M. Tech. in Computer Aided Design and Manufacturing
(M. Tech. - CAD/CAM)

Minimum credits required to complete the Programme				
Core: 18	Electives: 18	Dissertation: 20	Mandatory: 6	Total: 68
Independent Study and Seminar: 6				

SEMESTER – I

S.no.	Course No.	Course Name	L	T	P	C
1	MEL 50X	Core – 1	3	0	0	3
2	MEL 50X	Core – 2	3	0	0	3
3	MEL 52X	Elective – 1	3	0	0	3
4	MEL 52X	Elective – 2	3	0	0	3
5	MEL 55X	Mandatory – 1	3	0	0	3
6	MEP 511	Computer Aided Design and Manufacturing Laboratory (Core Lab)	0	0	6	3
Total			**15**	**0**	**6**	**18**

SEMESTER – II

S.No.	Course No.	Course Name	L	T	P	C
1	MEL 50X	Core – 3	3	0	0	3
2	MEL 50X	Core – 4	3	0	0	3
3	MEL 58X	Elective – 3	3	0	0	3
4	MEL 58X	Elective – 4	3	0	0	3
5	MEL 55X	Mandatory – 2	3	0	0	3
6	MEP 561	Computer Aided Engineering Laboratory (Core Lab)	0	0	6	3
Total			**15**	**0**	**6**	**18**

SEMESTER-III

S.No.	Course No.	Course Name	L	T	P	C
1	MEP 600	Dissertation – I	-	-	-	8
2	MEL 62X	Elective – 5	3	0	0	3
3	MEL 62X	Elective – 6	3	0	0	3
4	MEP 602	Independent Study & Seminar	-	-	-	2
Total			**6**	**-**	**-**	**16**

SEMESTER-IV

S.No.	Course No.	Course Name	L	T	P	C
1	MEP 650	Dissertation- II	-	-	-	12
2	MEP 652	Independent Study & Seminar	-	-	-	4
Total			**-**	**-**	**-**	**16**

Core Courses:

S.N.	Code	Course Name	L	T	P	C	Remarks
1	MEL 501	Computer Aided Design	3	0	0	3	Compulsory Courses
2	MEL 502	Computer Aided Manufacturing & Computer Integrated Manufacturing	3	0	0	3	
3	MEL 503	Robotics	3	0	0	3	
4	MEL 504	Finite Element Method	3	0	0	3	
5	MEP 511	Computer Aided Design and Manufacturing Laboratory	0	0	6	3	
6	MEP 561	Computer Aided Engineering Laboratory	0	0	6	3	
Total			**12**	**0**	**12**	**18**	

Mandatory Courses:

S.N.	Code	Course Name	L	T	P	C	Remarks
1	MEL 551	Computational Methods in Engineering	3	0	0	3	Compulsory Courses
2	MEL 552	Design of Experiments and Research Methodology	3	0	0	3	
Total			**6**	**0**	**0**	**6**	

Elective Courses:

S.N.	Code	Course Name	L	T	P	C	Remarks
1	MEL 521	Advanced Strength of Materials	3	0	0	3	Electives 1 & 2
2	MEL 522	Advanced Materials Technology	3	0	0	3	
3	MEL 523	Engineering Elasticity and Plasticity	3	0	0	3	
4	MEL 524	Advanced Optimization Techniques	3	0	0	3	
5	MEL 581	Advanced Mechanical Vibrations	3	0	0	3	Electives 3 & 4
6	MEL 582	Production and Operations Management	3	0	0	3	
6	MEL 583	Computational Fluid Dynamics	3	0	0	3	
7	MEL 584	Product Design and Development	3	0	0	3	
8	MEL 585	Manufacturing of Plastic Products	3	0	0	3	
9	MEL 586	Modeling and Simulation	3	0	0	3	
10	MEL 587	Product Life Cycle Assessment	3	0	0	3	
11	MEL 621	Advanced Mechanism Design	3	0	0	3	Elective 5 & 6
12	MEL 622	Computer Aided Product Design	3	0	0	3	
13	MEL 623	Advanced Finite Element Method	3	0	0	3	
14	MEL 624	Design for Manufacturing	3	0	0	3	
Minimum Requirement			**18**	**0**	**0**	**18**	

Independent Study and Seminar:

S.N.	Code	Course Name	L	T	P	C	Remarks
1	MEP 602	Independent Study and Seminar	-	-	-	2	Compulsory
2	MEP 652	Independent Study and Seminar	-	-	-	4	
Total			**-**	**-**	**-**	**6**	

Dissertation:

S.N.	Code	Course Name	L	T	P	C	Remarks
1	MEP 600	Dissertation-I	-	-	-	8	Compulsory
2	MEP 650	Dissertation-II	-	-	-	12	
Total			**-**	**-**	**-**	**20**	

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 501	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Core			
Course Title	Computer Aided Design			
Course Coordinator				
Course objectives:	• To acquire knowledge for generating high quality images of massive geometric models in a short time. • To learn about the concepts of surface modeling, physically based modeling and surface visualization.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total Teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil				
Prerequisite credits	Nil				
Equivalent course codes as per proposed course and old course	Nil				
Overlap course codes as per proposed course numbers	Nil				
Text Books:					
1.	Title	Computer Aided Design: A Conceptual Approach			
	Author	Jayanta Sarkar			
	Publisher	CRC Press			
	Edition	1st Edition			

Reference Book:		
1.	Title	Design Theory and Methods using CAD/CAE: The Computer Aided Engineering Design Series
	Author	Kuang-Hua Chang
	Publisher	Academic Press
	Edition	1st Edition

Content

Unit 1:

Introduction: Historical Development, Geometric Modeling, Explicit and Implicit Equations, Intrinsic Equations, Parametric Equations, Coordinate Systems. **(6 hours)**

Unit 2:

Curve Design: Fundamental of Curve Design, Parametric Space of a Curve, Blending Functions, Reparametrization, Space Curves, Straight lines, Spline Curves, Bezier Curves, B-Spline Curve, Rational Polynomials, NURBS. **(6 hours)**

Unit 3:

Surface Design: Fundamental of Surface Design, Parametric Space of a Surface, Reparametrization of a Surface patch, Sixteen Point form, Four Curve Form, Plane surface, Cylindrical and Ruled Surfaces, Surface of Revolution, Bezier Surface, B-Spline Surface. **(6 hours)**

Unit 4:

Solid Design: Fundamental of Solid Design, Parametric Space of a Solids, Continuity and Composite Solids, Surfaces and Curves in a Solid. **(6 hours)**

Unit 5:

Solid Modeling: Topology and Geometry, Set Theory, Boolean Operators, Set-membership Classification, Euler operators, Graph Based Models, Boolean Models, Instances and Parameterized Shapes, Cell Decomposition and Spatial Occupancy Enumeration, Sweep

	Representation, Constructive Solid Geometry, Boundary Representation. **(6 hours)** **Unit 6:** **Transformations:** Translation, Rotation, Scaling, Symmetry and Reflection, Homogeneous Transformations, Orthographic Projections, Axonometric Projections, Oblique Projections, Perspective Transformation. **(3 hours)** **Unit 7:** **Assembly Design:** Assembly-Modeling, Analytical Properties, Relational Properties and Intersections, Data Transfer Formats. **(3 hours)**
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 502	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Core			
Course Title	Computer Aided Manufacturing & Computer Integrated Manufacturing			
Course Coordinator				
Course objectives:	• To train on part programming and program generation from a CAD model. • To train on machining in various CNC machines. • To train on various modern measuring instruments.			

POs					
Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil				
Prerequisite credits	Nil				
Equivalent course codes as per proposed course and old course	Nil				
Overlap course codes as per proposed course numbers	Nil				
Text Books:					
1.	Title	Computer-Aided Manufacturing			
	Author	Tien-Chien Chang			
	Publisher	Pearson			
	Edition	3rd Edition			
Reference Book:					
1.	Title	Computer-Aided Design and Manufacturing			
	Author	Justin Riggs			
	Publisher	Willford Press			
	Edition				
Content	**Unit 1:3** **Fundamentals of Numerical Control:** Need and Future of NC Systems, Principles and Types of NC, Design Features of NC M/c Tools; Machining Centre. **Unit2: 3** **NC Part Programming:** Manual, Computer Assisted-APT, EXAPT, ADAPT and CAD based Part Programming. **Unit3: 3** **Feedback Devices-** Resolvers, Encoders, and Inductosyns.				

	Unit4: 3 **Actuation Systems-** Hydraulic, Pneumatic and Electromechanical. **Unit5: 3** **Computer Control and Adaptive Control System-CNC,** DNC and AC. **Unit6: 3** **Flexible Manufacturing Systems-Concept** and Classification, Types of Flexibility, pallets, fixtures, work handling systems, simulation and analysis in the design of FMS. **Unit7: 3** **Concurrent Engineering-Objectives,** Tools and Applications. **Unit8: 3** **Automated Quality Control Systems-Working,** Programming and Applications of CMM. Fundamentals of Automation in Manufacturing Systems: Manufacturing Systems, Concept Objectives, Types and Trends; Concepts of Mechanization, Automation and Integration. **Unit9: 3** **Functions and Components of CIM System**: Concept of CIMS, Group Technology and Cellular Manufacturing. **Unit10: 3** **Planning and Scheduling Functions in CIM System**,Computer-Aided Process Planning: Approaches – Variant and Generative, Feature Classification and Recognition, Process Classifications and Selections, Machines and Tool Selection, Setting Process Parameters, Process Sheet Documentation. **Unit11: 3** **Automated Material Handling Systems**: Industrial Robots, Conveyors, AGVs, Automatic Storage and Retrieval Systems. **Unit12: 3** **Advanced Manufacturing Systems**: Lean Manufacturing systems, Agile Manufacturing Systems, Reconfigurable Manufacturing Systems, Holonic Manufacturing Systems and Agent-Based Manufacturing Systems.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 503	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Core			
Course Title	Robotics			
Course Coordinator				
Course objectives:	• The objective of this course is to introduce the basic concepts in Robotics The course will illustrate the robot kinematics, sensors, effectors, control systems, and briefly discuss robot application in industry.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	Nil	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			

Text Books:		
1.	Title	Principles of Robot Motion: Theory, Algorithms, and Implementations
	Author	Howie Choset and Kevin M. Lynch
	Publisher	Elsevier
	Edition	

Reference Book:		
1.	Title	Introduction to Robotics: Analysis, Control, Applications
	Author	Saeed B. Niku
	Publisher	Elsevier
	Edition	

Content	**Unit1: 6** **Fundamentals of Robots**: Introduction to Robotics, major component so a robot, robotic like devices, classification of robots – Classification by coordinate system and by control method, Basic components of robot system, functions and specifications of robot, fixed versus flexible automation, overview of robot application. **Unit2: 6** **Robot end Effectors**: Introduction, end effectors, interfacing, types of end effectors, grippers and tools, considerations in the selection and design of remote centered devices. **Unit3: 6** **Actuators:**Types, Characteristics of actuating system: weight, Power-to-weight ratio, Operating pressure, Stiffness vs. compliance, Use of reduction gears, Comparison of hydraulic, Electric, pneumatic, actuators, Hydraulic actuators, Proportional feedback control, Electric Motors: DC motors, Reversible AC motors, Brushless DC motors, Stepper motors- structure and principle of operation, Stepper motor speed-torque characteristics. **Unit4: 6** **Sensors:**Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Velocity sensor- encoders, tachometers, Force and Pressure sensors - piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, Optical, Ultrasonic, Inductive, Capacitive, Eddy-current proximity sensors.

	Unit5: 6 **Robot Kinematics:**Robots as mechanism, Matrix representation-representation of point, vector in space, representation of frame at origin and in reference frame. Homogeneous transformation Matrices, Representation of transformations – pure translation, pure rotation, combined transformations. Forward solution – Denavit Hartenberg procedure. Problems on simple 2R and 3R manipulator, Puma manipulator, SCARA manipulator, Inverse or backward solution – techniques, problems involved of 2R, 3R manipulator. **Unit6: 6** **Velocity and Statics of Manipulators**: Differential relationships, Jacobian, Differential motions of a frame (translation and rotation), Linear and angular velocities of links in serial 2R manipulators Jacobian of serial manipulator, Singularities. Dynamics of Manipulators: Equation of motion of 2R manipulators using Lagrangian, Newton-Euler formulation. Introduction to trajectory planning, basics of trajectory planning.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 504	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Core			
Course Title	Finite Element Method			
Course Coordinator				
Course objectives:	• To study the fundamentals of finite element method. • To apply finite element method for solving one dimensional and two dimensional structural and thermal problems.			

	• To apply finite element method for non linear and structural dynamic problem.				
POs					
Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil				
Prerequisite credits	Nil				
Equivalent course codes as per proposed course and old course	Nil				
Overlap course codes as per proposed course numbers	Nil				
Text Books:					
1.	Title	The Finite Element Method: Linear Static and Dynamic Finite Element Analysis			
	Author	Thomas J. R. Hughes			
	Publisher	Dover Publications			
	Edition				
Reference Book:					
1.	Title	A First Course in the Finite Element Method			
	Author	Daryl L. Logan			
	Publisher	CL Engineering			
	Edition				
Content	**Unit1: 6** **Introduction:** Basic Concept of Finite Element Method, Historical Background, FEM Applications, General Description of FEM, Commercial FEM Software Packages. Spring Element-Stiffness Matrix, Boundary Conditions, Solving Equations, Variational Formulation				

	Approach, Rayleigh-Ritz Method, Principle of Minimum Potential Energy, Weighted Residual Method.Introduction of 0D, 3D and Rigid beam elements/mesh. Structural Vibration and Dynamic Analysis- a. Mode Shape b. Frequency Response analysis **Unit2: 6** **1-D Linear Static Analysis:** Bar and Beam Elements, Local and Global Coordinate System, Transformation of Coordinate Systems, Element Stress, Analysis of Truss, Natural Coordinate System, Interpolation Polynomial, Isoparametric Elements and Numerical Integration, Gaussian Quadrature Approach, Simple problems in 1-D. **Unit3: 6** **Finite Element Analysis of 2-D Problems:** Review of the Basic Theory in 2-D Elasticity, Plane Stress, 2-D Problems using Constant Strain Triangles (CST), Isoparametric Representation, Element Matrices, Stress Calculations. Finite Element Modeling and Simulation Techniques, Symmetry, Nature of FE Solutions, Error, Convergence, Adaptivity, Substructures (Super Elements) in FEA. **Unit4: 6** **Structural Vibration and Dynamic Analysis:** Review of Basic Dynamic Equations, Hamilton's Principle, Element Mass Matrices, Free Vibration (Normal Mode) Analysis, Eigen Values and Eigen Vectors. Introduction to Transient Response Analysis. **Unit5: 6** **Thermal Analysis:** Review of Basic Equations of Heat Transfer, Steady State One Dimensional Heat Conduction, Governing Equations, Boundary Conditions, Element Characteristics, Simple Problems in 1-D.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEP 511	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Core			
Course Title	Computer Aided Design and Manufacturing Laboratory			
Course Coordinator				
Course objectives:	• To review and train in CAD/CAM modeling.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	0	0	6	3	72
Prerequisite course code as per proposed course numbers	Nil				
Prerequisite credits	Nil				
Equivalent course codes as per proposed course and old course	Nil				
Overlap course codes as per proposed course numbers	Nil				

COURSE:	
Content	**CAD Lab:** CAD Introduction. Sketcher, Solid modeling –Extrude, Revolve, Sweep, etc and Variational sweep, Loft ,etc, Surface modeling –Extrude, Sweep, Trim ..etc and Mesh of curves, Free form etc, Feature manipulation – Copy, Edit, Pattern, Suppress, History operations etc, Assembly-Constraints, Exploded Views, Interference check, Drafting-Layouts, Standard & Sectional Views, Detailing & Plotting. Exercises in Modeling and drafting of Mechanical Components -

	Assembly using Parametric and feature based Packages like PRO-E / SOLID WORKS /CATIA / NX etc. (36 hours) **CAM Lab:** Simulation and Machining using CNC / DNC Machine Tools – Use of FEM Packages - Relational Data Base – Networking – Practice on Computer Aided Measuring Instruments - Image Processing – Software Development for Manufacturing – CNC Controllers – Use of advanced CNC Machining Packages – Business Data Processing. (36 hours)
Course Assessment	Continuous Evaluation 50% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEP 561	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Core			
Course Title	Computer Aided Engineering Laboratory			
Course Coordinator				
Course objectives:	• To train on various areas of finite element analysis of mechanical components.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	0	0	6	3	72
Prerequisite course code as per proposed course numbers	Nil				
Prerequisite credits	Nil				
Equivalent course codes	Nil				

as per proposed course and old course				
Overlap course codes as per proposed course numbers	Nil			
COURSE:				
Content	**CAE Lab:** Analysis of Mechanical Components – Use of FEA Packages like ANSYS/ NASTRAN etc., Exercises shall include analysis o 1. FEA introduction 2. CAD Import 3. Types of elements 0D-1D-2D-3D-Rigid Beam Elements 4. Meshing – 2D 3D Meshing 5. Convergence of mesh size 6. Defining mesh Joints 7. Application of Loads and boundary conditions 8. Solver – Types of analysis a. Machine elements under Static loads b. Thermal Analysis of mechanical systems c. Modal Analysis d. Machine elements under Dynamic loads e. Non-linear systems 9. Post processing – a. Viewing FEA results – Stress, deflection, Mode shapes etc. b. Interpretation of FEA Results for design validation.10) Machine elements under Static loads 11) Thermal Analysis of mechanical systems 12) Modal Analysis 13) Machine elements under Dynamic loads Non-linear systems.			
Course Assessment	Continuous Evaluation 50% End Semester 50%			

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 551	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Mandatory			
Course Title	Computational Methods in Engineering			
Course Coordinator				
Course objectives:	• To familiarize students with computational methods in engineering problems. • To expose the students to numerical solutions of partial			

	differential equations.				
POs					
Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil				
Prerequisite credits	Nil				
Equivalent course codes as per proposed course and old course	Nil				
Overlap course codes as per proposed course numbers	Nil				
Text Books:					
1.	Title	Numerical Solution of Partial Differential Equations			
	Author	K. W. Morton and D. F. Mayers			
	Publisher	Cambridge University Press			
	Edition				
Reference Book:					
1.	Title	The finite Difference Methods in Partial Differential Equations			
	Author	A. R. Mitchell and D. F. Griffiths			
	Publisher	John Wiley			
	Edition				

Content	**Unit1: 18** **Introduction to numerical methods applied to engineering problems** *Systems of linear equations*: Matrix notation, Determinants and inversion, Iterative methods, Relaxation methods. *Solution of non-linear equations*: Bisection method, Newton's method, computer programs. *Numerical integration:*Newton-Cotes integration formulas, Simpson's rules, Gaussian quadrature. Adaptive integration. *Curve fitting and approximation of functions:*Least square approximation, fitting of non-linear curves by least squares, regression analysis, multiple linear regression, non linear regression, computer programs. *Boundary value problems and characteristic value problems*:Shooting method, Derivative boundary conditions, Rayleigh–Ritz method, Characteristic value problems. **Unit2: 18** **Numerical solutions of partial differential equations** *Parabolic partial differential equations:*Explicit method, Crank-Nicolson method, Derivative boundary condition, Stability and convergence criteria, computer programs. *Elliptic partial differential equations:*Laplace's equation, Representations as a difference equation, Iterative methods for Laplace's equations, Poisson equation, Examples, Derivative boundary conditions, Irregular and non rectangular grids, Matrix patterns, sparseness, ADI method. *Hyperbolic partial differential equations:*Method of characteristics, Solving wave equation by finite differences, stability of numerical method, wave equation in two space dimensions, computer programs.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 552	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**

	No	No	No	No
Type of course	Mandatory			
Course Title	Design of Experiments and Research Methodology			
Course Coordinator				
Course objectives:	• To provide a perspective on research to the scholars so as to broaden their conceptions of what research involves. • To impart knowledge on techniques related to research such as problem formulation, literature survey, information retrieval, use of statistical techniques, writing of research reports and evaluation.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers					
Prerequisite credits	Nil				
Equivalent course codes as per proposed course and old course	Nil				
Overlap course codes as per proposed course numbers	Nil				

Text Books:		
1.	Title	A DOE Handbook:: A Simple Approach to Basic Statistical Design of Experiments
	Author	Bert Gunter and Daniel Coleman
	Publisher	CreateSpace Independent Publishing Platform
	Edition	
Reference Book:		

1.	Title	Design and Analysis of Experiments
	Author	Douglas C. Montgomery
	Publisher	Wiley
	Edition	

Content

Unit1: 6

Introduction: Defining Research, Scientific Enquiry, Hypothesis, Scientific Method, Types of Research, Research Process and steps in it. Research Proposals – Types, contents, sponsoring agent's requirements, Ethical, Training, Cooperation and Legal aspects.

Unit2: 6

Research Design: Meaning, Need, Concepts related to it, categories; Literature Survey and Review, Dimensions and issues of Research Design, Research Design Process – Selection of type of research, Measurement and measurement techniques ,Selection of Sample, Selection of Data Collection Procedures, Selection of Methods of Analysis, Errors in Research.

Unit3: 6

Research Problem: Problem Solving – Types, Process and Approaches – Logical, Soft System and Creative; Creative problem solving process, Development of Creativity, Group Problem Solving Techniques for Idea Generation – Brain storming and Delphi Method.

Unit4: 6

Research Modeling: (a) Mathematical – Classification of Models, Development of Models, Stages in Model building, Principles of Modeling, Use of Analogy, Models as Approximations, Data consideration and Testing of Models (b) Heuristics and Simulation – Definition, Applications and reasons for using Heuristics, Heuristic Methods and approaches, Meta- Heuristics; Simulation – Meaning, Applications and Classification of Simulation Models, Process of Simulation, Steps and Features of Simulation Experiments and their Validation.

	Unit5: 6 **Experimentation**: Objective, Strategies, Factorial Experimental Design, Applications of Experimental Design, Basic Principles – Replication, Randomization and Blocking, Guidelines for designing experiments; Laboratory Experiments, Methods of manipulating Variables, Errors in Experiments, Steps in Design of Experiments, Basis Process Optimization: Factorial Design principles, Two factor Factorial Design, General Factorial Design, Fitting response Curves and Surfaces, Blocking, Taguchi Approach to Parameter Design, Robust Design **Unit6: 6** **Analysis and Report writing**: Analysis of Variance and Co-variance, Hypothesis Testing – Parametric and Non-Parametric Tests, Uni-variate and Bi-variate analysis.Pre-writing Considerations, Principles of Thesis Writing, Format of Report Writing, Format of Publication in Research Journals, Oral Presentations (Briefing).
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 521	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Advanced Strength of Materials			
Course Coordinator				
Course objectives:	• To provide knowledge in the design of 2D and 3D members by understanding their state of stresses and the design of curved members and non circular sections.			

POs					
Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	Nil	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			
Text Books:					
1.	Title	Advanced Strength of Materials			
	Author	J. P. Den Hartog			
	Publisher	Dover Publications			
	Edition				
Reference Book:					
1.	Title	Advanced Mechanics of Materials and Applied Elasticity			
	Author	Ansel C. Ugural, Saul K. Fenster			
	Publisher	Prentice Hall			
	Edition				
Content	**Unit1: 6** **SHEAR CENTRE**: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections. Unsymmetrical bending: Bending stresses in Beams subjected to				

	Nonsymmetrical bending; Deflection of straight beams due to nonsymmetrical bending. **Unit2: 6** **CURVED BEAM THEORY**: Winkler Bach formula for circumferential stress – Limitations – Correction factors – Radial stress in curved beams – closed ring subjected to concentrated and uniform lads- stresses in chain links. **Unit3: 6** **TORSION**: Torsion of a cylindrical bar of Circular cross Section; Saint-Venant's semi-inverse methods; Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section; Hallow thin wall torsion members, Multiply connected Cross section, Thin wall torsion members with restrained ends. Axi-Symmetric Problems: Rotating Discs – Flat discs, Discs of uniform thickness, Discs of Uniform Strength, Rotating Cylinders. **Unit4: 6** **THEORY OF PLATES**: Introduction; Stress resultants in a flat plate; Kinematics: Strain- Displacement relations for plates; Equilibrium equations for small displacement theory of flat plates; Stress – Strain – Temperature relation for Isotropic plates: Strain energy of a plate; Boundary conditions for plate; Solution of rectangular plate problem; Solution of circular plate problem. **Unit5: 6** **Beams on Elastic Foundation:**General theory; Infinite Beam subjected to Concentrated load; boundary conditions; Infinite beam subjected to a distributed lad segment; Semi-infinite beam with concentrated load near its end; Short Beams. **Unit6: 6** **CONTACT STRESSES:**Introduction, problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Methods of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact

	over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact. Normal and Tangent to contact area.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 522	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Advanced Materials Technology			
Course Coordinator				
Course objectives:	• To study the behavior of engineering materials. • To study the various modern materials, properties and their applications. • To understand the selection of metallic and non-metallic materials for various engineering applications.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite credits	Nil	Nil			
Equivalent course codes	Ni	Nil			

as per proposed course and old course				
Overlap course codes as per proposed course numbers	Nil	Nil		
Text Books:				
1.	Title	Mechanics Of Composite Materials		
	Author	Robert M. Jones		
	Publisher	CRC Press		
	Edition			
Reference Book:				
1.	Title	Mechanics of Composite Materials		
	Author	Autar K. Kaw		
	Publisher	CRC Press		
	Edition			

Content

Unit1: 6

Introduction to Composite Materials: Definition, Classification, Types of matrices & reinforcements, characteristics &selection, Fiber composites, laminated composites, particulate composites, prepregs, sandwich construction.

Unit2: 6

Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli – Rule of mixture, ultimate strengths of unidirectional lamina.

Unit3: 6

Macro Mechanics of a Lamina: Hooke's law for different types of materials, number of elastic constants, Two – dimensional relationship of compliance & stiffness matrix. Hooke's law for two dimensional angle lamina, engineering constants – angle lamina, Invariants, Theories of failure.

Unit4: 6

	Macro Mechanical Analysis of Laminate: Introduction, code, Kirchoff hypothesis – CLT, A, B, & D matrices, Engineering constants, Special cases of laminates, Failure criterion. **Unit5: 6** **Manufacturing:** Layup and curing – open and closed mould processing – Hand lay –up techniques – Bag moulding and filament winding. Pultrusion, pulforming, Thermoforming, Injection moulding, Cutting, Machining and joining, tooling, Quality assurance – Introduction, material qualification, types of defects, NDT methods. **Unit6: 6** **Application Developments:** Aircrafts, missiles, space hardware, automobile, electrical and electronics, marine, recreational and sports equipment-future potential of composites.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 523	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Engineering Elasticity and Plasticity			
Course Coordinator				
Course objectives:	• To study the elastic and plastic behavior of engineering materials.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	Nil	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			
Text Books:					
1.	Title	Elasticity and Plasticity: The Mathematical Theory of Elasticity and The Mathematical Theory of Plasticity			
	Author	J. N. Goodier (Author), Jr., P. G. Hodge (Author)			
	Publisher	Dover Publications			
	Edition				
Reference Book:					
1.	Title	Continuum Mechanics: Elasticity, Plasticity, Viscoelasticity			
	Author	Ellis H. Dill			
	Publisher	Dover Publications			
	Edition				
Content	**Unit 1: 6** **Elasticity**: Analysis of stress and strain, Definition of stress and strain at a point, Equilibrium and compatibility equations, Transformation of stress and strain at a point Principal stresses and strains: Stress and strain invariants, hydrostatic and deviator stress strains.				

	Unit2: 6 **Plane stress and plane strain**: - Simple two-dimensional problems in Cartesian and polar co-ordinates, Airy's stress function in rectangular and polar coordinates. **Unit3: 8** **Stress-strain relations for linearly elastic solids**: Generalized Hooke's law. Solution of axi-symmetric problems, stress concentration due to presence of a circular hole, Elementary problems of elasticity in three dimensions. **Unit4: 8** **Torsion:** St.Venant's approach-Prandtl's approach – Membrane analogy - Torsion of thin walled open and closed sections. **Unit5: 8** **Plasticity**: Physical Assumptions – Yield criteria - Tresca and VonMises criterion of yielding, plastic stress strain relationship, Elastic plastic problems in bending. Some engineering applications of elasticity and plasticity.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 524	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Advanced Optimization Techniques			
Course Coordinator				

Course objectives:	• To introduce the various optimization techniques with applications and their advancements in design engineering.				
POs					
Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil				
Prerequisite credits	Nil				
Equivalent course codes as per proposed course and old course	Nil				
Overlap course codes as per proposed course numbers	Nil				
Text Books:					
1.	Title	Optimization Techniques			
	Author	C. Mohan, Kusum Deep			
	Publisher	New Age Science			
	Edition				
Reference Book:					
1.	Title	Optimization Techniques: An Introduction			
	Author	L. R. Foulds			
	Publisher	Springer			
	Edition				
Content	**Unit1: 6** **Introduction:** Introduction to Optimization, Adequate and Optimum Design, Principles of Optimization, Statement of an Optimization Problem, Classification, Formulation of Objective Function, Design Constraints. **Unit 2: 6** **Classical Optimization Techniques:** Single Variable Optimization,				

	Multivariable Optimization with no Constraints, Exhaustive Search, Fibonacci Method, Golden Selection, Random, Pattern and Gradient Search Methods, Interpolation Methods, Quadratic and Cubic, Direct root Method. **Unit3:8** **Multi Variable Unconstrained and Constrained Optimization:** Direct Search Methods, Descent Methods, Conjugate Gradient Method, Indirect Methods, Transformation Techniques, Penalty Function Method. **Unit4: 8** **Traditional Optimization Techniques:** Genetic Algorithms, Simulated Annealing, Tabu Search Methods. Optimization techniques used by commercial FEA software. For example – Nastran and Hypermesh optistruct. **Unit5: 8** **Optimum Design of Machine Elements:** Desirable and Undesirable Effects, Functional Requirement, Material and Geometrical Parameters, Design of Simple Axial, Transverse Loaded Members for Minimum Cost and Minimum Weight, Design of Shafts, Springs, Vibration Absorbers.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 581	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Advanced Mechanical Vibrations			
Course				

Coordinator					
Course objectives:	• To understand the fundamentals of vibration phenomenon and its measurement. • To know the various constraints of vibration system and its analysis. • To study the vibrations of various generic components, its effect on balancing and the devices for its measurements.				
POs					
Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	Nil	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			
Text Books:					
1.	Title	Advanced Vibration Analysis			
	Author	S. Graham Kelly			
	Publisher	CRC Press			
	Edition				
Reference Book:					
1.	Title	Advanced Engineering Dynamics			
	Author	Jerry H. Ginsberg			
	Publisher	CRC Press			
	Edition				

Content	**Unit1: 6** **Introduction:** Characterization of engineering vibration problems, Review of single degree freedom systems with free, damped and forced vibrations. **Unit2: 6** **Two-degree of Freedom Systems:** Principal modes of vibration, Spring coupled and mass coupled systems, Forced vibration of an undamped close coupled and far coupled systems, Undamped vibration absorbers, Forced damped vibrations, Vibration isolation. **Unit3: 6** **Multi-degree Freedom systems:** Eigen-value problem, Close coupled and far coupled systems, Orthogonality of mode shapes, Modal analysis for free, damped and forced vibration systems, Approximate methods for fundamental frequency- Rayleigh's, Dunkerely, Stodola and Holzer method, Method of matrix iteration, Finite element method for close coupled and far coupled systems. **Unit4: 6** **Continuous systems:** Forced vibration of systems governed by wave equation, Free and forced vibrations of beams/ bars. **Unit5: 6** **Transient Vibrations:** Response to an impulsive, step and pulse input, Shock spectrum. **Unit6: 6** **Non-linear Vibrations:** Non-linear systems, Undamped and forced vibration with non-linear spring forces, Self-excited vibrations.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 582	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Production and Operations Management			
Course Coordinator				
Course objectives:	• To introduce the various production and operations management methods to be followed in the industry.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	Nil	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			

Text Books:		
1.	Title	Production and Operations Management Systems
	Author	Sushil Gupta and Martin Starr
	Publisher	CRC Press
	Edition	

Reference Book:		
1.	Title	Production and Operations Management: Manufacturing and Services
	Author	Richard B. Chase and Nicholas J. Aquilano
	Publisher	Richard D Irwin
	Edition	

Content

Unit1: 6

Introduction: Operations strategy, Framework for operations strategy in manufacturing, Operations strategy services, Meeting the competitive challenges.

Unit2: 6

Managing the Supply Chain: Supply chain management, Purchasing, JIT purchasing, Global sourcing, Electronic information flow, Forecasting, Qualitative techniques, Focus forecasting, Aggregate planning techniques, Inventory systems for independent demand, Inventory systems for independent time period models, Inventory systems for dependent demand, MRP type systems, Embedding JIT into MRP, Lot sizing in MRP, Advanced MRP Systems.

Unit3: 6

Operations Scheduling: Scheduling & control functions, Priority rules and techniques, Single machine scheduling problems, Scheduling in jobs on 'm' machines, Personal scheduling, Simulation methodology, Two assembly simulation.

Unit4: 6

Design of Facilities & Jobs: Strategic capacity planning concepts, determining capacity requirements, Planning service capacity, JIT production systems, Process and Product layout, GT layout, Retail service layout, Computer aided layout techniques. Job design and work measurement, Considerations in job design, Work measurements and standards, Financial incentive plans, Learning curves and its applications.

Unit5: 6

	Product Design & Process Selection: Product design process, Designing for the customer QFD, Value analysis, designing products for manufacturer & assembly. Process selection, Waiting line management & models, **Unit6: 6** **Quality management**: Quality specifications & costs, Tolls and procedures for continuous improvement, Shingo system of fail-safe design, Review of SQC models.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 583	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Computational Fluid Dynamics			
Course Coordinator				
Course objectives:	• To provide an overview of the theory and numerics of CFD and an introduction to the use of commercial CFD codes to analyze flow and heat transfer in problems of practical engineering interest.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code	Nil	Nil			

as per proposed course numbers				
Prerequisite credits	Nil	Nil		
Equivalent course codes as per proposed course and old course	Nil	Nil		
Overlap course codes as per proposed course numbers	Nil	Nil		

Text Books:		
1.	Title	Computational Fluid Dynamics
	Author	John Anderson
	Publisher	McGraw-Hill Education
	Edition	
Reference Book:		
1.	Title	Computational Fluid Mechanics and Heat Transfer
	Author	Richard H. Pletcher and John C. Tannehill
	Publisher	CRC Press
	Edition	

Content	**Unit1: 6** **Introduction**: Finite Difference Method, Finite Volume Method, Finite Element Method, Governing Equations and Boundary Conditions. **Unit2: 6** **Hyperbolic equations**: Explicit Schemes and Von Neumann Stability Analysis, Implicit Schemes, Multi Step Methods, Nonlinear Problems, Second Order One-Dimensional Wave Equations, Burgers Equations, Explicit and Implicit Schemes, Runge-Kutta Method. **Unit3: 6** **Formulations of Incompressible Viscous Flows**: Formulations of Incompressible Viscous Flows by Finite Difference Methods, Pressure Correction Methods, Vortex Methods.

	Unit4: 6 **Treatment of Compressible Flows**: Potential Equation, Euler Equations, Navier-Stokes System of Equations, Flow Field-Dependent Variation Methods, Boundary Conditions, Example Problems. **Unit5: 6** **Finite Volume Method:**Finite Volume Method via Finite Difference Method, Formulations for Two and Three-Dimensional Problems. **Unit6: 6** **Standard Variational Methods:** Linear Fluid Flow Problems, Steady State Problems, Transient Problems.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 584	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Product Design and Development			
Course Coordinator				
Course objectives:	• To gain knowledge on multiple functional areas like marketing, finance, industrial design, engineering and production in creating a new product.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load

Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	Nil	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			
Text Books:					
1.	Title	Product Design and Development			
	Author	Karl T. Ulrich and Steven D. Eppinger			
	Publisher	McGraw-Hill Education			
	Edition				
Reference Book:					
1.	Title	Making It: Manufacturing Techniques for Product Design			
	Author	Chris Lefteri			
	Publisher	McGraw-Hill Education			
	Edition				

Content	**Unit1: 6** **Introduction**: Significance of product design, product design and development process, sequential engineering design method, the challenges of product development. **Unit2: 6** **Product Planning and Project Selection**: Identifying opportunities, evaluate and prioritize projects, allocation of resources **Unit3: 6** **Identifying Customer Needs**: Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of

	needs. **Unit4: 6** **Product Specifications**: Establish target specifications, setting final specifications Concept Generation: Activities of concept generation, clarifying problem, search both internally and externally, explore the output, Industrial Design: Assessing need for industrial design, industrial design process, management, assessing quality of industrial design **Unit5: 6** **Concept Selection**: Overview, concept screening and concept scoring, methods of selection. Theory of inventive problem solving (TRIZ): Fundamentals, methods and techniques, General Theory of Innovation and TRIZ, Value engineering Applications in Product development and design, Model-based technology for generating innovative ideas. Concept Testing: Elements of testing: qualitative and quantitative methods including survey, measurement of customers' response. **Unit6: 6** **Intellectual Property**: Elements and outline, patenting procedures, claim procedure, Design for Environment: Impact, regulations from government, ISO system.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 585	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Manufacturing of Plastic Products			
Course Coordinator				

Course objectives:	This subject will give an exposure to the students about plastics and the various manufacturing technologies available for their fabrication.				
POs					
Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	Nil	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			
Text Books:					
1.	Title	Polymer Processing: Principles and Design			
	Author	Donald G. Baird and Dimitris I. Collias			
	Publisher	Elsevier			
	Edition				
Reference Book:					
1.	Title	Polymer Processing			
	Author	D. H. Morton-Jones			
	Publisher	Elsevier			
	Edition				
Content	**Unit1: 6** **Introduction to Polymers & Plastics** –Types of polymers, Commodity plastics and special purpose plastics, Environment friendly plastics, Plastic recycling & plastic identification codes**,** Additives and fillers				

	Unit2: 6 **Polymer processing technologies -** Melt flow, Extrusion, Injection molding, Rotational molding, Compression molding, Polymer foaming, Vacuum forming, Filament winding, Thermoforming, Calendaring, Resin transfer molding, foaming of polymers and its application in industries. **Unit3: 6** **Fiber Reinforced Polymeric Composites -** Introduction, Types of fibers, Manufacturing techniques, Micro & Macro mechanical analysis of Lamina**,** Testing of composites, fiber volume fraction, tensile, shear, compressive, flexural and thermoelastic responses of lamina and laminates, shear test, notched strength, essential work of fracture, fracture toughness, non destructive testing. **Unit4: 6** **Testing of polymer products -** Testing of plastics and dry rubber products – mechanical properties – tensile, Flexural, compressive, impact, hardness, abrasion and fatigue resistance tests, Thermal properties – thermal conductivity, thermal expansion and brittleness temperature, heat deflection temperature **Unit5: 6** **Types of material characterization techniques**: Scanning electron microscope,MFI, capillary rheometer test, viscosity, gel time and peak exothermic temperature.Manufacturing of test specimens **Unit6: 6** **Selecting plastics for end-applications** Automotive applications, Aerospace applications, House-hold applications, Textile applications, Food & packaging applications
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 586	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Modeling and Simulation			
Course Coordinator				
Course objectives:	• To provide a perspective on modeling and simulation of mechanical systems.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	Nil	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			

Text Books:		
1.	Title	Simulation Modeling and Analysis
	Author	Averill Law
	Publisher	Elsevier
	Edition	
Reference Book:		
1.	Title	Principles of Modeling and Simulation: A Multidisciplinary Approach

	Author	John A. Sokolowski and Catherine M. Banks
	Publisher	Elsevier
	Edition	

Content	**Unit1: 6** **Introduction**: A review of basic probability and statistics, random variables and their properties, Estimation of means variances and correlation. **Unit2: 6** **Physical Modeling**: Concept of System and environment, Continuous and discrete systems, Linear and non-linear systems, Stochastic activities, Static and Dynamic models, Principles of modeling, Basic Simulation modeling, Role of simulation in model evaluation and studies, advantages of simulation. **Unit3: 8** **System Simulation:** Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques, Continuous system models, Analog and Hybrid simulation, Feedback systems, Computers in simulation studies, Simulation software packages. **Unit4: 8** **System Dynamics**: Growth and Decay models, Logistic curves, System dynamics diagrams. Probability Concepts in Simulation: Stochastic variables, discrete and continuous probability functions, Random numbers, Generation of Random numbers, Variance reduction techniques, Determination of length of simulation runs. **Unit5: 8** **Simulation of Mechanical Systems**: Building of Simulation models, Simulation of translational and rotational mechanical systems, Simulation of hydraulic and pneumatic systems. Simulation of Manufacturing Systems: Simulation of waiting line systems, Job shop with material handling and Flexible manufacturing systems, Simulation software for manufacturing, Structure and development of expert systems.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 587	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Product Life Cycle Assessment			
Course Coordinator				
Course objectives:	• To know about the various aspects of Product life cycle assessment and management.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	Nil	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			

Text Books:		
1.	Title	Product Lifecycle Management: Driving the Next Generation of Lean Thinking
	Author	Michael Grieves
	Publisher	Elsevier
	Edition	

Reference Book:		
1.	Title	
	Author	
	Publisher	
	Edition	

Content	**Unit1: 6** **Product Life Cycle Management** – Need for PLM, Components of PLM, Product Data and Product workflow, Drivers for Change, The PLM Strategy, Developing a PLM Strategy, A Five-step Process. **Unit2: 6** **Strategy Identification and Selection:** Strategy Elements, Implications of Strategy Elements, Policies, Strategy Analysis, Communicating the Strategy. **Unit3: 6** **Change Management for PLM:** Configuration management, cost of design changes, schemes for concurrent engineering, Design for manufacturing and assembly, robust design, failure mode and effect-analysis. **Unit4: 6** **Modeling, Current Concepts:** part design, sketching, use of datum's construction features, free ovulation, pattering, copying, and modifying features, reference standards for datum specification, Standards for Engineering data exchange. **Unit5: 6** **Tolerance Mass Property Calculations:** rapid prototyping and tooling, finite modeling and analysis, general procedure, analysis techniques. **Unit6: 6** **Finite Element Modeling:** Applicability of FEM, Static analysis, thermal analysis, dynamic analysis.

Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 621	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Advanced Mechanism Design			
Course Coordinator				
Course objectives:	• To gain knowledge of advanced mechanisms and design considerations.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	Nil	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			

Text Books:		
1.	Title	Advanced Mechanism Design: Analysis and Synthesis Vol. II
	Author	Sandor and Arthur G. Erdman

	Publisher	Elsevier
	Edition	
Reference Book:		
1.	Title	Advanced Theory of Mechanisms and Machines
	Author	M.Z. Kolovsky and A.N. Evgrafov
	Publisher	Elsevier
	Edition	

Content	**Unit1: 8** **Introduction:** Concepts related to kinematics and mechanisms, Degrees of freedom, Grubler's Criteria, Transmission and Deviation angles, Mechanical advantage. **Unit2: 6** **Kinematic Synthesis:** Type, number and dimensional synthesis, Spacing of accuracy points, Chebyshev polynomials, Motion and function generation, Graphical synthesis with two, three and four prescribed motions and points, The complex number modeling in kinematic synthesis, The Dyad, Standard form, Freudentein's equation for three point function generation coupler curves, Robert's law, Cognates of the slider crank chain. **Unit3: 6** **Path Curvature Theory:** Fixed and moving centrode, Inflection points and inflection circle circle, Euler'-savary Equation, Bobillier's and Hartsman construction. **Unit4: 8** **Dynamic Force Analysis:** Introduction, Inertia force in linkages, Kineto static analysis by superposition and matrix approach, Time response of mechanisms, Force and moment balancing of linkages. **Unit5: 8** **Spatial Mechanism:** Introduction to 3-dimensional mechanisms, Planar Finite, Rigid body and spatial transformation, Analysis of spatial

	mechanisms.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 622	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Computer Aided Product Design			
Course Coordinator				
Course objectives:	• To impart the knowledge of computer aided product design and various approach of process planning and manufacturing.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			
Prerequisite credits	Nil	Nil			
Equivalent course codes as per proposed course and old course	Nil	Nil			
Overlap course codes as per proposed course numbers	Nil	Nil			
Text Books:					

1.	Title	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing
	Author	Ian Gibson and David Rosen
	Publisher	Elsevier
	Edition	
Reference Book:		
1.	Title	CAD and Rapid Prototyping for Product Design
	Author	Douglas Bryden
	Publisher	Elsevier
	Edition	

Content	**Unit1: 6** **Introduction:** Significance of product design, product design and development process, sequential engineering design method, the challenges of product development, World Class manufacturing, Product definition, Engineering Design Process, Prototype Design and Innovation, Impact of Cost, Quality and time, Key Process Requirements for Rapid Prototyping. **Unit2: 6** **Prototyping:** Product Prototyping, Prototype planning and management, Prototype cost estimation, Prototype Design Methods and tools. Materials Selection and Product Prototyping. **Unit3: 6** **Phases of Prototyping.** Fundamentals of R.P. Classification of R.P. Processes.Concept Generation: Activities of concept generation, clarifying problem, search both internally and externally, explore the output,Concept Testing: Elements of testing: qualitative and quantitative methods including survey, measurement of customers' response **Unit4: 6** **Rapid Prototyping Process:** - Automated Processes, Difference between Additive and Subtractive Processes, Process Chain, steps in involved in

	R.P. **Unit5: 6** **Types of R.P. systems:** - Liquid Based, Solid Based, & Powder Based. **Unit6: 6** **Application of R.P. in Manufacturing and Rapid Tooling:** Rapid Prototyping and Manufacturing Benchmarking, Modeling practice on softwares such as IDEAS, UNIGRAPHICS, ProE, etc.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 623	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Advanced Finite Element Method			
Course Coordinator				
Course objectives:	• Introduction to plates and shells theory. • To apply finite element method for non linear and structural dynamic problem.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course	Nil	Nil			

numbers				
Prerequisite credits	Nil	Nil		
Equivalent course codes as per proposed course and old course	Nil	Nil		
Overlap course codes as per proposed course numbers	Nil	Nil		
Text Books:				
1.	Title	Advanced Finite Element Method in Structural Engineering		
	Author	Yu-Qiu Long and Song Cen		
	Publisher			
	Edition			
Reference Book:				
1.	Title	Advanced Topics in Finite Element Analysis of Structures: With Mathematica and MATLAB Computations		
	Author	M. Asghar Bhatti		
	Publisher			
	Edition			

Content	**Unit1: 6** **Bending of Plates and Shells**: Review of Elasticity Equations, Bending of Plates and Shells, Finite Element Formulation of Plate and Shell Elements, Confirming and Non- Confirming Elements, C_o and C_1 Continuity Elements, Application and Examples. **Unit2: 6** **Non-Linear Problems:** Introduction, Iterative Techniques, Material, Non-Linearity, Elasto-Plasticity, Plasticity, Visco-Plasticity, Geometric Non-Linearity, Large Displacement Formulation, Application in Metal Forming Process, Contact Problems. **Unit3: 8** **Dynamic Problem:** Direct Formulation, Free, Transient and Forced Response, Solution Procedures, Subspace Iterative Technique, Houbolt,

	Wilson and New Mark Methods, Examples. **Unit4: 8** **Error Estimates and Adaptive Refinement:** Error Norms and Convergence Rates, -h Refinement with Adaptivity, Adaptive Refinement. **Unit5: 8** **Fluid Mechanics and Heat Transfer:** Governing Equations of Fluid Mechanics, In Viscid and Incompressible Flow Potential Formulations, Slow Non-Newtonian Flow, Metal and Polymer Forming, Navier Strokes Equation, Steady and Transient Solution.
Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%

COURSE CONTENT PERFORMA

Department: Mechanical Engineering

Course no: MEL 624	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	No	No
Type of course	Elective			
Course Title	Design for Manufacturing			
Course Coordinator				
Course objectives:	• To acquire knowledge for need and manufacturing based design and assembly.			
POs				

Semester	Autumn:		Spring:		
	Lecture	Tutorial	Practical	Credits	Total teaching load
Contact Hours	3	0	0	3	36
Prerequisite course code as per proposed course numbers	Nil	Nil			

Prerequisite credits	Nil	Nil		
Equivalent course codes as per proposed course and old course	Nil	Nil		
Overlap course codes as per proposed course numbers	Nil	Nil		
Text Books:				
1.	Title	Design for Manufacturability Handbook		
	Author	James Bralla		
	Publisher	McGraw-Hill Education		
	Edition			
Reference Book:				
1.	Title	Design for Manufacturability: How to Use Concurrent Engineering to Rapidly Develop Low-Cost, High-Quality Products		
	Author	David M. Anderson		
	Publisher	McGraw-Hill Education		
	Edition			

Content	**Unit1: 6** **INTRODUCTION:**Design philosophy steps in Design process - General Design rules for manufacturability - basic principles of design Ling for economical production - creativity in design. Materials: Selection of Materials for design Developments in Material technology - criteria for material selection - Material selection interrelationship with process selection process selection charts. **Unit2: 6** **MACHINING PROCESS:**Overview of various machining processes - general design rules for machining - Dimensional tolerance and surface roughness - Design for machining - Ease - Redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

	Unit3: 6 **METAL CASTING**: Appraisal of various casting processes, selection of casting process, - general design considerations for casting - casting tolerances - use of solidification simulation in casting design - product design rules for sand casting. **Unit4: 6** **METAL JOINING**: Appraisal of various welding processes, Factors in design of weldments - general design guidelines - pre and post treatment of welds - effects of thermal stresses in weld joints - design of brazed joints. Forging - Design factors for Forging - Closed dies forging design - parting lines of die5 drop forging die design - general design recommendations. Extrusion & Sheet Metal Work: Design guidelines for extruded sections - design principles for Punching, Blanking, Bending, Deep Drawing - Keeler Goodman Forming Line Diagram - Component Design for Blanking. **Unit5: 6** **ASSEMBLE ADVANTAGES**: Development of the assemble process, choice of assemble method assemble advantages social effects of automation. Automatic assembly transfer systems, Continuous transfer, intermittent transfer, indexing mechanisms, and operator - paced free – transfer machine. **Unit6: 6** **DESIGN OF MANUAL ASSEMBLY**: Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.

Course Assessment	Continuous Evaluation 25% Mid Semester 25% End Semester 50%