>Implementing Juran's Road Map for Quality Leadership: Benchmarks and Results</i>', 2000. 	

Mapping of Course outcome with Program Outcomes

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

Low-1, Medium -2, High-3

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 on Fifth unit.

Assessment Pattern:


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

Special Instructions if any: Nil


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EEMC2010: Environmental Studies	
Teaching Scheme	Examination Scheme
Lectures : 3 Hrs/Week	ISE I : 15 Marks
Tutorial : --	ISE II : 15 Marks
Total Credits : 0	ISE III : 10 Marks
	End -Semester Exam : 60 Marks

Pre-requisites: Nil

Course objectives:

1. To become aware about the various types of pollution, its sources, effects and control measures
2. To become aware about present environmental issues
3. To become aware of the importance of natural resources and environmental legislation
4. To become aware about environmental biotechnology and bio monitoring
5. To become aware of the biodiversity, conservation methods and factors for the loss of biodiversity

Unit wise Course Outcomes expected:

After completion of this course students will be able to-

CO1. Learn about the basics of environment
CO2. Understand the harmful effects of human activities on environment and their solutions
CO3. Understand the use of biotechnology and bio monitoring for the treatment of environment
CO4. Understand the concept of climate change, global warming, acid rain, various disasters and its mitigation measures

Detailed syllabus:

UNIT-I	<p>A) Concepts of Environmental Sciences Environment, Levels of organizations in environment, Structure and functions in an ecosystem; Biosphere, its Origin and distribution of land, in water and in air, Broad nature of chemical composition of plants and animals</p> <p>B) Natural Resources Renewable and Non-renewable Resources, Forests, water, minerals, Food and land (with example of one case study); Energy, Growing energy needs, energy sources (conventional and alternative)</p>
UNIT-II	<p>A) Biodiversity and its conservation Biodiversity at global, national and local levels; India as a mega-diversity nation; Threats to biodiversity (biotic, abiotic stresses), and strategies for conservation</p> <p>B) Environmental Pollution Types of pollution- Air, water (including urban, rural, marine), soil, noise, thermal, nuclear; Pollution prevention; Management of pollution- Rural/Urban/Industrial waste management [with case study of any one type, e.g., power (thermal/nuclear), fertilizer, tannin, leather, chemical, sugar], Solid/Liquid waste management, disaster management</p> <p>C) Environmental Biotechnology Biotechnology for environmental protection- Biological indicators, bio-sensors; Remedial measures- Bio-remediation, phyto remediation, biopesticides, bio-fertilizers; Bio-reactors- Design and application</p>
UNIT-III	<p>A) Social Issues and Environment Problems relating to urban environment- Population pressure, water scarcity, industrialization; remedial measures; Climate change-Reasons, effects (global warming, ozone layer depletion, acid rain) with one case study; Legal issues- Environmental legislation (Acts and issues involved), Environmental ethics</p> <p>Environmental Monitoring Monitoring- Identification of environmental problem, tools for monitoring (remote sensing, GIS); Sampling strategies- Air, water, soil sampling techniques</p>
UNIT-IV	<p>Laboratory Work including Practical and Field Work covering, of biogeographical zones and expanse of territorial waters on the map of India;</p>

	Identification of biological resources (plants, animals, birds) at a specific location; Determination of (i) pH value, (ii) water holding capacity and (iii) electrical conductivity of different types of soils; Determination of energy content of plants by bomb calorimeter; Measurement and classification of noise pollution; Determination of particulate matter from an industrial area by high volume sampler; Determination of physico-chemical parameters (pH, alkalinity, acidity, salinity, COD, BOD) of tap water, well water, rural water supply industrial effluent and sea water & potability issues; Demonstration of Remote Sensing and GIS methods; Industrial visit for environmental biotechnology processes (e.g., any one of the fermentation, tissue culture, pharmaceutical industries)
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Textbooks & Reference books

1. A Text Book of Environmental Studies by Bharucha E, University Press (India) Pvt. Ltd, 2005
2. A Text Book of Environmental Studies by Nadaf F. M., Pawaskar V. R., Intellectual Book Bureau, Bhopal, 2006
3. Fundamental of Ecology by Odum E. P, Natraj Publishers, Dehradun, 1996
4. Introduction to Environmental Engineering and science by Gilbert M and Wendell P., Pearson Education India, 2015
5. Environmental Science by S.C Santra, New Central Book Agency, 2011
6. Environmental Education by Sharma R. A, 1998

Mapping of Course outcome with program outcomes (Mechanical Engineering):

Course outcome	1	2	3	4	5	6	7	8	9	10	PO1 1	PO1 2	PO13	PO1 4	PO15
1															
2															
3															
4															
5															

1-Low 2- Medium 3- High Sample Assessment Table:

Assessment Tool	+K3	+K3	+K3	+K3
Unit wise Course outcomes	1	2	3	4
Class Test 30 Marks	10	10	10	
Teachers Assessment 10 Marks		05	05	
End Assessment 60 Marks	18	18	12	12

Sample Assessment Pattern:

Assessment Pattern Level no.	Knowledge Level	Test	Teachers Assessment/assignment	End Semester Examination
K1	Remember	10		12
K2	Understand	10		24
K3	Apply	10	10	12
K4	Analyze			12
TOTAL		30	10	60

Teaching Strategies:

The teaching strategy is planned through the lectures, tutorials and team-based homework. Exercises are assigned weekly to stimulate the students to actively use and revise the learned concepts which also help the students to express their way of solving the problems fluently in written form. Most critical concepts and mistakes are emphasized.

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 on Fifth unit.


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MEPC2010 : APPLIED THERMODYNAMICS		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs/ week	ISE I	15 Marks
Tutorial: 00 hrs/ week	ISE II	15 Marks
Credits: 03	ISE III	10 Marks
	End Semester Examination	60 Marks

Prerequisites: MEPC2006 Engineering Thermodynamics Course

description:

This course consists of understanding the working and analyzing the performance of reciprocating compressors. Basic understanding of internal combustion engines, various systems in IC engines is included in this course. Analysis of vapour power cycles is covered in this course. Also, this course includes theoretical understanding of vapour compression refrigeration, non-conventional refrigeration systems, need and working of various types of condensers and cooling towers.

Course Outcomes:

After completing the course, students will be able to:

	Course Outcomes
CO1	analyze the performance of air compressor
CO2	Analyze the performance of Nozzles
CO3	Identify various parts of refrigeration system and describe their functions.
CO4	Analyze the performance of vapour power cycles
CO5	Select condenser and cooling tower for particular application

Detailed Syllabus:

Unit1	<p>Gas Compressors</p> <p>A) Classifications and working principles, Reciprocating compressors. Terminologies used, effect of clearance volume, actual indicator diagram, multistage compression, two stage compressors (Numerical problems on reciprocating compressors)</p> <p>B) Rotary compressors, working principles, Roots blower, Vane type blower, Centrifugal compressor, axial flow compressor, Comparison between reciprocating and rotary compressors, air motor (Descriptive treatment only).</p>
Unit 2	<p>Flow Through Nozzles: Velocity and heat drop, mass discharge through a nozzle, critical pressure ratio and its significance, effect of friction and nozzle efficiency, supersaturated flow.</p>
Unit3	<p>Introduction to Refrigeration and Air Conditioning:</p> <p>Fundamentals of refrigeration systems, COP, unit of refrigeration, Introduction to Air conditioning, psychometric chart.</p> <p>Introduction to Steam Turbines:</p> <p>Principle of operation, classification, Velocity diagrams, Degree of reaction, methods of governing</p>

Unit 4	Vapour Power Cycles Carnot cycle using steam, ideal Rankine cycle, modified Rankine cycle, Reheat and Regenerative cycles with bleeding of steam, thermal efficiency, specific steam consumption, work ratio, power output, effect of superheat, inlet pressure and back pressure on performance of Rankine cycle (Numerical Treatment)
Unit 5	Steam Condensers Classifications, comparison between Jet and Surface condensers, vacuum efficiency, vacuum measurement, mass of circulating water required in a condenser, air removal, capacity of air extraction pumps, introduction to cooling towers.

Text and Reference Books

1. Domkundwar & Domkundwar, "Introduction to Thermal Power Engineering", Dhanpatrai and Sons, New Delhi, 2014.
2. Ballaney P.L., "Thermal Engineering", Khanna Publications, New Delhi, 2014.
3. Domkundwar S, Kothandaraman C. P. & Domkundwar A., "A Course in Thermal Engineering", Dhanpat Rai and Co. publication, New Delhi, 2004.
4. Eastop T D, McConkey A, "Applied Thermodynamics", Pearson education, New Delhi, 2002.
5. Rajadurai J S, "Thermodynamics and Thermal Engineering", New Age Publishers, N. Delhi, 2010.

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes 3 – High 2 – Medium 1 - Low

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	2			2	1	1	3	
CO2	3	2				2	2			2	1	1	3	
CO3	3	1				2	2			2	1	1	2	
CO4	3	2				2	2			2	1	1	3	
CO5	3	1				2	2			2	1	1	2	

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 on Fifth unit.

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	5	5		20

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K2	Understand	5	5	5	20
K3	Apply	5	5	5	20
K4	Analyze				
K5	Evaluate				
K6	Create				
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1, K2, K3	K1, K2, K3	K2 and K3	K2 and K3	K2 and K3
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	8	7			
ISE II (15 Marks)			8	7	
ISE III (10 Marks)	0	0	2	3	5
ESE Assessment (60 Marks)	12	12	12	12	12
Total Marks 100	20	19	22	22	17

Special Instructions if any: Nil


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MEPC2011 : Machine Drawing		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs/ week	ISE I	15 Marks
Tutorial: 00 hrs/ week	ISE II	15 Marks
Credits: 03	ISE III	10 Marks
	End Semester Examination	60 Marks

Prerequisites: MEES1001 Engineering Graphics and Design

Course description: After completing this course, students will have a broad and fundamental concept of intersection curves in sheet metal work, Apply concept of curves in manufacturing; apply the knowledge of developed surfaces in sheet metal product manufacturing, Assembly and Details

Course Outcomes:

After completing the course, students will able to:

	Course Outcomes
CO1	Draw curves of intersection of solids.
CO2	Applying the knowledge of sheet metal of manufacturing, draw the corresponding developed surfaces
CO3	Understand the Conventional methods of representing threaded fasteners
CO4	Understand the Conventional representation of Riveted joints

Detailed Syllabus:

Unit 1	Intersection of Surfaces Line or Curve of intersection of two solids, Methods: Line method, Cutting-plane method. Intersection of vertical prism with prism, cylinder, cone (Horizontal or Inclined), Intersection of vertical Cylinder with cylinder, cone, Intersection of vertical cone with cone, prism.
Unit 2	Development of Surfaces Introduction: Methods of Development, Development of lateral surfaces of right solids- Cube, Prism, Cylinders, Pyramids, Cone, Development of Transition Pieces, Spheres
Unit 3	Conventional Representation Standard convention using SP – 46 (1988)-Materials C.I., M.S, Brass, Bronze, Aluminum, wood, Glass, Concrete and Rubber-Long and short break in pipe, rod and shaft.- Various sections- Half, removed,-Standard convention of Knurling, splined shafts, and chain wheels Springs with square and flat ends, Gears, sprocket wheel-Countersunk & counter bore, Surface roughness-Indication of machining-symbol showing direction of lay, roughness grades, machining allowances, Machining symbols used in industry
Unit 4	Threaded Fasteners Screw thread terminology-Conventional representation of External threads and internal threads Draw the top and front view of hexagonal headed bolt with nut across flat and corner-Draw - square headed bolt across corner and flat-cylindrical headed bolt-Eye bolt. Riveted Joints Types of riveted joints-Draw the sectional front view and top view of-single riveted lap joint, double riveted lap joint with chain riveting and zigzag riveting.

Reference Books

1. Bhatt N. D., Panchal V. M., "Engineering Drawing", Charotar Publishing House, 2010.
2. Dhabhade M. L., "Engineering Graphics", Vol. - I and Vol.-II, Vision Publications,Pune, 2003.
3. Gill P. S., "Engineering Drawing", S. K. Katariya & Sons, Delhi, 2013.
4. Bhatt N. D., Panchal V. M., "Machine Drawing", Charotar Publishing House, 2014.
5. Siddheswar, Kannaiyah, and Shastry VVS, "Machine Drawing", TMH
6. Dhawan, "A Text Book of Machine Drawing," S. Chand publications 2014

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

1 – High 2 – Medium 3 - Low

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

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 on Fifth unit.

Assessment Pattern:

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

Assessment table:

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

Special Instructions if any: Nil

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MEPC2012 : STRENGTH OF MATERIALS

Teaching Scheme	Examination Scheme	
Lectures: 02 hrs/ Week	ISE I	10 Marks
Tutorial: 00 hrs/ Week	ISE II	10 Marks
Credits: 02	ISE III	05 Marks
	End Semester Examination	25 Marks

Prerequisites: MA1001: Engineering Mathematics I, MA1002: Engineering Mathematics II, AM1001 Engineering Mechanics

Course description: The strength of a material is its ability to resist external forces without breaking. Strength of Materials is the foundation for Engineering design courses. The course covers material behavior, stresses, strains and deformations with simple applications in engineering designs. Topics to be chosen from elastic and elastic-plastic behavior; plane stress and strain; constitutive relationships, principal stress and strain, failure criteria, bending and shearing stresses in beams, Mohr's circle, Euler's theory and Rankin's theory of column failure with different support conditions, torsion of solid and hollow circular sections, work and strain energy concepts.

Course Outcomes:

After completing the course, students will be able to:

CO1	Apply concepts of stress and strain to solve problems.
CO2	Compute Shear Force and Bending Moment for determinate beams and draw Shear Force and Bending Moment Diagrams for various loading conditions.
CO3	Apply the knowledge of bending and shear concept to determine various stresses and draw stress diagrams.
CO4	Explain theory of column failure with different support conditions and develop numerical ability to solve numerical problems.
CO5	Apply knowledge of strain energy and torsion to solve numerical problems.

Detailed Syllabus:

Unit 1	<p>Simple Stresses and Strains Elasticity, Stress, Strain, Hook's Law, Young's Modulus, numerical on stresses in bar of varying sections and composite bars, numerical on statically indeterminate problems, elastic constants, bulk modulus, shear modulus and their relations and numerical.</p>
Unit 2	<p>Shear Force and Bending Moment Definition of shear force and bending moment, relation between SF, BM and intensity of loading, numerical on statically determinate beams (simply supported, cantilever, overhanging).</p>


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Unit 3	<p>Stress in beams and Principal stresses and Strains</p> <p>a) Stress in beams: Theory of simple bending, assumptions, neutral axis, moment of resistance, section modulus, bending stress distribution diagram, numerical on statically determinate beams of rectangular and I section beams, section consisting of different materials, Shear stresses in beams</p> <p>b) Principal stresses and Strains: Tangential and normal stresses, Principal Planes, principal stresses, analytical and graphical methods to find stresses on an oblique section, Mohr's Circle.</p>
Unit 4	<p>Columns & Struts</p> <p>Euler's theory and Rankin's theory of column failure with different support conditions, derivations, radius of gyration, slenderness ratio, factor of safety, numerical on single and built-up cross sections.</p>
Unit 5	<p>Strain Energy, Theory of torsion</p> <p>a) Strain Energy: Definition, resilience, Proof resilience, Modulus of resilience, strain energy stored in the body due to gradually applied loads, suddenly applied loads and impact loads, strain energy due to shear, bending</p> <p>b) Theory of torsion: Theory of torsion, assumptions, torsional stresses and strains numerical on solids hollow circular shafts, composite shafts and varying sections.</p>

Text and Reference Books

1. S.S. Rattan – “Strength of Material” – Tata McGraw Hill Publication Co. Ltd. S, 2017.
2. Ramamurtham – “Strength of material” - Dhanpat Rai Publication, 2020.
3. Singer and Pytel – “Strength of materials” - Harper and row Publication, 1990.
4. Beer and Johnston – “Strength of materials” - CBS Publication, 2014.
5. Timoshenko and Young – “Strength of Materials” - CBS Publication, 2002.

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 on Fifth unit.

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	3		3								3
CO2		3	2	2		2								
CO3		2	3	3		3						3		

C04		3	2	3		2					3			
C05		2	3	2		3							3	


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3 – High 2 – Medium 1 – Low

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	2.5	2.5	2.5	5
K2	Understand	2.5	2.5	2.5	5
K3	Apply	2.5	2.5	00	5
K4	Analyze	00	00	00	00
K5	Evaluate	2.5	2.5	00	10
K6	Create	00	00	00	00
Total Marks 50		10	10	5	25

Assessment table:

Assessment Tool	K3				
	CO1	CO2	CO3	CO4	CO5
ISE I (10 Marks)	6	4			
ISE II (10 Marks)			5	5	
ISE III (5 Marks)	1	1	1	1	1
ESE Assessment (25 Marks)	5	5	5	5	5
Total Marks 50	12	10	11	11	6

Special Instructions if any:


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MEPC2013 : METROLOGY AND QUALITY CONTROL		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs/ week	ISE I	15 Marks
Tutorial: 00 hrs/ week	ISE II	15 Marks
Credits:03	ISE III	10 Marks
	End Semester Examination	60 Marks

Prerequisites: MEES1001: Basics of Mechanical Engineering, PHBS1001: Engineering Physics,

Course description:

The course is aimed at giving the fundamentals of quality assurance methods for manufacturing processes and dimensional measuring systems. In particular, the course focuses on: introduction to quality management systems, measurement systems, requirements for measurement processes and measuring equipment, geometrical products specifications & verification, dimensional & geometrical metrology, coordinate measuring machine.

Course Outcomes:

After completing the course, students will be able to:

	Course Outcomes
CO1	Identify different types of standards and explain tolerance, limits of size, fits, geometric and position tolerances and gauge design.
CO2	Illustrate selection and use of comparators, angular measurement and gear measurement.
CO3	Summarize the methods of measurement of surface roughness and screw thread. Testing flatness, concave and concave surfaces by light wave interference. Understand working of Co-ordinate Measuring Machines, Laser Viewers for profile checks.
CO4	Recall the concept of Quality Control and ISO 9000 certification.
CO5	Construct the control charts and recommend acceptance sampling appropriately.

Detailed Syllabus:

Unit 1	<p>Metrology: Definition and concept of metrology and standardizations, Standards of linear measurement, Line standard, End standard and wavelength standard, Traceability, Reliability.</p> <p>Limits, Fits and Gauges:</p> <p>Limits: Tolerances, different ways of expressing accumulation, relationship between tolerances and cost, interchangeability, selective assembly maximum and minimum metal conditions, Indian standard (IS 919-1963)</p>
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	<p>Fits: Terminology for limits and fits, types of fits, hole basis system, shaft basis system, selection of fits, types of assemblies like trial and error, interchangeable assembly,</p> <p>Gauges: Plain gauges, ring gauges, snap gauges, adjustable gap gauges, control and profile gauges, material for gauges, Gauge design: Taylor's principle, gauge maker's tolerance, wear allowances, numerical on gauge design.</p> <p>Industrial applications of limits, fits and gauges.</p>
Unit 2	<p>Comparators: Introduction, types of comparators, construction and working of different types of comparators like mechanical, optical, electric, pneumatic. Industrial applications of comparators.</p> <p>Angular measurements: Venire bevel protector, universal bevel protector, sine bar, angle gauges, optical instrument like auto collimator, angle dekkor, optical profile projector. Industrial applications of angular measuring instruments.</p> <p>Measurement and testing of gears: Sources of errors in manufacturing gears, gear measurement, gear rolling tests.</p>
Unit 3	<p>Measurement of surface finish: Definition, terminology, methods of measuring surface finish by using surface roughness tester,</p> <p>Metrology of screw threads: Screw threads terminology, error in threads and their effects, measurements of various elements of threads.</p> <p>Measurement by using light-wave interference: Interference of two rays, light source for interferometry, interferometry applied to flatness, concave and convex testing.</p> <p>Measuring machines: Co-ordinate Measuring Machines (CMM), Laser Viewers for profile checks.</p>
Unit 4	<p>Quality Control: Quality: meaning of quality of product & services, Quality characteristics, Quality of design, Quality of conformance, Quality of performance, Concept of reliability, Cost, Quantity assurance, Cost of rework & repair, Quality Control & Inspection, Inspection stages. ISO 9000 Series & other standards: Concept, ISO 9000 series quality standards, QS14000, Standards in general, necessity of ISO 9000 certification and procedure.</p>
Unit 5	<p>Statistical Quality Control – Meaning and importance of SQC, Variable and attribute Measurement. control charts – inherent and assignable sources of variation, control charts for variables \bar{X} & R charts, control charts for attributes P and C charts, process capability of machine, determination of statistical limits, different possibilities, Rejection area, statistically capable and incapable processes, Cp, Cpk.</p> <p>Acceptance Sampling – Concept, Comparison with 100% inspection, Different types of sampling plans, with merits and demerits, OC curve, It's importance and significance, Producer's risk, Consumer's risk, AQL, AOQL, IQL, LTPD</p>

Text and Reference Books

1. Jain R. K., "*Engineering Metrology*", Khanna Publishers, Delhi, 2004.
2. Gupta I. C., "*A Textbook of Engineering Metrology*", Dhanpat Rai and Sons, 2019.
3. ASTE, *Handbook of Industrial Metrology*, PHI Publications, 2013.
4. Grant and Leavenworth, "*Statistical Quality Control*", McGraw Hill publication, 2017.
5. *Quality Control*, NITTTR Madras, Tata McGraw Hill Publishing Ltd, 2014.
6. Hume K J, "*Engineering Metrology*", Macdonald & Company Limited, London, 1963.

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 on Fifth unit.


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**Mapping of Course outcome with Program Outcomes and Program Specific Outcomes3 – High
2 – Medium 1 – Low**

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	2			3	3				3			2	
CO2	1				2	3				3			2	
CO3	1				1	3				3			2	
CO4	1					3				3			2	
CO5	1	1			2	3				3			2	

Assessment Pattern:

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

Assessment table:

Assessment Tool	K3				
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	7	8			
ISE II (15 Marks)			7	8	
TA (10 Marks)	2	2	2	2	2
ESE Assessment (60 Marks)	12	12	12	12	12
Total Marks 100	21	22	21	22	14

Special Instructions if any: Nil


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MEPE2014 : MACHINE TOOLS		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs./ week	ISE I	15 Marks
Tutorial: -	ISE II	15 Marks
Credits: 03	ISE III	10 Marks
	ESE	60 Marks

Prerequisites: NIL

Course description: After completing this course, students will have a broad and fundamental understanding of the concepts of terminology and geometry of tools and various operations on lathe, various milling operations, drilling, boring and broaching operations, grinding machines and process, non-traditional machining processes.

Course Outcomes:

After completing the course, students will be able to:

Course Outcomes	
CO1	Select the correct tool for the particular machining operation on lathe.
CO2	Acquire the knowledge of indexing on milling machine for gear cutting.
CO3	Acquire practical knowledge of drilling, boring, broaching and grinding operations.
CO4	Compare and select suitable Non-Traditional Machining process for particular application.

Detailed Syllabus:

Unit 1	<p>Lathe machines</p> <p>Functions of a lathe, types, size of a lathe, functions of various parts of a lathe, feed mechanism, thread cutting mechanism, lathe accessories and attachments, lathe operations, capstan and turret lathes, automatic lathes.</p>
Unit 2	<p>Milling machines and Gear Cutting</p> <p>Types of milling machines and their industrial applications, milling cutters and their uses, indexing and dividing heads, indexing methods, calculations of indexing, multi-axis milling, Gear cutting methods such gear generating and gear hobbing.</p>
Unit 3	<p>Drilling, Boring and Broaching machines</p> <p>Drilling- Introduction, types of drill, twist drill nomenclature, types of drilling machines and their applications, work holding devices, tool holding devices, drilling machine operation, speed, feed and machine time.</p> <p>Boring-Introduction, classification of boring machines, boring bars, boring heads, boring defects,</p> <p>Broaching- Introduction, principal parts of broach, broaching machines, application of broach, advantages of broaches, limitations of broaches and broaching tools.</p>
Unit 4	<p>Grinding machines</p> <p>Introduction, grinding wheels, manufacturing of artificial abrasives, bonds and bonding processes, grit, grade and structure of grinding wheels, types of wheels, method of specifying grinding wheel, selection of grinding wheels, dressing and truing of grinding wheels, types of grinding machines</p>

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Unit 5	<p>Shaper, Planning and Slotting Machines</p> <p>Shaper Machines-Types of shapers, principal parts, size, mechanisms, operations, industrial applications.</p> <p>Planning Machines-Types of planning machines, principal parts, size, mechanisms, operations, industrial applications.</p> <p>Slotting Machines- Types of slotting machines, principal parts, size, mechanisms, operations, industrial applications.</p>
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Text and Reference Books

1. H. Gerling, "All about Machine Tools", Wiley Eastern, 2nd edition, 2006.
2. Krar S. F., "Technology of Machine Tools", Mc Graw Hill, 7th edition, 2011.
3. G. Boothroyd, "Fundamentals of Metal Machining and Machine Tools", CRC press, 3rd edition, 2005.
4. Raghuvanshi B.S., "Workshop Technology", Vol. I, Dhanpat Rai & Co., New Delhi, 1991.
5. Hazra Choudhary, "Elements of Workshop Technology", Vol. I, Dhanpat Rai Pub., New Delhi, 1994
6. Jain R.K., "Production Technology", Khanna Publications, 17th edition New Delhi, 2014.
7. Bawa H.S., "Workshop Technology", Vol. I, Mc Graw Education, New Delhi, 1998.

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 on Fifth unit.

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes- High, 2 –

Medium, 1 - Low

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

Assessment Pattern:

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

Assessment table:

Assessment Tool	K3				
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	7	8			
ISE II (15 Marks)			7	8	
TA (10 Marks)	2	2	2	2	2
ESE Assessment (60 Marks)	12	12	12	12	12
Total Marks 100	21	22	21	22	14

Special Instructions if any: Nil


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MEPE2015 : PRODUCTION PROCESSES		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs./ week	ISE I	15 Marks
Tutorial: -	ISE II	15 Marks
Credits:3	ISE III	10 Marks
	ESE	60 Marks

Prerequisites: NIL

Course description:

This course provides the basic knowledge of Production processes. Course includes fundamentals of metal cutting, Design of jigs and fixtures, Sheet metal working, Gear manufacturing and CNC machine, Unconventional machining processes.

Course Outcomes:

After completing the course, students will be able to:

Course Outcomes	
CO1	Select the correct tool for the particular machining operation.
CO2	The knowledge of indexing process on milling machine for gear cutting
CO3	Design the jigs and fixtures and press tools.
CO4	Acquire the knowledge of grinding operations and Broaching operation
CO5	Understand practical aspects of nontraditional machining

Detailed Syllabus:

Unit 1	Theory of Metal cutting Mechanics of Metal cutting, Cutting parameters, chip formation & types, Machining forces and merchants force circle diagram. Tool materials, Tool Geometry, Tool life, Tool wear types, cutting forces and power consumption, economics of metal cutting, Cutting fluid classification.
Unit 2	Metal Joining Processes Welding processes- Introduction, weldability, Gas welding, Arc welding with D.C. and A.C., Gas Tungsten Arc welding (GTAW), Gas Metal Arc welding (MMAW), Plasma Arc, Submerged Gas welding, Resistance welding, Thermit welding, Electron beam welding, Laser welding, Friction welding, Ultrasonic welding and applications various welding methods, welding defects.
Unit 3	Gear manufacturing and super finishing processes Gear Manufacturing: Gear cutting process - Forming and generations, Gear cutting, Milling, Hobbing, Gear Shaping, Shaving, lapping, Grinding. Super finishing Process: Honning, lapping, burnishing and buffing processes with its working principle, advantages and disadvantages with their applications.

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Unit 4	Advanced Machining Processes PART -I Introduction, classification of machining processes, Abrasive jet machining (AJM), Ultrasonic machining (USM), Chemical machining (CHM), Electrochemical machining (ECM), Electrochemical grinding (ECG) and industrial applications of these advanced machining processes
Unit 5	Advanced Machining Processes PART-II Electro discharge machining (EDM) with Die Sinking EDM and Wire Cut EDM, Electron beam machining (EBM), Laser beam machining (LBM), Plasma arc machining (PAM), Ion beam machining and industrial applications of these advanced machining processes.

Text and Reference Books

1. DeGarmo, Black Koshier," *Materials and Processes in Manufacturing*" Prentice Hall of India edition 2005.
2. Amitabh Ghosh, Asok Kumar Malik," *Manufacturing Science*" EWP Affiliated EastWest Private Limited, edition 2006.
3. P N Rao Vo I & II, "*Manufacturing Technology*" edition 2009, Tata McGraw Hill Publication Manufacturing Processes -I &II, Bawa H.S, Tata McGraw HillPublication edition 2004.
4. P H Joshi, "*Jigs and Fixtures*"1 st edition, Tata McGraw Hill Publication, 2001.

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 on Fifth unit.

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes 3-High 2 – Medium

1 - Low

Course outcome	P O1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	1	3	3							2			
CO2	1	1	1	3	3										
CO3	2	1	1	2	1							2			
CO4	1	1	1	3	3										
CO5	2	2	2	3	1							2			


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Assessment Pattern:

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

Assessment table:

Assessment Tool	K3				
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	7	8			
ISE II (15 Marks)			7	8	
TA (10 Marks)	2	2	2	2	2
ESE Assessment (60 Marks)	12	12	12	12	12
Total Marks 100	21	22	21	22	14

Special Instructions if any: Nil


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MEPC2016 : LAB - APPLIED THERMODYNAMICS		
Teaching Scheme	Examination Scheme	
Practical: 2Hrs/Week	ISE I	25 Marks
Credits:01	End Semester Evaluation	25 Marks

Course Outcomes:

After completion of this course students will be able to:

Course Outcomes	
CO1	Hands on experience with reciprocating compressor and its performance analysis.
CO2	Hands on experience with centrifugal blower and its efficiency calculation,
CO3	Understand about working of nozzles, refrigerator and cooling tower
CO4	Communicate effectively by preparing laboratory report and Visit Report

List of the Experiments

The student shall perform minimum eight experiments of the following

Sr. No.	Title of the Experiments	Skill / Knowledge Level	CO
1	Trial on two stage Reciprocating air Compressors	K3	CO1 and CO4
2	Determination of efficiency of blower.	K3	CO2 and CO4
3	Study of Nozzles	K2	CO3 and CO4
4	Performance Evaluation of Vapor Compression Refrigeration system	K3	CO3 and CO4
5	Study of domestic refrigerator.	K2	CO3 and CO4
6	Study of surface condenser.	K2	CO3 and CO4
7	Study of cooling towers	K2	CO3 and CO4
8	Visit to industry related to applied thermal systems.	K2	CO4

Assessment:

ISE I

The ISE I will consist of submitting a file for all the experiments with neatly written records of the study and diagrams.

The term work will be assessed by the course coordinator


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End Semester Evaluation

The End Semester Evaluation will comprise of viva voce on the conducted practical's. The End Semester Evaluation will be done by two examiners, one will be the course coordinator and other will be examiner appointed by DSB

Assessment Pattern:

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

Assessment Pattern Level No.	Knowledge Level	ISE I	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 3-High 2 – Medium 1 - Low

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	3				2	1		3	3	1	1	3	2
CO2	3	3				2	1		3	3	1	1	3	2
CO3	3					1	1		3	3	1	1	3	2
CO4	1	2				1	1	1	3	3	2	3	3	2

Special Instructions if any:


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MEPC2017 : LAB- MACHINE DRAWING

Teaching Scheme	Examination Scheme	
Practical: 2Hrs/Week	ISE I	25 Marks
Credits:01	End Semester Evaluation	25 Marks

Course Outcomes:

After completion of this course students will be able to:

Course Outcomes	
CO1	Enhance the knowledge of drawing machine components

List of the Experiments

The student shall perform eight experiments of the following


Sr. No.	Title of the Experiments	Skill / Knowledge Level	CO
1.	One half imperial sheet on Problems on Intersection of Surfaces	K2 and K3	CO1
2.	One half imperial sheet on Problems on Development of Surfaces	K2 and K3	CO1
3.	One half imperial sheet on Problems on Conventional Representation of standards and Machining Symbols.	K2 and K3	CO1
4.	One half imperial sheet on Problems on Threaded Joints	K2 and K3	CO1
5.	One half imperial sheet on Problems on Riveted Joints	K2 and K3	
6.	Introduction to the unit assembly drawing, steps involved in preparing assembly drawing from Details-Sequence in assembly. One half imperial sheet on Problems on Assembly Drawing	K2 and K3	CO1
7.	One half imperial sheet on Problems on Assembly Drawing	K2 and K3	CO1
8.	One Full imperial sheet on Problems on Assembly Drawing	K2 and K3	CO1

Assessment : The ISE I will consist of submitting a Portfolio of all sheets drawn by students. The quality of drawing and usage of relevant standards by the students will be taken into consideration for assessment. The term work will be assessed by the course coordinator

End Semester Evaluation

The End Semester Evaluation will comprise of viva voce on the conducted practicals.

The End Semester Evaluation will be done by two examiners, one will be the course coordinator and other will be examiner appointed by DSB


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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
S1	Imitation	05	10
S2	Manipulation	10	8
S3	Precision	10	7
S4	Articulation		
S5	Naturalization		
Total Marks		25	25

Assessment Pattern LevelNo.	Knowledge Level	ISE I	End Semester Examination
K1	Remember		
K2	Understand	15	10
K3	Apply	10	15
K4	Analyze		
K5	Evaluate		
K6	Create		
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	1	2	1										1	1

Special Instructions if any: Nil


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MEPC2018 :Lab - STRENGTH OF MATERIALS		
Teaching Scheme	Examination Scheme	
Practical: 2Hrs/Week	ISE I	25 Marks
Credits:01	End Semester Evaluation	25 Marks

Course Outcomes:

After completion of this course students will be able to:

	Course Outcomes
CO1	Interpret the test results
CO2	Test and measure the performance of material
CO3	Apply test knowledge to define and understand different material behavioral concept

List of the Experiments

The student shall perform minimum eight experiments of the following using MATLAB/ MIPOWER/PSCAD

Sr. No.	Title of the Experiments	Skill / Knowledge Level	CO
1	Study of Universal Testing Machine and its attachments and Extensometer	S1	CO1
2	Tension test on mild steel and Tor Steel specimens	S2	CO2
3	Shear test on metals (Direct and punching)	S2	CO3
4	Flexural test on timber specimens	S2	CO3
5	Impact test on metals	S3	CO3
6	Hardness test on metals (Brinell and Rockwell)	S4	CO2
7	Torsion test on mild steel and Tor steel circular Specimens	S5	CO2

Assessment: ISE I

The ISE I will consist of submitting a file for all the experiments with neatly written records of the study and diagrams.

The term work will be assessed by the course coordinator

End Semester Evaluation

The End Semester Evaluation will comprise of viva voce on the conducted practicals. The End Semester Evaluation will be done by two examiners, one will be the course coordinator and other will be examiner appointed by DSB

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
K1	Remember	5	5

K2	Understand	5	5
K3	Apply	5	5
K4	Analyze	2	3
K5	Evaluate	5	5
K6	Create	3	2
Total Marks		25	25

Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
S1	Imitation	5	3
S2	Manipulation	5	2
S3	Precision	5	10
S4	Articulation	5	5
S5	Naturalization	5	5
Total Marks		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
CO1		1	1			2				
CO2		2		1		2				
CO3				2		2				


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MEPC2019 : LAB- METROLOGY AND QUALITY CONTROL		
Teaching Scheme	Examination Scheme	
Practical: 2Hrs/Week	ISE I	25 Marks
Credits:01	End Semester Evaluation	25 Marks

Course Outcomes:

After completion of this course students will be able to:

Course Outcomes	
CO1	To apply knowledge of appropriate measuring instruments, gauges or comparators used to determine geometry and dimensions of components in engineering applications.
CO2	To perform experiments and experiments to analyze and interpret data used for quality control.
CO3	Analyze the measurement of the surface roughness.
CO4	To understand the advances in Metrology such as use of CMM, Laser, Machine Vision System for Metrology etc.
CO5	To understand of Quality Control Techniques and its applications in engineering industries.

List of the Experiments

The student shall perform minimum eight experiments of the following.

Sr. No.	Title of the Experiments	Skill / Knowledge Level
1	Demonstration and measurements by linear measuring instruments for linear measurements.	K1, K2, K3, K4, K5
2	Demonstration and measurements by limit gauges for gauging tolerances.	K1, K2, K3, K4, K5
3	Demonstration and measurements by different types of comparators like mechanical optical, electronic and pneumatic	K1, K2, K3


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4	Demonstration and measurements by different types of angular measuring instruments such as Venirebevel protector, universal bevel protector, sine bar, sine centre, angle gauges, optical instruments like auto collimator, angle dekkor,	K1, K2, K3
5	Testing of gears by gear rolling tester	K1, K2, K3
6	Demonstration and measurements of surface roughness by surface roughness measuring instrument.	K1, K2, K3
7	Demonstration and measurements of screw thread parameters by using one wire, two and three wire methods.	K1, K2, K3
8	Demonstration of interferometry applied to flatness, concave and convex testing.	K1, K2, K3
9	Industrial visit to understand the use of CMM and Laser Viewers for profile checks.	K1, K2
10	Demonstration and construction of control charts for variables and attributes	K1, K2, K3, K4, K5

Assessment:

ISE I

The ISE I will consist of submitting a file for all the experiments with neatly written records of the study and diagrams.

The term work will be assessed by the course coordinator

End Semester Evaluation

The End Semester Evaluation will comprise of viva voce on the conducted practical's.

The End Semester Evaluation will be done by two examiners, one will be the course coordinator and other will be examiner appointed by DSB

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
K1	Remember	5	6
K2	Understand	5	6
K3	Apply	5	6
K4	Analyze	6	6
K5	Evaluate	4	4
K6	Create		
Total Marks		25	25

all
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Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
S1	Imitation	6	6
S2	Manipulation	6	6
S3	Precision	6	6
S4	Articulation	6	6
S5	Naturalization	7	7
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	1		3	3								1	1	
CO2	1		3	3								1	1	
CO3	1		3	3								1	1	
CO4	1		3	3								1	1	
CO5	1		3	3								1	1	
CO6	1		3	3								1	1	
CO7	1		3	3								1	1	
CO8	1		3	3								1	1	
CO9	1		3	3	1							1	1	
CO10	1		3	3								1	1	

3-High 2 – Medium 1 - Low

Special Instructions if any:


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MEPC2020 : WORKSHOP PRACTICE – III		
Teaching Scheme	Examination Scheme	
Practical: 2Hrs/Week	ISE I	25 Marks
Credits:01	End Semester Evaluation	25 Marks

Course Outcomes:

After completion of this course students will be able to:

Course Outcomes	
CO1	Enhancing the skills in operations like pattern making, moulding, sheet metal working and CNC Machining

List of the Experiments

Sr. No.	Title of the Experiments	Skill / Knowledge Level	CO
1	Turning Shop: Study of different operations to be carried on the lathe machine, Machining time calculations, taper turning methods (calculations), single point cutting tool operations, external threading, facing, finishing cuts, internal threading, safety precautions etc. Job: preparing a job on lathe machine performing the above operations individually	S1	CO1
2	Machine shop: study of different operations to be carried on the milling machine, the use indexing, gear cutting, slot cutting, spline cutting, and safety precautions etc. Job: preparing at least one job involving indexing operations spur gear cutting	S2	CO1
3.	Grinding Shop: study of different grinding operations and safety precautions. Job: preparing at least one job using grinding machine.	S3	CO1
4	Experimentation/ Preparing at least one job by using any one non-conventional machining processes.	S4	CO1

Assessment:

ISE I

The ISE I will consist of submitting a jobs for all the sections with neatly written records of the study and diagrams.

The term work will be assessed by the course coordinator

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End Semester Evaluation

The End Semester Evaluation will comprise of viva voce by conducting practical exam. The End Semester Evaluation will be done by two examiners, one will be the course coordinator and other will be examiner appointed by DSB

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
K1	Remember	4	4
K2	Understand	4	4
K3	Apply	4	4
K4	Analyze	5	5
K5	Evaluate	4	4
K6	Create	4	4
Total Marks		25	25

Assessment Pattern Level No.	Knowledge Level	ISE I	End Semester Examination
S1	Imitation	5	5
S2	Manipulation	5	5
S3	Precision	5	5
S4	Articulation	5	5
S5	Naturalization	5	5
Total Marks		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
CO1	3	2	2		1					

3 – High 2 – Medium 1 – Low

Special Instructions if any:


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MEOE1020: AUTOMATION ENGINEERING		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs/ week	ISE I	15 Marks
Tutorial: -	ISE II	15 Marks
Credits: 3	ISE III	10 Marks
	End Semester Examination	60 Marks

Prerequisites:NIL

Course description:

Automation is playing a key role in Industries. Industries rely heavily on automation for economic viability and mass production. It is important for the students to learn basic of automation, how system works and importance of PLC, SCADA and robots in automation. This course will provide opportunity to learn industrial automation techniques


Course Outcomes:

After completing the course, students will be able to:

	Course Outcomes
CO1	Understand the concept of automation and human factors
CO2	Designing a Pneumatic and Hydraulic system for a given application
CO3	Demonstrate the use of different sensors for automation
CO4	Design automation systems for a given application
CO5	Understand the circuit optimization techniques

Detailed Syllabus:

Unit 1	Introduction to Automation of different manufacturing processes, types of automation, degree of automation, technical, economic and human factors in automation
Unit 2	Types of systems - mechanical, electrical, electronics; Data conversion devices, transducers, signal processing devices, relays, contactors and timers. Sensors and their interfaces;
Unit 3	Hydraulics & Pneumatic Systems design and their application to manufacturing equipment; Sequence operation of hydraulic and pneumatic cylinders and motors; Electro Pneumatic & Electrohydraulic Systems design, Relay Logic circuits, Feedback control systems, PID Controller;
Unit 4	Drives and mechanisms of an automated system: stepper motors, servo drives. Ball screws, linear motion bearings, electronic camming and gearing, indexing mechanisms, tool magazines, and transfer systems.
Unit 5	Programmable Logic Controllers, I/Os, system interfacing, ladder logic, SCADA; Motion controller and their programming, PLC Open Motion Control blocks, Introduction to CNC control. automated guided vehicle systems.


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Text and Reference Books

1. Mikell P.Groover, "Automation, Production Systems & Computer Integrated Manufacturing" PHI Learning Pvt. Ltd. New Delhi, 3rd Edition 2012.
2. M.P.Groover, "Automation, production systems and Computer-integrated Manufacturing", Eastern Economy Edition, 2016.
3. Andrew Parr, "Hydraulic and Pneumatics", Butterworth-Heinemann. ISBN:0750644192, 1999.
4. W Bolton., "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering" Prentice-Hall. ISBN: 0131216333, 2003.
5. Tiess Chiu Chang & Richard A. Wysk, "An Introduction to Automated Process Planning Systems" 1998.
6. Amber G.H & P.S. Amber, "Anatomy of Automation" PrenticeHall, 1962.

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 on Fifth unit.

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes
3 – High2 – Medium1 - Low

Course outcome	P O1	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		2							3	3	3
CO2		3		1	2									
CO3				2	3					3			3	2
CO4		2		1	3				3			3	3	
CO5	1			3										

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	5	2	2	10
K2	Understand	5	1	2	10
K3	Apply	5	10	2	20
K4	Analyze		2	2	10
K5	Evaluate			2	10
K6	Create				
Total Marks 100		15	15	10	60


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Assessment table:

Assessment Tool	K3				
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	7	8			
ISEII (15 Marks)			7	8	
ISEIII (10 Marks)	2	2	2	2	2
ESE Assessment (60 Marks)	12	12	12	12	12
Total Marks 100	21	22	21	22	14

Special Instructions if any:


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Open Electives Offered by Mechanical Department

Sr No	Course Code	Course Name	Pre-requisite	Eligible students from department	Credits L-T-P	Offered Semester
1	MEOE0010	Total Quality Management	NIL	All department	3-0-0	Odd
2	MEOE1020	Automation Engineering	NIL	All department	3-0-0	Even
3	MEOE0030	Quality Management Systems	NIL	All department	3-0-0	Odd
4	MEOE0031	Renewable Energy Sources	NIL	All department	3-0-0	Odd
5	MEOE1040	Entrepreneurship Development	NIL	All department	3-0-0	Even
6	MEOE1041	Operation Research	NIL	All department	3-0-0	Even
7	MEOE0050	Additive Manufacturing	NIL	All department	3-0-0	Odd


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MEOE0010 : TOTAL QUALITY MANAGEMENT		
Teaching Scheme	Examination Scheme	
Lectures: 02 hrs/ week	ISE I	15 Marks
Tutorial: 01 hrs/ week	ISE II	15 Marks
Credits: 03	ISE III	10 Marks
	End Semester Examination	60 Marks

Course description: After completing this course, students will have a broad and fundamental understanding of Quality. Students will have knowledge of different definitions of quality. Students will understand different quality control tools. Students will be able to understand concepts quality circles, kaizen, 5s etc. Students will understand and acquire knowledge of different ISO standardization series Students will be able to understand concepts of Just In Time (JIT) and Business Process Reengineering (BPR).

Course Objectives:

- To understand the importance of quality in modern business scenarios to individuals, organizations, customers, suppliers, and society.
- To understand E +4xcellence and Best Value
- To understand the Implication of Quality on Business.
- To understand the process of managing quality and managing services.
- To illustrate the use of total quality control tools

Course Outcome

After completing the course, students will be able to:

CO1	Define quality and discuss obstacles of quality management.
CO2	Use TQM improvement tools to enhance customer satisfaction and improve processes within their organization
CO3	Use quality management methods analyzing and solving problems of organization
CO4	Recognize the role of attitudes, beliefs, behaviors, and ethics in what we know and what we do.

Detailed Syllabus:

Unit 1	<p>TQM Premises</p> <p>Concept of Quality, Different definitions of Quality by various thinkers, Concept of Brand, Different Parameters for ascertaining quality, Dimensions of product and service in quality, Customer orientation, continuous improvement, Cost of Quality, Productivity and flexibility, approaches and philosophies of TQM,</p>
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Unit 2	Tools of TQM Basic Analytical tools-check sheets, Histograms, Pareto charts, Cause and Effect diagrams, flow charts, scatter diagrams, run charts, Cost of Quality; Quality cost measurement, Reliability and failure analysis
Unit 3	Quality Circles Introduction, implementation, formation, intangible impact of quality circle, inhibiting factors, Kaizen: Introduction, the Japanese style of management & Kaizen implementation, modeling kaizen process and benefit
Unit 4	Just in Time concept and TQM Introduction and Concept of JIT, Relevance & advantages, approach to quality, importance of KANBAN in JIT, Introduction to ISO series of Quality Standard, Certification Requirements, Evolving Standards
Unit 5	Latest Trends Concept of six sigma, and Japanese 5S principle, Implementation in manufacturing and service sector, Leadership issues, Quality, vision mission and policy statements
Text and Reference Books	
<ol style="list-style-type: none"> 2. Deming W. Edward, 'Out of crisis', MIT publishing, 1982. 3. Ishikawa & Lu, 'What is Total Quality Control? The Japanese way', PrenticeHall, 1988 4. Tally D. J., 'Total Quality Management', ASQC Quality Press A. V. Feigenbaum, 'Total Quality Control', McGraw Hill International, 6th Editions, USA, 2009. 5. Juran J.M., 'Quality Control Handbook', McGrawHillBookCompany 5th edition, USA, 2009. 6. Masaaki Imai, 'Kaizen: The key to Japan's Competitive Success', McGraw Hill International Editions, and USA, 1986. 7. Al Endres, Wiley, "Implementing Juran's Road Map for Quality Leadership: Benchmarks and Results", 2000. 	

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				1								
CO2	1				2		2					
CO3		2				1						
CO4					1							
CO 5		1										


Low-1, Medium -2, High-3

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 on Fifth unit.


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Assessment Pattern:

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

Special Instructions if any: Nil


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MEOE1020 : AUTOMATION ENGINEERING		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs/ week	ISE I	15 Marks
Tutorial: -	ISE II	15 Marks
Credits: 3	ISE III	10 Marks
	End Semester Examination	60 Marks

Prerequisites:NIL

Course description:

Automation is playing a key role in Industries. Industries rely heavily on automation for economic viability and mass production. It is important for the students to learn basic of automation, how system works and importance of PLC, SCADA and robots in automation. This course will provide opportunity to learn industrial automation techniques


Course Outcomes:

After completing the course, students will be able to:

	Course Outcomes
CO1	Understand the concept of automation and human factors
CO2	Designing a Pneumatic and Hydraulic system for a given application
CO3	Demonstrate the use of different sensors for automation
CO4	Design automation systems for a given application
CO5	Understand the circuit optimization techniques

Detailed Syllabus:

Unit 1	Introduction to Automation of different manufacturing processes, types of automation, degree of automation, technical, economic and human factors in automation
Unit 2	Types of systems - mechanical, electrical, electronics; Data conversion devices, transducers, signal processing devices, relays, contactors and timers. Sensors and their interfaces;
Unit 3	Hydraulics & Pneumatic Systems design and their application to manufacturing equipment; Sequence operation of hydraulic and pneumatic cylinders and motors; Electro Pneumatic & Electrohydraulic Systems design, Relay Logic circuits, Feedback control systems, PID Controller;
Unit 4	Drives and mechanisms of an automated system: stepper motors, servo drives. Ball screws, linear motion bearings, electronic camming and gearing, indexing mechanisms, tool magazines, and transfer systems.
Unit 5	Programmable Logic Controllers, I/Os, system interfacing, ladder logic, SCADA; Motion controller and their programming, PLC Open Motion Control blocks, Introduction to CNC control. automated guided vehicle systems.


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Text and Reference Books

1. Mikell P.Groover, "Automation, Production Systems & Computer Integrated Manufacturing" PHI Learning Pvt. Ltd. New Delhi, 3rd Edition 2012.
2. M.P.Groover, "Automation, production systems and Computer- integrated Manufacturing", Eastern Economy Edition, 2016.
3. Andrew Parr, "Hydraulic and Pneumatics", Butterworth- Heinemann. ISBN:0750644192, 1999.
4. W Bolton., "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering" Prentice-Hall. ISBN: 0131216333, 2003.
5. Tiess Chiu Chang & Richard A. Wusk, "An Introduction to Automated Process Planning Systems" 1998.
6. Amber G.H & P.S. Amber, "Anatomy of Automation" PrenticeHall, 1962.

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 on Fifth unit.

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes
3 – High2 – Medium1 - Low

Course outcome	P O1	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		2							3	3	3
CO2		3		1	2									
CO3				2	3					3			3	2
CO4		2		1	3				3			3	3	
CO5	1			3										

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	5	2	2	10
K2	Understand	5	1	2	10
K3	Apply	5	10	2	20
K4	Analyze		2	2	10
K5	Evaluate			2	10
K6	Create				
Total Marks 100		15	15	10	60

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Assessment table:

Assessment Tool	K3				
	CO1	CO2	CO3	CO4	CO5
ISE I (15 Marks)	7	8			
ISEII (15 Marks)			7	8	
ISEIII (10 Marks)	2	2	2	2	2
ESE Assessment (60 Marks)	12	12	12	12	12
Total Marks 100	21	22	21	22	14

Special Instructions if any:


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MEOE0030: QUALITY MANAGEMENT SYSTEMS		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs/ week	ISE I	15 Marks
Tutorial: 00 hrs/ week	ISE II	15 Marks
Credits: 03	ISE III	10 Marks
	End Semester Examination	60 Marks

Prerequisites: NIL

Course description: This course is to create awareness about quality management system among students. A quality management system (QMS) is defined as a formalized system that documents processes, procedures, and responsibilities for achieving quality policies and objectives. Its purpose is to ensure that, every time a process is performed, the same information, methods, skills and controls are used and applied in a consistent manner.

Course Outcomes:

After completing the course, students will able to:

CO1	Explain the principles and various philosophies of quality management.
CO2	Apply Just in time technique
CO3	Apply various techniques of SQC and TQM.
CO4	Explain quality standards and supply chain management.

Detailed Syllabus:

Unit 1	Quality Management: Introduction to Quality management, principal of Quality management, Philosophies of various Quality Gurus, Quality planning, leadership theories, Theories of motivation (Maslow and Herzberg), Fred W. Riggs model of comparative Management.
Unit 2	Element of Just In Time manufacturing, Advantages, limitations, plant arrangement for flexible plan, planning, control, kanban, just in time logistics, Implementation issues in JIT manufacturing, Inventory management for JIT , Decision making in JIT, leadership theories, Theories of motivation
Unit 3	Quality circle, Human dimension in TQM, Quality Management Tools like Brainstorming, Histogram, check sheet, pareto diagram, Ishiwaka Diagram, control chart, scatter diagram, Affinity diagram, Tree diagram, Five S theory. Quality certification, ISO 9000, TPM-Definition and distinctive feature of TPM, Four developmental Stages of TPM Relationship between TPM, Terotechnology and logistics, Maximization equipment effectiveness organization for TPM implementation, communication and control
Unit 4	Customers and suppliers -- Define internal and external customers, identify their expectations, and determine their satisfaction levels; define internal and external suppliers and key elements of relations with them, Customer satisfaction and loyalty, Basic customer service principles, Multiple and diverse customer management.
Unit 5	Quality principles for products and processes -- Identify basic quality principles related to products (such as features, fitness-for-use, freedom from defects, etc.) and processes (such as Monitoring, measuring, continuous improvement, etc.). • Quality standards, requirements, and specifications Supply Chain Management ,Supplier Selection ,• Supplier communications, Supplier Performance , Supplier Improvement, Supplier Certification, Partnerships, and Alliances Supplier Logistics


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 Council, Dated 23/07/2022

Text and Reference Books

1. D. C. Montgomery, *Introduction to Statistical Quality Control*, John Wiley & Sons,
2. Mitra A., *Fundamentals of Quality Control and Improvement*, PHI
3. J Evans and W Linsay, *The Management and Control of Quality*, Thomson.
4. Besterfield, D H et al., *Total Quality Management*, Pearson Education.
5. D. C. Montgomery, *Design and Analysis of Experiments*, John Wiley & Sons
6. D. C. Montgomery and G C Runger, *Applied Statistics and Probability for Engineers*, John Wiley & Sons

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	PSO 1	PSO II	PSO III
CO1				3									1		
CO2	3				2		2		2				2		
CO3		2				3							1		
CO4					3								3		

3 – High 2 – Medium 1 – Low

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 on Fifth unit.

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	05	05	03	10
K2	Understand	03	03	02	10
K3	Apply	02	02	03	20
K4	Analyze	02	02	02	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
	CO1	CO1/CO4	CO3	CO4/CO2
ISE I (15 Marks)	05	05	03	02
ISE II (15 Marks)	05	05	03	02
ISE III (10 Marks)	00	05	05	00
ESE Assessment (60 Marks)	05	15	20	20
Total Marks 100	15	30	31	24

Special Instructions if any:

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MEOE0031: RENEWABLE ENERGY SOURCES		
Teaching Scheme	Examination Scheme (Semester – I) Theory	
Lectures: 03 hrs/ week	ISE I	15 Marks
Tutorial: 0 hrs/ week	ISE II	15 Marks
Practical: 02 hrs/ week	ISE III	10 Marks
Credits: 03	End Semester Examination	60 Marks

Pre-requisites: ME1001 Basics of Mechanical Engineering

Course Description: This course consists of basic understanding of various types of renewable energies like solar energy, wind energy, biomass energy, hydro energy etc and their sources and applications. It will give the knowledge of conversion of renewable energies into useful form of electrical energy. This also consist of various types of power plants based on renewable energy and their economic analysis.

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

CO1	roduction to solar energy, their resources and collections.
CO2	Introduction to wind energy and wind turbines.
CO3	derstand biomass and biogas and their conversions.
CO4	roduction to fuel cells, types and applications.
CO5	roduction to various power plants.
CO6	alyze economic analysis of power plants.

Detailed Syllabus:

Unit1	Solar Energy. Introduction, Applications, terms and definitions, merits and demerits, solar constant, solar insolation, Tilt angle of the fixed flat plate collector, different types of collectors (solar thermal modified flat plate, parabolic through, paraboloidal dish), solar photovoltaic cell principal, V-I characteristics, efficiency of solar cell.
Unit2	Wind energy. Introduction, application, merits and limitations, wind energy quantum, wind power density, power in wind stream, wind turbine efficiency, wind velocity duration curve, Wind turbines. Terms and definitions, types, horizontal axis propeller type wind turbine, three blade horizontal axis wind turbine, vertical axis wind turbine, power duration curve, economic considerations.
Unit3	Biomass and Hydro Energy. Biomass. Introduction, origin of biomass, biomass energy resources, biomass conversion processes, direct combustion of biomass, thermo chemical conversion of biomass, biochemical conversion, fermentation, raw biomass material for conversion to biogas, agriculture waste and energy, aquatic biomass, raw material for biogas production, significance of biogas plants in India's energy strategy, average composition of biogas, anaerobic fermentation, types of biogas plants. Hydro energy. Introduction, merits and demerits, hydro-electric energy resources in India, types of hydro-electric plants, energy conservation scheme, terms and definitions, typical hydro-electric power plants, classification of hydro-electric turbines, impulse turbine and reaction turbine, merits of hydro turbine


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Unit4	<p>Energy Storage Systems and Fuel Cells.</p> <p>Energy Storage. Introduction, pump hydro energy storage plant, underground pumped hydro, compressed air energy storage (CAES), solar energy storage, battery energy storage systems, thermal energy storage systems</p> <p>Fuel Cells. Introduction, advantages of fuel cell, theory of electro-chemistry, principal and operation, classification and types, fuels for fuel cells, schematic of fuel cell power plant, acidic and alkaline electrolyte fuel cells, molten carbonate fuel cells, solid oxide fuel cells, methanol and hydrazine fuel cells</p>
Unit5	<p>Power Plants.</p> <p>Solar thermal power plants, solar pond, wind turbines, wind power plants, generators sets, horizontal axis, vertical axis, wind energy farms, fuel cells power plants, biogas power plants, hydraulic turbines, hydraulic power plant, fluctuating loads on power plants, economic analysis of power plants and tariffs.</p>
<p>TextBooks and Reference Books</p> <ol style="list-style-type: none"> 1. G. D. Rai, “<i>Non-Conventional Energy Sources</i>”, Standard Publishers Distributors.2016 2. R. K. Rajput, “<i>Non-Conventional Energy Sources and Utilisation</i>”, S. Chand Publications 2019 3. Sukhatme, “<i>Solar Energy: Principles of thermal collection and storage</i>”, TMH Publication 2020 4. S. Rao, Dr B. B. Parulekar, “<i>Energy Technology</i>”, Khanna Publishers.2019 5. G. N. Tiwari, R. K. Mishra, “<i>Advanced Renewable Energy sources</i>”, RSC Publishing 2014 6. Garg and Prakash, H. P. Garg, “<i>Solar energy: Fundamentals and Applications</i>”, TMH Publication 2015 7. Arora and Domkundwar,” <i>Power Plant Engineering</i>” DhanpatRai& Co. Publishing. 2017 	

Mapping of Course outcome with Program Outcomes


 Approved in XXIVth Academic
 Council, Dated 23/07/2022

3 – High 2 – Medium 1 – Low

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	2	1	1		1	2	1							1
CO2	3	1	1	1	2	1								
CO3	3	2	2	1	1	2							2	
CO4	3	2	3		1	1					1			
CO5	3	2	1				1					1		

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 on Fifth unit.

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	03	03	02	10
K2	Understand	04	04	02	10
K3	Apply	03	03	02	20
K4	Analyze	05	05	02	20
K5	Evaluate	00	00	02	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K3	K4	K5
Cos	CO1	CO1/CO5	CO3	CO4/CO2	CO5
Class Test					
(15 Marks)	3	4	3	3	2
Class Test					
(15 Marks)	3	4	3	3	2
Teachers Assessment (10 Marks)	2	2	2	2	2
ESE Assessment (60 Marks)	12	5	10	15	2

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Special Instructions if any:

MEOE1040: ENTREPRENEURSHIP DEVELOPMENT PROGRAMME		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs/ week	ISE I	15 Marks
Tutorial: 00 hrs/ week	ISE II	15 Marks
Credits: 03	ISE III	10 Marks
	End Semester Examination	60 Marks

Prerequisites: NIL

Course description: This course is to create awareness about entrepreneurship among students. This course focuses on motivating students for entrepreneurship. The more focus is given on creativity and innovation.

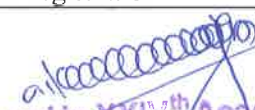
Course Outcomes:

After completing the course, students will be able to:

CO1	Identify qualities of entrepreneurs
CO2	Write project proposal
CO3	Use various entrepreneurship models
CO4	Understand various schemes supporting entrepreneurship
CO5	Think creative and innovative

Detailed Syllabus:

Unit 1	Introduction to entrepreneurship Entrepreneur- definition, Characteristics of a successful entrepreneur, Qualities and skills required to be an entrepreneur Six Hat, 5 S technique, Principles of Management, Types of entrepreneurs, Social and Women Entrepreneurship, Functions of entrepreneur, Social and Environmental responsibilities of entrepreneur, Role of entrepreneur in nation building, society up liftmen, poverty alleviation and employment generation.
Unit 2	Project report preparation Introduction, Idea selection, Selection of product or service, Aspects and phases of project, Contents of Project report
Unit 3	Introduction to various types of entrepreneurships Manufacturing sector, Service Sector, Freelancing, E commerce platform, Leadership and its types
Unit 4	Entrepreneurial Support Agencies Industrial Park, Special Economic Zones (SEZ), National Small Industries Cooperation (NSIC), The Small Industries Development Bank of India (SIDBI), Entrepreneurship Development Institute of India (EDII), Maharashtra Centre for Entrepreneurship Development (MCED)
Unit 5	Marketing Management Introduction, Types of marketing, Product marketing, Marketing Research and Consumer Behavior, Sales management and promotion, Product pricing, Advertising and branding, Decision Making Compliances for business Introduction, Companies Act 2013 and Environment Act 1986, Types of companies Basic compliances , Company registration, GST registration, Udyam registration


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Text and Reference Books

1. Dr. Gupta and Dr. Srinivasan, *Entrepreneurship development in India*, 2014
2. Sarugadharan and Resia Begum, *Women Entrepreneurship; institutional support and problems*, 2017
3. D.L. Saxon and RW Sniilor(eds), *The Art and Science of Entrepreneurs*, 2018
4. Raja opal, *Agriculture Business and Entrepreneurship*, 2017
5. Venkateshwara Rao and UdaiPareek,(Eds) *Entrepreneurship-A Handbook*, 2019

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	PSOII	PSOIII
CO1						1	1	1	1	1	1				
CO2						1	1		2	1					
CO3						1	1	1	1	1	1				
CO4								1	1				1	1	
CO5								1	1	1					

3 – High 2 – Medium 1 – Low

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 on Fifth unit.

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	05	05	00	10
K2	Understand	05	05	05	10
K3	Apply	03	03	05	20
K4	Analyze	02	02	00	20
K5	Evaluate	00	00	00	00
K6	Create	00	00	00	00
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool	K1	K2	K3	K4
	CO1/CO4	CO2	CO3/CO4	CO3/CO5
ISE I (15 Marks)	05	05	03	02
ISE II (15 Marks)	05	05	03	02
ISE III (10 Marks)	00	05	05	00
ESE Assessment (60 Marks)	05	15	20	20
Total Marks 100	15	30	31	24

Special Instructions if any:

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MEOE1041 : Operation Research		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs/ week	ISE I	15 Marks
Tutorial: 00 hrs/ week	ISE II	15 Marks
Credits: 02	ISE III	10 Marks
	End Semester Examination	60 Marks

Prerequisites: MABS 1001 Engineering Mathematics

Course Outcomes:

After completing the course, students will be able to:

Course Outcomes	
CO1	Understand the mathematical modelling of real-life optimization problems
CO2	Learn how to identify, formulate and solve optimization problem.
CO3	Learn simulation techniques.
CO4	Learn project management techniques.

Detailed Syllabus:

Unit 1	Development, history, definitions, objectives, characteristics, limitations, phases, and applications. Optimization models and their classifications. Linear Programming Formulation of LP problem, Simplex method (minimization / maximization cases). Degeneracy in LP, Duality in LP, Sensitivity analysis.
Unit 2	Introduction. Methods for finding initial solution. Test of optimality Maximization Transportation problem. Tran-shipment problem. Degeneracy. Assignment Problem Introduction. Solution methods. Variations of the assignment problem. Traveling Salesman Problem. Replacement of capital equipment that deteriorates with time, Replacement of items that fail without deteriorating.
Unit 3	Scheduling and sequencing. Assumptions in sequencing models. Processing "n" jobs on "m" machines. Inventory Control System (Quantitative Approach) Introduction. Meaning of Inventory Control. Functional classifications of Inventories. Advantages of Inventory Control. Deterministic Inventory Models: economic lot size with instantaneous replenishment with and without shortage costs, economic lot size models with quantity discount.
Unit 4	Queuing Systems: Introduction, cost associated with, Classification of queuing models. Kendall's notations. Models: $\{(M/M/1): (\alpha / FSFS)\}$. Single server models. Simulation Introduction to discrete event Simulation. Monte -Carlo Simulation. Problems related to Monte-Carlo Simulation. Dynamic Programming Distinguishing characteristics of D.P. Deterministic DP problems
Unit 5	. Network Models Introduction to PERT / CPM. Concepts and construction of network diagrams. Critical path and project duration, floats, network crashing, optimum project duration and cost, PERT activity, time estimate, probability of completion of a project on before specified time, Resource allocation and load smoothening. Minimal Spanning tree, shortest route and Maximal Flow problems.

Text and Reference Books

1. Taha *Operations Research: An Introduction*, Prentice Hall of India Pvt. Ltd 2020
2. Wagner H. N. *Principles of Operations Research with applications to Managerial Decisions*, Prentice Hall of India Pvt. Ltd', 2019
3. P.K.Gupta, D.S.Hira, '*Operations Research*', S. Chand Publications, New Delhi. 2017

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4. J K Sharma, "Operations Research Theory and Applications", 3rd edition, Macmillan India Ltd. 2019
5. Manohar Mahajan, "Operations Research", Dhanpat Rai & Company Pvt. Limited. 2020
6. S. D. Sharama, "Operations Research" Kedar Nath Ram Nath & Co. Meerut. 2020
7. Taha, Hamdy A., "Operations Research, An Introduction", 7th edition (with CD Rom), Prentice Hall Inc. 2003.
8. N. D. Vohra, 'Quantitative techniques in Management', Tata McGraw Hill Publishing Company Limited, New Delhi. 2007
9. Ragsdale, Cliff T., "Spreadsheet Modeling and Decision Analysis, A Practical Introduction to Management Science", Southwestern, Cengage Learning. 2009

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

3 – High 2 – Medium 1 – Low

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

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 on Fifth unit.

Assessment Pattern:

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


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Assessment table:

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


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Council, Dated 23/07/2022

MEOE0050 : ADDITIVE MANUFACTURING		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs/ week	ISE I	15 Marks
Tutorial: 00 hrs/ week	ISE II	15 Marks
Credits: 03	ISE III	10 Marks
	End Semester Examination	60 Marks

Prerequisites: Engineering Design, Materials Science

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

Course Outcomes:

After completing the course, students will be able to:

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:

Unit 1	Introduction to Additive Manufacturing (AM) General overview Introduction to reverse engineering Traditional manufacturing vis AM Computer aided design (CAD) and manufacturing (CAM) and AM Different AM processes and relevant process physics AM process chain Application level: Direct processes – Rapid Prototyping, Rapid Tooling, Rapid Manufacturing; Indirect Processes - Indirect Prototyping, Indirect Tooling, Indirect Manufacturing
Unit 2	Software Technologies and Tools Design/Fabrication Processes: Data Sources, Software Tools, File Formats, Model Repair and Validation, Pre- & Post-processing, Designing for Additive Manufacturing
Unit 3	Materials science for AM Discussion on different materials used Use of multiple materials, multifunctional and graded materials in AM Role of solidification rate Evolution of non-equilibrium structure property relationship Grain structure and microstructure
Unit 4	AM technologies Powder-based AM processes involving sintering and melting (selective laser sintering, shaping, electron beam melting, involvement). Printing processes (droplet-based 3D Solid-based AM processes - extrusion based fused deposition modelling object Stereo lithography Micro- and nano-additive
Unit 5	Process Selection planning, control for AM Selection of AM technologies using decision methods Additive manufacturing process plan: strategies and post processing. Monitoring and control of defects, transformation
Unit 6	Applications of AM Applications of AM: Aerospace, Automotive, Biomedical Applications of AM. Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing.


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Text and Reference Books

- Gibson, Rosen, Stucker, *Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing*. Springer, 2009
- Andreas Gebhardt, *Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing*, Hanser Publishers, 2011.
- J Evans and W Linsay, *The Management and Control of Quality*, Thomson. 2011
- Hopkinson, Hague, Dickens, *Rapid Manufacturing: An Industrial Revolution for the Digital Age*. Wiley, 2005.
- J.D. Majumdar and I. Manna, *Laser-assisted fabrication of materials, Springer Series in Material Science*, e-ISBN: 978-3-642- 28359-8.
 5. Zhiqiang Fan and Frank Liou, *Numerical modeling of the additive manufacturing (AM) processes of titanium alloy*, InTech, 2012

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	PSOII	PSOIII
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

3 – High 2 – Medium 1 – Low

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 on Fifth unit.

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	03	02	02	10
K2	Understand	03	03	02	15
K3	Apply	02	03	02	10
K4	Analyze	03	02	02	10
K5	Evaluate	02	03	01	10
K6	Create	02	02	01	05
Total Marks 100		15	15	10	60

Assessment table:

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

Special Instructions if any:

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HSS

Offered By Mechanical Department

MEHS0020	Industrial Organization & Management	Odd
MEHS1030	Engineering Economics & Costing	Even
MEHS1040	NPTEL/MOOCs Courses	Even


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ME0020 : INDUSTRIAL ORGANIZATION AND MANAGEMENT		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs./ week	ISE I	15 Marks
Tutorial: 0 hrs./ week	ISE II	15 Marks
Credits: 3	ISE III	10 Marks
	End Semester Examination	60 Marks

Prerequisites: NIL

Course Description:

1. Students are able to understand the evolution of management thought.
2. Students will be able to understand the premises of administrative behavior and decision making required for proper motivation of employees.
3. Capable to understand the different functions and structure of management.
4. Capable to understand various concepts and practices in personnel administration.
5. Able to understand and compare the management in developed and developing countries and the effect of environment on management.

Course Outcomes:

After completing the course, students will be able to:

	Course Outcomes
CO1	Explain and apply principles of scientific management.
CO2	Explain and apply theories of motivation.
CO3	Explain various methods of recruitment and trainings.
CO4	Explain organizational structure and principles.

Detailed Syllabus:

Unit 1	Theories of Management Scientific Management (Taylor and the Scientific Management Movement), Classical Theory (Fayol, Urwick, Gulick and others) Bureaucratic Theory (Weber and his critics). Ideas of Mary Parker Follett and C.I. Barnard; Human Relations School (Elton Mayo and others). Behavioral Approach, Systems approach.
Unit 2	Administrative Behavior, Decision making with special reference to H. Simon, communication and control, leadership theories. Theories of motivation (Maslow and Herzberg).
Unit 3	Organization Hierarchy, Principles of organization- Unity of command, Span of control, Authority and Responsibility, Co-ordination, Centralization and Decentralization, Delegation, Supervision, Types of organizations, structures
Unit 4	Personnel Administration, Position classification, Recruitment, Training, Promotion, Pay and Service conditions, Administrative Ethics.
Unit 5	Administrative Systems Comparative management features of USA, Great Britain, France and Japan (Riggs concept)

Text Books and Reference Books

1. *Organisational Behaviour*, Stephen P. Robbin , pearson education 2016
2. O. P. Khanna, "*Industrial Organization and Management*, Khanna Publications 2017
3. D. Ravindra Prasad and V. S. Prasad, *Administrative Thinkers*, Sterling Publishers.2019.

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4. *Public administration and Public affairs*, Nicholas Henry, Routledge
 5. *Management of Organizational Behaviour* 2nd Edition by Paul Hersey, Kenneth H. Blanchard, Prentice-Hall, 2015
 6.D. Gvishiyani, *Organization and Management*, Progress Publishers, Moscow, 2019

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes
1 – High 2 – Medium 3 - Low

Course outcome	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1			3							2			2	
CO2				2			2		2				2	
CO3			2			3		3					2	
CO4					3					1			2	

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 on Fifth unit.

Assessment Pattern:

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

Assessment table:

Assessment Tool	CO1	CO2	CO3	CO4
ISE I(15 Marks)	7	8		
ISEII(15 Marks)			7	8
ISEIII (10 Marks)	2	3	2	3
ESE Assessment (60 Marks)	15	15	15	15
Total Marks 100	24	26	24	26

Approved in XXIVth Academic Council, Dated 23/07/2022

MEHS1030: ENGINEERING ECONOMICS AND COSTING		
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs./ week	ISE I	15 Marks
Tutorial: 0 hrs./ week	ISE II	15 Marks
Credits: 3	ISE III	10 Marks
	End Semester Examination	60 Marks

Prerequisites: -Industrial Management

Course Description:

This course consists of basic understanding of various types' renewable energies like solar energy, wind energy, biomass energy, hydro energy etc and their sources and applications. It will give the knowledge of conversion of renewable energies into useful form of electrical energy. This also consists of various types of power plants based on renewable energy and their economical analysis.

Course Objectives:

1. Introduction to engineering economics
2. Understand profit loss philosophy and break-even analysis
3. Understand various aspects of costing, budgeting and payback period.
4. Understanding cost control and various expenses.
5. Understanding Measurement of Cost of Capital and methods of cost allocations.

Course Outcomes:

After completing the course, students will be able to:

Course Outcomes	
CO1	Apply concepts of economic analysis to a industry.
CO2	Understand Break Even Analysis, Standard Costing, Marginal Costing.
CO3	Apply probabilistic risk analysis methods.
CO4	Understand budgeting.

Detailed Syllabus:

Unit 1	Introduction: Engineering and Economics, Definition and scope of Engineering Economics, Time value of money : Simple and compound interest, Time value equivalence, Compound interest factors, Cash flow diagrams, Calculation, Calculation of time –value equivalences. Present worth comparisons, Comparisons of assets with equal, unequal and infinite lives, comparison of deferred investments, Future worth comparison, payback period comparison
Unit 2	Fund flow analysis, concepts, objectives, techniques of Fund flow statement. Ratio analysis: Classification of ratios, structural group, standards for comparison limitations of Ratio analysis, returns on investment and integral ratio. Cost volume profit analysis: mechanics of break even chart, profit planning and break-even analysis, margin of safety.
Unit 3	Standard Costing: - Concept, Development and use of Standard Costing, Budget and Budgetary Control, Variance Analysis. Marginal Costing:- Use of Marginal Costing in Decision Making. Allocation of Resources: Capital Budgeting: Control of Capital Expenditure, Evaluation Process – Payback approach, Accounting of Rate of Return, Present Value Method Vs Internal Rate of Return.

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Unit 4	Introduction to Cost Control , Significance for Engineers, Limitations of Financial Accounting, Corporate Objectives, Profitability and other objectives, Product, Services and Market Mix. Elements of Cost:- Material, Labor , Expenses, Overheads, Direct and Indirect Cost, Fixed and Variable Cost, other classifications
Unit 5	Cost of Capital: Relevant Cost, Measurement of Cost of Capital, Cost of Debt, Preference Shares, Equity Shares, Internal Financing, Dividends, Cost of Retained Earnings Concept Cost Allocation:- Cost Accumulation and Allocation, Allocation of cost of Service Departments – Reciprocal Method, Allotting cost from one department to other Depreciation, Various methods for calculation.

Text Books and Reference Books

1. Prasad N. K., *Cost Accounting* Book Syndicate Pvt. Ltd., Kolkata
2. C. B.Gupta, *Fundamentals of Business*, Sultan Chand & Cc.
3. Henry M. Stenier, *engineering economics Principles*, Mc Grow hill Publication.
4. P. A. Samuelson, *Economics*, Mc Grow hill International.
5. Colin Drury, *management and Cost Accounting*, English Language Book Society.
6. Basu S.K., Sahu K.C and Rajiv B, *Industrial Organization and Management* –. PHI

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

1 – High 2 – Medium 3 - Low

Course outcome	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	1		1	2	1						1	
CO2	3	1	1	1	2	1						1	2	
CO3	3	2	2	1	1	2							2	
CO4	3	2	3		1	1					1			

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 on Fifth unit.

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	3	3	2	10
K2	Understand	4	4	2	10
K3	Apply	3	3	2	20
K4	Analyze	5	5	2	20
K5	Evaluate	0	0	2	0
K6	Create	0	0	0	0
Total Marks 100		15	15	10	60

Assessment table:

Assessment Tool				
	CO1	CO2	CO3	CO4
ISE I(15 Marks)	3	4	4	4
ISEII(15 Marks)	3	4	4	4
ISEIII (10 Marks)	2	3	2	3
ESE Assessment (60 Marks)	12	18	12	18
Total Marks 100	20	29	22	29


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MEHS4016

Guidelines to Enroll NPTEL/Massive Open Online Courses (MOOCs)

NPTEL/MOOCs : -It is mandatory to all students to successfully complete NPTEL/MOOC Course(s) at UG Engineering level (Total of 12 weeks) will be equivalent for one Humanities Course of three credits and submit its certificate to COE through their guide.

- The students have to Register and complete NPTEL/MOOC Course(s) up to VIIth Semester and the assessment will be in VIIIth semester.
- Students must select NPTEL/MOOC course through the list provided by BOS Chairman Mechanical Engineering Department.
- After submission of authentic course certificate, credit of MEHS4016 will be transferred.
- It is compulsory to appear online exam of Swayam/ NPTEL/ MOOCs course under supervision of department otherwise performance of student will not be considered.
- The ESE depends upon the performance and marks obtained in the exams of NPTEL/ MOOC courses and Percentage score obtained by students in will be graded as per autonomy rule with 10% of boost.

Sr. No.	Marks Obtained	Final Percentage (with 10% of boost) for grade calculations
1	100-81	100-91
2	71-80	81-70
3	61-70	71-80
4	51-60	61-70
5	40-50	50-60
6	<40	FAIL


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