

Dr. Ambedkar Institute of Technology

(An Autonomous Institute affiliated to VTU, Accredited by NAAC with 'A' grade)

Department of Mechanical Engineering

SCHEME OF TEACHING AND EXAMINATION I SEMESTER (Autonomous) 2020-21, 2021-22

M. Tech in Machine Design

I SEMESTER

Sl. No.	Sub Code	Subject Title	Teaching Department	Teaching hours per week			Maximum Marks allotted			Examination Credits
				Lecture	Tutorial/ Seminar/ Assignment	Practical / Project	CIE	SEE	Total	
1	20MMD11	Mathematical Techniques in Engineering	MAT	4	-	-	50	50	100	3
2	20MMD12	Advanced Mechanics of Solids	MECH	4	-	-	50	50	100	3
3	20MMD13	Finite Element Method	MECH	4	-	-	50	50	100	3
4	20MMD14	Advanced Design of Mechanisms	MECH	4	-	-	50	50	100	3
5	20MMD15X	ELECTIVE – I	MECH	4	-	-	50	50	100	3
6	20MMD16X	ELECTIVE – II	MECH	4	-	-	50	50	100	3
7	20MMDL17	Computer Aided Engineering Design Work Tool Laboratory	MECH	-	-	3	50	50	100	2
8	20MMDS18	Technical Seminar	MECH	-	4	-	50	-	50	2
9	20MMDM19	Industry visit	MECH	-	-	6	50	-	50	2
Total							450	350	800	24

*Technical Seminar: Seminar on Advanced topics from refereed journals by each student.

ELECTIVE - I		
Sl.No	Subject Code	Subject title
1	20MMD151	Experimental Methods
2	20MMD152	Mechatronics System Design
3	20MMD153	Design For Additive Manufacturing
4	20MMD154	Material Handling Equipment Design

ELECTIVE - II		
Sl. No	Subject Code	Subject title
1	20MMD161	Composite Materials & Technology
2	20MMD162	Technical Acoustics
3	201MMD63	Design Optimization
4	20MMD164	Product Design for Quality

Dr. Ambedkar Institute of Technology

(An Autonomous Institute affiliated to VTU, Accredited by NAAC with 'A' grade)

Department of Mechanical Engineering

SCHEME OF TEACHING AND EXAMINATION II SEMESTER (Autonomous) 2020-21, 2021-22

M. Tech in Machine Design

II SEMESTER

Sl. No.	Sub Code	Subject Title	Teaching Department	Teaching hours per week			Maximum Marks allotted			Examination Credits
				Lecture	Tutorial/ Seminar/ Assignment	Practical / Project	CIE	SEE	Total	
1	20MMD21	Advanced Theory of Vibrations	MECH	4	-	-	50	50	100	3
2	20MMD22	Design For Fatigue Loading	MECH	4	-	-	50	50	100	3
3	20MMD23	Tribology and Bearing Technology	MECH	4	-	-	50	50	100	3
4	20MMD24	Fracture Mechanics	MECH	4	-	-	50	50	100	3
5	20MMD25X	ELECTIVE – III	MECH	4	-	-	50	50	100	3
6	20MMD26X	ELECTIVE – IV	MECH	4	-	-	50	50	100	3
7	20RM27	Research Methodology		2	--	-	50	50	100	2
8	20MMDL28	ANALYSIS Laboratory	MECH	-	-	3	50	50	100	2
9	20MMDP29	Project Work Phase – I (Presentation of Synopsis)	MECH	-	-	6	50	-	50	2
Total							450	400	850	24

ELECTIVE-III		
Sl .No	Subject Code	Subject title
1	20MMD251	Advanced System Design
2	20MMD252	Automobile System Design
3	20MMD253	Design of Hydraulic & Pneumatic Systems
4	20MMD254	Advance Finite Element Analysis

ELECTIVE-IV		
Sl. No	Subject Code	Subject title
1	20MMD261	Pressure vessel design
2	20MMD262	Design for Manufacture and Assembly
3	20MMD263	Smart Materials and Structures
4	20MMD264	Industrial Automation And Robotics

ADMISSION YEAR : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

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	SEE 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.										

ADMISSION YEAR : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

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	SEE 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 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, 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, four noded 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 isoparametric 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 : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

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	SEE 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. Analytical 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 : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

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	SEE 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, Isoclinics Iso 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.	10

	Brittle Coatings Method: Brittle coating technique Principles data analysis - coating materials, Coating techniques. Moire Technique - Geometrical approach, Displacement approach-sensitivity of Moire data data reduction, In plane and out plane Moire methods, Moire photography, Moire grid production. Holography: Introduction, Equation for plane waves and spherical waves, Intensity, Coherence, Spherical radiator as an object (record process), Hurter, Driffeld curves, Reconstruction process, Holographic interferometry, Real time. and double exposure methods, Displacement measurement, Isopachics.	
--	--	--

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 KChaudhry, Tata McGraw-Hill Companies, Inc, New York, Seventh Edition, 2006.

REFERENCES BOOKS:

1. Measurement Systems Application and Design - Doebelin 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: After the completion of this course, student will be able to:

CO1	Undertake experimental investigations to verify predictions by other methods.
CO2	To acquire skills for experimental investigations an accompanying laboratory course is desirable.
CO3	To analyze fringe patterns, calibration studies.
CO4	Analysis and evaluations of polariscope.
CO5	Study and evaluation techniques of coating technology.

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 : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

COURSE TITLE : MECHATRONICS SYSTEMS DESIGN		
Sub Code: 20MMD152	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 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

#	CONTENTS	Hrs
UNIT-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.	11
UNIT-2	STUDY OF SENSORS AND TRANSDUCERS: Pneumatic and Hydraulic Systems, Mechanical Actuation System, Electrical Actual Systems, Real time interfacing and Hardware components for Mechatronics.	11
UNIT-3	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
UNIT-4	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.	10
UNIT-5	DATA PRESENTATION SYSTEMS: Basic System Models, System Models, Dynamic Response of system. ADVANCED APPLICATIONS IN MECHATRONICS: Fault Finding, Design, Arrangements and Practical Case Studies, Design for manufacturing, User-friendly design	10

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. Histan& David. Alciatore, "Introduction to Mechatronics & Measurement Systems"- Mc Graw Hill, 2002.

COURSE OUTCOME: After the completion of this course, 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.
CO5	Design of system models in application of advanced mechatronics system.

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 : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

COURSE TITLE: DESIGN FOR ADDITIVE MANUFACTURING		
Sub Code: 20MMD153	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 acquaint the learner on fundamentals of additive manufacturing/rapid prototyping, reverse engineering techniques and its applications.
2. To familiarize students with different processes in rapid prototyping systems.
3. To teach students about mechanical properties and geometric issues relating to specific rapid prototyping applications.

#	CONTENTS	Hrs
UNIT-1	Introduction: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems. Stereo Lithography Systems: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application.	11
UNIT-2	Selective Laser Sintering and Fusion Deposition Modeling: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications, Principle of Fusion deposition modeling, Process parameter, Path generation, Applications.	11
UNIT-3	Solid Ground Curing: Principle of operation, Machine details, Applications. Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application.	10
UNIT-4	Rapid Tooling: Indirect Rapid tooling -Silicone rubber tooling – Aluminum filled epoxy tooling Spray metal tooling, Cast kirksite, 3Q keltool, Direct Rapid Tooling Direct. AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling.	10
UNIT-5	RP Process Optimization: factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation.	10

REFERENCES BOOKS:

1. Stereo lithography and other RP & M Technologies -Paul F. Jacobs- SME, NY1996
2. Rapid Manufacturing - Flham D.T &Dinjoy S.S - Verlog London2001.
3. Rapid automated - Lament wood - Indus press NewYork
4. Wohler's Report 2000 - Terry Wohlers - Wohler's Association -2000

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

CO1	Describe product development, conceptual design and classify rapid prototyping systems; explain stereo lithography process and applications
------------	---

CO2	Explain direct metal laser sintering, LOM and fusion deposition modeling processes.
CO3	Demonstrate solid ground curing principle and process.
CO4	Discuss LENS, BPM processes, point out the application of RP system in medical field define virtual prototyping and identify simulation components.
CO5	Understand the RP Process Optimizations.

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		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 : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

COURSE TITLE: MATERIAL HANDLING EQUIPMENT DESIGN		
Sub Code: 20MMD154	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 develop competency for system visualization and design.
2. To enable student select materials and to design internal engine components.
3. To acquaint student to optimum design and use optimization methods to design mechanical components.
4. To enable and evaluate design material handling systems

#	CONTENTS	Hrs
UNIT-1	Elements of Material Handling System: Importance, Terminology, Objectives and benefits of better Material Handling; Principles and features of Material Handling System; Classification of Material Handling Equipment's, Interrelationships between material handling and plant layout, physical facilities and other organizational functions.	11
UNIT-2	Selection of Material Handling Equipment's: Factors affecting for selection; Material Handling Equation; Choices of Material Handling Equipment; General analysis Procedures; Basic Analytical techniques; The unit load concept; Selection of suitable types of systems for applications ; Activity cost data and economic analysis for design of components of Material Handling Systems; functions and parameters affecting service; packing and storage of materials.	11
UNIT-3	Design of Mechanical Handling Equipment's: Design of Hoists: Drives for hoisting, components, and hoisting mechanisms; rail traveling components and mechanisms; hoisting gear operation during transient motion; selecting the motor rating and determining breaking torque for hoisting mechanisms. Design of Cranes: Hand-propelled and electrically driven E.O.T. overhead Traveling cranes; Traveling mechanisms of cantilever and monorail cranes; design considerations for structures of rotary cranes with fixed radius ; fixed post and overhead traveling cranes; Stability of stationary rotary and traveling rotary cranes.	10
UNIT-4	Study of systems and Equipment's used for Material Storage: Objectives of storage; Bulk material handling; Gravity flow of solids through slides and chutes; Storage in bins and hoppers; Belt conveyors; Bucket-elevators; Screw conveyors; Vibratory Conveyors; Cabin conveyors; Mobile racks etc.	10
UNIT-5	Material Handling / Warehouse Automation and Safety considerations: Storage and warehouse planning and design: computerized warehouse planning; Need, Factors and Indicators for consideration in warehouse automation; which function, When and How to automate; Levels and Means of Mechanizations. Safety and design; Safety regulations and discipline.	10

TEXT BOOKS:

1. Materials Handling Equipment – N. Rudenko , Envee Publishers, New Delhi
2. Materials Handling Equipment – M.P. Alexandrov. Mie publications, Moscow

REFERENCE BOOKS:

1. Aspects of Material handling – Arora
2. Introduction to Material Handling- Ray
3. Plant Layout and Material Handling- Chowdary R B

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

CO1	Explain about the different types of material handling, advantages and disadvantages. It also suggests the selection procedure for the material handling along with its specifications.
CO2	Need for Material handling also explained with different techniques like Automated Material handling Design Program, Computerized material handling Planning will be dealt.
CO3	Demonstrate ability to successfully complete Fork Lift Certification to safely and effectively operate in the manufacturing environment.
CO4	The Material handling is explained with models, selection procedure of material handling is depending on different function oriented systems. This also related with plant layout by which the minimization of the handling charges will come down.
CO5	The ergonomics related to material handling equipment about design and miscellaneous equipment's.

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			
CO3		1	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 : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

COURSE TITLE : COMPOSITE MATERIALS & TECHNOLOGY		
Sub Code: 20MMD161	No of Credits : L-T-P-SS 3:0:0:4	No. of lecture hours/week :04
Exam Duration:3 hours	CIE Marks:50	SEE Marks :50

COURSE OBJECTIVES:

1. To study the basics of Composite materials.
2. To acquaint mechanics of lamina.
3. To study the micro and macro analysis of the lamina.
4. To gain knowledge of different techniques involved in production of composites.

#	CONTENTS	Hrs
UNIT-1	INTRODUCTION TO COMPOSITE MATERIALS: Definition, Classification, Types of matrices material and reinforcements, Characteristics & selection, Fiber composites, laminated composites, Particulate composites, Pre-pegs, and sandwich construction. Metal Matrix Composites: Reinforcement materials, Types, Characteristics and selection, Base metals, Selection, Applications	11
UNIT-2	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.	11
UNIT-3	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, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problem, practical recommendations	10
UNIT-4	MACRO MECHANICAL ANALYSIS OF LAMINATE: Introduction, code, Kirchhoff 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) 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	10
UNIT-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.	10

TEXT BOOKS:

1. Autar K. Kaw, Mechanics of Composite materials, CRC Press, 2nd Ed, 2005.
2. Madhijit Mukhopadhyay, 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.

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

CO1	Identify the role of matrices and reinforcements used in practical composite structures.
CO2	Analyze problems on macro mechanical behavior of lamina.
CO3	Analyze problems on micro and assess the strength of laminated composite and predict its failure for given static loading conditions.
CO4	Understand various method involved in synthesis of composites and to optimize laminates.
CO5	Develop understanding of different methods of manufacturing and testing of composites

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		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 : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

COURSE TITLE: MECHANICAL ACOUSTICS		
Sub Code: 20MMD162	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 acquaint students the fundamentals of acoustics related to generation, transmission and control techniques.
2. To provide basic knowledge and understanding of noise and vibration control necessary for professional practice as a noise control engineer.
3. To expose them to acoustic instrumentation and techniques of sound measurement.
4. To understand Noise reduction and control techniques in Machinery, auditorium, and HVAC systems

#	CONTENTS	Hrs
UNIT-1	Introduction to Acoustics: Basics of acoustics - speed of sound, wavelength, frequency, and wave number, acoustic pressure and particle velocity, acoustic intensity and acoustic energy density, spherical wave, directivity factor and directivity index, levels and the decibel, combination of sound sources, octave bands, weighted sound levels.	11
UNIT-2	Acoustics Evaluation Techniques: Room Acoustics, Reverberation time, Acoustic materials, Absorption and Absorption Coefficient, Evaluation techniques. Sound and vibration analyzer (SVAN) Sound sources and Propagation – Plane and spherical waves, near and far field, free and reverberant field - Anechoic and Reverberant chambers.	11
UNIT-3	Noise and physiological effects: Noise and physiological effects , Acoustic criteria, the human ear, hearing loss, industrial noise criteria, speech interference level, noise criteria for interior spaces , Loudness, hearing, hearing loss, hearing protectors, Mechanism -Weighted Networks -Noise standards for traffic - Community noise -Aircraft - Environmental noise, Articulation index, and Machinery acoustics.	10
UNIT-4	Acoustic Instrumentation: Sound level and intensity meters - Octave analyzers, octave band filters, acoustic analysers, dosimeter, measurement of sound power, sound power measurement in a reverberant room, sound power measurement in an anechoic chamber, sound power survey measurements, measurement of the directivity factor, calibration, noise measurement procedures. Sound power estimation - Instruments for building acoustics -Speech Interference - Sound systems and Auditorium acoustics.	10
UNIT-5	Noise control techniques: At source and transmission path-Barriers and Enclosures- HVAC system noise, Machinery acoustics and levels- Near field monitoring and diagnostics - Active noise control techniques. Noise control in rooms, sound absorption.	10

TEXT BOOKS:

1. J.D. Irwin and E.R.Graf, (2001), Industrial Noise and Vibration control, Prentice Hall Inc.

REFERENCE BOOKS:

1. Bies and Colin. H. Hanson, (2001): Engg. Noise Control, E &FN SPON.
2. Noise Control Hand Book of Principles and Practices, David M.Lipsdomls Van Nostrand

Reinhold Company.

3. Acoustic and Noise Control, (2000), B.J. Smith, R.J.Peters, Stephanie Owen.
4. Harris, C.K.–Handbook of Noise Control.
5. Petrusowicz and Longmore –Noise and Vibration control for industrialists.
6. Thumann and Miller- Secrets of Noise control.

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

CO1	Select appropriate noise control techniques for the solution of practical noise problems and evaluate their performance.
CO2	Understand how to use pressure wave expressions to describe sound transmission in different media.
CO3	Analyze complex noise environments and predict sound levels in desired locations.
CO4	Evaluate acoustic enclosures, barriers and walls for effective noise control.
CO5	Become familiar with sound measurement instrumentation.

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		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 : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

COURSE TITLE : DESIGN OPTIMIZATION		
Sub Code: 20MMD163	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
Pre-requisites	Research Methodology, Composite Material, Basic Mathematics	

COURSE OBJECTIVES:

1. To induce the students to the basics of Design optimization.
2. To acquaint Optimum Design Problem Formulation.
3. To analyze sensitivity analysis, Linear and Non Linear Approximations and Optimization Disciplines.
4. To explore and distinguish 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.	11
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	11
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	10
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.	10
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.	10

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. Jasbir Arora, Introduction to Optimum Design, McGraw Hill, 2011.

REFERENCE BOOKS:

1. Optimisation 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.

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
CO4	Apply the concept of manufacturing constraint and design interpretation to optimization problems
CO5	Understand the concept of dynamic programming and apply the concept of optimization in engineering design

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	

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 : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

COURSE TITLE: PRODUCT DESIGN FOR QUALITY		
Sub Code: 20MMD164	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. Apply the principles of product design to modify existing engineering systems or to develop new artifacts.
2. Design a system taking into consideration the concepts of ease of production, maintenance, handling, installation etc.
3. Translate the concepts of economics in design, optimization of design and human factors approach to product design.

#	CONTENTS	Hrs
UNIT-1	Design for quality: Taguchi's Approach to Quality, On-line and Off-line Quality Control, Quality Loss Function, System Design, Parameter Design, Design for Environment, Human factor design, Design for casting and forging, Causes of Variation.	11
UNIT-2	Quality Function Deployment –Introduction, QFD team, benefits, voice of customer, organisation of information, house of quality, QFD process Design of Experiments: Basic methods- Two factorial experiments-Extended method reduced tests and fractional experiments, orthogonality, base design method, higher dimensional fractional factorial design	11
UNIT-3	Failure Mode Effect Analysis: Refining geometry and layout, Failure tree analysis, Defects and failure modes Techniques of failure analysis, Field inspection of failure, Macroscopic and Microscopic examination, Additional tests, Analysis of data and report of failure.	10
UNIT-4	Statistical Consideration in Product Design and Development Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams-Cause and Effect diagrams-Box plots- Probability distribution- Statistical Process control–Scatter diagrams –Multivariable charts	10
UNIT-5	Six Sigma – Overview, Basics and history of the approach for six sigma, Methodology and focus, the application of Six Sigma in production and in-service industries, Relationship of Six Sigma and Lean Management, linking Six Sigma project goals with organizational strategy	10

REFERENCE BOOKS:

1. Total quality Management Kevin Otto & Kristin Wood, Product Design Techniques in Reverse
2. Engineering and New Product Development, Pearson Education (LPE), 2001. ISBN10: 0130212717
3. Product Design and Development, Karl T. Ulrich, Steven D. Eppinger, TATA McGraw - HILL - 3rd Edition, 2003. ISBN:13: 978-0073404776
4. The Management and control of Quality, James R. Evens, William M Lindsay, 6th edition- South-Western Publishers ISBN: 0314062157
5. Engineering Design, George E Dieter, 3rd Edition, McGraw hill International Edition, ISBN: 0-07- 116204-6

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

CO1	Apply a system based approach for quality management
CO2	Identify the importance of various principles of quality in product or service
CO3	Use statistical tools in product development
CO4	Apply basic risk analysis and experiment design techniques into practical cases
CO5	Demonstrate knowledge about Six sigma, Design of Experiments

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	

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 : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

COURSE TITLE : COMPUTER AIDED ENGINEERING DESIGN WORK TOOL -LAB		
Sub Code: 20MMDL17	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	SEE Marks : 50

COURSE OBJECTIVES:

1. The objective of this lab is to acquaint students with knowledge in the interface of 3-D software and to make students efficient to produce CAED designs.
2. By the end of course one should also be able to understand what a machine drawing is and will also be able to produce machine drawings.
3. To gain knowledge about all symbols used in production drawings and how they are inserted in production drawings using design software's.

PART –A COMPUTER AIDED ENGINEERING DESIGN- CAED BASICS		Hours
1	Introduction about CAED and different workbenches in it.	4
2	Interface, Sketch Tools, View Tool bar, Profile Tool bar, Operation Tool bar, Tools , Constrain tool bar, Transformation Tool bar, User Selection Filter,.	4
3	Sketch Based Features, Dress up Features, Transformation Features, Reference Elements, Measure, Thickness, Boolean Operations.	4
4	Walls, Cutting and Stamping, Bending, Rolled Walls	4
5	Visualizations Surface, Operations	4
6	Wireframe, Replication. Standards Product Structure Tools, Constrains	4
PART –B DESIGN AND DEVELOPMENT OF A PRODUCT USING CAD WORK TOOL		Hours
1	Introduction to Geometric Dimensioning and Tolerance, Weld Symbols, GD&T Symbols, Types of Tolerances, Types of views, Roughness Symbols	4
2	Views, Annotations, Sheet Background.	4
3	Design of any two types of Aircraft structures	4
4	Design of fuselage with internal components	4
5	Design of Nose cone structures	4
6	Design of Main landing gear and nose landing gear	6

TEXT BOOKS:

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	

CONTINUOUS 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 : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

COURSE TITLE: TECHNICAL SEMINAR		
Sub Code: 20MMDS18	No of Credits : L-T-P-SS 0:0:2:0=02	No. of Lecture hours/week :
Exam Duration: 3Hrs.	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

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 : 2021-22
SEMESTER : FIRST

ACADEMIC YEAR: 2021-22

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

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. Industrial 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 : 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

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	SEE 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: 1439062129
2. Theory of Vibration with Application, William T. Thomson, Marie Dillon Dahleh, Prentice Hall Edition, ISBN, 0748743804, 2011
3. Vibrations & Acoustics, Sujatha, Tata McGraw Hill Edition, ISBN: 9780070148789, 2013
4. 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 : 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

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	SEE 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. 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.

REFERENCES BOOKS:

1. Metal Fatigue in engineering, Ralph I. Stephens, Ali Fatemi, Robert, Henry o. Fuchs, John Wiley New York, Second edition. 2001. ISBN: 978-1-933489-67-4
2. Failure of Materials in Mechanical Design, Jack. A. Collins, John Wiley, New York 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 : 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

COURSE TITLE: TRIBOLOGY & BEARING TECHNOLOGY		
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 York Company.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 : 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

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 press 1998.

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 : 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

COURSE TITLE:ADVANCED SYSTEM DESIGN		
Sub Code: 20MMD251	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 nonlinear materials.
4. To prepare the students for broader applications of fracture mechanics in material testing, evaluation, characterization, and material selection.

#	CONTENTS	Hrs
UNIT-1	INTRODUCTION: What is designing, Man as a designer: Design by evolution, inadequacies of traditional design method: System approach of engineering problems: Need models: design history of large scale existing system. Morphology of Design: The three phases of design projects, the structure of design process, decision making and iteration.	10
UNIT-2	IDENTIFICATION, NEED ANALYSIS & DESIGN CONCEPT: Preliminary need statement, analysis of need, specifications, and standards of performance and constraints. Process of idealization, mental fixity, analysis, AIDA, brain storming etc.	10
UNIT-3	PRELIMINARY DESIGN: Mathematical modeling for functional design: concept of sensitivity, compatibility and stability analysis. Evaluation Of Alternatives And Design Decisions.	10
UNIT-4	DESIGN TREE: Quality of design, Concept of utility, multi criteria decisions, decisions under uncertainty and risk (Numerical), Bath tub curve, exponential reliability function, system reliability concept. (Numerical)	10
UNIT-5	ECONOMICS AND OPTIMIZATION IN ENGINEERING DESIGN: Economics in Engineering Design, Fixed and variable costs, break-even analysis. (Numerical) Optimization: Introduction to LPP. Man Machine Interaction, Designing for use and maintenance, Man-Machine Cycle, Design of displays and controls. Factors influencing displays and controls.	12

REFERENCES BOOKS:

1. Mechanical System Design by: W. E. Ederlecturer In Mechanical Engineering And'w. Gosling

2. Harrison Kim, Dept. of Industrial and Enterprise Systems Engineering (ISE) - 2 - 1. Papalambros, P.Y. and Wilde, D., Principles of Optimal Design (2nd Ed.), Cambridge University Press, New York, 2000. 2.

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

CO1	Analyze the types of design and concepts
CO2	Applying the concept of need based design.
CO3	Implement preliminary design concept in real life.
CO4	Analyzing the process of design in the form of sequence of actions.
CO5	Implement economics during engineering Design and study Man-Machine Cycle.

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			1		1	
CO3	1		1	1								1
CO4		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 : 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

COURSE TITLE:AUTOMOBILE SYSTEM DESIGN		
Sub Code: 20MMD252	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 of the stages involved in automobile system design.
2. To expose the industrial practices in design of various systems of automobile.
3. To study importance and features of different systems like axle, differential, brakes, Steering, suspension, and balancing etc.
4. To study working of various Automobile Systems.

#	CONTENTS	Hrs
UNIT-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.	10
UNIT-2	Design of I.C. Engine I: Combustion fundamentals, combustion chamber design, cylinder head design for both SI & C. I. Engines.	10
UNIT-3	Design of I.C. Engine II: Design of crankshaft, camshaft, connecting rod, piston & piston rings for small family cars (max up to 3 cylinders).	10
UNIT-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.	10
UNIT-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.	12

REFERENCES BOOKS:

1. **Mechanical System Design** by: W. E. Ederlecturer In Mechanical Engineering And'w. Gosling
2. Harrison Kim,Dept. of Industrial and Enterprise Systems Engineering (ISE) - 2 - 1. Papalambros, P.Y. and Wilde, D., **Principles of Optimal Design** (2nd Ed.), Cambridge University Press, New York, 2000. 2.

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

CO1	Gain an insight into aspects of vehicle design, operation and maintenance, which will be useful for taking up a position in the automotive industry.
CO2	Apply the knowledge in creating a preliminary design of Automobile sub systems.
CO3	Identify construction, working, preventive maintenance, trouble shooting and diagnosis of various Automobile Systems.
CO4	Identify Modern technology and safety measures used in Automotive Vehicles.
CO5	Analyse the cooling and Emission control in automotive vehicles.

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	1	
CO3	1			1	1				1		1	
CO4	1		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 : 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

COURSE TITLE: DESIGN OF HYDRAULIC & PNEUMATIC SYSTEMS		
Sub Code: 20MMD253	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 of the stages involved in Hydraulic & Pneumatic design.
2. To expose the maintenance practices in various systems of hydraulics.
3. To study and analyze the hydraulic circuit design.
4. To study working of Pneumatic Systems.

#	CONTENTS	Hrs
UNIT-1	Introduction to Hydraulic System: Introduction, Basic hydraulic system, classification of hydraulic motors, hydraulic pumps, Performance of hydraulic motors, Hydraulic actuators, types of hydraulic actuators. Control Components in Hydraulic Systems: Introduction, Direction control valves, Solenoid actuated valve, Pilot operated valve, Rotary spool DCV, Pressure control valves, Hydraulic fuse, Flow control valve, graphic symbols.	10
UNIT-2	Maintenance of Hydraulic Systems: Prime function of hydraulic fluids, desirable properties of hydraulic fluids, general types of fluids, factors affecting the selection of fluids, sealing devices, reservoir systems, filters and strainers, heat exchangers, pressure switch, wear of moving parts, troubleshooting of hydraulic systems. Maintenance of Pumps	10
UNIT-3	Hydraulic circuit Design and Analysis: Control of a single acting cylinder, double acting cylinder, regenerative circuit, counter balance valve applications, Hydraulic cylinder sequencing circuits, automatic cylinder reciprocating systems, Locked cylinder using pilot check valves, cylinder synchronizing circuits, fail safe circuits..	10
UNIT-4	Pneumatic Concepts: Introduction, comparison of hydraulics/pneumatics/and electrical system, air compressor system, types of compressors, compressed air behavior, pneumatic actuators, direction control valves, building a pneumatic circuits, application of logic valves. Design of Pneumatic Circuits: Speed control circuits, Application of time delay valves. Position sensing in pneumatic cylinders, roller lever valve, pressure sensing in pneumatic circuits, pressure sequence valve, two cylinder movement, cascade method.	10
UNIT-5	Electro-Pneumatics: Introduction, Pilot operated solenoid valve, Electrical connection to the solenoid, Electro-pneumatic circuit, Electrical limit switches and proximity switches, Relays, Solenoid, PE converter, Concept of latching. Servo System and PLC Applications in Pneumatics: Closed loop control with servo system, Hydro- mechanical servo system, Electro-hydraulic servo system, Conventional valve vs proportional valve, Proportional valve in hydraulic circuits, characteristics of proportional valve and servo valve. PLC application in fluid power, logic in ladder logic diagram and Mnemonics, Timer- on delay and of delay.	12

REFERENCES BOOKS:

1. Introduction to Hydraulics and Pneumatics, S Ilango, V Soundararajan, PHI Publication, ISBN-978-81-203-3079-5.
2. Hydraulics and Pneumatics, Jagadeesha T, I K International Publication, ISBN: 978-93-84588-90-8
3. Introduction to fluid power, James L Johnson, Cengage Learning, First Edition 2003, ISBN- 981- 243-661-8
4. Hydraulic and pneumatic controls, R Srinivasan, Tata McGraw hill, second edition, 2010 ISBN – 978-81-8209-138-2.

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

CO1	Describe the constructional features of hydraulic and pneumatic components.
CO2	Apply hydraulic and pneumatic controls in the design of automated controls.
CO3	Evaluate the design of hydraulic and pneumatic components for building a circuit.
CO4	Design the hydraulic and pneumatic based systems for industrial applications.
CO5	Analyze the PLC applications in Pneumatics.

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
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 : 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

COURSE TITLE: ADVANCED FINITE ELEMENT ANALYSIS		
Sub Code: 20MMD254	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 of the stages involved in Hydraulic & Pneumatic design.
2. To expose the maintenance practices in various systems of hydraulics.
3. To study and analyze the hydraulic circuit design.
4. To study working of Pneumatic Systems.

#	CONTENTS	Hrs
UNIT-1	Basics of Finite Element Analysis: Shape function of the linear bar element, quadratic bar element, 2-D Constant strain triangular element, 2-D linear triangular element, 4 noded quadrilateral element, 9- noded quadrilateral element and serendipity elements. Stiffness, traction and body force equations for 1-D 2 noded element, 2-D truss element, CST element and 4 noded quadrilateral elements and related problems.	11
UNIT-2	Axisymmetric Solids: Structures of Revolution, Axisymmetric Solid Iso-P Elements, Iso-P Quadrilateral Ring Elements, Benchmark Problems. A Complete Axisymmetric FEM Program. Axisymmetric Solid.	11
UNIT-3	General Solids: Solid Elements: Overview. The Linear Tetrahedron, The Quadratic Tetrahedron. The 8-Node Hexahedron. The 20-Node Hexahedron. Pyramid solid elements: a successful application of morphing.	10
UNIT-4	Dynamic Analysis using Finite Element Method: Introduction – vibrational problems – equations of motion based on weak form – longitudinal vibration of bars – transverse vibration of beams – consistent mass matrices – element equations – solution of eigenvalue problems – vector iteration methods – normal modes – transient vibrations – modeling of damping – mode superposition technique – direct integration methods.	10
UNIT-5	Applications in Heat Transfer & Fluid Mechanics: One dimensional heat transfer element – application to one-dimensional heat transfer problems- scalar variable problems in 2-Dimensions– Applications to heat transfer in 2- Dimension – Application to problems in fluid mechanics in 2-D	10

REFERENCES BOOKS:

1. Introduction to Finite Elements in Engineering, Chandrupatla T. R., and Belegundu, A.D., Prentice
2. Hall, 2003.
3. An Introduction to the Finite Element Method, Reddy, J. N. 3rd Edition, McGraw-Hill
4. Science/Engineering/Math, 2005.
5. The Finite Element Method in Engineering, S. S. Rao, Fifth Edition, Elsevier Publications.

6. Advanced Finite Element Methods and Applications, Thomas Apel and Olaf Steinbach, Springer
7. Publications, ISBN 978-3-642-30315-9, 2013

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

CO1	Explain the fundamentals of finite element methods
CO2	Develop the knowledge to analyses, structures under static and dynamic conditions.
CO3	Selection of numerical techniques for solving engineering problems
CO4	Explore the use of finite element method knowledge to implement industrial project.
CO5	Analyze the applications of Finite Element Analysis in 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		1	
CO2		1	1		1				1		1	
CO3	1		1		1						1	
CO4	1		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 : 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

COURSE TITLE: PRESSURE VESSEL DESIGN		
Sub Code: 20MMD261	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. Apply the principles of product design to modify existing engineering systems or to develop new artifacts.
2. Design a system taking into consideration the concepts of ease of production, maintenance, handling, installation etc.
3. Translate the concepts of economics in design, optimization of design and human factors approach to product design.

#	CONTENTS	Hrs
UNIT-1	General Introduction: Review of equations of elasticity- kinematics, compatibility equations, stress measures- equations of motions- constitutive relations- transformation of stresses, strains and stiffness- energy principles and variational methods in elasticity- virtual work- external and internal virtual work variational operator- functionals- Euler Lagrange equations- energy principles- Hamilton's principle- principle of minimum total potential- applications.	11
UNIT-2	Classical Theory Of Plates: Plates as structural elements- stress and moment resultants- assumptions made in the classical theory- displacement fields and strains- equations of equilibrium in Cartesian coordinates and in polar coordinates- boundary conditions – bending of rectangular plates with various boundary conditions and loading- symmetrical and asymmetrical bending of circular plates- limitations of classical theory- finite element analysis	11
UNIT-3	Buckling Analysis of Rectangular Plates: Buckling of simply supported plates under compressive forces- governing equations- the Navier solution- biaxial compression of a plate- uniaxial compression of a plate- buckling of plates simply supported on two opposite edges- Levy's solution- buckling of plates with various boundary conditions- general formulation- finite element analysis	10
UNIT-4	Vibration of Plates: Governing equations for natural flexural vibrations of rectangular plates- natural vibrations of plates simply supported on all edges- vibration of plates with two parallel sides simply supported Levy's solution- vibration of plates with different boundary conditions- Rayleigh-Ritz method Natural vibration of plates with general boundary conditions- transient analysis of rectangular plates- finite element analysis.	10
UNIT-5	Analysis of Thin Elastic Shells of Revolution: Classification of shell surfaces- geometric properties of shells of revolution- general strain displacement relations for shells of revolution- stress resultants- equations of motion of thin shells, analytical solution for thin cylindrical shells- membrane theory- flexure under axisymmetric loads, shells with double curvature- geometric considerations- equations of equilibrium- bending of spherical shells- vibration of cylindrical shells- finite element analysis.	10

REFERENCE BOOKS:

1. Theory and Analysis of Elastic Plates & Shells, Reddy, J.N., C.R.C. Press, NY, USA, 2nd Edition, ISBN 9780849384158
2. Theory and Analysis of Plates, Szilard, R., Prentice Hall Inc., 1999, ISBN 0-12-9353336-2
3. Theory of Plates and Shells, Timoshenko, S. and Krieger S.W, McGraw Hill Book Company, New York 1990, ISBN 0-13-913426-3
4. Stresses in shells, Wilhelm Flügge, Springer –Verlag, ISBN 978-3-662-01028-0.

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

CO1	Review the equations of elasticity.
CO2	Apply the structural mechanics approximations of membrane, plates and shells.
CO3	Develop simple modifications to the membrane plate and shell theories.
CO4	Describe the static, dynamic, and non-linear motion of membrane, plate and shell structures.
CO5	Analyze numerical problems in shells of revolution.

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		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: 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

COURSE TITLE: DESIGN FOR MANUFACTURE AND ASSEMBLY		
Sub Code: 20MMD262	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 various general design rules for manufacturability and criteria for material selection
2. To study various machining process and tolerance aspects in machining.
3. To know the design considerations for casting, forging and welding process.
4. To study the general design guidelines for manual assembly and development of DFMA Methodology.

#	CONTENTS	Hrs
UNIT-1	Introduction to Design for Manufacture & Assembly: Steps in DFMA, Advantages of DFMA, Design guidelines for Manual Assembly and High-Speed Automatic and Robotic Assembly. Geometrical Dimensioning & Tolerance – Dimensions & Tolerance, Limits, Fits and Tolerances, Hole and Shaft Basis, Three datum – functional, machining and manufacturing, geometrical and form tolerance, conventional and advanced tools and techniques for measurements, numerical.	11
UNIT-2	Metal Casting Processes – Gravity Die Casting : compute the dimensions for Pattern, Mould, based on materials to be cast – ferrous and non-ferrous alloys, influence of parting line, cast holes, special sand cores, shrinkage compensation, numericals, Pressure Die Casting: Die casting alloys, machine selection, operation, sub-systems, post-processing equipments, mould design, number of cavities, manufacturing and assembly of moulds, design principles.	11
UNIT-3	Design for Injection Molding – Injection moulding systems – injection subsystem, ejection system, clamping and feeding system, machine sizing, materials for injection moulding and its properties, injection mould design – cavity and core, manufacturing processes for moulds, operation and cycle time.	10
UNIT-4	Design for Powder Metallurgy Processes: Introduction to PM process, blending and mixing, compaction, sintering processes. Tooling materials, heat treatment, surface treatments and preparation of green compacts, Press tools for PM process – load, tooling layout, capacity; sintering furnace and influence of process and materials parameters on shrinkage.	10
UNIT-5	Design for Sheet Metal Processing: Design of moulds for shearing, piercing, bending, deep drawing, progressive die operation, selection of press – hydraulic and electric, sub-systems, turret operation, cycle time calculation, laser cutting of sheet metals. Cost Estimation for sand casting, pressure die casting, injection moulding, PM process and sheet metal processes.	10

REFERENCE BOOKS:

1. A.K. Chitale and R. C. Gupta, Product Design and Manufacturing, PHI 2007.
2. G.Boothroyd, P.Dewhurst and W.Knight, Product Design for Manufacture and Assembly, Marcell Dekker, 2002.
3. R.Bryan , Fischer, Mechanical Tolerance stackup and analysis, Marcell Dekker, 2004.
4. M. F. Spotts, Dimensioning and Tolerance for Quantity Production, Prentice Hall Inc., 1999.

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

CO1	Explain the concept of DFMA and GD&NT.
CO2	Apply engineering products and suggest suitable manufacturing process.
CO3	Evaluate the influence of design, material and manufacturing processes on product assembly.
CO4	Develop appropriate manufacturing and assembly processes for a given product.
CO5	Analyze cost estimation of various metal processes.

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		1	
CO4	1		1	1					1			
CO5	1			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 : 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

COURSE TITLE : SMART MATERIALS AND STRUCTURES		
Sub Code: 20MMD263	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 study the basic sources of smart materials and structures.
2. To acquaint with the effects of Shape memory Alloy, ER and MR fluids.
3. To study the usefulness of vibration absorbers and control of structures.
4. To gain knowledge of MEMS and devices.

#	CONTENTS	Hrs
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 Coercive Field, field strain relation. Hysteresis, Creep and Strain Rate effects, Inchworm Linear Motor.	11
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.	11
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	10
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. 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.	10

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Electroceramics: Materials, Properties and Applications - A. J. Moulson and J. M. Herbert. John Wiley & Sons, ISBN: 0471497429
2. Piezoelectric Sensors: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors. Materials and Amplifiers, Springer, Berlin; New York, 2002 (ISBN: 3540422595).
3. Piezoelectric Actuators and Ultrasonic Motors -K. Uchino, Kluwer Academic Publishers, Boston, 1997 (ISBN: 0792398114).

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

CO1	Understand the behaviour and applicability of various smart materials.
CO2	Design Simple models for smart structures and materials.
CO3	Understanding the concepts of shape memory, ER and MR fluids and their characteristics.
CO4	To get knowledge about vibration absorbers and controlling of structures.
CO5	The fundamentals of MEMS and their intrinsic characteristics and devices.

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			
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 : 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

COURSE TITLE: INDUSTRIAL AUTOMATION AND ROBOTICS		
Sub Code: 20MMD264	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 develop the student's knowledge in various robot structures and their workspace.
2. To develop student's skills in perform kinematics analysis of robot systems.
3. To provide the student with some knowledge and analysis skills associated with trajectory planning.
4. To provide the student with some knowledge and skills associated with robot control and automation.

#	CONTENTS	Hrs
UNIT-1	Automation and Robotics - Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, Complete Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, Types of Drive Systems and their Relative Merits, the Wrist & Gripper Subassemblies. Concepts and Model about Basic Control System, Control Loops of Robotic Systems, PTP and CP Trajectory Planning, Control Approaches of Robots	11
UNIT-2	Kinematics of Robot Manipulator: Introduction, General Description of Robot Manipulator, Mathematical Preliminaries on Vectors & Matrices, Homogenous Representation of Objects, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll-Pitch-Yaw(RPY) Transformation, Relative Transformation, Direct & Inverse Kinematics' Solution, D H Representation & Displacement Matrices for Standard Configurations, Geometrical Approach to Inverse Kinematics. Homogeneous Robotic Differential Transformation: Introduction, Jacobian Transformation in Robotic Manipulation	11
UNIT-3	Robotic Workspace & Motion Trajectory: Introduction, General Structures of Robotic Workspaces, Manipulations with n Revolute Joints, Robotic Workspace Performance Index, Extreme Reaches of Robotic Hands, Robotic Task Description. Robotic Motion Trajectory Design: – Introduction, Trajectory Interpolators, Basic Structure of Trajectory Interpolators, Cubic Joint Trajectories. General Design Consideration on Trajectories: 4-3-4 & 3-5-3 Trajectories, Admissible Motion Trajectories.	10
UNIT-4	Dynamics of Robotic Manipulators: Introduction, Bond Graph Modeling of Robotic Manipulators, Examples of Bond Graph Dynamic Modeling of Robotic Manipulator. Brief Discussion on Lagrange–Euler (LE) Dynamic Modeling of Robotic Manipulators: - Preliminary Definitions, Generalized Robotic Coordinates, Dynamic Constraints, Velocity & Acceleration of Moving Frames, Robotic Mass Distribution & Inertia Tensors, Newton's Equation, Euler Equations, The Lagrangian& Lagrange's Equations. Application of Lagrange–Euler	10

	(LE) Dynamic Modeling of Robotic Manipulators: - Velocity of Joints, Kinetic Energy T of Arm, Potential Energy V of Robotic Arm, The Lagrange L, Two Link Robotic Dynamics with Distributed Mass, Dynamic Equations of Motion for A General Six Axis Manipulator.	
UNIT-5	Autonomous Robot: Locomotion Introduction, Key issues for locomotion Legged Mobile Robots Leg configurations and stability Examples of legged robot locomotion Wheeled Mobile Robots Wheeled locomotion: the design space Wheeled locomotion: case studies Mobile Robot Kinematics Introduction Kinematic Models and Constraints Representing robot position Forward kinematic models Wheel kinematic constraints Robot kinematic constraints, Mobile Robot manoeuvrability Degree of mobility Degree of steerability Robot manoeuvrability.	10

REFERENCE BOOKS:

1. A Robot Engineering Textbook, Mohsen Shahinpoor, Harper & Row publishers, New York. ISBN:006045931X
2. Robotics, control vision and intelligence, Fu, Lee and Gonzalez, McGraw Hill International. ISBN:0070226253
3. Introduction to Robotics, John J. Craig, Addison Wesley Publishing, ISBN:0201543613
4. Autonomous mobile robots, Roland Illah R. Siegwart Nourbakhsh, The MIT Press Cambridge, Massachusetts London, England, 2004. ISBN:0262015358

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

CO1	Analyze the manipulator design including actuator, drive and sensor issues.
CO2	Calculate the forward kinematics, inverse kinematics and jacobian industrial robots.
CO3	Solve trajectory and dynamic related robotic problems.
CO4	Evaluate the different configurations and stability of autonomous robots.
CO5	Understand the concept of autonomous robot.

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			
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 : 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

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	SEE 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.

PART	CONTENTS	Hrs.
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, cantilevr. beams with UDL, beams with varying load.etc (Minimum 10 exercises) .	10
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	
	III. Dynamic Analysis ➤ Fixed- fixed beam for natural frequency determination	4
	➤ Bar subjected to forcing function ➤ Fixed- fixed beam subjected to forcing function	12

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 CONTINUOUS 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 : 2021-22
SEMESTER : SECOND

ACADEMIC YEAR: 2021-22

COURSE TITLE: PROJECT WORK PHASE -I		
Sub Code: 20MMDP29	No of Credits : L-T-P-SS 0:0:0:12=06	No. of Lecture hours/week : --- --
Exam Duration:-----	CIE Marks: 50	SEE Marks :-----

COURSE OBJECTIVES:

1. Support independent learning.
2. A aim of identifying 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. The Project Work will start in Third semester and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
2. The students are required to take up a project work relevant to the course, which involves
 - Introduction
 - literature review
 - problem formulation
 - methodology
 - analysis of results and discussion
 - future scope and conclusion
3. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.
4. Extensive survey should be based on the area of specialization in which the candidate wish to do the dissertation work.
5. The student should prepare a report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report.
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 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.

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

CO1	Demonstrate a sound technical knowledge of their selected project topic.
CO2	Will be able to identify a problem in the area relevant to the program through literature survey.
CO3	The candidate would have prepare a consolidated report of the problem formulation.
CO4	Design engineering solutions to complex problems utilising a systems approach.
CO5	Demonstrate the knowledge, skills and attitudes of a design engineer.

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	
CO3	1		1		1				1		1	
CO4	1		1			1				1		
CO5		1		1		1				1		

(An Autonomous Institute affiliated to VTU, Accredited by NAAC with 'A' grade)

SCHEME OF TEACHING AND EXAMINATION III SEMESTER (Autonomous) 2021-22, 2022-23

III semester

Sl. No.	Sub Code	Subject Title	Teaching Department	Teaching hours per week			Maximum Marks allotted			Examination Credits
				Lecture	Tutorial/ Seminar/ Assignment	Practical / Field Work	CIE	SEE	Total	
1	20MMD31	Self Study – Massive Open Online Course (MOOC)*	MECH	--	6	--	50	50	100	3
2	20MMDI32	Internship	MECH	--	--	16	50	50	100	8
3	20MMDS33	Technical Seminar	MECH	-	4	-	50	-	50	2
4	20MMDP34	Evaluation of Project Work Phase I	MECH	-	-	14	50	50	100	7
Total							200	150	350	20

Sl. No.	Sub Code	Subject Title	Teaching Department	Teaching hours per week			Maximum Marks allotted			Examination Credits
				Lecture	Tutorial/ Seminar/ Assignment	Practical / Field Work	CIE	SEE	Total	
1	20MMDP41	Project Phase – II Midterm Internal Evaluation	MECH	-	-	8	100	-	100	2
2	20MMDP42	Project Work Evaluation and Viva Voce	MECH	-	4	24	100	100	200	18
Total							200	100	300	20
Grand Total (I to IV Semester) :										2300 Marks
Total Credits (I to IV Semester)										88 Credits

ADMISSION YEAR: 2020-21
SEMESTER: THIRD

ACADEMIC YEAR: 2021-22

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
<ul style="list-style-type: none">➤ 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
SEMESTER: THIRD

ACADEMIC YEAR: 2021-22

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
SEMESTER: THIRD

ACADEMIC YEAR: 2021-22

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
SEMESTER: THIRD

ACADEMIC YEAR: 2021-22

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
SEMESTER: FOURTH

ACADEMIC YEAR: 2021-22

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
SEMESTER: FOURTH

ACADEMIC YEAR: 2021-22

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	