Curriculum

KIT - Kalaignarkarunanidhi Institute of Technology

An Autonomous Institution

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NAAC with 'A' GRADE & NBA (AERO, CSE, ECE, EEE, MECH & MBA)
An ISO 9001 : 2015 Certified Institution, Coimbatore - 641 402.

DEPARTMENT OF MECHANICAL ENGINEERING

M.E. - ENGINEERING DESIGN

Conceptual Frame work
(For Students admitted from the Academic Year 2023-24 and onwards)

Semester	Level of Course	Hrs. / Week	No of Courses	Range of Credits / Courses	Total Credits
A - Foundation Courses					
I	Basic Science (BS)	4	1	4	4
B - Professional Core Courses					
I to II	Professional Core (PC)	34	11	2 - 4	31
C - Elective Courses					
I to III	Professional Elective (PE)	15	5	3	15
III	Open Elective (OE)	3	1	3	3
D - Project Work Courses					
II to IV	Project Work (PW)	63	3	2 - 12	20
Total Credit					**73**

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Curriculum and Scheme of Assessment

(For Students admitted from the Academic Year 2023-24 and onwards)

SEMESTER - I											
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory											
M23MAT103	Applied Mathematics for Engineers	**BS**	4	3	1	0	**4**	40	60	100
M23EDT101	Computer Applications in Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT102	Quality Concepts in Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT103	Advanced Finite Element Analysis	**PC**	4	3	1	0	**4**	40	60	100
M23EDT104	Advanced Machine Tool Design	**PC**	3	3	0	0	**3**	40	60	100
	Professional Elective I	**PE**	3	3	0	0	**3**	40	60	100
Practical											
M23EDP101	CAD Laboratory	**PC**	3	0	0	3	**2**	60	40	100
M23EDP102	Advanced Analysis and Simulation Laboratory	**PC**	3	0	0	3	**2**	60	40	100
Total credits to be earned							**24**			

SEMESTER - II											
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory											
M23EDT201	Tribology in Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT202	Mechanical Behavior of Materials	**PC**	3	3	0	0	**3**	40	60	100
M23EDT203	Integrated Mechanical Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT204	Vibration Analysis and Control	**PC**	3	3	0	0	**3**	40	60	100
	Professional Elective II	**PE**	3	3	0	0	**3**	40	60	100
	Professional Elective III	**PE**	3	3	0	0	**3**	40	60	100
Practical											
M23EDP201	Vibration Laboratory	**PC**	3	0	0	3	**2**	60	40	100
M23EDP202	Design Project	**PW**	3	0	0	6	**2**	60	40	100
Total credits to be earned							**22**			

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SEMESTER - III										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory										
	Professional Elective IV	**OE**	3	3	0	0	**3**	40	60	100
	Professional Elective V	**PE**	3	3	0	0	**3**	40	60	100
	Professional Elective VI	**PE**	3	3	0	0	**3**	40	60	100
Practical										
M23EDP301	Project Work Phase - I	**PW**	20	0	0	12	**6**	60	40	100
Total credits to be earned							**15**			

SEMESTER - IV										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Practical										
M23EDP401	Project Work Phase II	**PW**	40	0	0	24	**12**	60	40	100
Total credits to be earned							**12**			

BASIC SCIENCE (BS)										
SEMESTER – I										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
M23MAT103	Applied Mathematics For Engineers	**PC**	4	3	1	0	**4**	40	60	100

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PROFESSIONAL CORE (PC)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory										
M23EDT101	Computer Applications in Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT102	Quality Concepts in Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT103	Advanced Finite Element Analysis	**PC**	4	3	1	0	**4**	40	60	100
M23EDT104	Advanced Machine Tool Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT201	Tribology in Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT202	Mechanical Behavior of Materials	**PC**	3	3	0	0	**3**	40	60	100
M23EDT203	Integrated Mechanical Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT204	Vibration Analysis and Control	**PC**	3	3	0	0	**3**	40	60	100
Practical										
M23EDP101	CAD Laboratory	**PC**	3	0	0	3	**2**	60	40	100
M23EDP102	Advanced Analysis and Simulation Laboratory	**PC**	3	0	0	3	**2**	60	40	100
M23EDP201	Vibration Laboratory	**PC**	3	0	0	3	**2**	60	40	100

PROFESSIONAL ELECTIVES (PE)										
SEMESTER – I										
ELECTIVE – I										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
M23EDE101	Optimization Techniques in Design	**PE**	3	3	0	0	**3**	40	60	100
M23EDE102	Research Methodology, IPR and Patents	**PE**	3	3	0	0	**3**	40	60	100
M23EDE103	Engineering Fracture Mechanics	**PE**	3	3	0	0	**3**	40	60	100
M23EDE104	Additive Manufacturing and Tooling	**PE**	3	3	0	0	**3**	40	60	100
M23EDE105	Information Analytics	**PE**	3	3	0	0	**3**	40	60	100

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SEMESTER – II										
ELECTIVE – II & III										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
M23EDE201	Artificial Intelligence and Machine Learning	PE	3	3	0	0	3	40	60	100
M23EDE202	Modal Analysis of Mechanical Systems	PE	3	3	0	0	3	40	60	100
M23EDE203	Advanced Metal Forming Techniques	PE	3	3	0	0	3	40	60	100
M23EDE204	Surface Engineering	PE	3	3	0	0	3	40	60	100
M23EDE205	Mechanisms Design and Simulation	PE	3	3	0	0	3	40	60	100
M23EDE206	Design of Material Handling Systems	PE	3	3	0	0	3	40	60	100
M23EDE207	Bio Materials	PE	3	3	0	0	3	40	60	100
M23EDE208	Mechanical Measurements and Analysis	PE	3	3	0	0	3	40	60	100
M23EDE209	Computational Fluid Dynamics	PE	3	3	0	0	3	40	60	100
M23EDE210	Design of Hybrid and Electric Vehicles	PE	3	3	0	0	3	40	60	100

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SEMESTER – III										
ELECTIVE – IV & V										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
M23EDE301	Advanced strength of materials	PE	3	3	0	0	3	40	60	100
M23EDE302	Design of Hydraulic and Pneumatic Systems	PE	3	3	0	0	3	40	60	100
M23EDE303	Design for X	PE	3	3	0	0	3	40	60	100
M23EDE304	Product Design for Sustainability	PE	3	3	0	0	3	40	60	100
M23EDE305	Green Manufacturing Practices	PE	3	3	0	0	3	40	60	100
M23EDE306	Design for Manufacture, Assembly and Environments	PE	3	3	0	0	3	40	60	100
M23EDE307	Engineering Biomechanics	PE	3	3	0	0	3	40	60	100
M23EDE308	Composite Materials and Mechanics	PE	3	3	0	0	3	40	60	100
M23EDE309	Design for Internet of Things	PE	3	3	0	0	3	40	60	100
M23EDE310	Human Factors Engineering in Product Design	PE	3	3	0	0	3	40	60	100
M23EDE311	Product Lifecycle Management	PE	3	3	0	0	3	40	60	100
M23EDE312	Cost Management of Engineering Projects	PE	3	3	0	0	3	40	60	100

PROJECT WORK (PW)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
M23EDP202	Design Project	PW	3	0	0	6	2	40	60	100
M23EDP301	Project Work Phase I	PW	20	0	0	12	6	40	60	100
M23EDP401	Project Work Phase II	PW	40	0	0	24	12	40	60	100

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Semester - I

M.E - E.D	M23MAT103 - APPLIED MATHEMATICS FOR ENGINEERS	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	This course is designed to enrich the knowledge in various advanced mathematical techniques such as matrix theory, calculus of variations, probability and random variables, Laplace transforms and Fourier transforms.
2.	The fundamental concepts in these areas will be more useful for the students to model the engineering problems and solving them by applying these methods.
3.	Mathematics fundamental necessary to formulate, solve and analyze engineering problems.
4.	An understanding of Linear Algebra through matrices.
5.	An understanding of Complex integration.

UNIT - I	MATRIX THEORY	12

The Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Least squares method - Singular value decomposition.

UNIT - II	CALCULUS OF VARIATIONS	12

Concept of variation and its properties – Euler's equation – Functional dependent on first and higher order derivatives – Functional dependent on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems - Direct methods : Ritz and Kantorovich methods.

UNIT - III	ONE DIMENSIONAL RANDOM VARIABLES	12

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

UNIT - IV	LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS	12

Laplace transform - Definitions - Properties – Transform error function - Bessel's function - Dirac delta function - Unit step functions – Convolution theorem – Inverse Laplace transform: Complex inversion formula – Solutions to partial differential equations: Heat equation - Wave equation.

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UNIT - V	FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS	12
Fourier transform: Definitions – Properties – Transform of elementary functions – Dirac delta function – Convolution theorem – Parseval's identity – Solutions to partial differential equations: Heat equation - Wave equation - Laplace and Poisson's equations.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Apply various methods in matrix theory to solve system of linear equations
CO2	Solve maximizing and minimizing the functional that occur in mechanical engineering disciplines.
CO3	Solve moments, MGF and different types of distributions problems.
CO4	Apply Laplace transforms to initial value, initial–boundary value and boundary value problems in Partial Differential Equations
CO5	Apply Fourier transforms to initial value, initial–boundary value and boundary value problems in Partial Differential Equations

Reference Books	
1.	Andrews L.C. and Shivamoggi, B. "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi,2003.
2.	Bronson, R. "Matrix Operations", Schaum's outline series, McGraw Hill, 2nd Edition, 2011.
3.	James, G., "Advanced Modern Engineering Mathematics ", Pearson Education, 3rd Edition, 2004.
4.	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
5.	O'Neil, P.V., "Advanced Engineering Mathematics ", Thomson Asia Pvt. Ltd., Singapore,2011.
6.	SankaraRao, K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 2011.

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M.E - E.D	M23EDT101 - COMPUTER APPLICATIONS IN DESIGN	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the Fundamentals of CAD/CAM.
2.	To evaluate and refine the design using computer simulations.
3.	To understand the solid modeling techniques.
4.	To visualize the visual realism using software package.
5.	To understand the assembly and data exchange process.

UNIT - I	INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS	9

Output primitives (points, lines, curves etc.,), 2-D & 3-D transformation (Translation, scaling, rotation) windowing - view ports - clipping transformation.

UNIT - II	CURVES AND SURFACES MODELING	9

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations. Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: Hermite bi-cubic surface- Bezier surface and B-Spline surface- surface manipulations.

UNIT - III	NURBS AND SOLID MODELING	9

NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations – constructive solid Geometry - comparison of representations - user interface for solid modeling.

UNIT - IV	VISUAL REALISM	9

Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages.

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UNIT - V	ASSEMBLY OF PARTS AND PRODUCT DATA EXCHANGE	9
Assembly modeling - interferences of positions and orientation - tolerances analysis – mass property calculations - mechanism simulation. Graphics and computing standards - GKS- Bitmaps - Open GL Data Exchange standards - IGES - STEP - CALS - DXF - Communications standards - WAN - LAN.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the fundamentals of computer graphics.
CO2	Apply different techniques for geometric modeling.
CO3	Apply different algorithm to create prismatic and lofted parts.
CO4	Outline tolerance analysis and mass property calculations.
CO5	Explain data exchange standards and communication standards.

Text Books	
1.	Ibrahim Zeid Mastering CAD/CAM – McGraw Hill, International Edition, 2010.
2.	David F. Rogers, James Alan Adams “Mathematical elements for computer graphics” fifth edition, Tata McGraw-Hill edition.2011.

Reference Books	
1.	Donald Hearn and M. Pauline Baker “Computer Graphics”, Prentice Hall, Inc., 2013.
2.	Foley, Wan Dam, Feiner and Hughes – Computer graphics principles & practices, Pearson Education – 2010.
3.	William M Neumann and Robert F. Sproull “Principles of Computer Graphics”, McGraw Hill Book – 2011.

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M.E - E.D	M23EDT102 - QUALITY CONCEPTS IN DESIGN	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on materials selection and manufacturing processes integrated with Engineering Design.
2.	To evaluate and refine the design using computer simulations.
3.	To understand the need for component design.
4.	To understand the concept of conveyors.
5.	To calculate and evaluate design of elevators.

UNIT - I	DESIGN FUNDAMENTALS, METHODS AND MATERIAL SELECTION	9

Morphology of Design – The Design Process – Computer Aided Engineering – Concurrent Engineering – Competition Bench Marking – Creativity – Theory of Problem solving (TRIZ) – Value Analysis - Design for Manufacture, Design for Assembly – Design for casting, Forging, Metal Forming, Machining and Welding.

UNIT - II	DESIGN FOR QUALITY	9

Identification of customer needs - customer requirements - Quality Function Deployment - Product Design Specifications - Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics – Ethical conflicts – Environment responsible design - future trends in interaction of Engineering with society.

UNIT - III	FAILURE MODE EFFECTS ANALYSIS AND DESIGN FOR SIX SIGMA	9

Basic methods : Refining geometry and layout, general process of product embodiment - Embodiment checklist - **Advanced methods :** systems modeling, mechanical embodiment principles - MEA method - linking fault states to systems modeling - Basis of SIX SIGMA – Project selection for SIX SIGMA - SIX SIGMA problem solving - SIX SIGMA in service and small organizations - SIX SIGMA and lean production – Lean SIX SIGMA and services.

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UNIT - IV	DESIGN OF EXPERIMENTS	9
Importance of Experiments, Experimental Strategies, Basic principles of Design, Terminology, ANOVA, Steps in Experimentation, Sample size, Single Factor experiments - Completely Randomized design, Randomized Block design, Statistical Analysis, Multifactor experiments - Two and three factor full Factorial experiments, 2K factorial Experiments, Confounding and Blocking designs, Fractional factorial design, Taguchi's approach - Steps in experimentation, Design using Orthogonal Arrays, Data Analysis, Robust Design- Control and Noise factors, S/N ratios.		

UNIT - V	STATISTICAL CONSIDERATION AND RELIABILITY	9
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 – Matrix plots and 3-D plots - Reliability - Survival and Failure - Series and parallel systems - Mean time between failure - Weibull distributions.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Apply and illustrate the basic concepts of Design.
CO2	Identify the materials and integrate the manufacturing processes with Engineering Design.
CO3	Apply economic principles for a component design.
CO4	Explain the various concepts in design, quality and reliability principles in the design of an engineering product or a service
CO5	Examine fracture rate and residual stress objects for the components.

Text Books	
1.	Dieter, George E., "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Editions, Singapore, 2010.
2.	Fundamentals of Quality control and improvement 5th edition, Amitava Mitra, Pearson Education Asia, 2012.

Reference Books	
1.	Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons, 2013.
2.	Phillip J.Rose, Taguchi techniques for quality engineering, McGraw Hill, 2010.
3.	Product Design and Development, Karl t. Ulrich, Steven D. Eppinger, TataMcgraw - Hill - 5th Edition, 2013.

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M.E - E.D	M23EDT103 - ADVANCED FINITE ELEMENT ANALYSIS	T	P	TU	C
		3	0	1	4

Course Objectives	
1.	To apply the finite element procedure to solve 1D and 2D structural and heat transfer problems.
2.	To describe the finite element formulation of structural and heat transfer problems using 2D quadratic.
3.	To solve problems in axisymmetric elements.
4.	To demonstrate the Iso-parametric formulation.
5.	To solve structural dynamics problems using 1D elements.

UNIT - I	INTRODUCTION	13

Relevance of finite element analysis in design – Modeling and discretization Interpolation, elements, nodes and degrees-of-freedom-applications of FEA One-Dimensional Elements and Computational Procedures : Bar element – beam element – bar and beam elements of arbitrary orientation – assembly of elements – properties of stiffness matrices - boundary conditions solution of equations - mechanical loads and stresses - thermal loads and stresses - example problems.

UNIT - II	TWO DIMENSIONAL PROBLEMS	13

Interpolation and shape functions - element matrixes - triangular elements - CST - LST - quadratic triangular elements - bilinear rectangular elements - quadratic rectangular elements - theory of elasticity - plane stress - plane strain - Heat transfer - torsion problems.

UNIT - III	AXISYMMETRIC PROBLEMS	11

Axisymmetric formulation - element stiffens matrix and force vector - body force and temperature effects - stress calculations boundary conditions - Applications to cylindrical under internal or external pressure - rotating disc. Non liner problems - material non linearity - geometric nonlinearity - large displacements.

UNIT - IV	ISOPARAMETRIC ELEMENTS	11

Introduction - bilinear quadrilateral elements – quadratic quadrilaterals – hexahedral elements – Numerical Integration – gauss quadrature - static condensation – load considerations – stress calculations – examples of 2D and 3D applications.

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UNIT - V	FLUID MECHANICS AND HEAT TRANSFER	12
Governing Equations of Fluid Mechanics – Solid structure interaction - Inviscid and Incompressible Flow – Potential Formulations – Slow Non-Newtonian Flow – Metal and Polymer Forming – Navier Stokes Equation – Steady and Transient Solution.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Apply the finite element procedure to solve 1D and 2D structural and heat transfer problems.
CO2	Explain the finite element formulation of structural and heat transfer problems using 2D quadratic.
CO3	Solve problems in axisymmetric elements.
CO4	Demonstrate the Iso-parametric formulation.
CO5	Solve structural dynamics problems using1D elements.

Text Books	
1.	Cook, Robert Davis et al “Concepts and Applications of Finite Element Analysis “, Wiley Student Edition, 2017.
2.	J.N. Reddy, " An Introduction to the Finite Element Method" , McGraw Hill, 3rd edition, Nov 2005.

Reference Books	
1.	Segerlind L.J., “Applied Finite Element Analysis”, John Wiley, 2008
2.	George R Buchaman, “ Schaum’s Outline of Finite Element Analysis”, McGraw Hill Company, 2010.
3.	R3 - Singiresu S. Rao, " Finite Element Analysis ", Butterworth-Heinemann Ltd; 5th Revised edition, December 2010.

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M.E - E.D	M23EDT104 – ADVANCED MACHINE TOOL DESIGN	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	Selecting the different machine tool mechanisms.
2.	Designing the Multi speed Gear Box and feed drives.
3.	Designing the machine tool structures.
4.	Designing the guide ways and power screws.
5.	Designing the spindles and bearings.

UNIT - I	INTRODUCTION TO MACHINE TOOL DESIGN	9

Introduction to Machine Tool Drives and Mechanisms, Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission

UNIT - II	REGULATION OF SPEEDS AND FEEDS	9

Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design

UNIT - III	DESIGN OF MACHINE TOOL STRUCTURES	9

Functions of Machine Tool Structures and their Requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures, Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriage.

UNIT - IV	DESIGN OF GUIDEWAYS AND POWER SCREWS	9

Functions and Types of Guideways, Design of Guideways, Design of Aerostatic Slide ways, Design of Anti-Friction Guideways, Combination Guideways, Design of Power Screws.

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UNIT - V	DESIGN OF SPINDLES AND SPINDLE SUPPORT	9
Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings. Dynamics of Machine Tools: Machine Tool Elastic System, Static and Dynamic Stiffness.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Select the different machine tool mechanisms.
CO2	Design the Multi speed Gear Box and feed drives.
CO3	Design the machine tool structures.
CO4	Design the guideways and power screws.
CO5	Design the spindles and bearings.

Reference Books	
1.	N.K. Mehta, Machine Tool Design and Numerical Control, TMH, New Delhi, 3rd edition 2012
2.	G.C. Sen and A. Bhattacharya, Principles of Machine Tools, New Central Book Agency, 2015
3.	K Pal, S. K. Basu, “Design of Machine Tools”, 6th Edition. Oxford IBH, 2014
4.	N. S. Acherkhan, “Machine Tool Design”, Volume 2 University Press of the Pacific, 2000
5.	F. Koenigsberger, Machine Tool Structures, Pergamon Press,1970.

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M.E.	M23EDP101 - CAD LABORATORY	T	P	TU	C
		0	3	0	2

Course Objectives	
1.	To Sketch the complex components in orthographic and isometric views using CAD packages.
2.	To illustrate assembly drawing of various machine components.
3.	To Practice the method, meshing, and analysis of simple Components. An understanding of Linear Algebra through matrices.
4.	Increase ability to communicate with people.
5.	Prepare the student for future Engineering positions.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Preparation of 2-D drawings Orthographic views of standard machine components:
2.	Brackets, V Blocks, Screw threads and threaded fasteners.
3.	3D part modeling – protrusion, cut, sweep, draft, loft, blend, rib.
4.	Preparation of assembled drawing of standard machine components.
5.	Exercises in modeling using Simulation feature in packages like CREO / SOLID EDGE / SOLIDWORKS / CATIA etc.
6.	Exercises in Modeling and Analysis of simple Components using Parametric and feature based Packages like PRO-E / SOLID EDGE / CATIA / ANSYS / NASTRAN etc.
	Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Construct the complex components in orthographic and isometric views using CAD packages.
CO2	Illustrate assembly drawing of various machine components.
CO3	Make use of the method, meshing, and analysis of simple Components.

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CO4	Develop and sketches to engineered drawings will increase.
CO5	Make use of architectural and engineering scales will increase.

LIST OF EQUIPMENT FOR A BATCH OF 18 STUDENTS

Sl. No.	NAME OF THE EQUIPMENT	Qty.
1.	Computers with necessary accessories	18
2.	Assembly drawings using any 2D / 3D CAD Software	18
3.	Printer	1

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M.E.	M23EDP102 - ADVANCED ANALYSIS AND SIMULATION LABORATORY	T	P	TU	C
		0	3	0	2

Course Objectives	
1.	To give exposure to software tools needed to analyze engineering problems.
2.	To expose the students to different applications of simulation and analysis tools.
3.	To impart the fundamental knowledge on using various analytical tools like ANSYS, FLUENT, etc., for Engineering Simulation.
4.	To know various fields of engineering where these tools can be effectively used to improve the output of a product.
5.	To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

List of Experiments	
Expt. No.	**Description of the Experiments**
A. Simulation	
1.	MATLAB basics, dealing with matrices, Graphing-Functions of one variable and two variables
2.	Use of Mat lab to solve simple problems in vibration
3.	Mechanism Simulation using Multi body Dynamic software
B. Analysis	
1.	Force and Stress analysis using link elements in Trusses, cables etc.
2.	Stress and deflection analysis in beams with different support conditions.
3.	Stress analysis of flat plates and simple shells.
4.	Stress analysis of axi – symmetric components.
5.	Thermal stress and heat transfer analysis of plates.

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6.	Thermal stress analysis of cylindrical shells.
7.	Vibration analysis of spring-mass systems.
8.	Model analysis of Beams.
9.	Harmonic, transient and spectrum analysis of simple systems.
	Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Construct the complex components and simulate the experiments
CO2	Illustrate the components and analyze to meet the global requirements
CO3	Make use of the tools like ANSYS or FLUENT in solving real time problems and day to day problems.
CO4	Make use of these tools for any engineering and real time applications.
CO5	Acquire knowledge on utilizing these tools for a better project in their curriculum as well as they will be prepared to handle industry problems.

LIST OF EQUIPMENT FOR A BATCH OF 18 STUDENTS

Sl. No.	NAME OF THE EQUIPMENT	Qty.
1.	Computers with necessary accessories	18
2.	MAT Lab and ANSYS Software	18
3.	Printer	1

Approved by BoS Chairman

Semester - II

M.E - E.D	M23EDT201 - TRIBOLOGY IN DESIGN	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge in the friction , wear and lubrication aspects of machine components.
2.	To understand the material properties which influence the tribological characteristics of surfaces.
3.	To understand the analytical behavior of different types bearings and design of bearing based on analytical / theoretical approach.
4.	To study about the Topographic measurements.
5.	To study about vibration measurements.

UNIT - I	SURFACES, FRICTION AND WEAR	9

Topography of Surfaces – Surface features – Surface interaction – Theory of Friction – Sliding and Rolling Friction, Friction properties of metallic and non-metallic materials – friction in extreme conditions – wear, types of wear – mechanism of wear – wear resistance materials – surface treatment – Surface modifications – surface coatings.

UNIT - II	LUBRICATION THEORY	9

Lubricants and their physical properties lubricants standards – Lubrication Regimes Hydrodynamic lubrication – Reynolds Equation, Thermal, inertia and turbulent effects – Elasto hydrodynamic and plasto hydrodynamic and magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication.

UNIT - III	DESIGN OF FLUID FILM BEARINGS	9

Design and performance analysis of thrust and journal bearings – Full, partial, fixed and pivoted journal bearings design – lubricant flow and delivery – power loss, Heat and temperature rotating loads and dynamic loads in journal bearings – special bearings – Hydrostatic Bearing design.

UNIT - IV	ROLLING ELEMENT BEARINGS	9

Hours Geometry and kinematics – Materials and manufacturing processes – contact stresses – Hertzian stress equation – Load divisions – Stresses and deflection – Axial loads and rotational effects, Bearing life capacity and variable loads – ISO standards – Oil films and their effects – Rolling Bearings Failures.- Orbital forging – Isothermal forging – Hot and cold isostatic pressing – High speed extrusion – Rubber pad forming – Fine blanking – LASER beam forming.

Approved by BoS Chairman

UNIT - V	ELECTROMAGNETIC FORMING AND ITS APPLICATIONS	9
Surface Topography measurements – Electron microscope and friction and wear measurements – Laser method – instrumentation - International standards – bearing performance measurement – bearing vibration measurement.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Demonstrate the basic concepts of friction, lubrication and wear processes
CO2	Perform analysis in fluid film bearings
CO3	Categorize the design aspects and kinematics of rolling element bearings.
CO4	Explain the concepts of tribology instrumentation.
CO5	List the vibration measurement techniques of bearings

Text Books	
1.	Ghosh M.K, Theory of lubrbication, 2017.
2.	Mihirkumar josh Fundamentals of fluid film lubrication, Mcgrawhill, 2014.

Reference Books	
1.	Mohammad NurulHoque “Vibration analysis of rolling element bearings”, 2011
2.	A.K. Sawney, “Electronic measurement and instrumentation”, 2015.

Approved by BoS Chairman

M.E - E.D	M23EDT202 - MECHANICAL BEHAVIOR OF MATERIALS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Impart the knowledge on mechanical behavior of materials.
2.	Acquire knowledge in various classes of materials and their applications.
3.	Import knowledge on various surface modification techniques.
4.	Analyze the type of fracture in materials.
5.	Impart the knowledge of creep and fatigue in materials.

UNIT - I	BASIC CONCEPTS OF MATERIAL BEHAVIOR	10

Elasticity in metals and polymers – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviour – Super plasticity – Griffith's theory, – Ductile, brittle transition in steel – High temperature fracture, creep – Larson Miller parameter – Deformation and fracture mechanism maps.

UNIT - II	BEHAVIOUR UNDER DYNAMIC LOADS AND DESIGN APPROACHES	10

Stress intensity factor and fracture toughness – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law.- Safe life, Stress life, strain-life and fail - safe design approaches -Effect of surface and metallurgical parameters on fatigue – Fracture of non-metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

UNIT - III	SELECTION OF MATERIALS	10

Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications – Computer aided materials selection.

Approved by BoS Chairman

UNIT - IV	NONMETALLIC MATERIALS	7
Composite materials, ceramics, plastics -Introduction, an overview of processing, their characteristic features, types and applications.		

UNIT - V	MODERN MATERIALS AND ALLOYS	8
Super alloys - Refractory metals - Shape memory alloys - Dual phase steels, Micro alloyed, High strength low alloy steel, Transformation induced plasticity (TRIP) steel, Maraging steel – SMART materials, Metallic glass – Quasi crystal and Nano crystalline materials., metal foams.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the mechanical behavior of metallic systems and its importance
CO2	Demonstrate on engineering alloys and nonmetallic materials and their selection.
CO3	Explain the different types of surface modifications of materials.
CO4	Analyze the type of fracture in materials
CO5	Categorize the behavior of creep and fatigue in materials

Text Books	
1.	Callister W.D. (2015) "Material Science and Engineering- An introduction", Wiley –Eastern.
2.	Raghavan, V., (2003) "Physical Metallurgy", Prentice Hall of India.

Reference Books	
1.	Ashby M.F., materials selection in Mechanical Design 2nd Edition, Butter worth 2017.
2.	Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., Selection and use of engineering materials, (34th edition), Butterworth-Heiremann, 2000.
3.	Flinn, R.A., and Trojan, P.K., Engineering Materials and their Applications, (4th Edition) Jaico, 2010.

Approved by BoS Chairman

M.E - E.D	M23EDT203 - INTEGRATED MECHANICAL DESIGN	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the principals involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
2.	To learn to use standard practices and standard data
3.	To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
4.	To understand the standard procedure available for Design of Transmission of Mechanical elements.
5.	To know the integrated design procedure of different machine elements for mechanical applications.

UNIT - I	FUNDAMENTALS AND DESIGN OF SHAFTS	15

Phases of design – Standardization and interchangeability of machine elements - Process and Function Tolerances – Individual and group tolerances – Selection of fits for different design situations – Design for assembly and modular constructions – Concepts of integration – BIS, ISO,DIN, BS, ASTM Standards. Oblique stresses – Transformation Matrix – Principal stresses – Maximum shear stress - Theories of Failure – Ductile vs. brittle component design - Analysis and Design of shafts for different applications – integrated design of shaft, bearing and casing – Design for rigidity.

UNIT - II	DESIGN OF GEARS AND GEAR BOXES	15

Principles of gear tooth action – Gear correction – Gear tooth failure modes – Stresses and loads – Component design of spur, helical, bevel and worm gears – Design for sub assembly – Integrated design of speed reducers and multi-speed gearboxes – application of software packages.

UNIT - III	BRAKES	12

Dynamics and thermal aspects of vehicle braking – Integrated design of brakes for machine tools, automobiles and mechanical handling equipments.

Approved by BoS Chairman

UNIT - IV	INTEGRATED DESIGN	18
Integrated Design of systems consisting of shaft, bearings, springs, motor, gears, belt, rope, chain, pulleys, Cam & Follower, flywheel etc. Example - Design of Elevators, Escalators Gear Box, Valve gear Mechanisms, Machine Tools.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Outline the usage of standards and tolerances in design
CO2	Solve problems in design of shaft
CO3	Design gears for various application
CO4	Design the clutches
CO5	Discuss the working of brakes for automobile, machine tools and material

Reference Books	
1.	Newcomb, T.P. and Spur, R.T., “Automobile Brakes and Braking Systems”, Chapman and Hall, 2nd Edition, 2010.
2.	Juvinall, RL.C., “Fundamentals of Machine Component Design”, John Wiley, 2012.
3.	Maitra G.M., “Hand Book of Gear Design”, Tata McGraw Hill, 2016.
4.	Shigley, J.E., “Mechanical Engineering Design”, McGraw Hill, 2015.

Approved by BoS Chairman

M.E - E.D	M23EDT204 - VIBRATION ANALYSIS AND CONTROL	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the Fundamentals of Vibration and its practical applications
2.	To understand the working principle of various vibration measuring instruments
3.	To understand the operations of various vibration measuring instruments
4.	To understand the various Vibration control strategies.
5.	To understand the experimental methods in vibration analysis.

UNIT - I	FUNDAMENTALS OF VIBRATION	11

Review of Single degree freedom systems – Response to arbitrary periodic Excitations – Duhamel's Integral – Impulse Response function – Virtual work – Lagrange's equation – Single degree freedom forced vibration with elastically coupled viscous dampers – System Identification from frequency response – Transient Vibration – Laplace transformation formulation.

UNIT - II	TWO DEGREE FREEDOM SYSTEM	11

Free vibration of spring-coupled system – mass coupled system – Vibration of two degree freedom system – Forced vibration – Vibration Absorber – Vibration isolation.

UNIT - III	MULTI - DEGREE FREEDOM SYSTEM	15

Normal mode of vibration – Flexibility Matrix and Stiffness matrix – Eigen values and eigen vectors – orthogonal properties – Modal matrix - Modal Analysis – Forced Vibration by matrix inversion – Modal damping in forced vibration – Numerical methods for fundamental frequencies.

UNIT - IV	VIBRATION OF CONTINUOUS SYSTEM	11

Systems governed by wave equations – Vibration of strings – vibration of rods – Euler Equation for Beams – Effect of Rotary inertia and shear deformation – Vibration of plates.

Approved by BoS Chairman

UNIT - V	EXPERIMENTAL METHODS IN VIBRATION ANALYSIS	12
Bucket elevators : design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Develop the equation of motion for single degree of freedom by using various methods.
CO2	Analyze the vibration effect of two degree of freedom mechanical systems.
CO3	Analyze the vibration effect of multi-degrees of freedom system by using various methods.
CO4	Analyze the effect of vibration in continuous system.
CO5	Identify the natural frequency of mechanical system by using vibration instruments.

Reference Books	
1.	W. T. Thomson, Marie Dillon Dahleh – “Theory of Vibration with Applications”, Pearson; 5th edition,1 November 2013
2.	Den Hartog, J.P, “Mechanical Vibrations,” Dover Publications, 2013.

Approved by BoS Chairman

M.E.	M23EDP201 - VIBRATION LABORATORY	T	P	TU	C
		0	3	0	2

Course Objectives	
1.	Introduce basic aspects of vibrational analysis, considering both single and multi-degree-of freedom systems.
2.	Discuss the use of exact and approximate methods in the analysis of complex systems.
3.	To develop and exercise critical thinking in interpreting results from FEM analysis such as the ability to identify the mode shapes, stress contours, eigen frequency as well as response characteristics.
4.	To be able to mathematically model real-world mechanical vibration problems.
5.	To use computer software programs to investigate and understand vibration problems.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	To determine forced Vibration of a Cantilever Beam with a Lumped Mass at Free End
2.	To determine the critical (whirling) speed of the given rotor.
3.	To determine moment of inertia of unknown object by oscillation
4.	To determine the radius of gyration ‘k’ of a given compound pendulum
5.	To determine the natural frequency of undamped torsional vibration of a single rotor shaft system.
6.	To determine the natural frequency of undamped torsional vibration of two rotor shaft system.
7.	To determine the frequency of undamped free vibration of an equivalent spring mass system
8.	To determine the frequency of damped force vibration of a spring mass system.
9.	Balancing of rotating masses
10.	Balancing of reciprocating masses in various speed
	Total Instructional hours : 45

Approved by BoS Chairman

Course Outcomes : Students will be able to	
CO1	Solve the equations of motion for vibratory systems.
CO2	To determine the natural frequency of vibration problems that contains single and multidegree of freedom systems
CO3	Identify the natural frequency (or frequencies) of vibratory systems
CO4	To calculate the damping coefficient of single and multi-degree of freedom systems.
CO5	Design a passive vibration absorber to ameliorate vibrations in a forced system.

LIST OF EQUIPMENT FOR A BATCH OF 18 STUDENTS

Sl. No.	NAME OF THE EQUIPMENT	Qty.
1.	Transverse Vibration	1
2.	Compound Pendulum	1
3.	Single Rotor System	1
4.	Two Rotor System	1
5.	Spring Mass System	1
6.	Rotating Masses	1
7.	Reciprocating Mass	1
8.	Whirling of Shaft	1

Approved by BoS Chairman

M.E.	M23EDP202 - DESIGN PROJECT	T	P	TU	C
		0	6	0	2

Course Objectives	
1.	Identify the key processes and requirements of project management.
2.	Plan for project risks, communication, and change control.
3.	To offer students a glimpse into real world problems and challenges that need design based solutions
4.	To introduce students to the vast array of literature available of the various research challenges in the field of design.
5.	To enable students to use all concepts of design in creating a solution for a problem

Description of the Experiments
Each student is required to select any new component or an integrated mechanical system that involves various sub components which are to be designed as per design standards and further required to be analyzed for optimum dimensions with respect to the strength and stiffness.
Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Construct a survey of several available literatures in the preferred field of study.
CO2	Choose and discuss the several existing solutions for research challenge.
CO3	Develop an ability to work in teams and manage the conduct of the research study.
CO4	Formulate and propose a plan for creating a solution for the research plan identified.
CO5	Develop and present the findings of the study conducted in the preferred domain.

Approved by BoS Chairman

Professional Elective - I

M.E - E.D	M23EDE101 – OPTIMIZATION TECHNIQUES IN DESIGN	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on various categories of existing engineering problems and solutions to such problems through different optimization techniques and approaches.
2.	Understanding the Concept of optimization and classification of optimization problems.
3.	Study the Queuing Model, poison and exponential distributions.
4.	Understand the maximization and minimization of convex functions.
5.	To study equality constraints, inequality constraints.

UNIT - I	CLASSICAL OPTIMIZATION TECHNIQUES	9

Engineering applications of optimization, statement of optimization problem, classification of optimization problem, single variable optimization, multi variable optimization with no constraint, equality constraint, in-equality constraint.

UNIT - II	LINEAR PROGRAMMING AND NON-LINEAR PROGRAMMING	9

Simplex algorithm, two phases of the simplex method, applications - One-dimensional minimization - exhaustive search, golden section method, quasi-newton method, random search methods, Powell's method.

UNIT - III	MODERN METHODS OF OPTIMIZATION	9

Genetic algorithms, simulated annealing, fuzzy optimization, neural-network-based methods.

UNIT - IV	TOPOLOGY OPTIMIZATION	9

Problem formulation and parameterization of design, solution methods, topology optimization as a design tool, combining topology and shape design, buckling problems, stress constraints.

Approved by BoS Chairman

UNIT - V	EVOLUTIONARY STRUCTURAL OPTIMIZATION (ESO) METHODS	9
ESO Based on Stress Level, evolutionary methods, two-bar frame, Michell type structure, ESO for stiffness or displacement optimization, Bi-directional Evolutionary Structural Optimization (BESO) method, BESO Based on von Mises Stress, topology optimization for natural frequency.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Summarize clearly a problem, identify its parts and analyze the individual functions.
CO2	Identify study for solving an optimization problem.
CO3	Apply a mathematical translation of the verbal formulation of an optimization problem.
CO4	Construct design algorithms, the repetitive use of which will lead reliably to finding an approximate solution.
CO5	Develop optimization techniques using algorithms.

Reference Books	
1.	Goldberg, D.E., “Genetic Algorithms in Search, Optimization and Machine Learning”, Pearson, 2016.
2.	Johnson Ray, C., “Optimum design of mechanical elements”, Wiley, John & Sons, 2012.
3.	Kalyanmoy Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall of India Pvt. 2014.
4.	Rao, Singaresu, S., “Engineering Optimization – Theory & Practice”, New Age International (P) Limited, New Delhi, 2010.

Approved by BoS Chairman

M.E - E.D	M23EDE102 - RESEARCH METHODOLOGY AND IPR	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand some basic concepts of research and its methodologies.
2.	To understand the methodology of carrying out research skills of analysing data using statistical tools.
3.	To highlight different mathematical tools for analysis.
4.	To get an idea about IPR.
5.	To know how to file a patent.

UNIT - I	HIST RESEARCH METHODOLOGY INTRODUCTION	9

Research methodology – definition and significance, types of research – exploratory research, conclusive research, modeling research, algorithmic research, casual research, theoretical and empirical research, cross-sectional and time series research. Research process - steps, research problems, objectives, characteristics, hypothesis and research in an evolutionary perspective.

UNIT - II	SAMPLING TECHNIQUE / EXECUTING THE RESEARCH	9

Sampling methods – Probability sampling methods – simple random sampling with replacement and without replacement, stratified sampling, cluster sampling. Non-probability, sampling method – convenience sampling, judgment sampling, quota sampling. Nonparametric tests- One sample tests – one sample sign test, Kolmogorov-Smirnov test, run test for randomness, two sample tests – two sample sign test, Mann - Whitney U test, K-sample test – Kruskal Wallis test (H-test).

UNIT - III	MATHEMATICAL TOOLS FOR ANALYSIS	9

Hypothesis testing – Testing of hypotheses concerning means (one mean and difference between two means – one tailed and two tailed tests), concerning variance – one tailed Chi-square test. Introduction to Disciminant, Factor analysis, cluster analysis, multi-dimensional scaling, conjoint analysis, multiple regression and correlation, application of statistical software for data analysis.

UNIT - IV	INTRODUCTION TO IPR	9

Introduction to IPRs, Basic concepts and need for Intellectual Property – Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO – TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

Approved by BoS Chairman

UNIT - V	PATENT SPECIFICATION DRAFTING	9
Patentability of Inventions : Statutory Exceptions to Patentability; Novelty and Anticipation; Inventive Step; Capable of Industrial Application; Person Skilled in the Art, Provisional and Complete Specifications; Structure of a Patent Specification – Title, Abstract, Description, Claims, etc.; Reading a Patent Specification – Fair basis, Enabling Disclosure, Definiteness, Priority; Introduction to Patent Drafting.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the basic framework of research process.
CO2	Examine the various research design and techniques.
CO3	Get knowledge on different mathematical tools for research data analysis.
CO4	Get knowledge on Intellectual Property Rights and their significance.
CO5	Recognize various Patent filling Procedures and Patent Specification.

Text Books	
1.	V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India Pvt Ltd, 2012.
2.	Kothari, K.C., Research Methodology, 2nd Edition, New Age Publication, 2009.
3.	Dr.Tripathi, P.C, Research Methodology, 1st Edition, Prentice Hall Inc., 2009.

Reference Books	
1.	Donald R. Cooper and Pamela S. Schindler, business Research Methods, 9th Edition, Tata Mcgraw Hill, 2006.
2.	William G.Zikmund, Business Research Methods, 7th Edition, Tata Mc Graw Hill, 2009.

Approved by BoS Chairman

M.E - E.D	M23EDE103 - ENGINEERING FRACTURE MECHANICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on mechanics of cracked components of different modes by which these components fail under static load conditions.
2.	To impart knowledge on mechanics of cracked components of different modes by which these components fail under fatigue load conditions.
3.	To understand the relation between Energy balance and crack growth.
4.	To understand the effect of Fatigue crack growth.
5.	To understand the applications of fracture mechanics.

UNIT - I	ELEMENTS OF SOLID MECHANICS	9

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation – limit analysis – Airy's function – field equation for stress intensity factor.

UNIT - II	STATIONARY CRACK UNDER STATIC LOADING	9

Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation - plastic zone size – Dugdaale model – determination of J integral and its relation to crack opening displacement.

UNIT - III	ENERGY BALANCE AND CRACK GROWTH	9

Griffith analysis – stable and unstable crack growth – Dynamic energy balance – crack arrest mechanism – K1c test methods - R curves - determination of collapse load.

UNIT - IV	FATIGUE CRACK GROWTH CURVE	9

Empirical relation describing crack growth law – life calculations for a given load amplitude – effects of changing the load spectrum – rain flow method – external factors affecting the K1c values - leak before break analysis.

Approved by BoS Chairman

UNIT - V	APPLICATIONS OF FRACTURE MECHANICS	9
Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures - crack instability in thermal and residual stress fields - numerical methods.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Develop the components that contain crack under static load condition.
CO2	Develop the components that contain crack and its growth under fatigue load condition.
CO3	Explain mechanics of crack tip fields and appropriate fracture characterizing parameters like stress intensity factor
CO4	Construct for strength, stiffness or fatigue life make use of elementary concepts based on Strength of Materials and Theory of Elasticity
CO5	Develop structural components taking into account presence of flaws, nature of loading and constitutive behavior of the material.

Reference Books	
1.	TribikramKundu, “Fundamentals of Fracture Mechanics”, Ane Books Pvt. Ltd. New Delhi / CRC Press, 1st Indian Reprint, 2012.
2.	Preshant Kumar, “Elements of Fracture Mechanics”, Wheeler Publishing, 2010.

Approved by BoS Chairman

M.E - E.D	M23EDE104 – ADDITIVE MANUFACTURING AND TOOLING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology and the associated Aerospace, Architecture, Art, Medical and industrial applications.
2.	Understand the various software tools, processes and techniques that enable advanced/additive manufacturing and personal fabrication.
3.	Learn how to create physical objects that satisfy product development/prototyping requirements, using advanced/additive manufacturing devices and processes.
4.	Understand the latest trends and business opportunities in AM, distributed manufacturing and mass customization.
5.	Learn what Advanced/Additive manufacturing (AM) is and understand why it has become one of the most important technology trends in decades for product development and innovation.

UNIT - I	INTRODUCTION	9
Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM - Classification of AM processes-Benefits- Applications.		

UNIT - II	REVERSE ENGINEERING AND CAD MODELING	9
Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.		

UNIT - III	LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS	9
Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, Recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, 9weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.		

Approved by BoS Chairman

UNIT - IV	POWDER BASED ADDITIVE MANUFACTURING SYSTEMS	9
Selective Laser Sintering (SLS) : Principle, process, Indirect and direct SLS - powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS) : Processes, materials, products, advantages, limitations and applications – Case Studies.		

UNIT - V	TOOLING	9
Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling, Fabrication processes, Applications Case studies automotive, aerospace and electronics industries.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Infer history, concepts and terminology of additive manufacturing
CO2	Apply the reverse engineering concepts for design development
CO3	Construct the variety of additive manufacturing techniques
CO4	Design and develop newer tooling models
CO5	Analyze the cases relevant to mass customization and some of the important research challenges associated with AM and its data processing tools

Reference Books	
1.	Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers, 2010.
2.	Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications, 2003.
3.	Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
4.	Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.
5.	Kamrani, A.K. and Nasr, E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.

Approved by BoS Chairman

M.E - E.D	M23EDE105 – INFORMATION ANALYTICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	Expose the students with fundamental concepts and the tools needed to understand emerging role of information analytics in the organization.
2.	Ability to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.
3.	Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies.
4.	Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.
5.	Ability to integrate machine learning libraries and mathematical and statistical tools with modern technologies like hadoop and mapreduce.

UNIT - I	DATA ANALYTICS LIFE CYCLE	9

Introduction to Big data Business Analytics - State of the practice in analytics role of data scientists - Key roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders.

UNIT - II	STATISTICS	9

Sampling Techniques - Data classification, Tabulation, Frequency and Graphic representation - Measures of central value - Arithmetic mean, Geometric mean, Harmonic mean, Mode, Median, Quartiles, Deciles, Percentile - Measures of variation – Range, IQR, Quartile deviation, Mean deviation, standard deviation, coefficient variance, skewness, Moments & Kurtosis.

UNIT - III	PROBABILITY AND HYPOTHESIS TESTING	9

Random variable, distributions, two dimensional R.V, joint probability function, marginal density function. Random vectors - Some special probability distribution - Binomial, Poison, Geometric, uniform, exponential, normal, gamma and Erlang. Multivariate normal distribution - Sampling distribution – Estimation - point, confidence - Test of significance, 1 & 2 tailed test, uses of t distribution, F-distribution, X2 distribution.

Approved by BoS Chairman

UNIT - IV	PREDICTIVE ANALYTICS	9
Predictive modeling and Analysis - Regression Analysis, Multicollinearity, Correlation analysis, ank correlation coefficient, Multiple correlation, Least square, Curve fitting and good ness of fit.		

UNIT - V	TIME SERIES FORECASTING AND DESIGN OF EXPERIMENTS	9
Forecasting Models for Time series: MA, SES, TS with trend, season - Design of Experiments, one way classification, two way classifications, ANOVA, Latin square, and Factorial Design.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Analyze the importance of data analysis in the design of new products.
CO2	Choose probability analysis and hypothesis testing.
CO3	Apply Perform predictive analysis.
CO4	Identify the effect of forecasting methods and to apply for business process.
CO5	Choose a reliable, scalable, distributed information system.

Reference Books

1.	Alberto Cordoba, “Understanding the Predictive Analytics Lifecycle”, Wiley, 2014.
2.	Chris Eaton, Dirk Deroos, Tom Deutsch et al., “Understanding Big Data”, McGraw Hill, 2012.
3.	James R Evans, “Business Analytics – Methods, Models and Decisions”, Pearson 2013.
4.	R. N. Prasad, Seema Acharya, “Fundamentals of Business Analytics”, Wiley, 2015.
5.	S M Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, Academic Foundation, 2011.

Approved by BoS Chairman

Professional Elective - II

M.E - E.D	M23EDE201 - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To gain knowledge on artificial intelligence.
2.	To understand the concepts of Machine Learning.
3.	To appreciate supervised learning and their applications.
4.	To appreciate the concepts and algorithms of unsupervised learning.
5.	To understand the theoretical and practical aspects of Probabilistic Graphical Models.

UNIT - I	ARTIFICIAL INTELLIGENCE	9

Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

UNIT - II	INTRODUCTION TO MACHINE LEARNING	9

Machine Learning – Types of Machine Learning – Machine Learning process - preliminaries, testing Machine Learning algorithms, turning data into Probabilities, and Statistics for Machine Learning Probability theory – Probability Distributions – Decision Theory.

UNIT - III	SUPERVISED LEARNING	9

Linear Models for Regression – Linear Models for Classification- Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models – Decision Tree Learning – Bayesian Learning, Naïve Bayes – Ensemble Methods, Bagging, Boosting, Neural Networks, Multilayer Perceptron, Feed-forward Network, Error Back propagation - Support Vector Machines.

UNIT - IV	UNSUPERVISED LEARNING	9

Clustering- K-means – EM Algorithm - Mixtures of Gaussians – Dimensionality Reduction, Linear Discriminant Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis.

Approved by BoS Chairman

UNIT - V	PROBABILISTIC GRAPHICAL MODELS	9
Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed Graphical Models – Bayesian Networks – Conditional Independence properties – Markov Random FieldsHidden Markov Models – Conditional Random Fields (CRFs).		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Develop the robots using Artificial Intelligence.
CO2	Select a learning model appropriate to the application.
CO3	Apply Probabilistic Discriminative and Generative algorithms for an application of your choice and analyze the results.
CO4	Identify applications suitable for different types of Machine Learning with suitable justification.
CO5	Utilize a tool to implement typical Clustering algorithms for different types of applications.

Reference Books	
1.	Christopher Bishop,“Pattern Recognition and Machine Learning” Springer, 2007.
2.	Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Chapman and Hall, CRC Press, Second Edition,2014.
3.	Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
4.	Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Third Edition, 2014.
5.	Tom Mitchell, “Machine Learning”,McGraw-Hill,1997.

Approved by BoS Chairman

M.E - E.D	M23EDE202 - MODAL ANALYSIS OF MECHANICAL SYSTEMS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on modal testing and modal analysis of single and multi- degree of freedom systems.
2.	To understand the fundamentals of Vibration Theory.
3.	To understand the modeling and analysis of one-dof-systems - free vibrations, transient and steady-state forced vibrations, viscous and hysteric damping.
4.	To be able to mathematically model real-world mechanical vibration problems
5.	To use computer software programs to investigate and understand vibration problems.

UNIT - I	INTRODUCTION	9

Introduction to Modal Testing – Applications of Modal Testing – Philosophy of Modal Testing – Summary of Theory – Summary of Measurement Methods – Summary of Analysis – Review of Test Procedure.

UNIT - II	VIBRATIONS	9

Introduction – Single Degree of Freedom (SDOF) System Theory – Presentation and Properties of FRF Data for SDOP System – Undamped Multi-degree of freedom (MDOF) system – Proportional Damping – Hysteretic Damping – General Case – Viscous Damping – General Case – Characteristics and presentation of MDOF – FRF Data – Complete and incomplete models - Nonsinusoidal vibration and FRF Properties – Analysis of Weakly Nonlinear Structures.

UNIT - III	MOBILITY MEASUREMENT TECHNIQUES	9

Introduction – Basic Measurement System – Structure preparation – Excitation of the Structure – Transducers and Amplifiers – Analyzers – Digital Signal Processing – Use of Different Excitation types – Calibration – Mass Cancellation – Rotational Mobility Measurement – Measurement on Non linear structures – Multi point excitation methods.

UNIT - IV	MODAL PARAMETER EXTRACTION METHODS	9

Introduction – Preliminary checks of FRF Data – SDOF Modal Analysis - I – Peak - amplitude – DOF Modal Analysis - II – Circle Fit Method – SDOF Modal Analysis III – Inverse Method – Residuals – MDOF curve-fitting procedures – MDOF curve fitting in the Time Domain – Global or Multi-Curve fitting – Non linear systems.

Approved by BoS Chairman

UNIT - V	MATHEMATICAL MODELS	9
Introduction – Modal Models – Display of Modal Model – Response Models – Spatial Models – Mobility Skeletons and System Models.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Select the natural frequency of transverse vibrations of the shaft and torsional vibrations of rotor systems.
CO2	Identify the vibration measurement by using transducers and vibration exciters
CO3	Select the natural frequencies and mode shapes of a multi degree of freedom system and explain the modal analysis of a vibrating system.
CO4	Select the numerical methods to determine natural frequencies of the beam and rotor systems.
CO5	Analyze the mathematical modeling of the two degrees of freedom systems and explain about the working principle of vibration absorber.

Text Books	
1.	Ewins Modal Testing: Theory and Practice “, John Wiley & Sons Inc., 1988 D J, “ 2013

Reference Books	
1.	Michel Geradin, “Mechanical Vibrations : Theory and Application to Structural Dynamics”, 3rd Edition 2015
2.	Singiresu S. Rao ., “ Vibration of Continuous Systems” 2nd Edition 2019.
3.	Nuno Manuel Mendes Maia et al, “Theoretical and Experimental Modal Analysis”, Wiley John & sons, 2012.

Approved by BoS Chairman

M.E - E.D	M23EDE203 - ADVANCED METAL FORMING TECHNIQUES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the concepts of latest metal forming techniques and their applications in metal forming industry.
2.	To study the thermo mechanical regimes and its requirements of metal forming
3.	To study the special forming process
4.	To study the recent advances of bulk forming process
5.	To study and apply electromagnetic farming

UNIT - I	INTRODUCTION TO THEORY OF PLASTICITY AND FORMING	9

Theory of plastic deformation – Yield criteria – Tresca and Von-mises – Distortion energy – Stress strain relation – Mohr's circle representation of a state of stress – cylindrical and spherical coordinate system – upper and lower bound solution methods – thermo elastic Elasto plasticity – elastovisco plasticity.

UNIT - II	THEORY AND PRACTICE OF BULK FORMING PROCESSES	9

Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction – calculation of forces, work done – Process parameters, equipment used – Defects – applications – Recent advances in Forging, Rolling, Extrusion and Drawing processes – Design consideration in forming - Formability of laminated sheet - Overview of FEM applications in Metal Forming analysis.

UNIT - III	SHEET METAL FORMING	9

Formability studies – Conventional processes – H E R F techniques – Superplastic forming techniques – Hydro forming – Stretch forming – Water hammer forming – Principles and process parameters – Advantage, Limitations and application

UNIT - IV	POWDER METALLURGY AND SPECIAL FORMING PROCESSES	9

Overview of P/M technique – Advantages – applications – Powder preform forging – powder rolling - Tooling, process parameters and applications. - Orbital forging – Isothermal forging – Hot and cold isostatic pressing – High speed extrusion – Rubber pad forming – Fine blanking – LASER beam forming.

Approved by BoS Chairman

UNIT - V	ELECTROMAGNETIC FORMING AND ITS APPLICATIONS	9
Electromagnetic Forming Process – Electro – Magnetic Forming Machines – Process Variables – Coils and Dies – Effect of Resistivity and Geometry – EM tube and sheet forming, stamping, shearing and welding – Applications – Finite Element Analysis of EM forming.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Apply the mechanism of deformation for different metal forming processes and develop analytical relation between input and output parameters of process.
CO2	Analyze the concept of yield criteria applicable to different material deformation processes.
CO3	Apply theoretical and experimental techniques for measurement of important outcomes of metal forming processes
CO4	Select the different lubrication mechanisms, lubricants and other valuable affecting the metal forming processes under different working conditions
CO5	Select the different types of defects, causes and apply their remedial measures in metal forming process.

Text Books	
1.	Juneja.B.L. Fundamentals of metal cutting and machine tools, New age international, 2018.
2.	Richaerdheine (Author), Carlloper (Author), Philip Rosenthal (Author), Principles of metal casting, Mcgrawhill, 2017.

Reference Books	
1.	Ronakkhandelwal “Performance analysis of electromagnetic forming process”, 2015
2.	H.S Shan, “Manufacturing Processes: Casting, Forming and Welding”, 2017.

Approved by BoS Chairman

M.E - E.D	M23EDE204 - SURFACE ENGINEERING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the surface preparation techniques
2.	To import knowledge on thermal spraying process and electrodeposited coating
3.	To study the process of Hot dip and diffusion coating
4.	To induce the testing procedure for surface coating
5.	Acquire knowledge in the selection of coatings

UNIT - I	METAL CLEANING AND PREVIEW ON SURFACE ENGINEERING	8

Need and relevance of surface engineering – pre-treatment of coating, General cleaning process for ferrous and non-ferrous metals and alloys – selection of cleaning process – alkaline cleaning – emulsion cleaning- ultrasonic cleaning – acid and pickling salt bath descaling – abrasive bath cleaning– polishing and short peening – classification of surface engineering processes.

UNIT - II	THERMAL SPRAYING PROCESSES AND ELECTRODEPOSITED COATINGS	10

Thermal spraying – flame, arc, plasma and HVOF processes – PLV process – design for thermally sprayed coatings – coating production – spray consumables principles of electroplating – Technology and control electroplating systems – properties and Faraday's Law – factors affecting throwing power – Applications of electrodeposites – non-aqueous and electroless deposition.

UNIT - III	HOT DIP COATING AND DIFFUSION COATINGS	10

Principles – surface preparation batch coating and continuous coating process – coating properties and applications, Principles of cementation – cladding – Diffusion coating of C.N. Al, Si, Cr and B – structure, properties and application of diffusion coatings – chemical vapour deposition – physical vapour deposition.

UNIT - IV	NON-METALLIC COATING OXIDE AND COVENSION COATINGS	9

Plating coating – laequers – rubbers and elastomers – vitreous enamels – anodizing phosphating and chromating – application to aluminium, magnesium, tin, zinc, cadmium copper and silver – phosphating primers.

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UNIT - V	QUALITY ASSURANCE, TESTING AND SELECTION OF COATINGS	8
The quality plan – design – testing and inspection of thickness adhesion, corrosion, resistance and porosity measurement – selection of coatings – industrial applications of engineering coatings. Basic mechanisms of wear – abrasive, adhesive wear, contact fatigue – fretting corrosion – testing wear resistance practical diagnosis of wear.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the important of surface engineering to industries
CO2	Demonstrate of the thermal spray for coating
CO3	Explain the process and mechanism of different diffusion coating Process
CO4	Explain the methods of non-metallic coating
CO5	Explain the testing procedure for quality assurance.

Text Books	
1.	Stand Grainger engineering coatings – design and application jaico publishing House, 2010.

Reference Books	
1.	Parthasarathy. N.V., Electroplating Handbooks, Prentice Hall, 2011
2.	Metals Hand Book, Vol. 2, 8th Edition, American society of metals 2012
3.	Gabe. D.R., “Principles of Metal surface treatment and protection”, Pergamon, 2013
4.	Niku-Lavi, “Advances in surface treatments”, Pergamon, 2014.

Approved by BoS Chairman

M.E - E.D	M23EDE205 – MECHANISMS DESIGN AND SIMULATION	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To develop a thorough understanding of the various mechanisms and its design and simulation with ability to effectively uses the various mechanisms in real life problems.
2.	Discuss the kinematic analysis of linkages in an assembly.
3.	Select the motion resulting from a specified set of linkages in a mechanism.
4.	Solve the displacement, velocity and acceleration at any point in a link of a mechanism.
5.	Analysis for special mechanisms and robotic manipulations.

UNIT - I	INTRODUCTION	5

Review of fundamentals of kinematics – mobility analysis – formation of one D.O.F. multi loop kinematics chains, Network formula – Gross motion concepts.

UNIT - II	KINEMATIC ANALYSIS	5

Position Analysis – Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages. Analytical methods for velocity and acceleration Analysis– four bar linkage jerk analysis. Planar complex mechanisms.

UNIT - III	PATH CURVATURE THEORY	6

Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature.

UNIT - IV	SYNTHESIS OF MECHANISMS	15

Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation. Graphical methods. Cognate linkages -Coupler curve synthesis, design of six-bar mechanisms. Algebraic methods. Application of instant centre in linkage design. Cam Mechanisms – determination of optimum size of Cams.

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UNIT - V	DYNAMICS OF MECHANISMS , SPATIAL MECHANISMS AND ROBOTICS	14
Static force analysis with friction – Inertia force analysis – combined static and inertia force analysis, shaking force, Kinetostatic analysis. Introduction to force and moment balancing of linkages.Kinematic Analysis of Spatial RSSR mechanism – Denavit – HartenbergParameters.Forward and inverse Kinematics of Robotic Manipulators. Study and use of Mechanism using Simulation Software packages.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain and discuss the kinematic analysis of linkages in an assembly.
CO2	Solve the displacement, velocity and acceleration at any point in a link of a mechanism.
CO3	Select the motion resulting from a specified set of linkages in a mechanism.
CO4	Organize the mechanism of cams and to find their optimum sizes.
CO5	Choose analysis for special mechanisms and robotic manipulations.

Text Books	
1.	Arthur G. Erdman,George N. SandoR,"Mechanism Design: Analysis and Synthesis", Prentice Hall Mar 2017
2.	Shigley, J.E., and Uicker, J.J., “Theory of Machines and Mechanisms”, McGraw Hill, 2013.

Reference Books	
1.	AmitabhaGhosh and Asok Kumar Mallik, “Theory of Mechanism and Machines”, EWLP, Delhi, 2009.
2.	Norton R.L., “Design of Machinery”, McGraw Hill, 2003
3.	Kenneth J, Waldron, Gary L. Kinzel, “Kinematics, Dynamics and Design of Machinery”, John Wiley-sons, 2007
4.	Uicker.J.J, Pennock.G.R, Shighley.J.E, “Theory of machines and mechanisms”, Oxford university press, 2005.

Approved by BoS Chairman

M.E - E.D	M23EDE206 – DESIGN OF MATERIAL HANDLING EQUIPMENTS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the Fundamentals of CAD/CAM.
2.	To evaluate and refine the design using computer simulations.
3.	Understand the flow and type of movement of industrial goods.
4.	Apply general rules for the type of movement.
5.	Identify the appropriate material handling systems to suit the said requirement.

UNIT - I	MATERIALS HANDLING EQUIPMENT	5
Types, selection and applications		

UNIT - II	DESIGN OF HOISTS	10
Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types.		

UNIT - III	DRIVES OF HOISTING GEAR	10
Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes - slewing, jib and bluffing gear - cogwheel drive - selecting the motor ratings.		

UNIT - IV	CONVEYORS	10
Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.		

UNIT - V	ELEVATORS	10
Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.		
Total Instructional hours : 45		

Approved by BoS Chairman

Course Outcomes : Students will be able to	
CO1	Outline the importance of proper material handling techniques and regarding hoisting and conveying equipment.
CO2	List the hazards associated with hoisting and conveying.
CO3	Illustrate the various hoisting gear drives used in various applications.
CO4	Apply knowledge and attention on various types of conveyor designs.
CO5	List the different types of elevators and trucks and their design.

Reference Books	
1.	Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.
2.	Boltzharol, A., Materials Handling Handbook, the Ronald Press Company, 1958.
3.	Conveyor Equipment Manufacturer's Association, "Belt conveyors for bulk materials" 6th edition, The New CEMA Book, 2018
4.	P.S.G. Tech., "Design Data Book", KalaikathirAchchagam, Coimbatore, 2003.
5.	Rudenko, N., Materials handling equipment, ELnvee Publishers, 1970.
6.	Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and II, MIR Publishers, 2011.

Approved by BoS Chairman

M.E - E.D	M23EDE207 - BIOMATERIALS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study different concepts in selecting bio and smart materials
2.	To import knowledge on different electro-rheological and piezoelectric materials
3.	To import knowledge on different shape memory materials and their applications of materials in biomedical engineering and special materials for actuators, sensors, etc.
4.	To import knowledge on Materials for oral and maxillofacial surgery
5.	To import knowledge on materials for cardiovascular ophthalmology and skin regeneration.

UNIT - I	INTRODUCTION	9

Human anatomy- tissues- organs- repair- regeneration- Wolff's Law – biomaterial – compatibility – classification - Biomimetics – Material response: swelling and leaching, corrosion and dissolution, deformation and failure, friction and wear – host response: the inflammatory process – coagulation and hemolysis- in vitro and in vivo evaluation of biomaterials – Testing and validation - government regulatory bodies.

UNIT - II	DENTAL MATERIALS	9

Teeth composition, formation and properties – temporary fixation devices -classification – biomaterials used- metals and alloys - Fillings and restoration materials – oral and maxillofacial surgery – dental cements and dental amalgams – dental adhesives.

UNIT - III	ORTHOPAEDIC MATERIALS	9

Bone composition, formation and regeneration - properties – defects - temporary fixation devices – joint replacement – biomaterials used in bone and joint replacement metals and alloys- stress shielding effect- bone tissue engineering.

UNIT - IV	WOUND DRESSING MATERIALS AND SURGICAL AIDS	9

Skin structure – defects (burn, ulcer, trauma etc) and disease- skin regeneration – classification of regenerative material – Sutures- Adhesives – classification – Surgical toolsmaterials – sterilization - Laparoscopic tools.

Approved by BoS Chairman

UNIT - V	CARDIOVASCULAR, OPTHALMOLOGY AND DRUG DELIVERY MATERIALS	9
Blood clotting – blood theology – approaches to thrombo resistance materials development – blood vessels – The heart – aorta and valves – geometry of blood circulation – cardiac pacemakers – extracorporeal blood circulation devices. lungs – vascular implants: vascular graft, cardiac valve prostheses – Eye - defects – correction - Biomaterials in opthalmology – drug delivery methods and materials.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Use of Bio materials for cardiovascular Opthalmology and Skin Regeneration.
CO2	Use of Bio materials for Dental & Bone application.
CO3	Use of shape memory alloys in engineering application.
CO4	Explain the characteristics of Bio and smart materials.
CO5	Use of smart materials as sensors, actuators.

Reference Books	
1.	Mohsen Shahinpoor and Hans-Jorg Schneider “Intelligent Materials”, RSC Publishing, 2008.
2.	Sujata V., Bhat., “Biomaterials”, Narosa Publication House, New Delhi, 2002.
3.	Buddy D. Ratner (Editor), Allan S. Hoffman (Editor), Frederick J. Schoen (Editor), Jack E. Lemons, “Biomaterials Science: An Introduction to Materials in Medicine”, Academic Press, 2nd edition, 2004.
4.	M. V. Gandhi and B. S. Thompson, “Smart Materials and Structures”, Chapman and Hall, London, First Edition, 1992
5.	Duerig, T.W., Melton, K.N, Stockel, D. and Wayman, C.M., “Engineering aspects of Shape memory Alloys”, Butterworth – Heinemann, 1990.

Approved by BoS Chairman

M.E - E.D	M23EDE208 - MECHANICAL MEASUREMENTS AND ANALYSIS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	The student will understand the principle of force and strain measurement.
2.	The student will understand the vibration measurement and their applications.
3.	To impart knowledge on the principle behind acoustics and wind flow measurements.
4.	To familiarize with the distress measurements.
5.	To realize the non-destructive testing principle and application.

UNIT - I	FORCES AND STRAIN MEASUREMENT	9

Strain gauge, principle, types, performance and uses. Photo elasticity – Principle and applications - Moire Fringe - Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines.

UNIT - II	VIBRATION MEASUREMENTS	9

Characteristics of Structural Vibrations – Linear Variable Differential Transformer(LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters – Digital data Acquisition systems.

UNIT - III	ACOUSTICS AND WIND FLOW MEASUREMENTS	9

Principles of Pressure and flow measurements – pressure transducers – sound level meter – venturimeter and flow meters – wind tunnel and its use in structural analysis – structural modeling – direct and indirect model analysis.

UNIT - IV	DISTRESS MEASUREMENTS	9

Diagnosis of distress in structures – crack observation and measurements – corrosion of reinforcement in concrete – Half-cell, construction and use – damage assessment – controlled blasting for demolition.

Approved by BoS Chairman

UNIT - V	NON DESTRUCTIVE TESTING METHODS	9
Load testing on structures, buildings ,bridges and towers – Rebound Hammer – acoustice mission – ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Measure physical quantities such as forces and strains.
CO2	Apply different vibration measurements techniques.
CO3	Measure physical quantities such as pressure and flow.
CO4	Apply techniques involved in crack measurement.
CO5	Select the appropriate nondestructive testing methods for various engineering applications.

Reference Books	
1.	Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 2009
2.	James W. Dally and William Franklin Riley, "Experimental Stress Analysis", McGraw Hill, 3rd Edition,1991
3.	Bray Don E and Stanley, R.K., "Non-destructive Evaluation", McGraw Hill Publishing Company, N.Y. 1989
4.	Garas, F.K., Clarke, J. Land Armer GST, "Structuralassessment", Butter worths, London,1987.
5.	Sirohi, R.S. and Radhakrishna, H.C, "MechanicalMeasurements", New Age International (P) Ltd, 3rd Edition, 1997.

Approved by BoS Chairman

M.E - E.D	M23EDE209 - COMPUTATIONAL FLUID DYNAMICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	This course aims to introduce numerical modeling and its role in the field of heat, fluid flow and combustion. It will enable the students to understand the various discretization methods and solving methodologies and to create confidence to solve complex problems in the field of heat transfer and fluid dynamics.
2.	To develop finite volume discretised forms of the governing equations for diffusion processes.
3.	To develop finite volume discretised forms of the convection-diffusion processes.
4.	To develop pressure-based algorithms for flow processes.
5.	To introduce various turbulence models, Large Eddy Simulation and Direct Numerical Simulation.

UNIT - I	GOVERNING DIFFERENTIAL EQUATIONS AND DISCRETISATION TECHNIQUES	9

Basics of Heat Transfer, Fluid flow – Mathematical description of fluid flow and heat transfer – Conservation of mass, momentum, energy and chemical species - Classification of partial differential equations – Initial and Boundary Conditions – Discretisation techniques using finite difference methods – Taylor's Series - Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT - II	DIFFUSION PROCESSES : FINITE VOLUME METHOD	9

Steady one-dimensional diffusion, Two- and three-dimensional steady state diffusion problems, Discretisation of unsteady diffusion problems – Explicit, Implicit and Crank-Nicholson's schemes, Stability of schemes.

UNIT - III	CONVECTION-DIFFUSION PROCESSES: FINITE VOLUME METHOD	9

One dimensional convection – diffusion problem, Central difference scheme, upwind scheme – Hybrid and power law discretization techniques – QUICK scheme.

Approved by BoS Chairman

UNIT - IV	FLOW PROCESSES : FINITE VOLUME METHOD	9
Discretisation of incompressible flow equations – Pressure based algorithms, SIMPLE, SIMPLER & PISO algorithms.		

UNIT - V	TURBULENCE MODELS	9
Turbulence – RANS equation - Algebraic Models, One equation model, Two equation models – k & standard k – ϵ model, Low Reynold number models of k- ϵ, Large Eddy Simulation (LES), Direct Numerical Simulation (DNS) - Introduction. Solving simple cases using standard CFD codes.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Analyse the governing equations and boundary conditions.
CO2	Analyse various discretization techniques for both steady and unsteady diffusion problems.
CO3	Analyse the various convection-diffusion problems by Finite-Volume method.
CO4	Analyse the flow processes by using different pressure bound algorithms.
CO5	Select and use the different turbulence models according to the type of flows.

Reference Books

1. Versteeg and Malalasekera, N, “An Introduction to computational Fluid Dynamics The Finite Volume Method,” Pearson Education, Ltd., Second Edition, 2014
2. JiyuanTu, Guan Heng Yeoh, Chaogun Liu, “Computational Fluid Dynamics A Practical Approach” Butterworth – Heinemann An Imprint of Elsevier, Madison, U.S.A., 2008
3. Muralidhar, K., and Sundararajan, T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 2003.

Approved by BoS Chairman

M.E - E.D	M23EDE210 - DESIGN OF HYBRID AND ELECTRIC VEHICLES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	Fundamental concepts of electric and hybrid vehicle operation and architectures.
2.	Understand the properties of batteries and its types.
3.	Provide knowledge about design of series hybrid electric vehicles.
4.	Provide knowledge about design of parallel hybrid electric vehicles.
5.	Understand of electric vehicle drive train.

UNIT - I	INTRODUCTION TO ELECTRIC VEHICLES	9

Electric Vehicles (EV) system - EV History – EV advantages – EV market – vehicle mechanics : roadway fundamentals - law of motion - vehicle kinetics - dynamics of vehicle motion – propulsion power – velocity and acceleration - propulsion system design.

UNIT - II	ENERGYSOURCE	9

Battery basics - lead acid battery – alternative batteries – battery parameters - technical characteristics – battery power – alternative energy sources : Fuel cells - Fuel Cell characteristics - Fuel cell types.

UNIT - III	SERIES HYBRID ELECTRIC DRIVE TRAIN DESIGN	9

Operation Patterns - Control Strategies - Sizing of the Major Components - Design of peaking power source - Traction Motor Size - Design of the Gear Ratio - Verification of Acceleration Performance - Verification of grade ability - Design of Engine/Generator Size - Design of the Power Capacity Design of the Energy Capacity – Fuel Consumption.

UNIT - IV	PARALLEL HYBRID ELECTRIC DRIVE TRAIN DESIGN	9

Control Strategies of Parallel Hybrid Drive Train - Drive Train Parameters - Engine Power Capacity Electric Motor Drive Power Capacity - Transmission Design - Energy Storage Design.

Approved by BoS Chairman

UNIT - V	ELECTRIC VEHICLE DRIVE TRAIN	9
EV Transmission configurations – Transmission components – Ideal gear box – Gear ratiotorque – speed characteristics - EV motor sizing – initial acceleration - rated vehicle velocity – maximum velocity – maximum gradability		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain how a hybrid vehicle works and describe its main components and their function.
CO2	Choose proper energy storage systems for vehicle applications
CO3	Design series hybrid electric vehicles.
CO4	Design parallel hybrid electric vehicles.
CO5	Describe the transmission components and their configurations for electric vehicles.

Reference Books	
1.	Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
2.	Ehsani, M, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2005
3.	James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.

Approved by BoS Chairman

Semester - III

M.E. - E.D	M23EDP301 - PROJECT WORK PHASE - I	L	T	P	C
		0	0	12	6

Course Objectives	
1.	To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
2.	To develop the methodology to solve the identified problem.
3.	To train the students in preparing project reports and to face reviews a viva-voce examination.

Description of the Experiments

The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

Total Instructional hours : 180

Course Outcome

Design project at the end of the course the students will have a clear idea of their area of work and they will be in a position to carry out the remaining phase II work in a systematic way.

Approved by BoS Chairman

M.E. - E.D	M23EDE301 - ADVANCED STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand and explain the concept of stress – strain relationship.
2.	To understand the general equation of elasticity.
3.	To analyze the problems in curved and flat plates.
4.	To understand the problems in torsions in tubes and non circular sections.
5.	To analyze the problems in contact stresses.

UNIT - I	ELASTICITY	9

Stress-Strain relations and general equations of elasticity in Cartesian, Polar and spherical coordinates differential equations of equilibrium-compatibility-boundary conditions representation of three-dimensional stress of a tension generalized hook's law - St. venant's principle-plane stress Airy's stress function

UNIT - II	SHEAR CENTER AND UNSYMMETRICAL BENDING	10

Location of shear center for various sections -shear flows, Stresses and deflections in beams subjected to unsymmetrical loading-kern of a section.

UNIT - III	CURVED FLEXIBLE MEMBERS AND STRESSES IN FLAT PLATES	10

Circumference and radial stresses-deflections-curved beam with restrained ends-closed ring subjected to concentrated load and uniform load-chain links and crane hooks.-Stresses in circular and rectangular plates due to various types of loading and end conditions -buckling of plates.

UNIT - IV	TORSION OF NON-CIRCULAR SECTIONS	7

Torsion of rectangular cross section - St. Venants theory - elastic membrane analogy prandtl's stress function - torsional stress in hollow thin walled tubes.

Approved by BoS Chairman

UNIT - V	STRESSES DUE TO ROTARY SECTIONS AND CONTACT STRESSES	9
Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Methods of computing contact stress-deflection of bodies in point and line contact applications.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply the concepts of theory of elasticity in three-dimensional stress system.
CO2	Determine the shear centre of various cross-sections and deflections in beams subjected to unsymmetrical bending.
CO3	Evaluate the stresses in flat plates and curved members.
CO4	Calculate torsional stress of non-circular sections.
CO5	Determine the stresses in rotating members, contact stresses in point and line contact applications.

Reference Books	
1.	Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill Education (India) Private Limited, 3rd Edition, February, 2010.
2.	Arthur P. Boresi, Richard J. Schmidt, Advanced Mechanics of Materials, 6th Edition, Wiley, New York, 2002.
3.	Allan F. Bower, “Applied Mechanics of Solids”, CRC press – Special Indian Edition, 2012
4.	Hibbeler. R.C., “Mechanics of Materials”, Prentice-Hall, 2018.
5.	Srinath. L.S., “Advanced Mechanics of Solids”, Tata McGraw Hill, 2009

Approved by BoS Chairman

M.E. - E.D	M23EDE302 - DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To develop efficient hydraulic and pneumatic circuits.
2.	To impart students on the science, use and application of hydraulics and pneumatics as fluid power in Industry.
3.	To impart knowledge on the methodology of basic and advanced design of pneumatics and hydraulics systems.
4.	Identify various components of Pneumatic and Hydraulic control systems.
5.	Design and analyse problems relating to Pneumatic and Hydraulic control systems and components.

UNIT - I	OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS	9
Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics		

UNIT - II	CONTROL AND REGULATION ELEMENTS	9
Pressure - direction and flow control valves - relief valves, non-return and safety valves – actuation systems.		

UNIT - III	HYDRAULIC CIRCUITS	9
Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits – industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuitsdesign and selection of components - safety and emergency mandrels.		

UNIT - IV	PNEUMATIC SYSTEMS AND CIRCUITS	9
Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits – switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design.		

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UNIT - V	ELECTRONIC CONTROL OF HYDRAULICS & PNEUMATIC CIRCUIT	9
Electrical control of pneumatic circuits – use of relays, counters, timers, ladder diagrams, use of microprocessor in circuit design – use of PLC in hydraulic and pneumatic circuits -fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation-Robotic circuits.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Demonstrate the working of different types of pumps and actuators
CO2	Explain the working and actuation mechanism of control valves.
CO3	Design hydraulic circuits for various applications.
CO4	Explain the fundamentals of pneumatics and construct pneumatic circuits.
CO5	Construct ladder diagram for controlling hydraulic and pneumatic circuits

Reference Books	
1.	Anthony Esposito, “Fluid Power with Applications”, Pearson Education;7th edition 2013.
2.	James R. Daines "Fluid Power: Hydraulics and Pneumatics" August 2012.
3.	Andrew Parr, “Hydraulics and Pneumatics: A Technician's and Engineer's Guide”, Elsevier,3rd Revised edition, January 2011.
4.	Jagadeesha T, “Pneumatics Concepts, Design and Applications “, Universities Press, 2015
5.	Majumdar S.R., “Oil Hydraulic Systems – Principles and Maintenance”, 2nd Edition, Tata McGraw-Hill, New Delhi, 2012.

Approved by BoS Chairman

M.E. - E.D	M23EDE303 - DESIGN FOR X	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the design Principles for Manufacturability and GD&T.
2.	To apply design principles focusing on easy machining of component.
3.	To understand the design principles for maintainability and reliability.
4.	To apply design principles for improving the sustainability of product.
5.	To gain knowledge about the design for additive manufacturing.

UNIT - I	INTRODUCTION	9

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric tolerances - Assembly limits - Datum features - Tolerance stacks - FACTORS INFLUENCING FORM DESIGN - Working principle, Material, Manufacture, Design - Possible solutions - Materials choice – Influence of materials on form design - form design of welded members, forgings and castings.

UNIT - II	COMPONENT DESIGN - MACHINING CONSIDERATION	9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility.

UNIT - III	DESIGN FOR RELIABILITY AND MAINTAINABILITY	9

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress-strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair. MTTR – mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability.

Approved by BoS Chairman

UNIT - IV	SUSTAINABLE DESIGN	9
Industrial ecology, multiple life cycle design, principles of design, green engineering, cradle to cradle design, The Natural Step, biomimicry, design for reuse, dematerialization, modularization, Design to minimize material usage – Design for disassembly – Design for recyclability – design for flexibility, design for disassembly, design for inverse manufacturing, design for the environment, – Design for energy efficiency – Design to regulations and standards etc.		

UNIT - V	DESIGN FOR ADDITIVE MANUFACTURING	9
Concepts and Objectives - AM Unique Capabilities - Part Consolidation - Topology Optimization - Lightweight Structures - DFAM for Part Quality Improvement - CAD Modeling - Model Reconstruction - Data Processing for AM.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Select relevant process; apply the general design principles for manufacturability; GD&T
CO2	Apply design considerations while designing the formed and machined components
CO3	Be exposed to maintenance systems and reliability based design
CO4	Apply design considerations for environmental issues
CO5	Apply design considerations for additive manufacturing

Text Books	
1.	Boothroyd, G , Dewhurst, P, and Knight, W, “Product Design for Manufacture and Assembly”, 3rd Edition, CRC Press,Taylor & Francis, 2010
2.	Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.

Approved by BoS Chairman

Reference Books	
1.	Karl Ulrich, Steven Eppinger, Maria C. Yang, “Product Design And Development”, McGraw Hill, 2020
2.	K.Venkataraman, “Maintenance Engineering and Management”, PHI Learning, 2007
3.	Fixel, J. Design for the Environment McGraw Hill., 1996.
4.	Ben Redwood, Brian Garret, Filemon Schöffer, and Tony Fadel, “The 3D Printing Handbook: Technologies, Design and Applications”, 3D Hubs B.V., Netherland, 2017. ISBN-13: 978- 9082748505.

Approved by BoS Chairman

M.E. - E.D	M23EDE304 - PRODUCT DESIGN FOR SUSTAINABILITY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the basic concepts of sustainability.
2.	To gain knowledge about the tools and techniques for sustainable design.
3.	To understand the principles for sustainable design.
4.	To improve the design by assessing the customer needs.
5.	To know the knowledge about various marketing techniques.

UNIT - I	BASIC CONCEPTS IN SUSTAINABILITY	9

Understanding the language of sustainable engineering design, construction and operation. Natural resources terminology. Carrying capacity. Sustainable development, corporate responsibility, biophysical constraints, environmental management.

UNIT - II	TOOLS AND TECHNIQUES	9

Sustainable Engineering Design Tools – Life cycle analysis, carbon foot printing. Life cycle assessment (LCA), Types of LCA‟s: baseline, comparative, streamlined. LCA inventory analysis: process or inputoutput. Hybrid inventory analysis. Sustainable Product Design. Whole systems design. Light weighting and materials reduction. Designing for a lifetime. Design for durability, repair and upgrade disassembly and recycling. Energy use in design. Reducing energy losses in design.

UNIT - III	FOUNDATIONAL CONCEPTS & PRINCIPLES FOR SUSTAINABLE BREAKTHROUGH DESIGN	9

Infrastructure for managing flows of materials, energy and activities; sustainable value creation approaches for all stakeholders, environmental design characteristics; design changes & continual improvement; inclusive sustainable design principles, crowd sourcing, multiple-objective designs; infrastructures that support system thinking; knowledge management for sustainable design, learning systems and experimentation; smart data systems, understanding variation.

Approved by BoS Chairman

UNIT - IV	SUSTAINABLE DESIGN	9
Industrial ecology, multiple life cycle design, principles of design, green engineering, cradle to cradle design, The Natural Step, bio mimicry, design for reuse, dematerialization, modularization, design for flexibility, design for disassembly, design for inverse manufacturing, design for the environment, etc.		

UNIT - V	CUSTOMER AND USER NEEDS ASSESSMENT	9
Identification & breakdown structures that describe customers & stakeholders, green marketing, socially conscious consumerism, sources of customer information, collecting information, analyzing customer behavior, translating the voice of the customer, use analysis, structuring customer needs, service gap analysis, prioritizing customer needs, strategic design, Kano technique.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply the concept of sustainability in terms of design, construction and development.
CO2	Make use of life cycle assessment and other technique for a design.
CO3	Apply sustainable value creation approaches, design changes & continual improvement.
CO4	Choose sustainable design, green engineering, flexible design etc.
CO5	Design according to the customer needs and Design the products that are environmentally friend.

Reference Books

1.	Clarke, Abigail & John K. Gershenson, “Design for the Life Cycle,” Life-cycle Engineering Laboratory, , 2006.
2.	Finster, Mark P., “Sustainable Perspectives to Design and Innovation”, 2013.
3.	Ramaswamy, Rohit, “Design and Management of Service Processes: Keeping Customers for Life”, Prentice Hall, 1996.
4.	Schmitt, Brent, “Customer Experience Management”, Wiley and Sons, 2003.

Approved by BoS Chairman

M.E. - E.D	M23EDE305 - GREEN MANUFACTURING PRACTICES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge of air pollution.
2.	To know impact of Nosie pollution.
3.	To understand water demand and water quality.
4.	To understand the concepts of environmentally friendly machining.
5.	To understand the strategies for reducing waste in manufacturing.

UNIT - I	AIR POLLUTION SAMPLING AND MEASUREMENT	9

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants- solution to the atmosphere dispersion equationthe Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dixide, carbon monoxide, oxidants and ozone.

UNIT - II	NOISE POLLUTION & CONTROL	9

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise-Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects.

UNIT - III	WATER DEMAND, WATER QUALITY	9

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues

Approved by BoS Chairman

UNIT - IV	ENVIRONMENTALLY-FRIENDLY MACHINING	9
Sustainable Manufacturing Technologies- Dry Machining and Near-Dry Machining - Cryogenic Machining - High Pressure Jet Assisted Machining - Assessment of Machining Process Sustainability - Assessment Methods - Material Production, Cutting Fluid Preparation, Tool Preparation, Machine Tool Construction, Material Removal, Cleaning Process.		

UNIT - V	ZERO-WASTE IN MANUFACTURING	9
Concepts of Zero Waste in Manufacturing - Waste Assessment Process and Systems Approach - Common Strategies for Zero Waste - Recyclable Product Identification, Paper Product Reduction Strategies, Collection Stations, Packaging, Source Reduction, Green Purchases and Green Partners- Case Study.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Understand the impact of air pollution and tools for air pollution measurement.
CO2	Determine the noise pollution of environment.
CO3	Explain the Factors affecting consumption of water and quality of water.
CO4	Choose the machining process that are environmentally friendly.
CO5	Apply various strategies to achieve zero waste in manufacturing.

Reference Books	
1.	Dornfield David, Green Manufacturing, Springer, 2012.
2.	Davim.J.Paulo, Green Manufacturing Processes and Systems, Springer, 2013.
3.	Cairncrss, Francis, Costing the Earth: The Challenge for Governments, the Opportunities for Business, Harvard Business School Press, 2009.
4.	Gradel.T.E. and B.R. Allenby, Industrial Ecology, Prentice Hall, 2010.
5.	World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press, 2005.

Approved by BoS Chairman

M.E. - E.D	M23EDE306 - DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENTS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To know the concept of design for manufacturing, assembly and environment.
2.	To know the computer application in design for manufacturing and assembly.
3.	To know the environment friendly manufacturing methods.
4.	To improve knowledge on redesigning of castings.
5.	To understand the recycling and minimizing material usage methods.

UNIT - I	INTRODUCTION	9

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric tolerances Assembly limits -Datum features - Tolerance stacks.

UNIT - II	FACTORS INFLUENCING FORM DESIGN	9

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice – Influence of materials on form design - form design of welded members, forgings and castings.

UNIT - III	COMPONENT DESIGN - MACHINING CONSIDERATION	9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation – simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility - Design for assembly.

UNIT - IV	COMPONENT DESIGN – CASTING CONSIDERATION	9

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design- Modifying the design - group technology - Computer Applications for DFMA.

Approved by BoS Chairman

UNIT - V	DESIGN FOR THE ENVIRONMENT	9
Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application – Lifecycle assessment – Basic method – AT&T‟s environmentally responsible product assessment - Weighted sum assessment method Lifecycle assessment method – Techniques to reduce environmental impact – Design to minimize material usage – Design for disassembly – Design for recyclability – Design for remanufacture – Design for energy efficiency – Design to regulations and standards.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Select of material, manufacturing process and mechanism for a product.
CO2	Design a component by considering the form design and machining.
CO3	Design a component by considering machining process.
CO4	Design a component based on casting considerations.
CO5	Design an eco-friendly product

Reference Books	
1.	Boothroyd, G , Dewhurst, P, and Knight, W, “Product Design for Manufacture and Assembly”, 3rd Edition, CRC Press,Taylor & Francis, 2010
2.	Bralla, James G, Design for Manufacturability handbook, McGraw hill, 1999.
3.	Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.
4.	Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.
5.	Fixel, J., “Design for Environment: A Guide to Sustainable Product Development”, 2nd Edition McGraw Hill., 2009.

Approved by BoS Chairman

M.E. - E.D	M19EDE307 - ENGINEERING BIOMECHANICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the principles of mechanics.
2.	To Learn the mechanics of physiological systems.
3.	To understand the various bio tissues.
4.	To understand the biomechanics of joints and implants.
5.	Be familiar with the mathematical models used in the analysis of biomechanical systems.

UNIT - I	INTRODUCTION TO MECHANICS	9

Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, Couette flow and Hagen-poiseuille equation, turbulent flow. Cardiovascular system - biological and mechanical valves development, artificial heart valves testing of valves, Structure, functions, material properties and modeling of Blood vessels.

UNIT - II	BIOFLUID MECHANICS	9

Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, Couette flow and Hagen-poiseuille equation, turbulent flow. Cardiovascular system - biological and mechanical valves development, artificial heart valves testing of valves, Structure, functions, material properties and modeling of Blood vessels.

UNIT - III	BIOSOLID MECHANICS	9

Hard Tissues : Bone structure & composition mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, Maxwell & Voight models – anisotropy. Soft Tissues: Structure, functions, material properties and modeling of Soft Tissues: Cartilage, Tendon, Ligament, Muscle.

UNIT - IV	BIOMECHANICS OF JOINTS AND IMPLANTS	9

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle. Design of orthopedic implant, specifications for a prosthetic joint, biocompatibility, requirement of a biomaterial, characteristics of different types of biomaterials, manufacturing process of implants, fixation of implants.

Approved by BoS Chairman

UNIT - V	MODELING AND ERGONOMICS	9
Introduction to Finite Element Analysis, Analysis of bio mechanical systems using Finite element methods, Graphical design. Ergonomics- Gait analysis, Design of work station, Sports biomechanics, Injury mechanics.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the mechanics of physiological systems.
CO2	Understand the various biofluid mechanics.
CO3	Explain the bone structure & composition mechanical properties of bone.
CO4	Design an orthopedic implant, specifications for a prosthetic joint.
CO5	Analyse the bio mechanical systems.

Reference Books	
1.	Marcelo Epstein, “The Elements of Continuum Biomechanics”, Wiley, ISBN: 978-1-119-99923-2, 2012.
2.	Duane Knudson, “Fundamentals of Biomechanics”, Second Edition, Springer, 2007
3.	Jay D. Humphrey, Sherry De Lange, “An Introduction to Biomechanics: Solids and Fluids, Analysis and Design”, Springer, 2004.
4.	Shrawan Kumar, “Biomechanics in Ergonomics”, Second Edition, CRC Press 2007.
5.	Y.C. Fung, “Bio-Mechanics- Mechanical Properties of Tissues”, Springer-Verlag, 2013.

Approved by BoS Chairman

M.E. - E.D	M23EDE308 - COMPOSITE MATERIALS AND MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand different composite materials and finding its mechanical strength.
2.	To Fabricate FRP and other composites by different manufacturing methods
3.	To stress analysis of fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
4.	To calculate stresses in the lamina of the laminate using different failure theories
5.	To calculate residual stresses in different types of laminates under thermo-mechanical load using the Classical Laminate Theory

UNIT - I	INTRODUCTION TO COMPOSITE MATERIALS	9

Definition-Matrix materials-polymers-metals-ceramics - Reinforcements: Particles, whiskers, inorganic fibers, metal filaments- ceramic fibers- fiber fabrication- natural composite wood, Jute - Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite Materials, Dispersion-Strengthened composite, Fiberreinforced composites Rule of mixtures-Characteristics of fiber-Reinforced composites, Manufacturing fiber and composites.

UNIT - II	MANUFACTURING OF COMPOSITES	9

Manufacturing of Polymer Matrix Composites (PMCs)-hand lay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-, bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) – Solid state, liquid state, vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs) –hot pressing-reaction bonding process-infiltration technique, direct oxidation- interfaces.

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UNIT - III	INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS	9
Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.		

UNIT - IV	LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES	9
Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies.		

UNIT - V	THERMAL ANALYSIS	9
Assumption of Constant Co-efficient of Thermal Expansion (C.T.E.) - Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E‟s. C.T.E‟s for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the basic concepts of different types of Composites with its applications.
CO2	Choose appropriate composite fabrication techniques.
CO3	Develop models the mechanical behavior of Composites in both micro and macro level.
CO4	Evaluate the stresses in the lamina of the laminate using different failure theories
CO5	Analyze thermo-mechanical behavior and evaluate residual stresses in different types of laminates.

Approved by BoS Chairman

Reference Books	
1.	Chung, Deborah D.L., “Composite Materials: Science and Applications”, Springer, 2nd Edition, 2012.
2.	Madhujit Mukhopadhyay, “Mechanics of Composite Materials and Structures”, University Press, 2005.
3.	Issac M. Daniel and Ori Ishai, “Engineering Mechanics of Composite Materials”, Oxford University Press-2006, First Indian Edition – 2007.
4.	Mallick, P.K., “Fiber –Reinforced Composites: Materials, Manufacturing and Design”, 3rd Edition, CRC Press, 2007.
5.	Halpin, J.C., “Primer on Composite Materials, Analysis”, Routledge, Taylor & Francis, 2017.

Approved by BoS Chairman

M.E. - E.D	M23EDE309 - DESIGN FOR INTERNET OF THINGS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge of concepts and terminology of Machine to Machine (M2M) to IoT.
2.	To learn functions and features of IoT structure.
3.	To understand different modules offered in M2M and IoT Technology.
4.	To understand IoT Architecture implementation approaches.
5.	To understand integration of IoT Reference Architecture with other applications.

UNIT - I	INTRODUCTION	9

Machine to Machine (M2M) to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.

UNIT - II	IOT STRUCTURE	9

M2M to IoT – A Market Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

UNIT - III	IOT NETWORKING	9

M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.

UNIT - IV	IOT ARCHITECTURE	9

IoT Architecture-State of the Art – Introduction, State of the art, Architecture Reference Model - Introduction, Reference Model and architecture, IoT reference Model.

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UNIT - V	ARCHITECTURE MODELING	9
IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control. Industrial Automation- Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation- Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the vision of IoT from a global context.
CO2	Determine the Market perspective of IoT.
CO3	Use of Devices, Gateways and Data Management in IoT.
CO4	Build state of the art architecture in IoT.
CO5	Apply of IoT in Industrial and Commercial Building Automation and Real-World Design Constraints.

Reference Books	
1.	Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, A press Publications, 2013.
2.	Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Aves and, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
3.	Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014

Approved by BoS Chairman

M.E. - E.D	M23EDE310 - HUMAN FACTORS ENGINEERING IN PRODUCT DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the concept of ergonomic design.
2.	To design the work environment and equipments
3.	To analyse the human performance and set standard.
4.	To design information display and control for a system.
5.	To understand the concept occupational safety in product design.

UNIT - I	INTRODUCTION & DESIGN TO FIT TASKS, PROCESSES, AND PEOPLE	9

Introduction - Ergonomic Design - Human-Centered Design - Ergonomic Criteria - Models of Human Performance - Macro-ergonomics - Ergonomic Methods - Ergonomic Design Principles - Visual Graphs of Operations - Analysis of Tasks and Jobs.

UNIT - II	DESIGN OF THE PHYSICAL ENVIRONMENT, WORK AREAS, TOOLS, AND EQUIPMENT	9

Cleanliness, Clutter, and Disorder - Temperature and Humidity - Lighting and Illumination - Noise – Applied Anthropometry - Design of Work Areas and Stations - Design of Tools and Equipment – Protective Equipment for the Operator.

UNIT - III	DESIGN & ANALYSIS OF PHYSICAL TASKS - MEASURING & PREDICTING HUMAN PERFORMANCE – LEARNING CURVE	9

Methods Improvement - Motion and Micro-motion Study - Manual Materials Handling – Probabilistic Assumptions - Time Study - Performance Leveling - Determining Allowances - Maintaining Standards - Indirect Performance Measurement - Criteria Other Than Time - Synthetic Data Systems - Standard Data Systems - Cognitive Modeling - Learning Curve Models - Fitting Learning Curves.

UNIT - IV	DESIGN OF COMMUNICATION, DISPLAY & CONTROL	9

Communication Theory - Human Information Processing - Display Design - Hazard Communication - Control Systems - Manual Control - Design of Controls - Fuzzy Control - Supervisory Control.

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UNIT - V	DESIGN OF PRODUCT QUALITY & MACRO-ERGONOMICS OF OCCUPATIONAL SAFETY AND HEALTH	9
Quality Management and Customer-Driven Design - Usability Analysis and Testing – Designed Experiments - Fundamental Concepts of Industrial Safety and Health - Contemporary Occupational Health and Safety Management - Hazards and Control Measures - Warnings and Safety Programs.		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Apply the fundamental concepts and principles of ergonomics in product design and development
CO2	Apply the principles of work place design & equipment design in product design and development
CO3	Apply the principles of physical task design in product design and development. Apply the measurement and prediction methods of human performance with relation to learning curve theory in product design and development.
CO4	Apply the principles of communication, display & control design in product design and development
CO5	Apply the principles of product quality in product design and development. Apply the principles of macro-ergonomics of occupational safety and health.

Reference Books	
1.	Mark R. Lehto & James R. Buck, “Introduction to Human Factors & Ergonomics for Engineers”, CRC Press, Taylor & Francis, 2008.
2.	Chandler Allen Phillips, “Human Factors Engineering”, John Wiley and sons, New York, 2000
3.	Mark S Sanders, “Human Factors in Engineering and Design”, McGraw Hill, New York,1993.
4.	Martin Helander, “A guide to Human Factors and Ergonomics”, 2nd Edition, CRC, Taylor & Francis Group 2006.
5.	McCormik, J., “Human Factors Engineering and Design”, McGraw Hill, 1992.

Approved by BoS Chairman

M.E. - E.D	M23EDE311 - PRODUCT LIFECYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand history, concepts and terminology of PLM.
2.	To understand functions and features of PLM/PDM.
3.	To understand different modules offered in commercial PLM/PDM tools.
4.	To understand PLM/PDM implementation approaches.
5.	To explore the possibility of digital manufacturing in practical applications

UNIT - I	HISTORY, CONCEPTS AND TERMINOLOGY OF PLM	9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM – Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM).PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications.

UNIT - II	PLM / PDM FUNCTIONS AND FEATURES	9

User Functions –Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.

UNIT - III	DETAILS OF MODULES IN A PDM/PLM SOFTWARE AND DIGITAL LIFE CYCLE	9

Case studies based on top few commercial PLM/PDM tools - Collaborative Product Development, Mapping Requirements to specifications. Part Numbering, Engineering Vaulting, Product reuse, Engineering Change Management, Bill of Material and Process Consistency. Digital Mock up and Prototype development. Virtual testing and collateral. Introduction to Digital Manufacturing.

Approved by BoS Chairman

UNIT - IV	ROLE OF PLM IN INDUSTRIES	9
Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance.		

UNIT - V	PLM DIGITAL MANUFACTURING	9
Digital Manufacturing – PLM Digital manufacturing, benefits manufacturing, manufacturing the first-one, Ramp up, virtual learning curve, manufacturing the rest, production planning.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Outline history, concepts and terminology of PLM.
CO2	Apply the functions and features of PLM/PDM.
CO3	Make use of different modules offered in commercial PLM/PDM tools.
CO4	Outline PLM/PDM implementation approaches.
CO5	Realize potential for digital manufacturing in contemporary manufacturing applications.

Reference Books	
1.	John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, Springer Publisher, 2011 (2nd Edition).
2.	Antti Saaksvuori and Anselmi Immonen, “Product Lifecycle Management”, Springer Publisher, 2008 (3rd Edition).
3.	Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.
4.	John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher, 2007.

Approved by BoS Chairman

M.E. - E.D	M23EDE312 - COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To outline the need for Project Management.
2.	To highlight different techniques of activity planning.
3.	To know the basic structure of pricing.
4.	To study and understand the concept of Engineering Economics and apply in the real word.
5.	To gain knowledge in the field of cost estimation and enable the students to estimate the cost of

UNIT - I	INTRODUCTION TO PROJECT MANAGEMENT	9

Objectives of Project Management - Importance of Project Management - Types of Projects Project Management Life Cycle - Project Selection – Feasibility study : Types of feasibility Steps in feasibility study

UNIT - II	PROJECT PLANNING AND IMPLEMENTATION	9

Project Scope - Estimation of Project cost – Cost of Capital – Project Representation and Preliminary Manipulations - Basic Scheduling Concepts - Resource Levelling – Resource Allocation.

UNIT - III	PRICING	9

Determinants of price – Pricing under different objectives – Pricing under different market structures – Price discrimination – Pricing of Joint products – Pricing methods in practice.

UNIT - IV	PRODUCTION AND COST ANALYSIS	9

Production Analysis – Production function, Returns to a factor, Returns to scale, ISO quants and Least cost combination of inputs. Cost Analysis – Cost concepts, Determinants of cost, Short-run cost-output Relationship, Long-run cost output relationship, Economies and Diseconomies of scale and Estimating cost – Output Relationship.

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UNIT - V	ESTIMATION OF COST MANAGEMENT	9
Introduction to Estimation and Costing – Elements of costs – Allocation of overheads – Estimation of Material cost – Estimation of Labour cost, -Estimation in Machine shop – Estimation in Sheet metal shop – Estimation in Forging shop –Estimation in welding shop – Estimation in Foundry shops.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the concept of projects, its process, objectives and functions of project management.
CO2	Discuss the functions of project management.
CO3	Apply project management principles in business situations to optimize time and resource utilization.
CO4	Apply the principles of micro economics and cost estimation.
CO5	Apply the principles to appreciate the functioning of product and input market as well as the economy.

Reference Books	
1.	Arun Kanda, “Project Management A Life Cycle Approach”, Prentice Hall of India, 2011.
2.	R.B.Khanna, “Project Management”, Prentice Hall of India, 2011.
3.	R.Panneerselvam and P.Senthilkumar, “Project Management”, Prentice Hall of India, 2009.
4.	T.R. Banga and S.C. Sharma, Mechanical Estimating and Costing, 17th Edition, Khanna Publishers, 2001.
5.	V.L. Mote, Samuel Paul and G.S. Gupta, Managerial Economics – concepts and cases, Tata McGraw-Hill, 40th reprint 2007.

Approved by BoS Chairman

Semester - IV

M.E. - E.D	M23EDP401 - PROJECT WORK PHASE - II	L	T	P	C
		0	0	24	12

Course Objectives	
1.	To solve the identified problem based on the formulated methodology.
2.	To develop skills to analyze and discuss the test results, and make conclusions.

Description of the Experiments

The student should continue the phase I work on the selected topic as per the formulated methodology under the same supervisor. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report submitted and the viva-voce examination by a panel of examiners including one external examiner.

Total Instructional hours : 360

Course Outcome

Design calculations and analysis on completion of the project work students will be in a position to take up any challenging practical problem in the field of engineering design and find better solutions to it.

Approved by BoS Chairman