DAYANANDA SAGAR UNIVERSITY

Shavige Malleshwara Hills, Kumaraswamy Layout,

Bengaluru - 560078, Karnataka.

SCHOOL OF ENGINEERING

SCHEME & SYLLABUS
FOR
MASTER OF TECHNOLOGY (M.Tech) – 2016

MECHANICAL ENGINEERING

SPECIALIZATION: DESIGN ENGINEERING

(With Effect from 2016-17)

SCHOOL OF ENGINEERING
PROGRAMME: MASTER OF TECHNOLOGY (M. TECH) – 2016-17
DEPARTMENT / BRANCH: MECHANICAL ENGINEERING

SPECIALIZATION: DESIGN ENGINEERING

SEMESTER – 1

SL. NO.	COURSE CODE	COURSE TITLE	CR / AU	NO. OF HOURS OF TEACHING				SCHEME OF EVALUATION	
				L	T	P	C	CIA	END EXAM
1	16MDE501	APPLIED MATHEMATICS	CR	03	02	--	04	40	60
2	16MDE502	FINITE ELEMENT METHOD	CR	03	--	--	03	40	60
3	16MDE 503	SOLID MECHANICS	CR	03	--	--	03	40	60
4	16MDE5XX	DEPARTMENT ELECTIVE	CR	03	02	--	04	40	60
5	16MDE5XX	DEPARTMENT ELECTIVE	CR	03	02	--	04	40	60
6	16MDE571	DESIGN LAB – I	CR	--	--	04	02	40	60
7	16MDE572	DESIGN LAB – II	CR	--	--	04	02	40	60
GRAND TOTAL = 700				**15**	**06**	**08**	**22**	**280**	**420**

SEMESTER – 2

SL. NO.	COURSE CODE	COURSE TITLE	CR / AU	NO. OF HOURS OF TEACHING				SCHEME OF EVALUATION	
				L	T	P	C	CIA	END EXAM
1	16MDE504	ADVANCES IN MATERIAL TECHNOLOGY	CR	03	02	--	04	40	60
2	16MDE505	MECHANICS OF COMPOSITE MATERIALS	CR	03	--	--	03	40	60
3	16MDE506	ADVANCED MACHINE DESIGN	CR	03	--	--	03	40	60
4	16MDE5XX	DEPARTMENT ELECTIVE	CR	03	02	--	04	40	60
5	16MDE5XX	DEPARTMENT ELECTIVE	CR	03	02	--	04	40	60
6	16MDE573	DESIGN LAB – III	CR	--	--	04	02	40	60
7	16MDE574	DESIGN LAB – IV	CR	--	--	04	02	40	60
GRAND TOTAL = 700				**15**	**06**	**08**	**22**	**280**	**420**

NOTE: CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, C – No. of Credits, CIA – Continuous Internal Assessment

SCHOOL OF ENGINEERING
PROGRAMME: MASTER OF TECHNOLOGY (M. TECH) – 2016-17
DEPARTMENT / BRANCH: MECHANICAL ENGINEERING

SPECIALIZATION: DESIGN ENGINEERING

SEMESTER – 3

SL. NO.	COURSE CODE	COURSE TITLE	CR / AU	NO. OF HOURS OF TEACHING				SCHEME OF EVALUATION	
				L	T	P	C	CIA	END EXAM
1	16MDE6XX	DEPARTMENT ELECTIVE	CR	03	02	--	04	30	70
2	16MDE6XX	INSTITUTIONAL ELECTIVE	CR	03	--	--	03	30	70
3	16MDE681	DISSERTATION	CR	--	--	--	03	100	--
GRAND TOTAL = 300				**06**	**02**	**--**	**10**	**160**	**140**

SEMESTER – 4

SL. NO.	COURSE CODE	COURSE TITLE	CR / AU	NO. OF HOURS OF TEACHING				SCHEME OF EVALUATION	
				L	T	P	C	CIA	END EXAM
1	16MDE6XX	DEPARTMENT ELECTIVE	CR	03	02	--	04	30	70
2	16MDE682	DISSERTATION	CR	--	--	--	06	200	100
GRAND TOTAL = 400				**03**	**02**	**--**	**10**	**230**	**170**

NOTE: CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits, CIA – Continuous Internal Assessment

SPECIALIZATION: DESIGN ENGINEERING
DEPARTMENTAL ELECTIVES (BATCH: 2016 – 2017):

COURSE CODE	COURSE TITLE	COURSE CODE	COURSE TITLE
16MDE521	EXPERIMENTAL STRESS ANALYSIS	16MDE621	RESEARCH METHODOLOGY
16MDE522	DYNAMICS	16MDE622	EMBEDDED SYSTEMS
16MDE523	PRODUCT DEVELOPMENT	16MDE623	SENSORS AND SIGNAL CONDITIONING
16MDE524	DATA VISUALIZATION	16MDE624	MICRO ELECTRICAL MECHANICAL SYSTEMS (MEMS)
16MDE525	ROBOTICS	16MDE625	TRIBOLOGY
16MDE526	DIGITAL CONTROL SYSTEMS	16MDE626	AUTOMOTIVE ELECTRONICS
16MDE527	FRACTURE MECHANICS	16MDE627	JIGS AND FIXTURES DESIGN
16MDE528	DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	16MDE628	OPTIMIZATION TECHNIQUES
16MDE529	LEAN MANUFACTURING	16MDE629	DESIGN OF EXPERIMENTS
16MDE530	SMART MATERIALS AND STRUCTURES	16MDE630	RELIABILITY AND FAILURE ANALYSIS
16MDE531	MECHATRONICS SYSTEM DESIGN	16MDE631	ROBUST DESIGN
16MDE532	MODELLING AND SIMULATION	16MDE632	FINITE ELEMENT METHODS FOR STRUCTURAL MECHANICS APPLICATIONS
16MDE533	MECHANISM DESIGN	16MDE633	DESIGN OF MATERIALS HANDLING SYSTEMS
16MDE534	INDUSTRIAL DESIGN AND ERGONOMICS	16MDE634	THEORY OF PLASTICITY
16MDE535	ADDITIVE MANUFACTURING	16MDE635	NON LINEAR ANALYSIS

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE501
TITLE OF THE COURSE : Applied Mathematics
L: T/A: P: C : 3: 2: 0: 4

COURSE OBJECTIVES:

1. To learn the various numerical schemes for curve fitting, solving linear equations and partial differential equations.
2. To study the solution to extreme problems using vibrational principle.

COURSE OUTCOMES:

1. Solve problems using numerical methods.
2. Solve partial differential equations
3. Use vibrational principle

Calculus of Variation: Introduction, The First Variation, Euler-Lagrange equation, Isoperimetric problems.

Curve Fitting: Linear regression, Polynomial regression, General Linear Least Squares, Newton's Divided Differences, Lagrange interpolating polynomials, Inverse interpolation, spline interpolation, and Multidimensional interpolation.

Numerical solution of PDE's

Laplace Equation, Solution technique, Boundary conditions, the control-volume approach, Heat conduction equation, explicit methods, a simple implicit method, Crank Nicolson method, parabolic equations in two spatial domains, Case studies.

Numerical Linear algebra: Gauss Elimination, LU decomposition, Special Matrices and Gauss Seidel, Case studies

TEXTBOOKS:

1. Chapra, S.C. and Canale, R.P. Numerical Methods for Engineers, Sixth Edition, McGraw Hill.
2. Bruce van Brunt, The Calculus of Variations, Springer.

REFERENCE BOOKS:

1. Chapra, S.C. Applied Numerical Methods with MATLAB, Second Edition, Mc Graw-Hill.
2. Cheney W. and Kincaid, D. Numerical Mathematics and Computing, Sixth Edition, Brooks/Cole

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE502
TITLE OF THE COURSE : FINITE ELEMENT METHOD
L: T/A: P: C : 3: 0: 0: 3

COURSE OBJECTIVES:

1. Introduce the various aspects of FEMas applied to engineering problems.
2. Define the element properties such as shape function and stiffness matrix for the various elements.
3. Formulate element properties for 1D, 2D elements.
4. Use of FE tool in linear problems, structural problems, Fluid mechanics and Heat transfer and vibration problems.
5. Demonstrate ability to make use of commercial software to solve complex problems.

COURSE OUTCOMES:

The student will be able to:

1. Formulate and solve the finite element problems in structural problems, Fluid mechanics and Heat transfer and vibration. problems for 1d and 2D cases.
2. Demonstrate ability to make use of commercial software to solve problems.

Introduction to Finite Element Method - Engineering Analysis, Convergence criteria, Vibrational formulations, weighted residual methods, Potential Energy 1D Bar Element, Admissible displacement function, Strain matrix, Element equations, Stiffness matrix, Consistent nodal force vector: Body force, Initial strain.

One-Dimensional Elements- Analysis of Bars and Trusses, Basic Equations and Potential Energy Functional, 1-D Bar Element, Assembly Procedure, Boundary and Constraint Conditions, 2-D Bar Element, 3-D Bar Element, Beam Element, Hermite shape functions, 1D Heat transfer, Truss element, Test Problems and Applications.

Two-Dimensional Elements - Analysis of Plane Elasticity Problems, Three- Noded Triangular Element (TRIA 3), Four- Noded Quadrilateral Element (QUAD 4), Higher Order Elements Axisymmetric Solid Elements- Analysis of Bodies of Revolution. Axisymmetric Quadrilateral Ring Element- Geometric representation, Admissible displacement functions, Element stain matrix, element stress recovery, Element stiffness matrix, Consistent nodal force vector: Body force, initial strain. Surface traction, Element equations. Test Problems – Assessment of Accuracy, Practical Applications.

Three-Dimensional Elements-Applications to Solid Mechanics Problems: Basic Equations and Potential Energy Functional, Four-Noded Tetrahedral Element (TET 4), Eight-Noded Hexahedral Element (HEXA 8), Tetrahedral elements, Hexahedral elements: Serendipity family, Hexahedral elements: Lagrange family. Shape functions for Higher Order Elements

Dynamic Considerations- Formulation for point mass and distributed masses, Consistent element mass matrix of one dimensional bar element, truss element, beam element. Lumped mass matrix, Evaluation of eigen values and eigen vectors, Applications to bars, stepped bars, and beams.

TEXT BOOKS:

1. Lakshminarayana H. V., Finite Elements Analysis, Procedures in Engineering, Universities Press, 2004.
2. Rao S. S., Finite Elements Method in Engineering, 4th Edition, Elsevier, 2006.
3. Chandrupatla T. R., Finite Elements in Engineering, 2nd Edition, PHI, 2007.

REFERENCE BOOKS:

1. Reddy J.N., An Introduction to the Finite Element Method, McGraw - Hill International Edition, New York, 1993.
2. Bathe K. J. Finite Elements Procedures, PHI,2002.
3. Cook R. D., et al. Concepts and Application of Finite Elements Analysis, 4th Edition, Wiley & Sons, 2003.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE503
TITLE OF THE COURSE : SOLID MECHANICS
L: T/A: P: C : 3: 0: 0: 3

COURSE OBJECTIVES:

1. To study stress strain relationship for plain stress and strain problems, stress strain temperature relations
2. To gain knowledge on theories of failure and plastic flow and applying various failure criteria for stress-strain space
3. Application of variables in axisymmetric problems
4. To solve solid mechanics problems

COURSE OUTCOMES:

1. Provide knowledge about how solid materials and structures behaves when exposed to stress and strain relations
2. Understanding mathematical and physical foundations of the mechanics of solids
3. Ability to apply the principles of solid mechanics to solve engineering problems

Analysis of Stress- Introduction, Body Force, Surface Force and Stress Vector, The State of Stress at a point, Stress Components on an Arbitrary Plane. Principle Stresses, Mohr's Circles for the Three-Dimensional State of Stress, Octahedral Stresses, The plane stress state, Differential equations of equilibrium in Cartesian and cylindrical coordinates, axi-symmetric stress state.

Analysis of Strain- Introduction, Deformations, Change in length of a linear element, The state of strain at a point ,Principle axes of strain and principle strains, Plane strain state, compatibility conditions.

Stress - Strain Temperature Relations-Introduction, Generalised statement of Hooke's Law, Stress-Strain relations for Isotropic materials, Modulus of Rigidity, Bulk Modulus, Young's Modulus and Poisson's Ratio, Relations between the Elastic Constants, Displacement equations of Equilibrium, Problems.

Theories of Failure- Introduction, Mohr's theory, Ideally plastic solid, stress space and strain space, yield Surfaces of Trescanad Von Mises, Stress-Strain Relations (Plastic Flow). Prandtl-Reuss Equations, saint Venant- Von Mises equations.

Torsion of Prismatic Bars- Bars of circular and elliptical cross sections, Rectangular cross sections, Torsion of thin walled tubes. Axi-symmetric Problems- Lames problem, Stresses in interference fitted assemblies, Rotating discs and shafts, Thermal stress analysis of solid and annular discs.

TEXT BOOKS:

1. Srinath , L. S. Advanced Mechanics of Solids , Tata McGraw-Hill Education, Third Edition, 2008.
2. Kazimi, S. M. A. Solid Mechanics, Tata McGraw-Hill Education, 2001
3. Allan F. Bower, Applied Mechanics of Solids, CRC Press, 2009

REFERENCE BOOKS:

1. Shames I.H and Pitarresi, J.M.P., Introduction to Solid Mechanics, PHI Publications, Third Edition, 1999.
2. Phillips, Durelli and Tsao, Analysis of Stress and Strain, McGraw Hill Book, 1958.

SEMESTER/YEAR : II SEM
COURSE CODE : 16MDE504
TITLE OF THE COURSE : ADVANCES IN MATERIAL TECHNOLOGY
L: T/A: P: C : 3: 2: 0: 4

COURSE OBJECTIVES:

1. Introduce the various aspects Ceramics, composites, MMCS
2. To learn fabrication and operational skills and applications for Composite materials
3. To have overview of surface engineering and other treatments for materials environment.

COURSE OUTCOMES:

1. Should be able to process and prepare composite materials effectively.
2. Will be able to understand the selection of materials and challenges in material sector

Introduction- Properties of Materials, Structure property relationship, Newer Materials
– Ceramics and Composite materials, Ceramics – Fine ceramics, Types of ceramics, Structure of Ceramics, Properties of Ceramics, Applications.

Composite Materials- Types – Metal matrix Composites (MMC), Ceramic Matrix Composites (CMC), Polymeric composites Structure, Properties and Applications of different composite materials.

Processing of MMC & CMC, Vacuum infiltration, squeeze casting, pressure die casting, Rheo-casting, Compo-casting, Super plastic forming

Processing of PMC-Hand Lay Up, Bag Molding Process, Autoclave molding, Compression molding, Pultrusion, Filament winding, Resin Transfer molding, Injection molding. Surface Engineering- Surface quality & integrity, concepts, Mechanical treatment, Thermal & Thermo-chemical treatment.

Thermal Spraying Processes and Applications- Vapour depositions processes and applications, Ion-treatment, Laser Treatment.

TEXT BOOKS:

1. Paul Degarmo, E. Black, J.T. and Ronald A Kohser, Materials and Processing in Manufacturing, John Wiley & Sons, 2011.
2. Minoru Taya, and Richard J. Arsenault, Metal Matrix Composites, Elsevier Science & Technology, 1989
3. Mallick, P.K. Fiber-Reinforced Composites: Materials, Manufacturing, and Design, Third Edition, CRC Press, 2007

REFERENCES BOOKS:

1. Schwartz, M.M. Composite Materials Handbook, Second Edition, McGraw Hill Higher Education, NewYork, 1995
2. Tadeusz Burakowski and Tadeusz Wierzchon, Surface Engineering of Metals: Principles, Equipment, Technologies, CRC Press, 1998

SEMESTER/YEAR : II SEM
COURSE CODE : 16MDE505
TITLE OF THE COURSE : MECHANICS OF COMPOSITE MATERIALS
L: T/A: P: C : 3:0: 0: 3

COURSE OBJECTIVES:

1. Familiarize on types of composite materials and fabrication process.
2. Familiarize with the method of analysis of composite Materials.
3. Familiarize with the governing equation of different laminates.
4. Familiarize with sandwich construction and failure models of sandwich Panels

COURSE OUTCOMES:

1. Upon successful completion of this course the students will be able to analyze the characteristics of fiber-reinforced plastics.
2. Understand the various molding process of composite materials, stress analysis of composite beams, plates and shells

Introduction to Composite Materials-Definition and Characteristics, Historical Development, Applications, Advantages and Limitations. Structural Performance of Conventional Materials, Geometric and Physical Definitions, Material Response under Load, types and Classifications of composite Materials, Lamina and Laminate , scales of Analysis, Basic lamia properties, Degree of Anisotropy, Manufacturing Methods for Composite Materials.

Elastic Behavior of Composite Lamina -Stress- Strain relations, Relations between Mathematical and Engineering Constants, Stress- Strain Relations for a Thin Lamina (2-D), Transformation of stress and stain (2-D, 3-D), Transformation of Elastic Parameters (2-D, 3-D), Transformation of stress and strain relations in terms of Engineering Constants (2 –D), Transformation relations for Engineering Constants (2 – D).

Strength of Composite Lamina-Introduction, Failure Theories, Maximum Stress Theory, Maximum Strain Theory, and Energy based Interaction Theory, Interactive Tensor Polynomial Theory, Failure- Mode – Based Theories, Failure Criteria for Textile Composites, Computational Procedure for Determination of Lamina Strength, Evaluation and Application of lamina Failure Theories.

Elastic behavior of Multidirectional Laminates-Basic Assumptions, Strain – Displacement Relations, Stress- Strain Relations of a Layer within a laminate, Force and Moment Resultants, General Load –Deformation Relations: Laminate Stiffness, Inversion Load – Deformation Relations: Laminate Compliances, symmetric Laminates, Balance Laminates, Orthotropic Laminates, quasi- isotropic Laminates, Laminate

Engineering Properties. Computational Procedure for Determination of Engineering Elastic Properties.

Hydrothermal Effects -Introduction, Hydrothermal Effects on Mechanical Behavior, Coefficient of thermal and Moisture Expansion of a Unidirectional Lamina, Hygro thermal Strains in a Unidirectional lamina, Hydro thermo elastic Load - Deformation and

Deformation – Load relations, Hygro thermal Load- Deformation relations, Co-efficient of thermal and Moisture Expansion - Multidirectional Laminates and Balanced/Symmetric laminates. Physical significance of Hydro thermal forces and Moments, Hygro thermal Isotrophy and Stability. Coefficient of thermal Expansion of Unidirectional and Multidirectional carbon/ Epoxy Laminates, Hygro thermo elastic stress Analysis of Multidirectional laminates, Residual stresses.

TEXT BOOKS:

1. Isaac M. Daniel and Ori Ishai, Engineering Mechanics of Composite Materials, Oxford Universities Press, Second Edition, 2007
2. Robert M. Jones, Mechanics of Composite Materials, Mc-Graw Hill Kogakusha Ltd.1975.
3. Chawla, K. K. Composite Science and Engineering, Springer Verlag 1998.

REFERENCE BOOKS:

1. Autar K. Kaw, Mechanics of Composite Materials, CRC Press, 1997.
2. Reddy, J. N. Mechanics of laminated composite plates and shells, CRC Press, 2004.

SEMESTER/YEAR : II SEM
COURSE CODE : 16MDE506
TITLE OF THE COURSE : ADVANCED MACHINE DESIGN
L: T/A: P: C : 3:0: 0: 3

COURSE OBJECTIVES:

1. To review the theory of failures, fatigue, creep, wear of surfaces
2. Understand fatigue crack growth, stress life and LEFM approach
3. To identify and able to solve engineering design problems
4. To know the basics of surface failure, stress and strength

COURSE OUTCOMES:

1. Student will be able to design mechanical components considering fatigue, creep, wear of surfaces
2. Gain knowledge on basic machine elements in machine design and understand their concepts in life estimation

Introduction- Role of failure prevention analysis in mechanical design, Modes of mechanical failure, Review of failure theories for ductile and brittle materials including Mohr's theory and modified Mohr's theory, Numerical examples. High cycle and low cycle fatigue, Fatigue design models ,Fatigue design methods ,Fatigue design criteria, Fatigue testing, Test methods and standard test specimens, Fatigue fracture surfaces and macroscopic features, Fatigue mechanisms and microscopic features.

Stress-Life (S-N) Approach- S-N curves, Statistical nature of fatigue test data, General S-N behavior, Mean stress effects, Different factors influencing S-N behaviour, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using S-N approach. Strain-Life (ε-N) approach: Monotonic stress -strain behavior ,Strain controlled test methods ,Cyclic stress-strain behavior ,Strain based approach to life estimation, Determination of strain life fatigue properties, Mean stress effects, Effect of surface finish, Life estimation by ε-N approach.

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

Fatigue from Variable Amplitude Loading- Spectrum loads and cumulative damage, Damage quantification and the concepts of damage fraction and accumulation, Cumulative damage theories, Load interaction and sequence effects, Cycle counting methods, Life estimation using stress life approach.

Surface Failure - Introduction, Surface geometry, Mating surface, Friction, Adhesive wear, Abrasive wear, Corrosion wear, Surface fatigue spherical contact, Cylindrical contact, General contact, Dynamic contact stresses, Surface fatigue strength.

TEXT BOOKS:

1. Ralph I. Stephens, Ali Fatemi, Robert .R. Stephens and Henry O. Fuchs, Metal Fatigue in Engineering, John Wiley, New York, Second edition. 2001.
2. Jack. A. Collins, Failure of Materials in Mechanical Design, John Wiley, New York 1992.

REFERENCE BOOKS:

1. S. Suresh, Fatigue of Materials, Second Edition, Cambridge University Press, Cambridge, U.K.1998
2. Julie. A. Benantine, Fundamentals of Metal Fatigue Analysis, Prentice Hall,1990
3. ASM Metals Hand Book, Fatigue and Fracture, Vol 19, 2002.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE521
TITLE OF THE COURSE : EXPERIMENTAL STRESS ANALYSIS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Study the strain measurement using strain gauges.
2. Understand the photo elastic principles for 1D and 2D strain measurements
3. Study basic concepts of Moire photography, holography and other technique in optics.

COURSE OUTCOMES:

1. Student will be able to make measurements of strain using the photo elastic principles.
2. Students will have a basic understanding of experimental coating methods
3. Able to solve simple problems involving stress and strain analysis.

Electrical Resistance Strain Gages- Strain sensitivity of gage metals, Gage construction, Gage sensitivity and gage factor, Performance characteristics, Environmental effects in Strain, gage circuits, Potentiometer, Wheat Stone's bridges, Constant current circuits. Strain Analysis Methods: Two element and three element, rectangular and delta rosettes, Correction for transverse strains effects, stress gage - plane shear gage, Stress intensity factor gage.

Photo elasticity -Nature of light, - wave theory of light, optical interference – Polariscopes stress optic law - effect of stressed model in plane and circular Polari scopes, Isoclines, Isochromatics fringe order determination - Fringe multiplication techniques - Calibration Photo elastic model materials.

Two Dimensional Photo elasticity Stress Analysis- Separation methods shear difference method, Analytical separation methods, Model to prototype scaling. Three Dimensional Photo elasticity : Stress freezing method, General slice, Effective stresses, Stresses separation, Shear deference method, Oblique incidence method Secondary principals stresses, Scattered light photo elasticity, Principals, Polari scope and stress data analyses.

Coating Methods a) Photo elastic Coating Method: Birefringence coating techniques - Sensitivity Reinforcing and thickness effects - data reduction - Stress separation techniques Photo elastic strain gauges b) Brittle Coatings Method: Brittle coating technique Principles data analysis - coating materials, Coating techniques.

Moire Technique: Geometrical approach, Displacement approach- sensitivity of Moire data reduction, In plane and out plane Moire methods, Moire photography, Moire grid production. Holography- Introduction, Equation for plane waves and spherical waves, Intensity, Coherence, Spherical radiator as an object (record process), Hurter, Driffeld curves, Reconstruction process, Holograpic interferomerty, Real-time and double exposure methods, Displacement measurement, Isopachics.

TEXT BOOKS:

1. James W. Dally, and William Franklin Riley, Experimental Stress Analysis, McGraw Hill.1991
2. Sadhu Singh, Experimental Stress Analysis**,** Khanna publisher,1982

REFERENCES BOOKS

1. Srinath, Lingaiah, Raghavan, Gargesa, Ramachandra and Pant, Experimental Stress Analysis, Tata McGraw Hill. 1984
2. Frocht, M.M., Photo elasticity Vol I and Vol II , John Wiley and Sons,1948.
3. Perry and Lissner, Strain Gauge Primer, McGraw-Hill, 1962.
4. Kuske, Albrecht and Robertson, Photo elastic Stress analysis **-** John Wiley & Sons, 1974.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE522
TITLE OF THE COURSE : DYNAMICS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Study the dynamics of holonomic and no holonomic systems using Euler equations Lagrangian principles.
2. Analyse the transient dynamic motion using phase plane representation.
3. Study the motion of rigid bodies to small perturbations.

COURSE OUTCOMES:

1. Able to study and interpret system dynamics in phase plane representation
2. Be proficient in the use of handling Eulers and Lagrange's equation in dynamics and solve dynamic problems

Representation of translation and rotation of rigid bodies, degrees of freedom and generalized coordinates, motion of a rigid body and multi-body systems,

Generalised Principles of Dynamics: Fundamental Laws of Motion Generalised Co-Ordinates, Holonomic and Non-Holonomic Constraints, Euler's Equation of Motion.

Lagrange's Equation: Lagrange's Equation From D' Alembert's Principles, Hamilton Principles, Lagrange's Equation from Hamilton Principle, Application of Lagrange Equation for Conservative and Non Conservative systems.

System Dynamics: Motion of Gyroscopes, Mechanical Transients, Phase Plane Representation, Response of Linear Systems to Transient Forcing Functions Phase Plane Methods.

Autonomous Systems with Holonomic and Nonholonomic Constraints, Application to Systems with very small Displacements and to Impulsive Motion.

TEXT BOOKS:

1. Rao V. Dukkipati, Solving Engineering System Dynamics Problems with MATLAB**,** 1st Edition, New Age International Publishers, 2007
2. Wilson and Sadler, Kinematics and Dynamics of Plane machinery**,** 3rd Edition, Pearson, 2007

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE523
TITLE OF THE COURSE : PRODUCT DEVELOPMENT
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Identify the customer needs, formulate the specifications and carry out need analysis.
2. Generate, screen and test the concepts.
3. Modeling the prototypes and carry out economic analysis.

COURSE OUTCOMES:

1. Solve problems independently and identification of customer needs for the product growth
2. Have a basic knowledge of concept generation and prototyping for small product business
3. Understanding the process of product planning and specifications

Introduction- Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development. Development Processes and Organizations- A generic development process, concept development: the front-end process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization.

Product Planning- The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process. Product Specifications- What are specifications, when are specifications established, establishing target specifications, setting the final specifications. Identifying Customer Needs- Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.

Concept Generation- The activity of concept generation clarify the problem, search externally, search internally, explore systematically, reflect on the results and the process, Concept Selection- Overview of methodology, concept screening, and concept scoring, Concept Testing- Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process.

Product Architecture- What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues.

Product Development Economics- Elements of economic analysis, base case financial mode, Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.

Prototyping- Prototyping basics, principles of prototyping, technologies, planning for prototypes.

TEXT BOOKS:

1. Karl.T.Ulrich and Steven D Eppinger, Product Design and Development-Irwin/McGrawHill - 2000.
2. Geoffery Boothroyd, Peter Dewhurst and Winston Knight, Product Design for Manufacture and Assembly - 2002

REFERENCE BOOKS:

1. Chitale, A. C. and Gupta, R. C., Product Design and Manufacturing, PH1, 3rd Edition, 2003.
2. Tim Jones and Butterworth Heinmann, New Product Development, Oxford, UCI,1997

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE524
TITLE OF THE COURSE : DATA VISUALISATION
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Review of viewing transformations
2. Study the clipping algorithms
3. Representing curves, surfaces and solids
4. Study visual realism principles

COURSE OUTCOMES:

1. Learned to generate mathematical representation of surfaces and Visualizations appropriate to the specific task and data source
2. Creating transformations and clipping of multiple versions of visualizations using mathematical techniques.

Viewing Transformations- Representation of points, Transformations: Rotation, Reflection, Scaling, Combined Transformations, Translations and Homogeneous Coordinates, A geometric interpretation of homogeneous coordinates, Over all scaling, Points at infinity, Rotation about an arbitrary point, Reflection through an arbitrary line. Viewing transformation, Clipping - points, lines, Text, Polygon, Cohen, Sutherland line clipping, Sutherland, Hodgmen algorithm.

Types and Mathematical Representation of Curves- Curve representation, Explicit, Implicit and parametric representation. Nonparametric and parametric representation of Lines, Circles, Ellipse, Parabola, Hyperbola, Conics. Parametric representation of synthetic curve, Hermite cubic splines, , Bezier curves: Blending function, Properties, generation, B-spline curves- Cox-de Boor recursive formula, Properties, Open uniform basis functions, Non-uniform basis functions, Periodic B-spline curve.

Types and Mathematical Representation of Surfaces- Surface entities- Plane, Ruled, surface of revolution, Tabulated cylinder, Bezier surface, B-spline surface, Coons patch, Off set surface, Surface representation, Parametric representation of analytic surface-plane, Ruled surface, Surface of revolution, Tabulated cylinder, Parametric representation of synthetic surfaces, Hermite bicubic surface, Bezier surface, B-spline surface, Coons surface, Offset surface.

Types and Mathematical Representation of Solids- Solid entities- block, Cylinder, cone, Sphere, wedge, Torus, Solid representation, Fundamentals of solid modeling, Set theory, Regularized set operations, Set membership classification, Half spaces, Basic elements, Building operations, Boundary representation, Basic elements, Building operations, Constructive solid geometry, Basic elements, Building operations, Sweep representation.

Visual Realism- Visibility of object views, Visibility techniques: minimax test, Containment test, Surface test, Silhouttes, Homogeneity test, Sorting, Coherence, Hidden line priority algorithm, Hidden surface removal- Z-buffer algorithm, Warnock's algorithm, Hidden solid removal - ray tracing algorithm. Shading, Shading models, Diffuse reflection, specular reflection, Ambient light, Shading surfaces Constant shading, Gourmand shading, Phong shading, Shading enhancements, Shading Solids, Ray tracing for CSG, z- buffer algorithm for B-rep and CSG, octree encoded objects, Colouring- RGB, CMY, HSV, HSL colour models

.

TEXT BOOKS:

1. Ibraham Zeid, CAD/CAM-Theory and Practice, McGraw Hill, 2006
2. Rogoer's Adams, Mathematical Elements for Computer Graphics, McGraw Hill,1990

REFERENCE BOOKS:

1. Xiang Z, Plastock, R. A, Computer Graphics, Schaums Outlines, McGraw Hill. 2007.
2. Foley, Van- Damn, Finner and Hughes, Computer Graphics principles and practice, Addison Wesley,1990

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE525
TITLE OF THE COURSE : ROBOTICS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. To introduce principles of robotics, which includes problems in transformations, kinematics and inverse kinematics, dynamics, and control.

2. To work and contribute in a teamwork robotic environment
3. To teach students about basic robotics through lectures and simulations

COURSE OUTCOMES:
Upon completion of this course the student shall be able to:

1. To solve problems in robot kinematics, Dynamics and control.

2. Know the knowledge of statics and dynamics of manipulators

3. To handle programming principles for robot control.

Introduction and Mathematical Representation of Robots- History of Robots, Types of Robots, Notation, Position and Orientation of a Rigid Body, Some Properties of Rotation Matrices, Successive Rotations, Representation by X-Y-Z, Z-Y-Z Euler Angles, Transformation between coordinate system, Homogeneous coordinates,
Properties of ${}^{A}_{B}T$, Types of Joints: Rotary, Prismatic joint, Cylindrical joint, Spherical joint, Representation of links using Denvit-Hartenberg parameters: Link parameters for intermediate, first and last links, Link transformation matrices, Transformation matrices of 3R manipulator, PUMA560 manipulator, SCARA manipulator. The planar four bar mechanisms, Degrees of freedom of a manipulator, Loop constraint equations. Three DOF parallel manipulator, A six-DOF parallel (hybrid) manipulator.

Kinematics of Serial and Parallel Manipulators- Direct kinematics of 2R and 3R manipulator, Puma560 manipulator, SCARA manipulator, Stanford arm, The Planar four bar mechanism, Direct kinematics of Stewart-Gough Platform. Inverse kinematics of 2R, 3R manipulator, Inverse kinematics of Stewart-Gough Platform. Velocity and Statics of Manipulators: Differential relationships, Jacobian, Differential motions of a frame (translation and rotation), Linear and angular velocity of a rigid body, Linear and angular velocities of links in serial manipulators, 2R, 3R manipulators, Jacobian of serial manipulator, Velocity ellipse of 2R manipulator, Singularities of serial and parallel manipulators 2R, 3R, three DOF parallel manipulator.

Statics of serial manipulators, Static force and torque analysis of 3R manipulator, Statics of parallel manipulator, Singularity in force domain. Dynamics of Manipulators-Inertia of a link, Recursive formulation of dynamics using Newton Euler equation, Equation of motion of 2R and 3R manipulators using Lagrangian, Newton-Euler formulation.

Trajectory Planning- Joint space schemes, cubic trajectory, Joint space schemes with via points, Cubic trajectory with a via point, Third order polynomial trajectory planning, Linear segments with parabolic blends,

Control- Feedback control of a single link manipulator- first order, second order system, PID control, Non-linear control of manipulators-computed torque method, Force control of manipulator, Partitioning a task for force and position control- lever, peg in hole Hybrid force and position controller.

TEXT BOOKS:

1. Ghosal A, Fundamental Concepts and Analysis, Robotics, Oxford, 2006.
2. Niku, S. B. Introduction to Robotics Analysis, Systems, Applications, Pearson Education, 2008.

REFERENCE BOOKS:

1. Schilling R. J., Fundamentals of Robotics, Analysis and Control, PHI, 2006.
2. Fu, K, S., Gonzalez R. C., and Lee C.S.G., Robotics Control, Sensing, Vision and Intelligence, McGraw Hill, 1987.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE526
TITLE OF THE COURSE : DIGITAL CONTROL SYSTEMS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Ability to carry out the stability analysis and control systems.
2. Ability to learn processors for industrial applications.

COURSE OUTCOMES:

1. Solve problems using z-transform, inverse z- transform techniques.
2. Know the advantage of state variable technique, controllability, observability for effective design of controller using digital technique

Sampling and holding – Sample and hold device D/A, A/D conversion – Z transform – Inverse Z transform – properties – Pulse transfer function and response between sampling intervals –Reconstruction.

State equations of discrete data systems – State transition equations – Relationship between state equation and transfer functions - Characteristic equations – Eigen value – eigen vector –Diagonalization of Matrix – Jordan canonical form – Methods of computing state transition matrix –State diagram – Decomposition of discrete data transfer function.

Controllability and observability of linier time invariant discrete data systems – Relationships between controllability, observability and transfer function-Stability of linier discrete control system – Stability tests – Bilinear transformation method – Jury's stability test.

Correlation between time response and root locations in S plane and Z plane – Direct design in Z and W plane – State space design – Design via pole placement, digital PID controller design.

Selection of processors – Mechanization of control algorithms – Merits and demerits – Applications of temperature control – Control of electric drives.

TEXT BOOKS:

- Ogata, K. Discrete Time Control Systems, Pearson Education Asia, 2001
- Gopal, M. Digital Control and State Variable Methods, Tata McGraw Hill,1999

REFERENCE BOOKS:

1. Kuo, B.C. Digital Control Systems, Oxford University Press, 1992.
2. Gopal, M. Digital Control Engineering, Willey Eastern Ltd.1989.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE527
TITLE OF THE COURSE : FRACTURE MECHANICS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. The course will give much knowledge on fracture mechanics principles, fatigue failure and non-destructive testing and their applications.
2. Test methods and other techniques for fracture study will be discussed
3. The syllabus is designed for students interested in basic building knowledge on mechanics and learns more on engineering materials against crack induced fracture, diagnosis of cause and mechanisms of failure.

COURSE OUTCOME:

1. Able to possess the analytical tools needed to solve the idealised problem
2. Be able to use these solutions and make appropriate design against failure analysis

Background – Kinds of failure, Modes of fracture failure, Damage tolerance. Energy Release rate- Introduction, Griffith's Dilemma, Surface energy, Definition , Mathematical formulation ,Energy release rate of DCB specimen, Crack resistance, Stable and unstable crack growth, R- Curve for brittle Cracks, Critical energy release rate.

Mixed mode fracture criteria - Crack path selection. Interface cracks in layered structures. Anisotropic fracture, linear and nonlinear fracture mechanics, J-Integral Stress Intensity factor- Introduction, Stress and Displacement fields in isotropic elastic materials, Stress Intensity factor –Background for mathematical Analysis, Westergaard approach, Problems

SIF of More Complex Cases- Other applications of Westergaard, Approach, Application of the Finite dimensions, Cracks in a plate of finite dimensions. Edge cracks, embedded cracks, Critical stress intensity factor, Bending and Twisting of Cracked plates.

An elastic Deformation at the Crack tip- Further Investigation at the Crack Tip, Approximate Shape and size of the plastic zone, Effective crack length, Effect of plate thickness, Crack tip opening displacement, problems.

Test Methods-Introduction, -Test Techniques, Test Methods to determine and Determination of Critical CTOD. Fatigue failure- Low cycle and high cycle fatigue, Phase in fatigue life, Safe life and Fail-safe design philosophies, Principles of failure analysis.

TEXT BOOKS:

1. Ralph I. Stephens, Ali Fatemi, Robert R. Stephens, Henry O. Fuchs, Metal Fatigue in engineering, John Wiley New York, Second edition. 2001.
2. Jack. A. Collins, Failure of Materials in Mechanical Design, John Wiley, New York 1992.
3. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw-Hill Education, 2009

REFERENCE BOOKS:

1. Suresh, S., Fatigue of Materials, Cambridge University press, Cambridge, U.K.1991.
2. Fracture Mechanics, Fundamental and applications, Anderson T L, CRC Press, 2004.
3. Fatigue and Fracture, ASM Hand Book, Vol 19, 2002.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE528
TITLE OF THE COURSE : DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. To understand fundamentals of Hydraulic and Pneumatic systems
2. To design simple Hydraulic and Pneumatic circuits.
3. To design circuits for low cost automation.

COURSE OUTCOMES:

1. Understand fundamental of fluid power control.
2. Design special circuits for low cost automation.

Hydraulic Systems and Actuators- Basic principles- Hydraulic Principles. Hydraulic Power Generators - Selection and specification of pumps, pump characteristics. Hydraulic Actuators – Linear, Rotary - Selection Characteristics.

Control and Regulation Elements- Hydraulic Valves: Pressure, Flow, Direction Controls- Proportional Control valve. Fluid power symbols.

Design of Hydraulic Circuits- Hydraulic circuits:- Reciprocating, Quick return , Sequencing, synchronizing and other industrial circuits like press circuits - hydraulic milling machine - grinding, planning, copying, forklift, earth mover circuits - design and selection of components - safety and emergency mandrels. Selection and sizing of components-calculation of frictional head loss-equivalent length for various components- actuator load calculation- pump sizing.

Pneumatic Systems and Circuits- Pneumatic system fundamentals: FRL, actuators and valves. Logic Circuits - Position – Pressure Sensing, switching, electro-pneumatic. Design of Pneumatic circuits using– Karnaugh maps. Cascade-Step counter.
Installation, Maintenance and Special Circuits- Pneumatic equipments - selection of components - design calculations -application - fault finding – hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation

TEXT BOOKS:

1. Majumdar, S. R. Oil hydraulics and Pneumatics, Tata McGraw Hill, 2003.
2. Bolton, W. Pneumatic and hydraulic systems, Butterworth Heinemann, 1997.

REFERENCE BOOKS:

1. Anthony Esposite, Fluid Power with Applications, Pearson Education, 2000.
2. Andrew Parr, Hydraulics and Pneumatics, Jaico, 1999.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE529
TITLE OF THE COURSE : LEAN MANUFACTURING
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Understanding the system manufacturing, manufacturing strategy, design considerations for manufacture component and quality systems.

2. Identify materials for effective manufacturing and make a future state for lean manufacturing.
3. Opportunity to learn the fundamental principles of lean in manufacturing

COURSE OUTCOMES:

1. Understanding lean manufacturing practices
2. Evaluation of lean manufacturing practices

General - Brief history of lean manufacturing, Just in time production, Toyota systems, Kanban systems, Kanban rules, Benefits of lean manufacturing, Types of wastes, Reduction of wastes

Lean manufacturing: - Principles - Basic tools - Techniques - Definition - Assessment tools- Implementing lean manufacturing – Science behind lean manufacturing – Capacity utilization - Variability – Delivery

Strategic issues: - Actions - Issues - Focus - Leadership - Management of teams – Training. Lean accounting: Activity based costing - Product costing - Volume adjusted costing –Focused factory concept – Building strategic advantage through enterprise wide.

Value stream and process mapping: - Overview - Where to use - Step by step approach –How to use – Reduce stream mapping – Present and future states - VSM symbols – Process mapping - Detailed instructions - limits – facilitation.

Cellular manufacturing: - Work cell – Cell design - Facility planning – Plant layout – Balancing the work in work cells – Tact time – Defining - Benefits - Uses - Limitations – Facilities planning tools. Group technology coding classification - Productivity Improvement Aids - Kaizen – Kanban - 5S - TPM - Automation - Jidoka – Mistake proofing – Yoko poko Design Root cause analysis - Failure models and effects.

TEXT BOOKS

1. Taiichi Ohno, (1988), The Toyota Production System (Beyond Large Scale production), Portland, Oregon Productivity Press.

REFERENCE BOOKS

1.Kigoshi Suzaki, (1988), The New Manufacturing Challenge, Free Press, New York.

2. Shigeo Shing, (1989), Study of Toyota Production System, Portland, Oregon Productivity Press.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE530
TITLE OF THE COURSE : SMART MATERIALS & STRUCTURES
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

This course enables understanding the concept of MEMS and Microsystems.

1. Understand the diverse technological and functional approaches and applications.
2. Provides an insight of micro sensors, actuators and micro fluidics.

COURSE OUTCOMES:

On completion of the course, the students will be able to:

1. Become familiar with micro fabrication techniques
2. Assess whether using a MEMS based solution is the relevant and best approach
3. Select the most suitable manufacturing process and strategies for micro fabrication

Overview of Smart Materials, Structures and Products Technologies. Smart Materials (Physical Properties) - piezoelectric materials, materials, magneto strictive, electro strictive materials, magneto electric materials. Magneto rheological fluids, electro rheological fluids, shape memory materials, fiber-optic sensors.

Smart Sensor, Actuator and Transducer Technologies - smart sensors- accelerometers, force sensors, load cells, torque sensors, pressure sensors, microphones, impact hammers, MEMS sensors, sensor arrays smart actuators: displacement actuators, force actuators, power actuators, vibration dampers, shakers, fluidic pumps, motors smart transducers, ultrasonic transducers, sonic transducers, air transducers.

Measurement, Signal Processing, Drive and Control Techniques- quasi-static and dynamic measurement methods, signal-conditioning devices, constant voltage, constant current and pulse drive methods; calibration methods, structural dynamics and identification techniques, passive, semi-active and active control, feedback and feed forward control strategies.

Design, Analysis, Manufacturing and Applications of Engineering Smart Structures and Products - Case studies incorporating design, analysis, manufacturing and application issues involved in integrating smart materials and devices with signal processing and control capabilities to engineering smart structures and products.

Emphasis on structures, automation and precision manufacturing equipment, automotives, consumer products, sporting products, computer and telecommunications products, medical and dental tools and equipment.

TEXT BOOKS:

1. Culshaw, B., Smart Structures and Materials, Artech House, Boston, 1996.
2. Srinivasan, A. V., Smart Structures: Analysis and Design, Cambridge University Press, Cambridge; New York, 2001.

REFERENCE BOOKS:

1. Uchino, K., Piezoelectric Actuators and Ultrasonic Motors, Kluwer Academic Publishers, Boston, 1997.
2. Otsuka, K. and Wayman, C. M., Shape Memory Materials – Cambridge University Press, Cambridge; New York, 1996.
3. Gandhi, M. V. and Thompson, B.S, Smart Materials and Structures, Chapman and Hall, London; New York, 1992.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE531
TITLE OF THE COURSE : MECHATRONICS SYSTEM DESIGN
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

1. This course makes the student to appreciate multi-disciplinary nature of modern engineering systems.
2. After undergoing this course the student is in a position to understand how mechatronics systems can be designed and developed.

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

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

Signal Conditioning- Signal conditioning, the operational amplifier, Protection, Filtering, Wheatstone Bridge, Digital signals , Multiplexers, Data Acquisition, Introduction to digital system processing, pulse-modulation.

MEMS and Microsystems- Introduction, Working Principle, Materials for MEMS and Microsystems, Micro System fabrication process, Overview of Micro Manufacturing, Micro system Design, and Micro system Packaging. Data Presentation Systems-Basic System Models, System Models, Dynamic Responses of System

Advanced Applications in Mechatronics- Fault Finding, Design, Arrangements and Practical Case Studies, Design for manufacturing, Automated Manufacturing – Artificial intelligence in Mechatronics – Fuzzy Logic Applications in Mechatronics – Micro sensors in Mechatronics.

TEXT BOOKS:

1. Bolton, W. Mechatronics - Addison Wesley Longman Publication, 1999
2. Tai-Ran Hsu, MEMS And Microsystems Design and Manufacture- Tata McGraw-Hill Education, 2002

REFERENCE BOOKS:

1. Kamm, L. J., Understanding Electro-Mechanical Engineering an Introduction to Mechatronics - IEEE Press, 1st Edition,1996.
2. Shetty and Kolk, Mechatronics System Design- Cengage Learning, 2009.
3. Mahalik, Mechatronics- Tata McGraw-Hill Education, 2003.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE532
TITLE OF THE COURSE : MODELLING AND SIMULATION
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Gain hands training and experience on Simulation software.
2. Developing skill to apply simulation software for goal driven system models.
3. Acquire working knowledge in statistical techniques, modelling approach and systems simulation.

COURSE OUTCOMES:

1. Able to develop performance models for real world systems and will be able to solve those models through simulation and statistical techniques.
2. Understanding the behavior of modelling system and create model for simulation studies.

Introduction to Simulation: Simulation, Advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study. Simulation Examples: Simulation of Queuing systems, Simulation of Inventory System, Other simulation examples.

General Principles: Concepts in discrete - event simulation, event scheduling/ Time advance algorithm, simulation using event scheduling. Random Numbers: Properties, Generations methods, Tests for Random number- Frequency test, Runs test, Autocorrelation test.

Random Variate Generation: Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and log normal Distributions, convolution methods- Erlang distribution, Acceptance Rejection Technique Optimisation Via Simulation: Meaning, difficulty, Robust Heuristics, Random Search.

Analysis of Simulation Data Input Modelling: Data collection, Identification and distribution with data, parameter estimation, Goodness of fit tests, Selection of input models without data, Multivariate and time series analysis. Verification and Validation of Model – Model Building, Verification, Calibration and Validation of Models.

Output Analysis – Types of Simulations with Respect to Output Analysis, Stochastic Nature of output data, Measures of Performance and their estimation, Output analysis of terminating simulation, Output analysis of steady state simulations. Simulation

Softwares: Selection of Simulation Software, Simulation packages, Trend in Simulation Software.

TEXT BOOKS:

1. Jerry Banks, John S Carson, II, Berry L Nelson, David M Nicol, Discrete Event system Simulation, Pearson Education, Asia, 4th Edition, 2007, ISBN: 81-203-2832-9.
2. Geoffrey Gordon, System Simulation, Prentice Hall publication, 2nd Edition, 1978, ISBN: 81-203-0140-4.
3. Averill Law & David M. Kelton, Simulation, Modelling and Analysis, TMH 3rd Edition, 2003.
4. Banks, J., J.S. Carson, B.L. Nelson, and D.M. Nicol, Discrete-Event System Simulation, Fourth Edition, Prentice-Hall, 2005.

REFERENCE BOOKS:

1. Gordon, G., System Simulation, PHI, 2006.
2. Averill M Law, W David Kelton, Simulation Modelling & Analysis, McGraw Hill International Editions – Industrial Engineering series, 4th Edition, ISBN: 0-07-100803-9.
3. Narsingh Deo, Systems Simulation with Digital Computer, PHI Publication (EEE), 3rd Edition, 2004, ISBN : 0-87692-028-8
4. Deo, System Simulation with Digital computer, PHI, 1978.
5. Francis Neelamkovil, Computer Simulation and Modelling, John Wiley and Sons, 1987.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE533
TITLE OF THE COURSE : MECHANISM DESIGN
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Study kinematic synthesis and analysis of linkages using graphical and analytical tools.
2. Understand the various quantitative and qualitative approaches for compliant mechanisms.
3. Able to formulate, identify and solve mechanic problems.

COURSE OUTCOMES:

1. Possess the basic knowledge, skills, method required to conceptualize, model, fabricate, and mechanical designs into practical products and equipment.
2. Should be able to analyze problems of mechanism design and evaluate mechanisms.

Terminology, planar, Spherical and spatial mechanisms, mobility, Grashoffs law, Equivalent mechanisms, Unique mechanisms, Kinematic analysis of plane mechanisms**:** Auxiliary point method using rotated velocity vector, Hall - Ault auxiliary point method, Goodman's indirect method. Position Analysis - Vector loop Equations for 4 bar, Slider Crank, Six bar linkages, Analytical and Graphical methods for velocity and acceleration.

Type, Number and Dimensional Synthesis, Function Generation, Path Generation and Motion Generation, Graphical Methods Two Position, Three Position and Four Position Synthesis of 4bar Mechanism, Slider Crank Mechanism, Precision positions Over lay Method, Guiding a body through two and three distinct positions. The roto centre triangle. Guiding a body through four distinct positions. Burnester's curve.

Analytical Methods - Blotch's Synthesis, Freudestien's Method, Coupler curve Synthesis, Cognate linkages - The Roberts – Chebychev theorem.

Introduction to plane motion. The Inflection circle, Euler – Savary Equation, Analytical and graphical determination of Bobillier's Construction, Collineation axis, Hartmann's Construction, Inflection circle for the relative motion of two moving planes, Application of the Inflection circle to kinematic analysis.

Motion Generation: Poles and relative poles, Location of poles and relative poles, polode, Curvature, Inflection circle.

TEXT BOOKS:

1. Waldron, K.J. & Kinzel, G.L., Kinematics, Dynamics and Design of Machinery, Wiley, 2007.
2. Sandor,G.N and Erdman, A.G. Applied Mechanism Design, PHI, 1988.

REFERENCE BOOKS:

1. Hall, A.S., Kinematics and Linkage Design, PHI.
2. Ambekar, A.G., Mechanism and Machine Theory, PHI, 2007.
3. David H. Myszka, Machines and Mechanisms, Pearson Education, 2005.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE534
TITLE OF THE COURSE : INDUSTRIAL DESIGN AND ERGONOMICS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Identify and quantify ergonomics problems and prioritize the outcomes
2. To complete value added systems and controls
3. Integrating ergonomics and anthropometric information into industrial design projects
4. Apply practical design methodology and process to design project and objects

COURSE OUTCOMES:

1. Respond to the socio economic and cultural contexts of industrial design and the ethical duties.
2. Develop design strategies, form detail concepts and communicate design proposals.
3. Contribute professional practice relevant to industrial design and ergonomics

An approach to industrial design -elements of design structure for industrial design in engineering application in modern manufacturing systems. General approach to the man-machine relationship- workstation design-working position.

Shapes and sizes of various controls and displays-multiple, displays and control situations -design of major controls in automobiles, machine tools etc., and design of furniture -redesign of instruments.

Ergonomics and product design - ergonomics in automated systems- expert systems for ergonomic design. Anthropometric data and its applications in ergonomic, design-limitations of anthropometric data- use of computerized database. Case study.

Visual Effects of Line and Form- The mechanics of seeing- psychology of seeing general influences of line and form. Aesthetic Concepts. Concept of unity- concept of order with variety -concept of purpose style and environment-Aesthetic expressions. Style-components of style- house style, observation style in capital goods, case study.

Colour and light - colour and objects- colour and the eye - colour consistency- colour terms- reactions to colour and colour continuation -colour on engineering equipment's. Industrial Design in Practice - specifying design equipments- rating the importance of industrial design -industrial design in the design process.

TEXT BOOKS:

1. Mayall W.H., Industrial Design for Engineers - London Hiffee books Ltd. -1988.
2. Brain Shakel (Edited) - Applied Ergonomics Hand Book, Butterworth Scientific. London, 1988.

REFERENCE BOOKS:

1. Bridger, R. C., Introduction to Ergonomics, McGraw Hill Publications, 1995.
2 Sanders & McCormick, Human Factor Engineering, McGraw Hill Publications, 6th edition, 2002.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE535
TITLE OF THE COURSE : ADDITIVE MANUFACTURING
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Analyze and evaluate engineering products using the knowledge of science and engineering
2. Apply additive manufacturing concepts to all possible fields of science
3. Create the design of an object suitable for additive manufacturing processes

COURSE OUTCOMES:

1. Will solve complex manufacturing problems for technological development.
2. Students will read literatures, discuss current research problems, and identify possible contribute to the field of additive manufacturing.

Introduction: Definition of Prototype, Types of prototype, Need for the compression in product development, History of RP systems, Survey of applications, Growth of RP industry, classification of RP systems. Stereo lithography Systems: Principle, Process parameter, process details, Data preparation, data files and machine details, Application.

Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications. Fusion Deposition Modelling: Principle, Process parameter, Path generation, Applications.

Solid Ground Curing: Principle of operation, Machine details, Applications, Laminated Object Manufacturing: Principle, of operation, LOM materials, process details, application. Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer, GenisysXs printer HP system 5, object Quadra systems, Laser Engineering Net Shaping (LENS)

Rapid Tooling : Indirect Rapid tooling -Silicon rubber tooling, Aluminum filled epoxy tooling Spray metal tooling ,Cast kirksite, 3D keltool, Direct Rapid Tooling — Direct, AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Pro-Metal ,Sand casting tooling ,Laminate tooling soft Tooling vs. hard tooling. Software for RP: Stl files, Overview of Solid view, magics, imics, magic communicator, etc. Internet based software, Collaboration tools.

Rapid Manufacturing Process Optimization: factors influencing accuracy, data preparation errors, Part building errors, Error in finishing, influence of build orientation. Allied Processes: vacuum, casting, surface digitizing, surface generation from point cloud, surface modification — data transfer to solid models.

TEXT BOOKS:

1. Paul F. Jacobs, Stereo Lithography and other RP & M Technologies, SME NY, 1996.
2. Flham D.T & Dinjoy S.S,Rapid Manufacturing, Verlog London 2001.

REFERENCE BOOKS:

1. Terry Wohler, Wohler's Report 2000, Wohler's Association 2000.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE571
TITLE OF THE COURSE : DESIGN LABORATORY-I (FINITE ELEMENT SOLUTIONS)
L: T/A: P: C : 0:0: 4: 2

COURSE OBJECTIVES:

1. To know how to model, analyze mechanical systems using finite element analysis software
2. Learn the concepts of finite element analysis and use their skill for getting solutions
3. Develop models of mechanical systems using finite element software.

COURSE OUTCOMES:

1. Interpret the obtained results from finite element analyses software and compare with the experimental work.
2. Take note on necessary information and work on structural, thermal and dynamic analysis using finite element software

Stress analysis of rectangular plate with circular hole under 1). Uniform Tension and 2). Shear: Calculation and Plot of normalized hoop Stress at hole boundary in Infinite Plate, Modelling of plate geometry under chosen load conditions and study the effect of plate geometry. Numerical Analysis using FEA package.

Modelling: Surface modelling. Solid modelling and Assembly. Generation of Ferguson's cubic surface patches, Generation of Bezier UNISURF surface patches, Generation of Coon's patches.

Analysis of Structures: Static Analysis. Modal Analysis. Harmonic Analysis. Spectrum Analysis. Buckling Analysis, Analysis of Composites.

Students are trained in 3D Modelling and Finite Element Software such as Pro-E, SolidWorks, ANSYS, as part of the Lab exercise.

SEMESTER/YEAR : I SEM
COURSE CODE : 16MDE572
TITLE OF THE COURSE : DESIGN LABORATORY- II (EXPERIMENTAL STRESS ANALYSIS)
L: T/A: P: C : 0:0: 4: 2

COURSE OBJECTIVES:

1. Prepare and to study subjects such as mechanics of materials and machines, vibration and controls, and the design of tools and machines.
2. Provide stress analysis tools for designing equipment and instrumentation studies.
3. Use and evaluate stress measurement techniques.

COURSE OUTCOMES:

1. Ability to convey information regarding designing and reporting results of experiments
2. Ability to calculate stress from experimental measurements and get familiarity with photo elastic material properties

Contact Stress Analysis of Circular Disc under diametrical compression**:** 3-D Modelling of Circular Discs with valid literature background, Experimental results on contact stress, 2D Photo Elastic Investigation; Stress analysis in Curved beam in 2D.

Experimental studies using Strain Gauge Instrumentation, 2D Photo elastic Investigation, Modelling and Numerical Analysis using FEM. Experimental Investigations using a Journal Bearing Test Rig. Stress Analysis of a Thick Walled Cylinder with specified Temperature at inner and outer Surfaces.

Preparation and calibration of Photo elastic sheets. Preparation of Photo elastic models like Discs, Beams and Columns

Stress determination for different models having regular shapes, loaded conventionally, and comparison of results with theoretical values. Measurement of strains for different shapes, by different arrangements of strain gauges.

SEMESTER/YEAR : II SEM
COURSE CODE : 16MDE573
TITLE OF THE COURSE : DESIGN LABORATORY- III (DYNAMICS LABORATORY)
L: T/A: P: C : 0:0: 4: 2

COURSE OBJECTIVES:

1. Understand the basic software tools for the design and implementation for systems.
2. Ability to design and conduct experiment
3. Perform several lab design experiments for structural, thermal engineering and mechanics

COURSE OUTCOMES:

1. Work independently and demonstrating the professional and ethical responsibilities.
2. Ability to design a system and required component to meet the desired needs for manufacturability, sustainability and safety.

Single edge notched beam in four point bending: Modelling of single edge notched beam in four point bending, Numerical Studies using FEA, Correlation Studies

Determination of damped natural frequency of vibration of the vibrating system with different viscous oils. Determination of steady state amplitude of a forced vibratory system. Static balancing using steel balls. Determination of the magnitude and orientation of the balancing mass in dynamic balancing. Field balancing of the thin rotors using vibration pickups. Determination of the magnitude of gyroscopic couple, angular velocity of precession and representation of vectors

Structural Analysis: FE modelling of a stiffened Panel Buckling, Bending and Modal analysis of stiffened Panels.

SEMESTER/YEAR : II SEM
COURSE CODE : 16MDE574
TITLE OF THE COURSE : DESIGN LABORATORY- IV (SIMULATION LABORATORY)
L: T/A: P: C : 0:0: 4: 2

COURSE OBJECTIVES:

1. To practice skills in a safe environment and conduct an inventory of simulation technologies
2. Design and plan for implementing simulation activities
3. To develop mathematical model equations for the simulation system

COURSE OUTCOMES:

1. Ability to demonstrate the model solving ability for various operations
2. To develop model equations for the system and able to process simulation

Numerically Calculation and MATLAB Simulation: Invariants, Principal stresses and strains with directions, Maximum shear stresses and strains and planes, Von-Mises stress, Calculate and Plot Stresses in Thick-Walled Cylinder

Modelling and Simulation of Control Systems using MATLAB; Vibration Characteristics of a Spring Mass Damper System- Analytical Solutions, MATLAB Simulation, Correlation Studies. Torsion of Prismatic bar with Rectangular cross-section-Elastic solutions, MATLAB Simulation.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE621
TITLE OF THE COURSE : RESEARCH METHODOLOGY
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. To understand the different aspects of social and managerial research.

2. To understand the approach and methods of managerial research.

3. To develop a thorough understanding of the fundamental theoretical ideas and research.

COURSE OUTCOMES:

1. Understand basic concepts of survey, research techniques and data process methodologies
2. Organize and conduct a scientific research in a more appropriate manner with report writing and show research work in much of field work.

Meaning of research - nature and scope of research, the research process and types of research, Definition of research problem-methods of problem formulation. Role of literature review in formulation of research problem, Research design, Uses and applications, Types of research designs, Exploratory, descriptive, experimental research designs.

Survey and sample study- sampling theories- random sampling and non-random sampling, Different methods of random and non-random sampling-sample size decisions, factors influencing sample size decision, Optimum sample size, Pilot survey.

Methods and techniques of data collection, Observation and survey methods, Tools of data collection, Questionnaire and interview schedule, Questionnaire preparation, attitude measurement, Scaling techniques, Different types of scales, Validity and reliability of scale, Scale values.

Field work and data processing, Classification and tabulation, Data summarization, analysis and interpretation of data, Univariate analysis, bivariate analysis, correlation and regression analysis, testing of hypothesis, Parametric and non parametric tests, multivariate analysis, Factor analysis, discriminate analysis, conjoint analysis, cluster Analysis.

Report writing, Types of reports, Substance of report, format of reports, Executive summary, Content of the report, Bibliography, References, Presentation of reports.

TEXT BOOKS:

1. Poulin V Young, Scientific social Surveys and Research, Prentice Hall of India, New Delhi, 1984.
2. Kothari C.R, Research Methodology- Methods and Techniques, Vishwa Prakashan, New Delhi, 2001.

REFERENCE BOOK:

1. Gibaldi, Joseph, MLA Handbook for Writers of Research Papers, Affiliated East West Press Pvt. Ltd., New Delhi 2000.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE622
TITLE OF THE COURSE : EMBEDDED SYSTEMS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Students will be learning on the design issues of embedded systems
2. Fluent application of engineering techniques and tools for embedded systems
3. Have knowledge about the development of embedded software Outcomes
4. Understanding the statistics, mathematics, computer numerical analysis and information sciences

COURSE OUTCOMES:

1. Understanding the general process of embedded system design and microcontrollers
2. Design and evaluate embedded solutions to real world situations using digital components and systems

Introduction to Microprocessors- Introduction to Microprocessors, recent processors, comparison of microprocessors and microcontrollers, use of microprocessors and microcontrollers in automation. Architecture of 8086 processor: functional block diagram, General purpose registers, segment registers, pointers and index registers, flag register. Bus interface unit, Execution unit, Memory segmentation. Minimum and Maximum mode configuration.

Instruction Set and Assembler Directives of 8086 Processor- Addressing modes for accessing immediate and register data, addressing modes for accessing data in memory, addressing modes for accessing I/O ports, relative addressing mode, implied addressing mode. Data Transfer Instructions, Arithmetic Instructions.

Bit manipulation Instructions (Logical Instructions), shift instructions, Rotate Instructions, Program Execution Transfer instructions, iteration control instructions, processor control instructions, Interrupt Instructions, String Instructions.

Interrupt Systems, Memory and I/O Interfacing In 8086 Microprocessor: Introduction to Interrupts, Interrupt related Instructions, Interrupt Processing, Memory Devices, Address Decoding, 8/16-Bit Memory Interfacing, DRAM Memory Systems. Introduction to I/O Interfacing. Memory Mapped and I/O Mapped I/O Application examples related to Stepper Motor, Temperature Control and Robot Control.

Introduction to Micro Controllers- Introduction, Comparing Microprocessors and Micro Controllers, Z-80, 8051, PIC Micro Controllers, PIC Development Tools. The Micro Controller Survey, 4Bit, 8Bit, 16Bit And 32 Bit Micro Controllers. Develop Systems for Micro Controllers.Micro Controllers Architecture: 8051 Architecture, PIC Architecture, 8051 Micro Controller Hardware, Input/Output Pins, Ports and Circuits, External Memory, Counter And Timers, Serial Data Input/Output, Interrupts.

TEXT BOOKS:

1. Douglas V.Hall, Microprocessors and Interfacing, Tata McGraw Hill publications, 2nd edition, 2006.
2. John B Peatman, Design with PIC and Micro controllers**,** Pearson Education, 2003.

REFERENCE BOOKS:

1. Udaya Kumar, K. & Umashankar. B.S., Advanced Microprocessors and IBM PC.TMH, 2003.
2. Kenneth J. Ayala, The 8051 Micro Controller Architecture, Programming, and applications, Penram International, 1996.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE623
TITLE OF THE COURSE : SENSORS AND SIGNAL CONDITIONING
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. To instil knowledge of advanced sensor systems.

2. To provide an application oriented approach in instrumentation.

COURSE OUTCOMES:

1. Identify the most suitable method of sensing and transduction for an application.
2. Design instrumentation and associated data acquisition system.

Basic Concepts of Measurements and characteristics of an Instrumentation System-System configuration, Problem analysis, Basic characteristics of measuring, Calibration, Generalized measurements, Zero order, First order, second order system, Dead time element.

Sensors and Transducers –Electromechanical sensors, Resistance type, Potentiometer, Strain gauge, Resistance thermometer, RTD, Inductance type, Capacitance type, Piezo Electric type.

Magnetic sensors – NMR, MRI, Fiber optic sensors, Opto electronic sensors, CCD, Digital transducers.

Analog and Digital Instrumentation - Operational Amplifiers, Signal generation, Signal processing, Filtering and signal analysis.

Data Acquisition, Conversion, Transmission and Processing- Signal Conditioning of the inputs – Single channel and Multichannel data acquisition, Data conversion, Multiplexers, Sample and hold circuits, Data transmission systems, Pulse code formats, Modulation techniques, Telemetry system.

TEXT BOOKS:

1. Nubert, H.K.P., Instruments Transducers, Clarendon Press, Oxford, 1963
2. Ernest O. Doebelin, Measurement System Application & Design McGraw Hill, New York, 1983.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE624
TITLE OF THE COURSE : MICRO ELECTRICAL MECHANICAL SYSTEMS (MEMS)
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1.To learn dynamics and modelling of micro-systems
2.Understanding design and analysis of micro and Nano system applications
3.Develop experience on microsystems for sensors and actuators applications
4.To learn and characterize technology for MEMS

COURSE OUTCOMES:

1.Gain knowledge and have knowledge on state-of-the-art MEMS techniques for Microsystems
2.Have an ability to identify, formulate and solve problems in the field of micro electrical systems.

Introduction - Micro Electro-Mechanical Systems, Ultra Precision Engineering, Micro-sensors; Micro-actuators; Microelectronics Fabrication; Micromachining; Mechanical MEMS; Thermal MEMS : MOEMS; Magnetic MEMS; RF MEMS; Micro-fluidic Systems; Bio and Chemo – Devices; MEMS Packages and Design Considerations; Micro-Instrumentation.

Mechanical Sensors and Actuators- Principles of Sensing and Actuation; Beam and Cantilever; Micro plates; Capacitive Effects; Piezoelectric material as Sensing and Actuating Elements; Strain Measurement; Pressure measurement; Flow Measurement using Integrated Paddle – Cantilever Structure; Pressure Measurement by Microphone; Shear mode Piezo actuator; Gripping Piezo actuator; Inchworm Technology.

Thermal and Fluidic Micro Sensors and Actuators - Thermal sensors, Electrical Sensors, Chemical and Biosensors Electromagnetic and Thermal micro actuation, Mechanical design of micro actuators, examples, Micro Fluidic systems, Fluid actuation methods, micro valves, micro pumps, micro motors-Micro actuator systems : Ink-Jet printer heads, Micro-mirror TV Projector.

MEMS- Design and Analysis- Basic concepts of design of MEMS devices and processes, Design for fabrication, Other design considerations, Analysis of MEMS devices, FEM and Multiphysics analysis, Modelling and simulation.

MEMS- Characterization- Technologies for MEMS characterization, Scanning Probe Microscopy (SPM): Atomic Force Microscopy (AFM), Scanning tunnelling microscopy (STM), Magnetic Force Microscopy, Scanning Electron Microscope, Laser Doppler vibrometer, Electronic Speckle Interference Pattern technology (ESPI).

TEXT BOOKS:

1. Rai-Choudhury P. MEMS and MOEMS Technology and Applications, PHI Learning Private Limited, 2009.
2. Stephen D. Senturia, Microsystem Design, Springer, 2001
3. Marc Madou, Fundamentals of Microfabrication, Taylor & Francis Group, 2002
4. Gregory Kovacs, Micromachined Transducers Sourcebook, McGraw Hill, 1998

REFERENCE BOOKS:

1. Bao, M.H., Micromechanical Transducers- Pressure sensors, accelerometers, and gyroscopes, Handbook, Elsevier, 2000.
2. Nadim Maluf, An Introduction to Micro electromechanical Systems Engineering, Artech House Publishers, 2000.
3. Stephen D. Senturia, Microsystems Design, Kluwer Academic Publishers, New York, November 2000

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE625
TITLE OF THE COURSE : Tribology
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Understand the steps involved in fundamentals of tribology
2. Able to know how to use the technology to gather and analyze data for bearings applications
3. Identify different types of bearings and lubrication and examine the applications and troubleshoot problems
4. Provide a broad based and discipline mechanism learning concept for tribology.

COURSE OUTCOMES:

1. Learning basic and fundamental skills for tribological analyses
2. Appreciation the importance of tribology and extending product life of bearings.
3. Methodologies of design and troubleshooting tribological and EHL systems

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

Hydrostatic Bearings- Hydrostatic thrust bearings, hydrostatic circular pad, annular pad, rectangular pad bearings, types of flow restricters, expression for discharge, load carrying capacity and condition for minimum power loss, numerical problems, and hydrostatic journal bearings.

Journal Bearings- Introduction to idealized full journal bearings. Load carrying capacity of idealized full journal bearings, Sommerfeld number and its significance, short and partial bearings, Comparison between lightly loaded and heavily loaded bearings, effects of end leakage on performance, Numerical problems.

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

Hydrodynamic Lubrications- Pressure development mechanism. Converging and diverging films and pressure induced flow. Reynolds's 2D equation with assumptions. Introduction to idealized slide bearing with fixed shoe and Pivoted shoes. Expression for load carrying capacity. Location of center of pressure, effect of end leakage on performance, Numerical problems, EHL Contacts**-** Introduction to Elasto - hydrodynamic lubricated bearings. Introduction to 'EHL' constant. Grubin type solution.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Dudley D.Fulier., Theory and practice of Lubrication for Engineers, New York Company.1998
2. Moore., Principles and applications of Tribology**,** Pergamon press, 1975.
3. Pinkus 'O' Stemitch., Theory of Hydrodynamic Lubrication.
4. Stachowiak, G. W, Batchelor, A W., Engineering Tribology, Elsevier publication 1993.
5. Butterworth., Hydrostatic and hybrid bearings, 1983.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE626
TITLE OF THE COURSE : AUTOMOTIVE ELECTRONICS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. To have a overview of vehicle electronic and electrical systems
2. To become familiar with automotive design and development and how the vehicle electronics fits in the system.
3. Understanding the challenges in the automotive environment
4. Learning the Fundamentals of Signal, control and instrumentation devices.

COURSE OUTCOMES:

1. Understanding the electronic system, testing and trouble shooting
2. Knowledge in problem solving and decision making in automotive electronics
3. Solving electronic engineering tasks and challenges related to automotive systems using modern technique in electronics engineering.

Sensors & Actuators- Introduction, Basic sensor arrangement, Types of sensors, oxygen sensors, Crank angle position sensors, fuel metering/vehicle speed sensors and detonation sensors, altitude sensors, flow sensors, throttle position sensors, solenoids, stepper motors, relays.

Electronic Fuel Injection & Ignition System- Introduction, feedback carburettor system, throttle body injection and multi point fuel injection system, injection system controls, advantage of electronic ignition systems, types of solid state system and their principle of operation, electronic spark timing. Digital Engine Control System- engine cooling and warm-up control, acceleration, deceleration and idle speed control, integrated engine control system, on-board diagnostics, future automotive electronic systems.

Automotive Electrical- Batteries, starter motor & drive mechanism, D.C. generator and alternator; regulation for charging, lighting design, dash board instruments, horn, warning system and safety devices.

Comfort & Safety- Seats, mirrors and sun roofs, central locking and electronic Windows, cruise control, in -car multimedia, security, airbag and belt tensioners, other safety and comfort systems, new developments.

The system approach to control & instrumentation- Fundamentals, Electronic components and circuits, digital electronics, microcomputer instrumentation and control, sensors and actuators, digital engine control systems, vehicle motion control, automotive instrumentation. Electromagnetic Interference Suppression- Electromagnetic compatibility - Electronic dash board instruments - Onboard diagnosis system. Security and warning system.

TEXT BOOKS:

1. Ronald K. Jurgen, Automotive Electronics Handbook, McGraw Hill Publishing Co., 1999.
2. Al Santini, Automotive Electricity and Electronics, Delmar Publishers, NewYork, 2013.
3. Young, Griffins, Automobile Electrical & Electronic Equipments, Butterworth Publication, London, 1980.

REFERENCE BOOKS:

1. Bechfold, Understanding Automotive Electronics, SAE 1998
2. William B. Ribbens, Understanding Automotive Electronics, Allied Publishers Pvt. Ltd., Chennai, 2006.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE627
TITLE OF THE COURSE : JIGS AND FIXTURES DESIGN
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Understanding the difference between jigs & fixtures design
2. To understand the construction design of various types of jigs and fixtures
3. To prepare and design of mounting of fixtures on the machine tool and learn more about indexing.
4. Learning the sequence of operations involved in jigs and fixtures.

COURSE OUTCOMES:

1. More idea on machined components for dimensional stability & functionality
2. Design and develop productive and cost effective jigs and fixtures for machines

Introduction- Definition of Jigs and Fixtures, Difference between jigs and fixtures, Advantages, Steps for design. Location Degree of freedom, 3-2-1 principles, Choice of location, redundant location, Diamond pin calculation, Locating methods, Surface location, Rest blocks, pins, V-blocks, Equalizers, Profile locators.

Clamping- Basic principles, cutting forces, Rigid clamping, wedge clamping, Cam clamping, quick action clamps, Toggle clamps, simultaneously acting clamps, Guiding Elements**-** Jig bushes, Standards, Setting gauges.

Indexing Jigs and Fixtures- Indexing methods, Linear, Rotary, Indexing jigs, Indexing fixtures. Assembly and Welding Fixture – Principles

Design of Jigs and Fixture Bodies other Elements types of Jigs and Fixtures- Plate jigs, Box jigs, Indexing jigs, Milling fixtures, and Indexing-milling fixtures, turning fixtures, Grinding fixtures, Universal jigs and fixtures, welding fixtures, Broaching fixtures, and Assembly Fixtures.

Preparation and Presentation of typical designs- Drill Jig, Drilling and Reaming Jigs, Milling Fixtures, Turning Fixtures, Indexing Jigs, Indexing Milling, Fixtures

TEXT BOOKS:

1. Joshi, P .H. Jigs & Fixtures, Tata McGraw Hill Pub. Co. Ltd., 11th print, New Delhi, 1999.
2. Boyes E. William- Michigan, Jigs & Fixtures & Gauges, SME 1st Ed. 1986.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE628
TITLE OF THE COURSE : OPTIMIZATION TECHNIQUES
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Concentrating on solving complex optimization problems that arise in engineering applications.
2. Applying the mathematical results, search methods and numerical techniques for optimization.
3. Apply optimization knowledge for minimal cost

COURSE OUTCOMES:

1. To know the search theory problems and concentrating the results that are useful in algorithm and computation
2. Using numerical optimization techniques, algorithms and computer tools to solve the problem

Engineering application of optimization, Statement of optimization problem, Classification of optimization problems, single variable optimization, Multivariable optimization with no constraints. Multivariable optimization with equality constraints and inequality constraints, Kuhn - Tucker conditions.

One - dimensional minimization methods- Unimodal function, unrestricted search, Exhaustrive search, Dichotomous search, Fibonacci method, Golden section method. Quadratic, Cubic interpolation methods.

Direct search methods- Univariate method, Hook and Jeeves' method, Powell's method, Simplex method. Descent Methods- Steepest descent, Conjugate gradient, Quasi - Newton, Davidon - Fletcher - Powell method.

Genetic Algorithms - Simulated Annealing - Tabu search methods.

Desirable and undesirable effects – functional requirement – material and geometrical parameters – Design of simple axial, transverse loaded members for minimum cost and minimum weight.

TEXT BOOKS:

1. Rao, S. S., Optimisation - Theory and Application, Wiley Eastern, 1979.
2. Deb, K., Optimization for Engineering Design -Algorithms and Examples, Prentice-Hall India, 1995

REFERENCE BOOKS:

1. Arora, J. S., Introduction to Optimum Design, Mc Graw-Hill, 1989.
2. Reklaitis, G. V., Ravindran, A. and Ragsdell, K. M., Engineering Optimization-Methods and Applications, Wiley, 1983.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE629
TITLE OF THE COURSE : DESIGN OF EXPERIMENTS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Introduction of logic, application, and interpretation of various analysis of variance models
2. With up-to-date knowledge on factorial and Taguchi design tools for simulation, analysis, design and control
3. To learn more about response surface design

COURSE OUTCOMES:

1. Understanding the design approach covered in class and their application to fundamental research
2. Ability to work independently on design of experiments

Design of experiments-Introduction, factor constraints, Interaction terms, Number of runs, enter data, analyze the data, level of factors, Custom designs-Introductions, examples, Screening design creation- Statistical Software introduction, demo using simple case studies.

Response surface design -Introduction, creation, Central Composite Design, Box Behnken design, Contour profile of response surface plot, Design table, analyze the data, using Statistical software simple case study examples- Evolutionary operation, Experiment with random factor-Simple case studies.

Factorial Design-Basic definition, principles and advantages- Creating, Blocking, responses and factors, Simple case studies,2- level fractional factorial design, Mixture design- Introduction, optimal mixture design, Simplex centroid design- examples, 2k Factorial design, linear Regression analysis error prediction, Full factorial design-Simple Case studies.

Taguchi design approach, Orthogonal array, S/N Ratio, Smaller is better, nominal is better and Larger is better, with simple case studies, analyze the data-Factor effect diagram, Levels of parameters, Confirmation test-Augmented design, simple case study problems.

Analysis of Variance-Sum of square - Experimentation with single factor- Determining sample size-Model adequacy checking-Regression approach least square method-Non parametric method- Simple problems.

TEXT BOOKS:

1. Douglas C Montgomery, Design and analysis of experiments, John Wiley& Sons, ltd., 5th edition, 2005.
2. Cox. C.R., The Theory of Design of Experiments, Chapman and Hall, 2000.

REFERENCE BOOKS:

1. JMP. Design of Experiments, SAS Institute Inc., Cary, NC, USA, 2005.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE630
TITLE OF THE COURSE : RELIABILITY AND FAILURE ANALYSIS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. To understand the course and is planned for those interested in reliability and failure analysis of experiments.
2. To allows and increase efficiency of experimentation, and reveal the essential reliability nature of a process.
3. In particular, risk analysis and techniques are learnt more.

COURSE OUTCOMES:

1. The course will examine how to avoid failure design and analyze the data for success.
2. The program will provide more knowledge in terms of fault tree analysis, system reliability and applications.

Reliability Definition- Introduction, Definition of reliability, Failure data, Mean failure rate, mean time to failure((MTTF), Mean time between failures (MTBF), Graphical plots, Four important points, MTTF in terms of failure density, Generalization, Reliability in terms of Hazard rate and failure density, Mean time to failure in integral form. Hazard Models- Constant hazard, Linearly-increasing hazard, The weibull model, On density function and distribution function, Distribution function and reliability analysis, Choice of distribution, Expected value, Standard deviation and variance, Theorems concerning expectation and variance.

System Reliability- Series configuration, Parallel configuration, Mixed configurations, Application to specific hazard models, Anr-out-of-n structure, Methods of solving complex systems, cut and tie set method, Systems not reducible to Mixed configurations, Mean time to failure of systems, Logic diagrams, Markov models, Markov Graphs, Systems Subjected to Probability Laws. Reliability Improvement-Improvement of Components, Redundancy, Element Redundancy, Unit Redundancy, Standby Redundancy, Optimization, Reliability- cost Trade- off.

Fault-Tree Analysis and other Techniques- Fault-Tree Analysis, Fault-Tree Construction, Calculation of Reliability from fault tree, Tie-Set and cut -set, Use of Boolean Algebra, Basic operations, Truth Tables, De Morgan's Theorem, Application to reliability analysis, Probability Calculations.

Maintainabilty and Availabity- Maintainability, Availability (Qualitative Aspects) System Downtime, Availabity, Reliability and Maintainability trade-off, Instantaneous repair rate, Mean time to repair (MTTR), Reliability and Availability functions. Reliability Allocation and Applications- Reliability Allocation for a Series System, Applications, Marine power plant, Computer System, Nuclear Power Plants, General Complex Systems, Failure Modes and Effects Analysis (FMEA).

Risk analysis- Definition and measurement of risk - risk analysis techniques - risk reduction resources - industrial safety and risk assessment.

TEXT BOOKS:

1. Modarres, Reliability and Risk analysis, Mara Dekker Inc., 1993
2. New Juran, J.M and Gryna, F.M, Quality Planning and Analysis - Tata Mc Graw Hill publishing Company Ltd. 1982, Delhi, India.

REFERENCE BOOKS:

1. Halpern, Seigmund, The Assurances Sciences, Prentice Hall International, New Jersey, U.S.A. 1978
2. Blanchard, Bejamin S. Logistics Engineering and Management, Prentice Hall International, New Jersey, U.S.A. 1986.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE631
TITLE OF THE COURSE : ROBUST DESIGN
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Optimize designs with multiple outputs and variability.
2. Learn design costs and develop branching arrays.
3. Modeling output variation and ranking the contribution to the output variation
4. Estimating the process capability for design variability and inputs

COURSE OUTCOMES:

1. Understanding typical quality engineering applications.
2. Plan, design, and conduct experimental investigations effectively for design purpose.
3. Developing tolerance level and sensitivity for design applications.

Elements of cost, Noise factors causes of variation, Quadratic loss function and variation of quadratic loss functions. Steps in robust design - parameter design and tolerance design**,** Experimental Design: Classical experiments- factorial experiments, terminology, factors. Levels, Interactions, Treatment combination, randomization, 2-level experimental design for two factors and three factors. 3-level experiment deigns for two factors and three factors, factor effects, factor interactions, Fractional factorial design, Saturated design, Central composite designs, Illustration through numerical examples**.**

Measures of variability, Concept of confidence level, Statistical distributions - normal, log normal and Weibull distributions. Hipothesis testing, Probability plots, choice of sample size illustration through numerical examples.

Measures of variability, Ranking method, column effect method and ploting method, Analysis of variance (ANOVA), in factorial experiments - YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data, illustration through numerical examples.

Types orthogonal arrays, Selection of standard orthogonal arrays, Linear graphs and interaction assignment, dummy level technique, Compound factor method, modification of linear graphs, Column merging method, Branching design, Strategies for constructing orthogonal arrays. Taguchi's inner and outer arrays,

Evaluation of sensitivity to noise, Signal to noise ratios for static problems, Smaller – the – better types, Nominal – the – better – type, larger – the- better – type. Signal to noise ratios for dynamic problems, Illustrations through numerical examples. Parameter and tolerance design concepts, Parameter design strategy, Tolerance deign strategy, Illustrations through numerical examples**.**

TEXT BOOKS:

1. Douglas Montgomery, Design and analysis of experiments, Willey India Pvt. Ltd., V Ed., 2007.
2. Phillip J. Ross, Techniques for Quality Engineering, 2nd edition. McGraw Hill Int. Ed., 1996.

REFERENCE BOOKS:

1.Thomas B. Barker, Quality by Experimental Design, Marcel Dekker Inc ASQC Quality Press, 1985
2.Jeff Wu, C.F., and Michael Hamada, Experiments planning, analysis and parameter design optimization**,** John Willey Ed., 2002.
3.Condra, W.L. and Marcel Dekker, Reliability improvement by Experiments, Marcel Dekker Inc ASQC Quality Press, 1985

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE632
TITLE OF THE COURSE : FINITE ELEMENT METHODS FOR STRUCTURAL MECHANICS APPLICATIONS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Understand the fundamental ideas of the FEM
2. Prepare a suitable FE model for structural mechanical analysis problems
3. Understanding of the significance, calculation, interpretation and convergence criteria for structural mechanics.

COURSE OUTCOMES:

1. Have acquired knowledge of finite element analysis linear and nonlinear analysis of structural application problems.
2. To evaluate and interpret FEA analysis results for structural design and evaluation purposes.

Beam Elements –Analysis of Beams and Frames, 1-D Beam Element, 2-D Beam Element, 3-D Beam Element, Shear Flexible Beam Elements, Test Problems, practical Applications and computational Problems.

Finite Elements for Plates, Plate Theories – Classical plate theory, shear deformation theory, improved shear deformation theory. Kirchoff Plate Elements, Mindlin Plate Elements, Test Problems, Practical Applications and Computational Problems.

Finite Elements or Shells, Flat Shell Elements: Facet Approximation, Curved Shell Elements Isoparametric Shell Elements: Eight- node quadrilateral shell element. Axisymmetric Shell Elements, Practical Applications in Stress analysis of industrial fan impeller, Vibration analysis of a cylinder cantilever shell, Buckling analysis of a blade stiffened panel, Nonlinear behavior of a curved panel , Computational Problems.

Finite Element Analysis Programs- FEA Program, Organization, Capabilities-Material Models Element library, procedures library, Data processing. FEA Program- A Catalogue, MSc.Nastran, NISA, MARC.LS-DYNA, ANSYS.

Advanced Applications, Nonlinear Finite Element Analysis, Analysis of laminated Composite Structures. Computational Fracture Mechanics, Structural Optimization, Computational Heat Transfer, Computational Fluid Dynamics, Electromagnetic and Coupled- Field analyses, Simulation of Manufacturing Processes.

TEXT BOOK:

1. Lakshminarayana, H. V. Finite Element Analysis Procedures in Engineering, Universities Press private Limited, Hyderabad, 2012.

REFERENCE BOOK:

1. Tirupathi R. Chandrupatla, Ashok D. Belegundu, Introduction to Finite Elements in Engineering, PHI Learning, 2008.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE633
TITLE OF THE COURSE : DESIGN OF MATERIALS HANDLING SYSTEMS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. To expose the students with latest material handling system used in industry.
2. To reduce manufacturing cycle time, delays, damage and improve working conditions of the systems
3. Developing tools for robot handling systems.

COURSE OUTCOMES:

At the end of this course the student should be able to understand the:

1. Basics of material handling system.
2. Various material handling equipment used in industry.
3. AGV's AS/RS system, conveyor systems.
4. Application of Robotics in material handling

Material Handling – Functions, Types, analysis, Importance & Scope, Principles, - Part feeding device – types of material handling system – Unit material movement & Unit loads – Receiving, Shipping, in process handling – bulk handling equipment & methods.

Industrial trucks, lifting device, monorails, manipulators, conveyors, storage systems, elevators, racks, bins, pallets, cranes –Automation of material handling – mechanization of part handling.

Types of AGV's – Guidance techniques – Painted line, wire guided, vision guided method – Applications – Vehicle guidance & routing – Traffic control & safety – system management – Quantitative analysis of AGV system.

Conveyor systems – types, Quantitative relationship & analysis – Automated storage system, performance – AS/RS system – Basic components, types, controls, features, applications, Quantitative analysis – carousel storage system – applications.

General considerations in robot material handling – material transfer application – pick & place operations – machine loading & unloading – characteristics of robot application – Robot cell design – processing, operations – Spot welding, Spray painting, Plastic moulding, forging.

TEXT BOOKS:

1. Mikell P. Groover, Automated Production system & computer integrated manufacturing –– Prentice Hall of India – 1987.
2. Govindan .K.R, Plant Layout & Material Handling – Anuradha agency – 2001.

REFERENCE BOOKS:

1. Allegeri, Theodove . H, Material Handling Principle &Practice - C.B.S. Publisher, 1987.
2. Material Handling Equipment for the Manufacturing Industry - AICTE, 1995.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE634
TITLE OF THE COURSE : THEORY OF PLASTICITY
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. Introduction of plasticity and elasto plastic analysis of systems.
2. System Formulation and solving them

COURSE OUTCOMES:

1. Student shall be able to demonstrate knowledge and understanding on concepts of stress, strain, bending, torsion, vibrations, beams and frames.
2. Knowledge of strain problems in practical applications with steady and non-steady case.
3. Know the difference between plasticity and elasticity.

Stresses and Strains: Introduction, The Stress–Strain Behaviour, Analysis of Stress, Mohr's Representation of Stress, Analysis of Strain Rate, Concepts of Stress Rate

Foundations of Plasticity: The Criterion of Yielding, Strain -Hardening Postulates, The Rule of Plastic Flow, Particular Stress–Strain Relations, The Total Strain Theory, Theorems of Limit Analysis, Uniqueness Theorems, Extremum Principles, Plastic Analysis of Beams and Frames: Introduction, Limit Analysis of Beams, Limit Analysis of Plane Frames, Displacements in Plane Frames, Variable Repeated Loading, Minimum Weight Design, Influence of Axial Forces, Limit Analysis of Space Frames.

Elastoplastic Bending and Torsion: Plane Strain Compression and Bending, Cylindrical Bars Under Torsion and Tension, Thin-Walled Tubes Under Combined Loading, Pure Bending of Prismatic Beams Under Transverse Loads, Torsion of Prismatic Bars, Torsion of Bars of Variable Diameter, Combined Bending and Twisting of Bars. Advanced Elastoplastic Problems: Expansion of a Thick Spherical Shell, Expansion of a Thick Walled Tube, Thermal Stresses in a Thick-Walled Tube, Thermal Stresses in a Thick Spherical Shell, Pure Bending of a Curved Bar, Rotating Discs and Cylinders, Infinite Plate with a Circular Hole, Yielding Around a Cylindrical Cavity.

Steady Problems in Plane Strain: Symmetrical Extrusion Through Square Dies, Unsymmetrical and Multihole Extrusion, Sheet Drawing Through Tapered Dies, Extrusion Through Tapered Dies, Extrusion Through Curved Dies, Ideal Die Profiles in Drawing and Extrusion, Limit Analysis of Plane Strain Extrusion, Cold Rolling of Strips, Analysis of Hot Rolling, Mechanics of Machining.

Non steady Problems in Plane Strain: Indentation by a Flat Punch, Indentation by a Rigid Wedge, Compression of a Wedge by a Flat Die, Cylindrical Depression in a Large Block, Compression Between Smooth Platens, Compression Between Rough Platens, Yielding of Notched Bars in Tension, Bending of Single-Notched Bars, Bending of Double-Notched Bars, Bending of Beams and Curved Bars, Large Bending of Wide Sheets.

TEXT BOOKS:

1. Chakrabarty, J Theory of Plasticity, 3rd ed., 2006, Elsevier.
2. Jacob Lubliner, Plasticity Theory, Revised Edition, 2008.
3. Owen, D. R. J. and Hinton, E. Finite Elements in Plasticity- Theory & Practice, Pineridge Press.

REFERENCES:

1. Hill R, Mathematical theory of plasticity, Oxford, 1998
2. Han W B. Daya Reddy, Plasticity-Mathematical Theory and Numerical Methods, Springer
3. Maugin, G. A. The Thermo-Mechanics of Plasticity and Fracture, Cambridge University Press.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE635
TITLE OF THE COURSE : NON LINEAR ANALYSIS
L: T/A: P: C : 3:2: 0: 4

COURSE OBJECTIVES:

1. To introduce linear and nonlinear vibration analysis of systems.
2. Formulation of continuous system problems and solving them.

COURSE OUTCOMES:

1. Student shall be able to demonstrate knowledge and understanding on concepts of degrees of freedom, vibration control, linear and non-linear vibrations.
2. Application of non-linear analysis problems in practical applications.

R**eview of one degree of freedom free and forced vibrations**, Transient Vibration of single Degree-of freedom systems- Impulse excitation, Arbitrary excitation, Laplace transform formulation, Pulse excitation and rise time, Shock response spectrum, Shock isolation,

Vibration Control- Introduction, Vibration isolation theory, Vibration isolation and motion isolation for harmonic excitation, practical aspects of vibration analysis, shock isolation, Dynamic vibration absorbers, and Vibration dampers. Modal analysis & Condition Monitoring, Dynamic Testing of machines and Structures, Experimental Modal analysis, Machine Condition monitoring and diagnosis.

Non Linear Vibrations- Introduction, Sources of nonlinearity, Qualitative analysis of nonlinear systems. Phase plane, Conservative systems, Stability of equilibrium, Method of isoclines, Perturbation method, Method of iteration, Self-excited oscillations.

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

Continuous Systems- Vibrating string, longitudinal vibration of rods, Torsional vibration of rods, Euler equation for beams.

TEXT BOOKS:

1. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, Theory of Vibration with Application, 5th Edition Pearson Education, 2008.
2. Rao, S. S., Mechanical Vibrations, 4th Edition, Pearson Education, 2004.

REFERENCE BOOKS:

1. Graham Kelly, S., Mechanical Vibrations, Schaum's Outlines, Tata McGraw Hill, 2007.
2. Sujatha, C, Vibraitons and Acoustics - Measurements and signal analysis, Tata McGraw Hill, 2009.

SEMESTER/YEAR : III & IV SEM
COURSE CODE : 16MDE681
TITLE OF THE COURSE : DISSERTATION
L: T/A: P: C : 0:0: 0: 3

COURSE OBJECTIVES:

1. To develop the work practice in students to apply theoretical and practical tools/techniques
2. To improve the professional competency
3. To improve research aptitude by touching the areas which otherwise not covered by theory or laboratory classes.
4. To solve real life problems related to industry and current research.

COURSE OUTCOMES:

1. Solving of real time problems not necessarily new line of enquiry, but shows that student has mastered research and synthesizing skills in producing a contribution to knowledge.
2. Builds competency and research aptitude.

The thesis shall consist of research work done by the candidate or a comprehensive and critical review of any recent development in the subject of specialization or a detailed report of project work consisting of experimentation/numerical work, design and or development work that the candidate has executed.

COURSE CODE : 16MDE682
TITLE OF THE COURSE : DISSERTATION
L: T/A: P: C : 0:0: 0: 6

COURSE OBJECTIVES:

1. The dissertation demonstrates the student's mastery of relevant resources and methods.
2. An ordered, critical exposition of knowledge gained through student's own effort.
3. Demonstrates sound under-standing of research process.
4. Demonstrates knowledge of appropriate methodology.
5. Demonstrates ability to present study in a disciplined way in scholarly conventions of the discipline.
6. Ability to make critical use of published work.

COURSE OUTCOMES:

1. Improves the professional competency and research
2. Develops the work to apply theoretical and practical tools/techniques
3. Solve problems related to industry and current research.
4. Possible publication in journal or conferences.

THE REPORT GENERALLY CONTAINS:

1. Cover
2. Title page
3. Certificate(s)
4. Acknowledgements
5. Abstract
6. Contents page
7. List of figures or Tables
8. Introduction
9. Literature survey
10. Methodology
11. Results and Discussion
12. Conclusion and scope of future work.
13. Reference list / Bibliography
14. Appendices.

AVOIDING PLAGIARISM

1. Plagiarism is taking the words, theories, or ideas of another person and passing them off as your own.
2. Plagiarism can be copying inadvertently/advertently a passage from a book or journal or pasting something from the internet into report without referencing the original source.
3. Plagiarism can also result from wrong referencing**.**
4. The guide/supervisor shall certify that the report is checked for plagiarism and is within 25% of the content.

The thesis shall consist of research work done by the candidate or a comprehensive and critical review of any recent development in the subject of specialization or a detailed report of project work consisting of experimentation/numerical work, design and or development work that the candidate has executed. It is expected that students should refer national and international journals, proceedings of national and international seminars. Emphasis should be given to the introduction to the topic, literature review,

and scope of the proposed work along with some preliminary work/experimentation carried out on the thesis topic. Student should submit the thesis covering the content discussed above and highlighting the features of work to be carried out in the thesis. Student should follow standard practice of thesis writing. At the end of successfully finishing the work he/she has to submit a detailed report and has to present for a viva–voce.