Government College of Engineering Aurangabad, Chhatrapati Sambhajinagar

(An Autonomous Institute of Government of Maharashtra)
Station Road, Osmanpura, Chhatrapati Sambhajinagar – 431005 (M.S.)
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Curriculum for M. Tech. in Mechanical Engineering Design
(NEP Compliant)

(With Effect from Academic Year 2025-26)

Dr. S. A. Sonawane
Head, Mechanical

Dr. Anil Karwankar
Dean , Academics

Approved in XXXth Academic Council Meeting
Dated: 5th July 2025

Vision of the Institute

- In pursuit of global competitiveness, the institute is committed to excel in engineering education and research with concern for environment and society.

Mission of the Institute

- Provide conducive environment for academic excellence in engineering education.
- Enhance research and development along with promotion to sponsored projects and industrial consultancy.
- Foster development of students by creating awareness for needs of society, sustainable development and human values.

Vision of the Mechanical Engineering Department

- To develop excellence in Mechanical Engineering.

Mission of the Mechanical Engineering Department

- Impart sound knowledge and technical skills through conducive ambiance with right attitude towards society and environment.
- Enhance research facilities, collaboration with industry and provide testing and consultancy services.
- Nurture entrepreneurial qualities, creativity and provide motivation for higher education.
- Inculcate self-learning, team work and adoptability to change.

Program Outcomes

PO1: An ability to independently carry out research investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: An ability to apply advance design concept and method in Mechanical Design to solve complex design problem.

PO5: Apply ethical principles and commit to professional ethics and responsibilities in practice.

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GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (P) per week	1 Credit

B. Range of Credits: M.Tech. in Mechanical Engine Design : The total number of credits proposed for the two-year full time M.Tech. in Mechanical Engine Design Engineering is kept as **82.**

C. Semester wise Credit Distribution Structure for Two-Year Full-Time PG Program in Mechanical Design Engineering:

Semester		**I**	**II**	**III**	**IV**	**Total Credits**
Programme Core Course (PCC)	Program Courses	**08**	**12**	**-**	**-**	**20**
Programme Elective Course (PEC)		**08**	**06**	**-**	**-**	**14**
Open Elective (OE) Other than a particular program	Multidisciplinary Courses	**-**	**03**	**03**	**-**	**06**
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	**02**	**02**	**-**	**-**	**04**
Ability Enhancement Course (AEC)	Humanities Social Science and Management (HSSM)	**-**	**03**	**-**	**-**	**03**
Entrepreneurship/Economics/ Management Courses		**-**	**-**	**03**	**-**	**03**
Indian Knowledge System (IKS)		**-**	**-**	**02**	**-**	**02**
Research Methodology	Experiential Learning Courses	**04**	**-**	**-**	**-**	**04**
Project		**-**	**-**	**10**	**16**	**26**
Co-curricular Courses (CC)	Liberal Learning Courses	**-**	**-**	**-**	**-**	**Audit**
Total Credits (Major)		**22**	**26**	**18**	**16**	**82**

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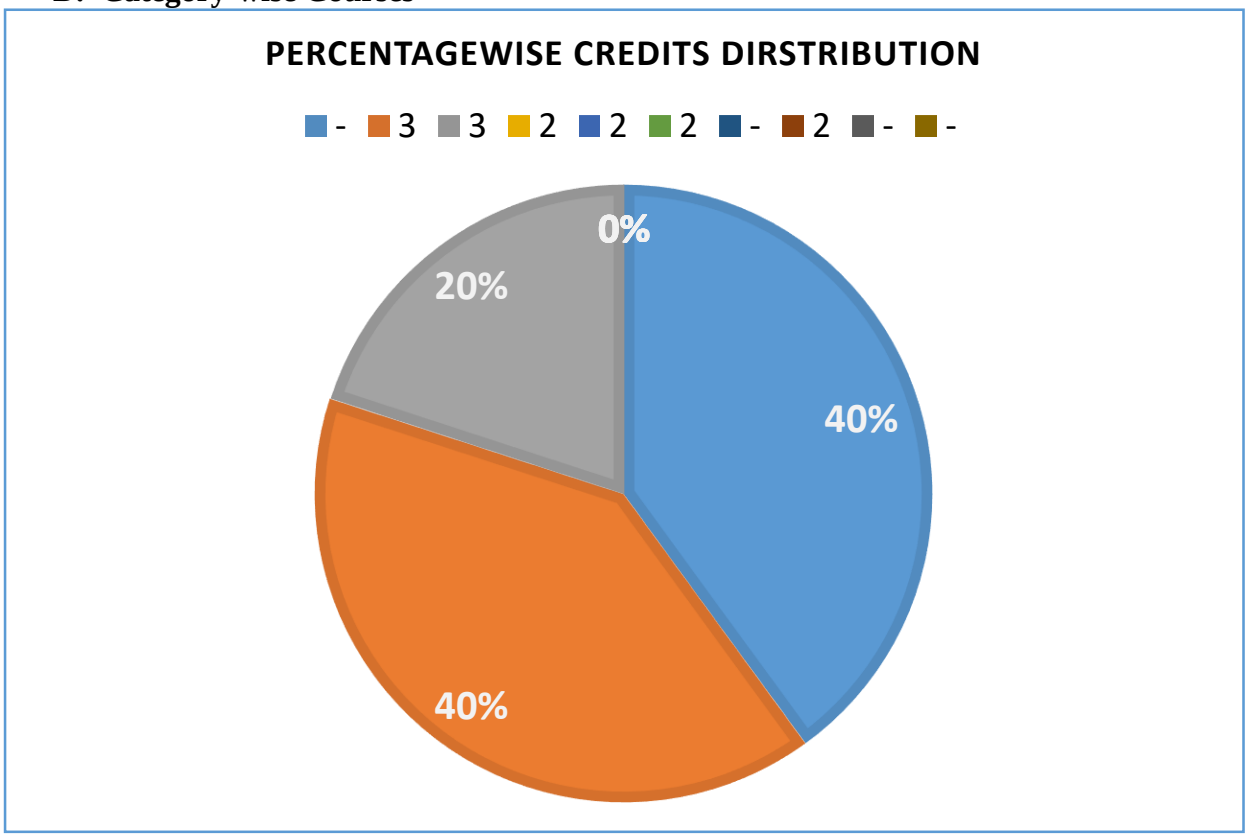
D. Category-wise Courses



1. VOCATIONAL AND SKILL ENHANCEMENT COURSE (VSEC)

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	VSEC	Mini Project – I	I	0	0	4	**02**
2	VSEC	Mini Project – II	II	0	0	4	**02**
Total Credits							**04**

2. HUMANITIES & SOCIAL SCIENCES COURSES [HSSM]

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	Ability Enhancement Course (AEC)	Technical Communication	II	3	0	0	**03**
2	Entrepreneurship/Economics/ Management Courses	Economics / Management Courses	III	3	0	0	**03**
3	Indian Knowledge System (IKS)		III	2	0	0	**02**
Total Credits							**08**

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3. EXPERIENTIAL LEARNING COURSES (ELC)

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	Research Methodology	Research Methodology	I	4	0	0	**04**
2	Project	Dissertation - I	III	0	0	20	**10**
3	Project	Dissertation - II	IV	0	0	32	**16**
Total Credits							**30**

4. LIBERAL LEARNING COURSES (CO-CURRICULAR COURSES (CC))

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	CC	Stress management through Yoga	I	0	0	2	**Audit**
Total Credits							**-**

5. OPEN ELECTIVE (OE) OTHER THAN A PARTICULAR PROGRAM

Two courses of 3 credits

Following courses are offered as Open Electives (OE) by Mechanical Engineering Department

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	OE	Robotics	II	3	0	0	**03**
2	OE	Additive Manufacturing	III	3	0	0	**03**
Total Credits							**06**

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Teaching and Evaluation Scheme from Academic Year 2025-26 as per NEP - 2020
M. Tech. Program in Mechanical Engineering Design (Full Time)

Semester – I

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	PCC	MEPCC 5041	Design Engineering	3	0	0	**3**	20	20	60	**100**
2.	PCC	MEPCC 5042	Lab – Design Engineering	0	0	2	**1**	-	25	-	**25**
3.	PCC	MEPCC 5003	Advanced Mathematical Methods	3	0	0	**3**	20	20	60	**100**
4.	PCC	MEPCC 5004	Lab – Advanced Mathematical Methods	0	0	2	**1**	-	25	-	**25**
5.	PEC		Programme Elective Course - I	4	0	0	**4**	20	20	60	**100**
6.	PEC		Programme Elective Course - II	4	0	0	**4**	20	20	60	**100**
7.	VSEC	MEVSE 5001	Mini Project – I	0	0	4	**2**	-	25	25	**50**
8.	ELC	MERMC 5001	Research Methodology	4	0	0	**4**	20	20	60	**100**
9.	CC	INCCC 5001	Stress Management Through Yoga #	0	-	2	**-**	-	-	-	**-**
Total				**19**	**0**	**10**	**22**	**100**	**175**	**325**	**600**

Programme Elective Course – I	**Programme Elective Course – II**
1. MEPEC5041 - Modern Engineering Materials	1. MEPEC5044 - Robotics and Automation
2. MEPEC5042 - Geometrical Modeling and Applications	2. MEPEC5005 - Engineering Experimental Techniques
3. MEPEC5043 - Machine Stress analysis	3. MEPEC5045 - Industrial Tribology

 # Audit Course

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Semester – II

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	PCC	MEPCC5045	Finite Element Methods	4	0	0	**4**	20	20	60	**100**
2.	PCC	MEPCC5046	Mechanical Vibrations Analysis	4	0	0	**4**	20	20	60	**100**
3.	PCC	MEPCC5047	Computer Aided Optimization	3	0	0	**3**	20	20	60	**100**
4.	PCC	MEPCC5048	Lab - Computer Aided Optimization	0	0	2	**1**	-	25	-	**25**
5.	PEC		Programme Elective Course - III	3	0	0	**3**	20	20	60	**100**
6.	PEC		Programme Elective Course - IV	3	0	0	**3**	20	20	60	**100**
7.	OE		Open Elective – I*	3	0	0	**3**	20	20	60	**100**
8.	VSEC	MEVSE5002	Mini Project – II	0	0	4	**2**	-	25	25	**50**
9.	AEC	EEAEC5001	Technical Communication	3	0	0	**3**	20	20	60	**100**
Total				**23**	**0**	**6**	**26**	**140**	**215**	**445**	**800**

Programme Elective Course – III

1. MEPEC5007 - Machine Tool Design
2. MEPEC5046- Simulation and Mathematical Modeling
3. MEPEC5009 - Engineering Economics

Programme Elective Course – IV

1. MEPEC5047 - Advanced Machine Design
2. MEPEC5048 - Design and Analysis of Experiments
3. MEPEC5049 - Material Handling Equipment Design

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Open Elective – I*

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

S.No.	Open Elective – I Course	Course Offering Department
1	AMOEC5001 - Basics of Finite Element Analysis	Applied Mechanics
2	CSOEC5002 - Professional Ethics & Cyber Law	Computer Science & Engineering
3	CEOEC5003 - Engineering Optimization	Civil Engineering
4	MEOEC5004 - Robotics (Not for Mechanical PG Students)	Mechanical Engineering
5	EEOEC5005 - Electric Vehicles (Not for Electrical PG Students)	Electrical Engineering
6	ECOEC5006 - IoT for Smart Systems	Electronics & Telecommunication

Semester – III

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	OE		Open Elective – II*	3	0	0	**3**	20	20	60	**100**
2.	HSSM		Entrepreneurship / Economics / Management Course	3	0	0	**3**	20	20	60	**100**
3.	IKS	INIKS 6001	Vedic Approach to Mathematics	2	0	0	**2**	10	10	30	**50**
4.	ELC	MEDI S6001	Dissertation – I	0	0	20	**10**	-	100	100	**200**
Total				**8**	**0**	**20**	**18**	**50**	**150**	**250**	**450**

Open Elective – II*

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

S.No.	Open Elective – II Course	Course Offering Department
1	AMOEC6001 - Indian Constitution	Applied Mechanics
2	CSOEC6002 - Data Science (Not for CSE PG Students)	Computer Science & Engineering
3	CEOEC6003 - Disaster Management	Civil Engineering
4	MEOEC6004 - Additive Manufacturing	Mechanical Engineering
5	EEOEC6005 - Smart Grid Systems	Electrical Engineering
6	ECOEC6006 - Soft Computing	Electronics & Telecommunication

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HSSM: - Entrepreneurship / Economics / Management Course

S.No.	Open Elective – II Course	Course Offering Department
1	MEEEM6001 – Entrepreneurship Development	Mechanical Engineering
2	ECEEM6002 – Engineering Economics	Electrical Engineering
3	MEEEM6003 – Industrial Management	Mechanical Engineering

Semester – IV

Sr. No	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	ELC	MEDIS6002	Dissertation – II	-	-	32	**16**	-	-	150	150
Total				**0**	**0**	**32**	**16**	**0**	**0**	**150**	**150**

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MEPCC5041 : DESIGN ENGINEERING		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Apply concepts of principal planes and stresses, analyse tri - axial stress states, calculate strain energy & shear strain energy due to principal stresses.
CO2	Explain the concepts related to crack initiation, propagation, and failure, Investigate cracks in materials under stress.
CO3	Explain fatigue, differentiate between low-cycle and high-cycle fatigue, & the concept of fatigue life and its dependence on various factors.
CO4	Analyze the plastic flow process, including how materials deform under bending beyond their yield point.
CO5	Interpret creep, its key characteristics (time-dependence, elevated temperature, and plastic deformation), & stages of creep (primary, secondary, and tertiary).

Detailed Syllabus:

Unit 1	**Fundamentals of Design Considerations** Principle planes and principle stresses, tri axial state of stresses, Mohr's circle for tri axial stresses and strains, volumetric strain, principle stresses computed from principle strains, principle strains due to perpendicular stresses and shear stresses, strain energy stored due to principle stresses in three directions, shear strain energy due to principle stresses.
Unit 2	**Fracture Mechanics** Types, concepts, fracture criterion, strain energy release, fracture mechanics, stress analysis of cracks, stress around cracks, Irwin's approach, crack displacement, crack closure, Griffith theory of brittle fracture, Metallographic aspects of brittle fracture, ductile fracture, Notch effect in fracture, plastic zone correction, crack opening displacement, J – contour integral, R – curves, fracture toughness testing, fracture under combine stresses.
Unit 3	**Fatigue of Metals** Fatigue phenomena, statistical nature, structural features, micro mechanisms: initiation and propagation, fatigue changes in different metals, fracture mechanism for fatigue, influential factors, effect of stress concentration, size effect, fatigue dislocation structure, fatigue crack growth, surface effects, corrosion fatigue, effect of mean stress on fatigue under multi-axial cyclic stresses, effect of metallurgical variables and temperature, fatigue of plastic and composites.

Unit 4	**Plastic Bending** The plastic flow process, shape factor, spring back, plastic bending with strain hardening material, plastic bending of wide plates, plastic hinges, and plastic deflection.
Unit 5	**Creep** Creep of material at high temperature, exponential creep law, and hyperbolic sine creep law, true stress and true strain, estimation of time to rupture, creep rupture testing, theories of low temperature and high temperature creep, presentation of creep data, prediction of long time properties, creep during bending, creep under multi-axial stresses, stress relaxation, Creep fatigue interaction, viscoelasticity, creep behaviour of plastics.

Text and Reference Books

1. Smith Seely, "Advanced Mechanics of Materials", John Willey & Sons Publications.
2. Timoshenko, " Strength of Materials"
3. Kocanda, , " Fatigue Failure of Metal", Sijthoff & Noordhoff International Publications.
4. Frost N. E., "Metals Fatigue", Oxford University Press, London.
5. Benhan & Crawford, "Mechanics of Engineering Materials", John Willey & Sons Pub.
6. Spotts M. F., "Mechanical Design Analysis", PHI Publications, New Delhi.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern:

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

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Mapping of Course outcomes with Program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	–
CO2	3	2	3	2	–
CO3	3	2	3	2	–
CO4	3	–	3	3	–
CO5	2	–	2	2	–

1 – Low, 2 – Medium, 3 – High

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MEPCC5042 : LAB – DESIGN ENGINEERING		
Teaching Scheme	**Examination Scheme**	**Total**
Practical:02Hrs. /Week	**ISEII**	**25Marks**
Credit:01		

Course Objectives: Upon successful completion of this course, students will be able to:

1. Introduce students to advanced concepts in the mechanics of materials. Specifically focusing on complex stress states and their fundamental implications in design.
2. Provide a comprehensive understanding of material failure modes.
3. Develop students' ability to analyze the behaviour of engineering materials under various loading conditions.
4. Apply advanced techniques to solve real-world design problems, fostering critical thinking for reliable component design under extreme conditions.

Course Outcomes (COs): After completing the course students will able to

Course Outcomes	
CO1	Identify cracks in materials under stress, understand concepts related to crack initiation, propagation, and failure. (K2)
CO2	Explain fatigue, differentiate between low-cycle and high-cycle fatigue, & understand the concept of fatigue life and its dependence on various factors. (K3)
CO3	Analyze the plastic flow process, including how materials deform under bending beyond their yield point. (K4)
CO4	Demonstrate creep, its key characteristics (time-dependence, elevated temperature, and plastic deformation), & stages of creep (primary, secondary, and tertiary). (K2)

List of the Experiments: The student shall perform any six out of following experiments:

Sr. No.	Title of the Experiments
1	To experimentally determine principal stresses and strains on a component under biaxial loading and validate them using Mohr's Circle.
2	To determine the impact energy absorption and transition temperature of different materials and relate it to brittle vs. ductile fracture behavior.
3	To visualize stress concentration around geometric discontinuities and experimentally determine the stress concentration factor (Kt).
4	To determine the fatigue life (S-N curve) and fatigue limit (if applicable) for a given material under cyclic loading.
5	To investigate the influence of a stress concentrator (e.g., a notch or hole) on the fatigue life of a material.
6	To demonstrate the transition from elastic to plastic bending, observe the phenomenon of springback, and qualitatively analyze the effect of material properties on springback.
7	To experimentally determine the shape factor for different beam cross-sections and compare it with theoretical values.

8	To conduct a constant-load creep rupture test, obtain a creep curve, and analyze its different stages.
9	To investigate the influence of applied stress on the steady-state creep rate and determine the stress exponent.
10	To observe the phenomenon of stress relaxation in a material under constant strain.

Assessment Pattern: ISE II- Continuous Assessment of individual student during each experiment.

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

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

Mapping of Course Outcomes with Program Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	–	3	2	–
CO2	2	–	3	2	–
CO3	3	1	3	3	–
CO4	2	–	2	2	–

1 – Low, 2 – Medium, 3 – High

MEPCC5003: ADVANCED MATHEMATICAL METHODS		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Use differential equations for solving engineering problems.
2. Effectively use numerical techniques for solving complex engineering problems.
3. Differentiate between analytical and numerical methods.
4. Compare system's behaviour with the experimental data.
5. Apply finite difference methods to solve engineering problems.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Apply differential equations to solve engineering problems.
CO2	Solve system of equations using direct and iterative numerical methods.
CO3	Apply systems of equations to solve mechanical engineering problems.
CO4	Design and create a model using curve fitting.
CO5	Apply finite difference method for solving engineering problems.

Detailed Syllabus:

Unit 1	**Numerical Methods to Solve Partial Differential Equations:** Hyperbolic equations, parabolic equations, elliptic equations, solution of Laplace equations, solution of Poisson's equations, solution of elliptic equations by relaxation method, solution of 1-D and 2-D heat flow equation, solution of wave equation.
Unit 2	**Matrices:** Matrix inversion, Gauss elimination method, Gauss Jordan method, Crout's triangularisation method, Partition method, Iterative method, Homogeneous systems the eigen- value problem, the power method, Jacobi's method, eigen-values of symmetric matrices, transformation method, transformation of generalized eigen-value problem to standard, Thomas Algorithm for Tri-Diagonal Matrix.
Unit 3	**Solution of Algebraic and Transcendental Equations:** Basic properties of equations, Bisection method, False Position method, Secant method, Iteration method, Aitken's Δ^2 method, Newton Raphson method, Horner's method, Muller's method, Root squaring method and Comparison of iterative method.
Unit 4	**Curve Fitting:** Least square curve fitting procedures for straight line, Nonlinear curve fitting, weighted least square approximation, Method of least square for continuous function.
Unit 5	**Finite Difference Methods:** Formation of difference equation, linear difference equation, rules for finding out complementary function and particular integral, difference equations reducible to linear form, simultaneous difference equation with constant coefficients, application to deflection of a loaded string and simply supported beams or cantilevers.

Text and Reference Books

1. Kreyszig Erwin, "Advanced Engineering Mathematics", Wiley.
2. Mathews John. H., "Numerical Methods", PHI, New Delhi.
3. Rajasekaran S., "Numerical Methods in Science and Engineering", Wheeler Publications
4. Grewal B. S., "Numerical Methods", Khanna Publication, New Delhi
5. Shastry S. S., "Introductory Methods of Numerical Analysis", PHI, New Delhi.
6. Chapra S. C., Canale R. P., "Numerical Methods for Engineers", McGraw Hill Education.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	05	12
K3	Apply	10	05	12
K4	Analyze	00	05	12
K5	Evaluate	00	05	12
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2		2		2
CO2	1		2		
CO3	2		2		2
CO4	1	1			
CO5	2		2		2

1 – Low, 2 – Medium, 3 – High

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MEPCC5004: LAB - ADVANCED MATHEMATICAL METHODS		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week	**ISE II**	**25 Marks**
Credit: 01		

Course Objectives:

1. Prepare base for understanding engineering analysis software.
2. Develop logical sequencing for solution procedure and skills in soft computing
3. Formulate algorithms and programming.
4. Prepare student with mathematical tools and techniques.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Estimate solutions for differential equations using numerical techniques.
CO2	Solve system of equations using iterative numerical methods.
CO3	Design and create a model using curve fitting.
CO4	Develop solution for engineering applications with numerical techniques.

List of the Experiments:

The student shall perform following experiments:

Sr. No.	Title of the Experiments
1	Development of codes for solving partial differential equations for a) Parabolic Equation, b) Laplace Equation
2	Development of codes for solving matrices a) Gauss Elimination Method, b) Thomas Algorithm for Tridiagonal Matrix
3	Development of codes for solving algebraic and Transcendental equations a) Bisection Method, b) False Position method, c) Newton Raphson method
4	Development of codes for curve fitting a) Straight line, b) Power equation, c) Exponential equation, d) Quadratic equation
5	Coding the algorithms developed for solution of any problem selected by student from the field of Production Engineering.

Assessment:

ISE II- Continuous Assessment of individual student during each experiment.

Maximum Marks-25

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II
S1	Implementation	04
S2	Manipulation	07
S3	Precision	14
S4	Articulation	00
S5	Naturalization	00

Total Marks	25

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

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2				2
CO2	3				2
CO3	1	2			2
CO4	2			2	3

1 – Low, 2 – Medium, 3 – High

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MEPEC5041 : MODERN ENGINEERING MATERIALS		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Examine the mechanical properties, heat treatments, and engineering applications of various ferrous materials such as HSLA, tool steels, and alloy cast irons.
CO2	Apply knowledge of mechanical properties and heat treatment processes to select appropriate nonferrous alloys like brasses, bronzes, and Al-alloys for specific industrial applications.
CO3	Differentiate between types of composite materials and evaluate their suitability for different structural and functional applications.
CO4	Analyze and calculate mechanical properties of composite laminates using rule of mixtures and orthotropic lamina theories.
CO5	Classify and compare the properties and applications of organic materials including polymers, ceramics, and concrete in engineering practice.

Detailed Syllabus:

Unit 1	**Ferrous Materials** Mechanical properties, heat treatments and applications; stainless steel and heat resisting steels, precipitation harden-able steels, valve steels, high strength low alloy steel (HSLA), micro alloyed steels, ball bearing steel, tool steels, high nitrogen steels, alloy cast iron.
Unit 2	**Nonferrous Materials** Mechanical properties, heat treatments and applications; copper alloys (Brasses and Bronzes), Al –alloys (Al-Mg-Si, Al-Cu, Al-Si), designation system in Al – alloys.
Unit 3	**Composites** Classifications, properties, application of composites, polymer matrix materials, metal matrix materials, ceramic matrix materials, carbon materials, glass materials, fibre reinforcements, types of fibres, whiskers, laminar composites, particulate reinforced composites.
Unit 4	**Design of composites materials** Hybrid composites, angle plied composites, mechanism of composites, calculation of properties, unidirectional fibre composites, critical volume fraction, discontinuous fibre composites, rule of mixtures equation, critical angle. Analysis of an Orthotropic Lamina, strengths of orthotropic lamina, analysis of Laminated Composites, stress strain variations in laminates.

Unit 5	**Organic & Inorganic Materials** Classification, properties, application of polymers, plastics and elastomers. Ceramics: Classification, properties, structures of refractories, abrasive materials, electronic ceramics, cement and concrete.

Text and Reference Books

1. Jastrezebski Z.D., The nature and properties of engineering Materials, Wiley Newyork.
2. Aver S.H, Introduction to Physical Metallurgy, McGraw Hill,Tokyo.
3. Sharma S.C,Composite Material, Narosa Publishing House,New Delhi.
4. DeGarmo E.P.,Black J.T,Kosher R.A,Materials and processes in Manufacturing,Prentice Hall.
5. Rajput R.K.,Materials Science and Engineering,Kataria and sons.
6. Chawla K.K,Composite Materials,Springer

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern:

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

Mapping of Course outcomes with Program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	**2**	**–**	**3**	**2**	**–**
CO2	**2**	**–**	**3**	**3**	**–**
CO3	**2**	**–**	**3**	**2**	**–**
CO4	**3**	**1**	**3**	**3**	**–**
CO5	**2**	**–**	**2**	**1**	**1**

1 – Low, 2 – Medium, 3 – High

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Dated: 5th July 2025

MEPEC5042 : GEOMETRICAL MODELING AND APPLICATIONS		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:
After completing the course students will able to

Course Outcomes	
CO1	Acquire the knowledge of 2-D, 3-D transformations, projections.
CO2	Demonstrate how various curve representations are used in geometric modeling.
CO3	Generate surfaces using algorithms.
CO4	Interpret the use of algorithms for windowing, clipping.
CO5	Apply algorithms for hidden line and surface removal.

Detailed Syllabus:

Unit 1	**Differential Geometry** 2D transformations: basic transformations, matrix representations and homogeneous coordinates, concatenated transformations, general pivot rotation & scaling, general reflection through arbitrary line. 3D transformations: basic and general transformations, orthographic projections, auxiliary projections and perspective projections.
Unit 2	**Curves** Plane curves: Curves representations, parametric and non-parametric representations of circle, ellipse, parabola, hyperbola and cones. Space curves: representation of space curves, cubic splines, normalized cubic splines, parabolic bending, begnin-curves and B-spline curves.
Unit 3	**Surface Description and Generation** Surface revolution, sweep surfaces, quadric surfaces, piecewise surface representation, bilinear surfaces, ruled and developed surfaces, linear coons surfaces, coons bi-cubic surfaces, Bezier surfaces, B-splines surfaces. Algorithms to draw 2- D primitives' line and circle drawing algorithms and Bresenham's algorithm.
Unit 4	**Windowing and Clipping** Clipping algorithms, two-dimensional clipping, sultherland-cohen subdivision, line clipping algorithm and polygon clipping. 2-D and 3-D viewing, 3-D solid representation, basic modeling, and geometric algorithms, data structures and Boolean set operations.
Unit 5	**Hidden Line and Surface Removal Algorithms** Hidden Line and Surface Removal Algorithms, light colour and shading, animation, virtual reality environment. Orientation of a few CAD packages.

Text and Reference Books

1. Faux, Prat, "Computational Geometry for Design and Manufacture".
2. Rogers and Adams, "Mathematical elements for Computer Graphics" McGraw Hill Publications, New
3. Rogers and Adams, "Procedural elements for Computer Graphics", McGraw Hill Publications, New York.
4. Mortenson M. E., "Geometric Modeling", John Wiley and Sons, New York, 1985
5. Hearn, Paulin, "Computer Graphics"
6. Martti Mantylla, "An introduction to Solid Modeling", Computer Science Press

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

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

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

Assessment Pattern:

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

Mapping of Course outcomes with Program outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5
CO1	2	–	3	2	–
CO2	2	–	3	3	–
CO3	3	–	3	3	–
CO4	2	–	2	2	–
CO5	3	–	3	3	–

1 – Low, 2 – Medium, 3 – High

MEPEC5043 : MACHINE STRESS ANALYSIS		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Apply the procedure based on critical conditions of loading in two and three dimensional state.
CO2	Interpret deflections and reactions in a variety of structural configurations using the principles of energy methods and Castigliano's theorems.
CO3	Demonstrate Application of practical problems based on torsion, shear centre and contact stresses
CO4	Apply various experimental techniques for determining stress and strain distributions in materials and structures.
CO5	Apply the concept of shear center and contact stresses in engineering problems solving.

Detailed Syllabus:

Unit 1	**Theory of Elasticity** Plane stress, & strain, stress and strain at a point, differential equations of equilibrium, boundary conditions, compatibility equations, and Airy's stress function. Two-dimensional problems in rectangular coordinates, Solutions by polynomials, end effects, Saint Venant's principal. Two-dimensional problems in polar coordinates, General equations in polar coordinates, stress distribution symmetrical about axis, strain components in polar coordinates.
Unit 2	**Applications of Energy Methods** Castigliano's theorems, First and second, applications foe analysis of loaded members to determine deflections and reactions at supports.
Unit 3	**Theory of Torsion** Torsion of prismatic bars of non-circular cross sections, Thin walled hollow and rectangular cross sections, Saint Venant's theory, Prandtle's membrane analogy, Kelvin's fluid flow analogy, warping of the cross sections.
Unit 4	**Experimental Stress Analysis** Stress analysis by mechanical, optical and electrical strain gauges, strain rosette, whole field methods, Moire fringe method, and brittle coatings for strain indication.

Unit 5	**Shear Center and Contact Stresses** Shear center for beams of different cross sections Hertz's contact stresses, expression for principle stresses, deflection of bodies in point contact, stress in bodies in point and line contacts

Text and Reference Books

1. Timoshenko and Young, "Theory of Elasticity", TMH Publications.
2. Seely and Smith, "Advanced Mechanics of Materials", John Wiley, New York
3. Den Hartog J. P., "Advanced Strength of Materials", McGraw Hill Publications.
4. Nash W., "Strength of Materials", Schaum's outline series, McGraw Hill

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern:

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

Mapping of Course outcomes with Program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3	–	3	3	–
CO2	2	–	3	2	–
CO3	3	–	3	3	–
CO4	3	1	3	3	–
CO5	2	–	3	3	–

1 – Low, 2 – Medium, 3 – High

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Dated: 5th July 2025

MEPEC5044: ROBOTICS AND AUTOMATION		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. To understand robot anatomy and characteristic of different type, dynamic performance of robotic system and its kinematics.
2. To know the different sensors, gripers their selection and dynamic performance analysis.
3. To accustom with robot programming and its use in casting, welding, machining industry.
4. To know the CNC, PLC and DC servo systems and machine interfacing.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Explain robot anatomy and robot performance
CO2	Illustrate robot force and motion for particular case and knowledge for sensor and gripper selection
CO3	Classify different controllers of robots and compute the gripper operations
CO4	Illustrate PLC's programming for particular industrial systems

Detailed Syllabus:

Unit 1	**Automation and Robotics:** Definition, need of the robotics, market and future prospects, differentiation of robots from other automation systems, near relations to robots, robot usages and conditions for its application, robot anatomy and characteristics: classification, point to point and continuous path system, control loops of robot system, work volume, speed of movement, dynamic performance, accuracy and repeatability, drive system, sensors used in robotics, letter symbol, coding and kinematics arrangement
Unit 2	**Transformations and Kinematics:** Coordinate transformation -vector operations – basic transformations matrices - properties of transformation matrices- homogeneous transformations– forward solution, DH algorithm - inverse kinematic solution, brief robot dynamics
Unit 3	**Controls and End Effectors:** Control system concepts - analysis - control of joints -adaptive and optimal control – end effectors - classification - mechanical - magnetic - vacuum - adhesive - drive systems and controls- force analysis and gripper design
Unit 4	**Robot Applications:** Work cell control and interlocks, robot applications in manufacturing like material transfer and machine loading/unloading, processing operations, assembly and inspection, etc., introduction to robotics technology of the future, future applications.

Unit 5	**Automation:** Introduction, types of automation, types of automation systems, Programmable Logic Controllers, parts of a typical PLC system, programming of PLC, example applications of PLC in a CNC machine.

Text and Reference Books

1. Groover M. P., Willis, "Industrial Robotics", McGraw Hill.
2. Aures R. U. and Miller S. M., "Robotics applications and implications", Ballinger Publishing Co., Cambridge
3. Groover M. P. and Zimmer E. W., "Computer Aided Design and Manufacturing", Prentice Hall of India Ltd, New Delhi
4. "Mechatronics", HMT Limited, Tata McGraw Hill Publications, New Delhi
5. David G., "Mechatronics", Tata McGraw Hill Publications, New Delhi
6. Handbook of Industrial Robotics

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern

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

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	1			2	1
CO2	1	1		1	2
CO3	1	1		2	
CO4	1	2		1	2

1 – Low, 2 – Medium, 3 – High

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MEPEC5005: ENGINEERING EXPERIMENTAL TECHNIQUES		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. **Problem Identification and Formulation**: Develop the ability to identify engineering problems that can be addressed through experimentation and to formulate relevant research questions.
2. **Hands-on Experience**: Gain practical, hands-on experience in the laboratory setting to reinforce theoretical concepts and develop a deeper appreciation for the role of experimentation in engineering.
3. **Data Collection and Analysis**: Learn how to collect accurate and reliable data during experiments, and develop proficiency in organizing, analyzing, and interpreting experimental results using statistical methods and software tools.
4. **Experimental Techniques**: Acquire practical skills in conducting experiments related to different engineering disciplines, such as mechanical, electrical, chemical, civil, or materials engineering. Understand techniques for measuring properties like stress, strain, temperature, pressure, flow rate, and more.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Explain dynamic measurements
CO2	Interpret experimental data
CO3	Interpret experimental observation using statistical tools
CO4	Apply procedure of selection of appropriate measuring equipment, measuring sensors, data acquisition and storage system

Detailed Syllabus:

Unit 1	**Basic Concepts:** Definition of terms, Calibration, Standards, Dimensions and units, the generalized measurement system, Basic concepts in dynamic measurements, system response, distortion, impedance matching, experimental planning, first-order and second-order responses.
Unit 2	**Analysis of Experimental Data:** Causes and types of experimental errors, uncertainty analysis, evaluation of uncertainties for complicated data reduction
Unit 3	**Statistical analysis of experimental data:** probability distributions, the Gaussian, normal error distribution, probability graph paper, the Chi-square test of Goodness of fit, The method of least squares, the correlation coefficient, standard deviation of the mean, t-distribution, Graphical analysis and curve fitting, general considerations in data analysis.
Unit 4	**Force Torque and Strain Measurements:** Mass balance measurements, elastic elements of force measurements, torque measurement, stress strain measurements, various types of strain gauges,

	Motion and Vibration measurement: Simple vibration instruments, principles of the seismic instruments, practical considerations of seismic instruments, sound measurements. Pressure, Temperature, Heat flux, Thermal conductivity measurement, various transducers, selection of measuring instruments.
Unit 5	**Data Acquisition and Processing:** The general data acquisition system, signal conditioning, data transmission, analog to digital and digital to analog conversions, data storage and display, the program as substitute for wired logic.

Text and Reference Books

1. Jain R. K., "Mechanical Measurements", Khanna Publishers, New Delhi, 2018
2. Sawhney A. K., "A course in electrical and electronic measurement and instrumentation", Dhanpat Rai pub, Delhi, 2012
3. Nakra B. C., Chaudhary K. K., "Instrumentation Measurement and Analysis", McGraw-Hill Publication, 4th edition, 2016
4. Ernest O. Doebelin, "Measurement system", 6th edition, McGraw-Hill Publication, 2017
5. Holman J. P., "Experimental Methods for Engineers", 9th Ed, McGraw Hill Publications, New York, 2015

Useful Links:

6. https://nptel.ac.in/courses/112105117/13
7. https://nptel.ac.in/courses/112105117/4
8. https://nptel.ac.in/courses/112105166/28

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern

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

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Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2				
CO2	1	2	1	3	2
CO3	1			3	2
CO4		1	1	2	

1 – Low, 2 – Medium, 3 – High

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Dated: 5th July 2025

MEPEC5045 : INDUSTRIAL TRIBOLOGY		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:
After completing the course students will able to

Course Outcome	
CO1	Demonstrate the parameters affecting on viscosity, temperature and pressure on wear.
CO2	Apply the Reynolds' equation for different types of bearings.
CO3	Interpret the pressure distribution and power required for hydrostatic bearings.
CO4	Apply procedure of design for different types of bearing
CO5	Interpret different lubricants applications and its testing, bearing materials

Detailed Syllabus:

Unit 1	**Viscosity and Wear** Definition, Petroff's law, Hagen-Poiseuille law, variation of viscosity with temperature and pressure, viscosity index, effect of pressure on flow through slot. Types of wear, theories of friction and wear, dry friction and boundary friction, effects of bearing metal composition and wear.
Unit 2	**Hydrodynamic Lubrication** Generalized Reynold's equation, solution for long-finite and short tapered bearings, flow rate, eccentricity, hydro-dynamic thrust bearings, plain tapered land bearing, Rayleigh's step bearings, behaviour of hydro-dynamic bearings under variable loads, squeeze films, thermal equilibrium of sliding system, elasto- hydrodynamic lubrication.
Unit 3	**Hydrostatic Lubrication** Pressure distribution in a simple hydrostatic thrust bearing, pumping power and pump capacity, hydrostatic formal bearings, hydrostatic thrust bearing with rotation and compensation.
Unit 4	**Gas Lubrication** Merits and de-merits of gas lubrication, aerodynamic and aerostatic journal bearings, solution of Reynold's Equation for gas bearings, load carrying capacity of aerostatic bearings.
Unit 5	**Lubricants and Bearing Materials** Types, lubricating oils, composition, additive properties, testing of lubricants and selection of lubricants for various conditions. Desirable properties, white metals, bronzes, silver, aluminium alloys, Teflon, rubber, graphite

Text and Reference Books

1. Shaw and Mack, " Lubrication and Bearings"
2. Fuller D. D., " Theory of Lubrication"
3. Cameron, " Lubrication"
4. Norton, " Industrial Tribology"
5. A.S.M.E. Handbooks

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern:

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

Mapping of Course outcomes with Program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	**2**	**–**	**3**	**2**	**–**
CO2	**3**	**–**	**3**	**3**	**–**
CO3	**2**	**–**	**3**	**3**	**–**
CO4	**2**	**–**	**3**	**3**	**–**
CO5	**2**	**–**	**2**	**2**	**1**

1 – Low, 2 – Medium, 3 – High

MEVSE5001: MINI PROJECT – I		
Teaching Scheme	**Examination Scheme**	
Practical: 04 Hrs. / Week	**ISE II**	**25 Marks**
Credit: 02	**ESE**	**25 Marks**

Course Objectives:

1. To make the student conversant with industrial activities / project execution activities
2. To exemplify various industrial aspects in manufacturing processes and industrial design
3. Student will able to analyze and solve industrial mini problem / work on in-house project

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Illustrate industrial project / in-house project
CO2	Identify industrial problems / in-house
CO3	Integrate and apply the knowledge gained through different courses into practical problems
CO4	Prepare a consolidated report

Detailed description:

1. Student shall identify and collect pragmatic industrial information / in-house project / social problem as a Mini Project – I.
2. Student shall obtain a solution by applying suitable techniques
3. Student has to exhibit the continuous progress review through regular reporting and presentations (at least two during semester) and proper documentation of the frequency of the activities. The continuous assessment of the progress needs to be documented unambiguously. Progress will be monitored by an evaluation committee consisting of guide, two faculty appointed by the BoS / Head of Department / BoS Chairman.
4. The candidate shall submit the report on Mini Project – I in standard format for satisfactory completion of the work, duly approved and certified by the concerned guide, Head of the Department and Principal.
5. The candidate will be assessed during ESE by two examiners, one of whom will be the guide and other is necessarily an external examiner appointed by the BoS / Head of Department / BoS Chairman. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation and report.
6. For standardization and documentation, it is recommended to follow the formats and guidelines approved by the Board of Studies.

Assessment:

ISE II- Continuous Assessment of individual student

Maximum Marks-25

ESE – Viva Voce based on presentation and report

Maximum Marks-25

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II	ESE
S1	Implementation	04	04
S2	Manipulation	03	03
S3	Precision	14	14
S4	Articulation	04	04
S5	Naturalization	00	00
Total Marks		25	25

Knowledge Level	ISE II	ESE
Preparation S1	04	04
Articulation of problem S4	04	04
Observation S3	08	08
Record S2	03	03
Mini project/ Presentation/Viva Voce S3	06	06
Total Marks	**25**	**25**

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	1	1	2	1
CO2	2	1	1	3	1
CO3	1	1	1	3	1
CO4		3		1	

1 – Low, 2 – Medium, 3 – High

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Approved in XXXth Academic Council Meeting
Dated: 5th July 2025

MERMC5001: RESEARCH METHODOLOGY		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. To guide students from understanding foundational research concepts to critically formulating research problems, culminating in the adept creation of comprehensive research plans and literature reviews.
2. To develop a comprehensive understanding of various research methods, both qualitative and quantitative
3. To facilitate students in analysing, evaluating, and creating research proposals.
4. To attain mastery in data collection methods, sampling, data analysis techniques, and result interpretation for robust research outcomes.
5. To Equip students with the skills to proficiently create and present diverse research reports, encompassing various formats, oral delivery, technical writing, and ethical awareness regarding plagiarism.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Develop the ability to comprehend core research concepts, define key elements like variables and hypotheses, and critically evaluate literature to identify research gaps.
CO2	Justify their chosen research methods and explain their advantages and limitations.
CO3	Create well-structured research proposals that include clear research objectives, methods, and expected outcomes.
CO4	Proficient in using data analysis techniques relevant to their chosen research methods, such as statistical analysis for quantitative research or thematic analysis for qualitative research.
CO5	Create comprehensive research reports in diverse formats, such as academic papers, presentations, and technical reports.

Detailed Syllabus:

Unit 1	**Introduction to RM:** Meaning of Research, Objectives of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem, Selecting the Problem, Technique Involved in Defining a Problem, Research Design, Important Concepts Relating to Research Design, Developing a Research Plan, Literature review.
Unit 2	**Methods of Research:** Qualitative and quantitative methods of research like Historical, case study, ethnography, exposit facto, documentary and content analysis, survey (Normative, descriptive, evaluative etc.) field and laboratory experimental studies. Characteristics of methods and their implications in research area.

Unit 3	**Development of research proposal:** Research proposal and its elements Formulation of research problem-criteria of sources and definition Development of objectives and characteristics of objectives. Development hypotheses and applications.
Unit 4	**Methods of data collection:** Concept of sampling and other concepts related to sampling. Probability and non-probability samples, their characteristics and implications. Tools of data collections, their types, attributes and uses. Redesigning, research tools-like questionnaire, opinionnaire, observation, interviews, scales and tests etc. **Methods of data analysis:** Analysis of qualitative data based on various tools. Analysis of quantitative data and its presentation with tables, graphs etc. Statistical tools and techniques of data analysis-measures of central tendency, dispersion. Decision making with hypothesis testing through parametric and non-parametric tests. Validity and delimitations of research findings.
Unit 5	**Interpretation and Report Writing:** Meaning of Interpretation, Techniques of Interpretation, Significance of Report Writing, Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Writing a technical paper, plagiarism and its implications.

Text and Reference Books

1. Garg B. L., Karadia R., Agarwal F. and Agarwal U. K., An introduction to Research Methodology, RBSA Publishers, 2002
2. Kothari C. R., Research Methodology: Methods and Techniques. New Age International, 1990.
3. Merriam S. B., Tisdell E. J., Qualitative Research: A Guide to Design and Implementation, 4th edition, John Wiley & Sons, 2016.
4. Creswell J. W., Research Design: Qualitative, Quantitative and Mixed Methods Approaches, 4th edition, SAGE Publications, Inc, 2014.
5. Olsen C., Devore J., Peck R., Introduction to Statistics and Data Analysis, 5th edition, Brooks/Cole, 2015.
6. Panneerselvam R., Research Methodology, 2nd edition, PHI Learning, 2014.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	02	06
K2	Understand	10	08	24
K3	Apply	00	03	09

K4	Analyze	05	04	12
K5	Evaluate	00	03	09
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3		
CO2	2	2	2		
CO3	2		3	1	
CO4	1		3	1	
CO5	1	3	2		2

1 – Low, 2 – Medium, 3 – High

INCCC5101: STRESS MANAGEMENT THROUGH YOGA		
Teaching Scheme	**Examination Scheme**	
Practice : 2 hr/week	**Credits: Audit Course**	

Course Objectives:

This course aims at enabling students:

1. To get awareness of Physical, Mental, Social and Spiritual health
2. To learn to manage the Stress through art of Yoga.
3. Understand and perform skill of Yoga Asanas
4. Gain knowledge and benefits of Pranayam and Dhyan
5. Importance of diet, food and nutrition.

	Course Outcomes The students will able to -
CO1	Aware regarding healthy and peaceful living
CO2	Understand the cause of stress and its relief
CO3	Perform skill of Yoga Asanas and Meditation
CO4	Bring peace and harmony in the society at large
CO5	Aware of yogic diet, food and nutrition.

Detailed Syllabus:

Unit 1	Introduction, meaning and definition of health, various dimensions of health, like, Physical, Mental, Social and Spiritual health
Unit 2	Concept of stress according to yoga, causes and consequences of stress, stress management through Yoga.
Unit 3	Introduction and definition of yoga, Fundamental concept of yoga, relationship of yoga and health.
Unit 4	Yogic sukshma vyayam, Maharshi Patanjali Ashtang Yog sutra, different types and benefits of asanas (min. five in each pose), Suryanamaskar, different types and benefits of Pranayam (min. Five), Meaning and importance of dhyan .
Unit 5	Importance of yogic diet, food and nutrition.
List of Practice Sessions	1. Practice of Yogic Sukshma Vyayam 2. Practice of different Asanas 3. Practice of different Pranayam 4. Practice of Dhyan

Text and Reference books:

1. K, N, Udupa, Stress and its Management by Yoga, Motilal Banaridas Publishers
2. Acharya Yetendra, Yoga and Stress Management, Finger print Publications
3. B. K. S. Iyengar, Light on Yoga, Harper Collins Publisher, New Delhi, 2005
4. Swami Vivekanand, Patanjali Yog Sutra, Geeta Press, Gorakhpur
5. Swami Ramdev, Pranayam Rahasya, Divya Prakashan, 2009

MEPCC5045 : FINITE ELEMENT ANALYSIS		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:
After completing the course students will able to

	Course Outcomes
CO1	Demonstrate FEM and Develop finite element formulations of engineering
CO2	Apply the concepts of element discretization, shape functions, boundary conditions, to solve complex engineering problems.
CO3	Analyze and solve problems related to the behaviour of deformable solids under various loads, utilize computer programs for complex scenarios.
CO4	Formulate and solve heat transfer problems.
CO5	Analyze complex fluid flow problems using various mathematical and computational techniques.

Detailed Syllabus:

Unit 1	**Introduction** Basic concept, Historical background, engineering applications, general description, comparison with other methods, Need for weighted – integral forms, relevant mathematical concepts and formulae, displacement transformation matrix, stiffness matrix, weak formulation of boundary value problems, variational methods, Rayleigh –Ritz method and weighted residual approach.
Unit 2	**Finite Element Techniques** Model boundary value problem, finite element discretization, element shapes, sizes, and node locations, interpolation functions, shape functions, derivation of element equations, connectivity, boundary conditions, principal of potential energy, FEM solution, post-processing, Compatibility and completeness requirements, convergence criteria, higher order and iso-parametric elements, natural coordinates, Langrange and Hermit Polynomials.
Unit 3	**Applications to solid and structural mechanics problems** External and internal equilibrium equations, one-dimensional stress-strain relations, plane stress and strain problems, strain displacement relations, boundary conditions compatibility equations, analysis of trusses, frames and solids of revolution, computer programs.
Unit 4	**Application to heat transfer problem** Variational approach, Galerkin approach, one dimensional and two-dimensional steady state problems for conduction, convection and radiation.

Unit 5	**Application to fluid mechanics problems** In viscid incompressible flow, potential function and stream function formulation, incompressible viscous flow, stream function, velocity pressure and stream function-vorticity formulation, solution of incompressible and compressible fluid film lubrication problems.

Text and Reference Books

1. Reddy J.N., "An Introduction to Finite Element Method", (2005), TMH, New Delhi
2. Seshu P., "Finite Element Analysis", (2006), PHI, New Delhi
3. Introductory Finite Element Method by Chandrakant S Desai, Tribikram Kundu
4. The Finite Element Method: Volume 2 by O C Zienkiewicz, R L Taylor

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern:

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

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Mapping of Course outcomes with Program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**–**	**3**	**3**	**–**
CO2	**3**	**–**	**3**	**3**	**–**
CO3	**3**	**–**	**3**	**3**	**–**
CO4	**3**	**–**	**3**	**2**	**–**
CO5	**3**	**–**	**3**	**2**	**–**

1 – Low, 2 – Medium, 3 – High

MEPCC5046 : MECHANICAL VIBRATIONS AND ANALYSIS		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs / Week	**ISE I**	**20 Marks**
Credits: 04	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

	Course Outcomes
CO1	Explain fundamental concepts of different types of vibrations & response of various vibration systems.
CO2	Analyze 2-DOF system, determine natural frequencies, and identify principal modes of vibration.
CO3	Analyze the behaviour of complex mechanical systems with multiple degrees of freedom.
CO4	Analyse infinite degrees of freedom, for strings, rods, beams, and shafts. Model these systems mathematically.
CO5	Analyze continuous, self-excited and nonlinear vibrations.

Detailed Syllabus:

Unit 1	**Single Degree of Freedom Systems** Un-damped vibrations, damped vibrations, forced vibrations. Types of damping, reciprocating and rotating unbalance, spring mass system, torsional vibrations, pendulums, transverse vibrations.
Unit 2	**Two Degree of Freedom Systems** Systems with two degree of freedom, determination of natural frequencies, principle modes of vibration, node point systems with rectilinear and angular modes, dynamic and centrifugal pendulum vibration absorbers, response of systems to forced vibrations, viscous and coulomb dampers. Lagrange's equations and applications.
Unit 3	**Multi Degree of Freedom Systems** Influence coefficients, well reciprocal theorem, frequencies of free vibrations, modes of vibrations, response to forced vibration, co-ordinate coupling, static and dynamic coupling, principle co-ordinates, orthogonality principle. Application of numerical methods for vibration analysis.
Unit 4	**Vibrations Through Continuous Medium** Vibrations of systems having infinite degrees of freedom, vibrations of strings, longitudinal and transverse vibrations of rods and beams, torsional vibrations of shafts having different end conditions.
Unit 5	**Self-Excited and Non-linear Vibrations** Criterion for stability, cause of instability, analysis of special cases of self-excited vibrations.**:** Free vibrations with non-linear elasticity and damping, relaxation

	oscillations, sub-harmonic response, phase-plane plots, perturbation techniques, Duffing's equation, jump phenomenon etc.

Text and Reference Books

1. Grover G. K., "Mechanical Vibrations"
2. Pujara Kewal, "Vibration and Noise for Engineering"
3. Tse, Morse, Hinkle, "Mechanical Vibrations"
4. Hartog Den, "Mechanical Vibrations"
5. Church, "Mechanical Vibrations"

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern:

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

Mapping of Course outcomes with Program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	**2**	**–**	**3**	**2**	**–**
CO2	**3**	**–**	**3**	**3**	**–**
CO3	**3**	**–**	**3**	**3**	**–**
CO4	**3**	**–**	**3**	**3**	**–**
CO5	**3**	**–**	**3**	**2**	**–**

1 – Low, 2 – Medium, 3 – High

MEPCC5047 : COMPUTER AIDED OPTIMIZATION		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Comparative analysis of optimisation methods.
CO2	Analyse and use of Multivariable optimisation.
CO3	Demonstrate Analysis of constrains in optimisation.
CO4	Apply specific algorithm for given problem.
CO5	Apply procedure of selection and use of reliable optimisation method for problem solving.

Detailed Syllabus:

Unit 1	**Introduction** Optimal problem formulation, engineering optimization problems, optimization algorithms. Single Variable Optimization Algorithms: Optimality criteria, bracketing methods, region elimination methods, point estimation methods, gradient based methods, root finding using optimization techniques.
Unit 2	**Multivariable Optimization Algorithms** Optimality criteria, unidirectional search, direct search methods, gradient based methods, Computer programs on above methods.
Unit 3	**Constrained Optimization Algorithms** Kuhn-Tucker conditions, transformation methods, sensitivity analysis, direct search for constrained minimization, linearized search techniques, feasible direction method, generalized reduced gradient method, gradient projection method, Computer programs on above methods.
Unit 4	**Special Optimization Algorithms** Integer programming, Geometric programming, Genetic Algorithms, Simulated annealing, global optimization, Computer programs on above methods.
Unit 5	**Optimization in Operations Research** Linear programming problem, simplex method, artificial variable techniques, dual phase method, sensitivity analysis.

Text and Reference Books

1. Deb Kalyanmoy, " Optimization in Engineering Design", PHI, New Delhi
2. Rao S. S. "Engineering Optimization", John Wiley, New Delhi.

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3. Deb Kalyanmoy, " Multi-objective Algorithms using Evolutionary Algorithms", John Wiley, New Delhi.
4. Paplambros P. Y. and Wilde D. J., "Principles of Optimum Design: Modeling and
5. Computation", Cambridge University Press, UK 5. Chandrupatla, "Optimization in Design", PHI, New Delhi.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern:

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

Mapping of Course outcomes with Program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	**2**	**–**	**3**	**2**	**–**
CO2	**3**	**–**	**3**	**3**	**–**
CO3	**3**	**–**	**3**	**2**	**–**
CO4	**3**	**–**	**3**	**3**	**–**
CO5	**3**	**–**	**3**	**3**	**–**

1 – Low, 2 – Medium, 3 – High

MEPCC5048 : Lab- Computer Aided Optimization		
Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs. / Week	**ISE II**	**25 Marks**
Credit: 01		

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Formulate engineering problems into mathematical optimization models.
CO2	Apply single and multi-variable optimization algorithms to practical problems.
CO3	Implement constrained optimization techniques including Kuhn-Tucker conditions and transformation methods.
CO4	Apply special optimization techniques like Genetic Algorithms and Simulated Annealing for global optimization.
CO5	Solve linear programming and operations research problems using simplex and other methods including sensitivity analysis.

List of the Experiments:

The student shall perform following experiments (At least Eight Experiments):

Sr. No.	Practical Title	Simple Description / Purpose
1	**Golden Section Method**	To find the minimum value of a function that depends on one variable using a step-by-step search method.
2	**Univariate Search for Two Variables**	To find the best value of a function with two variables by changing one variable at a time.
3	**Gradient Descent Method**	To reach the lowest point of a curve by following the direction of the steepest slope.
4	**Newton-Raphson Method**	To solve equations and find roots using a smart guess-and-improve method.
5	**Lagrange Multipliers for Constraints**	To find the maximum or minimum of a function when there's a rule (constraint) to follow.
6	**Kuhn-Tucker Conditions**	To check if a solution is the best when the function has some limits or conditions.
7	**Simplex Method for LPP**	To solve real-world problems like maximizing profit or minimizing cost using a table method.
8	**Integer Programming (Branch and Bound)**	To solve problems where only whole number answers are allowed.
9	**Genetic Algorithm**	To find the best solution using the concept of natural selection (like evolution).
10	**Simulated Annealing**	To find a good solution by slowly reducing the chance of bad guesses (like metal cooling slowly).
11	**Geometric Programming**	To solve special types of math problems often used in engineering designs.

12	**Sensitivity Analysis in LPP**	To see how small changes in data affect the final answer of a linear programming problem.

Assessment:
ISE II- Continuous Assessment of individual student during each experiment.
Maximum Marks-25

Assessment Pattern:

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

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

Mapping of Course Outcomes with Program Outcomes:

CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**–**	**3**	**2**	**–**
CO2	**3**	**–**	**3**	**3**	**–**
CO3	**3**	**–**	**3**	**3**	**–**
CO4	**3**	**–**	**3**	**3**	**–**
CO5	**3**	**–**	**3**	**2**	**–**

1 – Low, 2 – Medium, 3 – High

MEPEC5007: MACHINE TOOL DESIGN		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Understand fundamental concepts machine tool design, drives, various transmission systems of machine tools.
2. Identify the importance of feed and speed regulation in machine tools.
3. Recognize the significance of machine tool design structures**.**
4. Understand design procedure of Guide ways, Power screws and spindles.
5. Know working of Numerical Control of Machine Tools**.**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Associating the concepts of transmission system
CO2	Implement the knowledge to develop machine tool
CO3	Articulate and formulate Engineering problems in Machine tool Design
CO4	Execution of analytical skill on working with Numerical Control of Machine Tools.

Detailed Syllabus:

Unit 1	**Machine Tool Drives and Mechanism and design of cutting tools:** Working, Auxiliary Motions in Machines tools, Calculation of machining times for turning, External relief, Chamfer, Knurling, Forming, Facing, Drilling, Boring, Undercutting, Shaping, Planning, Slotting, Broaching, Sawing, Milling, Grinding, Threading and Tapping. Machine tool drives, Hydraulic transmission, mechanical transmission, different types of driving mechanisms used in machine tools, requirements of machine tool design, Engineering design process applied to Machine Tools,
Unit 2	**Regulation of Speed and Feed Rates in Machine Tools:** Speed and feed rates regulation, design of speed box, design of feed box, Machine tool drives in multiple speed motors, special cases, gearing diagram, determination of number of teeth.
Unit 3	**Design of Machine Tool Structures:** Materials of machine tool structures, Design criteria for machine tool structures, Materials of machine tool structures, Static and Dynamic stiffness, Profiles of Machine Tool Structures, Basic design for procedure of Machine Tool Structures, Design of beds, columns, housings, bases and tables, Model technique in design of machine tool structures
Unit 4	**Design of Guide ways, Power screws and spindles:** Functions and types of guide ways**,** Design of slideways, design criteria and calculations for slideways, guideways operating under liquid friction conditions, design of aerostatic slideways, design of anti-friction guideways, combination guide ways, protecting devices of slide ways, design of power screws, design calculations of spindles. Antifriction

	bearings and sliding bearings, stability of machine tools, forced vibrations of machine tools
Unit 5	**Numerical Control of Machine Tools:** Fundamental Concepts, Classification and Structures of Numerical Control Systems, Manual Part Programming, Computer Aided Part Programming, Distributive Numerical Control, Computer Numerical Control, Machining Centres, CNC Programming.

Text and Reference Books

1. Basu S. K., "Design of Machine Tools", Allied Publishers
2. Acharkan, "Metal Cutting Machine Tools", Technical Publishing House
3. Bhattacharya A., Sen G. C., "Principles of Machine Tools", New Central Age, New Delhi
4. Mehta N. K., "Machine Tool Design", Tata McGraw-Hill
5. Brandon C. Gegg , C. Steve Suh, Albert C. J. Luo, Machine Tool Vibrations and Cutting Dynamics, Springer New York, NY, 2014
6. P. Bézier, Numerical control: Mathematics and applications, Wiley, London

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern

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

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1		2	1		
CO2	1	3	2		
CO3			1	3	
CO4	3		2		

1 – Low, 2 – Medium, 3 – High

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MEPEC5046 : SIMULATION AND MATHEMATICAL MODELING		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

	Course Outcomes
CO1	Interpret the system environment and components, concepts of discrete simulation models.
CO2	Apply statistical model in simulation, and random number generation.
CO3	Demonstrate behaviour of different simulation models, characteristics and properties of random numbers using different techniques.
CO4	Execution of input models with verification and validation by use of simulation.
CO5	Explain output analysis of single model.

Detailed Syllabus:

Unit 1	**Introduction to Simulation** System and system environment, Components of the system, Type of systems, type of models, steps in simulation, study advantages and disadvantages of simulation, concept of discrete simulation, time-advance mechanisms, components and organization of a discrete-event simulation model.
Unit 2	**Statistical models in simulation** Useful statistical models, discrete distribution, continuous distribution, Poisson Process, empirical distribution. Queuing Models: Characteristics of queuing systems, queuing notations, long run measures, of performance of queuing systems, steady state behaviour finite population model.
Unit 3	**Random number generation** Properties of random numbers, generation of pseudo random numbers, techniques for random numbers generation, tests for random numbers. Random variate generation: Inverse transform techniques, convolution method, acceptance rejection techniques.
Unit 4	**Input Modeling** Data collection, identifying the distribution of data, parameter estimation, goodness of fit tests, selection of input model without data, multivariate and time series input model. Verification and Validation of Simulation Model: length of simulation runs, validation.
Unit 5	**Output Analysis for a Single Model** Types of simulations with respect to output analysis, stochastic nature of output data, measure of performance and their estimation, output analysis of terminating

	simulators, output analysis for steady state simulation. Case studies in simulation, orientation of simulation software such as GPSS.

Text and Reference Books

1. Law A. W., Kelton D., "Simulation Modeling and Analysis", Tata McGraw Hill, 2003
2. Gordon Geoffrey, "System Simulation", 2nd Ed. PHI, New Delhi, 1990
3. Deo Narsingh, "System Simulation with Digital Computers", PHI, New Delhi, 1989
4. Zeigler B., Prachofer H., Kim T. G., "Theory of Modeling and Simulation", Academic Press
5. Body Donald W., "System Analysis and Modeling", Academic Press Harcourt India
6. Banks Jerry, Carson John, Nelson Barry, Nicole David, "Discrete Event System Simulation"
7. Kelton W. D. Sadowski R., Sadowski D., "Simulation with Arena", McGraw Hill Publications

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern:

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

Mapping of Course outcomes with Program outcomes:

CO \ PO	PO1	PO2	PO3	PO4	PO5
CO1	2	–	3	2	–
CO2	3	–	3	2	–
CO3	3	–	3	2	–
CO4	3	–	3	2	–
CO5	2	–	2	1	–

1 – Low, 2 – Medium, 3 – High

MEPEC5009: ENGINEERING ECONOMICS		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. To build up the knowledge of managerial economics and analysis of project considering economical concepts.
2. Expertise in costing, finance and accounting related to the organization. Able to execute corporate planning.
3. Assess the best feasible investment proposal among the alternatives based on the common index.
4. Acquire basic concepts of cost accounting relevant for managerial decision making.
5. Explores the relationship, which exists between costs, revenue, output levels and resulting profit.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Implement the knowledge of economics to the production engineering
CO2	Evaluate investment opportunities using engineering economy factors
CO3	Perform a replacement study considering inflation and indirect cost allocation
CO4	Estimate the cost of component and total cost of operation
CO5	Perform breakeven analysis and profitability analysis under different conditions.

Detailed Syllabus:

Unit 1	**Engineering Economics and Estimation:** The principle and use of economic analysis in engineering practice. Discounted cash flow analysis, corporate tax and investment, Depreciation and economic studies, replacement analysis, valuation of assets. Estimating: Importance and aim, objectives, functions, Estimating Procedure, Constituents of Estimation. Concept of direct tax, indirect tax as GST.
Unit 2	**Depreciation & break-even analysis:** Introduction, purpose, methods for calculating depreciation-straight line method, diminishing balance method, sum of year digit method, machine hour basis method. **Break even analysis:** Introduction, assumptions in break-even analysis, important terms and definitions, calculation of breakeven point, advantages and limitations.
Unit 3	**Economic analysis of projects**: analysis of risks and uncertainty, elements of demand analysis and forecasting, production function, output and pricing decisions **Comparison of Alternative Proposals**: Formulating alternatives, Bases of comparison- present worth amount, annual equivalent amount, future worth amount, rate of return, Defining mutually exclusive alternatives, Decision criteria for selection of investment proposals, Comparison of alternatives with unequal service life, Sensitivity analysis

Unit 4	**Costing:** Definition, aims, procedure for Costing, types of costs, Costing controls, Control of Costs, Profit and Pricing Policy. Costing methodology for raw materials, Products and Services, Nature of Costs-Direct, Traceable and Non traceable. Determining of Cost of manufactured products, methods of overhead allocation
Unit 5	**Corporate Planning:** Corporate objectives, goals and policies, process of corporate planning, SWOT analysis, GAP analysis, strategy formulation, investment evaluation, capital budgeting, industrial dynamics, Business case development.

Text and Reference Books

1. Owler W., Brown J. L., "Cost Accounting and Cost Methods", McDonald and Evans Publications
2. Kuchal S. C., Financial Management - An Analytical and Conceptual Approach", Chaitanya Publishing House
3. Shukla M. S. and Grewal T. S., "Advance Accounts", S. Chand and Co., New Delhi
4. Sinha B. P., Mechanical Estimating and Costing, Tata McGraw Hill Publishing Co. Ltd. N. Delhi
5. Banga T. R. and Sharma S. C., Mechanical Estimating and Costing, Khanna Publishers, Delhi-6
6. Sharma S. K., Savita Sharma, Industrial Engineering & Operations management, Kataria publishers
7. Kesoram R. & others, Process Planning & Cost Estimation, New Age International Pub., New Delhi
8. Dennis Lock, Handbook of Engineering Management, Butter work & Heinemanky Ltd.
9. Theusan G. J., "Engineering Economics", PHI, New Delhi
10. Dean Joel, "Managerial Economics", PHI, New Delhi
11. Hussey D. D., "Introducing Corporate Planning", Pergamon Press, New York

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern

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

Total Marks 100	20	20	60

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	
CO2	3	2	3		2
CO3	2	3	2	3	3
CO4	1			3	
CO5		2	3	2	

1 – Low, 2 – Medium, 3 – High

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MEPEC5047 : ADVANCED MACHINE DESIGN		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Interpret the concept of optimization like PDE, SDE and LE in respect of tensile bar, torsional bar, beam etc.
CO2	Apply procedure of design of Belleville, torsional square spring, torsional bar and rectangular spring in axial and fatigue loading.
CO3	Demonstrate analysis of advance cam profile and dynamics of high speed cam.
CO4	Apply procedure of design of flat plates at different temperature and different types of supports and loading.
CO5	Demonstrate the concept of advanced machine design, QFD, functional approach, problem formulation etc.

Detailed Syllabus:

Unit 1	**Optimum Design of Mechanical Elements** Statistical consideration for factor of safety, relationship between actual load and load capability, selection of factor of safety based on percentage estimates for tolerances on actual load and load capability and where the occurrence of the failure phenomenon would be disastrous. Optimum design for mechanical elements by considering adequate design, optimum design, P.D.E., S.D.E., limit equations, principles of optimum design with normal specifications, redundant specifications, incompatible specifications, optimum design of tensile bar, torsion shaft, beams, step shafts and with combined loading.
Unit 2	**Mechanical Springs** Design of square or rectangular bar helical springs, Belleville springs, ring springs, torsion bar springs, theory of square or rectangular bar helical springs under axial loading, cone or flat disc spring theory.
Unit 3	**Cams** Basic curves, cam size determination, calculating cam profiles, advance curves, polydyne cams, dynamics of high speed cam systems, surface materials, stresses and accuracy, ramps.
Unit 4	**Flat plate** Stress resultants in a flat plate, kinematics strain- displacement, relations for plates, equilibrium equation for small displacement, theory of plates, stress-strain

	temperature relations for isotropic elastic plates, strain energy of a plate, boundary conditions for plates, Circular plates with hole and without hole with different types of support and loading.
Unit 5	**Advances in machine design** Defining design, creativity, invention and innovation, design methodology, patterns of evaluation, design patents, functional approach, performance specifications, Quality Function Deployment, improvement of ideality, design strategy, problem definition, objective, top down and bottom up approaches, system, problem formulation, substance field analysis, morphological analysis, creative problem solving, inventive principle, evaluation of ideas or concepts, product design specifications, selection of best design.

Text and Reference Books

1. Johnson R.C., "Optimum Design of mechanical elements"
2. Wahl A.M., "Mechanical springs"
3. Rothbart John, "Cams", Wiley & sons.
4. Sidebottom Borosi, "Advance mechanics of materials", John Wiley & sons.
5. Hirani H., "Advances in Machine design", IIT Bombay, Mumbai.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern:

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

Mapping of Course outcomes with Program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**–**	**3**	**3**	**–**
CO2	**2**	**–**	**3**	**3**	**–**
CO3	**3**	**–**	**3**	**3**	**–**
CO4	**2**	**–**	**3**	**3**	**–**
CO5	**3**	**1**	**3**	**3**	**1**

1 – Low, 2 – Medium, 3 – High

MEPEC5048 : DESIGN AND ANALYSIS OF EXPERIMENTS		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

	Course Outcomes
CO1	Demonstrate the fundamental concepts and principles of design of experiments, sampling and sample selection as per DOE methods.
CO2	Interpret analysis of variance for single factor. Recognize and perform statistical analysis by using different methods.
CO3	Explain the advantages of blocking, and identify when to use each design type depending on the experimental setup.
CO4	Explain second and third factorial design by fitting response curve and surfaces at two and mixed level.
CO5	Estimate model parameters, perform hypothesis tests, and construct confidence intervals.

Detailed Syllabus:

Unit 1	**Introduction** Applications of experimental design, basic principles and guidelines for designing experiments, simple comparative experiments, sampling and sampling distribution, inferences about the differences, in means, randomized designs, paired comparison designs, variances of normal distribution.
Unit 2	**Experiments with single factor** The Analysis of Variance, analysis of Fixed Effects Model, model adequacy checking, practical interpretation of results, determining sample size, regression approach to analysis of variance.
Unit 3	**Randomized Blocks, Latin Squares, and related designs** The randomized complete block design, statistical analysis of the RCBD, the Latin square design, the Graeco-Latin square design, balanced incomplete block design.
Unit 4	**Factorial Designs** The advantages of factorial designs, 2^k and 3^k factorial design, model accuracy checking, estimating the model parameters, fitting response curves and surfaces, blocking in factorial design, blocking and compounding in the 2^k and 3^k factorial design, two level fractional factorial design, factorials with mixed levels.
Unit 5	**Fitting Regression Models** Linear regression models, estimation of parameters in LRM, hypothesis testing and confidence intervals in multiple regressions, regression model diagnostics, testing

	for lack of fit. Taguchi Method: Taguchi method as a new approach to DOE, application procedures, analysis and areas of application.

Text and Reference Books

1. Montgomery D. C., "Design and Analysis of Experiments", 5th Ed, John Wiley, Publications, New York.
2. Roy R. K., "Design of Experiments Using Taguchi Approach", John Wiley, Publications, New York.
3. Kothari C. R., "Research Methodology", Wishwa Prakashan, New Delhi.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern:

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

Mapping of Course outcomes with Program outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**1**	**3**	**2**	**–**
CO2	**3**	**–**	**3**	**2**	**–**
CO3	**2**	**–**	**3**	**2**	**–**
CO4	**3**	**–**	**3**	**2**	**–**
CO5	**3**	**–**	**3**	**2**	**–**

1 – Low, 2 – Medium, 3 – High

MEPEC5049 : MATERIAL HANDLING EQUIPMENT DESIGN		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

	Course Outcomes
CO1	Demonstrate functions, characteristics and applications of different material handling systems.
CO2	Explain different types of material handling equipment & their functions in relation to material movement, storage, and packaging.
CO3	Explain material handling systems in industries.
CO4	Demonstrate kinematic and dynamic analysis of cranes, elevators and conveyors
CO5	Apply design process to troubleshooting conveyor systems.

Detailed Syllabus:

Unit 1	**Introduction** Objectives of material handling systems and the basic principles, classification and selection of material handling equipment, Characteristics and applications.
Unit 2	**Description of various material handling equipments** Functions and parameters, effecting service, packaging and storage of materials and their relations with material handling.
Unit 3	**Theory construction of various components** Parts of mechanical handling devices, wire ropes, chains, hooks, shackles, grabs, ladles and lifting electromagnets, pulleys, sheaves, shears, sprockets, and drums, winches, brakes and ratchet stops, gears and power transmission systems, runner wheels and rails, buffers and controls of travel mechanisms.
Unit 4	**Kinematic and dynamic analysis** Kinematic and dynamic analysis of various types of cranes and elevators, stability and structural analysis, discussion of principles and applications of conveyors and related equipments.
Unit 5	**Design of various types of conveyors and their elements** Fault finding and failure analysis of material handling systems, system design and economics.

Text and Reference Books

1. Rudenko N., "Materials Handling Equipments", Peace Publishers, Moscow
2. Spivakowsky and Dyachke V., "Conveyors and Related Equipments", Peace Publishers, Moscow
3. Immer R. John, "Materials Handling", McGraw Hill, 1953.

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern:

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

Mapping of Course outcomes with Program outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	–	3	2	–
CO2	2	–	3	2	–
CO3	2	–	3	2	–
CO4	3	–	3	3	–
CO5	3	–	3	3	–

1 – Low, 2 – Medium, 3 – High

MEOEC5004: Robotics		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Understand robot configuration, structure, basic components, work space and generation of robots
2. Get acquainted with performing spatial transformations and solve kinematics of robot
3. Learn about various sensors and actuators
4. Acquire knowledge of robot drive systems and grippers

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Explain robot degree of freedom and classifications
CO2	Illustrate robot force and motion for particular case
CO3	Classify different sensors and controllers of robots
CO4	Illustrate selections of drives and grippers of robots

Detailed Syllabus:

Unit 1	**Introduction to robots and robotics:** History of robotics, different components of a robotic system, method of determining degrees of freedom, classifications of the robots, Workspace analysis of manipulators, Economic analysis Applications
Unit 2	**Kinematic Analysis:** forward and inverse kinematics analysis with problems, smooth variation of joint angles of the robot, trajectory planning schemes, velocity analysis, Jacobian matrix, inverse dynamics problems of robots, Lagrange-Euler formulation, motion planning algorithms
Unit 3	**Robot Controls**: Sensors used in robots, actuators and transmission, Controls in robot, joint torques, manipulators, analysis on wheeled and multi-legged robots, robot vision
Unit 4	**Robot drive systems and grippers** - Selection of joint motors, servo motors for manipulators and gears for robot systems, different types of grippers, design considerations and force, torque requirements, analysis of gripper, Applications of robots in different areas like in manufacturing units, medical science, space etc

Text and Reference Books

1. Groover M. P., "Industrial Robotics: Technology Programming and Applications, McGraw Hill Education
2. Aures R. U. and Miller S. M., "Robotics applications and implications", Ballinger Publishing Co., Cambridge
3. Groover M. P. and Zimmer E. W., "Computer Aided Design and Manufacturing", Prentice Hall of India Ltd, New Delhi
4. "Mechatronics", HMT Limited, Tata McGraw Hill Publications, New Delhi

5. David G., “Mechatronics”, Tata McGraw Hill Publications, New Delhi
6. I. K. Mittal, R. J Nagrath, "Robotics Mechanics and Control", McGraw Hill Education
7. Ramchandran Nagarajan, " Introduction to Industrial Robotics", Pearson Education India

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern

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

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	1	1			2
CO2	1			1	2
CO3	2	1	1	1	
CO4	2	1		1	2

1 – Low, 2 – Medium, 3 – High

MEVSE5002: Mini Project – II		
Teaching Scheme	**Examination Scheme**	
Practical: 04 Hrs. / Week	**ISE II**	**25 Marks**
Credit: 02	**ESE**	**25 Marks**

Course Objectives:

1. To make the student conversant with industrial activities / project execution activities
2. To exemplify various industrial aspects in manufacturing processes and industrial design
3. Student will be able to analyze and solve industrial mini problem / work on in-house project

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Illustrate industrial project / in-house project
CO2	Identify industrial problems / in-house
CO3	Integrate and apply the knowledge gained through different courses into practical problems
CO4	Prepare a consolidated report

Detailed description:

1. Student shall identify and collect pragmatic industrial information / in-house project / social problem as a Mini Project – II.
2. Student shall obtain a solution by applying suitable techniques.
3. Student has to exhibit the continuous progress review through regular reporting and presentations (at least two during semester) and proper documentation of the frequency of the activities. The continuous assessment of the progress needs to be documented unambiguously. Progress will be monitored by an evaluation committee consisting of guide, two faculty appointed by the BoS / Head of Department / BoS Chairman.
4. The candidate shall submit the report on Mini Project – II in standard format for satisfactory completion of the work, duly approved and certified by the concerned guide, Head of the Department and Principal.
5. The candidate will be assessed during ESE by two examiners, one of whom will be the guide and other is necessarily an external examiner appointed by the BoS / Head of Department / BoS Chairman. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation and report.
6. For standardization and documentation, it is recommended to follow the formats and guidelines approved by the Board of Studies.

Assessment:

ISE II- Continuous Assessment of individual student

Maximum Marks-25

ESE – Viva Voce based on presentation and report.

Maximum Marks-25

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II	ESE
S1	Implementation	04	04
S2	Manipulation	03	03
S3	Precision	14	14
S4	Articulation	04	04
S5	Naturalization	00	00
Total Marks		25	25

Knowledge Level	ISE II	ESE
Preparation S1	04	04
Articulation of problem S4	04	04
Observation S3	08	08
Record S2	03	03
Mini project/ Presentation/Viva Voce S3	06	06
Total Marks	25	25

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	1	1	2	1
CO2	2	1	1	3	1
CO3	1	1	1	3	1
CO4		3		1	

1 – Low, 2 – Medium, 3 – High

EEAEC5001: TECHNICAL COMMUNICATION		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Understand the nature and objective of Technical Communication relevant for the work place as Engineers.
CO2	Utilize the technical writing for the purposes of Technical Communication and its exposure in various dimensions
CO3	Enhance confidence in face of diverse audience.
CO4	Evaluate their efficacy as fluent & efficient communicators by learning the voice-dynamics.

Detailed Syllabus:

Unit 1	**Fundamentals of Technical Communication:** Technical Communication: Features; Distinction between General and Technical Communication; Language as a tool of Communication; Dimensions of Communication: Reading & comprehension; Technical writing: sentences; Paragraph; Technical style: Definition, types & Methods; The flow of Communication: Downward; upward, Lateral or Horizontal; Barriers to Communication.
Unit 2	**Forms of Technical Communication:** Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Key-Note Speech: Introduction & Summarization; Expert Technical Lecture: Theme clarity; Analysis & Findings; 7 Cs of effective business writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration.
Unit 3	**Technical Presentation:** Strategies & Techniques Presentation: Forms; interpersonal Communication; Classroom presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear: Confident speaking; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.
Unit 4	**Technical Communication Skills:** Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of expression &

	conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and non verbal means.
Unit 5	**Kinesics & Voice Dynamics: Kinesics:** Definitions; importance; Features of Body Language; Voice Modulation: Quality, Pitch; Rhythm; intonation; Pronunciation; Articulation; stress & accent; Linguistic features of voice control: Vowel & Consonant Sounds.

Text and Reference Books

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
2. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
3. Practical Communication: Process and Practice by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2014, Delhi.
4. Modern Technical Writing by Sherman, Theodore A (et.al); Apprentice Hall; New Jersey; U.S.
5. A Text Book of Scientific and Technical Writing by S.D. Sharma; Vikas Publication, Delhi.
6. Skills for Effective Business Communication by Michael Murphy, Harward University, U.S.
7. Business Communication for Managers by Payal Mehra, Pearson Publication, Delhi.

MEOEC6004: Additive Manufacturing		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Gain a foundational understanding of additive manufacturing principles, including the various techniques, processes, and terminology used in the field.
2. Learn about different types of software technologies and tools, materials used in additive manufacturing, their properties, and how they impact the final product.
3. Develop the skills to design 3D printable models, taking into consideration design constraints, support structures, and optimization for additive manufacturing processes.
4. Study real-world case studies and applications of additive manufacturing across various industries, including aerospace, medical, automotive, and consumer goods.

Course Outcomes:

After completing the course students will able to

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

Detailed Syllabus:

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 **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 3	**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 Stereolithography Micro- and nano-additive

Unit 4	**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 5	**Applications of AM:** Aerospace, Automotive, Biomedical Applications of AM. Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing

Text and Reference Books

1. Gibson, Rosen, Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing. Springer, 2009
2. Andreas Gebhardt, Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing, Hanser Publishers, 2011.
3. Hopkinson, Hague, Dickens, Rapid Manufacturing: An Industrial Revolution for the Digital Age. Wiley, 2005
4. Gibson, Advanced Manufacturing Technologies for Medical Applications. Wiley, 2005.
5. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: principles and applications, 3rd Edition, World Scientific, 2010
6. Zhiqiang Fan and Frank Liou, Numerical modeling of the additive manufacturing (AM) processes of titanium alloy, lnTech, 2012.
7. J. D. Majumdar and I. Manna, Laser-assisted fabrication of materials, Springer Series in Material Science, e-ISBN:978-3-642- 28359-8.

Useful Links

1. https://additivemanufacturing.com/basics/
2. https://www.ge.com/additive/additive-manufacturing
3. https://www.additive.sandvik/en/

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	00	12
K2	Understand	05	10	18
K3	Apply	10	10	18
K4	Analyze	00	00	12
K5	Evaluate	00	00	00
K6	Create	00	00	00
Total		20	20	60

Dr. S. A. Sonawane
Head, Mechanical

Dr. Anil Karwankar
Dean , Academics

Approved in XXX[th] Academic Council Meeting
Dated: 5[th] July 2025

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	1		3		2
CO2	1		3		2
CO3		1	3	3	2
CO4	2		3	2	1

1 – Low, 2 – Medium, 3 – High

Dr. S. A. Sonawane
Head, Mechanical

Dr. Anil Karwankar
Dean , Academics

Approved in XXXth Academic Council Meeting
Dated: 5th July 2025

MEEEM6001: Entrepreneurship Development		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Interpreting information about support systems, skill sets, financial and risk covering institutions and other for building an enterprise so that a budding entrepreneurs can make right decisions for starting and running a venture.
2. Articulating the entrepreneurial process of creating new businesses, role of Creativity and innovation in Entrepreneurial start-ups
3. Preparing a context of social innovation and social entrepreneurship and issues and practices of financing entrepreneurial businesses., and live cases of social, techno, women entrepreneurs

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Articulate the value proposition of an Entrepreneurial venture.
CO2	Evaluate a business plan to determine if it is complete and of investment grade;
CO3	Demonstrate key entrepreneurial leadership qualities
CO4	Determine the competitiveness of their business versus direct competitors by creating a competitive matrix

Detailed Syllabus:

Unit 1	Introduction to Entrepreneurship. Business ideas, Development of a Business plan
Unit 2	Establishing a small-scale enterprise, Functional strategies for new business, Overview of financial markets – Meaning and scope
Unit 3	Social entrepreneurship, Sustainability of non-profit organizations, Financing and risks in social enterprises, Business Strategies and Scaling up
Unit 4	Entrepreneurial Management, managing growth, expansion and winding up of business, Valuation of a new company, corporate entrepreneurship, Entrepreneurship in the era of Globalization: Environment and Strategy
Unit 5	Entrepreneurship, Creativity and Innovation, Centre of Innovation, Incubation and Entrepreneurship- An expert Interview, Entrepreneurship: Role of stimulating creativity, Creative teams and managerial responsibilities, Innovation and entrepreneurship: types and sources of innovation, Creativity and Innovations in Start Ups, Start-up Case Studies

Text and Reference Books

1. Eric Ries, "The Lean Startup" Crown Business, USA
2. Alexander Osterwalder and Yves Pigneur, "Business Model Generation" Pigneur Publications
3. Bill Aulet, "Disciplined Entrepreneurship: 24 Steps to a Successful Startup", 1st edition, Wiley
4. Steve Blank and Bob Dorf, "The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company", Strategyser Publishing
5. Bruce R. Barringer and R. Duane Ireland, "Entrepreneurship: Successfully

Launching New Ventures", Pearson Global Edition

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern

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

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	2	1	2	
CO2	1	2	2		3
CO3	1	3	2	2	3
CO4	1		1		

1 – Low, 2 – Medium, 3 – High

MEEEM6003: Industrial Management		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Objectives:

1. Provide an overview of the principles, concepts, and importance of industrial management in modern business environments.
2. Examine techniques for maintaining and improving product and service quality.
3. Develop skills in formulating and implementing strategic plans for industrial organizations to achieve long-term objectives and stay competitive in the market.
4. Provide an overview of the role and importance of Management Information Systems in modern organizations, including their impact on decision-making, efficiency, and competitive advantage.
5. Introduce students to the fundamental concepts, theories, and models that underlie human resource development, including adult learning principles, organizational development, talent management, and performance improvement.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Understanding of fundamental concepts and theories related to industrial management.
CO2	Acquire the ability to analyze complex industrial challenges
CO3	Evaluate methodologies to ensure consistent product quality and process improvement.
CO4	Examining human resources in various industrial setting
CO5	Formulate and implement strategic plans that align with organizational goals and adapt to changing market dynamics.

Detailed Syllabus:

Unit 1	**Basics of Management**: Introduction, Definition of management, characteristics of management, functions of management - Planning, Organizing, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision Making, Principles of management – F. W. Taylor, Henry Fayol, Elton Mayo, Administration and management, Nature of management, levels of management, managerial skills, managerial roles, Forms of Organization- Line, Line –staff etc. Forms of ownerships – Partnership, Proprietorship, Joint stock, Co-operative society, Govt. Sector etc., concept of Globalization
Unit 2	**Quality Management:** Definition of quality, goalpost view of quality, continuous improvement definition of quality, types of quality – quality of design, conformance and performance, phases of quality management, Juran's and Demings view of quality, Quality Management Assistance Tools: Ishikawa diagram – Pareto Analysis – Pokka Yoke (Mistake Proofing).quality circles, TQM, Kaizen, Five S (5S), Six sigma Quality Management Standards (Introductory aspects only)- The ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004 Environmental Management System Standard- ISO 27001:2005 Information Security Management System.

Unit 3	**Strategic Management:** Military origins of strategy Evolution - Concept and Characteristics of strategic management –Defining strategy – Mintzberg's 5P's of strategy – Corporate, Business and Functional Levels of strategy - Strategic Management Process.
Unit 4	**Management Information Systems:** Concept of data and information, characteristics of information, types of information, Definition of MIS, Need, Purpose and Objectives, Contemporary Approaches to MIS, Components of an information system, need to study information systems, Classification of information systems, Decision-making models, Types of decisions, Decision 3 Support Systems
Unit 5	**Human Resource Development (**HRM): Objectives of HRM; challenges to HR professionals; role, Responsibilities and competencies of HR professionals; HR department operations; Human Resource Planning - objectives and process; human resource information system. Talent acquisition; recruitment and selection strategies, career planning and management, training and development, investment in training Programme; executive development.

Text and Reference Books

1. O. P. Khanna, "Industrial Engineering and Management", Dhanpat Rai publications Ltd, New Delhi.
2. L. C. Jhamb, Savitri Jhamb, Industrial Management – I, Everest Publishing House.
3. Dinesh Seth and Subhash C. Rastogi, "Global Management Solutions", Cengage Learning, Second Edition, USA.
4. B. Davis and Margrethe H. Olson, "Management Information Systems", Mc-Graw-Hill International Editions.
5. Azar Kazmi, "Strategic Management & Business Policy", Tata McGraw Hill, New Delhi
6. Kenneth C. Laudon and Jane P. Laudon, ""Management Information Systems", Eighth Edition, Pearson Education
7. K. Shridhara Bhat, "Materials and Logistics Management", Himalaya Publishing House, Mumbai
8. M. Y. Khan and P. K. Jain, "Financial Management", Tata McGraw Hill, New Delhi
9. Ravi M. Kishore, "Project Management", Tata McGraw Hill

Assessment: ISEI (Class Test), ISEII (TA) & ESE

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

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

Assessment Pattern

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

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1		1	3	2	3
CO2	1	2	2	3	2
CO3	2	1	2	2	3
CO4	1		2	3	
CO5	1	2	3	2	

1 – Low, 2 – Medium, 3 – High

INIKS6001: Vedic Approach to Mathematics		
Teaching Scheme	**Examination Scheme**	
Lectures: 2 Hrs. / Week	ISE I	10 Marks
Credits: 2	ISE II	10 Marks
	End Semester Examination	30 Marks

Course description: This course is planned as Ability enhancement course. It is an exposure to the engineering students about Vedic Mathematics. Vedic Mathematics is a collection of Techniques/Sutras to solve mathematical arithmetic in easy and faster way. It consists of 16 Sutras (Formulae) and 13 sub-sutras (Sub Formulae) which can be used for problems involved in arithmetic, algebra, geometry, calculus, conics. By using Vedic Mathematics, the problems are solved mentally with the use of few or some of steps which increase accuracy and reduce mistakes. Through the application of the sutras, it ensures both speed and accuracy and enhances computational skills. In this course some of the topics from Vedic Mathematics are introduced which are use full to Engineering Students.

Course Objectives:

1. Multiply two- or three-digits numbers.
2. Compute the division by two- and three-digit divisors.
3. Check the divisibility by two- or three-digit numbers without actual division.
4. Evaluate square, cubes, square roots and cube roots of larger numbers within no time.
5. To factorize the quadratic expressions of single variable.
6. To find the Solution of Linear Simultaneous Equations.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Do multiplication and division of two- and three-digit numbers by applying Sutras in Vedic Mathematics.
CO2	To factorize and find LCM/HCF of numbers by applying Sutras in Vedic Mathematics.
CO3	To solve Simultaneous Linear Equations by applying Sutras in Vedic Mathematics.

Detailed Syllabus:

Unit 1	**Multiplication:** 1. Ekadhikenpurven method (multiplication of two numbers of two digits) 2. Eknunenpurven method (multiplication of two numbers of three digits) 3. Urdhvatiragbhyam method (multiplication of two numbers of three digits) 4. Nikhilam Navtashchramam Dashtaha (multiplication of two numbers of three digits)
Unit 2	**Division and Divisibility:** **Part A: Division** 1. Nikhilam Navtashchramam Dashtaha (two digits divisor) 2. Paravartya Yojyet method (three digits divisor) **Part B: Divisibility** 1. Ekadhikenpurven method (two digits divisor) 2. Eknunenpurven method (two digits divisor)
Unit 3	**Factorisation /LCM/HCF**

Unit 4	**Solution of Linear Simultaneous Equations:** Simple equations, Simultaneous Simple Equations, Quadratic Equations, Cubic Equations, Simultaneous Quadratic Equations.
Unit 5	**Power and Root Power:** (i) Square (two-digit numbers), (ii) Cube (two-digit numbers). (iii) Square root (four-digit number) (iv) Cube root (six digit numbers) [Self Study and assignments]

Text and Reference Books

1. Vedic Mathematics, Jagadguru Swami Sri BHARATI KRSNA TIRTHAJI MAHARAJA, Motilal Banarsi Das Publishing House, New Delhi.
2. Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.
3. Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.
5. Leelavati, Chokhambba Vidya Bhavan, Varanasi.
6. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi

Assessment:

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

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

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE1	ISEII	ESE
Kl	Remember	05	05	10
K2	Understand	05	05	20
K3	Apply	-	-	-
K4	Analyze	-	-	-
KS	Evaluate	-	-	-
K6	Create	-	-	-
Total Marks 50		**10**	**10**	**30**

Assessment table

Assessment Tool	K1, K2	K1, K2	K1, K2
	CO1	CO2	CO3
ISE I (10 Marks)	10	-	-
ISE II (10 Marks)	-	10	-
ESE (30 Marks)	10	10	10

Dr. S. A. Sonawane
Head, Mechanical

Dr. Anil Karwankar
Dean , Academics

Approved in XXXth Academic Council Meeting
Dated: 5th July 2025

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

Course Outcomes	PO1	PO2	PO3	PO4	PO5
CO1					2
CO2					2
CO3					2

1 – Low, 2 – Medium, 3 – High

MEDIS6001: Dissertation – I		
Teaching Scheme	**Examination Scheme**	
Practical: 20 Hrs. / Week	**ISE II**	**100 Marks**
Credit: 10	**ESE**	**100 Marks**

Course description:
The dissertation shall consist of a report on research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a work related to production engineering that the candidate has to execute. The dissertation will consist of two parts as dissertation – I and dissertation – II.

Course Objectives:
1. To acquaint with the process of undertaking literature survey / industrial visit and identifying the problem
2. Able to define precise problem
3. To specify objectives on the basis of problem statement
4. To identify the research methodology processes and its implementation.

Course Outcomes:
After completing the course students will able to

Course Outcomes	
CO1	Identify a practical problem from industry or research problem
CO2	Review literature to identify gaps and define objectives & scope of the work to decide the problem definition
CO3	Interpret the problem

Detailed description:
1. Dissertation – I is an integral part of the dissertation work. In this, the student shall complete the preliminary work of the dissertation which will consist of problem statement, literature review, scheme of implementation, Layout and Design of the Set-up. The student is expected to complete the dissertation at least up to the design phase.
2. The candidate has to exhibit the continuous progress through regular reporting and presentations (at least three during semester) and proper documentation of the frequency of the activities. The continuous assessment of the progress needs to be documented unambiguously. Progress will be monitored by an evaluation committee consisting of guide, two faculty appointed by the BoS / Head of Department / BoS Chairman.
3. The candidates have to validate their work undertaken by submitting and/or publishing it at standard platforms – conference and/or peer reviewed journal.
4. The candidate shall submit the report of dissertation – I in standard format for satisfactory completion of the work, duly approved and certified by the concerned guide, Head of the Department and Principal.
5. The candidate will be assessed during ESE by two examiners, one of whom will be the guide and other is necessarily an external examiner appointed by the BoS / Head of Department / BoS Chairman. The assessment will be broadly based on literature study, work undergone, content delivery, presentation skills, documentation and report.
6. For standardization and documentation, it is recommended to follow the formats and guidelines approved by the Board of Studies.

Assessment:
ISE II- Continuous Assessment of individual student

Maximum Marks-100
ESE – Viva Voce based on presentation and report
Maximum Marks-100

Assessment Pattern:

Assessment Pattern Level No.	**Knowledge Level**	**ISE II**	**ESE**
S1	Implementation	10	10
S2	Manipulation	00	00
S3	Precision	70	70
S4	Articulation	20	20
S5	Naturalization	00	00
Total Marks		100	100

Knowledge Level	**ISE II**	**ESE**
Preparation S1	10	10
Literature analysis and summarization of Results S3	50	50
Record and Articulation S4	20	20
Mini project / Presentation / Viva Voce S3	20	20
Total Marks	100	100

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	1	2	2	2
CO2	2	2	2	2	2
CO3	2	2	2	3	1

1 – Low, 2 – Medium, 3 – High

MEDIS6002: Dissertation – II		
Teaching Scheme	**Examination Scheme**	
Practical: 32 Hrs. / Week	**ISE II**	**150 Marks**
Credit: 16	**ESE**	**150 Marks**

Course Objectives:

1. To excel in progress review and follow schedule meticulously to meet the objectives of proposed work
2. To test the hypothesis rigorously before deployment of system
3. To validate the work undertaken
4. To consolidate the work as furnished report

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Implement suitable research methodology
CO2	Carryout experimentation responsibly and ethically
CO3	Evaluate data and evidence of work
CO4	Synthesize and write the project work

Detailed description:

1. In Dissertation – II, the student shall consolidate and complete the remaining part of the dissertation which will consist of selection of research methodology, installations, implementations, testing, results, measuring performance, discussions using data tables considered for the improvement with existing / known algorithms / systems, comparative analysis, characterization and validation of results and conclusions.
2. The candidate has to exhibit the continuous progress through regular reporting and presentations (at least three during semester) and proper documentation of the frequency of the activities. The continuous assessment of the progress needs to be documented unambiguously. Progress will be monitored by an evaluation committee consisting of guide, two faculty appointed by the BoS / Head of Department / BoS Chairman.
3. The investigations and findings need to be validated appropriately at standard platforms one at conference and other in peer reviewed journal.
4. The candidate shall submit the report of dissertation – II in standard format for satisfactory completion of the work, duly approved and certified by the concerned guide, Head of the Department and Principal.
5. The candidate will be assessed during ESE by two examiners, one of whom will be the guide and other is necessarily an external examiner appointed by the BoS / Head of Department / BoS Chairman. The assessment will be broadly based on literature study, work undergone, results and conclusion, contribution, content delivery, presentation skills, documentation and report.
6. For standardization and documentation, it is recommended to follow the formats and guidelines approved by the Board of Studies.

Format for Dissertation Report:

1. The total No. of minimum pages shall not be less than 70.
2. Plagiarism check by standard and approved software is must, and certificate shall be enclosed with the report.
3. Three report copies, loosely bound, shall be submitted in the department, one for examiner, one for supervisor and one for department.

4. The report shall be both side print hard bound. A hardbound report shall be made after examination by completing the examiner and guide's expected correction, before that report must be loosely bound.
5. For standardization of the reports the following format shall be strictly followed.

   Page size: A4
   Top Margin: 1"
   Bottom Margin: 1"
   Left Margin: 1.5"
   Right Margin: 1.5"
   Para Text: Times New Roman 12-point font
   Line Spacing: 1.5 Lines
   Page Numbers: Right aligned at footer. Font 10-point Times New Roman
   Headings: 14-Points, Times New Roman, Boldface.

Index of Report

1. Title Sheet
2. Certificate (Institution) as per standard format. Certificate shall have signatures of Guide, External Examiner, HoD and Principal.
3. Certificate (Company, if sponsored by company)
4. Undertaking by candidate as per standard format
5. Acknowledgement
6. Table of Contents
7. List of abbreviations
8. List of Figures
9. List of Photographs / Plates
10. List of Tables
11. Abstract of the Dissertation
12. Introduction
13. Literature Survey / Theory
14. Design / Experimentation / Fabrication / Production / Actual work carried out for the same
15. Observation, Results Analysis and validation
16. Conclusion
17. References
18. List of papers published
19. Plagiarism check report

Assessment:

ISE II- Continuous Assessment of individual student
Maximum Marks-150
ESE – Viva Voce based on presentation and report
Maximum Marks-150

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II	ESE
S1	Implementation	10	10
S2	Manipulation	60	60
S3	Precision	80	80
S4	Articulation	00	00
S5	Naturalization	00	00
Total Marks		150	150

Knowledge Level	ISE II	ESE
Preparation S1	10	10
Conduct of Experiment S2	30	30
Observation & analysis of Results S3	50	50
Record S2	30	30
Mini project/ Presentation/Viva Voce S3	30	30
Total Marks	150	150

Mapping of Course Outcomes with Program Outcomes:

Outcomes	PO1	PO2	PO3	PO4	PO5
CO1	2	1	2	3	2
CO2	2		1	2	
CO3	3	2	3	3	3
CO4	1	3	2	2	

1 – Low, 2 – Medium, 3 – High