Dr. Ambedkar Institute of Techonolgy
Department of Mechanical Engineering

The documents enclosed are verified and approved.

HOD
Dept. of Mechanical Engineering

HOD
Department of Mechanical Engineering
Dr. Ambedkar Institute of Technology
Bengaluru - 560 056.

Panchajanya Vidya Peetha Welfare Trust (Regd)

Dr. Ambedkar Institute of Technology

An Autonomous Institution, Affiliated to Visvesvaraya Technological University, Belagavi,
Aided by Govt. of Karnataka, Approved by All India Council for Technical Education (AICTE), New Delhi
Accredited by NBA and NAAC with 'A' Grade
BDA Outer Ring Road, Mallathalli, Bengaluru - 560 056

Ref. No. .....

Date : .....

This is to certify that the list of courses for the Employability, Entrepreneurship and skill development have been introduced during the 2016-2018 with the approval from the BOS chairman and BOS Members

Sl.No	Subject	Subject Code	Activities/content with direct bearing on Employability/ Entrepreneurship/skill development.
1.	Finite Element Method	16MMD12	Employability and Skill Development.
2.	Advanced Theory of Vibrations	16MMD14	Employability and Skill Development.
3.	Mechatronics Systems Design	16MMD151	Employability and Skill Development.
4.	Vibration Lab	16MMDL16	Skill Development..
5.	Technical Seminar	16MMDS17	Skill Development.
6.	Mini Project	16MMDM18	Skill Development.
7.	Composite Material techonology	16MMD21	Employability and Skill Development.
8.	Tribology & Bearing Design	16MMD24	Employability and Skill Development.
9.	Finite Element Analysis Lab	16MMDL26	Skill Development..
10.	Mini Project	16MMDM28	Skill Development.
11.	Midterm Presentation on Internship	16MMD31	Employability and Skill Development.
12.	Project Phase-I	16MMD32	Skill Development.
13.	ProjectPhase-II	16MMD43	Skill Development.

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BOS Chairman

Principal

PRINCIPAL
Dr. Ambedkar Institute of Technology
Bengaluru-560 056

FINITE ELEMENT METHOD

Course Code	**:**	**16MMD12**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L: T: P: 4:0:0**		**SEE Marks**	**:**	**50**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 hours**

Course Objectives

1. To present the Finite element method (FEM) as a numerical method for engineering analysis of continua and structures
2. To present Finite element formulation using variational and weighted residual approaches
3. To present Finite elements for the analysis of bars & trusses, beams & frames, plane stress & plane strain problems and 3-D solids, for thermal and dynamics problems.

Course Content: Chapters/ Units

1. **Approximations and round off errors**: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors. Mathematical modeling and Engineering problem solving: Simple mathematical model, Conservation Laws of Engineering**. 06 Hours**
   System of Linear Algebraic Equations and Eigen Value Problems: Introduction, Direct methods, Cramer's Rule, Gauss Elimination Method, Gauss-Jordan Elimination Method, Triangularization method, Cholesky Method, Partition method, error Analysis for direct methods, Iteration Methods. Eigen values and Eigen Vectors: Bounds on Eigen Values, Jacobi method for symmetric matrices. **06 Hours**

2. **Introduction to Finite Element Method:** Basic Steps in Finite Element Method to solve mechanical engineering (Solid, Fluid and Heat Transfer) problems: Functional approach and Galerkin approach, Displacement Approach: Admissible Functions, Convergence Criteria: Conforming and Non-Conforming elements, C_o C_1 and C_n Continuity Elements. Basic Equations, Element Characteristic Equations, Assembly Procedure, Boundary and Constraint Conditions. **06 Hours**
   Solid Mechanics: One-Dimensional Finite Element Formulations and Analysis – Bars- uniform, varying and stepped cross section-Basic (Linear) and Higher Order Elements Formulations for Axial, Torsional and Temperature Loads with problems. Beams- Basic (Linear) Element Formulation-for uniform, varying and stepped cross section- for different loading and boundary conditions with problems. Trusses, Plane Frames and Space Frame Basic (Linear) Elements Formulations for different boundary condition -Axial, Bending, Torsional, and Temperature Loads with problems. **06 Hours**

3. **Two-Dimensional Finite Element Formulations for Solid Mechanics Problems:** Triangular Membrane (TRIA 3, TRIA 6, TRIA 10) Element, Four-Noded Quadrilateral Membrane (QUAD 4, QUAD 8) Element Formulations for in-plane loading with sample problems.
   Triangular and Quadrilateral, Axis-symmetric basic and higher order Elements formulation for axis-symmetric loading only with sample problems.
   Three-Dimensional Finite Element Formulations for Solid Mechanics Problems: Finite Element Formulation of Tetrahedral Element (TET 4, TET 10), Hexahedral Element (HEXA 8, HEXA 20), for different loading conditions. Serendipity and Lagrange family Elements **10 Hours**

4. **Finite Element Formulations for Structural Mechanics Problems:** Basics of plates and shell theories: Classical thin plate Theory, Shear deformation Theory and Thick Plate theory. Finite Element Formulations for triangular and quadrilateral Plate elements. Finite element formulation of flat, curved, cylindrical and conical Shell elements **08 Hours**
5. **Dynamic Analysis:** Finite Element Formulation for point/lumped mass and distributed masses system, Finite Element Formulation of one-dimensional dynamic analysis: bar, truss, frame and beam element. Finite Element Formulation of Two-dimensional dynamic analysis: triangular membrane and axisymmetric element, quadrilateral membrane and axisymmetric element. Evaluation of eigen values and eigen vectors applicable to bars, shaft, beams, plane and space frame. **10 Hours**

NOTE: students are advised to prepare the report in the form of assignment to understand the subject and its relevance in the industry.

Text Books:

1. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, 2005.
2. Steven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, Tata McGraw Hill, 4th Ed, 2002.
3. M K Jain, S.R.K Iyengar, R K. Jain, Numerical methods for Scientific and engg computation, New Age International, 2003.
4. T. R. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall, 3rd Ed, 2002.
5. Lakshminarayana H. V., Finite Elements Analysis– Procedures in Engineering, Universities Press, 2004.

Reference Books:

1. Rao S. S., Finite Elements Method in Engineering- 4th Edition, Elsevier, 2006
2. P. Seshu, Textbook of Finite Element Analysis, PHI, 2004.
3. Bathe K. J., Finite Element Procedures, Prentice-Hall, 2006.
4. Cook R. D., Finite Element Modeling for Stress Analysis, Wiley,1995.
5. David. C. Lay, Linear Algebra and its applications, 3rd edition, Pearson Education, 2002

Course Outcomes:

Upon completion of this course, the students will be able to

CO1	It's important for the students to have basic knowledge about applied mathematics
CO2	Apply basic concepts about developing governing equations by finite element method, Formulate and perform one dimensional,
CO3	Two-dimensional structural analysis using bar, beam, triangular and quadrilateral elements. for Solid Mechanics Problems
CO4	Formulate axisymmetric triangular element and analyze problems on solids of revolution.
CO5	Formulate mass matrices and compute eigen values and eigen vectors for a 1- D and 2D analysis of mechanical system.

SCHEME OF EXAMINATION (QUESTION PAPER PATTERN)

1. Seven FULL questions to be set.
2. Five FULL questions to be answered.
3. Chapter-3, Chapter-4, Chapter-5, are compulsory, with one question from each chapter
4. Chapter-1 and Chapter-2: two questions to be set with choice.

ADVANCED THEORY OF VIBRATIONS

Course Code	**:**	**16MMD14**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L: T: P: 4:0:0**		**SEE Marks**	**:**	**50**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 hours**

Course Objective:

To teach students how to use the theoretical principles of vibration, and vibration analysis techniques, for the practical solution of vibration problems. The course thus builds on student's prior knowledge of vibration theory, and concentrates on the applications. Thus the student will fully understand the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions.

Course Content: Chapters/ Units

1. **Review of Mechanical Vibrations:** Basic concepts; free vibration of single degree of freedom systems with and without damping, forced vibration of single DOF-systems, Natural frequency.
   Transient Vibration of single Degree-of freedom systems: Impulse excitation, Arbitrary excitation, Laplace transform formulation, pulse excitation and rise time, Shock response spectrum, Shock isolation. **10 Hours**

2. **Vibration Control:** Introduction, Vibration isolation theory, Vibration isolation and motion isolation for harmonic excitation, practical aspects of vibration analysis, shock isolation, Dynamic vibration absorbers, Vibration dampers.
   Vibration Measurement and applications: Introduction, Transducers, Vibration pickups, Frequency measuring instruments, Vibration exciters, Signal analysis. **13 Hours**

3. **Modal analysis & Condition Monitoring:** Dynamic Testing of machines and Structures, Experimental Modal analysis, Machine Condition monitoring and diagnosis. Non-Linear Vibrations: Introduction, Sources of nonlinearity, Qualitative analysis of nonlinear systems. Phase plane, Conservative systems, Stability of equilibrium, Method of isoclines, Perturbation method, Method of iteration, Self-excited oscillations. **13 Hours**

4. **Random Vibrations:** Random phenomena, Time averaging and expected value, Frequency response function, Probability distribution, Correlation, Power spectrum and power spectral density, Fourier transforms, FTs and response. **08 Hours**
5. **Continuous Systems:** Vibrating string, longitudinal vibration of rods, Torsional vibration of rods, Euler equation for beams.
   Different methods of vibration dissipation in structural components for general and rotating machinery. **08 Hours**

NOTE: the students are advised to prepare the report in the form of assignment to understand the subject and its relevance in the industry

Text Books:

1. Theory of Vibration with Application, - William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, 5th edition Pearson Education
2. S. Graham Kelly, "Fundamentals of Mechanical Vibration" - McGraw-Hill, 2000
3. S. S. Rao, "Mechanical Vibrations", Pearson Education, 4th edition.

Reference Books:

1. S. Graham Kelly, "Mechanical Vibrations", Schaum's Outlines, Tata McGraw Hill, 2007.
2. C Sujatha , "Vibrations and Acoustics – Measurement s and signal analysis Tata McGraw Hill, 2010

Course Outcome:

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

CO1	Model and analyze a free damped, undamped and forced response of a mechanical system.
CO2	Develop equation and analyze the transient response of a single degree freedom system.
CO3	Assess the response characteristics of a continuous mechanical system.
CO4	Analyze and discuss the behavior of single degree freedom system for linear and non-linear behavior.

SCHEME OF EXAMINATION (QUESTION PAPER PATTERN)

1. Seven FULL questions to be set.
2. Five FULL questions to be answered.
3. Chapter-1, Chapter-4, Chapter-5, are compulsory, with one question from each chapter
4. Chapter-2 and Chapter-3: two questions to be set with choice.

Elective-I

MECHATRONICS SYSTEMS DESIGN

Course Code	**:**	**16MMD151**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L: T: P: 4:0:0**		**SEE Marks**	**:**	**50**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 hours**

Course Objective

1. To educate the student regarding integration of mechanical, electronic, electrical and computer systems in the design of CNC machine tools, Robots etc.
2. To provide students with an understanding of the Mechatronic Design Process, actuators, Sensors, transducers, Signal Conditioning, MEMS and Microsystems and also the Advanced Applications in Mechatronics.

Course Content: Chapters/ Units

1. **Introduction:** Definition and Introduction to Mechatronic Systems. Modeling &Simulation of Physical systems Overview of Mechatronic Products and their functioning, measurement systems. Control Systems, simple Controllers. Study of Sensors and Transducers: Pneumatic and Hydraulic Systems, Mechanical Actuation System, Electrical Actual Systems, Real time interfacing and Hardware components for Mechatronics. **13 Hours**

2. **Electrical Actuation Systems:** Electrical systems, Mechanical switches, Solid state switches, solenoids, DC & AC motors, Stepper motors.
   System Models: Mathematical models: - mechanical system building blocks, electrical system building blocks, thermal system building blocks, electromechanical systems, hydro-mechanical systems, pneumatic systems. **10 Hours**

3. **Signal Conditioning:** Signal conditioning, the operational amplifier, Protection, Filtering, Wheatstone Bridge, Digital signals, Multiplexers, Data Acquisition, Introduction to digital system processing, pulse-modulation.
   MEMS and Microsystems: Introduction, Working Principle, Materials for MEMS and Microsystems, Micro System fabrication process, Overview of Micro Manufacturing, Micro system Design, and Micro system Packaging. **13 Hours**

4. **Data Presentation Systems:** Basic System Models, System Models, Dynamic Response of system. **8 Hours**

5. **Advanced Applications in Mechatronics:** Fault Finding, Design, Arrangements and Practical Case Studies, Design for manufacturing, User-friendly design **8 Hours**

NOTE: the students are advised to prepare the report in the form of assignment to understand the subject and its relevance in the industry

Text Books:

1. W. Bolton, "Mechatronics" - Addison Wesley Longman Publication, 1999
2. HSU "MEMS and Microsystems design and manufacture"- Tata McGraw-Hill Education, 2002

Reference Books:

1. Kamm, "Understanding Electro-Mechanical Engineering an Introduction to Mechatronics"- IEEE Press, 1 edition ,1996
2. Shetty and Kolk "Mechatronics System Design"- Cengage Learning, 2010
3. Mahalik "Mechatronics"- Tata McGraw-Hill Education, 2003
4. HMT "Mechatronics"- Tata McGraw-Hill Education, 199 8
5. Michel.B. Histand& David. Alciatore, "Introduction to Mechatronics & Measurement Systems"–. Mc Graw Hill, 2002
6. "Fine Mechanics and Precision Instruments"- Pergamon Press, 1971.

Course Outcome:

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

CO1	Appreciate multi-disciplinary nature of modern engineering systems.
CO2	Model and analyze mechanical and electrical systems and their connection.
CO3	Be able to integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems.
CO4	Address issues of design, fabrication, and packaging issues of Microsystems.

SCHEME OF EXAMINATION (QUESTION PAPER PATTERN)

1. Seven FULL questions to be set.
2. Five FULL questions to be answered.
3. Chapter-2, Chapter-4, Chapter-5, are compulsory, with one question from each chapter
4. Chapter-1 and Chapter-3: two questions to be set with choice.

Design Engineering Laboratory – Lab 1

Course Code	**:**	**16MMDL16**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L: T: P: 0:0:3**		**SEE Marks**	**:**	**50**
Credits	**:**	**02**		**SEE Duration**	**:**	**3 hours**

Note:

1) These are independent laboratory exercises
2) A student may be given one or two problems stated herein
3) Student must submit a comprehensive report on the problem solved and give a Presentation on the same for Internal Evaluation
4) Any one of the exercises done from the following list has to be asked in the Examination for evaluation.

Course Content:

Experiment #1
Vibration analysis using portable vibration meter with FFT analyzer.

Experiment #2
Modal analysis

Experiment #3
Vibration analysis using accelerometers

- **a)** Uni-axial
- **b)** Tri-axial
- **c)** High temperature Tri-axial

Experiment #4
Vibration Shaker

Experimental #5
Vibration analysis on Beams

Experiment #6
Torsional vibration

Experiment #7
Vibration Characteristics of a Spring Mass Damper System.
Part A: Analytical Solutions.
Part C: Correlation Studies.

Experiment #8
Stress analysis in curved beam in 2D
Part A: Experimental studies using Strain Gauge Instrumentation.
Part B: 2D Photo elastic Investigation.

TECHNICAL SEMINAR

Course Code	**:**	**16MMDS17**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L: T: P: S 0:0:0:3**		**SEE Marks**	**:**	**50**
Credits	**:**	**02**		**SEE Duration**	**:**	**3 hours**

- **Seminar**: At the end of second CIE each student is required to present the seminar of his/her interested field (Related to design subjects).
- Report submissions and final Evaluation is to be carried out by the Internal Guide of the college and a senior faculty along with HOD.

MINI PROJECT/ INDUSTRIAL VISIT/ FIELD WORK

Course Code	**:**	**16MMDM18**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L: T: P: S 0:0:0:3**		**SEE Marks**	**:**	**50**
Credits	**:**	**02**		**SEE Duration**	**:**	**3 hours**

- **Industrial Visit**: At the end of second CIE the industrial visit will be arranged in the domain field, each student is required to submit the report of the visit.
- Report submissions and final Evaluation is to be carried out by the Internal Guide of the college and a senior faculty along with HOD.

II Semester

COMPOSITE MATERIALS TECHNOLOGY

Course Code	**:**	**16MMD21**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L: T: P: 4:0:0**		**SEE Marks**	**:**	**50**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 hours**

Course Objective:
Mechanics of composite materials provides a methodology for stress analysis and progressive failure analysis of laminated composite structures for aerospace, automobile, marine and other engineering applications.

Course Content: Chapters/ Units

1. **Introduction to Composite Materials:** Definition, Classification, Types of matrices material and reinforcements, Characteristics &selection, Fiber composites, laminated composites, Particulate composites, Prepegs, and sandwich construction.
   Metal Matrix Composites: Reinforcement materials, Types, Characteristics and selection, Base metals, Selection, Applications
   Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Derivation of nine independent constants for orthotropic material, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Invariant properties. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems. **10 Hours**

2. **Micro Mechanical Analysis of a Lamina:** Introduction, Evaluation of the four elastic moduli, Rule of mixture, Numerical problems. Experimental Characterization of Lamina- Elastic Moduli and Strengths
   Failure Criteria: Failure criteria for an elementary composite layer or Ply, Maximum Stress and Strain Criteria, Approximate strength criteria, Inter-laminar Strength, Tsa-Hill theory, Tsai, Wu tensor theory, Numerical problem, practical recommendations. **12 Hours**

   3. Macro Mechanical Analysis of Laminate: Introduction, code, Kirchoff hypothesis, Classical Lamination Theory, A, B, and D matrices (Detailed derivation), Special cases of laminates, Numerical problems. Shear Deformation Theory, A, B, D and E matrices (Detailed derivation)
   10 Hours

4. **Analysis of Composite Structures:** Optimization of Laminates, composite laminates of uniform strength, application of optimal composite structures, composite pressure vessels, spinning composite disks, composite lattice structures. **8 Hours**

5. **Manufacturing and Testing:** Layup and curing - open and closed Mould processing, Hand lay-up techniques, Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Cutting, Machining, joining and repair. NDT tests – Purpose, Types of defects, NDT method - Ultrasonic inspection, Radiography, Acoustic emission and Acoustic ultrasonic method.
   Applications: Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment-future potential of composites. **12 Hours**

NOTE: the students are advised to prepare the report in the form of assignment to understand the subject and its relevance in the industry

Text Books:

1. Autar K. Kaw, Mechanics of Composite materials, CRC Press, 2nd Ed, 2005.
2. Madhijit Mukhopadhay, Mechanics of Composite Materials & Structures, Universities Press, 2004.

Reference Books:

1. J. N. Reddy, Mechanics of Laminated Composite Plates & Shells, CRD Press, 2nd Ed, 2004.
2. Mein Schwartz, Composite Materials handbook, McGraw Hill, 1984.
3. Rober M. Jones, Mechanics of Composite Materials, Taylor & Francis, 1998.
4. Michael W, Hyer, Stress analysis of fiber Reinforced Composite Materials, Mc-Graw Hill International, 2009.
5. Composite Material Science and Engineering, Krishan K. Chawla, Springer, 3e, 2012.
6. Fiber Reinforced Composites, P.C. Mallik, Marcel Decker, 1993.

Course Outcomes:

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

CO1	Identify the role of matrices and reinforcements used in practical composite structures.
CO2	Analyze problems on micro and macro mechanical behavior of lamina.
CO3	Assess the strength of laminated composite and predict its failure for given static loading conditions.
CO4	Develop understanding of different methods of manufacturing and testing of composites.

SCHEME OF EXAMINATION (QUESTION PAPER PATTERN)

1. Seven FULL questions to be set.
2. Five FULL questions to be answered.
3. Chapter-1, Chapter-3, Chapter-4, are compulsory, with one question from each chapter
4. Chapter-2 and Chapter-5: two questions to be set with choice.

TRIBOLOGY AND BEARING DESIGN

Course Code	**:**	**16MMD24**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L: T: P: 4:0:0**		**SEE Marks**	**:**	**50**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 hours**

Course Objective:

Gives in-depth knowledge regarding hydrodynamic, hydrostatic lubrication and various bearings, with their design and applications

Course Content: Chapters/ Units

1. **Introduction to Tribology:** Introduction, Friction, Wear, Wear Characterization, Regimes of lubrication, Classification of contacts, lubrication theories, Effect of pressure and temperature on viscosity. Newton's Law of viscous forces, Flow through stationary parallel plates. Hagen's Poiseuille's theory, viscometers. Numerical problems, Concept of lightly loaded bearings, Petroff's equation, Numerical problems. **8 Hours**

2. **Hydrodynamic Lubrications:** Pressure development mechanism. Converging and diverging films and pressure induced flow. Reynolds's 2D equation with assumptions. Introduction to idealized slide bearing with fixed shoe and Pivoted shoes. Expression for load carrying capacity. Location of center of pressure, effect of end leakage on performance, Numerical problems
   Journal Bearings: Introduction to idealized full journal bearings. Load carrying capacity of idealized full journal bearings, Sommer Feld number and its significance, short and partial bearings, Comparison between lightly loaded and heavily loaded bearings, effects of end leakage on performance, Numerical problems. **12 Hours**

3. **Hydrostatic Bearings:** Hydrostatic thrust bearings, hydrostatic circular pad, annular pad, rectangular pad bearings, types of flow restrictors, expression for discharge, load carrying capacity and condition for minimum power loss, numerical problems, and hydrostatic journal bearings.
   EHL Contacts: Introduction to Elasto- hydrodynamic lubricated bearings. Introduction to 'EHL' constant, Grubin type solution. **12 Hours**

4. **Antifriction bearings:** Advantages, selection, nominal life, static and dynamic load bearing capacity, probability of survival, equivalent load, cubic mean load, bearing mountings.
   Porous Bearings: Introduction to porous and gas lubricated bearings. Governing differential equation for gas lubricated bearings, Equations for porous bearings and working principal, Fretting phenomenon and its stages. **10 Hours**

5. **Magnetic Bearings:** Introduction to magnetic bearings, Active magnetic bearings. Different equations used in magnetic bearings and working principal. Advantages and disadvantages of magnetic bearings, Electrical analogy, Magneto-hydrodynamic bearings.
   Advanced bearing systems and their advantages over conventional bearing systems, testing of different types of bearings **10 hours**

NOTE: Students are advised to prepare the report in the form of assignment to understand the subject and its relevance in the industry

Text Books

1. Mujamdar.B.C "Introduction to Tribology of Bearing", Wheeler Publishing, New Delhi 2001
2. Radzimovsky, "Lubrication of Bearings - Theoretical principles and design" Oxford press Company, 2000

Reference Books

1. Dudley D. Fulier " Theory and practice of Lubrication for Engineers", New YorkCompany.1998
2. Moore "Principles and applications of Tribology" Pergamon press, 1975
3. Oscar Pinkus, Beno Sternlicht, “Theory of hydro dynamic lubrication”, McGraw-Hill, 1961
4. G W Stachowiak, A W Batchelor, “Engineering Tribology”, Elsevier publication 1993.
5. Hydrostatic and hybrid bearings, Butterworth 1983.
6. F. M. Stansfield, Hydrostatic bearings for machine tools and similar applications, Machinery Publishing, 1970

Course Outcome:

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

CO1	Students develop skills to design and selection of bearings on Various tribological factors to be considered in moving and rotating parts.
CO2	The students are exposed to orient towards the various types of bearings and their applications.
CO3	Students are exposed to synthesis and analysis of the bearings including fault diagnosis.

SCHEME OF EXAMINATION (QUESTION PAPER PATTERN)

1. Seven FULL questions to be set.
2. Five FULL questions to be answered.
3. Chapter-1, Chapter-4, Chapter-5, are compulsory, with one question from each chapter
4. Chapter-2 and Chapter-3: two questions to be set with choice.

Design Engineering Laboratory - Lab 2

Course Code	**:**	**16MMDL26**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L: T: P: 0:0:3**		**SEE Marks**	**:**	**50**
Credits	**:**	**02**		**SEE Duration**	**:**	**3 hours**

Note:

1) These are independent laboratory exercises
2) A student may be given one or two problems stated herein
3) Student must submit a comprehensive report on the problem solved and give a Presentation on the same for Internal Evaluation
4) Any one of the exercises done from the following list has to be asked in the Examination for evaluation.

Course Content:

Experiment #1 Structural Analysis

Part A: FE Modeling of a stiffened Panel using a commercial preprocessor.
Part B: Buckling, Bending and Modal analysis of stiffened Panels.
Part C: Parametric Studies.

Experiment #2 Design Optimization

Part A: Shape Optimization of a rotating annular disk.
Part B: Weight Minimization of a Rail Car Suspension Spring.
Part C: Topology Optimization of a Bracket.

Experiment #3 Thermal analysis

Part A: Square Plate with Temperature Prescribed on one edge and Opposite edge insulated.
Part B: A Thick Square Plate with the Top Surface exposed to a Fluid at high temperature, Bottom Surface at room temperature, Lateral Surfaces Insulated.

Experiment #4 Thermal Stress Analysis

Part A: A Thick-Walled Cylinder with specified Temperature at inner and outer Surfaces.
Part B: A Thick-Walled Cylinder filled with a Fluid at high temperature and Outer Surface exposed to atmosphere.

Experiment#5 CFD Analysis

Part A: CFD Analysis of a Hydro Dynamic Bearing using commercial code.
Part B: Comparison of predicted Pressure and Velocity distributions with Target solutions.
Part C: Experimental Investigations using a Journal Bearing Test Rig.
Part D: Correlation Studies.

Experiment #6 Welded Joints.

Part A: Fabrication and Testing.
Part B: FE Modeling and Failure Analysis.
Part C: Correlation Studies.

Experiment #7 Bolted Joints.
Part A: Fabrication and Testing.
Part B: FE Modeling and Failure Analysis.
Part C: Correlation Studies.

Experiment #8 Adhesive Bonded Joints.
Part A: Fabrication and Testing.
Part B: FE Modeling and Failure Analysis.
Part C: Correlation Studies.

MINI PROJECT/ INDUSTRIAL VISIT/ FIELD WORK

Course Code	**:**	**16MMDM28**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L: T: P: S 0:0:0:3**		**SEE Marks**	**:**	**50**
Credits	**:**	**02**		**SEE Duration**	**:**	**3 hours**

- **Industrial Visit**: At the end of second CIE the industrial visit will be arranged in the domain field, each student is required to submit the report of the visit.
- Report submissions and final Evaluation is to be carried out by the Internal Guide of the college and a senior faculty along with HOD.

OR

- **Seminar**: At the end of second CIE each student is required to present the seminar of his/her interested field (Related to design subjects).
- Report submissions and final Evaluation is to be carried out by the Internal Guide of the college and a senior faculty along with HOD.

FRACTURE MECHANICS

Course Code	**:**	**16MMD41**		**CIE Marks**	**:**	**50**
Hrs/Week	**:**	**L: T: P: 4:0:0**		**SEE Marks**	**:**	**50**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 hours**

Course Objective:

Fracture mechanics provides a methodology for prediction, prevention and control of fracture in materials, components and structures. It provides a background for damage tolerant design. It quantifies toughness as materials resistance to crack propagation.

Course Content: Chapters/ Units

1. **Fracture mechanics principles:** Introduction and historical review, Sources of micro and macro cracks. Stress concentration due to elliptical hole, Strength ideal materials, Griffith's energy balance approach. Fracture mechanics approach to design. NDT and Various NDT methods used in fracture mechanics, Numerical problems. The Airy stress function. Complex stress function. Solution to crack problems. Effect of finite size. Special cases, Elliptical cracks, Numerical problems. **13 Hours**

2. Plasticity effects, Irwin plastic zone correction. Dugdale approach. The shape of the plastic zone for plane stress and plane strain cases, Plastic constraint factor. The Thickness effect, numerical problems.
   Determination of Stress intensity factors and plane strain fracture toughness: Introduction, analysis and numerical methods, experimental methods, estimation of stress intensity factors. Plane strain fracture toughness test, The Standard test. Size requirements.Non-linearity.Applicability. **13 Hours**

3. The energy release rate, Criteria for crack growth. The crack resistance(R curve). Compliance, J integral. Tearing modulus. Stability.
   Elastic plastic fracture mechanics : Fracture beyond general yield. The Crack-tip opening displacement. The Use of CTOD criteria. Experimental determination of CTOD. Parameters affecting the critical CTOD. Use of J integral. Limitation of J integral. **12 Hours**

4. **Dynamics and crack arrest:** Crack speed and kinetic energy. Dynamic stress intensity and elastic energy release rate. Crack branching. Principles of crack arrest. Crack arrest in practice. Dynamic fracture toughness**.** **6 Hours**

5. **Fatigue crack propagation and applications of fracture mechanics:** Crack growth and the stress intensity factor. Factors affecting crack propagation. variable amplitude service loading, Means to provide fail-safety, Required information for fracture mechanics approach, Mixed mode (combined) loading and design criteria. **8 Hours**

NOTE: the students are advised to prepare the report in the form of assignment to understand the subject and its relevance in the industry

Text Books:

1. David Broek, “Elementary Engineering Fracture Mecha nics”, Springer Netherlands,2011
2. Anderson , “Fracture Mechanics-Fundamental and Appl ication”, T.L CRC press1998.

Reference Books:

1. Karen Hellan , “Introduction to fracture mechanics” , McGraw Hill, 2nd Edition
2. S.A. Meguid , “Engineering fracture mechanics” Else vier Applied Science, 1989
3. Jayatilaka, “Fracture of Engineering Brittle Mater ials”, Applied Science Publishers, 1979
4. Rolfe and Barsom , “Fracture and Fatigue Control in Structures” , Prentice Hall, 1977
5. Knott , “Fundamentals of fracture mechanisms”, But terworths, 1973

Course Outcome:

At the end of the course students will:

CO1	Develop fundamental understanding of the effects of crack like defects on the performance of aerospace, civil, and mechanical engineering structures.
CO2	Select appropriate materials for engineering structures to ensure damage tolerance.
CO3	Employ modern numerical methods to determine critical crack sizes and fatigue crack propagation rates in engineering structures.
CO4	Gain appreciation of the status of academic research in field of fracture mechanics.

SCHEME OF EXAMINATION (QUESTION PAPER PATTERN)

1. Seven FULL questions to be set.
2. Five FULL questions to be answered.
3. Chapter-3, Chapter-4, Chapter-5, are compulsory, with one question from each chapter
4. Chapter-1 and Chapter-2: two questions to be set with choice.

PROJECT PHASE-II

Course Code	**:**	**16MMDP42**		**CIE Marks**	**:**	**100**
Hrs/Week	**:**	**L: T: P: 4:0:0**		**SEE Marks**	**:**	**100**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 hours**

Project Phase-II - Internal Evaluation of progress in Project work shall be evaluated after 8 weeks for 100 marks by the committee constituted for the purpose by the Head of the Department comprising the guide and senior faculty of the department with HOD as Chairman.

Project Phase-III - Internal Evaluation of Project Demonstration, which shall be evaluated after 15 weeks for 100 marks by the committee constituted for the purpose by the Head of the Department.

Final Evaluation of Project Work and Viva-voce.

Final evaluation of project to be carried out after 16 weeks from the date of commencement of 4^{th} semester.

The Internal Examiner (the project guide with a teaching experience of at least three years) and External Examiner with HOD as chairman will complete the final evaluation of Project.

Internal and External Examiners shall carry out the evaluation for 100 Marks each and the average of these marks shall be the final marks of the Project Evaluation.

Viva – Voce: The Viva-Voce shall be conducted jointly by Internal Examiner and External Examiner with HOD as chairman for 100 Marks.

Panchajanya Vidya Peetha Welfare Trust (Regd)

Dr. Ambedkar Institute of Technology

An Autonomous Institution, Affiliated to Visvesvaraya Technological University, Belagavi,
Aided by Govt. of Karnataka, Approved by All India Council for Technical Education (AICTE), New Delhi
Accredited by NBA and NAAC with 'A' Grade
BDA Outer Ring Road, Mallathalli, Bengaluru - 560 056

Ref. No. .....

Date : .....

This is to certify that the list of courses for the Employability, Entrepreneurship and skill development have been introduced during the 2018-2020 with the approval from the BOS chairman and BOS Members

Sl.No	Subject	Subject Code	Activities/content with direct bearing on Employability/ Entrepreneurship/skill development.
1.	Advanced Mechanics of Solids	18MMD11	Employability and skill development.
2.	Finite Element Method	18MMD12	Employability and skill development.
3.	Experimetal Mechanics	18MMD131	Employability and skill development.
4.	Design For Manufacture	18MMD142	Employability and skill development.
5.	Automobile System Design	18MMD152	Employability and skill development.
6.	Advanced Machine Design	18MMD21	Employability and skill development.
7.	Advanced Theory of Vibrations	18MMD22	Employability and skill development.
8.	Design optimization	18MMD232	Employability and skill development.
9.	Theory of Plasticity	18MMD251	Employability and skill development.
10.	Fracture Mechanics	18MMD31	skill development.
11.	Smart Materials And Structures	18MMD321	Employability and skill development.
12.	Internship	18MMDI34	skill development.
13.	Modeling And Analysis Lab	18MMDL35	skill development.
14.	Technical Seminar	18MMDS36	skill development.
15.	Project Phase -1	18MMDP37	skill development.

HOD
Department of Mechanical Engineering
Dr. Ambedkar Institute of Technology
Bengaluru - 560 056.

BOS Chairman

Principal
PRINCIPAL
Dr. Ambedkar Institute of Technology
Bengaluru-560 056

1ST SEMESTER

ADMISSION YEAR:2018-19 **ACADEMIC YEAR: 2018-19**

COURSE TITLE: ADVANCED MECHANICS OF SOLIDS		
Sub Code:18MMD11	**No of Credits: L-T-P-SS 4:0:0:0 =4**	**No. of lecture hours/week: 04**
Exam Duration: 3 hours	**CIE Marks: 50**	**Exam Marks: 50**
Pre-requisites	**MOM, DESIGN OF MACHINE ELEMENTS.**	

COURSE OBJECTIVES:

To study the basic concept of stresses, stress distribution, elastic constants when the material is subjected to loading within the elastic limits. Study the stress distribution in plane, polar and cylindrical coordinate systems. Analyze the material or component subjected to torsion of circular and non-circular shafts (elliptical, triangular bars) Study the thermo-elastic properties of the material at elevated temperatures.

#	CONTENTS	Hrs
UNIT-1	**INTRODUCTION TO STRESS:** Definition and Notation for forces and stresses. Components of stresses, equations of Equilibrium, Specification of stress at a point. Principal stresses and shear stresses and Mohr's diagram in three dimensions. Boundary conditions. Stress transformation, Stress components on an arbitrary plane, Stress invariants, Octahedral stresses, Decomposition of state of stress.	08
UNIT-2	**INTRODUCTION TO STRAIN**: Deformation, Strain Displacement relations, Strain components, The state of strain at a point, Principal strain, Strain transformation, Compatibility equations, Cubical dilatation. **STRESS-STRAIN RELATIONS AND THE GENERAL EQUATIONS OF ELASTICITY**: Generalized Hooke's; law in terms of engineering constants. Formulation of elasticity Problems. Existence and uniqueness of solution, Saint -Venant's principle, Principle of super position and reciprocal theorem.	10
UNIT-3	**ENERGY METHODS**: Work done by forces and elastic strain energy stored, Begg's Deformeter, First theorem of Castigliano, Theorem of virtual work, Kirchhoff's theorem.	10
UNIT-4	**TWO DIMENSIONAL PROBLEMS IN CARTESIAN CO-ORDINATES:** Airy's stress function, investigation for simple beam problems. Bending of a narrow cantilever beam under end load, simply supported beam with uniform load, Use of Fourier series to solve two dimensional problems. **TORSION OF PRISMATIC BARS:** Torsion of Circular and elliptical cross section bars, Membrane analogy, Torsion of thin-walled closed tubes.	14

UNIT-5	**TWO DIMENSIONAL PROBLEMS IN POLAR CO-ORDINATES:** General equations, stress distribution symmetrical about an axis, thick cylinder, shrink fit, Strain components in polar co-ordinates, Rotating disk and cylinder, Thermal stresses in thin discs, Stress concentration around a circular hole in an infinite plate. Thermo-elastic stress –strain relations.	**1**4

TEXT BOOKS:

1. **Advanced Mechanics of solids**, L. S. Srinath, Tata Mc. Graw Hill, 2003
2. **Theory of Elasticity,** S. P. Timoshenko and J. N Gordier, McGraw Hill International, 3rd edition, 1972

REFERENCES BOOKS:

1. **Theory of Elasticity,** Dr. Sadhu Singh, Khanna Publications, 1988
2. **Elasticity, Theory, Applications &Numericals,** Martin H Sadd, Elsevier. 2005
3. **Applied Elasticity,** Seetharaman & Govindaraju, Interline Publishing
4. **Applied Elasticity,** C.T. WANG Sc. D. Mc. Graw Hill Book Co.1953.

REMINDER

BREAK-UP OF COURSE CONTENTS FOR;
CIE-1: UNIT 1 (100%) + UNIT 2 (100%)
CIE-2: UNIT 3 (100%) + UNIT 4 (FIRST 50%)
CIE-3: UNIT 4 (NEXT 50%) + UNIT 5 (100%)
(Irrespective of portions covered due to whatever might be the reason)

QUESTION PAPER PATTERN (SEE)

Q. No	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Unit	**1**		**2**		**3**		**4**		**5**	

SCHEME OF EXAMINATION (SEE)

1. Ten Full Questions to be set.
2. Five full Questions to be answered.
3. Students shall answer Q1 or Q2 from Unit-1, Q3 or Q4 from Unit-2, Q5 or Q6 from Unit-3, Q7 or Q8 from Unit-4, Q9 or Q10 from Unit-5 with two questions from each Unit.
4. Each question shall contain maximum of 2 subdivisions
5. Each main question carries equal Marks.

COURSE OUTCOMES:

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

CO1	Apply basic concepts in continuum mechanics of solids viz. Stress and strain tensors, equilibrium, compatibility and constitutive equations and methods of solution to elasticity problems
CO 2	Evaluate stresses and displacements in simple solids such as pressurized cylinders, shrink fitted cylinders, rotating disc and shaft, plate with hole and non-circular shafts and thin tubes under torsion.
CO 3	Use MATLAB or equivalent software to evaluate and plot particular solutions.
CO 4	Apply the principles of plastic deformation to estimate yielding in simple engineering structures.

CO 5	Apply principles of continuum mechanics to design a structure or component to achieve desired performance under realistic constraints.

MAPPING OF COs WITH POs

COs/POs	po1	po2	po3	po4	po5	po6	po7	po8	po9	po10	po11	po12
CO1	3	3	3	2	2	3	3	2	3	3	1	2
CO2	2	3	3	2	2	1	3	2	3	3	3	2
CO3	3	3	3	2	3	2	3	1	3	2	3	2
CO4	3	3	2	2	3	2	3	1	2	2	3	3

ADMISSION YEAR :2018-19 **ACADEMIC YEAR: 2018-19**

COURSE TITLE:	**FINITE ELEMENT METHOD**	
Sub Code:18MMD12	**No of Credits: L-T-P-SS 3:0:0:1 =4**	**No. of lecture hours/week: 04**
Exam Duration: 3 hours	**CIE Marks: 50**	**Exam Marks: 50**
Pre-requisites	**Engineering Mechanics, Design of Machine Elements**	

COURSE OBJECTIVES:

This course enables the student to identify failure modes and evolve design by analysis methodology. Design against fatigue failure is given explicit attention. **To** impart structures analysis for stress, strain & dynamic loading knowledge. To enable formulation of the design problems into FEA. To comprehend the basic concepts and enhance capabilities for solving complex problems. To introduce the concepts of elastic and static analysis problems.

#	CONTENTS	Hrs
UNIT-1	**MATHEMATICS FOR FEM**: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors. Mathematical modeling. **SYSTEM OF LINEAR ALGEBRAIC EQUATIONS AND EIGEN VALUE PROBLEMS:** Gauss Elimination Method, Gauss-Jordan Elimination Method, Triangularization method, Cholesky Method, Partition method, Iteration Methods. Eigen values and Eigen Vectors: Bounds on Eigen Values, Jacobi method for symmetric matrices.	08
UNIT-2	**Introduction to Finite Element Method:** Basic Steps in Finite Element Method to solve mechanical engineering (Solid, Fluid and Heat Transfer) Galerkin approach, Displacement Approach: Admissible Functions, Convergence Criteria: Conforming and Non-Conforming elements, C_o C_1 and C_n Continuity Elements. Basic Equations, Element Characteristic Equations, Assembly Procedure, Boundary and Constraint Conditions	08
UNIT-3	**Solid Mechanics: One-Dimensional Finite Element Formulations and Analysis** – Bars-uniform, varying and stepped cross section-Basic (Linear) and Higher Order Elements Formulations for Axial, Torsional and Temperature Loads with problems. Beams- Basic (Linear) Element Formulation-for uniform, varying and stepped cross section- for different loading and boundary conditions with problems.	08
UNIT-4	**FINITE ELEMENT FORMULATIONS FOR STRUCTURAL MECHANICS PROBLEMS:** Basics of plates and shell theories: Classical thin plate Theory, Shear deformation Theory and Thick Plate theory. Finite Element Formulations for triangular and quadrilateral Plate elements. Finite element formulation of flat, curved, cylindrical and conical Shell elements **TWO-DIMENSIONAL FINITE ELEMENT FORMULATIONS FOR SOLID MECHANICS PROBLEMS**: Triangular Membrane (TRIA 3, TRIA 6, TRIA 10) Element, Four-Noded Quadrilateral Membrane (QUAD 4, QUAD 8) Element Formulations for in-plane loading with sample problems. Triangular and Quadrilateral, Axis-symmetric basic and higher order Elements formulation for axis-symmetric loading only with sample	14

	problems.	
UNIT-5	**THREE-DIMENSIONAL FINITE ELEMENT FORMULATIONS FOR SOLID MECHANICS PROBLEMS:** Finite Element Formulation of Tetrahedral Element (TET 4, TET 10), Hexahedral Element (HEXA 8, HEXA 20), for different loading conditions. Serendipity and Lagrange family Elements. **DYNAMIC ANALYSIS:** Finite Element Formulation for point/lumped mass and distributed masses system, Finite Element Formulation of one-dimensional dynamic analysis: bar, truss, frame and beam element. Finite Element Formulation of Two-dimensional dynamic analysis: triangular membrane and axisymmetric element, quadrilateral membrane and axisymmetric element. Evaluation of eigen values and eigen vectors applicable to bars, shaft, beams, plane and space frame.	14

Text Books:

1. **S.S. SASTRY**, Introductory Methods of Numerical Analysis, PHI, 2005.
2. **STEVEN C. CHAPRA, RAYMOND P. CANALE**, Numerical Methods for Engineers, Tata McGraw Hill, 4th Ed, 2002.
3. **M K JAIN, S.R.K IYENGAR, R K. JAIN**, Numerical methods for Scientific and engg computation, New Age International, 2003.
4. **T. R. CHANDRUPATLA AND A. D. BELEGUNDU**, Introduction to Finite Elements in Engineering, Prentice Hall, 3rd Ed, 2002.
5. **LAKSHMINARAYANA H. V.**, Finite Elements Analysis– Procedures in Engineering, Universities Press, 2004.

Reference Books:

1. **RAO S. S.**, Finite Elements Method in Engineering- 4th Edition, Elsevier, 2006
2. **P. SESHU**, Textbook of Finite Element Analysis, PHI, 2004.
3. **BATHE K. J**., Finite Element Procedures, Prentice-Hall, 2006.
4. **COOK R. D.**, Finite Element Modeling for Stress Analysis, Wiley,1995.
5. **DAVID. C. LAY**, Linear Algebra and its applications, 3rd edition, Pearson Education, 2002

SYLLABUS COVERAGE FOR CIE-1, 2, 3

CIE-1: UNIT-1 (100%) + UNIT- 2 (50%)
CIE-2: UNIT-2 (50%) + UNIT -3 (Firs100%)
CIE-3: UNIT- 4 (100%) + UNIT- 5 (100%)

QUESTION PAPER PATTERN (SEE)

Q. No	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Unit	**1**		**2**		**3**		**4**		**5**	

SCHEME OF EXAMINATION (SEE)

1. Ten Full Questions to be set.

2. Five full Questions to be answered.
3. Students shall answer Q1 or Q2 from Unit-1, Q3 or Q4 from Unit-2, Q5 or Q6 from Unit-3, Q7 or Q8 from Unit-4, Q9 or Q10 from Unit-5 with two questions from each Unit.
4. Each question shall contain maximum of 2 subdivisions
5. Each main question carries equal Marks.

COURSE OUTCOMES: Learners will able to

CO1	Model some simple mathematical models of physical Applications. Develop governing equation for a mechanical system and apply principles of variation and integral formulation to formulate finite element equations.
CO2	Formulate and perform one dimensional, two-dimensional structural analysis using bar, beam, triangular and quadrilateral elements.
CO3	Formulate axisymmetric triangular element and analyze problems on solids of revolution.
CO4	Formulate mass matrices and compute eigen values and eigen vectors for a 1- D and 2D analysis of mechanical system.

MAPPING OF COs WITH POs

COs/POs	po1	po2	po3	po4	po5	po6	po7	po8	po9	po10	po11	po12
CO1	3	3	3	2	2	3	3	2	3	3	1	2
CO2	2	3	3	2	2	1	3	2	3	3	3	2
CO3	3	3	3	2	3	2	3	1	3	2	3	2
CO4	3	3	2	2	3	2	3	1	2	2	3	3

ADMISSION YEAR :2018-19 **ACADEMIC YEAR: 2018-19**

EXPERIMENTAL MECHANICS

Course Code	**:**	**18MMD131**		**CIE Marks**	**:**	**50**
Hrs./Week	**:**	**L: T: P: 3:1:0**		**SEE Marks**	**:**	**50**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 hours**

Course Objective:
This course aims at a comprehensive study of mechanics of solids. The objective of this course is to familiarize the student with state-of-the-art experimental techniques namely strain gauges, photo elasticity, moiré interferometry, brittle coating, moiré fringes and holography.

Course Content: Chapters/ Units

1. **Introduction**: Definition of terms, calibration, standards, dimension and units, generalized measurement system, Basic concepts in dynamic measurements, system response, distortion, impedance matching, experiment planning.
   Analysis of Experimental Data: Cause and types of experimental errors, error analysis. Statistical analysis of experimental data- Probability distribution, gaussian, normal distribution. **8 Hours**

2. **Force, Torque and Strain Measurement:** Mass balance measurement, Elastic Element for force measurement, torque measurement. Strain Gages -Strain sensitivity of gage metals, Gage construction, Gage sensitivity and gage factor, Performance characteristics, Environmental effects Strain, gage circuits, Potentiometer, Wheat Stone's bridges, Constant current circuits. Strain Analysis Methods-Two element and three element, rectangular and delta rosettes, Correction for transverse strains effects, stress gage - plane shear gage, Stress intensity factor gage. **8 Hours**

3. **Stress Analysis:** Two-Dimensional Photo elasticity - Nature of light, - wave theory of light, - optical interference - Polariscopes stress optic law - effect of stressed model in plane and circular Polariscopes, Isoclinic, isochromatic fringe order determination. Calibration Photo elastic model materials. Model to prototype scaling**.** . **8 Hours**

4. **Three-Dimensional Photo elasticity:** Stress freezing method, General slice, Effective stresses, Stresses separation, Shear deference method, Oblique incidence method Secondary principal stresses, Scattered light photo elasticity, Principals, Polari scope and stress data analyses**.**
   Holography: Introduction, Equation for plane waves and spherical waves, Intensity, Coherence, Spherical radiator as an object (record process), Hurter, Driffield curves, Reconstruction process, Holographic interferometry, Realtime. and double exposure methods, Displacement measurement, Isopaches **14 Hours**

5. **Coating Methods:** a) Photo elastic Coating Method-Birefringence coating techniques Sensitivity Reinforcing and thickness effects - data reduction - Stress separation techniques Photo elastic strain gauges. b) Brittle Coatings Method: Brittle coating technique Principles data analysis - coating materials, Coating techniques. c) Moire Technique - Geometrical approach, Displacement approach-sensitivity of Moire data reduction, In plane and out plane Moire methods, Moire photography, Moire grid production. **14 Hours**

NOTE: the students are advised to prepare the lab report in the form of assignment to understand the subject and its relevance in the industry

Text Books:

1. **Holman,** "Experimental Methods for Engineers" 7th Edition, Tata McGraw-Hill Companies, Inc, New York, 2007.
2. **R. S. Sirohi, H. C. Radha Krishna,** "Mechanical measurements" New Age International Pvt. Ltd., New Delhi, 2004
3. **Experimental Stress Analysis** - Srinath, Lingaiah, Raghavan, Gargesa, Ramachandra and Pant, Tata McGraw Hill, 1984.
4. **Instrumentation, Measurement and Analysis** -Nakra & Chaudhry, B C Nakra K Chaudhry, Tata McGraw-Hill Companies, Inc, New York, Seventh Edition, 2006.

Reference Books:

1. **Measurement Systems Application and Design** - Doeblin E. A., 4th (S.I.) Edition, McGraw Hill, New York. 1989
2. **Design and Analysis of Experiments -** Montgomery D.C., John Wiley & Sons, 1997.
3. **Experimental Stress Analysis** - Dally and Riley, McGraw Hill, 1991.
4. **Experimental Stress Analysis -** Sadhu Singh, Khanna publisher, 1990.
5. **Photoelasticity Vol I and Vol II -** M.M.Frocht,. John Wiley and sons, 1969.
6. **Strain Gauge Primer -** Perry and Lissner, McGraw Hill, 1962.

Course Outcomes:

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

CO1	Understand functional requirements of a generalized measurement system and identify suitable components for an application.
CO2	Use concepts of Data Acquisition, Processing and apply the same for interpretation and analysis of experimental data.
CO3	Determine stresses and strains in a structure using different methods such as strain gages, photo-elasticity, brittle coating and holography.
CO4	Identify and apply suitable experimental stress analysis to practical problems

SYLLABUS COVERAGE FOR CIE-1, 2, 3

CIE-1: UNIT-1 (100%) + UNIT- 2 (50%)
CIE-2: UNIT-2 (50%) + UNIT -3 (Firs100%)
CIE-3: UNIT- 4 (100%) + UNIT- 5 (100%)

QUESTION PAPER PATTERN (SEE)

Q. No	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Unit	**1**		**2**		**3**		**4**		**5**	

SCHEME OF EXAMINATION (SEE)

1. Ten Full Questions to be set.
2. Five full Questions to be answered.
3. Students shall answer Q1 or Q2 from Unit-1, Q3 or Q4 from Unit-2, Q5 or Q6 from Unit-3, Q7 or Q8 from Unit-4, Q9 or Q10 from Unit-5 with two questions from each Unit.
4. Each question shall contain maximum of 2 subdivisions
5. Each main question carries equal Marks.

MAPPING OF COs WITH POs

COs/POs	po1	po2	po3	po4	po5	po6	po7	po8	po9	po10	po11	po12
CO1	3	3	3	2	2	3	3	2	3	3	1	2
CO2	2	3	3	2	2	1	3	2	3	3	3	2
CO3	3	3	3	2	3	2	3	1	3	2	3	2
CO4	3	3	2	2	3	2	3	1	2	2	3	3

ADMISSION YEAR :2018-19 **ACADEMIC YEAR: 2018-19**

COURSE TITLE:	**DESIGN FOR MANUFACTURE**	
Sub Code: 18MMD142	**No of Credits: L-T-P-SS 4:0:0:0 =4**	**No. of lecture hours/week: 04**
Exam Duration: 3 hours	**CIE Marks: 50**	**Exam Marks: 50**
Pre-requisites	**metrology & Measurements, Design Of Machine Elements.**	

COURSE OBJECTIVES:

To educate students a clear understanding of factors to be considered in designing parts and components with focus on manufacturability**.** To study Effect of material properties on mechanical design. To acquaint with the concepts of Tolerance. To Design the components with casting consideration. Emphasis on various types of limit gauges for both hole and shaft.

#	CONTENTS	Hrs
UNIT-1	**EFFECT OF MATERIALS AND MANUFACTURING PROCESS ON DESIGN:** Major phases of design. Effect of material properties on design, Effect of manufacturing processes on design. Material selection process cost per unit property, Weighted properties and limits on properties methods.	08
UNIT-2	**TRUE POSITIONAL THEORY:** Comparison between co-ordinate and convention method of feature location. Tolerance and true positioning tolerance virtual size concept, Floating and fixed fasteners. Projected tolerance zone. Assembly with gasket, zero position tolerance. Functional gauges, Paper layout gauging.	10
UNIT-3	**SELECTIVE ASSEMBLY:** interchangeable part manufacture and selective assembly, deciding the number of groups -model-1: group tolerance of mating parts equal, model total and group tolerances of shaft equal. control of axial play-introducing secondary machining operations, laminated shims, examples. Datum features: functional datum, datum for manufacturing, changing the datum. examples	10
UNIT-4	**DESIGN CONSIDERATIONS:** Design of components with casting consideration. Pattern, Mould, and Parting line. Cored holes and Machined holes. Identifying the possible and probable parting line. Casting requiring special sand cores. Designing to obviate sand cores. Component Design: Component design with machining considerations link design for turning components-milling, Drilling and other related processes including finish-machining operations.	12
UNIT-5	**Design of Gauges:** Design of gauges for checking components in assemble with emphasis on various types of limit gauges for both hole and shaft. **TOLERANCE ANALYSIS:** Process capability, mean, variance, skewness, kurtosis, Process capability metrics, Cp, Cpk, Cost aspects, Feature tolerances, Geometries tolerances, Geometric tolerances, Surface finish, Review of relationship between attainable tolerance grades and different machining process. Cumulative effect of tolerance- Sure fit law and truncated normal law.	12

Text Books:

1**. HARRY PECK**, "Designing for Manufacturing", Pitman Publications, 1983.

2. **DIETER,** "Machine Design" - McGraw-Hill Higher Education, -2008.

3. **R.K. JAIN**, "Engineering Metrology", Khanna Publishers, 1986.

4. **GEOFFREY BOOTHROYD, PETER DEWHURST, WINSTON KNIGHT**, "Product design for manufacture and assembly", Merce Dekker. Inc. CRC Press, Third Edition

5. **MATERIAL SELECTION AND DESIGN**, Vol. 20 - ASM Hand book.

SYLLABUS COVERAGE FOR CIE-1, 2, 3

CIE-1: UNIT-1 (100%) + UNIT- 2 (50%)
CIE-2: UNIT-2 (50%) + UNIT -3 (First100%)
CIE-3: UNIT- 4 (100%) + UNIT- 5 (100%)

QUESTION PAPER PATTERN (SEE)

Q. No	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Unit	**1**		**2**		**3**		**4**		**5**	

SCHEME OF EXAMINATION (SEE)

1. Ten Full Questions to be set.
2. Five full Questions to be answered.
3. Students shall answer Q1 or Q2 from Unit-1, Q3 or Q4 from Unit-2, Q5 or Q6 from Unit-3, Q7 or Q8 from Unit-4, Q9 or Q10 from Unit-5 with two questions from each Unit.
4. Each question shall contain maximum of 2 subdivisions
5. Each main question carries equal Marks.

COURSE OUTCOMES:

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

CO1	Understand the role of manufacture and assembly in development of mechanical parts and their assemblies.
CO2	Apply manufacturing considerations in the design and development of components made of casting and machining.
CO3	Apply geometrical dimensioning and tolerances issues in mechanical design.

MAPPING OF COs WITH POs

COs/POs	**po1**	**po2**	**po3**	**po4**	**po5**	**po6**	**po7**	**po8**	**po9**	**po10**	**po11**	**po12**
CO1	3	3	3	3	2	2	3	2	3	1	3	3
CO2	2	3	3	2	3	3	3	1	2	3	3	2
CO3	3	3	2	3	3	3	1	3	3	2	3	2
CO4	3	3	2	3	3	2	3	2	1	2	3	3

AUTOMOBILE SYSTEM DESIGN

Course Code	**:**	**18MMD152**		**CIE Marks**	**:**	**50**
Hrs./Week	**:**	**L: T: P: 4:0:0**		**SEE Marks**	**:**	**50**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 hours**

Course Objective:
This course would facilitate understanding of the stages involved in automobile system design. The student will be exposed to industrial practices in design of various systems of an automobile.

Course Content: Chapters/ Units

1. **Body Shapes**: Aerodynamic Shapes, drag forces for small family cars.
   Fuel Injection: Spray formation, direct injection for single cylinder engines (both SI & CI), energy audit. **08 Hours**

2. **Design of I.C. Engine** I: Combustion fundamentals, combustion chamber design, cylinder head design for both SI & C. I. Engines. 0**8 Hours**

3. **Design of I.C. Engine II**: Design of crankshaft, camshaft, connecting rod, piston & piston rings for small family cars (max up to 3cylinders). 08 **Hours**

4. **Transmission System**: Design of transmission systems – gearbox (max of 4-speeds), differential.
   Suspension System: Vibration fundamentals, vibration analysis (single & two degree of freedom, vibration due to engine unbalance, application to vehicle suspension. **14 Hours**

5. **Cooling System**: Heat exchangers, application to design of cooling system (water cooled).
Emission Control: Common emission control systems, measurement of missions, exhaust gas emission testing. **14 Hours**

NOTE: the students are advised to prepare the report in the form of assignment to understand the subject and its relevance in the industry

Text Books:

1. **Design of Automotive Engines**, - A. Kolchin& V. Demidov, MIR Publishers, Moscow
2. **The motor vehicle, Newton steeds &Garratte** - Iliffee& sons Ltd., London
3. **I.C. Engines** - Edward F Obert, International text book company.

Reference Books:

1. **Introduction to combustion** - Turns
2. **Automobile Mechanic** -, N.K. Giri, Khanna Publications, 1994
3. **I.C. Engines** - Maleev, McGraw Hill book company, 1976
4. **Diesel engine design** – Heldt P.M., Chilton company New York.
5. **Problems on design of machine elements** - V.M. Faires & Wingreen, McMillan Company., 1965
6. **Design of I.C. Engines** - John Heywood, TMH

Course Outcome:

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

CO1	The student will be able to apply the knowledge in creating a preliminary design of automobile sub systems.
CO2	Students are exposed to aerodynamic analysis of the auto mobiles.
CO3	Students are exposed to engine performances, combustion analysis and exhaust gas analysis to meet the BIS standards (10000 series).

SYLLABUS COVERAGE FOR CIE-1, 2, 3

CIE-1: UNIT-1 (100%) + UNIT- 2 (50%)
CIE-2: UNIT-2 (50%) + UNIT -3 (First100%)
CIE-3: UNIT- 4 (100%) + UNIT- 5 (100%)

QUESTION PAPER PATTERN (SEE)

Q. No	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Unit	**1**		**2**		**3**		**4**		**5**	

SCHEME OF EXAMINATION (SEE)

1. Ten Full Questions to be set.
2. Five full Questions to be answered.
3. Students shall answer Q1 or Q2 from Unit-1, Q3 or Q4 from Unit-2, Q5 or Q6 from Unit-3, Q7 or Q8 from Unit-4, Q9 or Q10 from Unit-5 with two questions from each Unit.
4. Each question shall contain maximum of 2 subdivisions
5. Each main question carries equal Marks.

II Semester

ADMISSION YEAR :2018-19 **ACADEMIC YEAR: 2018-19**

COURSE TITLE:	**ADVANCED MACHINE DESIGN**	
Sub Code: 18MMD21	**No of Credits: L-T-P-SS 4:0:0:0 =4**	**No. of lecture hours/week: 04**
Exam Duration: 3 hours	**CIE Marks: 50**	**Exam Marks: 50**
Pre-requisites	**Engineering Mechanics, MoM, Design of Machine Elements**	

COURSE OBJECTIVES:

To study Role of failure prevention analysis in mechanical design. To acquaint with the concepts of damage fraction and accumulation in various damage theories. To study Role of surface failure in mechanical design. Enable the students to have high ethical standards in terms of team work to be a good design engineer.

#	CONTENTS	Hrs
UNIT-1	**INTRODUCTION:** Role of failure prevention analysis in mechanical design, Modes of mechanical failure, Review of failure theories for ductile and brittle materials including Mohr's theory and modified Mohr's theory, Numerical examples. **FATIGUE OF MATERIALS:** Introductory concepts, High cycle and low cycle fatigue, Fatigue design models, Fatigue design methods, Fatigue design criteria, Fatigue testing, Test methods and standard test specimens.	08
UNIT-2	**FATIGUE FROM VARIABLE AMPLITUDE LOADING:** Spectrum loads and cumulative damage, Damage quantification and the concepts of damage fraction and accumulation, Cumulative damage theories, Load interaction and sequence effects, Cycle counting methods, Life estimation using stress life approach.	08
UNIT-3	**SURFACE FAILURE:** Introduction, Surface geometry, Mating surface, Friction, Adhesive wear, Abrasive wear, Corrosion wear, Surface fatigue spherical contact, cylindrical contact, General contact, Dynamic contact stresses, Surface fatigue strength	08
UNIT-4	**STESS-LIFE (S-N) APPROACH:** S-N curves, Statistical nature of fatigue test data, General S-N behavior, Mean stress effects, Different factors influencing S-N behavior, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using S-N approach. **STRAIN-LIFE(E-N) APPROACH:** Monotonic stress-strain behavior, Strain controlled test methods, Cyclic stress-strain behavior, Strain based approach to life estimation, Determination of strain life fatigue properties, Mean stress effects, Effect of surface finish, Life estimation by ε-N approach.	14

UNIT-5	**LEFM APPROACH:** LEFM concepts, Crack tip plastic zone, Fracture toughness, Fatigue crack growth, Mean stress effects, Crack growth life estimation. Notches and their effects: Concentrations and gradients in stress and strain, S-N approach for notched membranes, mean stress effects and Haigh diagrams, Notch strain analysis and the strain – life approach, Neuber's rule, Glinka's rule, applications of fracture mechanics to crack growth at notches.	14

Text Books:

1. **Ralph I. Stephens, Ali Fatemi, Robert, Henry o. Fuchs,** "Metal Fatigue in engineering", John Wiley New York, Second edition. 2001.
2. **Failure of Materials in Mechanical Design**, Jack. A. Collins, John Wiley, New York 1992.
3. **Robert L. Norton, "Machine Design",** Pearson Education India, 2000

Reference Books:

1. **S. Suresh, "Fatigue of Materials"**, Cambridge University Press, -1998
2. **Julie. A. Benantine,** "Fundamentals of Metal Fatigue Analysis", Prentice Hall,1990
3. **Fatigue and Fracture**, ASM Hand Book, Vol 19,2002.

SYLLABUS COVERAGE FOR CIE-1, 2, 3

CIE-1: UNIT-1 (100%) + UNIT- 2 (50%)
CIE-2: UNIT-2 (50%) + UNIT -3 (First100%)
CIE-3: UNIT- 4 (100%) + UNIT- 5 (100%)

QUESTION PAPER PATTERN (SEE)

Q. No	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Unit	**1**		**2**		**3**		**4**		**5**	

SCHEME OF EXAMINATION (SEE)

1. Ten Full Questions to be set.
2. Five full Questions to be answered.
3. Students shall answer Q1 or Q2 from Unit-1, Q3 or Q4 from Unit-2, Q5 or Q6 from Unit-3, Q7 or Q8 from Unit-4, Q9 or Q10 from Unit-5 with two questions from each Unit.
4. Each question shall contain maximum of 2 subdivisions
5. Each main question carries equal Marks.

COURSE OUTCOMES:

Learners will able to

CO1	Predict failure of engineering components using appropriate failure theories.

CO2	Identify and explain the types of fractures of engineered materials and their characteristic features;
CO3	Estimate life of components using stress life, strain life and LEFM approach.
CO4	Categorize different types of surface failures.

MAPPING OF COs WITH POs

COs/POs	po1	po2	po3	po4	po5	po6	po7	po8	po9	po10	po11	po12
CO1	3	3	3	3	2	2	3	2	3	1	3	3
CO2	2	3	3	2	3	3	3	1	2	3	3	2
CO3	3	3	2	3	3	3	1	3	3	2	3	2
CO4	3	3	2	3	3	2	3	2	1	2	3	3

ADVANCED THEORY OF VIBRATIONS

Course Code	**:**	**18MMD22**		**CIE Marks**	**:**	**50**
Hrs./Week	**:**	**L: T: P: 4:0:0**		**SEE Marks**	**:**	**50**
Credits	**:**	**04**		**SEE Duration**	**:**	**3 hours**

Course Objective:

To teach students how to use the theoretical principles of vibration, and vibration analysis techniques, for the practical solution of vibration problems. The course thus builds on student's prior knowledge of vibration theory, and concentrates on the applications. Thus, the student will fully understand the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions.

Course Content: Chapters/ Units

1. **Review of Mechanical Vibrations:** Basic concepts; free vibration of single degree of freedom systems with and without damping, forced vibration of single DOF-systems, Natural frequency.
   Transient Vibration of single Degree-of freedom systems: Impulse excitation, Arbitrary excitation, Laplace transform formulation, pulse excitation and rise time, Shock response spectrum, Shock isolation. **08 Hours**

2. **Vibration Control:** Introduction, Vibration isolation theory, Vibration isolation and motion isolation for harmonic excitation, practical aspects of vibration analysis, shock isolation, Dynamic vibration absorbers, Vibration dampers.
   Vibration Measurement and applications: Introduction, Transducers, Vibration pickups, Frequency measuring instruments, Vibration exciters, Signal analysis. **08 Hours**

3. **Random Vibrations:** Random phenomena, Time averaging and expected value, Frequency response function, Probability distribution, Correlation, Power spectrum and power spectral density, Fourier transforms, FTs and response. **08 Hours**

4. **Modal analysis & Condition Monitoring:** Dynamic Testing of machines and Structures, Experimental Modal analysis, Machine Condition monitoring and diagnosis. Non-Linear Vibrations: Introduction, Sources of nonlinearity, Qualitative analysis of nonlinear systems. Phase plane, Conservative systems, Stability of equilibrium, Method of isoclines, Perturbation method, Method of iteration, Self-excited oscillations. **14 Hours**

5. **Continuous Systems:** Vibrating string, longitudinal vibration of rods, Torsional vibration of rods, Euler equation for beams.
   Different methods of vibration dissipation in structural components for general and rotating machinery. **14 Hours**

NOTE: the students are advised to prepare the report in the form of assignment to understand the subject and its relevance in the industry

Text Books:

1. Theory of Vibration with Application, - William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, 5th edition Pearson Education
2. S. Graham Kelly, "Fundamentals of Mechanical Vibration" - McGraw-Hill, 2000
3. S. S. Rao, "Mechanical Vibrations", Pearson Education, 4th edition.

Reference Books:

1. S. Graham Kelly, "Mechanical Vibrations", Schaum's Outlines, Tata McGraw Hill, 2007.
2. C Sujatha, "Vibrations and Acoustics – Measurement s and signal analysis Tata McGraw Hill, 2010

Course Outcome:

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

CO1	Model and analyze a free damped, undamped and forced response of a mechanical system.
CO2	Develop equation and analyze the transient response of a single degree freedom system.
CO3	Assess the response characteristics of a continuous mechanical system.
CO4	Analyze and discuss the behavior of single degree freedom system for linear and non-linear behavior.

SYLLABUS COVERAGE FOR CIE-1, 2, 3

CIE-1: UNIT-1 (100%) + UNIT- 2 (50%)
CIE-2: UNIT-2 (50%) + UNIT -3 (First100%)
CIE-3: UNIT- 4 (100%) + UNIT- 5 (100%)

QUESTION PAPER PATTERN (SEE)

Q. No	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Unit	**1**		**2**		**3**		**4**		**5**	

SCHEME OF EXAMINATION (SEE)

1. Ten Full Questions to be set.
2. Five full Questions to be answered.
3. Students shall answer Q1 or Q2 from Unit-1, Q3 or Q4 from Unit-2, Q5 or Q6 from Unit-3, Q7 or Q8 from Unit-4, Q9 or Q10 from Unit-5 with two questions from each Unit.
4. Each question shall contain maximum of 2 subdivisions
5. Each main question carries equal Marks.

MAPPING OF COs WITH POs

COs/POs	po1	po2	po3	po4	po5	po6	po7	po8	po9	po10	po11	po12
CO1	3	3	3	3	2	2	3	2	3	1	3	3
CO2	2	3	3	2	3	3	3	1	2	3	3	2
CO3	3	3	2	3	3	3	1	3	3	2	3	2
CO4	3	3	2	3	3	2	3	2	1	2	3	3

ADMISSION YEAR:2018-19 **ACADEMIC YEAR: 2018-19**

COURSE TITLE: DESIGN OPTIMIZATION		
Sub Code:18MMD232	**No of Credits: L-T-P-SS 4:0:0:0 =4**	**No. of lecture hours/week: 04**
Exam Duration: 3 hours	**CIE Marks: 50**	**Exam Marks: 50**
Pre-requisites	**Research methodology, Composite material, Basic mathematics**	

COURSE OBJECTIVES:

It aids the students to acquire the basics of optimum design, Classical Optimization Techniques, Non - linear Programming, Unconstrained Optimization Techniques, Integer Programming and Dynamic Programming.To study the basics of Design optimization. To acquaint Optimum Design Problem Formulation. To study the Sensitivity Analysis, Linear and Non-Linear Approximations and Optimization Disciplines.To gain knowledge of different Manufacturability in Optimization Problems and Design Interpretation.

#	CONTENTS	Hrs
UNIT-1	**Engineering Design Practice:** Evolution of Design Technology, Introduction to Design and the Design Process, Design versus Analysis, Role of Computers in Design Cycle, Impact of CAE on Design, Numerical Modeling with FEA and Correlation with Physical Tests.	08
UNIT-2	**Optimum Design Problem Formulation**: Types of Optimization Problems, The Mathematics of Optimization, Design Variables and Design Constraints, Feasible and Infeasible Designs, Equality and Inequality Constraints, Discrete and Continuous Optimization, Linear and Non-Linear Optimization. **Optimization Theory** – Fundamental Concepts, Global and Local Minimum, Gradient Vector and Hessian Matrix, Concept of Necessary and Sufficient Conditions, Constrained and Unconstrained Problems, Lagrange Multipliers and Kuhn Tucker Conditions	08
UNIT-3	**Sensitivity Analysis, Linear and Non-Linear Approximations**. Gradient Based Optimization Methods – Dual and Direct. **Optimization Disciplines:** Conceptual Design Optimization and Design Fine Tuning, Combined Optimization, Optimization of Multiple Static and Dynamic Loads, Transient Simulations, Equivalent Static Load Methods	08
UNIT-4	**Manufacturability in Optimization Problems:** Design For Manufacturing, Manufacturing Methods and Rules, Applying Manufacturing Constraints to Optimization Problems. **Design Interpretation:** Unbound Problems, Over Constrained Problems, Problems with No of Multiple Solutions, Active and Inactive Constraints, Constraint Violations and Constraint Screening, Design Move Limits, Local and Global Optimum	14

UNIT-5	**Dynamic Programming:** Introduction, Multistage decision processes, Principle of optimality, Computational Procedure in dynamic programming, Initial value problem, Examples. **Applications of Optimization in Engineering Design:** Automotive, Aerospace and General Industry Applications, Optimization of Metallic and Composite Structures, Minimization and Maximization Problems, MDO and MOO	14

NOTE: the students are advised to prepare the report in the form of assignment to understand the subject and its relevance in the industry

Text Books:

1. S.S. Rao, Engineering Optimization: Theory and Practice, John Wiley, 2009
2. JasbirArora, Introduction to Optimum Design, McGraw Hill, 2011.

Reference Books:

1. Optimization and Probability in System Engg - Ram, Van Nostrand.
2. Optimization methods - K. V. Mital and C. Mohan, New age International Publishers, 1999.
3. Optimization methods for Engg. Design - R.L Fox, Addison – Wesley, 1971.

SYLLABUS COVERAGE FOR CIE-1, 2, 3

CIE-1: UNIT-1 (100%) + UNIT- 2 (50%)
CIE-2: UNIT-2 (50%) + UNIT -3 (First100%)
CIE-3: UNIT- 4 (100%) + UNIT- 5 (100%)

QUESTION PAPER PATTERN (SEE)

Q. No	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Unit	**1**		**2**		**3**		**4**		**5**	

SCHEME OF EXAMINATION (SEE)

1. Ten Full Questions to be set.
2. Five full Questions to be answered.
3. Students shall answer Q1 or Q2 from Unit-1, Q3 or Q4 from Unit-2, Q5 or Q6 from Unit-3, Q7 or Q8 from Unit-4, Q9 or Q10 from Unit-5 with two questions from each Unit.
4. Each question shall contain maximum of 2 subdivisions
5. Each main question carries equal Marks.

Course Outcome:

At the completion of this course, students will be able to:

CO1	It provides the student with knowledge required to optimize an existing design with single or multiple objective functions.
CO2	Skills acquired through commercial optimization programs
CO3	Acquire the knowledge of engineering system design

ADMISSION YEAR:2018-19 **ACADEMIC YEAR: 2018-19**

COURSE TITLE: THEORY OF PLASTICITY		
Sub Code: MMD251	**No of Credits: L-T-P-SS 4:0:0:0 =4**	**No. of lecture hours/week: 04**
Exam Duration: 3 hours	**CIE Marks: 50**	**Exam Marks: 50**
Pre-requisites	**DESIGN OF MACHINE ELEMENTS, ADVANCED MECHANICS OF SOLIDS.**	

COURSE OBJECTIVES:

To study the basic concept of stresses, stress distribution, elastic constants when the material is subjected to loading within the elastic limits. Study the stress distribution in plane, polar and cylindrical coordinate systems. Analyze the material or component subjected to torsion of circular and non-circular shafts (elliptical, triangular bars) Study the thermo-elastic properties of the material at elevated temperatures.

#	CONTENTS	Hrs
UNIT-1	**DEFINITION AND SCOPE OF THE SUBJECT:** Brief review of elasticity, Octahedral normal and shear stresses, Spherical and deviatoric stress, Invariance in terms of the deviatoric stresses, Engineering and natural strains, Mathematical relationships between true stress and true strains, Cubical dilation, finite strains co- efficient Octahedral strain, Strain rate and the strain rate tensor.	08
UNIT-2	**BENDING OF BEAMS:** Torsion of rods and tubes, Nonlinear bending and torsion equations, Simple forms of indentation problems using upper bounds, Application of Metal forming: Extrusion, Drawing, Rolling and Forging.	08
UNIT-3	**SLIP LINE THEORY**: Introduction, Basic equations for incompressible two-dimensional flow, continuity equations, Stresses in conditions of plain strain convention for slip-lines, Geometry of slip lines, Properties of slip lines.	08
UNIT-4	**MATERIAL MODELS:** Stress-strain relations, Yield criteria for ductile metal, Von Mises, Tresca, Yield surface for an Isotropic Plastic material, Stress space, Experimental verification of Yield criteria, Yield criteria for an anisotropic material, flow rule normality of Yield locus, Symmetry and convexity, Deformation of isotropic and kinematic hardening, bilinear stress-strain relationship.	14
UNIT-5	**PLASTIC STRESS-STRAIN RELATIONS:** Prandtl-Reuss Saint Venant, Levy-Mises, Experimental verification of the Prandtl-Reuss equation, Upper and lower bound theorems. Application to problems: Uniaxial tension and compression.	**1**4

TEXT BOOKS

1. **R. A. C. Slater**, "Engineering Plasticity - Theory and Application to Metal Forming Process", McMillan Press Ltd., 1977.

2. **SADHU SINGH, "Theory of Plasticity and Metal forming Process", Khanna Publishers, Delhi, 1999.**

REFERENCE BOOKS

1. HOFFMAN AND SACHS, "Introduction to the Theory of Plasticity for Engineers", LLC, 2012.
2. **J CHAKRABARTY**, "Theory of plasticity", Butterworth, 2006. 3. Johnson and Mellor, "Plasticity for Mechanical Engineers", Van Nostrand, 1966.
3. **PLASTICITY FOR MECHANICAL ENGINEERS** - Johnson and Mellor, Van Nostrand, 1966.

SYLLABUS COVERAGE FOR CIE-1, 2, 3

CIE-1: UNIT-1 (100%) + UNIT- 2 (50%)
CIE-2: UNIT-2 (50%) + UNIT -3 (First100%)
CIE-3: UNIT- 4 (100%) + UNIT- 5 (100%)

QUESTION PAPER PATTERN (SEE)

Q. No	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
Unit	**1**		**2**		**3**		**4**		**5**	

SCHEME OF EXAMINATION (SEE)

1. Ten Full Questions to be set.
2. Five full Questions to be answered.
3. Students shall answer Q1 or Q2 from Unit-1, Q3 or Q4 from Unit-2, Q5 or Q6 from Unit-3, Q7 or Q8 from Unit-4, Q9 or Q10 from Unit-5 with two questions from each Unit.
4. Each question shall contain maximum of 2 subdivisions
5. Each main question carries equal Marks.

COURSE OUTCOMES:

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

CO1	Apply basic concepts in continuum mechanics of solids viz. Stress and strain tensors, equilibrium, compatibility and constitutive equations and methods of solution to elasticity problems
CO 2	Evaluate stresses and displacements in simple solids such as pressurized cylinders, shrink fitted cylinders, rotating disc and shaft, plate with hole and non-circular shafts and thin tubes under torsion.
CO 3	Use MATLAB or equivalent software to evaluate and plot particular solutions.
CO 4	Apply the principles of plastic deformation to estimate yielding in simple engineering structures.
CO 5	Apply principles of continuum mechanics to design a structure or component to achieve desired performance under realistic constraints.

MAPPING OF COs WITH POs

COs/POs	po1	po2	po3	po4	po5	po6	po7	po8	po9	po10	po11	po12
CO1	3	3	3	2	2	3	3	2	3	3	1	2
CO2	2	3	3	2	2	1	3	2	3	3	3	2
CO3	3	3	3	2	3	2	3	1	3	2	3	2
CO4	3	3	2	2	3	2	3	1	2	2	3	3

SEMESETER III

ADMISSION YEAR:2019-20 **ACADEMIC YEAR: 2019-20**

COURSE TITLE: FRACTURE MECHANICS		
Sub Code: 18MMD31	**No of Credits: L-T-P-SS** **4:0:0:0=4**	**No. of lecture hours/week :04**
Exam Duration :3 hours	**CIE Marks:50**	**Exam Marks :50**
Pre-requisites	**Metrology & Measurements, Design of Machine Elements'**	

COURSE OBJECTIVES:

Fracture mechanics provides a methodology for prediction, prevention and control of fracture in materials, components and structures. It provides a background for damage tolerant design. It quantifies toughness as materials resistance to crack propagation.

#	CONTENTS	Hrss
UNIT-1	**FRACTURE MECHANICS PRINCIPLES:** Introduction and historical review, Sources of micro and macro cracks. Stress concentration due to elliptical hole, Strength ideal materials, Griffith's energy balance approach. Fracture mechanics approach to design. NDT and Various NDT methods used in fracture mechanics. The Airy stress functions. Complex stress function. Effect of finite size. Special cases, Elliptical cracks.	10
UNIT-2	**PLASTICITY EFFECTS:** Irwin plastic zone correction. Dugdale approach. The shape of the plastic zone for plane stress and plane strain cases, Plastic constraint factor. The Thickness effect, numerical problems. **Determination of Stress intensity factors and plane strain fracture toughness**: Introduction, analysis and numerical methods, experimental methods, estimation of stress intensity factors. Plane strain fracture toughness test, The Standard test.	10
UNIT-3	**THE ENERGY RELEASE RATE:** Criteria for crack growth. The crack resistance (R curve). Compliance, J integral. Tearing modulus. Stability.	10

UNIT-4	**ELASTIC PLASTIC FRACTURE MECHANICS:** Fracture beyond general yield. The Crack-tip opening displacement. The Use of CTOD criteria. Experimental determination of CTOD. Parameters affecting the critical CTOD. Use of J integral. Limitation of J integral. **DYNAMICS AND CRACK ARREST:** Crack speed and kinetic energy. Dynamic stress intensity and elastic energy release rate. Crack branching. Principles of crack arrest. Crack arrest in practice. Dynamic fracture toughness**.**	12
UNIT-5	**FATIGUE CRACK PROPAGATION AND APPLICATIONS OF FRACTURE MECHANICS:** Crack growth and the stress intensity factor. Factors affecting crack propagation. variable amplitude service loading, means to provide fail-safety, required information for fracture mechanics approach, Mixed mode (combined) loading and design criteria.	10

Text Books:

1. **David Broek,** "Elementary Engineering Fracture Mechanics", Springer Netherlands,2011
2. **Anderson**, "Fracture Mechanics-Fundamental and Application", T.L CRC press1998.

Reference Books:

1. **Karen Hellan**, "Introduction to fracture mechanics", McGraw Hill, 2nd Edition
2. **S.A. Meguid**, "Engineering fracture mechanics" Elsevier Applied Science, 1989
3. **Jayatilaka,** "Fracture of Engineering Brittle Materials", Applied Science Publishers, 1979
4. **Rolfe and Barsom**, "Fracture and Fatigue Control in Structures", Prentice Hall, 1977
5. **Knott**, "Fundamentals of fracture mechanisms", Butterworths, 1973

SYLLABUS COVERAGE FOR CIE-1, 2, 3

CIE-1: UNIT-1 (100%) + UNIT- 2 (50%)

CIE-2: UNIT-2 (50%) + UNIT -3 (Firs100%)

CIE-3: UNIT- 4 (100%) + UNIT- 5 (100%)

QUESTION PAPER PATTERN (SEE)

Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	

(Irrespective of portions covered due to whatever might be the reason)

SCHEME OF EXAMINATION (SEE)

1. Ten Full Questions to be set.
2. Five full Questions to be answered.
3. Students shall answer Q1 or Q2 from Unit-1, Q3 or Q4 from Unit-2, Q5 or Q6 from Unit-3, Q7 or Q8 from Unit-4, Q9 or Q10 from Unit-5 with two questions from each Unit.
4. Each question shall contain maximum of 2 subdivisions
5. Each main question carries equal Marks.

COURSE OUTCOMES:

Learners will able to

CO1	Develop fundamental understanding of the effects of crack like defects on the performance of aerospace, civil, and mechanical engineering structures.
CO2	Select appropriate materials for engineering structures to ensure damage tolerance.
CO3	Employ modern numerical methods to determine critical crack sizes and fatigue crack propagation rates in engineering structures.
CO4	Gain appreciation of the status of academic research in field of fracture mechanics.

MAPPING OF COs WITH Pos

COs/POs	**po1**	**po2**	**po3**	**po4**	**po5**	**po6**	**po7**	**po8**	**po9**	**po10**	**po11**	**po12**
CO1	3	3	-	-	-	-	3	2	-	1	-	-
CO2	2	3	-	2	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	3	-	-	-	-	--	-
CO4	3	3	2	-	-	1	-	-	-	-	-	-

ADMISSION YEAR:2019-20 **ACADEMIC YEAR: 2019-2020**

COURSE TITLE: SMART MATERIALS AND STRUCTURES		
Sub Code: 18MMD321	**No of Credits: L-T-P-S** **4:0:0:0 =4**	**No. of lecture hours/week :04**
Exam Duration: 3 hours	**CIE Marks: 50**	**Exam Marks:50**
Pre-requisites	Mechatronics, Composite materials technology**.**	

COURSE OBJECTIVES:

To study the basic sources of smart materials and structures. To acquaint with the effects of Shape memory Alloy, ER and MR fluids. To study the usefulness of vibration absorbers and control of structures. To gain knowledge of MEMS and devices.

#	CONTENTS	Hrss
UNIT-1	**Smart Structures**: Types of Smart Structures, Potential Feasibility of Smart Structures, Key Elements of Smart Structures, Applications of Smart Structures. Piezoelectric materials, Properties, piezoelectric Constitutive Relations, Depoling and Coersive Field, field strain relation. Hysteresis, Creep and Strain Rate effects, Inchworm Linear Motor.	10
UNIT-2	**Beam Modeling:** Beam Modeling with induced strain Rate effects, Inchworm Linear Motor Beam Modeling with induced strain Actuation-single Actuators, dual Actuators, Pure Extension, Pure Bending harmonic excitation, Bernoulli-Euler beam Model, problems, Piezoelectric Applications.	10
UNIT-3	**Shape memory Alloy:** Experimental Phenomenology, Shape Memory Effect, Phase Transformation, Tanaka's Constitutive Model, testing of SMA Wires, Vibration Control through SMA, Multiplexing. Applications Of SMA and Problems. **ER and MR Fluids:** Mechanisms and properties, Fluid Composition and behavior, The Bingham Plastic and Related Models, Pre-Yield Response. Post-Yield flow applications in Clutches, Dampers and Others	12
UNIT-4	**Vibration Absorbers:** series and Parallel Damped Vibrations (Overview), Active Vibration Absorbers, Fiber Optics, Physical Phenomena, Characteristics, Sensors, Fiber Optics in Crack Detection, applications. **Control of Structures:** Modeling, Control Strategies and Limitations, Active Structures in Practice.	10
UNIT-5	**MEMS** – Mechanical Properties of MEMS Materials, Scaling of Mechanical Systems, Fundamentals of Theory, The Intrinsic Characteristics of MEMS, Miniaturization, Microelectronics Integration.	10

	Devices: Sensors and Actuators, Conductivity of Semiconductors, Crystal Planes and Orientation, (Stress and Strain Relations, Flexural Beam Bending Analysis Under Simple Loading Conditions), Polymers in MEMS, Optical MEMS Applications.	

Text Books:

1. Smart Materials and Structures -**M. V. Gandhi and B.S Thompson**, Chapman and Hall, London; New York, 1992 (ISBN: 0412370107).
2. Smart Structures and Materials **- Culshaw, Artech House, Boston**, 1996 (ISBN :0890066817).
3. Smart Structures: Analysis & Design **- A. Srinivasan**, Cambridge University Press, Cambridge; New York, 2001 (ISBN: 0521650267).

Reference Books:

1. Electro ceramics: Materials, Properties and Applications - **A. J. Moulson and J. M. Herbert**. John Wiley & Sons, ISBN: 0471497429
2. **Piezoelectric Sensories**: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors. Materials and Amplifiers, Springer, Berlin; New York, 2002 (ISBN: 3540422595).
3. Piezoelectric Actuators and Wtrasonic Motors -**K. Uchino, Kluwer** Academic Publishers, Boston, 1997 (ISBN: 0792398114).
4. Handbook of Giant Magneto strictive Materials - **G. Engdahl**, Academic Press, San Diego, Calif.; London, 2000 (ISBN: 012238640X).
5. Shape Memory Materials **- K. Otsuka and C.M. Wayman**, Cambridge University Press, Cambridge; New York, 199~ (ISBN: 052144487X).

SYLLABUS COVERAGE FOR CIE-1, 2, 3

CIE-1: UNIT-1 (100%) + UNIT- 2 (100%)

CIE-2: UNIT-3 (100%) + UNIT -4 (50%)

CIE-3: UNIT- 4 (50%) + UNIT- 5 (100%)

QUESTION PAPER PATTERN (SEE)

Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	

(Irrespective of portions covered due to whatever might be the reason)

SCHEME OF EXAMINATION (SEE)

1. Ten Full Questions to be set.
2. Five full Questions to be answered.
3. Students shall answer Q1 or Q2 from Unit-1, Q3 or Q4 from Unit-2, Q5 or Q6 from Unit-3, Q7 or Q8 from Unit-4, Q9 or Q10 from Unit-5 with two questions from each Unit.
4. Each question shall contain maximum of 2 subdivisions
5. Each main question carries equal Marks.

Course Outcome:

At the completion of this course, students will be able to:

CO1	Understand the behavior and applicability of various smart materials.
CO2	Design Simple models for smart structures and materials
CO3	Perform simulation of smart structures and material application.
CO4	Conduct experiments to verify the predictions.

MAPPING OF COs WITH POs

COs/POs	po1	po2	po3	po4	po5	po6	po7	po8	po9	po10	po11	po12
CO1	3	3	--	-	2	-	-	-	-	-	-	-
CO2	2	3	-	2	-	-	-	1	-	-	3	-
CO3	3	-	2	-	3	-	1	-	-	2	-	2
CO4	3	-	2	-	-	-	-	-	-	-	-	-

INTERNSHIP-18MMDI34

Internship: The student shall undergo internship for 16 weeks.

Preliminary Report submission and Evaluation after 8th week of Internship to be carried out by the Internal Guide of the college and a senior faculty for 100 marks

Final Report submission and Evaluation after 16th week of Internship to be carried out by the Internal Guide of the college and a senior faculty of Dept. Report Evaluation to be completed within two weeks of submission for 100 marks.

Viva-Voce on Internship - To be conducted by the Internship Guide (from the college) and the External Guide / Examiner within 2 weeks of Submission with a senior faculty / HoD as chairman for 100 marks

COURSE TITLE: Modelling & Analysis Lab		
Sub Code: 18MMDL35	**No of Credits: L-T-P-SS** **1:0:3:0=4**	**No. of Lecture hours/week :03**
Exam Duration:3 hours	**CIE Marks: 50**	**Exam Marks :50**
Pre-requisites	Design and vibration knowledge.	

Note:

1) These are independent laboratory exercises
2) A student may be given one or two problems stated herein
3) Student must submit a comprehensive report on the problem solved and give a Presentation on the same for Internal Evaluation
4) Any one of the exercises done from the following list has to be asked in the Examination for evaluation.

Course Content:

Experiment #1 Structural Analysis

Part A: FE Modeling of a stiffened Panel using a commercial preprocessor.

Part B: Buckling, Bending and Modal analysis of stiffened Panels.

Part C: Parametric Studies.

Experiment #2 Design Optimization

Part A: Shape Optimization of a rotating annular disk.

Part B: Weight Minimization of a Rail Car Suspension Spring.

Part C: Topology Optimization of a Bracket.

Experiment #3 Thermal analysis

Part A: Square Plate with Temperature Prescribed on one edge and Opposite edge insulated.

Part B: A Thick Square Plate with the Top Surface exposed to a Fluid at high temperature, Bottom Surface at room temperature, Lateral Surfaces Insulated.

Experiment #4 Thermal Stress Analysis

Part A: A Thick-Walled Cylinder with specified Temperature at inner and outer Surfaces.

Part B: A Thick-Walled Cylinder filled with a Fluid at high temperature and Outer Surface exposed to atmosphere.

Experiment#5 CFD Analysis

Part A: CFD Analysis of a Hydro Dynamic Bearing using commercial code.

Part B: Comparison of predicted Pressure and Velocity distributions with Target solutions.

Part C: Experimental Investigations using a Journal Bearing Test Rig.

Part D: Correlation Studies.

Experiment #6 Welded Joints.

Part A: Fabrication and Testing.

Part B: FE Modeling and Failure Analysis.

Experiment #7 Bolted Joints.

Part A: Fabrication and Testing.

Part B: FE Modeling and Failure Analysis.

Part C: Correlation Studies.

Experiment #8 Adhesive Bonded Joints.

Part A: Fabrication and Testing.

Part B: FE Modeling and Failure Analysis.

Part C: Correlation Studies.

Course Outcomes:

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

CO1	Acquire knowledge of stresses, strains and failure theories and analyze them in terms of mathematical models.
CO2	Design and conduct experiments involving photo elasticity and strain gauges.
CO3	Apply Experimental techniques for different engineering problems.
CO4	Use Finite element analysis software and make comparison with other techniques.

COURSE TITLE: TECHANICAL SEMINAR		
Sub Code: 18MMDS36	**No of Credits: L-T-P-SS** **0:0:2:0=2**	**No. of Lecture hours/week :02**
CIE Marks: 50		

Course Outcomes:

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

CO1	Identify and understand current trends and real-world issues related to topics in Machine Design.
CO2	Classify appropriate content and sources, through literature survey, that can be summarized and integrated into presentation
CO3	Review, analyze, and interpret data & results using critical thinking skills
CO4	Revise and present scientific case studies in presentation
CO5	Collaborate effectively with other students in analyzing results and preparing oral presentations
CO6	Prepare a technical seminar report and communicate effectively through oral presentation using multimedia tools

III SEMESTER

PROJECT PHASE: I 18MMDP37

Problem formulation and submission of **synopsis** within 8 weeks from the commencement of 3rd semester, which shall be evaluated for 50 marks by the committee constituted for the purpose by the Head of the Department comprising the guide, senior faculty of the department with HoD as Chairman.

Literature survey and progress done after 16 weeks shall be evaluated by guide and external examiner with senior faculty / HoD as chairman for 50 marks.

Panchajanya Vidya Peetha Welfare Trust (Regd)

Dr. Ambedkar Institute of Technology

An Autonomous Institution, Affiliated to Visvesvaraya Technological University, Belagavi,
Aided by Govt. of Karnataka, Approved by All India Council for Technical Education (AICTE), New Delhi
Accredited by NBA and NAAC with 'A' Grade
BDA Outer Ring Road, Mallathalli, Bengaluru - 560 056

Ref. No. .....

Date : .....

This is to certify that the list of courses for the Employability, Entrepreneurship and skill development have been introduced during the 2020-2022 with the approval from the BOS chairman and BOS Members

Sl.No	Subject	Subject Code	Activities/content with direct bearing on Employability/ Entrepreneurship/skill development.
1.	Advanced Mechanics of Solids	20MMD12	Employability and skill development.
2.	Finite Element Method	20MMD13	Employability and skill development.
3.	Advanced Design of Mechanisms	20MMD14	Employability and skill development.
4.	Computer Aided Engineering Design Work Tool Laboratory	20MMDL17	skill development.
5.	Technical Seminar	20MMDS18	skill development.
6.	Advanced Theory of Vibrations	20MMD21	Employability and skill development.
7.	Design For Fatigue Loading	20MMD22	Employability and skill development.
8.	Tribology and Bearing techonology	20MMD23	Employability and skill development.
9.	Fracture Mechanics	20MMD24	Employability and skill development.
10.	ANALYSIS Laboratory	20MMDL28	skill development.
11.	Self Study – Massive Open Online Course (MOOC)*	20MMD31	Employability and skill development.
12.	Internship	20MMDI32	skill development.
13.	Technical Seminar	20MMDS33	skill development.
14.	Project Phase – II Midterm Internal Evaluation	20MMDP41	skill development.

HOD
Department of Mechanical Engineering
Dr. Ambedkar Institute of Technology
Bengaluru - 560 056.

BOS Chairman

Principal

PRINCIPAL
Dr. Ambedkar Institute of Technology
Bengaluru-560 056

ADMISSION YEAR : 2020-21 **ACADEMIC YEAR: 2020-21**
SEMESTER : FIRST

COURSE TITLE:ADVANCED MECHANICS OF SOLIDS		
Sub Code: 20MMD12	**No of Credits : L-T-P-SS 3:0:0:0=3**	**No. of Lecture hours/week :04**
Exam Duration:3 hours	**CIE Marks: 50**	**Exam Marks :50**

COURSE OBJECTIVES:

1. To study the basic concept of stress, stress distribution, elastic constants when the material is subjected to loading within the elastic limits.
2. Study the stress distribution in plane, polar and cylindrical coordinate system.
3. Analyze the material or component subjected to torsion of circular and non-circular shafts (elliptical, triangular bars)
4. Study the thermo-elastic properties of the material at elevated temperatures.

#	CONTENTS	Hrs
UNIT-1	**Introduction to general theory of elasticity:** assumptions and applications of linear elasticity. Analysis of stress, stress tensors. State of stress at a point, principal stresses in two dimensions, Cauchy's stress principle, direction cosines, stress components on an arbitrary plane with stress transformation. Principal stresses in three dimensions, stress invariants, Equilibrium equations, octahedral stresses, Mohr's stress circle, construction of Mohr's Circle for two and three dimensional stress systems, equilibrium equations in polar coordinates for three-dimensional state of stresses.	**11**
UNIT-2	**Introduction to analysis of strain**, types of strain, strain tensors, strain transformation. Principal strains, strain invariants, octahedral strains, Mohr's Circle for Strain, equations of Compatibility for Strain, strain rosettes. Stress-strain relations, the Generalised Hooke's law, compatibility conditions, the transformation from Strain components to stress components. Strain energy in an elastic body, St.Venant's principle, uniqueness theorem.	**11**
UNIT-3	**Theories of Failure and Energy Methods:** Introduction, Theories of Failure, Use of Factor of Safety in Design, Mohr's theory of Failure, Ideally Plastic Solid, Stress space and Strain space, General nature of Yield locus, Yield Surfaces of Tresca and Von Mises, Stress- Strain relation (Plastic Flow), Prandtl Reuss theory, Saint venant – Von mises equations. **Principle of Superposition,** Reciprocal Relation, Maxwell-Betti-Rayleigh Reciprocal theorem, First theorem of Castigliano, Expressions for Strain Energy, Statically indeterminate structures, Theorem of Virtual Work, Second theorem of Castigliano, Maxwell – Mohr integrals.	**10**
UNIT-4	**Bending of Beams:** Introduction, Straight beams and Asymmetrical Bending, Euler – Bernoulli hypothesis, Shear centre or Centre of Flexure, Shear stresses in thin walled open sections, Bending of curved beams, Deflection of thick curved bars.	**10**
UNIT-5	**Torsion:** Introduction, Torsion of general prismatic bars – Solid sections, Torsion of Circular and Elliptical bars, Torsion of equivalent triangular bar, Torsion of rectangular bars, Membrane analogy, Torsion of thin walled tubes, Torsion of thin walled multiple cell closed sections, Multiple connected sections, Centre of twist and flexure centre	**10**

TEXT BOOKS:

1. Advanced Mechanics of solids, L. S. Srinath, Tata Mc. Graw Hill, 2003.
2. Theory of Elasticity, S. P. Timoshenko and J. N Gordier, Mc.Graw Hill International, 3rd edition, 1972.

REFERENCES BOOKS:

1. Theory of Elasticity, Dr. Sadhu Singh, Khanna Publications, 1988
2. Elasticity, Theory, Applications & Numericals, Martin H Sadd, Elsevier. 2005.
3. Applied Elasticity, Seetharamu & Govindaraju, Interline Publishing.
4. Applied Elasticity, C.T. WANG Sc. D. Mc. Graw Hill Book Co.1953.

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	Apply basic concepts in continuum mechanics of solids viz. Stress and strain tensors, equilibrium, compatibility and constitutive equations and methods of solution to elasticity problems.
CO2	Evaluate stresses and displacements in simple solids such as pressurized cylinders, shrink fitted cylinders, rotating disc and shaft, plate with hole and non-circular shafts and thin tubes under torsion.
CO3	Examine bodies subjected to three dimensional stresses for the onset of failure based on failure Criteria.
CO4	Analyze deflections in beams subjected to different types of loads for elastic, elastoplastic and plastic conditions.
CO5	Evaluate stresses in bars subjected to torsion for elastic, elasto plastic and plastic conditions.

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1			1				1			
CO2		1		1	1				1		1	
CO3	1		1		1						1	
CO4	1		1		1				1			
CO5	1		1						1		1	

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

REFERENCES BOOKS:

1. Theory of Elasticity, Dr. Sadhu Singh, Khanna Publications, 1988
2. Elasticity, Theory, Applications & Numericals, Martin H Sadd, Elsevier. 2005.
3. Applied Elasticity, Seetharamu & Govindaraju, Interline Publishing.
4. Applied Elasticity, C.T. WANG Sc. D. Mc. Graw Hill Book Co.1953.

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MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1			1				1			
CO2		1		1	1				1		1	
CO3	1		1		1						1	
CO4	1		1		1				1			
CO5	1		1						1		1	

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

ADMISSION YEAR : 2020-21 **ACADEMIC YEAR: 2020-21**
SEMESTER : FIRST

COURSE TITLE: FINITE ELEMENT METHOD		
Sub Code: 20MMD13	**No of Credits : L-T-P-SS 3:0:0:0=3**	**No. of Lecture hours/week :04**
Exam Duration:3 hours	**CIE Marks: 50**	**Exam Marks :50**
Pre-requisites	Mom, Design of Machine Elements.	

COURSE OBJECTIVES:

1. To present the Finite element method (FEM) as a numerical method for engineering analysis of continuum and structures.
2. To present Finite element formulation using variation and weighted residual approaches.
3. To present Finite elements for the analysis of bars & trusses, beams & frames, plane stress & plane strain problems and 3-D solids, for thermal and dynamics problems.
4. Learn to model complex geometry problems and technique of solutions.

#	CONTENTS	Hrs
UNIT-1	**Introduction to Finite Element Method**: basic steps in finite element method to solve mechanical engineering problems (solid, fluid and heat transfer). Functional approach and Galerkin approach. Displacement approach: admissible functions. Convergence criteria: conforming and nonconforming elements, C0, C1 and Cn continuity elements. Basic equations, element characteristic equations, assembly procedure, boundary and constraint conditions.	**11**
UNIT-2	**Solid Mechanics:** One-dimensional finite element formulations and analysibars-uniform, varying and stepped cross section. Basic (Linear) and higher order elements formulations for axial, torsional and temperature loads with problems. **Beams**- basic (linear) element formulation-for uniform, varying and stepped cross section- for different loading and boundary conditions, numericals. **Trusses, Plane frames and Space frame** – basic (Linear) elements formulations for different boundary conditions -axial, bending, torsional, and temperature loads, numericals.	**11**
UNIT-3	**Two dimensional finite element formulations for solid mechanics problems**: triangular membrane (tria 3, tria 6, tria 10) element, fournoded quadrilateral membrane (quad 4, quad 8) element formulations for in-plane loading with simple problems.Triangular and quadrilateral axi-symmetric basic and higher order elements formulation for axi-symmetric loading with simple numericals. **Three dimensional finite element formulations for solid mechanics problems**: finite element formulation of tetrahedral element (tet 4, tet 10), hexahedral element (hexa 8, hexa 20), for different loading conditions. Serendipity and Lagrange family elements.	**10**
UNIT-4	**Finite element formulations for structural mechanics problems:** Basics of plates and shell theories: classical thin plate theory, shear deformation theory and thick plate theory. Finite element formulations for triangular and quadrilateral plate elements. Finite element formulation of flat, curved, cylindrical and conical shell elements.	**10**
UNIT-5	**Dynamic analysis:** finite element formulation for point/lumped mass and distributed masses system, finite element formulation of one dimensional dynamic analysis: bar, truss, frame and beam element. Finite element formulation of two dimensional dynamic analysis: triangular membrane and axi-symmetric element, quadrilateral membrane and axi-symmetric element. Evaluation of eigen values and eigen vectors applicable to bars, shaft, beams, plane and space frame.	**10**

TEXT BOOKS:

1. T. R. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall, 3rd Ed, 2002.
2. Lakshminarayana H. V., Finite Elements Analysis– Procedures in Engineering, Universities Press, 2004.

REFERENCE BOOKS:

1. Rao S. S, Finite Elements Method in Engineering- 4th Edition, Elsevier, 2006
2. P.Seshu, Textbook of Finite Element Analysis, PHI, 2004.
3. J.N.Reddy, Introduction to Finite Element Method, mcgraw -Hill, 2006.
4. Bathe K. J, Finite Element Procedures, Prentice-Hall, 2006.
5. Cook R. D., Finite Element Modeling for Stress Analysis, Wiley, 1995.

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	Understand the concepts of Variation methods and Weighted residual methods.
CO2	Identify the application and characteristics of FEA elements such as bars, beams, plane and isoparimetric elements, and 3D element.
CO3	Develop element characteristic equations and generate global stiffness equations.
CO4	Apply suitable boundary conditions to a global structural equation, and reduce it to a solvable form.
CO5	Identify how the finite element method expands beyond the structural domain, for problems involving dynamics and heat transfer.

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1		1					1			
CO2	1		1		1				1		1	
CO3	1		1						1		1	
CO4		1		1					1		1	
CO5	1	1			1						1	
High-3 Medium-2 Low-1												

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

ADMISSION YEAR : 2020-21 **ACADEMIC YEAR: 2020-21**
SEMESTER : FIRST

COURSE TITLE: ADVANCED DESIGN OF MECHANISM		
Sub Code: 20MMD14	**No of Credits : L-T-P-SS 3:0:0:0=3**	**No. of Lecture hours/week :04**
Exam Duration:3 hours	**CIE Marks: 50**	**Exam Marks :50**
Pre-requisites	Mom, Design of Machine Elements.	

COURSE OBJECTIVES:

1. To provide a theoretical and practical foundation for analysis and design of articulated mechanical systems for desired applications.
2. Develop skills to analyze the displacement, velocity, and acceleration of mechanisms.
3. Improve understanding of the synthesis of mechanisms for given tasks.
4. To include dynamics for considerations in the design of mechanisms engineering applications.

#	CONTENTS	Hrs.
UNIT-1	**Geometry of Motion:** Introduction, analysis and synthesis, Mechanism terminology, planar, spherical and spatial mechanisms, mobility, Grashoffs law, Equivalent mechanisms, Unique mechanisms, Kinematic analysis of plane mechanisms: Development of different mechanisms and its inversions like four bar chain mechanism, slider crank mechanism, double slider cranks, mechanism.	**11**
UNIT-2	**Generalized Principles of Dynamics:** Fundamental laws of motion, Generalized coordinates, Configuration space, Constraints, Virtual work, Principle of Virtual Work, Energy and Momentum, Work and kinetic energy, Equilibrium and stability, Kinetic energy of a system, Angular momentum, Generalized momentum. Lagrange's Equation: Lagrange's equation from D'Alembert's principles, Examples, Hamilton's equations, Hamilton's principle, Lagrange's, equation from Hamilton's principle, Derivation of Hamilton's equations, Examples.	**11**
UNIT-3	**Analytical Methods of Dimensional Synthesis:** Synthesis of Linkages: Type, number, and dimensional synthesis, Function generation, Path generation and Body guidance, Precision positions, Structural error, Chebychev spacing, Two position synthesis of slider crank mechanisms, Crank-rocker mechanisms with optimum transmission angle Motion Generation: Poles and relative poles, Location of poles and relative poles, polode, Curvature, Inflection circle	**10**
UNIT-4	**Graphical Methods of Dimensional Synthesis**: Two position synthesis of crank and rocker mechanisms, Three position synthesis, Four position synthesis (point precision reduction) Overlay method, Coupler curve synthesis, Cognate linkages. Ana1ytical Methods of 32 Dimensional Synthesis: Freudenstein's equation for four bar mechanism and slider crank mechanism, Examples, Bloch's method of synthesis, Analytical synthesis using complex algebra.	**10**
UNIT-5	**Spatial Mechanisms:** Introduction, Position analysis problem, Velocity and acceleration analysis, Eulerian angles.	**10**

TEXT BOOKS:

1. K.J.Waldron&G.L.Kinzel , "Kinematics, Dynamics and Design of Machinery", Wiley India, 2007.
2. Greenwood, "Classical Dynamics", Prentice Hall of India, 1988.

REFERENCES BOOKS:

1. J E Shigley, "Theory of Machines and Mechanism" -McGraw-Hill, 1995

2. A.G.Ambekar , “Mechanism and Machine Theory”, PHI, 2007.
3. Ghosh and Mallick , “Theory of Mechanism and Mechanism”, East West press 2007.
4. David H. Myszka , “Machines and Mechanisms”, Pearson Education, 2005.

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	The knowledge of dynamics considerations in mechanism design is essential to use commercial multi body dynamics software in mechanical engineering design.
CO2	Carry out mobility analysis of mechanism and perform velocity and acceleration of complex planer mechanism.
CO3	Synthesize mechanisms for function generation and path generation.
CO4	Analyze the Dynamics of Mechanical systems using D’Alemberts. ,Lagrange’s, and Hamiltons Principles.
CO5	Demonstrate the skills to use software to analyze mechanisms, synthesis of linkages.

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1		1		1				1		1	
CO2	1	1		1							1	
CO3	1				1		1		1			
CO4	1		1	1							1	
CO5	1			1			1		1			
High-3 Medium-2 Low-1												

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

ADMISSION YEAR: 2020-21 **ACADEMIC YEAR: 2020-21**
SEMESTER: FIRST

COURSE TITLE:EXPERIMENTAL METHODS		
Sub Code: 20MMD151	**No of Credits : L-T-P-SS 3:0:0:0=3**	**No. of Lecture hours/week :04**
Exam Duration:3 hours	**CIE Marks: 50**	**Exam Marks :50**
Pre-requisites	Mom, Design of Machine Elements.	

COURSE OBJECTIVES:

1. To introduce the concepts of dynamic measurements and analysis of experimental data.
2. To expose them to the techniques of Data Acquisition, Signal conditioning and processing.
3. To introduce students to different aspects of measuring deformation, strains, and stresses for developing a mechanistic understanding of both the material and the structure behavior.

#	CONTENTS	Hrs
UNIT-1	**Introduction:** Definition of terms, calibration, standards, dimensions and units, generalized measurement system, Basic concepts in dynamic measurements, system response, distortion, impedance matching, experiment planning. Analysis of Experimental Data: Cause and types of experimental errors, error analysis. Statistical analysis of experimental data- Probability distribution, gaussian, normal distribution. Chi-square test, Method of least square, correlation coefficient, multivariable regression, standard deviation of mean, graphical analysis and curve fitting, general consideration in data analysis.	**11**
UNIT-2	**Data Acquisition and Processing:** General data acquisition system, signal conditioning revisited, data transmission, Analog-to-Digital and Digital-to-Analog conversion, Basic components (storage and display) of data acquisition system. Computer program as a substitute for wired logic. Force, Torque and Strain Measurement: Mass balance measurement, Elastic Element for force measurement, torque measurement. Strain Gages -Strain sensitivity of gage metals, Gage construction, Gage sensitivity and gage factor, Performance characteristics, Environmental effects Strain, gage circuits, Potentiometer, Wheat Stone's bridges, Constant current circuits. Strain Analysis Methods-Two element and three element, rectangular and delta rosettes, Correction for transverse strains effects, stress gage - plane shear gage, Stress intensity factor gage.	**11**
UNIT-3	**Stress Analysis**: Two Dimensional Photo elasticity - Nature of light, - wave theory of light,- optical interference - Polariscopes stress optic law - effect of stressed model in plane and circular Polariscopes, IsoclinicsIso chromatics fringe order determination - Fringe multiplication techniques - Calibration Photoelastic model materials. Separation methods shear difference method, Analytical separation methods, Model to prototype scaling.	**10**
UNIT-4	**Three Dimensional Photo elasticity:** Stress freezing method, General slice, Effective stresses, Stresses separation, Shear deference method, Oblique incidence method Secondary principals stresses, Scattered light photo elasticity, Principals, Polari scope and stress data analyses.	**10**
UNIT-5	**Coating Methods:** **Photo elastic Coating Method**-Birefringence coating techniques Sensitivity Reinforcing and thickness effects - data reduction - Stress separation techniques Photo elastic strain gauges. **Brittle Coatings Method:** Brittle coating technique Principles data analysis - coating materials, Coating techniques. **Moire Technique** - Geometrical approach, Displacement approach- sensitivity of	**10**

1. 3D Modelling and practices , Engineering , Prof P. Krishnakumar
2. Introduction to CATIA V5 Release 19, Book by Kirstie Plantenberg
3. CATIA V5 Design Fundamentals Jaecheol Koh

REFERENCE BOOKS:

1. CATIA V5 Workbook Release 19, **Book by Richard Cozzens**

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	Understand the concepts and various tools used in design module.
CO2	Understand the design of typical structural components
CO3	Understand the techniques and standards of designing a component in CAD Software
CO4	Understand the design of three view diagram of a typical aircraft.
CO5	Analyze and evaluate CAD models

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1			1				1			
CO2		1		1	1				1		1	
CO3	1		1		1						1	
CO4	1		1		1				1			
CO5	1		1						1		1	

CONTINOUS INTERNAL EVALUATION (CIE)	
Evaluation of lab manual	30 Marks
Internal evaluation	10 Marks
Viva-voce	10 Marks
Total	50 Marks

SEMESTER END EXAMINATION (SEE)					
Sl. No.	**Particulars**	**Max. Marks**	**Break Up of Max. Marks**		
			Write Up	**MODELLING**	**ANALYSIS**
1	PART -A	**15**	05	05	05
2	PART-B	**25**	05	10	10
3	Viva Voce	**10**	--	--	--

TOTAL MARKS	**50**	**10**	**25**	**15**

- Two Full Questions to be set.
- Students shall be to be answered two full Questions.
- Each question(Experiments contains different Marks and it is clearly mentioned in the above table)
- Changing of Experiments is not allowed from any unit
- Viva Voce is compulsory

ADMISSION YEAR : 2020-21 ACADEMIC YEAR: 2020-21
SEMESTER : FIRST

COURSE TITLE: TECHANICAL SEMINAR		
Sub Code: 20MMDS18	**No of Credits : L-T-P-SS 0:0:2:0=02**	**No. of Lecture hours/week :**
Exam Duration:-------	**CIE Marks: 50**	**SEE Marks :--------**

COURSE OBJECTIVES:

1. Exposure of students to a variety of research projects and activities in order to enrich their academic experience.
2. An opportunity for students to develop skills in presentation and discussion of research topics in a public forum.
3. To identify good journals and journal papers; study the papers and understand, analyze, interpret and explain the contents of the paper.

GUIDELINES

1.Each student, under the guidance of a Faculty, is required to

- Choose, preferably through peer reviewed journals, a recent topic of his/her interest relevant to the Course of Specialization.
- Carryout literature survey, organize the Course topics in a systematic order.
- Prepare the report with own sentences.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

2. All students should attend the seminars of other students of their specialization.

SCHEME FOR CONTINUOUS INTERNAL EVALUATION (CIE)

Each presentation shall be evaluated for 50 marks. Average marks obtained for three best presentations will be the student's CIE marks.

Marks distribution

Seminar Report: 20 marks

Presentation skill:20 marks

Question and Answer:10 marks

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	To identify good journals and journal papers
CO2	study the papers and understand, analyze, interpret and explain the contents of the paper

CO3	understand the shortcomings and plus points of published papers
CO4	To develop overall skills for technical communication and help technical decision making.
CO5	To understand the latest research in their field of study

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1			1					1		1	
CO2	1		1						1			
CO3	1			1					1		1	
CO4		1		1	1				1			
CO5	1			1					1			1
High-3 Medium-2 Low-1												

ADMISSION YEAR : 2020-21 **ACADEMIC YEAR: 2020-21**
SEMESTER : FIRST

COURSE TITLE: INDUSTRY VISIT		
Sub Code: 20MMDM19	**No of Credits : L-T-P-SS 0:0:0:2=02**	**No. of Lecture hours/week : ----- -----**
Exam Duration:---------	**CIE Marks: 50**	**SEE Marks :---------**

COURSE OBJECTIVES:

1. An opportunity to get exposure to the real workstations, plants, machines and systems.
2. to understand the end-to-end process at all levels
3. to understand the company policies in terms of production, quality, and service management.
4. Expert briefing about the functioning of machines and systems.

GUIDELINES

1. Iindustrial visit shall be arranged according to the academic requirements and as per the norms of the college.
2. HOD must certify that the tour is required for the students or is related to their curriculum.
3. The visiting companies shall be relevant and suitable ones to the specialization and academic requirements.
4. Industrial visit shall fall within the stipulated period set by the college.
5. The stipulated period shall be informed to the Faculty in-charge and Students through HOD well in advance to enable go through a diligent process including communicating to the potential companies and obtaining permission to visit.
6. The entire plan including permission letter from the visiting companies, permission letter, route map, list of students with their contact no. (Preferably mobile phone), list of faculty with their contact details, undertaking letter from student and parent and permit shall be available in the file and be checked by HOD.
7. The bus shall carry a banner exhibiting the college name and Industrial Visit.
8. Students must carry security ID cards with details of their parents or local guardians and their contact numbers.
9. Participating students must be given an undertaking that they will abide by the rules and guidelines throughout the tour.

SCHEME FOR CONTINUOUS INTERNAL EVALUATION (CIE)

CIE marks for the Industrial visit report (30 marks), seminar (10 marks) and viva voce (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department, The committee shall consist of three faculty from the department.

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	Students' exposure to industrial environments and experiences is undeniably one way for students to appreciate their theoretical learning to a more practical learning.
CO2	Acquaint Students with Interesting Facts and Newer Technologies.
CO3	Using the case study approach within the visit brings out critical thinking among students.
CO4	Practical application of instruments handled during course curriculum.
CO5	Students Aware with Industry Practices.

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1		1				1		1		1	1
CO2		1	1		1				1			
CO3	1		1		1				1		1	
CO4		1	1		1		1				1	
CO5	1		1		1						1	
High-3 Medium-2 Low-1												

ADMISSION YEAR : 2020-21 **ACADEMIC YEAR: 2020-21**
SEMESTER : SECOND

COURSE TITLE:ADVANCED THEORY OF VIBRATIONS		
Sub Code: 20MMD21	**No of Credits : L-T-P-SS 3:0:0:0=3**	**No. of Lecture hours/week :04**
Exam Duration:3 hours	**CIE Marks: 50**	**Exam Marks :50**

COURSE OBJECTIVES:

1. To acquainting the learners the importance of vibrations in design of machine parts subject to vibrations.
2. To explore the concepts of transient and Non-linear vibrations.
3. To acquire the skill of vibration measurements and its applications.
4. To evaluate the results of Transient and Nonlinear vibrations.

#	CONTENTS	Hrs
UNIT-1	**Review of Mechanical Vibrations:** Basic concepts; free vibration of single degree of freedom systems with and without damping, forced vibration of single DOF-systems, Natural frequency. Transient Vibration of single Degree-of freedom systems: Impulse excitation, Arbitrary excitation.	**11**
UNIT-2	**Vibration Control:** Introduction, Vibration isolation theory, Vibration isolation and motion isolation for harmonic excitation, practical aspects of vibration analysis, shock isolation, Dynamic vibration absorbers, and Vibration dampers. Vibration Measurement and applications: Introduction, Transducers, Vibration pickups, Frequency measuring instruments, Vibration exciters, Signal analysis.	**11**
UNIT-3	**Modal analysis:** Dynamic Testing of machines and Structures, Experimental Modal analysis. **Vibrations of beams:** equation of motion, modal analysis, approximate methods, initial value problem, forced vibrations, special problems, wave propagation Vibrations of membranes: equations of motion, modal analysis, and approximate methods. **Vibrations of plates:** equations of motion, modal analysis, approximate methods.	**10**
UNIT-4	**Random Vibrations :** Random phenomena, Time averaging and expected value, Frequency response function, Probability distribution, Correlation, Power spectrum and power spectral density, Fourier transforms, FTs and response.	**10**
UNIT-5	**Signature analysis** and preventive maintenance, Vibration testing equipment, signal generation, measuring and conditioning instruments. **Vibration testing equipment:** Signal analysis instruments, Vibration signatures and standards.	**10**

TEXT BOOKS:

1. S. S. Rao, " Mechanical Vibrations" , Pearson Education,4TH Edition.
2. S. Graham Kelly," Fundamentals of Mechanical Vibration" -McGraw-Hill, 2000 .

REFERENCES BOOKS:

1. Mechanical Vibrations, S. Graham Kelly, Schaum's Outlines, Tata McGraw Hill, 2007.ISBN-10:
2. 1439062129
3. Theory of Vibration with Application, William T. Thomson, Marie Dillon Dahleh, Prentice Hall
4. Edition, ISBN, 0748743804, 2011
5. Vibrations & Acoustics, Sujatha, Tata McGraw Hill Edition, ISBN: 9780070148789, 2013
6. Mechanical Vibrations, S.S.Rao, Pearson Education, 4th ed., ISBN 978-0-13-212819-3, 2012

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	Construct Equations of motion based on free body diagrams
CO2	Analyse systems under free and forced vibrations for natural frequency of vibration.
CO3	Evaluate Mechanical Systems are using modal analysis.
CO4	Develop solutions through testing for vibrations and signature analysis techniques.
CO5	Apply the fundamentals of vibration to its measurement and analysis.

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1									1		1
CO2		1			1				1		1	
CO3	1		1									
CO4	1			1						1		1
CO5		1				1					1	1
High-3 Medium-2 Low-1												

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

ADMISSION YEAR : 2020-21 ACADEMIC YEAR: 2020-21
SEMESTER : SECOND

COURSE TITLE:DESIGN FOR FATIGUE LOADING		
Sub Code: 20MMD22	**No of Credits : L-T-P-SS 3:0:0:0=3**	**No. of Lecture hours/week :04**
Exam Duration:3 hours	**CIE Marks: 50**	**Exam Marks :50**

COURSE OBJECTIVES:

1. To identify failure modes and evolve design by analysis methodology.
2. To understand the concept of fatigue testing of materials including criteria for fatigue design and different fatigue life models.
3. To understand the concept of crack nucleation, crack growth and fracture of materials using fundamentals of linear elastic fracture mechanics.
4. To understand the different surface failure mechanisms with stress distribution of various contact surfaces.

#	CONTENTS	Hrs
UNIT-1	**Introduction:** Role of failure prevention analysis in mechanical design, Modes of mechanical failure, Review of failure theories for ductile and brittle materials including Mohr's theory and modified Mohr's theory, Numerical examples. Fatigue of Materials: Introductory concepts, High cycle and low cycle fatigue, Fatigue design models, Fatigue design methods ,Fatigue design criteria, Fatigue testing, Test methods and standard test specimens, Fatigue fracture surfaces and macroscopic features, Fatigue mechanisms and microscopic features	**11**
UNIT-2	**Stress-Life (S-N) Approach:** S-N curves, the statistical nature of fatigue test data, General S-N behaviour, Mean stress effects, Different factors influencing S-N behaviour, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using SN approach. Strain-Life(ε- N)approach: Monotonic stress-strain behaviour ,Strain controlled test methods, Cyclic stress-strain behaviour, Strain based approach to life estimation, Determination of strain life fatigue properties,Mean stress effects, Effect of surface finish, Life estimation by ε-N approach.	**11**
UNIT-3	**LEFM Approach**: LEFM concepts, Crack tip plastic zone, Fracture toughness, Fatigue crack growth, Mean stress effects, Crack growth life estimation. Notches and their effects: Concentrations and gradients in stress and strain, S-N approach for notched membranes, mean 30 stress effects and Haigh diagrams, Notch strain analysis and the strain – life approach, Neuber's rule, Glinka's rule, and applications of fracture mechanics to crack growth at notches.	**10**
UNIT-4	**Fatigue from Variable Amplitude Loading:** Spectrum loads and cumulative damage, Damage quantification and the concepts of damage fraction and accumulation, Cumulative damage theories, Load interaction and sequence effects, Cycle counting methods, Life estimation using stress life approach.	**10**
UNIT-5	**Surface Failure:** Introduction, Surface geometry, Mating surface, Friction, Adhesive wear, Abrasive wear, Corrosive wear, Surface fatigue spherical contact, Cylindrical contact, General contact, Dynamic contact stresses, Surface fatigue strength.	**10**

TEXT BOOKS:

1. RalphI. Stephens,Ali Fatemi, Robert, Henryo. Fuchs, "MetalFatiguein engineering" , John WileyNew York, Second edition. 2001.

2. FailureofMaterials in Mechanical Design, Jack.A. Collins,John Wiley,New York 1992.
3. RobertL.Norton , " Machine Design" , Pearson EducationIndia, 2000.

REFERENCES BOOKS:

1. Metal Fatigue in engineering, Ralph I. Stephens, Ali Fatemi, Robert, Henry o. Fuchs, John wiley Newyork, Second edition. 2001. ISBN: 978-1-933489-67-4
2. Failure of Materials in Mechanical Design, Jack. A. Collins, John Wiley, Newyork 1992. ISBN: 988-3-955783-62-2
3. Machine Design, Robert L. Norton, Pearson Education India, 2000, ISBN 0-06-00849-3
4. Fatigue of Materials, S.Suresh, Cambridge University Press, -1998

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	Distinguish different design criteria and their procedure to carry out the design of mechanical components.
CO2	Design machine components which are subjected to fluctuating loads.
CO3	Design machine components using techniques like stress life approach, Strain life approach and Fracture mechanics approach.
CO4	Define the various statistical aspects of fatigue using different probability distribution plots.
CO5	Explain the contact stresses and implementation of Hertz contact phenomenon to the real field problem.

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1		1						1		1	
CO2	1	1		1		1				1		
CO3		1	1		1				1		1	
CO4	1			1	1					1	1	
CO5		1	1		1					1	1	
High-3 Medium-2 Low-1												

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

ADMISSION YEAR : 2020-21 ACADEMIC YEAR: 2020-21
SEMESTER : SECOND

COURSE TITLE: TRIBOLOGY & BEARING TECHONOLOGY		
Sub Code: 20MMD23	**No of Credits : L-T-P-SS 3:0:0:0=3**	**No. of Lecture hours/week :04**
Exam Duration:3 hours	**CIE Marks: 50**	**SEE MARKS:50**

COURSE OBJECTIVES:

1. To understand the fundamental principles of lubrication for reduction of friction and wear.
2. To understand the principles of hydrodynamic and hydrostatic lubrication and their design and applications.
3. To learn the computations required for selecting and designing bearings in machines.
4. To understand the factors influencing the design and selection of Porous and Magnetic bearings.

#	CONTENTS	Hrs
UNIT-1	**Introduction to Tribology:** Introduction, Friction, Wear, Wear Characterization, Regimes of lubrication, Classification of contacts, lubrication theories, Effect of pressure and temperature on viscosity. Newton's Law of viscous forces, Flow through stationary parallel plates. Hagen's poiseuille's theory, viscometers. Numerical problems, Concept of lightly loaded bearings, Petroff's equation, Numerical problems	**11**
UNIT-2	**Hydrodynamic Lubrications:** Pressure development mechanism. Converging and diverging films and pressure induced flow. Reynolds's 2D equation with assumptions. Introduction to idealized slide bearing with fixed shoe and Pivoted shoes. Expression for load carrying capacity. Location of center of pressure, effect of end leakage on performance, Numerical problems. **Journal Bearings:** Introduction to idealized full journal bearings. Load carrying capacity of idealized full journal bearings, Somerfield number and its significance, partial bearings, Comparison between lightly loaded and heavily loaded bearings, effects of end leakage on performance, Numerical problems.	**11**
UNIT-3	**Hydrostatic Bearings:** Hydrostatic thrust bearings, hydrostatic circular pad, annular pad, rectangular pad bearings, expression for discharge, load carrying capacity and condition for minimum power loss, numerical problems **Antifriction bearings:** Advantages, selection, nominal life, static and dynamic load bearing capacity, probability of survival, equivalent load, cubic mean load, bearing mountings.	**10**
UNIT-4	**EHL Contacts:** Introduction to Elasto - hydrodynamic lubricated bearings. Introduction to 'EHL' constant. Grubin type solution. **Porous Bearings:** Introduction to porous and gas lubricated bearings. Governing differential equation for gas lubricated bearings, Equations for porous bearings and working principal, Fretting phenomenon and its stages.	**10**
UNIT-5	**Magnetic Bearings:** Introduction to magnetic bearings, Active magnetic bearings. Different equations used in magnetic bearings and working principal. Advantages and disadvantages of magnetic bearings,,Electrical analogy, Magneto-hydrodynamic bearings.	**10**

TEXT BOOKS:

1. Mujamdar.B.C "Introduction to Tribology of Bearing", Wheeler Publishing, New Delhi 2001
2. Radzimovsky, "Lubrication of Bearings - Theoretical principles and design" Oxford press organization 2000.

REFERENCES BOOKS:

1. Theory and practice of Lubrication for Engineers, Dudley D.Fuller, New YorkCompany.1998
2. Principles and applications of Tribology, Moore, Pergamon press, 1975
3. Engineering Tribology, G W Stachowiak, A W Batchelor, Elsevier publication 1993.
4. Lubrication of Bearings - Theoretical principles and design, Radzimovsky, Oxford press Company, 2000.

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	Demonstrate fundamentals of tribology, lubricants and methods of lubrication
CO2	Analyze bearings for load carrying capacity, frictional force and power loss.
CO3	Illustrate the different modes of lubrication system for various applications.
CO4	Design the different bearing system such as antifriction bearings for various applications
CO5	Explain the concepts advanced bearings like magnetic bearings, porous bearings and gas lubricated bearings.

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1		1			1			1		1	
CO2		1		1	1		1	1		1	1	
CO3	1		1	1					1		1	
CO4			1	1			1		1		1	
CO5												
High-3 Medium-2 Low-1												

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

ADMISSION YEAR: 2020-21 **ACADEMIC YEAR: 2020-21**
SEMESTER: SECOND

COURSE TITLE:FRACTURE MECHANICS		
Sub Code: 20MMD24	**No of Credits : L-T-P-SS 3:0:0:0=3**	**No. of Lecture hours/week :04**
Exam Duration:3 hours	**CIE Marks: 50**	**SEE MARKS:50**

COURSE OBJECTIVES:

1. To understand the design principle of materials and structures using fracture mechanics approaches.
2. To introduce the mathematical and physical principles of fracture mechanics and their applications to engineering design.
3. To develop the ability in students to compute the stress intensity factor, strain energy release rate and the stress and strain fields around a crack tip for linear and non linear materials.
4. To prepare the students for broader applications of fracture mechanics in material testing, evaluation, characterization, and material selection.

#	CONTENTS	Hrs
UNIT-1	**Fracture Mechanics Principles:** Introduction and historical review, sources of micro and macro cracks, stress concentration due to elliptical hole, strength ideal materials, Griffith's energy balance approach. Fracture mechanics approach to design. NDT and Various NDT methods used in fracture mechanics, numerical problems. The Airy stress function, complex stress function, solution to crack problems, effect of finite size, special cases, elliptical cracks, numerical problems.	**11**
UNIT-2	Plasticity effects, Irwin plastic zone correction, and Dugdale approach. The shape of the plastic zone for plane stress and plane strain cases, plastic constraint factor. The thickness effect, and numerical problems. **Determination of stress intensity factors and plane strain fracture toughness**: Introduction, analysis and numerical methods, experimental methods, estimation of stress intensity factors. **Plane strain fracture toughness test;** standard test, and specimen size requirements.	**11**
UNIT-3	The energy release rate, and criteria for crack growth. The crack resistance (R curve), compliance, J integral, tearing modulus and stability. **Elastic Plastic Fracture Mechanics (EPFM)**: Fracture beyond general yield. The crack-tip opening displacement, the use of CTOD criteria, and experimental determination of CTOD. Parameters affecting the critical CTOD, use of J integral, and limitation of J integral.	**10**
UNIT-4	**Dynamics and crack arrest:** Crack speed and kinetic energy. Dynamic stress intensity and elastic energy release rate. Crack branching. Principles of crack arrest. Crack arrest in practice. Dynamic fracture toughness.	**10**
UNIT-5	**Fatigue crack propagation and applications of fracture mechanics:** Crack growth and the stress intensity factor. Factors affecting crack propagation. Variable amplitude service loading, means to provide fail-safety, required information for fracture mechanics approach, mixed mode (combined) loading and design criteria.	**10**

TEXT BOOKS:

1. David Broek, "Elementary Engineering Fracture Mechanics", Springer Netherlands,2011
2. Anderson , "Fracture Mechanics-Fundamental and Application", T.L CRC press1998.

REFERENCES BOOKS:

5. Karen Hellan , "Introduction to fracture mechanics", McGraw Hill, 2nd Edition.
6. S.A. Meguid , "Engineering fracture mechanics" Elsevier Applied Science, 1989.
7. Jayatilaka, "Fracture of Engineering Brittle Materials", Applied Science Publishers, 1979.
8. Rolfe and Barsom , "Fracture and Fatigue Control in Structures" , Prentice Hall, 1977.
9. Knott , "Fundamentals of fracture mechanisms", Butterworths, 1973.

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	Develop basic fundamental understanding of the effects of crack like defects on the performance of aerospace, civil, and mechanical engineering structures.
CO2	Be able to select appropriate materials for engineering structures to insure damage tolerance.
CO3	Learn to employ modern numerical methods to determine critical crack sizes and fatigue crack propagation rates in engineering structures.
CO4	Understanding of experimental techniques to determine the critical values of parameters at crack tip.
CO5	Understand and appreciate of the status of academic research in field of fracture mechanics.

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1		1					1		1	
CO2	1		1	1		1			1		1	
CO3	1		1	1	1				1		1	
CO4		1	1	1		1					1	
CO5	1	1		1	1						1	
High-3 Medium-2 Low-1												

QUESTION PAPER PATTERN (SEE)										
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
UNIT	1		2		3		4		5	
1. Two full questions (each of 20 Marks) are to be set from each unit.										
2. Student shall answer five full questions selecting one full question from each unit.										

ADMISSION YEAR : 2020-21 **ACADEMIC YEAR: 2020-21**
SEMESTER : SECOND

COURSE TITLE: ANALYSIS LAB		
Sub Code: 20MMDL28	**No of Credits : L-T-P-SS 0:0:3:0=2**	**No. of Lecture hours/week :03**
Exam Duration:3 hours	**CIE Marks: 50**	**Exam Marks :50**

COURSE OBJECTIVES:

1. To be able to understand and handle design problems in systematic manner
2. To gain practical experience in 2D drafting and 3D modeling software systems.
3. To be able to apply CAD in real life applications.
4. To be able to understand Various software used to solve the practical problems

	CONTENTS	Hrs.
	PART-A	
	I. Study of a FEA package and modelling stress analysis of	
	➢ Bars of constant cross section area and stepped bar	**02**
	➢ Trusses- (Minimum 6 exercises)	**08**
	➢ Beams - Simply supported, cantilever. beams with UDL, beams with varying load.etc (Minimum 10 exercises) .	**10**
	PART -B	
	I. Thermal Analysis - 2D problem with conduction and convection boundary conditions (Minimum 4 exercises)	**6**
	II. Fluid flow Analysis - Potential distribution in the 2 - D bodies	**4**
	III. Dynamic Analysis	**12**
	➢ Fixed- fixed beam for natural frequency determination	
	➢ Bar subjected to forcing function	
	➢ Fixed- fixed beam subjected to forcing function	

REFERENCE BOOKS:

1. **ANSYS Workbench Tutorial Release 14,** Structural and Thermal Analysis Using Ansys
2. Mechanical APDL Release 14 Environment, Kent Lawrence, Schroff Development Corporation,
3. Website: www.SDCpublications.com
4. **Practical Finite Element Analysis,** Nitin S. Gokhale, Sanjay S. Despande, Dr. Anand N. Thite,

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	Apply basics of theory of elasticity to continuum problems.
CO2	Formulate finite elements like bar, truss and beam elements for linear static Structural analysis.
CO3	Formulate 2d and axis-Symmetric finite elements.
CO4	Develop finite element equations for 1d heat transfer elements and solve Numerical.
CO5	Apply finite element simulation tool to solve practical problems (lab and Self-study).

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1		1					1			
CO2	1	1		1							1	
CO3	1		1	1					1			
CO4		1		1	1				1		1	
CO5	1			1	1				1			

SCHEME FOR CONTINOUS INTERNAL EVALUATION (CIE)	
Evaluation of lab manual	30 Marks
Internal evaluation	10 Marks
Viva-voce	10 Marks
Total	**50 Marks**

SEMESTER END EXAMINATION (SEE)					
Sl. No.	**Particulars**	**Max. Marks**	**Break Up of Max. Marks**		
			Write Up	**MODELLING**	**ANALYSIS**
1	PART -A	**15**	05	05	05
2	PART-B	**25**	05	10	10
3	Viva Voce	**10**	--	--	--
	TOTAL MARKS	**50**	**10**	**25**	**15**

- Two Full Questions to be set.
- Students shall be to be answered two full Questions.
- Each question(Experiments contains different Marks and it is clearly mentioned in the above table)
- Changing of Experiments is not allowed from any unit
- Viva Voce is compulsory

ADMISSION YEAR: 2020-21 **ACADEMIC YEAR: 2021-22**
SEMESTER: THIRD

COURSE TITLE: SELF STUDY – MASSIVE OPEN ONLINE COURSE (MOOC)		
Sub Code: 20MMD31	**No of Credits : L-T-P-SS 0:0:0:06=03**	**No. of Lecture hours/week :**
Exam Duration:3 Hrs.	**CIE Marks: 50**	**SEE Marks: 50**

GUIDELINES

- The student shall choose and register for any of the following NPTEL/SWAYAM core course amounting to a minimum of 16 weeks.
- List of Massive Open Online Courses (NPTEL/SWAYAM) will be decided in the Board of Studies meeting.
- Students shall register for MOOC during 1st /2nd /3rd semester and shall be completed before the last working day of the 3rd semester.
- The student shall choose a MOOC subject which is confined to his specialization and part of his final year thesis.
- The assignment and examination marks along with certificate should be submitted to the examination section.

Sl. No.	MOOC SUBJECT NAME
1.	Gas Dynamics and propulsion
2.	Nonlinear vibrations
3.	Modelling and control of Dynamic Electro Mechanical System
4.	Computer aided engineering design
5.	Kinematics of machines
6.	Finite Element Method: Variation Methods to Computer Programming
7.	Selection of Nanomaterials For Energy Harvesting And Storage Application
8.	Introduction to Mechanical Micro Machining
9.	Transport Phenomena in materials

ADMISSION YEAR: 2020-21 **ACADEMIC YEAR: 2021-22**
SEMESTER: THIRD

COURSE TITLE: INTERNSHIP		
Sub Code: 20MMDI32	**No of Credits : L-T-P-SS 0:0:0:16=08**	**No. of Lecture hours/week :**
Exam Duration:3 Hrs.	**CIE Marks: 50**	**SEE Marks :50**

COURSE OBJECTIVES:

1. Expose technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
2. Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
3. Expose students to the engineer's responsibilities and ethics.
4. Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

GUIDELINES

1. Internship must be related to the field of specialization.
2. The duration of the internship shall be for a period of 16 weeks on full time basis after II semester SEE exams.
3. Two guides will supervise the internship project work, one from the department and another one from industry.
4. The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
5. The candidate should submit a synopsis of the proposed work to be done during Internship programme. The synopsis received should be evaluated by the departmental committee.
6. The students shall report the progress of the internship to the internal guide twice in a month and seek internal guide advice.
7. Interim reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
8. Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report.
9. The final project presentation is evaluated on the basis of the recommendation given by outside supervisor and Internal guide.
10. The external guide from the industry has to be an examiner for the viva voce on Internship. Viva-Voce on internship shall be conducted at the college and the date of Viva-Voce shall be fixed in consultation with the external Guide. The Examiners shall jointly award the Viva - Voce marks.

SCHEME FOR CONTINUOUS INTERNAL EVALUATION (CIE)

CIE marks for the Internship report (30 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department, The committee shall consist of three faculty from the department.

SCHEME FOR SEMESTER END EVALUATION (SEE)
The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner. Evaluation done in Individually.

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	The purpose of the student internship program is to provide students with an opportunity to gain workplace skills
CO2	The internship will provide training that would be similar to that which would be given in an educational environment, including the Work Station and other hands-on training provided by educational institutions
CO3	Excellent opportunity to see how the theoretical aspects learned in classes are integrated into the practical world.
CO4	Opportunity to learn strategies like time management, multi-tasking etc. in an industrial setup.
CO5	Opportunity to learn new skills and supplement knowledge

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1			1							1	
CO2		1		1								
CO3	1		1	1							1	
CO4		1										
CO5	1			1		1					1	

ADMISSION YEAR: 2020-21 **ACADEMIC YEAR: 2021-22**

SEMESTER: THIRD

COURSE TITLE: TECHNICAL SEMINAR		
Sub Code: 20MMDS33	**No of Credits : L-T-P-SS 0:0:2:0=02**	**No. of Lecture hours/week :**
Exam Duration: 3 Hrs.	**CIE Marks: 50**	

COURSE OBJECTIVES:

1. Exposure of students to a variety of research projects and activities in order to enrich their academic experience.
2. An opportunity for students to develop skills in presentation and discussion of research topics in a public forum.
3. To identify good journals and journal papers; study the papers and understand, analyze, interpret and explain the contents of the paper.

GUIDELINES

1.Each student, under the guidance of a Faculty, is required to

- Choose, preferably through peer reviewed journals, a recent topic of his/her interest relevant to the Course of Specialization.
- Carryout literature survey, organize the Course topics in a systematic order.
- Prepare the report with own sentences.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

2. All students should attend the seminars of other students of their specialization.

SCHEME FOR CONTINUOUS INTERNAL EVALUATION (CIE)

Each presentation shall be evaluated for 50 marks. Average marks obtained for three best presentations will be the student's CIE marks.

Marks distribution

- Seminar Report: 20 marks
- Presentation skill:20 marks
- Viva Voce:10 marks

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	To identify good journals and journal papers
CO2	study the papers and understand, analyze, interpret and explain the contents of the paper
CO3	understand the shortcomings and plus points of published papers
CO4	To develop overall skills for technical communication and help technical decision making
CO5	To understand the latest research in their field of study

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1		1		1	1			1		1	
CO2		1		1					1		1	
CO3	1		1		1				1		1	
CO4		1		1					1		1	
CO5	1		1		1						1	

ADMISSION YEAR: 2020-21 **ACADEMIC YEAR: 2021-22**

SEMESTER: THIRD

COURSE TITLE: EVALUATION OF PROJECT WORK PHASE I		
Sub Code: 20MMDP34	**No of Credits : L-T-P-SS 0:0:0:14=07**	**No. of Lecture hours/week : -----**
Exam Duration:3 Hrs.	**CIE Marks: 50**	**SEE Marks :50**

COURSE OBJECTIVES:

1. Support independent learning.
2. The aim is to identify a problem in the area relevant to the program.
3. To formulate a research problem in the area relevant to the program
4. Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.

GUIDELINES

1. Evaluation of Project Work Phase I is continuation of Phase - I.
2. The duration of the Phase-II shall be of 16 weeks.
3. The student needs to complete the project work in terms of literature survey, objectives of the work and methodology.
4. The preliminary results (if available) of the problem may also be discussed in the report.
5. The student should prepare a report consisting of a detailed Literature Review and Methodology.
6. Present the seminar on the selected project through power point slides.

. The work has to be presented in front of the examiners panel set by Head of Department.

Scheme for Continuous Internal Evaluation (CIE) :

CIE marks for the report (20 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department, The committee shall consist of three faculty from the department in the area of specialization.

Semester End Examination (SEE) :

Project Report: 20 Marks.

- The basis for awarding the marks shall be the involvement of the student in the project and in the preparation of project report.
- To be awarded by the internal guide in consultation with external guide if any.

Project Presentation: 20 Marks.

- The Project Presentation marks of the **Evaluation Of Project Work Phase -I** shall be awarded by the committee constituted for the purpose by the Head of the Department.
- The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Viva Voce: 10 Marks.

The student shall be evaluated based on the ability in the Question and Answer session for 10 marks.

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CO2	Habituated to critical thinking and use problem solving skills.
CO3	The candidate would have applied the technical knowledge learnt to prepare a methodology to solve the research problem formulated.
CO4	The candidate would have conducted the experiments according the standards acceptable by the peers.
CO5	Understand experimental investigations to verify predictions by other methods.

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1		1		1				1		1	
CO2		1		1				1	1			
CO3	1		1		1						1	
CO4		1			1				1		1	
CO5	1		1		1							

ADMISSION YEAR: 2020-21 **ACADEMIC YEAR: 2021-22**

SEMESTER: FOURTH

COURSE TITLE: PROJECT PHASE- II		
Sub Code: 20MMDP41	**No of Credits : L-T-P-SS 0:0:0:08=02**	**No. of Lecture hours/week : -----**
Exam Duration: 3 Hours	**CIE Marks: 100**	

COURSE OBJECTIVES:

1. To expand intellectual capacity, credibility, judgement, intuition.
2. To impart flexibility and adaptability.
3. The candidate should be able to prepare a comprehensive report of the project work.
4. To induce responsibilities to oneself and others.

GUIDELINES

1. Project Phase -II is continuation of Evaluation of Project Work Phase -I.
2. The duration of the Phase-II shall be of 16 weeks.
3. The student needs to complete the project work in terms of methodology (experimental set up or numerical details as the case may be) of solution and Results.
4. The student is expected to exert on design, development and testing of the proposed work.
5. The student should prepare a report consisting of a detailed report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
6. Present the seminar on the selected project through power point slides.
7. The work has to be presented in front of the examiners panel set by Head of Department.

Scheme of Continuous Internal Examination (CIE)

Evaluation shall be carried out in three reviews. The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor.

	Activity	**Marks**
1.	Review and refinement of Objectives and Literature Review	20
2.	Project Specifications, Computer Aided Design	40
3.	Experimental Result & Analysis	40
	Total	100

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	Work in a team to achieve common goal.
CO2	Learn on their own, reflect on their learning and take appropriate actions to improve it.
CO3	Communicate the solutions through presentations and technical reports.
CO4	Enhance presentation skills and report writing skills.
CO5	Develop alternative solutions which are sustainable.

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1			1					1		1	
CO2		1		1					1			
CO3	1		1								1	
CO4	1	1		1								
CO5	1			1					1		1	

ADMISSION YEAR: 2020-21 **ACADEMIC YEAR: 2021-22**
SEMESTER: FOURTH

COURSE TITLE: PROJECT WORK EVALUATION AND VIVA VOCE		
Sub Code: 20MMDP42	**No of Credits : L-T-P-SS 0:4:0:24=18**	**No. of Lecture hours/week : -----**
Exam Duration:3 Hrs.	**CIE Marks: 100**	**SEE Marks :100**

COURSE OBJECTIVES:

1. To expand intellectual capacity, credibility, judgement, intuition.
2. To impart flexibility and adaptability.
3. The candidate should be able to prepare a comprehensive report of the project work.
4. To induce responsibilities to oneself and others.

GUIDELINES

1. Project Phase -II is continuation of Evaluation of Project Work Phase -I.
2. The duration of the Phase-II shall be of 16 weeks.
3. The student needs to complete the project work in terms of results and discussion of the Experimentation and Analysis of the defined problem.
4. The student should bring out the conclusions of the work and future scope for the study.
5. The student should prepare a report consisting of a detailed report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
6. The student should prepare the project report as per the norms avoiding plagiarism.
7. The student should present the seminar on the selected project through power point slides.
8. The work has to be presented in front of the examiners panel set by Head of Department.

SCHEME FOR SEMESTER END EVALUATION (SEE):

Major Project Phase-II SEE shall be conducted in two stages. This is initiated after fulfilment of submission of project report.

Stage-1:
Evaluation of Report

Evaluation of Project Report shall be done by guide and an external examiner.

Stage-2:
Project Viva-voce

Major Project Viva-voce examination is conducted after receipt of evaluation reports from guide and external examiner.

Both Stage-1 and Stage-2 evaluations shall be completed as per the evaluation formats**.**

SCHEME FOR SEMESTER END EVALUATION (SEE)			
Details	**Internal Guide**	**External Guide**	**Total**
Report Evaluation	100 Marks	100 Marks	**200 Marks**
Viva-Voce	Joint evaluation by Internal Guide & External Evaluator		**100 Marks**
		Total	**300 Marks**

COURSE OUTCOMES: After the completion of this course, student will be able to:

CO1	The Student will develop attitude of lifelong learning
CO2	The Student will learn to write technical reports and research papers to publish at national and international level
CO3	The Student will develop strong communication skills to defend their work in front of technically qualified audience
CO4	The Student will be able to either work in a research environment or in an industrial environment
CO5	Synthesize self-learning, sustainable solutions and demonstrate life-long learning.

MAPPING OF COs WITH POs												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1		1						1		1	
CO2		1	1		1				1		1	
CO3	1		1		1				1		1	
CO4	1	1			1				1			
CO5		1			1				1		1	