JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

(Established by an Act No.30 of 2008 of A.P. State Legislature)

Kukatpally, Hyderabad – 500 085, Andhra Pradesh (India)

M.TECH. (MACHINE DESIGN)
COURSE STRUCTURE AND SYLLABUS

I Year I Semester

Code	Group	Subject	L	P	Credits
		Advanced Mechanical Engineering Design	3	0	3
		Advanced Mechanics of Solids	3	0	3
		Fatigue, Creep & Fracture Mechanics	3	0	3
		Computational Methods in Engineering	3	0	3
	Elective -I	Advanced Finite Element Analysis Applied Triobology Gear Engineering Theory of Elasticity & Plasticity	3	0	3
	Elective -II	Advanced Mechanics of Composite Materials Data Base Management System Advanced Computer Aided Design Concurrent Engineering	3	0	3
	Lab	Kinematics and Dynamics Lab	0	3	2
		Seminar	-	-	2
		Total Credits	18	3	22

I Year II Semester

Code	Group	Subject	L	P	Credits
		Advanced Mechanics of Machinery	3	0	3
		Mechanical Vibrations	3	0	3
		Advanced Optimization Techniques and Applications	3	0	3
		Experimental Stress Analysis	3	0	3
	Elective -III	Pressure Vessel Design Design Synthesis Non Linear Vibrations Industrial Robotics	3	0	3
	Elective -IV	Signal Analysis and Condition Monitoring Mechatronics Computational Fluid Dynamics Theory of Plates and Shells	3	0	3
	Lab	Computer Aided testing, Analysis and modeling Lab	0	3	2
		Seminar	-	-	2
		Total Credits	18	3	22

II Year - I Semester

Code	Group	Subject	L	P	Credits
		Comprehensive Viva	-	-	2
		Project Seminar	0	3	2
		Project work	-	-	18
		Total Credits	-	3	22

II Year - II Semester

Code	Group	Subject	L	P	Credits
		Project work and Seminar	-	-	22
		Total Credits	-	-	22

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M.Tech I Year – I Sem.(Machine Design)

ADVANCED MECHANICAL ENGINEERING DESIGN

UNIT I

DESIGN PHILOSOPHY: Design process, Problem formation, Introduction to product design, Various design models-Shigley model, Asimov model and Norton model, Need analysis, Strength considerations -standardization. Creativity, Creative techniques, Material selections, Notches and stress concentration, design for safety and Reliability

UNIT II

PRODUCT DESIGN: Product strategies, value, planning and specification, concept generation, concept selection, concept testing.

Design for manufacturing: Forging design, Casting design, Design process for non metallic parts, Plastics, Rubber, Ceramic, Wood and Glass parts like. Material selection in machine design

UNIT III

FAILURE THEORIES: Static failure theories, Distortion energy theory, Maximum shear stress theory, Coulomb-Mohr's theory, Modified Mohr's theory, Fracture mechanics theory., Fatigue mechanisms, Fatigue failure models, Design for fatigue strength and life, creep: Types of stress variation, design for fluctuating stresses, design for limited cycles, multiple stress cycles, Fatigue failure theories ,cumulative fatigue damage, thermal fatigue and shock, harmful and beneficial residual stresses, Yielding and transformation

UNIT IV

SURFACE FAILURES: Surface geometry, mating surfaces, oil film and their effects, design values and procedures, adhesive wear, abrasive wear, corrosion wear, surface fatigue, different contacts, dynamic contact stresses, surface fatigue failures, surface fatigue strength,

UNIT V

ECONOMIC FACTORS INFLUENCING DESIGN: Economic analysis, Break-even analysis, Human engineering considerations, Ergonomics, Design of controls, Design of displays. Value engineering, Material and process selection in value engineering, Modern approaches in design.

REFERENCES:

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

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ADVANCED MECHANICS OF SOLIDS

UNIT - I

SHEAR CENTRE: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections.

Unsymmetrical bending: Bending stresses in Beams subjected to Nonsymmetrical bending; Deflection of straight beams due to nonsymmetrical bending.

UNIT - II

CURVED BEAM THEORY: Winkler Bach formula for circumferential stress – Limitations – Correction factors – Radial stress in curved beams – closed ring subjected to concentrated and uniform lads- stresses in chain links.

UNIT - III

TORSION: Torsion of a cylindrical bar of Circular cross Section; Saint-Venant's semi-inverse methods; Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section; Hallow thin wall torsion members, Multiply connected Cross section, Thin wall torsion members with restrained ends

Axi-Symmetric Problems: Rotating Discs – Flat discs, Discs of uniform thickness, Discs of Uniform Strength, Rotating Cylinders.

UNIT - IV

THEORY OF PLATES: Introduction; Stress resultants in a flat plate; Kinematics: Strain-Displacement relations for plates; Equilibrium equations for small displacement theory of flat plates; Stress – Strain – Temperature relation for Isotropic plates: Strain energy of a plate; Boundary conditions for plate; Solution of rectangular plate problem; Solution of circular plate problem.

Beams on Elastic Foundation: General theory; Infinite Beam subjected to Concentrated load; boundary conditions; Infinite beam subjected to a distributed lad segment; Semi-infinite beam with concentrated load near its end; Short Beams.

UNIT - V

CONTACT STRESSES: Introduction, problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Methods of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact. Normal and Tangent to contact area.

REFERENCES:

1. Advanced Mechanics of materials/Seely and Smith/ John Willey
2. Advanced Mechanics of materials / Boresi & Sidebottom/wiely international
3. Advanced strength of materials / Den Hortog J.P./Torrent
4. Theory of Plates /Timoshenko/
5. Strength of materials / Sadhu singh/ Khanna Publishers
6. Mechanics of Materials / Beer & Jhonson / McGraw Hill
7. Theory of Plates & Shells / Timoshenko/ McGraw Hill/ 2nd Edition

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FATIGUE, CREEP AND FRACUTRE MECHANICS

UNIT-I:

INTRODUCTION: Fracture behaviour of metals and alloys. The ductile/brittle transition temperatures for notched and un-notched components, Ductile rupture as a failure mechanism Fracture at elevated temperature.

Definitions of types of fracture and failure, Introduction to stress intensity factor and strain energy release rate, Equivalence of energy approach and stress intensity approach.

Basic stress analysis and mechanical properties: Elasticity, General 3-D relations, Plane stress and plane strain, Mohr's circle-principal stresses, Yield in materials, Tresca and Von Mises criteria, Ideal and actual strength of materials. Typical stress/strain curves for different classes of materials.

UNIT-II:

STRESS INTENSITY FACTOR AND ITS USE IN FRACTURE MECHANICS: Early concepts of stress concentrators and flaws, Ingles solution to stress round an elliptical hole-implications of results. Stress intensity factor for a crack. Westergaard's solution for crack tip stresses. Stresses and displacement in Cartesian and polar coordinates, Linear Elastic Fracture Mechanics. Typical values of fracture toughness, Different modes of crack opening. Superposition of crack tip stress fields, Direction of crack growth under mixed mode loadings.

Crack tip plasticity, Early estimates of plastics zone, Irwin plastic zone correction and Dugdale approach, Plastic zone shape in three dimensions and shape under plane stress and plane strain conditions, Allowable plasticity for LEFM to apply, the thickness criterion Experimental methods for measuring Kic.

UNIT-III:

ELASTIC/PLASTIC FRACTURE MECHANICS: Elastic/plastic fracture mechanics: The crack opening displacement and J-integral approaches, R-curve analysis Testing procedures, Measurement of these parameters, RAD, Fail sage and safe life design approaches, Practical applications. Advanced topics in EOFM.

UNIT-IV:

FATIGUE: Importance of fatigue in engineering, Low cycle fatigue, Coffin-Manson law, Cyclic work hardening and softening. Micro structural models of crack initiation. Stage I, II and III crack growth.

Analysis of Fatigue: The empirical laws of fatigue failure. High cycle-low strain fatigue, Basquin's law, Goodman, Soderberg and Gerber mean stress corrections, Miner's law of damage summation. Low cycle fatigue, Crack growth and application of fracture mechanics to fatigue, Paris-Ergodan law, Threshold stress intensity range. Crack closure and its theories Cycle counting methods, Developments in using rain-flow counting methods to recreate fatigue standard spectra. Standard spectra suitable for different applications.

UNIT-V:

FATIGUE OF WELDED STRUCTURES: Factors affecting the fatigue lives of welded joints, the codes and standards available to the designer, the use of fracture mechanics to supplement design rules. Practical examples.

Creep: Phenomenology, Creep curves, Creep properties, Multi-axial creep, Creep-fatigue interaction, Creep integrals.

REFERENCES:

1. Mechanical Metallurgy / Dieter / McGraw Hill
2. Fracture Mechanics: Fundamental and Applications /Anderson T.L & Boca Raton/ CRC Press, Florida, 1998.
3. Deformation and Fracture mechanics of Engineering Materials / Richard W Hertz /Wiley
4. Plasticity for structural Engineers / W.F. Chen and D.J,. Ha,
5. Engineering Fracture Mechanics/ D.R.J. Owen and A.J. Fawkes /Pincridge press, Swansea, U.K.

6. Fracture and fatigue control in structures/ S.T. Rolfe and J.M. Barsom/ Printice Hall, Eglewood cliffs, N.J..
7. Fracture of brittle solids/ B.R. Lawn and T.R. Wilshaw/ Cambridge university press.
8. Plastic deformation of Metals/ R.W.K. Honeycombe/ 2nd edition, Edward Arnold

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COMPUTATIONAL METHODS IN ENGINEERING

UNIT-I:

INTRODUCTION TO NUMERICAL METHODS APPLIED TO ENGINEERING PROBLEMS: Examples, solving sets of equation – Matrix notation – Determination and inversion – Iterative methods – Relaxation methods – System of non-linear equations – computer programs.

Numerical integration: Newton-Cotes integration formulas – Simpson's rules, Gaussian quadrature. Adaptive integration.

UNIT-II:

OPTIMIZATION: One dimensional unconstrained optimization, multidimensional unconstrained optimization – direct methods and gradient search methods, constrained optimization.

Boundary value problems and characteristic value problems: Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayieigh - Ritz method – Characteristic value problems,

UNIT-III:

NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS: Laplace's equations – Representation as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples – Derivative boundary conditions – Irregular and non-rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method.

Parabolic partial differential equations: Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria – Finite element for heat flow – computer programs.

UNIT-IV:

HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS: Solving wave equation by finite differences-stability of numerical method – method of characteristics wave equation in two space dimension-computer programs.

Curve fitting and approximation of functions: Least square approximation fitting of non-linear curves by least squares – regression analysis – multiple linear regression, non linear regression – computer programs.

REFERENCES:

1. Numerical Methods for Engineers/ Steven C.Chapra, Raymond P.Canale/ Tata Ma-Graw Hill
2. Applied numerical analysis / Curtis F.Gerald, partick.O.Wheatly /Addison-wesley,1989
3. Numerical methods / Douglas J.Faires, Riched Burden / Brooks-cole publishing company, 1998 Second edition.
4. Numerical mathematics and computing/ Ward cheney & David Kincaid / Brooks-cole publishing company 1999 fourth edition
5. Mathematical methods for physics and engineering / Riley K.F.M.P.Hobson & Bence S.J./ Cambridge university press,1999.

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ADVANCED FINITE ELEMENT ANALYSIS
ELECTIVE – I

UNIT-I:
Introduction to FEM, basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, variational approach, Glerkin's Methods. Co-ordinates, basic element shapes, interpolation function, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain- displacement relations.

UNIT-II:
1-D STRUCTURAL PROBLEMS: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems.
ANALYSIS OF TRUSSES : Plane Trusses and Space Truss elements and problems
ANALYSIS OF BEAMS : Hermite shape functions – stiffness matrix – Load vector – Problems.

UNIT-III:
2-D PROBLEMS: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Isoparametric elements – quadrilateral element, shape functions – Numerical Integration.
Finite element modelling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements.
3-D PROBLEMS: Tetrahedran element – Jacobian matrix – Stiffness matrix.

UNIT-VI:
SCALAR FIELD PROBLEMS: 1-D Heat conduction-Slabs – fins - 2-D heat conduction problems – Introduction to Torsional problems.

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

REFERENCES:

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

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APPLIED TRIBOLOGY
ELECTIVE – I

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

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

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

UNIT - IV
Surface Topography - Surface characterization - Apparent and real area of contact - Derivation of average Reynolds equation for partially lubricated surface - Effect of surface roughness on journal bearings

UNIT - V
Laws of friction - Friction theories - Surface contaminants - Frictional heating - Effect of sliding speed on friction - Classification of wear - Mechanisms of wear - Quantitative laws of wear - Wear resistance materials.

REFERENCES:

1. Introduction to Tribology of Bearings / Majumdar, B.C.
2. Friction. Wear, Lubrication : A Text book in Tribology / Kenneth C Ludema / CRC Press / 1st Edition
3. Engineering Tribology / John Williams / Cambridge University Press / 2005
4. Introduction to Tribology / Bharat Bhushan / Wiley / 2nd Edition
5. Engineering Tribology / Prasanta Sahoo / PHI Learning
6. Engineering Tribology / Stachowiak & Batchelor / Butterworth – Heinimann / 2005

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GEAR ENGINEERING

(PSG Design data Book is allowed)

ELECTIVE – I

UNIT – I

Introduction, Principles of gear tooth action, Generation of Cycloid and Involute gears, Involutometry, gear manufacturing process and Inspection, gear tooth failure modes, stresses, selection of right king of gears.

Spur Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of spur gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load. Design of gear shaft and bearings.

UNIT – II

HELICAL GEARS: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of helical gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load. Design of gear shaft and bearings.

GEAR FAILURES: Analysis of gear tooth failures, Nomenclature of gear tooth wear and failure, tooth breakage, pitting, scoring, wear, overloading, gear-casing problems, lubrication failures.

UNIT – III

WORM GEARS: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of worm gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load. Heat dissipation consideration. Design of gear shaft and bearings.

UNIT – IV

BEVEL GEARS: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of bevel gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load. Design of gear shaft and bearings.

UNIT – V

GEAR TRAINS: Simple, compound and epicyclic gear trains, Ray diagrams, Design of a gear box of an automobile, Design of gear trains from the propeller shafts of airplanes for auxiliary systems.

Optimal Gear design: Optimization of gear design parameters. Weight minimization, Constrains in gear train design-space, interference, strength, dynamic considerations, rigidity etc. Compact design of gear trains, multi objective optimization of gear trains. Application of Traditional and non-traditional optimization techniques.

REFERENCES:

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

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M.Tech I Year – I Sem.(Machine Design)

THEORY OF ELASTICITY AND PLASTICITY
ELECTIVE – I

UNIT - I
ELASTICITY: Two dimensional stress analysis - Plane stress - Plane strain - Equations of compatibility - Stress function - Boundary conditions.
PROBLEM IN RECTANGULAR COORDINATES - Solution by polynomials - Saint Venent's principles - Determination of displacement - Simple beam problems.
PROBLEMS IN POLAR COORDINATES - General equations in polar coordinates - Stress distribution symmetrical about axis - Strain components in polar coordinates - Simple and symmetric problems.

UNIT - II
ANALYSIS OF STRESS AND STRAIN IN THREE DIMENSIONS: Principle stresses - Homogeneous deformations - Strain spherical and deviatoric stress - Hydrostatic strain.
General theorems: Differential equations of equilibrium and compatibility - Displacement - Uniqueness of solution - Reciprocal theorem.

UNIT - III
BENDING OF PRISMATIC BARS: Stress function - Bending of cantilever beam - Beam of rectangular cross-section - Beams of circular cross-section.

UNIT - IV
PLASTICITY: Plastic deformation of metals - Structure of metals - Deformation - Creep stress relaxation of deformation - Strain rate condition of constant maximum shear stress - Condition of constant strain energy - Approximate equation of plasticity.

UNIT - V
METHODS OF SOLVING PRACTICAL PROBLEMS: The characteristic method - Engineering method - Compression of metal under press - Theoretical and experimental data drawing.

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

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ADVANCED MECHANICS OF COMPOSITE MATERIALS
ELECTIVE – II

UNIT – I
BASIC CONCEPTS AND CHARACTERISTICS: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.
Reinforcements: Fibres – Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT – II
MICROMECHANICS: Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.
Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

UNIT – III
COORDINATE TRANSFORMATION: Hooke's law for different types of materials, Hooke's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off – axis, stiffness modulus, off – axis compliance.
Elastic behavior of unidirectional composites: Elastic constants of lamina, relation ship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

UNIT – IV
STRENGTH OF UNIDIRECTIONAL LAMINA: Micro mechanics of failure, Failure mechanisms, strength of an orthotropic lamina, strength of a lamina under tension and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micros mechanical predictions of elastic constants.

UNIT – V
ANALYSIS OF LAMINATED COMPOSITE PLATES:
Introduction thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, problems using thin plate theory.

REFERENCES:

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

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DATA BASE MANAGEMENT SYSTEM
ELECTIVE – II

UNIT-I
Database System Applications, database system VS file system- view of data- data abstraction – instances and schemas – data models – the ER Model – Relational model – other models – Database languages – DDL – DML – database Access for applications programs – database users and administrator – transaction management – database system structure – storage manager – the query processor – history of database systems – database design and ER diagrams – Beyond ER design entities of ER model – concept design with the ER model – conceptual design for large enterprises.

UNIT-II
RELATIONAL MODEL: introduction to the relational model – integrity constraint over relations – enforcing integrity constraints – querying relational data – logical database design – introduction to views – destroying / altering tables and views.
Relational Algebra and Calculus : relational algebra – selection and projection set operations – renaming – joins – division – examples of algebra overviews – relational calculus – tuple relational calculus – domain relational calculus – expressive power of algebra and calculus.

UNIT – III
Form of basic SQL Query – examples of basic SQL Queries – introduction to nested queries – correlated nested queries set – comparison operators – Aggressive operators -Null values – comparison using null values – logical connectivity's – AND, OR and NOTR – impact on SQL constructs – Outer joins – disallowing NULL values – complex integrity constraints in SQL Triggers and Active Database.
Schema refinement – problems caused by redundancy – decompositions – problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF – Lossless join decomposition – Dependency preserving Decomposition – Schema refinement in database design – Multi valued dependencies – forth Normal Form.

UNIT-IV
OVERVIEW OF TRANSACTION MANAGEMENT: ACID properties – Transactions and schedules – concurrent execution of transaction – lock based concurrency control – performance locking – transaction support in SQL – Introduction to crash recovery.
Concurrency Control: serializability and recoverability – introduction to lock management – lock conversions dealing with dead locks – specialized locking techniques concurrency without locking.
Crash recovery : introduction to ARIES – the log – other recovery related structures – the write-Ahead Log Protocol – check pointing – recovering form a system crash – media recovery – other approaches and interaction with concurrency control.

UNIT-V
OVERVIEW OF STORAGE AND INDEXING : data on external storage – File organization and indexing – cluster indexing, primary and secondary indexes – index data structures – hash based indexing tree base indexing –comparison of file organizations – indexes and performance Tuning.
Storage data: Disks and Files: the Memory Hierarchy – redundant Arrays of independent – Disks – disk space management – buffer manager – files of records – page formats – record formats.
Tree structure Indexing : introduction for tree indexes – indexed sequential access methods (ISAM)-B+ Tress: A dynamic Index structure.
Hash based Indexing: Static Hashing – extendable hashing – Linear Hashing – Extandable vs. Linear hashing.

REFERENCES:
1. Database Management Systems/ Raghurama Krishnan, Johannes Gehrke/ TATA McGraw hills 3rd Edition.

2. Database systems Concepts/ Silberschatz, Korth/ McGraw hill, IV Edition
3. Database Management Systems/ P.Radha Krishna/ Hi-TECH Publications 2005
4. Introduction to Database Management Systems / C.J.Date/ Pearson Education
5. Database Systems design, Implemantation and Management/ Rob & Coronel/ 5th Edition, Thomson.
6. Database Management Systems/ Elmasri Navrate/ Pearson Education.
7. Database Management Systems /Mathew Leon, Leon Vikas/
8. Database Systems / Connoley/ Pearson Education.

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ADVANCED COMPUTER AIDED DESIGN
ELECTIVE – II

UNIT- I:
PRINCIPLES OF COMPUTER GRAPHICS : Introduction, graphic primitives, point plotting, lines, Bresenham's circle algorithm, ellipse, transformation in graphics, coordinate systems, view port, 2D and 3D transformation, hidden surface removal, reflection, shading and generation of characters.

UNIT- II:
CAD TOOLS: Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software. **GEOMETRICMODELLING:** Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves her mite cubic splines Bezier curves B-splines rational curves.

UNIT- III:
SURFACE MODELING :Mathematical representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.

UNIT- IV:
PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES:
Hermite Bicubic surface, **Bezier** surface, **B-** Spline surface, COONs surface, Blending surface Sculptured surface, Surface manipulation — Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).

UNIT- V:
GEOMETRICMODELLING-3D: Solid modeling, Solid Representation, Boundary Representation (13-rep), Constructive Solid Geometry (CSG).
CAD/CAM Exchange : Evaluation of data - exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF. Design Applications: Mechanical tolerances, Mass property calculations, Finite Element Modeling and Analysis and Mechanical Assembly.

Collaborative Engineering: Collaborative Design, Principles, Approaches, Tools, Design Systems.

REFERENCES :

1. Mastering CAD/CAM / Ibrhim Zeid / Mc Graw Hill International.
2. CAD/CAM Principles and Applications/ P.N.Rao/TMH/3rd Edition
3. CAD/CAM /Groover M.P./ Pearson education
4. CAD/CAM Concepts and Applications/ Alavala/ PHI
5. CAD / CAM / CIM, Radhakrishnan and Subramanian/ New Age
6. Principles of Computer Aided Design and Manufacturing/ Farid Amirouche/ Pearson
7. Computer Numerical Control Concepts and programming/ Warren S Seames/ Thomson.

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CONCURRENT ENGINEERING
ELECTIVE – II

UNIT - I
Introduction **-** Concurrent design of products and systems - Product design - Fabrication and assembly system design - designing production systems for robustness and structure.

UNIT - II
STRATEGIC APPROACH AND TECHNICAL ASPECTS OF PRODUCT DESIGN: Steps in the strategic approach to product design - Comparison to other product design methods - Assembly sequence generation - Choosing a good assembly sequence - Tolerances and their relation to assembly - Design for material handling and part mating - Creation and evaluation of testing strategies.

UNIT - III
BASIC ISSUES IN MANUFACTURING SYSTEM DESIGN: System design procedure - Design factors - Intangibles - Assembly resource alternatives - Task assignment - Tools and tool changing - Part feeding alternatives - Material handling alternatives - Floor layout and system architecture alternatives.

UNIT - IV
ASSEMBLY WORKSTATION DESIGN: Strategic issues - Technical issues analysis.
Design of automated fabrication systems: Objectives of modern fabrication system design - System design methodology - Preliminary system feasibility study - Perform detailed work content analysis - Define alternative fabrication configurations - Configuration design and layout - Human resource considerations - Evaluate technical performance of solution.

UNIT - V
CASE STUDIES: Automobile air conditioning module - Robot assembly of automobile rear axles.

REFERENCE:

1. Concurrent Design of Product and Processes/James L. Nevins and Daniel E. Whitney, /McGraw-Hill Publishing Company, 1989.
2. Concurrent Engineering: Automation, Tools and Techniques/ Andrew Kusiak/Johan Wiley & Sons
3. Concurrent Engineering Fundamentals: Integrated Product Development/Biren Prasad/ PH
4. Concurrent Engineering/ Johan R Hartley/Productivity Press
5. Concurrent Engineering: Concepts, Implementation and Practice/ Chanan & Menon/ Chapman & Hall

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M.Tech I Year – I Sem.(Machine Design)

KINEMATICS AND DYNAMICS LABORATORY

(A Minimum of 10 experiments are to be conducted)

Experiments:

1. Determination of damped natural frequency of vibration of the vibrating system with different viscous oils.
2. Determination of steady state amplitude of a forced vibratory system.
3. Static balancing using steel balls.
4. Determination of the magnitude and orientation of the balancing mass in dynamic balancing.
5. Field balancing of the thin rotors using vibration pickups.
6. Determination of the magnitude of gyroscopic couple, angular velocity of precession and representation of vectors.
7. Determination of natural frequency of given structure using FFT analyzer.
8. Diagnosis of a machine using FFT analyzer.
9. Direct Kinematic analysis of a robot.
10. Inverse Kinematic analysis of a robot.
11. Trajectory planning of a robot in joint space scheme.
12. Palletizing operation using Robot programming.

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ADVANCED MECHANICS OF MACHINERY

UNIT – I

ADVANCED KINEMATICS OF PLANE MOTION- I: Introduction to plane motion. The Inflection circle, Euler – Savary Equation, Analytical and graphical determination of d_i , 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.

UNIT - II

ADVANCED KINEMATICS OF PLANE MOTION - II: Polode curvature, Hall's Equation, Polode curvature in the four bar mechanism, coupler motion, relative motion of the output and input links, Determination of the output angular acceleration and its Rate of change, Freudenstein's collineation –axis theorem, Carter –Hall circle, The circling – point curve for the Coupler of a four bar mechanism.

UNIT – III

INTRODUCTION TO SYNTHESIS-GRAPHICAL METHODS - I: The Four bar linkage ,Guiding a body through Two distinct positions, Guiding a body through Three distinct positions, The Roto center triangle , Guiding a body through Four distinct positions, Burmester's curve.

UNIT - IV

INTRODUCTION TO SYNTHESIS-GRAPHICAL METHODS - II: Function generation- General discussion, Function generation: Relative – Roto center method, Overlay's method, Function generation- Velocity – pole method, Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem.

UNIT – V

INTRODUCTION TO SYNTHESIS - ANALYTICAL METHODS: Function Generation: Freudenstien's equation, Precision point approximation, Precision – derivative approximation, Path Generation: Synthesis of Four-bar Mechanisms for specified instantaneous condition, Method of components, Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link, Method of components.

REFERENCE:

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

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.Tech I Year – II Sem.(Machine Design)

MECHANICAL VIBRATIONS

UNIT- I:
SINGLE DEGREE OF FREEDOM SYSTEMS : Undamped and damped free vibrations; forced vibrations coulomb damping; Response to excitation; rotating unbalance and support excitation; vibration isolation and transmissibility- Response to Non Periodic Excitations: unit impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

UNIT- II:
TWO DEGREE FREEDOM SYSTEMS: Principal modes- undamped and damped free and forced vibrations; undamped vibration absorbers.

UNIT-III:
MULTI DEGREE FREEDOM SYSTEMS: Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi- rotor systems and geared systems; Discrete- Time systems.
Vibration measuring instruments: Vibrometers, velocity meters & accelerometers.

UNIT- IV:
FREQUENCY DOMAIN VIBRATION ANALYSIS: Over view, machine-train monitoring parameters-Data base development-vibration data acquisition-trending analysis-failure- node analysis-signature analysis-root cause analysis.

UNIT V:
NUMERICAL METHODS: Raleigh's stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods.

REFERENCES:

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

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M.Tech I Year – II Sem.(Machine Design)

ADVANCED OPTIMIZATION TECHNIQUES AND APPLICATION

UNIT- I

SINGLE VARIABLE NON-LINEAR UNCONSTRAINED OPTIMITION: One dimensional Optimization methods:- Uni-modal function, elimination method, Fibonacci method, golden section method, interpolation methods- quadratic & cubic interpolation methods.

UNIT - II

MULTI VARIABLE NON-LINEAR UNCONSTRAINED OPTIMIZATION: Direct search method – Univariant Method – pattern search methods – Powell's – Hook – Jeeves, Rosenbrock search methods – gradient methods, gradient of function, steepest decent method, Fletcher reeves method. **Variable** metric method.

UNIT - III

GEOMETRIC PROGRAMMING: Polynomials – arithmetic – geometric inequality – unconstrained G.P – constrained G.P

DYNAMIC PROGRAMMING: Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory. Allocation, scheduling replacement.

UNIT IV

LINEAR PROGRAMMING: formulation – Sensivity analysis. Change in the constraints, cost coefficients , coefficients of the constraints, addition and deletion of variable, constraints. Simulation – Introduction – Types – Steps – application – inventory – queuing – thermal system.

UNIT V

INTEGER PROGRAMMING: Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method.

STOCHASTIC PROGRAMMING: Basic concepts of probability theory, random variables – distributions – mean, variance, Correlation, co variance, joint probability distribution – stochastic linear, dynamic programming.

REFERENCES:

1. Optimization theory & Applications/ S.S Rao/ New Age International
2. Introductory to operation research/Kasan & Kumar/Springar
3. Optimization Techniques theory and practice / M.C Joshi, K.M Moudgalya/ Narosa Publications.
4. Operation Research/H.A. Taha/TMH
5. Optimization in operations research/R.L Rardin
6. Optimization Techniques/Benugundu & Chandraputla/Person Asia

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EXPERIMENTAL STRESS ANALYSIS

UNIT-I

Introduction**,** Theory of Elasticity, Plane stress and plane strain conditions, compatibility conditions, problem using plane stress and plane strain conditions, three-dimensional stress strain relations.

Strain measurement methods: various types of strain gauges, electrical resistance strain gauges, semiconductor strain gauge circuits.

UNIT-II

RECORDING INSTRUMENTS: Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies, telemetry systems.

UNIT-III

BRITTLE COATINGS: Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data.

Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometarical approach to moiré-fringe analysis, the displacement field approach to Moire-fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of moiré-fringes, experimental procedure and techniques.

UNIT-IV

PHOTO ELASTICITY: Photo elasticity, polariscope, plane and circularly polarized light, bright and dark filed setup, photo elasticity materials,, Isochromatic fringes – Isoclinics.

UNIT-V

THREE DIMENSIONAL PHOTO ELASTICITY: introduction, locking in model deformation, materials for three dimensional photo elasticity, machining cementing and slicing three dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear-difference method in three dimensions, applications of the Frozen-stress method, the scattered-light method

Birefringent coating: Introduction, coating stress and stains, coating sensitivity, coating materials, application of coatings, effective of coating thickness, fringe-order determinations in coatings, stress separation methods.

REFERENCES:.

1. Theory of elasticity / Timoshenko and Goodier Jr.
2. Experimental Stress analysis/ Dally and Riley, Mc Graw-Hill
3. A treatise on Mathematical theory of elasticity / LOVE A.H./ Dover Publications
4. Photo Elasticity / Frocht/ Wiley / 3rd Edition
5. Experimental Stress Analysis / Sadhu singh / Khanna Publications.

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M.Tech I Year – II Sem.(Machine Design)

PRESSURE VESSEL DESIGN
ELECTIVE - III

UNIT – I
Introduction, Materials- shapes of Vessels –stresses in cylindrical spherical and arbitrary, shaped shells. Cylindrical Vessels subjected to internal pressure, wind load bending and torque-ilation of pressure vessels –conical and tetrahedral vessels.
Theory of thick cylinders; Shrink fit stresses in built up cylinders – auto freltage of thick cylinders Thermal stresses in Pressure Vessels.

UNIT – II
THEORY OF RECTANGULAR PLATES : Pure bending – different edge conditions.
Theory circular plates: Simple support and clamped ends subjected to concentrated and uniformly distributed loads-stresses from local loads. Design of dome bends, shell connections, flat heads and cone openings.

UNIT – III
DISCONTINUITY STRESSES IN PRESSURE VESSELS: Introduction beam on an elastic foundation, infinitely long beam semi infinite beam, cylindrical vessel under axially symmetrical loading, extent and significance of load deformations on pressure vessels, discontinuity stresses in vessels, stresses in a bimetallic joints, deformation and stresses in flanges.
Pressure vessel materials and their environment : Introduction ductile material tensile tests, structure and strength of steel Leuder's lines determination of stress patterns from plastic flow observations, behavior of steel beyond the yield point, effect of cold work or strain hardening on the physical properties of pressure vessel steels fracture types in tension. Toughness of materials, effect of neutron irradiation of steels, fatigue of metals, fatigue erack growth fatigue life prediction cumulative fatigue damage stress theory of failure of vessels subject to steady state and fatigue conditions.

UNIT IV
STRESS CONCENTRATIONS: Influence of surface effects on fatigue, effect of the environment and other factors on fatigue life thermal stress fatigue creep and rupture of metals at elevated temperatures, hydrogen embitterment of pressure vessel steels brittle fracture effect of environment on fracture toughness, fracture toughness relationships criteria for design with defects, significance of fracture mechanics evaluations, effect of warm prestressing on the ambient temperature toughness of pressure vessel steels.

UNIT V;
DESIGN FEATURES: Localized stresses and their significance, stress concentration at a variable thickness transition section in a cylindrical vessel, stress concentration about a circular hole in a plate subject to tension, elliptical openings, stress concentration, stress concentration factors for position , dynamic and thermal transient conditions, theory of reinforced openings and reinforcement, placement and shape fatigue and stress concentration.

REFERENCES:

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

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DESIGN SYNTHESIS
ELECTIVE - III

UNIT – I

Design process and methodologies of systematic design conceptual design variants and evaluation Standardization and its exploitation in design.

UNIT – II

Tolerance from process and function, interchangeability and selective assembly, selection of fits for different design situations, surface finish.
Load transmission, load equalization light weigh and rigid constructions.

UNIT – III

Design of case, forged sheet metal parts and welded constructions Machine considerations.

UNIT – IV

Design for assembly and dismantling Modular constructions erection, operation inspection and maintenance considerations, Ergonomics Design of accuracy Location pins and registers, Machining in assembly, adjustment, Backlash and Clearance adjustment.

UNIT – V

Problems formulation for design optimization Example illustration the various principles available design variants for some of the common basic functional requirements.

REFERENCES:

1. Engineering Design a systematic approach/ G. Phal W. Beitz/ Springer /3rd Edition
2. Engineering Design a material and processing approach/ George Dieter/ McGraw Hi8ll international book company 1983
3. Mechanical Design Theory Methodology/ Manjula B. Waldron and Kenneth J. Waldron/ Springer Verlag New York 1996.

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NON LINEAR VIBRATIONS
ELECTIVE - III

UNIT - I
Undamped Free Vibrations :- Introduction Geometric Non linearity, Material or Power-law type of nonlinearity, Elliptic function approach, A-priori synthesis of nonlinear differential equations, Frequency calculation, Approximate methods, Perturbation method, Qualitative aspects of motion Phase- Plane techniques, Graphical techniques, Averaging method based on residuals.

UNIT- II
Damped Free Vibrations:- Introduction Motion with viscous damping, Quadratic (square-law) damping, Nonlinear system with variable damping, Damped free oscillators- Geometry of integral curves, Method of Averaging.

UNIT - III
Forced Vibrations: - Introduction Undamped nonlinear oscillator subject to harmonic excitation, Approximate method: Elliptic cosine-type excitation, Perturbation method, Iteration method: Undamped Duffing's equation, Discontinuous jump in amplitude as force varies in the equation ($x+\alpha x+\beta x^3=F\cos\omega t$), Stability of fundamental solution for Duffing's equation, Duffing's equation: Sub-Harmonics, Stability criteria for sub-harmonic of order 1/3.

UNIT -IV
Damped Forced vibrations: - Equivalent viscous damping, Variational methods, The method of slowly-varying parameters, Method of harmonic balance, Duffing's equation with viscous damping, Iteration method for undamped Duffing's equation , $1/3^{rd}$ order sub-harmonics in Duffing's equation with viscous damping.

UNIT - V
Transient Analysis of Nonlinear (Neoconservative Systems) Introduction-Step response, The Equation of Motion and method of solution, Pulse response of nonlinear systems, Pulse response of Duffing's oscillator.

REFERENCES:

1. Nonlinear Mechanical Vibrations / P.Srinivasan/,New age international publications.
2. Elements of vibration Analysis/ Leonard Meirovitch./ 2^{nd} Edition / McGrawHill.
3. Mechanical vibrations/ Francis TSC, Ivan , Rolland T. Hinkle/ 2^{nd} Edition/ CBS publications
4. Theory and Problems of Mechanical Vibrations/ William W. SETO /Schaums out line series/ McGrawHill.

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M.Tech I Year – II Sem.(Machine Design)

INDUSTRIAL ROBOTICS
ELECTIVE – III

UNIT - I

INTRODUCTION: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.

CONTROL SYSTEM AND COMPONENTS: basic concept and modais controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system.

UNIT - II

MOTION ANALYSIS AND CONTROL: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller.

UNIT - III

END EFFECTORS: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. SENSORS: Desirable features, tactile, proximity and range sensors, uses sensors in robotics.

MACHINE VISION: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

UNIT - IV

ROBOT PROGRAMMING: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINONAL AND DELAY commands, Branching capabilities and Limitations.

ROBOT LANGUAGES: Textual robot Languages, Generation, Robot language structures, Elements in function.

UNIT - V

ROBOT CELL DESGIN AND CONTROL: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detect ion, Work wheel controller.

ROBOT APPLICATION: Material transfer, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application.

REFERENCES:

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control / J J Craig/ Pearson / 3rd edition.
3. Robotics / Fu K S/ McGraw Hill.
4. Robotic Engineering / Richard D. Klafter, Prentice Hall
5. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
6. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.
7. Robotics and Control / Mittal R K & Nagrath I J / TMH

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SIGNAL ANALYSIS AND CONDITION MONITORING
ELECTIVE – IV

UNIT-I
Introduction, Basic concepts. Fourier analysis. Bandwidth. Signal types. Convolution.
Signal analysis: Filter response time. Detectors. Recorders. Analog analyzer types.

UNIT-II
PRACTICAL ANALYSIS OF STATIONARY SIGNALS: Stepped filter analysis. Swept filter analysis. High speed analysis. Real-time analysis.

UNIT-III
PRACTICAL ANALYSIS OF CONTINUOUS NON-STATIONARY SIGNALS: Choice of window type. Choice of window length. Choice of incremental step. Practical details. Scaling of the results.

UNIT-IV
PRACTICAL ANALYSIS OF TRANSIENTS: Analysis as a periodic signal. Analysis by repeated playback (constant bandwidth). Analysis by repeated playback (variable bandwidth).

UNIT-V
CONDITION MONITORING IN REAL SYSTEMS: Diagnostic tools. Condition monitoring of two stage compressor. Cement mill foundation. I.D. fan. Sugar centrifugal. Cooling tower fan. Air separator. Preheater fan. Field balancing of rotors. ISO standards on vibrations.

REFERENCES:

1. Condition Monitoring of Mechanical Systems / Kolacat.
2. Frequency Analysis /R.B.Randall.
3. Mechanical Vibrations Practice with Basic Theory / V. Ramamurti/ Narosa Publishing House.
4. Theory of Machines and Mechanisms/ Amitabh Ghosh & AK Malik/ EWP

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M.Tech I Year – II Sem.(Machine Design)

MECHATRONICS
ELECTIVE – IV

UNIT-I

Mechatronics systems, elements, levels of Mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of Mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion , force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

UNIT-II

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications.

UNIT-III

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems:

Mechanical actuating systems and electrical actuating systems.

UNIT-IV

Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

UNIT-V

System and interfacing and data acquisition, DAQS , SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of Mechatronics systems & future trends.

REFERENCES:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran & GK Vijaya Raghavan/WILEY India Edition/2008
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
3. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
4. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
5. Mechatronics System Design / Devdas shetty/Richard/Thomson.
6. Mechatronics/M.D.Singh/J.G.Joshi/PHI.
7. Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg. 4th Edition, Pearson, 2012 W. Bolton
8. Mechatronics – Principles and Application Godfrey C. Onwubolu, Elsevier, 2006 Indian print

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COMPUTATIONAL FLUID DYNAMICS
ELECTIVE – IV

UNIT – I

INTRODUCTION: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions, Derivation of finite difference equations.

Solution methods: Solution methods of elliptical equations — finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT - II

Hyperbolic equations: explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT - III

FORMULATIONS OF INCOMPRESSIBLE VISCOUS FLOWS: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

Treatment of compressible flows: potential equation, Euler equations, Navier-stokes system of equations, flow field-dependent variation methods, boundary conditions, example problems.

UNIT - IV

FINITE VOLUME METHOD: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

UNIT - V

STANDARD VARIATIONAL METHODS: Linear fluid flow problems, steady state problems, Transient problems.

REFERENCES:

1. Computational fluid dynamics/ T. J.C'hung/ Cambridge University press,2002.
2. Text book of fluid dynamics/ **Frank** Choriton/ CBS Publishers & distributors, 1985
3. Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hema shava Publishers corporation & Mc Graw Hill.
4. Computational Fluid Flow and Heat Transfer/ Muralidaran/ Narosa Publications
5. Computational Fluid Dynamics: Basics with applications/John D. Anderson/ Mc Graw Hill.
6. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities Press.
7. Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis /Oxford University Press/2nd Edition

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THEORY OF PLATES AND SHELLS
ELECTIVE – IV

UNIT -I

BENDING OF LONG RECTANGULAR PLATES TO A CYLINDRICAL SURFACE: Differential equation for cylindrical bending of plates - Cylindrical bending of uniformly loaded rectangular plates with simply supported edges - Cylindrical bending of uniformly loaded rectangular plates with built-in edges

Pure bending of plates: Slope and curvature of slightly bent plates - Relations between bending moments and curvature in pure bending of plates - Particular cases of pure bending - Strain energy in pure bending of plates.

UNIT -II

SYMMETRICAL BENDING OF CIRCULAR PLATES: Differential equation for symmetrical bending of laterally loaded circular plates - Uniformly loaded circular plates - Circular plate with a circular hole at the center - Circular plate concentrically loaded - Circular plate loaded at the center.

Small deflections of laterally loaded plates: The differential equation of the deflection surface - Boundary conditions - Alternate method of derivation of the boundary condition - Reduction of the problem of bending of a plate to that of deflection of a membrane

UNIT -III

SIMPLY SUPPORTED RECTANGULAR PLATES: Simply supported rectangular plates under sinusoidal load - Navier solution for simply supported rectangular plates.

Rectangular plates with various edge conditions: Bending of rectangular plates by moments distributed along the edges - Rectangular plates with two opposite edges simply supported and the other two edges clamped.

UNIT -IV

CONTINUOUS RECTANGULAR PLATES: Simply supported continuous plates - Approximate design of continuous plates with equal spans - Bending symmetrical with respect to a center.

Deformation of shells without bending: Definition and notation - Shells in the form of a surface of revolution and loaded symmetrically with respect to their axis - Particular cases of shells in the form of surfaces of revolution - Shells of constant strength.

UNIT -V

GENERAL THEORY OF CYLINDRICAL SHELLS: A circular cylindrical shell loaded symmetrically with respect to its axis - Particular cases of symmetrical deformation of circular cylindrical shells - Pressure vessels.

REFERENCES:

1. Theory of Plates and Shells / Timoshenko, S. and Woinowsky-Krieger, S/McGraw Hill
2. Stress in Beams, Plates and Shells / Ansel C. Ugural / CRC Press / 3rd Edition.

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COMPUTER AIDED TESTING, ANALYSIS AND MODELING LABORATORY

TESTING

1. Preparation and study of the Micro Structure of ferrous metals and alloys.
2. Preparation and study of the Microstructure of nonferrous metals and alloys.
3. Effect of tempering time on the hardness of quenched carbon steels.
4. Effect of tempering temperature on the hardness of a hardened carbon steels.
5. Preparation of metallic specimens by electro polishing.
6. Study of work hardening characteristics of a pure metal.
7. Determination of carbon percentage in the given ferrous specimen.

MODELING

1. Surface modeling.
2. Solid modeling.
3. Drafting.
4. Assembling.

ANALYSIS OF STRUCTURES USING FEA PACKAGES

1. Static Analysis.
2. Modal Analysis.
3. Harmonic Analysis.
4. Spectrum Analysis.
5. Buckling Analysis.
6. Analysis of Composites.
7. Fracture mechanics.
8. Transient analysis