DEPARTMENT OF MECHANICAL ENGINEERING
A.U. COLLEGE OF ENGINEERING (A), ANDHRA UNIVERSITY, VISAKHAPATNAM
SCHEME OF INSTRUCTION AND EXAMINATION FOR
M.TECH. (MACHINE DESIGN)
(With effect from 2015-16 academic year: CBCS)

I – SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam. Duration	Theory /Lab./Viva	Sess.		
MD 101	Core subject 1: **Theory of Elasticity and Plasticity**	4	--	4	3	70	30	100	4
MD 102	Core subject 2: **Advanced Mechanics of Solids**	4	--	4	3	70	30	100	4
MD 103	Core subject 3: **Advanced Mechanics of Machinery**	4	--	4	3	70	30	100	4
MD 104	Core subject 4: **Mechanical Vibrations**	4	--	4	3	70	30	100	4
MD 105	**Elective Subject 1** **1. Advanced Optimization Techniques** **2. Computer Simulation of Machines** **3. Mechanics of Metal Forming** **4. Non Linear Solid Mechanics** **5. Robotics** **6. Theory of Plates and Shells**	4	--	4	3	70	30	100	4

MD 106	**Elective Subject 2** **1. Integrated Computer Aided Design** **2. Design for Manufacturing & Assembly** **3. Mechatronics** **4. Fuzzy logic & Neural Networks** **5. Design and Analysis of Experiments** **6. Mechanical Behaviour of Engineering Materials**	4	--	4	3	70	30	100	4
MD 107	**Lab 1: MD 107** **Computer Aided Design, Modelling and Simulation Lab**	--	3	3	Viva-Voce	50	50	100	2
MD 108	**Lab 2: MD 108** **Mechanical Vibrations Lab**	--	3	3	Viva-Voce	50	50	100	2
Total		**24**	**6**	**30**		**520**	**280**	**800**	**28**

II – SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Duration of Exam. (hrs)	Theory Lab./ Viva	Sess.		
NT 201	Core subject 1: **Instrumentation & Experimental Stress Analysis**	4	--	4	3	70	30	100	4
NT 202	Core subject 2: **Signal Analysis and Condition Monitoring**	4	--	4	3	70	30	100	4
NT 203	Core subject 3: **Advanced Finite Element Analysis**	4	--	4	3	70	30	100	4
NT 204	Core subject 4: **Advanced Engineering Design**	4	--	4	3	70	30	100	4
NT 205	Elective Subject **1. Vehicle Dynamics** **2. Tribology** **3. Concurrent Engineering** **4. Pressure Vessel Design** **5. Gear Engineering** **6. Advanced Mechanics of Composite Materials**	4	--	4	3	70	30	100	4
NT 206	**Elective Subject 4** **1. Computational Fluid Dynamics** **2. Composite Materials** **3. Structural Health**	4	--	4	3	70	30	100	4

	Monitoring **4. Vision Systems And Image Processing** **5. Introduction to nanotechnology** **6. Polymer Based Nanocomposites**								
NT 207	Lab 1: **Characterization of Nanomaterials and nano structures**	--	3	3	Viva-Voce	50	50	100	2
NT 208	Lab 2: : **Computer Aided modeling and Simulation**		3	3	Viva-Voce	50	50	100	2
Total		**24**	**6**	**30**		**520**	**280**	**800**	**28**

III – SEMESTER

Code No	**Course title**	**Scheme of Examination**	**Total Marks**	**Credits**
NT 301	Dissertation (Preliminary)	Viva-voce	**100**	**10**

IV – SEMESTER

Code No	**Course title**	**Scheme of Examination**	**Total Marks**	**Credits**
NT 401	Dissertation (Final)	Viva-voce	**100**	**14**

oo0oo

MD 101 THEORY OF ELASTICITY AND PLASTICITY
(Four-Semester Course - CBCS- w.e.f. 2015-2016)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Elasticity: Two dimensional stress analysis - Plane stress - Plane strain - Equations of compatibility - Stress function - Boundary conditions.
Problem in rectangular coordinates - Solution by polynomials - Saint Venent's principles - Determination of displacement - Simple beam problems.
Problems in polar coordinates - General equations in polar coordinates - Stress distribution symmetrical about axis - Strain components in polar coordinates - Simple and symmetric problems.
Analysis of stress and strain in three dimensions - Principle stresses - Homogeneous deformations - Strain spherical and deviatoric stress - Hydrostatic strain.
General theorems: Differential equations of equilibrium and compatibility - Displacement - Uniqueness of solution - Reciprocal theorem.
Bending of prismatic bars - Stress function - Bending of cantilever beam - Beam of rectangular cross-section - Beams of circular cross-section.
Plasticity: Plastic deformation of metals - Structure of metals - Deformation - Creep stress relaxation of deformation - Strain rate condition of constant maximum shear stress - Condition of constant strain energy - Approximate equation of plasticity.
Methods of solving practical problems - The characteristic method - Engineering method - Compression of metal under press - Theoretical and experimental data drawing.

References:

1. Theory of Elasticity by Timoshenko, S.P. and Goodier, J.N./Koakusha Publishers
2. An Engineering Theory of Plasticity by E.P. Unksov/Butterworths
3. Applied Elasticity by W.T. Wang.
4. Theory of Plasticity by Hoffman and Sacks.
5. Theory of Elasticity and Plasticity/Sadhu Singh/ Khanna Publishers
6. Theory of Elasticity and Plasticity/Harold Malcolm Westergaard/Harvard University Press

MD 102 MECHANICAL VIBRATIONS
(Four-Semester Course - CBCS- w.e.f. 2015-2016)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Single degree freedom systems -Introduction - Single degree freedom systems - free and forced vibrations - Damping classification and damped systems .
Two degree freedom systems - Free, forced damped and undamped motions - Use of influence coefficients, Matrix methods and Lagrange's equations - Phenomenon of beat - Dynamic absorbers – Applications.
Transient (Shock) vibrations as applied to single and two degree freedom systems - Use of mathematics and graphical techniques in the analysis (superposition integral, Laplace transformations, phase plane techniques).
Multi degree freedom systems - Free and forced motions in longitudinal, torsional and lateral modes - damped and undamped, critical speeds of rotors. Continuous systems - free and forced vibrations of string, bars and beams - Principle of orthogonality Classical and energy methods by Rayleigh, Ritz and Gelerkin.
Frequency domain vibration analysis: Over view, machine-train monitoring parameters-Data base development-vibration data acquisition-trending analysis-failure- node analysis-signature analysis-root cause analysis.
Vibration Control in Structures: Introduction, State space representation of equations of motion, Passive control, Active control and semi active control, Free layer and constrained damping layers, piezo electric sensors and actuators for active control, semi active control of automotive suspension systems.

References:

1. Mechanical Vibrations by A.H. Church.
2. Vibration Problems in Engineering by Timoshenko and Young.
3. Mechanical Vibrations by Den Hartog.
4. Mechanical Vibrations/Groover/Nem Chand and Bros
5. Elements of Vibration Analysis by Meirovitch, TMH, 2001
6. Mechanical Vibrations/Schaum Series/ McGraw Hill
7. Mechanical Vibrations / SS Rao/ Pearson/ 2009, Ed 4
8. Mechanical Vibrations/Debabrata Nag/Wiley
9. Mechanical Vibrations and sound engineering/ A.G.Ambekar/ PHI
10. Theory and Practice of Mechanical Vibrations/JS Rao & K. Gupta/New Age Intl. Publishers/Revised 2nd Edition
11. Mechanical Vibrations/Groover/Nem Chand and Bros

\

MD 103 ADVANCED MECHANICS OF SOLIDS
(Four-Semester Course - CBCS- w.e.f. 2015-2016)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Flat plates: Introduction - Stress resultants in a flat plate - Kinematics: Strain - Displacement relations for plates - Equilibrium equations for small displacement theory of flat plates - Stress-strain-temperature relations for isotropic elastic plates - Strain energy of a plate - Boundary conditions for plates - Solutions of rectangular and circular plate problems.
Torsion: Torsion of cylindrical bar of circular cross-section Saint-Venant's semi-inverse method - Linear elastic solution - The Prandtl elastic - Membrane (soap-film) analogy - Narrow rectangular cross-section - Hollow thin-wall torsion members: Multiply connected cross-section - Thin-wall torsion members with restrained ends - Fully plastic torsion.
Beams on elastic foundation: General theory - Infinite beam subjected to concentrated load: Boundary conditions - Infinite beam subjected to a distributed load segment - Semi-infinite beam subjected to loads of its end - Semi-infinite beam with concentrated load near its end - Short beams - Thin-wall circular cylinders.
Stress concentrations: Basic concepts - Nature of a stress concentration problem. Stress concentration factor - Stress concentration factor. Theory of elasticity - Stress concentration factors. Experimental techniques - Stress gradients due to concentrated load - The stationary crack - Crack propagation. Stress intensity factor. Effective stress concentration factor: Applications - Stress concentration factor. Combined loads - Effective stress concentration factors - Effective stress concentration factors. Repeated loads - Effective stress concentration factors - Other influences - Effective stress concentration factors - In-elastic strains.
Contact stresses: Introduction - The problem of determining contact stresses - Assumptions on which a solution for contact stresses is based - Notation and meaning of terms - Expressions for principal stresses - Method of computing contact stresses - Deflection of bodies in point contact - Stress for two bodies in contact over narrow rectangular area (line contact). Loads normal to area - Stresses for two bodies in line contact. Loads normal and tangent to contact area.

References:

1. Advanced Mechanics of Materials by Boresi, A.P. and Sidebottm, O.M.
2. Advanced Mechanics of Materials by Seely and Smith.
3. Advanced Strength of Materials by Den Hartog.
4. Advanced Strength of Materials by Timoshenko S.P.
5. Advanced strength of materials / Den Hortog J.P./Torrent
6. Theory of Plates /Timoshenko
7. Strength of materials / Sadhu singh/ Khanna Publishers
8. Mechanics of Materials / Beer & Jhonson / McGraw Hill
9. Theory of Plates & Shells / Timoshenko/ McGraw Hill/ 2nd Edition

MD 104 MECHANICS OF MACHINERY
(Four-Semester Course - CBCS- w.e.f. 2015-2016)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Kinematics of complex mechanisms - Complex mechanisms, Low and high degree of complexity, Goodman's indirect acceleration analysis, Method of normal accelerations, Hall and Ault's auxiliary point method, Carter's method and comparison of methods.
Advanced kinematics of plane motion - The inflexion circle - Euler-Savary equation, Analytical and graphical determination of diameter of inflection circle - Bobbileier's construction, Collineation axis - Hartman's construction, Application of inflection circle to kinematic analysis - Polode curvature - General case and special case, Polode curvature in the four-bar mechanism - Coupler motion, Relative motion of the output and input links, Freudenstein's collineation axis theorem - Carter Hall circle, Circling-point curve (general case).
Introduction to synthesis (graphical methods) guiding a point through two, three and four distinct positions - Burmaster's curve, Function generation - Overlay's method, Path generation - Robert's theorem.
Introduction to synthesis (analytical methods) - Freudenstein's equation - Precision point approximation - Precision derivative approximation - Method of components - Block synthesis and Reven's method.
Forces in mechanisms - Free body diagrams - Friction in link connections - Forces in linkages.
Cam dynamics - Forces in rigid systems, Mathematical models, Response of a uniform - Motion undamped cam mechanism - Analytical method, Follower response by phase - Plane method - Position error, Jump, Crossover shock - Johnson's numerical analysis.

References:

1. Kinematics and Dynamics of Plane Mechanisms by J. Hirschhorn, McGraw Hill Book Co., 1962.
2. Theory of Machines and Mechanisms/ J.E Shigley and J.J . Uicker Jr./ McGraw-Hill, 1995
3. Theory of Mechanisms and Machines/ Amitabh Ghosh and Ashok Kumar Mallik/ E.W.P.Publishers.
4. Kinematics and Linkage Design/ Allen S.Hall Jr./ PHI,1964.
5. Kinematics and Dynamics of Machinery/Charles E Wilson/Pearson/3rd Edition

MD 105:1 ADVANCED OPTIMIZATION TECHNIQUES
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective - 1 Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Geometric programming (G.P): Solution of an unconstrained geometric programming, differential calculus method and arithmetic method. Primal dual relationship and sufficiency conditions. Solution of a constrained geometric programming problem (G.P.P), Complementary Geometric Programming (C.G.P)
Dynamic programming(D.P): Multistage decision processes. Concepts of sub optimization and Principal of optimality, computational procedure in dynamic programming calculus method and tabular methods. Linear programming as a case of D.P. and continuous D.P.
Integer programming(I.P): Graphical representation. Gomory's cutting plane method. Bala's algorithm for zero-one programming problem. Branch-and-bound method, Sequential linear discrete Programming, Generalized penalty function method.
Stochastic Programming (S.P): Basic Concepts of Probability Theory, Stochastic Linear programming.
Non-traditional optimization techniques: Multi-objective optimization - Lexicographic method, Goal programming method, Genetic algorithms, Simulated annealing, Neural Networks based Optimization.

References:

1. Operations Research- Principles and Practice by Ravindran, Phillips and Solberg, John Wiely
2. Introduction to Operations Research by Hiller and Lieberman, Mc Graw Hill
3. Engineering Optimization - Theory and Practice by Rao, S.S., New Age International (P) Ltd. Publishers.
4. Engineering Optimization By Kalyanmanai Deb, Prentice Hall of India, New Delhi.
5. Genetic Algorithms - In Search, Optimization and Machine Learning by David E. Goldberg, Addison-Wesley Longman (Singapore) Pvt. Ltd.

MD 105:2 COMPUTER SIMULATIONS OF MACHINES
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective - 1 Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Introduction, Overview, Why Simulate Mechanisms, Kinematics Simulations, Dynamic Simulation of Mechanisms, Summary, Vector Loop and Vector Chain Equations – Introduction, The Planar Vector, Single Loop Equations, Derivatives of Vectors, Other Common Mechanisms, Vector Chains.
Solutions of the position problem: Overview, Numerical Solutions of Nonlinear algebraic Equations, The Position Problem of a Four-Bar Linkage, Mat lab Solution of the position of a Four-Bar Linkage.
Kinematic simulations using SIMULINK: What is a Kinematic Simulation, Velocity Solution via Kinematic Simulation, Acceleration Solution via Kinematic Simulation, The Consistency Check, Kinematic Simulation of a Four-Bar Mechanism.
Introducing dynamics: Simulating the slider on inclined plane, Adding the Pendulum, Assembling the Matrix Equation, Creating a Dynamic Simulation, Setting Initial conditions and Running Simulation
Two-link planar Robot: Overview, Vector Equations, Dynamic Equations, The Simultaneous Constraint matrix, Dynamic Simulation, Robot Coordinate Control.

References:

1. Simulation Of Machines using Mat Lab and Simulink/John F. Gardner/ India Edition (IE)
2. CAD/CAM / Ibrahim zeid/ TMH.
3. Mat Lab / Raj Kumar Bansal / Pearson Education

MD 105:3 MECHANICS OF METAL FORMING
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective - 1 Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Fundamentals of metal forming: Classification of forming processes, mechanism of metal forming, temperature of metal working, hot working, cold working, friction and lubricants.
Rolling of metals: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations.
Forging: Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging.
Extrusion: Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes, production of seamless pipes.
Drawing: Drawing of tubes, rods, and wires: Wire drawing dies, tube drawing process, analysis of wire, deep drawing and tube drawing.
Sheet Metal forming: Forming methods, Bending, stretch forming, spinning and Advanced techniques of Sheet Metal Forming, Forming limit criteria, defect in formed parts.
Advanced metal forming processes: HERF, Electromagnetic forming, residual stresses, in-process heat treatment, computer applications in metal forming.
Press tool design: Design of various press tools and dies like piercing dies, blanking dies, compound dies and progressive blanking dies, design of bending, forming and drawing dies.
Jigs and fixture design: Principles of location, six-point location principle, clamping elements and methods.

References:

1. Mechanical Metallurgy / G.E. Dieter / Tata McGraw Hill, 1998. III Edition
2. Principles of Metal Working / Sunder Kumar
3. Principles of Metal Working processes / G.W. Rowe
4. ASM Metal Forming Hand book.

MD 105:4: NONLINEAR SOLID MECHANICS
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective - 1 Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction to Vectors and Tensors: Algebra of Vectors, Algebra of Tensors, Higher-order Tensors, Eigenvalues, Eigenvectors of Tensors, Transformation Laws for Basis Vectors and Components, General Bases, Scalar, Vector, Tensor Functions, Gradients and Related Operators, Integral Theorems.
Kinematics: Configurations and Motions of Continuum Bodies, Displacement, Velocity, Acceleration Fields, Material, Spatial Derivatives, Deformation Gradient, Strain Tensors, Rotation Tensor, Stretch Tensors, Rates of Deformation Tensors, Lie Time Derivatives.
The Concept of Stress: Traction Vectors, and Stress Tensors, Extremal Stress Values, Examples of States of Stress, Alternative Stress Tensors.
Balance Principles: Conservation of Mass, Reynolds' Transport Theorem, Momentum Balance Principles, Balance of Mechanical Energy, Balance of Energy in Continuum Thermodynamics, Entropy Inequality Principle, Master Balance Principle.
Some Aspects of Objectivity: Change of Observer, and Objective Tensor Fields, Superimposed Rigid-body Motions, Objective Rates, Invariance of Elastic Material Response.
Hyperelastic Materials: General Remarks on Constitutive Equations, Isotropic Hyperelastic Materials, Incompressible Hyperelastic Materials, Compressible Hyperelastic Materials, Some Forms of Strain-energy Functions, Elasticity Tensors, Transversely Isotropic Materials, Composite Materials with Two Families of Fibers, Constitutive Models with Internal Variables, Viscoelastic Materials at Large Strains, Hyperelastic Materials with Isotropic Damage. 32
Thermodynamics of Materials: Physical Preliminaries, Thermoelasticity of Macroscopic Networks, Thermodynamic Potentials, Calorimetry, Isothermal, Isentropic Elasticity Tensors, Entropic Elastic Materials, Thermodynamic Extension of Ogden's Material Model, Simple Tension of Entropic Elastic Materials, Thermodynamics with Internal Variables.
Variational Principles: Virtual Displacements, Variations, Principle of Virtual Work, Principle of Stationary Potential Energy, Linearization of the Principle of Virtual Work, Two-field Variational Principles, Three-field Variational Principles.

References:

1. Nonlinear Solid Mechanics: A Continuum Approach for Engineering by G. A. Holzapfel, John-Wiley & Sons.
2. Nonlinear Solid Mechanics: Theoretical formulations and finite element solutions by A. Ibrahimbegovic, Springer publications.

MD 105:5: ROBOTICS

(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective - 1 Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction, Transformations and kinematics: Historical development, A sense of mechanisms, Robotic systems, Classification of robots, Position, orientation and location of a rigid body, Mechanics of robot manipulators. Objectives, Homogeneous coordinates, Homogeneous transformations, Coordinate reference frames, Some properties of transformation matrices, Homogeneous transformations and the manipulator: The position of the manipulator in space, Moving the base of the manipulator via transformations, Moving the tool position and orientation.
Position analysis of serial manipulators: Link parameters and link coordinate systems, Denavit-Hartenberg homogeneous transformation matrices, Loop-closure equations, Other coordinate systems, Denavit-Hartenberg method: Position analysis of a planar 3-DOF manipulator: Direct kinematics, Inverse kinematics, Method of successive screw displacements, Wrist centre position.
Position analysis of parallel manipulators: Structure classification of parallel manipulators, Denavit-Hartenberg method versus geometric method, Position analysis of a planar 3RRR parallel manipulator, Geometry, Inverse kinematics and Direct kinematics, Position analysis of a spatial orientation mechanism.
Jacobian analysis of serial manipulators: Differential kinematics of a rigid body, Differential kinematics of serial manipulators, Screw coordinates and screw systems, Manipulator Jacobian matrix.
Trajectory generation: General considerations in path description and generation, Joint space schemes, Cartesian space schemes, Geometric problems with Cartesian paths, Path generation at run time, Description of paths, Planning paths using the dynamic model, Collision-free path planning.
Robot Programming: Robot languages: AL, AML, RAIL, RPL, VAL, Demonstration of points in space: Continuous path (CP), Via points (VP), Programmed points (PP).
Robot dynamics: Lagrange- Euler Formulation- Newton-Euler Formulations- Problems on Planar two link robot manipulators.

References:

1. Robot Analysis - The Mechanics of Serial and Parallel Manipulators by Lung-Wen Tsai, John Wiley & Sons, Inc.
2. Introduction to Robotics - Mechanics and Control by John J. Craig, Addison-Wesley Longman Inc., 1999.
3. Robotic Engineering - An Integrated Approach by Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Prentice-Hall of India Private Limited, 1994.
4. Robotics: Fundamental Concepts and Analysis / Ashitava Ghosal / Oxford.
5. Introduction to Robotic Mechanics and Control / J J Craig/ Pearson / 3rd edition.
6. Robotics / Fu K S/ McGraw Hill.
7. Robot Analysis and Intelligence /Asada and Slotine / Wiley Inter-Science.
8. Robotics and Control / Mittal R K & Nagrath I J / TMH
9. Mechanics of Serial and Parallel Manipulators – Lung Wen Tsai

MD 105:6: THEORY OF PLATES AND SHELLS
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective - 1 Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Bending of long rectangular plates to a cylindrical surface: Differential equation for cylindrical bending of plates - Cylindrical bending of uniformly loaded rectangular plates with simply supported edges - Cylindrical bending of uniformly loaded rectangular plates with built-in edges
Pure bending of plates: Slope and curvature of slightly bent plates - Relations between bending moments and curvature in pure bending of plates - Particular cases of pure bending - Strain energy in pure bending of plates.
Symmetrical bending of circular plates: Differential equation for symmetrical bending of laterally loaded circular plates - Uniformly loaded circular plates - Circular plate with a circular hole at the center - Circular plate concentrically loaded - Circular plate loaded at the center.
Small deflections of laterally loaded plates: The differential equation of the deflection surface - Boundary conditions - Alternate method of derivation of the boundary condition - Reduction of the problem of bending of a plate to that of deflection of a membrane
Simply supported rectangular plates: Simply supported rectangular plates under sinusoidal load - Navier solution for simply supported rectangular plates.
Rectangular plates with various edge conditions: Bending of rectangular plates by moments distributed along the edges - Rectangular plates with two opposite edges simply supported and the other two edges clamped.
Continuous rectangular plates: Simply supported continuous plates - Approximate design of continuous plates with equal spans - Bending symmetrical with respect to a center.
Deformation of shells without bending: Definition and notation - Shells in the form of a surface of revolution and loaded symmetrically with respect to their axis - Particular cases of shells in the form of surfaces of revolution - Shells of constant strength.
General theory of cylindrical shells: A circular cylindrical shell loaded symmetrically with respect to its axis - Particular cases of symmetrical deformation of circular cylindrical shells - Pressure vessels.

Reference:

1. Theory of Plates and Shells by Timoshenko, S. and Woinowsky-Krieger, S.

106: 1 - INTEGRATED COMPUTER AIDED DESIGN
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective – 2nd Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Fundamentals of CAD: Introduction, Design process, Application of computer for design, Creating the manufacturing database, Benefits of CAD, Design work station, CAD hardware.
Geometric modeling: Geometric modeling techniques - Multiple view 2D input, Wire frame geometry, Surface models, Geometric entities - Curves and Surfaces, Solid modelers, Feature recognition.
Computer aided drafting: AutoCAD tools, 3D model building using solid primitives and boolean operations, 3D model building using extrusion, Editing tools, Multiple views: Orthogonal, Isometric.
Visual realism: Shading solids, Coloring, Color models, Using interface for shading and coloring.
Graphic aids: Geometric modifiers, Naming scheme, Layers, Grids, Groups, Dragging and rubber banding.
Computer animation: Conventional animation, Computer animation - Entertainment animation, Engineering animation, Animation types, Animation techniques.
Mechanical assembly: Assembly modeling, Part modeling, Mating conditions, Generation of assembling sequences, Precedence diagram, Liaison-sequence analysis.
Mechanical tolerancing: Tolerance concepts, Geometric tolerancing, Types of geometric tolerances, Location tolerances, Drafting practices in dimensioning and tolerancing, Tolerance analysis.
Mass property calculations: Geometrical property formulation - Curve length, Cross-sectional area, Surface area, Mass property formulation - Mass, Centroid, Moments of inertia, Property mapping. Properties of composite objects.

References:

1. CAD/CAM Theory and Practice by Ibrahim Zeid.
2. CAD/CAM Principles and Applications by P.N. Rao, Tata McGraw Hill Publishing Company Ltd.
3. CAD/CAM Computer Aided Design and Manufacturing by Mikell P. Groover and Emory W. Zimmer, Jr.
4. Computer Integrated Design and Manufacturing by David D. Bedworth, Mark R. Henderson, Philip M. Wolfe.

MD 106: 2 - DESIGN FOR MANUFACTURE AND ASSEMBLY
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective – 2nd Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Design philosophy steps in Design process - General Design rules for manufacturability - basic principles of designing for economical production - creativity in design. Materials: Selection of Materials for design Developments in Material technology - criteria for material selection - Material selection interrelationship with process selection, process selection charts.

Machining process: Overview of various machining processes - general design rules for machining - Dimensional tolerance and surface roughness - Design for machining-Ease-Redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

Metal casting: Appraisal of various casting processes, selection of casting process, - general design considerations for casting - casting tolerances - use of solidification simulation in casting design - product design rules for sand casting.

Metal joining: Appraisal of various welding processes, Factors in design of weldments - general design guidelines - pre and post treatment of welds - effects of thermal stresses in weld joints - design of brazed joints. Forging - Design factors for Forging - Closed dies forging design - parting lines of dies drop forging die design - general design recommendations. Extrusion & Sheet Metal Work: Design guidelines for extruded sections - design principles for Punching, Blanking, Bending, Deep Drawing - Keeler Goodman Forming Line Diagram - Component Design for Blanking.

Assemble advantages: Development of the assemble process, choice of assemble method assemble advantages social effects of automation.

Automatic assembly transfer systems: Continuous transfer, intermittent transfer, indexing mechanisms, and operator - paced free – transfer machine.

Design of manual assembly: Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.

References:

1. Assembly Automation and Product Design/ Geoffrey Boothroyd/ Marcel Dekker Inc., NY, 1992.
2. Engineering Design - Material & Processing Approach/ George E. Deiter/McGraw Hill Intl. 2nd Ed. 2000.
3. Hand Book of Product Design/ Geoffrey Boothroyd/ Marcel and Dekken, N.Y. 1990.
4. Computer Aided Assembly London/ A Delbainbre/.
5. Product Design for Manufacturing and Assembly/ Geoffrey Boothroyd, Peter Dewhurst & Winston Ansthony Knight/CRC Press/2010
6. Design and Manufacturing / Surender Kumar & Goutham Sutradhar / Oxford & IBH Publishing Co. Pvt .Ltd., New Delhi, 1998.
7. ASM Handbook, Vol.20.

MD 106: 3 - MECHATRONICS
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective – 2nd Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Overview, History of mechatronics, Scope and significance of Mechatronics systems, elements of Mechatronic systems, Needs and benefits of Mechatronics in manufacturing.
Sensors: Classification of sensors basic working principles, displacement sensor – linear and rotary potentiometers, LVDT and RVDT, incremental and absolute encoders, Proximity and range sensors – Eddy current sensor, ultrasonic sensor, laser interferometer transducer, hall Effect sensor, inductive Proximity switch, Light sensors – Photodiodes, Phototransistors, Flow Sensors – ultrasonic Sensor, Laser Doppler Anemometer, Tactile Sensors – PVDF tactile sensor, micro-switch and reed switch, Piezoelectric sensors, Vision Sensor.
Actuators: Electrical Actuators: Solenoids, relays, diodes, thyristors, triacs, BJT, FET, DC motor, Servo Motor, BLDC Motor, AC Motor, Stepper Motor, Hydraulic & pneumatic devices – Power supplies, valves, Cylinder sequencing, Design of hydraulic & pneumatic circuits. PiezoElectric Actuators, Shape memory alloys.
Basic System models & Analysis: Modeling of one & two degrees of freedom Mechanical, Electrical, fluid and thermal systems, block diagram representations of these systems.
Dynamic Responses of System: Transfer function, modeling dynamic systems, first order systems, second order systems.
Digital Electronics: Number systems, BCD codes and arithmetic, Gray codes, self complimenting codes, Error detection and correction principles. Boolean functions using Karnaugh Map, Design of combinational circuits, design of arithmetic circuits, Design of code converters, encoders and decoders.
Signal Conditioning: Operational amplifiers, inverting amplifier, differential amplifier, Protection, comparator, filters, multiplexer, Pulse width modulation counters, decoders. Data acquisition – Quantizing theory, Analog to digital conversion, digital to analog conversion.
Controllers: Classification of Control systems, Feedback, Closed loop and open loop systems.
PLC Programming: PLC Principles of operation, PLC sizes, PLC hardware components, I/O section Analog I/O section, Analog I/O modules, digital I/O modules, CPU processor memory, module programming, Ladder Programming, ladder diagrams, Timers, Internal relays and counters, data handling, analogue input and output. Application on real time industrial automation systems.
Advanced Applications in Mechatronics: Sensors for condition monitoring, mechatronic control in automated manufacturing, Artificial intelligence in Mechatronics, micro sensors in mechatronics, Application of Washing machine as mechatronic device.

References:

1. W. Boton, “Mechatronics”, 5th edition, Adison WesleyLongman ltd, 2010.
2. Mehatronics system design by Devdas Shetty and Richard A. Kolk, P.W.S. Publishing company, 2001.
3. Alciatore David G & Histand Michael B, “Introduction to Mechatronics and Measurement systems”, 4th edition, Tata McGraw Hill, 2006.
4. Saeed B Niku, “Introduction to Robotics: Analysis, Systems, Applications “, 2nd edition, Pearson Education India, PHI, 2003.

MD 106: 4 - FUZZY LOGIC & NEURAL NETWORKS
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective – 2nd Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Fuzzy set theory and fuzzy logic control:
Basic concepts of fuzzy sets- Operations on fuzzy sets- Fuzzy relation equations- Fuzzy logic control- Fuzzification –Defuzzificatiuon- Knowledge base- Decision making logic- Membership functions – Rule base.

Adaptive fuzzy systems:
Performance index- Modification of rule base0- Modification of membership functions- Simultaneous modification of rule base and membership functions- Genetic algorithms-Adaptive fuzzy system- Neuro fuzzy systems.

Artificial neural networks:
Introduction- History of neural networks- multilayer perceptions- Back propagation algorithm and its Variants- Different types of learning, examples.

Mapping and recurrent net works:
Counter propagation –Self organization Map- Congnitron and Neocognitron- Hopfield Net- Kohonnen Nets- Grossberg Nets- Art-I, Art-II reinforcement learning

Case Studies:
Application of fuzzy logic and neural networks to Measurement- Control- Adaptive Neural Controllers – Signal Processing and Image Processing

References:

1. Vallum B.R And Hayagriva V.R C++, Neural networks and Fuzzy logic, BPB Publications, New Delhi, 1996
2. Neural Networks for control, Millon W.T, Sutton R.S and Werbos P.J, MIT Press 1992
3. Fuzzy sets Fuzzy logic, Klir, G.J anfd Yuan B.B Prentice Hall oif India Pvt. Ltd.,, New Delhi
4. Neural Networks and Fuzzy systems, Kosko.. Prentice hall of India Pvt. Ltd.,, New Delhi 1994
5. Introduction to Fuzzy control, Dirankov D. Hellendoorn H, Reinfrank M., Narosa Publications House, New Delhi 1996
6. Introduction to Artificial Neural systems, Zurada J.M Jaico Publishing House, New Delhi 1994

MD 106: 5 - DESIGN AND ANALYSIS OF EXPERIMENTS
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective – 2nd Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Fundamentals of Experimentation: Role of experimentation in rapid scientific progress, historical perspective of experimental approaches , Steps in experimentation, principles of experimentation
Simple comparative experiments: Basic concepts of probability & statistics, comparison of two means and two variances, comparison of multiple (more than two) means and ANOVA
Experimental designs: Factorial designs, fractional factorial designs, orthogonal arrays, standard orthogonal arrays and interaction tables, modifying orthogonal arrays, selection of suitable orthogonal array design, analysis of experimental data
Response surface methodology: Concept, linear model, steepest ascent, second order model, regression.
Taguchi's Parameter Design: Concept of robustness, noise factor, objective function & S/N ratios , inner array& outer array design, data analysis

References:

1. Montgomery DC, Design and Analysis of Experiments, 7th Edition, John Wiley & Sons, NY, 2008.
2. Ross P J , Taguchi techniques for Quality Engineering, McGraw-Hill Book Company, NY, 2008
3. Taguchi G, Chowdhury S and Taguchi S, Robust Engineering, TMH, 2000

MD 106: 6 - MECHANICAL BEHAVIOUR OF ENGINEERING MATERIALS
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective – 2nd Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Fracture behavior of metals and alloys. The ductile/brittle transition temperatures for notched and un-notched components, Ductile rupture as a failure mechanism Fracture at elevated temperature.
Definitions of types of fracture and failure, Introduction to stress intensity factor and strain energy release rate, Equivalence of energy approach and stress intensity approach.
Stress intensity factor and its use in fracture mechanics: Early concepts of stress concentrators and flaws, Ingles solution to stress round an elliptical hole-implications of results. Stress intensity factor for a crack. Westergaard's solution for crack tip stresses. Stresses and displacement in Cartesian and polar coordinates,
Linear elastic fracture mechanics (LEFM): Three loading modes and the state of stress ahead of the crack tip, stress concentration factor, strain energy release rate, fracture energy, R. Modification for ductile materials, loading conditions. Stress intensity factor and the material parameter, the critical stress intensity factor.
Elastic/plastic fracture mechanics: The crack opening displacement and J-integral approaches, R-curve analysis Testing procedures, Measurement of these parameters, RAD, Fail sage and safe life design approaches, Practical applications. Advanced topics in EOFM.
Fatigue: definition of terms used to describe fatigue cycles, High Cycle Fatigue, Low Cycle Fatigue, Fatigue of Welded structures: Factors effecting the fatigue lives of welded joints. Mean stress R ratio, strain and load control. S-N curves. Goodman's rule and Miners rule. Micro mechanisms of fatigue damage, fatigue limits and initiation and propagation control leading to a consideration of factors enhancing fatigue resistance. Total life and damage tolerant approaches to life prediction.
Creep deformation: The evolution of creep damage, primary, secondary and tertiary creep, Micro mechanisms of creep in materials and the role of diffusion, Ashby creep deformation maps. Stress dependence of creep – power law dependence. Comparison of creep performance under different conditions – extrapolation and the use of Larson-Miller parameters, Creep-fatigue interactions, Creep integrals, Examples.

References:

1. Mechanical Metallurgy / Dieter / McGraw Hill
2. Fracture Mechanics: Fundamental and Applications /Anderson T.L & Boca Raton/ CRC Press, Florida, 1998.
3. Deformation and Fracture mechanics of Engineering Materials / Richard W Hertz /Wiley
4. Plasticity for structural Engineers / W.F. Chen and D.J,. Ha,
5. Engineering Fracture Mechanics/ D.R.J. Owen and A.J. Fawkes /Pincridge press, Swansea, U.K.
6. Fracture and fatigue control in structures/ S.T. Rolfe and J.M. Barsom/ Printice Hall, Eglewood cliffs, N.J..
7. Fracture of brittle solids/ B.R. Lawn and T.R. Wilshaw/ Cambridge university press.
8. Plastic deformation of Metals/ R.W.K. Honeycombe/ 2nd edition, Edward Arnold
9. Elements of Fracture Mechanics/Prasanth Kumar/TMH
10. F.R.N. Nabarro, H.L. deVilliers, The Physics of Creep, Taylor and Francis, (1995)

MD 107 Computer Aided Design, Modelling and Simulation LAB
(Four-Semester Course - CBCS- w.e.f. 2015-2016)

Periods/week: 3Pr. Ses. : 50 Credits : 2

1. 2D and 3D modeling and assembly modeling using any one modeling packages like AutoCAD/ Auto Desk Mechanical desktop/CREO/IDEAS/CATIA/Unigraphics/Solid Works.
2. 1D, 2D and 3D Meshing, Linear and non-linear static and dynamic analysis using any one FEA packages like ANSYS/CAEFEM/NASTRAN/NISA.
3. 1D, 2D and 3D Steady State Thermal Analysis, Transient Thermal Analysis Couple Field (Thermal/Structural) Analysis using any one FEA packages like ANSYS/CAEFEM/ NASTRAN/NISA

MD 108 Mechanical Vibrations Lab
(Four-Semester Course - CBCS- w.e.f. 2015-2016)

Periods/week: 3 Pr. Ses. : 50 Credits: 2

1. To determine the radius of gyration of given bar by using bifilar and Trifiller suspension.
2. Find the CG of a connecting rod using free vibration techniques.
3. To determine natural frequency of free torsional vibrations of single rotor system. (a) Horizontal rotor (b) Vertical rotor
4. Harmonic excitation of cantilever and simply supported beams using electro-dynamic shaker and determination of resonant frequencies.
5. Finding the damping presence in the structure using logarithmic decrement method.
6. Finding the damping presence in the structure using half power band width method.
7. Finding the natural frequencies and mode shapes of cantilever beam and simply supported beams
8. Finding the natural frequencies and mode shapes of plate at different boundary conditions
9. Finding the natural frequencies and mode shapes of Simply supported beam.
10. Study of vibration measuring instruments.
11. Study of vibration measuring Analyzer.
12. Study of vibration measuring Vector network analyzer.

MD 201 INSTRUMENTATION AND EXPERIMENTAL STRESS ANALYSIS
(Four-Semester Course - CBCS- w.e.f. 2015-2016)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

PART - A (Instrumentation)

Basic concepts - Calibration - Standards - Basic concepts in dynamic measurements - System response - Distortion.
Sensing devices - Bridge circuits - Amplifiers - Filter circuits - Oscilloscope - Oscillograph - Transducers - variable resistance transducers, LVDT - Capacitive and piezoelectric transducers.
Pressure measurement: Mechanical pressure measurement devices - Bourdon tube pressure gauge - Diaphragm and bellow gauges - Low pressure measurement - Mcland gauge - Pirani gauge - Ionization gauge.
Flow measurement: Positive displacement methods - Flow obstruction methods - Flow measurement by drag effect - Hot wire anemometer.
Temperature measurement: Temperature measurements by mechanical effects, Electrical effects and by Radiation - Thermocouples; Force and torque measurement - Motion and vibration measurement.

PART - B (Stress Analysis)

Brittle lacquer method of stress analysis - Application of lacquer - Stress determination - Dynamic stresses.
Strain gauges - Mechanical resistance wire gauges - Types of resistance gauges - Cements and cementing of gauges - Wheatstone bridge - Balanced and unbalanced gauge factor - Calibration of gauges - Strain gauge rosette - Evaluation and principal stresses static and dynamic instrumentation **Photo elasticity** - Polariscope plane and circularly polarized light - Photo elastic materials - Calibration - Isochromatic fringes - Isoclines stress determination
Grid methods.
Note: Equal numbers of questions are to be answered from each section.

References:

1. Experimental Stress Analysis and Motion Measurement by Dove and Adams.
2. Experimental Methods for Engineers by Holman, J.P., McGraw Hill Book Company.
3. Experimental Stress analysis/ Dally and Riley, Mc Graw-Hill
4. A treatise on Mathematical theory of elasticity / LOVE A.H./ Dover Publications
5. Photo Elasticity / Frocht/ Wiley / 3rd Edition
6. Experimental Stress Analysis / Sadhu singh / Khanna Publications.

MD 202 SIGNAL ANALYSIS AND CONDITION MONITORING
(Four-Semester Course - CBCS- w.e.f. 2015-2016)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Basic concepts. Fourier analysis. Bandwidth. Signal types. Convolution.
Signal analysis: Filter response time. Detectors. Recorders. Analog analyzer types.
Practical analysis of stationary signals: Stepped filter analysis. Swept filter analysis. High speed analysis. Real-time analysis.
Practical analysis of continuous non-stationary signals: Choice of window type. Choice of window length. Choice of incremental step. Practical details. Scaling of the results.
Practical analysis of transients: Analysis as a periodic signal. Analysis by repeated playback (constant bandwidth). Analysis by repeated playback (variable bandwidth).
Condition monitoring techniques: Visual monitoring, Thermography, Vibration monitoring, Shock pulse monitoring, Wear debris monitoring, Motor current and signature analysis, Acoustic emission, Ultrasound monitoring, ISO standards, Fault detection sensors, Structural Health M0nitoring (SHM), integrated Vehicle Health Monitoring (IVHM).
Condition monitoring in real systems: Diagnostic tools. Condition monitoring of two stage compressor. Cement mill foundation. I.D. fan. Sugar centrifugal. Cooling tower fan. Air separator. Preheater fan. Field balancing of rotors. ISO standards on vibrations.

References:

1. Condition Monitoring of Mechanical Systems by Colacat.
2. Frequency Analysis by R.B.Randall.
3. Mechanical Vibrations Practice with Basic Theory by V. Ramamurti, Narosa Publishing House.
4. Machinery Condition Monitoring: Principles and Practices *by* A. R. Mohanty (ISBN: 9781466593046, CRC Press, 2014)
5. NPTEL II Video Lectures: Machinery Condition Monitoring and Signal Processing *by* A R MOHANTY (NPTEL, 2013)

MD 203 ADVANCED FINITE ELEMENT ANALYSIS
(Four-Semester Course - CBCS- w.e.f. 2015-2016)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Introduction to FEM, basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods**,** Finite elements of an elastic continuum - displacement approach, basic element shapes, interpolation function, generalization of the finite element concept - weighted residuals and variational approaches, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain- displacement relations. Plane stress and plane strain, Requirements of Convergence, h – refinement and p - refinement

1-D Structural Problems: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems, Plane Trusses and Space Truss elements and problems

2-D Problems: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Isoparametric elements – quadrilateral element, shape functions – Numerical Integration.

Finite element modelling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements.

Analysis of Beams and Frames: Hermite shape functions – stiffness matrix – Load vector – Problems related to Beams and Frames

3-D Problems: Tetrahedran element – Jacobian matrix – Stiffness matrix.

Steady-state Scalar field problems – 1D. 2 D Heat conduction, electric and magnetic potentials, field flow. The time domain, semi-descritization of field and dynamic problems and analytical solution procedures.

Dynamic considerations: Dynamic equations – consistent mass matrix – Eigen Values, Eigen vector, natural frequencies – mode shapes – modal analysis.

Analysis of Plates: Introduction, Triangular Membrane element, Quadratic Triangle element, Rectangular plate element (in-plane forces), Bending behavior of plates, finite element analysis of plates in bending, triangular plate bending element.

References:

1. Concepts and Applications of Finite Element Analysis by Cook, R.D.
2. Applied Finite Element Analysis by Segerland, L.J.
3. The Finite Element Methods in Engineering / SS Rao / Pergamon.
4. Finite Element Methods: Basic Concepts and applications, Alavala, PHI
5. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice – Hall
5. Finite Element Method – Zienkiewicz / Mc Graw Hill
6. Introduction to Fininte element analysis- S.Md.Jalaludeen, Publications, print-2012
7. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th Edition
8. Finite Element Method – Krishna Murthy / TMH
9. Finite Element Analysis – Bathe / PHI

MD 204 ADVANCED ENGINEERING DESIGN
(Four-Semester Course - CBCS- w.e.f. 2015-2016)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Design philosophy: Design process, Problem formation, Introduction to product design, Various design models-Shigley model, Asimov model and Norton model, Need analysis, Strength considerations -standardization. Creativity, Creative techniques, Material selections, Notches and stress concentration, design for safety and Reliability
Failure theories: Static failure theories, Distortion energy theory, Maximum shear stress theory, Coulomb-Mohr's theory, Modified Mohr's theory, Fracture mechanics theory., Fatigue mechanisms, Fatigue failure models, Design for fatigue strength and life, creep: Types of stress variation, design for fluctuating stresses, design for limited cycles, multiple stress cycles, Fatigue failure theories ,cumulative fatigue damage, thermal fatigue and shock, harmful and beneficial residual stresses, Yielding and transformation
Surface failures: Surface geometry, mating surfaces, oil film and their effects, design values and procedures, adhesive wear, abrasive wear, corrosion wear, surface fatigue, different contacts, dynamic contact stresses, surface fatigue failures, surface fatigue strength,
Economic factors influencing design: Economic analysis, Break-even analysis, Human engineering considerations, Ergonomics, Design of controls, Design of displays. Value engineering, Material and process selection in value engineering, Modern approaches in design.
Importance of Fits and Tolerance influencing design: Tolerance from process and function, interchangeability and selective assembly, selection of fits for different design situations, surface finish. Load transmission, load equalization light weigh and rigid constructions.
Team work and Ethics in engineering design: Team formation, functioning, discharge, team dynamics, Ethical issues considered during engineering design process
Product Design: Product strategies, Product value, Product planning, product specifications, concept generation, concept selection, concept testing.
Design for manufacturing: Forging design, Casting design, Design process for non metallic parts, Plastics, Rubber, Ceramic, Wood, Glass parts. Material selection in machine design

References:

1. Machine Design An Integrated Approach by Robert L. Norton, Prentice-Hall New Jersey, USA.
2. Mechanical Engineering Design by J.E. Shigley and L.D. Mitchell published by McGraw-Hill International Book Company, New Delhi.
3. Fundamentals of machine elements by Hamrock, Schmid and Jacobian, 2nd edition, McGraw- Hill International edition.
4. Product design and development by Karl T. Ulrich and Steven D. Eppinger. 3rd edition, Tata McGraw Hill.
5. Product Design and Manufacturing by A.K. Chitale and R.C. Gupta, Prentice Hall
6. Engineering Design / George E Dieter / McGraw Hill /2008
7. Fundamentals of machine elements/ Hamrock, Schmid and Jacobian/ 2nd edition /McGraw-Hill International edition.

MD 205:1 - VEHICLE DYNAMICS
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective – 3rd Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction to Vehicle Dynamics: Various kinds of vehicles, Motions, Mathematical modelling methods, Multibody system approach, Lagrangian formulations, Methods of investigations, Stability concepts.
Mechanics of pneumatic tyres: Tyre construction, SAE recommended practice, Tyre forces and moments, Rolling resistance of tyres, Tractive effort and longitudinal slip, Cornering properties of tyres, Performance of tyre traction on dry and wet surfaces, Ride properties of tyres.
Performance characteristics of road vehicle: Equation of motion and maximum tractive effort, Aerodynamic forces and moments, Vehicle power plant and transmission characteristics, Prediction of vehicle performance, Operating fuel economy, Braking performance.
Handling and stability characteristics of road vehicles: Steering geometry, Steady state handling characteristics, Steady state response to steering input, Testing of handling characteristics, Transient response characteristics, Directional stability, Effects of tyre factors, Mass distribution and engine location on stability of handling.
Vehicle ride characteristics: Human response to vibration, Vehicle ride models, Introduction to random vibration - 1) Road suirface profile as a random function, 2) Frequency response function, 3) Evaluation of vehicle vertical vibration in relation to ride comfort criteria, 4) Active and semi active systems, 5) Optimum design for ride comfort and road holding.

References:

1. Theory of Ground Vehicles by Wong, J.Y., John Wiley and Sons, NY, 1993.
2. Fundamentals of Vehicle Dynamics by Gillespie, T.D., SAE Publication, Warrendal, USA, 1992.
3. Tyres, Suspension and Handling by Dixon, J.C., SAE Publication, Warrendal, USA and Arnold Publication, London, 1997.

MD 205:2 - TRIBOLOGY
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective – 3rd Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Historical background - Viscosity - Viscometry - Effect of temperature on viscosity - Effect of pressure in viscosity - Other physical properties of mineral oils - The generalized Reynolds equation - Flow and shear stress - The energy equation - The equation of state - Mechanism of pressure development.

Circumferential flow - Oil flow through a bearing having a circumferential oil groove - Heat generation and lubricant temperature - Heat balance and effective temperature - Bearing design: Practical considerations - Design of journal bearings - Parallel surface bearing - Step bearing - Some situations under squeeze film lubrication - The mechanism of hydrodynamic instability - Stiffness and damping coefficients - Stability.

Elastohydrodynamic lubrication: Theoretical consideration - Grubin type solution - Accurate solution - Point contact - Dimensionless parameters - Film thickness equations - Different regimes in EHL contact - Deep-groove radial bearings - Angular contact bearings - Thrust ball bearings - Geometry - Kinematics - Stress and deformations - Load capacity.

Surface topography - Surface characterization - Apparent and real area of contact - Derivation of average Reynolds equation for partially lubricated surface - Effect of surface roughness on journal bearings - Laws of friction - Friction theories - Surface contaminants - Frictional heating - Effect of sliding speed on friction - Classification of wear - Mechanisms of wear - Quantitative laws of wear - Wear resistance materials.

Reference:

1. Introduction to Tribology of Bearings by Majumdar, B.C.

MD 205:3 - CONCURRENT ENGINEERING
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective – 3rd Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Concurrent design of products and systems - Product design - Fabrication and assembly system design - designing production systems for robustness and structure.
Strategic approach and technical aspects of product design: Steps in the strategic approach to product design - Comparison to other product design methods - Assembly sequence generation - Choosing a good assembly sequence - Tolerances and their relation to assembly - Design for material handling and part mating - Creation and evaluation of testing strategies.
Basic issues in manufacturing system design: System design procedure - Design factors - Intangibles - Assembly resource alternatives - Task assignment - Tools and tool changing - Part feeding alternatives - Material handling alternatives - Floor layout and system architecture alternatives.
Assembly workstation design: Strategic issues - Technical issues analysis.
Design of automated fabrication systems: Objectives of modern fabrication system design - System design methodology - Preliminary system feasibility study - Perform detailed work content analysis - Define alternative fabrication configurations - Configuration design and layout - Human resource considerations - Evaluate technical performance of solution.
Case studies: Automobile air conditioning module - Robot assembly of automobile rear axles.

Reference:
1. Concurrent Design of Product and Processes by James L. Nevins and Daniel E. Whitney, McGraw-Hill Publishing Company, 1989.

MD 205:4 – PRESSURE VESSEL DESIGN
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective – 3rd Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction, Materials- shapes of Vessels –stresses in cylindrical spherical and arbitrary, shaped shells. Cylindrical Vessels subjected to internal pressure, wind load bending and torque-ilation of pressure vessels –conical and tetrahedral vessels.
Theory of thick cylinders; Shrink fit stresses in built up cylinders – auto frettage of thick Cylinders Thermal stresses in Pressure Vessels.
Theory of rectangular plates: Pure bending – different edge conditions.
Theory circular plates: Simple support and clamped ends subjected to concentrated and Uniformly distributed loads-stresses from local loads. Design of dome bends, shell connections, flat heads and cone openings.
Discontinuity stresses in pressure vessels: Introduction beam on an elastic Foundation, infinitely long beam semi infinite beam, cylindrical vessel under axially symmetrical Loading, extent and significance of load deformations on pressure vessels, discontinuity stresses in vessels, stresses in a bimetallic joints, deformation and stresses in flanges.
Pressure vessel materials and their environment: Introduction ductile material tensile tests, Structure and strength of steel Leuder's lines determination of stress patterns from plastic flow Observations, behavior of steel beyond the yield point, effect of cold work or strain hardening on The physical properties of pressure vessel steels fracture types in tension. Toughness of Materials, effect of neutron irradiation of steels, fatigue of metals, fatigue crack growth fatigue life.
Fatigue aspects of Pressure vessel: Prediction cumulative fatigue damage stress theory of failure of vessels subject to steady state and fatigue conditions.
Stress concentrations: Influence of surface effects on fatigue, effect of the environment and other factors on fatigue life thermal stress fatigue creep and rupture of metals at elevated Temperatures, hydrogen embitterment of pressure vessel steels brittle fracture effect of Environment on fracture toughness, fracture toughness relationships criteria for design with Defects, significance of fracture mechanics evaluations, effect of warm prestressing on the Ambient temperature toughness of pressure vessel steels.
Design features: Localized stresses and their significance, stress concentration at a Variable thickness transition section in a cylindrical vessel, stress concentration about a circular Hole in a plate subject to tension, elliptical openings, stress concentration, stress concentration Factors for position, dynamic and thermal transient conditions, theory of reinforced openings and Reinforcement, placement and shape fatigue and stress concentration.

References:

1. Theory and design of modern Pressure Vessels / John F. Harvey 'Van/ Nostrand Reihold Company/NY.
2. Pressure Vessel Design and Analysis / Bickell M. B. Ruizes / Macmillan Publishers
3. Process Equipment design / Beowll & Yound Ett.
4. Indian standard code for unfired Pressure vessels IS 2825.
5. Pressure Vessels Design Hand Book Henry H. Bednar PE / CB S Publishers / New Delhi.
6. Theory of plates and shells / Timoshenko& Noinosky / Dover Publications.
7. Stress in Beams, Plates and Shells / Ansel C. Ugural / CRC Press / 3rd Edition

MD 205:5 - GEAR ENGINEERING
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective – 3rd Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Principles of gear tooth action, Generation of Cycloid and Involute gears, Involutometry, gear manufacturing processes and inspection, gear tooth failure modes, stresses, selection of right kind of gears.
Spur Gears : Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of spur gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.
Helical Gears: Tooth loads, Principles of Geometry, Design considerations and methodology,Complete design of helical gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.
Bevel Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of bevel gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.
Worm Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of worm gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Heat dissipation considerations. Design of gear shaft and bearings.
Gear failures: Analysis of gear tooth failures, Nomenclature of gear tooth wear and failure, tooth breakage, pitting, scoring, wear, overloading, gear-casing problems, lubrication failures
Gear trains: Simple, compound and epicyclic gear trains, Ray diagrams, Design of a gear box of an automobile, Design of gear trains from the propeller shafts of airplanes for auxiliary systems.
Optimal Gear design: Optimization of gear design parameters, Weight minimization, Constraints in gear train design-space, interference, strength, dynamic considerations, rigidity etc. Compact design of gear trains, multi objective optimization of gear trains. Application of Traditional and non-traditional optimization techniques

References:

1. Maleev and Hartman, Machine Design, C.B.S. Publishers, India.
2. Henry E.Merrit,Gear engineering ,Wheeler publishing,Allahabad,1992.
3. Practical Gear design by Darle W. Dudley, McGraw-Hill book company
4. Earle Buckingham, Analytical mechanics of gears, Dover publications, New York, 1949.
5. G.M.Maitha, Hand book of gear design, TaTa Mc.Graw Hill publishing company Ltd., New Delhi,1994.

MD 205:6 - ADVANCED MECHANICS OF COMPOSITE MATERIALS
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective – 3rd Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Basic concepts and characteristics: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.
Reinforcements: Fibres – Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.
Micromechanics: Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.
Coordinate transformation: Hooke's law for different types of materials, Hooke's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off – axis, stiffness modulus, off – axis compliance.
Elastic behavior of unidirectional composites: Elastic constants of lamina, relation ship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.
Strength of unidirectional lamina: Micro mechanics of failure, Failure mechanisms, strength of an orthotropic lamina, strength of a lamina under tension and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micros mechanical predictions of elastic constants.
Analysis of laminated composite plates:
Introduction thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, problems using thin plate theory.

References:

1. Mechanics of Composite Materials/ R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
3. Analysis and performance of fibre Composites/ B. D. Agarwal and L. J. Broutman/ Wiley- Interscience, New York, 1980.
4. Mechanics of Composite Materials/ Second Edition (Mechanical Engineering)/ Autar K. Kaw, Publisher**:** CRC
5. Analysis of Laminated Composite Structures/ L. R. Calcote/ Van Nostrand Rainfold, New York, 1969.
6. Advanced Mechanics of Composite Materials/ Vasiliev &Morozov/Elsevier/Second Edition

MD 206:1 - COMPUTATIONAL FLUID DYNAMICS
(Four-Semester Course - CBCS- w.e.f. 2015-2016)
(Core Elective – 4th Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions. Derivation of finite difference equations.
Solution methods: Solution methods of elliptical equations - finite difference formulations, interactive solution methods, direct method with Gaussian elimination.
Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.
Hyperbolic equations: explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations.
Burgers equations: Explicit and implicit schemes, Runge-Kutta method.
Formulations of incompressible viscous flows: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.
Treatment of compressible flows: potential equation, Eluer equations, Navier-stokes system of equations, flowfield-dependent variation methods, boundary conditions, example problems.
Finite volume method: Finite volume method via finite difference method, formulations for two and three-dimensional problems.
Standard variational methods - 1: Linear fluid flow problems, steady state problems,
Standard variational methods - 2: Transient problems.

References:

1. Computational fluid dynamics, T. J.Chung, Cambridge University press,2002.
2. Text book of fluid dynamics, Frank Chorlton, CBS Publishers & distributors, 1985.
3. Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hema shava Publishers corporation & Mc Graw Hill.
4. Computational Fluid Flow and Heat Transfer/ Muralidaran/ Narosa Publications
5. Computational Fluid Dynamics: Basics with applications/John D. Anderson/ Mc Graw Hill.
6. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities Press.
7. Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis /Oxford University Press/2nd Edition

MD 206:2 - COMPOSITE MATERIALS
(Four-Semester Course – CBCS - w.e.f. 2015-2016)
(Core Elective – 4^{th} Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Historical background; definitions, classification of composites: fibrous composites, particulate composites, potential features of composites, idealization of composites, mechanics of composites, basic steps in FRP molding. Applications.
Raw materials: Resins, polyester, epoxy, phenolics, melamine and urea formaldehydes, polyimide and silicone, high temperature matrices, metal matrices.
Reinforcement: glass fibers, boron fibers, silicone carbide, carbon and graphite fibers, Kevlar, sisil and other vegetable fibers, whiskers, fillers and parting agents.
Fabrication methods: Hand lay-up: materials, molding, bag molding, mating molds, spray-up molding, matched - die molding, preform molding, premix and sheet molding, pre impregnation, filament winding, winding patterns and winding machines, pultrusion, centrifugal molding.
Micro mechanics: Introduction, weight and volume fractions, properties of lamina, representative volume element, micro mechanics, analysis of continuous and discontinuous fibers, reinforced composites, failure modes of unidirectional composites. Stress-strain relations of anisotropic medium and plane stress orthotropic medium
Experimental characterization and testing methods of composites: Properties of constituents: Single filament tensile properties, matrix tensile properties, density, volume fractions, coefficient of thermal and moisture expansions, properties of composites: tensile test method, compression test method, in-plane shear test method, interlaminar shear strength, various testing techniques ultrasonic, radiography and acoustic emission methods.

References:

1. Analysis and performance of Fiber composites, B.D. Aggrawal and L.J. Broutman, Willey Interscience Publications, New York.
2. Mechanics of composite Materials, R.M. Jones, Scripta Book company, Washington DC
3. Design and manufacture of composite structures by Geoff Eckold, Jaiko Publishing House, Bombay.
4. The analysis of laminated composite structures by L.R. Calcote, Van Nostrand Reinhold Company, New York.
5. Principles of Composite Material Mechanics by Ronald Gibson, Tata McGraw Hill Company Ltd.

MD 206:3 - STRUCTURAL HEALTH MONITORING
(Four-Semester Course – CBCS - w.e.f. 2015-2016)
(Core Elective – 4th Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Definition, Principles, Significance of SHM, Potential Applications in Civil, Naval, Aerospace and Manufacturing Engineering.
Operational evaluation: Sensor technology, Piezoelectric wafer active sensors, Data acquisition and cleansing procedures, Elastic waves in solid structures, Guided waves.
Feature extraction methods: Identify damage sensitive properties, Signal Processing, Fourier and short term Fourier transform, Wavelet analysis.
Pattern recognition: State –of –Art damage identification and pattern recognition Methods, Neural networks, Feature extraction algorithm.
Case studies: SHM based Flaw detection in mechanical structures - Integrity and damage recognition in plates and pipes, defect identification in weld joints, Wear monitoring in cutting tools.
READING:
1. Daniel Balageas, Claus-Peter Fritzen and Alfredo Guemes, Structural Health Monitoring, John Wiley &Sons, 2006.

2. Victor Giurgiutiu,Structural Health Monitoring with Piezoelectric Wafer Active Sensors, Academic Press,2008.

MD 206:4 - VISION SYSTEMS AND IMAGE PROCESSING
(Four-Semester Course – CBCS - w.e.f. 2015-2016)
(Core Elective – 4^{th} Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Machine vision - Vision sensors - Comparison with other types of sensors - Image acquisition and recognition - Recognition of 3D objects - Lighting techniques - Machine vision applications.
Image representation - Application of image processing - Image sampling, Digitization and quantization - Image transforms.
Spatial domain techniques - Convolution, Correlation. Frequency domain operations - Fast Fourier transforms, FFT, DFT, Investigation of spectra. Hough transform
Image enhancement, Filtering, Restoration, Histogram equalisation, Segmentation, Region growing.
Image compression - Edge detection - Thresholding - Spatial smoothing - Boundary and Region representation - Shape features - Scene matching and detection - Image classification.

References:

1. Digital Image Processing by Gonzalez, R.C. and Woods, R.E., Addison Wesley Publications.
2 Robot Vision by Prof. Alan Pugh (Editor), IFS Ltd., U.K. 3. Digital Image Processing by A. Rosenfled and A. Kak, Academic Press.
4. The Psychology of Computer Vision by P. Winstan, McGraw-Hill.
5. Algorithms for Graphics and Image Processing by T. Pavidis, Springer Verlag.

MD 206:5 - INTRODUCTION TO NANOTECHNOLOGY
(Four-Semester Course – CBCS - w.e.f. 2015-2016)
(Core Elective – 4th Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction: Importance of Nano-technology, Emergence of Nano-Technlogy, Bottom-up and Top-down approaches, challenges in Nano Technology.
Properties of low dimensional system: Transport properties: quantization of conductance, density of states, Coulomb blockade, Kondo effect. Hall, quantum Hall, fractional quantum hall effects Vibrational and thermal properties: phonons, quantization of phonon modes, heat capacity and thermal transport, Optical properties: Collective oscillation (Gustav-Mie explanation), surface plasmon resonance, interactions between Nanoparticles, coupled-dipole approximation, Linear and Nonlinear optical properties.
Zero dimensional nano-structures: Nano particles through homogenous nucleation; Growth of nuclei, synthesis of metallic nano particles, Nano particles through heterogeneous nucleation; Fundamentals of heterogeneous nucleation and synthesis of nano particles using micro emulsions and Aerosol.
One dimensional nano-structure, nano wires and nano rods: Spontaneous growth: Evaporation and condensation growth, vapor-liquid-solid growth, stress induced recrystallization. Template based synthesis: Electrochemical deposition, Electrophoretic deposition. Electro spinning and Lithography.
Two dimensional nano-structures: Fundamentals of film growth. Physical vapour Depostion (PVD): Evaporation molecular beam epitaxy (MBE), Sputtering, Comparison of Evaporation and sputtering. Chemical Vapour Depostion (CVD) : Typical chemical reactions, Reaction kinetics, transport phenomena, CVD methods, diamond films by CVD.
Thin films: Atomic layer deposition (ALD), Electrochemical deposition (ECD), Sol-Gel films, Advantages, Disadvantages and Applications of Thin Fils
Transport phenomena: Confinement and Transport in nanostructure, Current, Reservoirs and Electron channels, Conductance formula for nanostructures, Quantized conductance. Local density of states. Ballistic transport, Coulomb blockade, Diffusive transport, Fock space.

References:

1. Nano structures and Nano materials: Synthesis, properties and applications by Guozhong Cao, Imperial College press.
2. Quantum wells, Wires & Dots,: Theoretical & Computational Physics of Semiconductors Nanostuructures, Paul Harrison
3. Handbook of nanotechnology : Bhushan.
4. Nano optoelectronics : M.Grundman.
5. Nanophotonics : Paras N.Prasad.
6. Brian J. Kirby, Micro- and Nanoscale Fluid Mechanics, Cambridge University Press.

MD 206:6 - POLYMER NANOCOMPOSITES
(Four-Semester Course – CBCS - w.e.f. 2015-2016)
(Core Elective – 4th Group)

Periods/week: 4 Th. Ses. : 30 Exam: 70
Examination (Theory): 3hrs. Credits: 4

Introduction of nanocomposites
Nanocomposites, Definition, Nanocomposites past and present, Nomenclature, Solids - Atomic and molecular solids, Role of statistics in materials, Primary, secondary and tertiary structure, Transitions.

Properties and features of nanocomposites
Physics of modulus, Continuum measurements, Yield, Fracture, Rubbery elasticity and viscoelasticity, Composites and nanocomposites, Surface mechanical properties, Diffusion and permeability, Features of nanocomposites, basics of polymer nano composites - Nanoreinforcements, Matrix materials, Hazards of particles

Nanocomposites
Metal-Metal nanocomposites, Polymer-Metal nanocomposites, Ceramic nanocomposites: Dielectric and CMR (Collosion Magneto Resistance) based nanocomposites. (One example for each type).

Fabrication/processing of nanocomposites
Viscosity, Types of flow, Viscosity- Experimental viscosity, Non-newtonian Flow, Low-viscosity processing, Solvent processing, Particle behavior, Direct Mixing, Solution Mixing, In-situ polymerization, In-Situ Particle Processing Ceramic/Polymer Composites, In-Situ Particle Processing Metal/Polymer Nanocomposites, Modification of Interfaces, Post-Forming, Hazards of solvent Processing, Melt, high -shear, and direct processing, Melting and softening, Melt processes with small shears or Low, shear rates flow, Melt processes with large deformations or high-shear rates, Thermo-kinetic processes.

Characterization of nanocomposites
Introduction to characterization, Experiment design, Sample preparation, Imaging, Structural characterization, Scales in nanocomposites, Texture, Electromagnetic energy, Visualization, Physicochemical analysis, Characterization of physical properties, Identification, Mechanical, Surface mechanical, Exposure, Barrier properties, Recipes and standards

Applications of nanocomposites
Nanocomposites, Optical, structural applications, Nanoparticulate systems with organic matrices, Applications, Biodegradable protein nanocomposites, Applications of Polypropylene nanocomposites, Application as exterior automatic components, Hybrid nanocomposite materials, Application for corrosion protection, Applications of Nanopolymers in Catalysis.

References:

1. Thomas E. Twardowski, Introduction to Nanocomposite Materials, Properties, Processing, Characterization, DesTech Publications, April 2007
2. Nanocomposite Science and Technology Pulickel M. Ajayan , Linda S. Schadler , Paul V. Braun, 2006, Wiley-VCH.
3. Polymer nanocomposites: Edited by Yiu-Wing Mai and Zhong-Zhen Yu, First published 2006, Woodhead Publishing Limited and CRC Press LLC, USA.

MD 207 INSTRUMENTATION AND EXPERIMENTAL STRESS ANALYSIS LAB
(Four-Semester Course - CBCS- w.e.f. 2015-2016)

Periods/week: 3 Pr.. Ses. : 50 Credits: 2

List of Experiments:

1. Measurement of strain by using strain gauges.
2. Calibration of Rotameter.
3. Calibration of Thermocouples.
4. Experiment with constant voltage/current Hot-wire Anemometer.
5. Experiments with piezo-electric pick-up, Inductive pick-ups. Determination of characteristics - Displacement, Velocity and Acceleration.
6. Experimental determination of undamped and damped frequencies of spring-mass system.
7. Ultrasonic flaw detector.
8. Experiment on photoelastic bench (Plain polariscope, Circular polariscope).
9. Photoelastic analysis of disc under diametric compression.
10. Photo elastic analysis of Ring under diametric compression.

MD 208 SEMINAR
(Four-Semester Course – CBCS - w.e.f. 2015-2016)

Periods/week: 3 Pr.. Ses. : 50 Credits: 2

The student has to give at least three seminars on topics related to Machine design.