Proposed Scheme of Instruction and Evaluation

TWO-YEAR M.TECH. PROGRAMME IN MECHANICAL ENGINEERING

M.TECH. DESIGN ENGINEERING

FIRST SEMESTER

Course Number	Course	Hours of Instruction per week		Scheme of Evaluation			Credits	Total Marks
				External Evaluation		Sessionals		
		Lectures	Practicals	Duration of Examination	Max Marks	Max Marks		
MTDE 11	Optimization Methods in Engineering Design	4	-	3 Hrs	100	50	4	600
MTDE 12	Fundamentals Principles of Engineering Design	3	-	3 Hrs	100	50	3	450
MTDE 13	Stress Analysis	4	-	3 Hrs	100	50	4	600
MTDE 14	Mechanical Vibrations	4	-	3 Hrs	100	50	4	600
MTDE 15	Computer Aided Design and Graphics	3	-	3 Hrs	100	50	3	450
MTDE 16	ELECTIVE – I	3	-	3 Hrs	100	50	3	450
MTDE 17	Mechanical Vibrations Lab	-	3	3 Hrs	100	50	2	300
MTDE 18	CAD Lab	-	3	3 Hrs	100	50	2	300
MTDE 19	Seminar	-	1	-		100	2	200
		21	**7**					3950

Elective-I: MTDE 16 A Smart Structures
MTDE 16 B: Design for Manufacture
MTDE 16 C: Design of Pressure Vessels and Piping

Proposed Scheme of Instruction and Evaluation

TWO-YEAR M.TECH. PROGRAMME IN MECHANICAL ENGINEERING

M.TECH. DESIGN ENGINEERING

SECOND SEMESTER

Course Number	Course	Hours of Instruction per week		Scheme of Evaluation			Credits	Total Marks
				External Evaluation		Sessionals		
		Lectures	Practicals	Duration of Exam	Max Marks	Max Marks		
MTDE 21	Finite Element Analysis	4	-	3 hrs.	100	50	4	600
MTDE 22	Advanced Mechanisms Design & Analysis	4	-	3 hrs.	100	50	4	600
MTDE 23	Advanced Materials Science and Engineering	3	-	3 hrs.	100	50	3	450
MTDE 24	Automation & Robotics	3	-	3 hrs.	100	50	3	450
MTDE 25	MEMS & Nano Technology	3	-	3 hrs.	100	50	3	450
MTDE 26	Elective – II	3	-	3 hrs.	100	50	3	450
MTDE 27	FEM Lab	-	3	3 hrs.	100	50	2	300
MTDE 28	Automation & Robotics Lab	-	3	3 hrs.	100	50	2	300
MTDE 29	Comprehensive Viva	-	-	3 hrs.	100	-	2	200
		20	**6**					**3800**

Elective-II: MTDE 26 A: Fault Diagnosis of Machines
MTDE 26 B: Fatigue, Fracture & Failure Analysis
MTDE 26 C: Design of Material Handling Equipment

Proposed Scheme of Instruction and Evaluation

TWO-YEAR M.TECH. PROGRAMME IN MECHANICAL ENGINEERING

M.TECH. DESIGN ENGINEERING

THIRD SEMESTER

Course Number	Name of the Course	Duration	Sessionals	External	Credits	Total marks
MTDE 31	Industrial Training	8 Weeks	50	-	2	100
MTDE 32	Dissertation	16 Weeks	100	100	2	400

Proposed Scheme of Instruction and Evaluation

TWO-YEAR M.TECH. PROGRAMME IN MECHANICAL ENGINEERING

M.TECH. DESIGN ENGINEERING

FOURTH SEMESTER

Course Number	Name of the Course	Duration	Sessionals	External	Credits	Total marks
MTDE 32	Dissertation	24 Weeks	100	100	4	800

MTDE 11 OPTIMIZATION METHODS IN ENGINEERING DESIGN

Class: **M.Tech. I Semester** *Lectures:***4**
Branch: Mech. Engg (Design Engg) *University Examination:***100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1. introduction: Classification of optimization problems, mathematical models in engineering optimization

2. concepts in linear optimization: General simplex method, revised simplex method, duality, decomposition principle, integer programming, branch and bound technique and the Gomory algorithm, post optimality analysis.

3. Non linear programming without constraints: Local and global maxima, minima, Hessian matrix, Fibonacci method, Golden section method, random search method, steepest descent method and conjugate gradient method.

4. Non linear programming with constraints: Lagrange multipliers, Kuhn-Tucker conditions, quadratic programming. Wolfe's and Beale's method, sequential linear programming approach, penalty methods. Interior and exterior penalty function method

5. Advanced optimization techniques: Concepts of multi-objective optimization, genetic algorithms and simulated annealing.

TEXT BOOK:

1. S.S.Rao, *Optimization-Theory and Applications, ,* Wiley Eastern, New Delhi, 1978
2. J.C.Pant, Introduction to Optimization, Jain Brothers, New Delhi, 1983
3. Kanthi Swaroop, et.at., *Operations Research,* S. Chand & Co., New Delhi,
4. Kalyanmoy Deb, *Optimization for Engineering Design Algorithms and Examples,* Prentice Hall of India, New Delhi, 1995
5. Kalyanmoy Deb, *Mulitobjective Optimization –An evolutionary Algorithmic Approcach,* John Wiley & Sons, New York.

REFERENCE BOOKS:

1. J.S. Arora, Introduction to optimum design, McGraw Hill, New York, 1989.
2. R.L. Fox, Optimization Methods for Engineering Design, Addison Wesley, New York, 1971.
3. D.E. Goldberg, Genetic Algorithms in Search, Optimization and Machine, Barnen, Addison Wesley, New York, 1989.

MTDE 12 FUNDAMENTAL PRINCIPLES OF ENGINEERING DESIGN

Class: **M.Tech. I Semester** *Lectures:* **3**
*Branch: Mech. Engg (*Design Engg**).** *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1. **Design Process**: Describing mechanical design problems and processes – Types of mechanical design problems, Languages of mechanical design, constraints, goals and design decisions, Designers and design teams.

2. **Planning of design process**: overview of the design processes, organization techniques, developing design project plans, steps in planning, case studies

3. **Design concept generation and evaluation:** Technique for functional decomposition, generating and developing concepts, evaluation based on feasibility judgment, technology – readiness assessment, Go/No Go screening, decision matrix.

4. **Development of Engineering specifications**: Steps in development of engineering specification, identification of customer\s requirements, quality functional deployment (QFD),

5. **Product Evaluation**: Importance and goals of Performance evaluation, robust design, sensitivity analysis, cost estimation in design, design for reliability, environment and maintenance

TEXT BOOKS

1 David G. Ullma, "The Mechanical Design Process", McGraw Hill, 1955.
2 George E. Dieter, "Engineering Design",

REFRENCE BOOKS

1. E.N.Baldwin and B.W. Niebel, , *Designing for Production*, Homewood, Illinois, 1975.
2. J.C.Jones, *Design Methods, Seeds of Human Futures,* John Wiley, New York, 1978.
3. J.G.Bralla, *Handbook of Product Design for Manufacture,* McGraw-Hill, New York, 1988.

MTDE 13 STRESS ANALYSIS

Class: **M.Tech. I Semester** L*ectures:* **4**
Branch: Mech. Engg Design **Engg.** *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1. **Analysis of Stress:** Definition and notation of stress, Differential equations of equilibrium, specification of stress at a point, Principal stresses and the Mohr Diagram, three dimensional stress at a point, Boundary conditions in terms of given surface forces.

2. **Analysis of Strain:** Strain components, Specification of strain at a point, Compatibility equations, three-dimensional strains, Mohr's circle for strains, Measurement of strains bonded strain gages.

3. **Stress-Strain Relations and the General Equations of Elasticity:** Idealization of Engineering Materials, Generalized Hooke's law, Elastic symmetry, Generalized Hooke's law in terms of Engineering elastic constants, Strain energy, Saint-Venant's principle.

4. **Plane-Stress and Plane-Strain Problems:** The governing differential equations, Thick cylinder under uniform pressure, shrink and force fits. The effect of small circular holes in strained plates, Stress concentration **Thermal Stresses:** Thermoelastic stress-strain relations,

5. Energy Principles and Variational Methods: Principle of Potential energy, Principle of complementary energy. Rayleigh-Ritz method, Galerkin method. Reciprocal Theorem and Castigliano's Theorems.
6.

TEXT BOOKS

1. C.T. Wang, *Applied Elasticity*, McGraw-Hill, New York, 1953.

REFERENCE BOOKS

1. A.C.Ugural and S.K. Fenster, *Advanced Strength and Applied Elasticity, 3/e* PTR Prentice Hall, Englewood Cliffs, New Jersey, 1995.
2. G.E.Dieter, *Mechanical Metallurgy,* McGraw-Hill Book Company, Singapore, 1988.
3. S.P.Timoshenko and J.N.Goodier, *Theory of Elasticity*, 3/e, McGraw-Hill, New York, 1985.

MTDE 14 MECHANICAL VIBRATIONS

Class: **M.Tech. II Semester** *Lectures:*4
Branch:Mech. Engg. (Design Engg). *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

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

2. **Two Degree Freedom System:** Free vibration of spring-coupled system – mass coupled system – Bending vibration of two degree freedom system – Forced vibration – Vibration Absorber – Vibration isolation.

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

4. **Experimental methods in Vibration Analysis:** Vibration instruments– Vibration exciters Measuring Devices – Analysis – Vibration Tests – Free and Forced Vibration tests. Examples of Vibration tests – Industrial, case studies.

TEXT BOOK

1. Rao, S.S., *Mechanical Vibrations*, Addison Wesley Longman, 1995.

REFERENCES

1. William T. Thomson and Marie Dillon Dahleh, *Theory of Vibration with Applications, 5/e,* Pearson Education, Singapore, 2003.
2. Meirovich, L. *Elements of Vibration Analysis*, McGraw-Hill, New York, 1986,
3. S. Graham Kelly, *Fundamentals of Mechanical Vibrations, 2/e*, McGraw-Hill, Singapore, 2000.
4. Den Hartog, J.P., *Mechanical Vibrations*, Dover Publications, 1990.

MTDE 15 COMPUTER AIDED DESIGN & GRAPHICS

Class: **M.Tech. I Semester** *Lectures:* **3**
Branch: Mech. Engg. **Design Engg.** *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1. **Overview of Computer Aided Drafting:** Applications, fundamentals of computer architecture, Input-Output devices, Interactive display devices.

2 **Graphics Primitives:** Monitor pixels, generation of points, lines, and circles, algorithms of line and circle.

3 **Transformations:** 2D and 3D transformations scaling, translation, shearing, Rotation, Reflection, homogeneous transformation, Matrix operations, concatenation, isometric, orthographic and perspective projections.

4**. Generation of Curves:** Cubic splines, Bezier Curves, B-spline curve, NURBS.

5**. Geometric Modeling:** Modeling of surfaces, coon's patch, Bezier surfaces, B-spline Surfaces, Solid models, wire frame models, solid modeling techniques, constructive solid Geometry, Boolean operations, hybrid modeling.

6. Engineering Data Management Systems: Need for standards, Graphic standards, Data Exchange standards,

TEXT BOOK

1. David F.Rogers and J.Alan Adams, *Mathematical Elements for Computer Graphics,* McGraw-Hill, New York.
2. I.Zeid, *CAD/CAM,* Tata McGraw-Hill, New Delhi, 2001.

REFERENCE BOOKS

1. Donald Hearn and M.Pauline Baker, *Computer Graphics, 2/e*, Prentice-Hall of India, New Delhi, 2000.
2. James D. Foley, Andries Van Dam, et. al., *Computer Graphics: Principles and Practice, 2/e in C*, Pearson Education, New Delhi, 2001.

MTDE 16A SMART STRUCTURES

Class: **M.Tech. I Semester** *Lectures:*3
Branch:Mech. Engg. (Design Engg). *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1. **Smart structures and Materials: Definitions, instrumented materials-basic considerations, functions and responses, structural responses, sensing systems, self-adiagnosis, signal processing considerations, Actuating systems and effectors, applications.**

2. **Sensing Technologies: Specifications and terminology for sensors in smart structures, physical measurements-piezoelectric strain measurement, inductively read transducers-the LVDT, fiber optic sensing techniques**.

3. **Actuator techniques; Mechanical impedence, conversion efficiencies and matching**.Actuators and actuator materials, piezo electric and electro restrictive materials, magnetorestrictive materials, shape memory alloys, electrorheological fluids, electromagnetic actuation.

4. **Signal processing and control of smart structures:** Sensors as geometrical processors, signal processing, control systems, the linear and the non-linear.

5. Smart structures-Some applications: Smart composites, Mechanical analysis and self testing structures.

TEXT BOOK

1. **Culshaw B.,** ***Smat Structures and Materials*****, Artec House, Boston, 1996.**

REFERENCE BOOKS

1. Gandhi M.V., and Thompson, *Smart Structures and Materials*, Chapman & Hall, New York, 1992.
2. Banks, H.T., Smith, R.C. and Wang, Y., ***Smart Material Structures: Modeling, Estimation and Control,*** **John Wiley & Sons, New York, 1996.**
3. Srinivasan, A.V. and Michael Me Farland, D., *Smart Structures: Analysis and Design*, Cambridge University Press, Cambridge, 2001.

MTDE 16B DESIGN FOR MANUFACTURE

Class: **M.Tech. I Semester** *Lectures:*3
Branch:Mech. Engg. (Design Engg). *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1 **INTROUDCTION TO DESIGN FOR MANUFACTURE (DFM):** Desgin Concepts considerations like part count, product weight, manufacturing costs assembly time etc., concurrent engineering – definition and concepts, improving competitiveness with concurrent engineering, implementation methodologies.

2. **MATERIALS AND PROCESSES:** Material selection and its inter relationship with process selection, comparison of various processes for productivity and produce-ability machining process, casting join processes, deformation processes.

3. **GENERAL CONSIDERATIONS IN DFM:** Performance considerations, Manufacturability considerations, Testability consideration, Serviceability considerations, Computer aided engineering and testing.

4 **IMPLEMENTATIONTECHNIQUES DFM:** Manufacturability evaluation methods, principles and rules for product design, Quantitative evaluation methods, Boothroyd and Dewhurst DFA method, Methodology for planning experiments in robust product and process design, Redesigning mature products for competitiveness. Designing for CNC manufacture knowledge based solutions for assembly problems, Linking manufacturing and product life cycles.

TEXTBOOK

1 John Cobert et. "Design for Manufacture – Strategirs, Principles and Techniques", Addison Wesley Pub.Co., 1995.
2 John Turino, "Managing Concurrent Engineering "Von Nostrand Reinhold, New York, 1992.
3 George E. Dieter, "Engineering Design – A material processing approach", McGraw International, 2nd ed. 1991.

MTDE 16C DESIGN OF PRESSURE VESSELS AND PIPING

Class: **M.Tech. II Semester** *Lectures:*3
Branch:Mech. Engg. (Design Engg). *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1. **Introduction:** Methods for determining stresses – Terminology and Ligament Efficiency – Applications.

2. **Stresses in Pressure Vessels:** Introduction – Stresses in a circular ring, cylinder – Membrane stress Analysis of Vessel Shell components – Cylinderical shells, torspherical Heads, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

3. **Design of Vessels: Localized stresses and their significance** – stress concentration – at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – pressure vessel Design.

4. **Supports for Vessels**: introduction, bracket or lug supports, leg supports, skirt supports, saddle supports.

5. **Buckling and Fracture Analysis in Vessels:** Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

6. **Piping:** Introduction – Flow diagram – piping layout and piping stress Analysis.

TEXTBOOKS

1. John F.Harvey, *Theory and Design of Pressure Vessels,* CBS Publishers and Distributors, 1987.
2. M.V. Joshi, *Process Equipment Design,* Macmillan India Ltd.

REFERENCEBOOKS

1. Henry H.Bedner, *Pressure Vessels,* Design Hand Book, CBS Publishers and Distributors, 1987.
2. Stanley, M.Wales, *Chemical process equipment, selection and Design,* Butterworths series in Chemical Engineering, 1988.
7. William J., Bees, *Approximate Methods in the Design and Analysis of Pressure vessels and Piping,* Pre ASME Pressure Vessels and Piping Conference, 1997.

MTDE 17 MECHANICAL VIBRATIONS LAB

Class: **M.Tech. II Semester** *Lectures:*3
Branch:Mech. Engg. (Design Engg). *University Examination:***100marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

LIST OF EXPERIMENTS

1 Determination of Radius of Gyration of giver Var by using Bi-fillar suspension.
2 Study of Longitudinal Vibrations of helical spring.
3 Study of undamped free vibrations of equivalent spring mass system
4 Study of Forced vibrations of equivalent spring mass system
5 Study of Torsional vibrations of Single rotor shaft system.
6 Study of free vibrations of two rotor shaft system.
7 Study of damped Torsional oscillations.
8 Verification of Dunkerlay's rule.

TEXT BOOK

1 Rao, S.S., *Mechanical Vibrations,* Addison Wesley Longman, 1995.

REFERENCES

1. William T. Thomson and Marie Dillon Dahleh, *Theory of Vibration with Applications, 5/e,* Pearson Education, Singapore, 2003.
2 Meirovich, L. *Elements of Vibration Analysis,* McGraw-Hill, New York, 1986,
3 .S. Graham Kelly, *Fundamentals of Mechanical Vibrations, 2/e,* McGraw-Hill, Singapore, 2000.
4 Den Hartog, J.P., *Mechanical Vibrations,* Dover Publications, 1990.

MED 18 C A D LABORATORY

Class: **M.Tech. I Semester** *Lectures:*3
Branch:Mech. Engg. (Design Engg). *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

LIST OF EXPERIMENTS

PART –A

2-D and 3-D Modelling using AutoCAD, ProE/CATIA

1. 2-D Drawing generatin.
2. Layout as per standard.
3. Simple 3 D geometry creation.
4. Complex 3 D generation with Boolean operations.
5. Viewports-Named viewports.
6. Project Work.

PART-B

1. Implementation of Bresenham's Line Algortihm using C / C++
2. Implementation of Bresenham's Circel Algorithm using C / C++
3. Cubic Spline generation using C / C++

REFERENCE BOOKS

1. AutoCAD 2000, BPB Publications.
2. Learners Manual AutoCAD.

MED 19 SEMINAR

Class: **M.Tech. I Semester** *Sessionals:* **100marks**
Branch:Mech. Engg. (Design Engg).

The student is required to go through the current developments in the design and analysis procedures for materials and structures, biomechanics, MEMS and nanotechnology, Advanced materials, failure analysis, dynamics of mechanical systems, robotics, microprocessor applications in mechanical engineering, noise and vibration analysis, friction and wear of materials, etc.

Under the guidance of the assigned faculty, the students will submit a brief report as per specified format and present before the evaluation committee.

The seminar evaluation will be based on the day to day work, report submission and presentation before the evaluation committee.

MTDE 21 FINITE ELEMENT ANALYSIS

Class: **M.Tech. II Semester** *Lectures:*4
Branch:Mech. Engg. (Design Engg). *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1. The Finite Element Method: Introduction, steps of the finite element method, historical background, advantages and limitations of the finite element method, basic concepts-nodes, equilibrium, continuity, degrees of freedom, boundary conditions, derivation of element stiffness equation by direct method: spring and spring assemblage, properties of stiffness matrix, stiffness matrix for an arbitrarily oriented bar, tensile and torsion loads on tapered bar, stepped bar, handling of distributed tensile loads-lumped loads, stress calculations in bar, thermal loads.

2. Truss element: Plain stress and plane strain conditions-biaxial stress and strain transformations, displacement transformation, stiffness matrix for truss element by equations of transformation, thermal load on truss element, stress calculation in a truss member, matrix sparsity, banded matrix, semi-band width, node numbering for reduction of band width and sparsity, equation solvers.

3. Beam element: Derivation of stiffness matrix for a beam element-direct method, plane frame element, space frame element, mechanical loads-reduced and consistent loads, fixed and cantilever beams with u.d.l. and point loads, roller, spring supports.

4. basic Elements: Interpolation and Shape functions: Linear, quadratic and cubic interpolations, C^o, C^1 continuity-derivation of stiffness matrix using the principle of virtual work-bar, beam element, constant strain triangle, linear strain triangle, bilinear rectangle, quadratic rectangle, Q_9 element, rectangular solid element, 20-node rectangular solid element, comparison of various elements, choice of interpolation functions, consistent nodal loads, stress calculation.

5. Isoparametric elements: Bar element, triangles, bilinear quadrilateral(Q4), numerical integration, quadratic quadrilateral, static condensation, choices in numerical integration, load considerations, stress calculations, effect of element geometry, validity of isoparametric elements, patch test.

6. Weighted Residual and Variational Methods: Galerkin method, bar and beam elements, Rayleigh-Ritz method, strong and weak form solutions, functional, Euler-Lagrange equation, heat conduction with convective boundary conditions-composite walls, fins.

7. Solids of Revolution: Elasticity relations, axisymmetric solid elements, loads without axial symmetry.

8. Dynamics and Vibrations: Dynamic equations, mass and damping matrix, mass matrices-consistent, diagonal and combination matrices, HRZ lumping, optimal lumping, natural frequencies and modes, damping, reduction of number of d.o.f., response history: modal methods, component mode synthesis.

TEXT BOOKS

1. Harold C. Martin, *Introduction to Matrix Methods of Structural Analysis*, McGraw Hill, New York, 1966.
2. Robert D. Cook, David S. Malkus, Michel E. Plesha, Robert J. Witt, *Concepts and Applications of Finite Element Analysis*, 4/e, John Wiley & Sons, Singapore, 2003.

REFERENCE BOOKS

1. P. Seshu, *Text Book of Finite Element Analysis,* Prentice Hall of India, New Delhi, 2003.
2. S. Rajasekaran, *Finite Element Analysis in Engineering Design*, S. Chand & Co., New Delhi, 2003.

MTDE 22 ADVANCED MECHANISMS DESIGN AND ANALYSIS

Class: **M.Tech. II Semester** *Lectures:*4
Branch:Mech. Engg. (Design Engg). *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1. **Introduction:** Review of fundamentals of kinematics – mobility analysis – formation of one D.O.F. multi-loop kinematic chains, Network formula – Gross motion concepts.

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

3. **Synthesis of Mechanisms:** Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation. Graphical methods..

4. **Dynamic of Mechanisms:** Static force analysis with friction – Inertia force analysis – combined static and inertia force analysis, shaking force. Kineto-static analysis. Introduction to force and moment balancing of linkages

TEXT BOOK

1. G.N. Sandor, A.G. Erdman, *Advanced Mechanism Design and Analysis and Synthesis*, vol. 2, Prentice Hall of India, New Delhi, 1984.

REFERENCE BOOKS

1. J.E. Shigley and J.J. Uicker, *Theory of Machines and Mechanisms,* McGraw-Hill, New York, 1995.
2. R.L. Norton, *Design of Machinery,* McGraw-Hill, New York, 1999.
3. Kenneth J. Waldron, Gary L. Kinzel, *Kinematics, Dynamics and Design of Machinery*, John Wiley & Sons, 1999.

MTDE 23 ADVANCE MATERIALS SCINECE AND ENGINEERING

Class: **M.Tech. II Semester** *Lectures:*3
Branch:Mech. Engg. (Design Engg). *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1. **Introduction to Engineering Materials:** Types of materials, material engineering Structures of solids, crystalline materials, formation crystal structures, Determination of structure, Defects in materials, their classification and significance. Effects of defects on properties.

2 **Non-crystalline Solids:** Types and their structures, Importance of non-crystalline structure, Role of bonding on structures, Multi componenet phases and their structures. Effect of various factors on phase formation, phase diagrams and their significance. Non-equilibrium structures.

3 **Structural Modifications:** Atomic movement in solid state. Transformation kinetics Tailoring of macrostructures. Typical heterogeneous transformations.

4. **Mechanical behavior of Materials:** Introduction, deformation processes. Fatigue, creep and Fracture and their behavior. Determination of properties of materials.

5. **Composite Materials:** Introduction, Principle classification, Materials for reinforcement and matrix, their characterstics, Processing techniques for composites, Micro-mechanics of composites, Mechanical properties of composites, Applications of composites.

6. **Surface Engineering:** Surface cleaning and finishing, surface plantings, Conversion coating,s hard facing, thermal spraying, diffusion processes, Spefcial surface treatments, organic coatings, process selection

7. **Materials Selection:** Design process, selection factos, Materials for typical machine componenents, Selection case histories.

TEXT BOOK

1 V.S.R. Murthy, AK. Jena, K.P. Gupta and G.S.Murthy, *Structure and properties of Engineering Materials*, Tata McGraw-Hill Publishing Company, 2003.

2 Kenneth G. Budinski, Michael K. Budinski, *Engineering Materials properties and Selection, 7/e,* Prentice Hall of India, 2003.

REFERENCE BOOKS

1. William D. Callister, Jr, *Materials, Science and Engineering: An Introduction, 6/e,* John Wiley & Sons, 2004.
2. Donald R. Askeland *A Science of Engineering Materials,* University of Missouri, Rolla.

MTDE 24 AUTOMATION AND ROBOTICS

Class: **M.Tech. I Semester** *Lectures:* **3**
*Branch: Mech. Engg. (*Design Engg**).*** *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1. Manufacturing Automation: Introuduction, Types of automations, automation strategies. Automated flow lines and automated assembly systems. Automated Material Handling and Storage system: Conveyors, AGVs, AS/RS and identification & data collections sytems.

2. Automated Manufacturing Systems: Introudction to NC, CNC & DNC and Adaptive control. Programmable Logic Controllers: logic control and sequencing elements. Automated Inspection Systems: CMM, Machine Vision, flexible inspection systems.

3. Basic concepts in robotics: classification of robotics, Drives and control system for robotics, Robot work cell design and applications

4. Robot arm kinematics: Direct kinematics, transformation matrices for rotations, combined rotations, Denavit -Hartenberg representation.

5. Control of robot manipulators: control of robot arm, computed torque technique, feed back control, resolved motion control,

6. Robot vision and sensing: Different types of sensors, proximity, touch, force and torque sensors, low level and high level vision, vision systems

TEXT BOOK

1. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, *Robotics*, McGraw Hill, 1987.
2. M.P.Groover, "Automation, Production Systems and Computer Integrated Manfucaturing", PHI, New Delhi.

REFERENCES

1. Y.Koren, *Robotics for Engineers,* McGraw Hill, 1985.
2. J.J. Craig, *Robotics,* Addison-Wesley, 1986.

MTDE 25 MEMS AND NANOTECHNOLOGY

Class: **M.Tech. II Semester** *Lectures:*3
Branch:Mech. Engg. (Design Engg). *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

2. Overview of MEMS and Microsystems: Typical MEMS and Microsystem products. Evolution of Microfabrication. Microsystems and Miniaturization. Applications of Microsystems in Automotive Industry, Healthcare Industry, Aerospace Industry, Applications in Industrial products, Consumer products. Applications in Telecommunications.

3. Working Principles of Microsystems: Microsensors,. Microactuation, MEMS with Microactuators, Micro accelerators, Microfluidics.

4. Engineering Science for Microsystems Design: Ions and Ionization, Doping of Semiconductors, the Diffusion process, Plasma physics, Electrochemistry, Quantum Physics. Microsystem Fabrication Processes: Photolithography, Ion implantation, Diffusion, Oxidation, Chemical vapor deposition, Physical vapor Deposition-Sputtering, Deposition by Epitaxy, Etching. Overview of Micromanufacturing-Bulk micromanufacturing, Surface micromachining, the LIGA process.

5. Materials for MEMS and Microsystems: Substrates and Wafers, Active Substrate Materials, Silicon compounds, Silicon Piezo resistors, Gallium Arsenide, Quartz, Piezoelectric crystals, Polymers, Packaging Materials.

6. Scaling Laws in Miniaturization: Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic forces, Electromagnetic forces, Electricity, Fluid Mechanics, Heat Transfer.

7. Microsystems Design and Packaging: Design considerations, Process Design, Mechanical Design, Mechanical Design using FEM, Design of a Silicon Die for a micropressure sensor, Design of Microfludic Network systems. Essential packaging Technologies. Selection of packaging Materials, Signal Mapping and Transduction.

8. Nanotechnology, Nanomachines, Nanorobots, Nanotubes, Nanowires, Nanomechanical amplifiers, Nanotransisters, tera-storage devices, Molecular engineering, DNA computing, Nanomedicine, Smart pills, Nanofabrication of structures.

TEXT BOOK

2. T-R. Hsu, *MEMS & Microsystems: Design and Manufacture*, Tata McGraw-Hill, New Delhi, 2002.

REFERENCE BOOKS

1. M.E.lwenspoek and R. Wiegerink, *Mechanical Microsensors*, Springer-Verlag, 2001
2. G.T.A. Kovacs, *Micromachined Transducers Source Book*, McGraw-Hill, 1998.
3. S.D. Senturia, *Microsystem Design*, Kluwer, 2001.
4. *http;//www.wpi.edu/`chslt*
5. K. Eric Drexler, *Nanosystems: Molecular Machinery, Manufacturing, and Computation*, John Wiley, New York, 2002.
6. Charles P. Poole, Jr., Frank J. Owens, *Introduction to Nanotechnology* , John Wiley, 2002.

MTDE 26A FAULT DIAGNOSIS OF MACHINES

Class: **M.Tech. II Semester** *Lectures:*3
Branch:Mech. Engg. (Design Engg). *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1. **Introduction**: System failure, component failure, failure decisions, failure classifications, types of failure, failure investigations, causes of failure, Methods of maintenance- condition based maintenance, preventive maintenance, proactive maintenance, time based maintenance, predictive maintenance.

2 **Condition Monitoring**: Need and importance of condition monitoring, the decision to monitor, common monitoring techniques, online/off-line monitoring, commonly measured operating characteristics, condition monitoring/predictive maintenance as used in industry.

3 **Transducers and Instrumentation for Recording and Analysis**: Vibration transducers, Displacement transducers, velocity pickups, accelerometers, Temperature transducers, Vibration meters, FFT analyzers, Time domain instruments, Tracking analyzers, Magnetic tape recorders, amplifiers.

4 **Analyzing Machine Condition**: General characteristics-Process measurements, vibration. Typical vibration sources, symptoms of other common machinery problems. Development and use of acceptance limits-guide lines and limits based on physical constraints, Vibration severity criteria, changing machinery condition-time trends, statistical limits, detailed diagnostic monitoring.

5 **Data Processing & Vibration Analysis**: Fourier analysis, frequency analysis techniques, vibration signature, vibration monitoring equipment, system monitors and vibration limit detectors.

6 **Performance Trend Monitoring**: Primary and secondary performance parameters, performance monitoring systems.

TEXT BOOKS

1 Collacott, R.A., *Mechanical Fault Diagnosis and Condition Monitoring,* Chapman and Hall, London, 1977.
2 John S.Mitchell: *Introduction to Machinery Analysis and Monitoring,* 2/e, Pennwell Books, Oklahama.

REFRENCE BOOKS

1. Trever M. Hunt, *Condition Monitoring of mechanical & Hydraulic Plant* A concise introduction and guide, Chapman & Hall, Madras
2. Philip Wild, *Industrial Sensors and applications for Condition Monitoring*, Mechanical Engineering Publications Ltd., London
3. Joseph Mathew, *Common Vibration Monitoring Techniques – handbook of Condition Monitoring*, Chapman & Hall, 1998

MTDE 26B FATIGUE, FRACTURE AND FAILURE ANALYSIS

Class: **M.Tech. II Semester** *Lectures:*3
Branch:Mech. Engg. (Design Engg). *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1. Introduction to fatigue and fracture mechanics, ductile and brittle fractures.
2. Mechanism of fatigue crack initiation and propagation, fatigue data representation,
3. Factors influencing fatigue strength, life prediction, prevention of fatigue failures, corrosion fatigue.
4. Linear elastic fracture mechanics, determination of fracture toughness, elastic plastic fracture mechanics, sub-critical growth in reactive environment.
5. Fatigue and fracture safe designs.
6. Investigation and analysis of failures, case studies in fatigue and fracture mechanics.

TEXTBOOK

1 S.T. Rolfe and J.M. Barsom, *Fracture and Fatigue Control in Structure*, Prentice Hall, 1977.

REFERENCES

1. D.Broek, Elementary Engineering Fracture Mechanics, Noordhoff, 1975.
2. S,Kocanda: Fatigue failure of Metals, Synthofford Noordhoff, 1978.
3. N.E. Fros, et al. Metal fatigue, Clarendon Press, 1974.
4. American Society for Metals, Case histories in failure analysis, ASM, 1979.

MTDE 26C DESIGN OF MATERIAL HANDLING EQUIPMENT

Class: **M.Tech. II Semester** *Lectures:*3
Branch:Mech. Engg. (Design Engg). *University Examination:* **100 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

1. **Objectives of material handling systems and the basic principles, classification and selection of material handling equipment, characteristics and applications.**

2. **Discussion of various material handling equipment functions and parameters effecting service, packaging and storage of materials and their relations with material handling.**

3. **Theory, construction and design of various component parts of mechanical handling devices, wire ropes, chains, hooks, shackles, grabs, ladles, and lifting electromagnets, pulleys, sheaves, shears, sprockets and drums, winches, brakes and ratchet stops, gears and power transmission systems, runner wheels and rails, buffers and controls of travel mechanisms.**

4. **Kinematics and dynamic analysis of various types of cranes and elevators. Stability and structural analysis.**

5. **Discussion of principles and application of conveyors and related equipment.Design of various types of conveyors and their elements. Fault finding and failure analysis of material handling systems.**

TEXT BOOKS

1. N. Rudenko, *Material Handling Equipment,* Peace Publishers, Moscow.
2. Spivakovsky and V. Dyachov, *Conveyors and Related Equipment,* Peace Publishers, Moscow.

REFERENCE BOOKS

1. R. John Immer, *Material Handling*, McGraw-Hill, 1953.
2. E. Ernst, *Die Hebezeuge, Band I and II,* Springer Verlag, 1978.

MTDE 27 FEM LAB

Class: **M.Tech. II Semester** *Lectures:*3
Branch:Mech. Engg. (Design Engg). *University Examination:* **50 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

List of Exercises

Part A:

Students will be allotted individual course projects that involve development of code using MATLAB. At the end of the Semester, each student will be required to present the results of the problem obtained from the code.

Part B:

1. Statically indeterminate reaction force analysis
2. Beam stresses and deflections
3. Thermally loaded support structure
4. Deflection of a hinged support
5. Residual stress problem
6. Combined bending and torsion
7. Bending of a solid beam(Plane elements)
8. Tie rod with lateral loading
9. Thermal structural contact of two bodies
10. Stresses in a long cylinder

Exercises from Part B will be solved using ANSYS package during regular class work in each week.

REFERENCEBOOKS

1. **Chandrupatla, T.R. and Belegundu, A.D.,** *Introduction to finite Elements in Engineering, 2/e,* Pearson Education, New Delhi, 2003.
2. ANSYS 5.6, Verification Manual.
3. ANSYS Structural Analysis Guide.

MTDE28 AUTOMATION & ROBOTICS LAB

Class: **M.Tech. I Semester** *Lectures:*3
Branch:Mech. Engg. (Design Engg). *University Examination:* **50 marks**
Duration of University Examination: **3 hours** *Sessionals:* **50 marks**

LIST OF EXPERIMENTS

1. Controlling of AC Non Servo motors using LS controller
2. Controlling of DC Servo motors using LS controller
3. Integration of PLC and PMC.
4. Simulation of Robot Motion using Robo X software
5. Study of Automated machines.
6. Simulation of Manufacturing and Material handling systems.

MTDE 29 COMPREHENSIVE VIVA

Class: **M.Tech. II Semester** *University Examination:* **100 marks**
Branch:Mech. Engg. (Design Engg).

The viva includes questions from all the subjects of first and second semesters with more emphasis on Design concepts and procedures.

MTDE 31 INDUSTRIAL TRAINING

Class: **M.Tech. III Semester** *Sessionals:* ***50 marks***
Branch:Mech. Engg. (Design Engg).

The candidate should submit the report and present talk on the training undergone highlighting the contents of the Report before the internal evaluation committee.

MTDE 32 DISSERTATION

Class: **M.Tech. III Semester** *Sessionals: 100 marks*
Branch:Mech. Engg. (Design Engg). University Examination: **100 marks**

The candidate will chose the topic of the Project Work in consulation witht the Guide allotted. A report in the presecribed format is to be submitted that includes extensive survey of literature on the topic, highlighting the scope of the work. It should also state the methodology to be adopted and work involved in different modules of the Project Work. The report should clearly specify the expected outcome.

The candidate should submit the report and present a talk on the work done, highlighting the contents of the Report before the internal evaluation committee.

MTDE 41 DISSERTATION & VIVA-VOCE

Class: **M.Tech. III Semester** *Sessionals: 100 marks*
Branch:Mech. Engg. (Design Engg). University Examination: **100 marks**

The candidate should submit the report and present a talk on the work done, highlighting the conclusions drawn and outcome of the work before the evaluation committee.