JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

Course Structure and syllabus for M.Tech-ME-Machine Design
for affiliated Engineering Colleges 2017-18

I YEAR I SEMESTER

S. No	Course code	Subject	L	T	P	C
1.	17DBS101	Computational Methods	4	-	-	4
2.	17D04101	Advance Finite element methods	4	-	-	4
3.	17D15101	Advanced Mechanisms	4	-	-	4
4.	17D15102	Advanced Mechanics of Solids	4	-	-	4
5.	 17D15103 17D15109 17D15105	Elective –I a. Computer Applications in Design b. Materials Technology c. Quality Concepts in Design	4	-	-	4
6.	 17D15106 17D15107 17D04105	Elective – II a Tribology in Design b Gear Engineering c Design of Hydraulic and Pneumatic Systems	4	-	-	4
7.	17D15108	Simulation Lab		-	3	2
		Total	24	-	3	26

I YEAR II SEMESTER

S. No	Course code	Subject	L	T	P	C
1.	17D04201	Advanced Optimization Techniques	4	-	-	4
2.	17D15201	Fracture fatigue and creep deformation	4	-	-	4
3.	17D04202	Industrial Robotics and Expert system	4	-	-	4
4.	17D15202	Mechanical Vibrations	4	-	-	4
5.	 17D15203 17D15204 17D15205	Elective – III a. Experimental Stress Analysis b. Theory of Plasticity c. Applied Engineering Acoustics	4	-	-	4
6.	 17D04109 17D15206 17D15207	Elective – IV a. Design for Manufacturing b. Pressure Vessel Design c. Mechanics of Composite Materials	4	-	-	4
7.	17D15208	Machine Dynamics Lab	-	-	3	2
		Total	24	-	3	26

III SEMESTER

S. No	Subject Code	Subject	L	T	P	C
1.	 17D20301 17D20302 17D20303	Elective V a) Research Methadology b) Human Values and Professional Ethics c) Intellectual Property Rights	4	-	-	4
2.	17D15301	Elective VI (MOOCS)	-	-	-	-
3.	17D15302	Comprehensive Viva – Voice	-	-	-	2
4.	17D15303	Seminar	-	-	-	2
5.	17D15304	Teaching Assignment	-	-	-	2
6.	17D15305	Project work phase – I	-	-	-	4

IV SEMESTER

S.No	Subject Code	Subject	L	T	P	C
1.	17D15401	Project work Phase – II	-	-	-	12

Project Viva Voce Grades:

A: Satisfactory
B: Not Satisfactory

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

L	T	P	C
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(17DBS101) COMPUTATIONAL METHODS

Course objectives:

1. Students will demonstrate aptitude in standard numerical techniques for solving various classes of problems.
2. Students will learn the theory underlying the derivation of standard numerical techniques and the development of algorithms.
3. Modeling of engineering problems drawn from different disciplines of mechanical engineering.

UNIT–I

Introduction to numerical methods applied to engineering problems: Examples, solving sets of equations – Matrix notation – Determinants 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 – Rayleigh – Ritz method – Characteristic value problems.

Unit – III

Numerical solutions of partial differential equations: Laplace's equations – Representations 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.

Unit – VI

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

Hyperbolic partial differential equations: Solving wave equation by finite differences-stability of numerical method –method of characteristics-wave equation in two space dimensions-computer programs.

Unit – V

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.

Course outcomes:

1. To enable students to formulate and solve engineering problems that are not amenable to analytical methods.
2. To demonstrate the application of numerical methods to data analysis and optimal design.

TEXT BOOKS:

1. "Numerical Methods for Engineers", Steven C.Chapra, Raymond P.Canale Tata Mc-Graw hill
2. "Applied numerical analysis", Curtis F.Gerald, partick.O.WheatlyAddison-wesley,1989
3. "Numerical methods", Douglas J..Faires,Riched BurdenBrooks/cole publishing company,1998.Second edition.

REFERENCES:

1. "Numerical mathematics and computing", Ward cheney &David Kincaid Brooks/Cole publishing company1999,fourth edition.
2. "Mathematical methods for physics and engineering"Riley K.F.M.P.Hobson.&.Bence S.J.Cambridge university press,1999.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

L	T	P	C
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(17D04101) ADVANCED FINITE ELEMENT METHODS

Course objective: You learn modern analysis techniques used widely in engineering practice and the sciences, and you use these techniques in a general finite element program.

You learn how to establish computational models of problems of solids and fluids, solve them on your laptop, and assess the accuracy of the results.

You capitalize on your knowledge of mechanics, reinforce your knowledge, and solve problems that can only be tackled numerically on the computer. Great knowledge in your tool box whatever your goals.

UNIT – I

Formulation Techniques: Methodology, Engineering problems and governing differential equations, finite elements., Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of variations, Essential and natural boundary conditions.

UNIT – II

One-dimensional finite element methods: Bar elements, temperature effects. Element matrices, assembling of global stiffness matrix, Application of boundary conditions, Elimination and penalty approaches, solution for displacements, reaction, stresses, temperature effects, Quadratic Element, Heat transfer problems: One-dimensional, conduction and convection problems. Examples: - one dimensional fin,

UNIT – III

Trusses: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses, temperature effects.
Beams and Frames: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses.

UNIT – IV

Two dimensional problems: CST, LST, four noded and eight nodded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions. Heat Transfer problems: Conduction and convection, examples: - two-dimensional fin.
Isoparametric formulation: Concepts, sub parametric, super parametric elements, numerical integration.

UNIT – V

Finite elements in Structural Dynamics: Dynamic equations, eigen value problems, and their solution methods, simple problems.

Convergence: Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, pascal's triangle.

Course out comes: Students will learn the mathematical formulation of the finite element method and how to apply it to basic (linear) ordinary and partial differential equations. Students will also learn how to implement the finite element method efficiently in order to solve a particular equation.

TEXT BOOK:

Introduction to Finite element methods by Chandraputla & Ashok D.Belagondu by Pearson 2012
An introduction to Finite element methods by VN Reddy published by Mcgraw Hill 2006.

REFERENCES:

1. Finite element method in Heat transfer and fluid dynamics, J.N.Reddy, CRC press,1994
2. Finite Element Method, Zienckiwicz O.C. & R. L. Taylor,McGraw-Hill,1983.
3. Finite Element of Nonlinear continua, . J. N. Oden, McGraw-Hill, New York, 1971.
4. Finite element procedures, K. J. Bathe, Prentice-Hall, 1996.

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M. Tech – I year I Sem. (Machine Design) **L T P C**
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(17D15101) ADVANCED MECHANISMS

Course Objectives:

To develop student understanding of the theoretical background for basic and advanced kinematics and synthesis of mechanisms to achieve desired motion.
To introduce students to basic and advanced computer-based tools for analysis and synthesis of mechanisms.
To provide an opportunity for students to use theory and application tools through a major mechanism design project.
To improve student ability to communicate understanding of the subject through professional technical reports and oral presentations.

Unit - I

Introduction: Elements of Mechanisms; Mobility Criterion for Planar mechanisms and manipulators; Mobility Criterion for spatial mechanisms and manipulators. Spherical mechanisms-spherical trigonometry.
Kinematics of plane motion- I: The Inflection circle ; Euler – Savary Equation; Analytical and graphical determination of d_i ; Bobillier's Construction ;Collineastion axis ; Hartmann's Construction ;Inflection circle for the relative motion of two moving planes; Application of the Inflection circle to kinematic analysis.

Unit – II

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; etermination 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 of a four bar mechanism.

Unit - III

Introduction to Synthesis-Graphical Methods: The Four bar linkage ;Guiding a body through Two distinct positions; Guiding a body through Three distinct positions; The Rotocenter triangle ; Guiding a body through Four distinct positions; Burmester's curve.
Function generation- General discussion; Function generation: Relative –rotocenter method, Overlay's method, Function generation- Velocity – pole method; Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem.

Unit – IV

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.

Unit - V

Manipulator kinematics: D-H notation, D-H convention of assignment of co-ordinate frames and link parameters table;D-H transformation matrix ; Direct and Inverse kinematic analysis of Serial manipulators: Articulated ,spherical & industrial robot manipulators- PUMA, SCARA,STANFORD ARM, MICROBOT.
Differential kinematics Formulation of Jacobian for planar serial manipulators and spherical manipulator; Singularity analysis.

Course Outcomes: In this course, we will study advanced topics in kinematics with a focus of mechanism synthesis techniques. The course will primarily focus on planar mechanism, but will also treat spherical and spatial mechanisms. Course content will come from a variety of sources including class notes, texts, and journal articles. Course topics will be applied through a semester long design project. Topics of study include: review of kinematics fundamentals, classification of mechanisms, type synthesis, graphical synthesis techniques, and analytical synthesis techniques including dyad form, ground pivot specification, M&K circles, Burmester curves, Chebychev spacing, velocity synthesis, four and five prescribed positions, and multi-loop synthesis. Spherical mechanisms, spatial mechanisms, spatial transformations, and spatial dyad synthesis will also be discussed. This course will involve large amounts of team interaction through active learning activities in class and a major design project, which will implement the key topics presented in class through practical applications.

Text Books:

1. Jeremy Hirschhorn, Kinematics and Dynamics of plane mechanisms, McGraw-Hill,1962.
2. L.Sciavicco and B.Siciliano, Modelling and control of Robot manipulators, Second edition, Springer -Verlag,London,2000.
3. Amitabh Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines. E.W.P.Publishers.

REFERENCES:

1. Allen S.Hall Jr., Kinematics and Linkage Design, PHI,1964.
2. J.E Shigley and J.J . Uicker Jr., Theory of Machines and Mechanisms , McGraw-Hill, 1995.
3. Mohsen Shahinpoor, A Robot Engineering Text book,Harper & Row Publishers, New York,1987.
4. Joseph Duffy, Analysis of mechanisms and Robot manipulators, Edward Arnold,1980

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

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(17D15102) ADVANCED MECHANICS OF SOLIDS

Course Objectives: After completing this course, the students would be able to 1. describe the concept of "stress at a point" (state of stress and strain in 3D) 2. analyze the transformation of stress and strain in 3D including the utilization of yield criteria 3. apply the knowledge to design the mechanical structures in the view point of both strength and deformation including the design by means of numerical simulation.

Unit I

Shear center: 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 loads-stresses in chain links.

Torsion : Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section ;Hollow thin wall torsion members ,Multiply connected Cross Section.

Unit III

Contact stresses: Introduction; problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Method 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.

Unit IV

Two Dimensional Elasticity Problems: Plane stress & Plain strain-Problems in Rectangular Co-ordinates, bending of cantilever loaded at the end, bending of a beam by uniform load.

general equations in polar coordinates, stress distribution symmetrical about an axis, pure bending of curved bars, displacements for symmetrical stress distributions, rotating discs.

Unit V

Introduction to Three Dimensional Problems: Uniform stress stretching of a prismatical bar by its own weight, twist of circular shafts of constant cross section, pure bending of plates.

Course outcomes: Fundamental Concept, Introduction to Cartesian Tensors, Two and Three Dimensional Theories of Stress and Strain (Method of Continuum Mechanics, Theory of Elasticity), Generalized Hooke's Law (Linear Stress-Strain-Temperature), Energy Principal in Solid Continuum, Application of Energy Methods, Inelastic Material Behavior, Theories of Failure, Application of Elasticity

TEXTBOOKS:

1.Advanced Mechanics of materials by Boresi & Sidebottom-Wiely International.
2. Theory of elasticity by Timoschenko S.P. and Goodier J.N. McGraw-Hill Publishers 3/e

REFERENCES:

1. Advanced strength of materials by Den Hortog J.P.
2. Theory of plates – Timoshenko.
3. Strength of materials & Theory of structures (Vol I & II) by B.C Punmia
4. Strength of materials by Sadhu singh

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

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(17D15103) COMPUTER APPLICATIONS IN DESIGN
(Elective-I)

Course objective:
To impart knowledge on computer graphics which are used routinely in diverse areas as science, engineering, medicine, etc.

UNIT I
INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS
Output primitives (points, lines, curves etc.,), 2-D & 3-D transformation (Translation, scaling, rotators) windowing - view ports - clipping transformation.

UNIT II CURVES AND SURFACES MODELLING
Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations. Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface , surface of revolution and tabulated cylinder – synthetic surfaces: Hermite bicubic surface- Bezier surface and B-Spline surface- surface manipulations.

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

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

UNIT V ASSEMBLY OF PARTS AND PRODUCT DATA EXCHANGE
Assembly modeling - interferences of positions and orientation - tolerances analysis - mass property calculations - mechanism simulation. Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc– Communication standards..

Course outcome:
With laboratory classes in conjunction, It helps the students to get familiarized with the computer graphics application in design. This understanding reinforces the knowledge being learned and shortens the overall learning curves which are necessary to solve CAE problems that arise in engineering.

REFERENCES
1. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", Mc Graw Hill Book Co. Singapore, 1989.
2. Donald Hearn and M. Pauline Baker "Computer Graphics", Prentice Hall, Inc., 1992.
3. Ibrahim Zeid Mastering CAD/CAM – McGraw Hill, International Edition, 2007.
4. Foley, Wan Dam, Feiner and Hughes – Computer graphics principles & practices, Pearson Education – 2003.
5. David F. Rogers, James Alan Adams "Mathematical elements for computer graphics" second edition, Tata McGraw-Hill edition.

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

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(17D15109) MATERIALS TECHNOLOGY
(Elective-I)

Course objective: The student should be able to understand and classify the sub branches and domains of Materials & Metallurgical Engineering stream.
The student should be able to analyze the possible opportunities in the domains of Materials & Metallurgical Engineering.
The student should be able to understand all basic principles involved in the theory of Elasticity and Plasticity

Unit – I
Elasticity in metals and polymers: Mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening.

Unit – II
Poly phase mixture, precipitation: particle, fiber and dispersion strengthening , effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non crystalline material.
Motivation of selection, cost basis and service requirements, selection for mechanical properties, strength, toughness, fatigue and creep.

Unit – III-
Modern metallic Materials: Dual phase steels, micro alloyed, high strength low alloy (HSLA) Steel, transformation induced plasticity (TRIP) Steel, maraging steel, intermetalics, Ni and Ti aluminides

Unit – IV-
Smart materials: shape memory alloys, metallic glass, quasi crystal and nano crystalline materials.
Non metallic materials: Polymeric materials and their molecular structures, production techniques for fibers, foams, adhesives and coatings, structure, properties and applications of engineering polymers.

Unit – V-
Advanced structural ceramics : WC, TiC, TaC, Al2O3, SiC, Si3 N4, CBN and diamond-properties, processing and applications.
Advance structural composites; Introduction, reinforcement, types of composite materials, -properties, processing and application, and mechanics of composite materials.

Course outcomes: The student will be able to understand and create the areas and domains in Materials & Metallurgical Engineering on the basis of his/her interestand opportunity available in present industrial scenario.
The student will be able to understand the basic principles of selection of materials and challenges to entrepreneurs in metallurgy

TEXT BOOKS:

1. Mechanical behavior of materials/Thomas H.Courtney/2nd Edition, McGraw-Hill, 2000
2. Mechanical Metallurgy/George E.Dieter/McGraw Hill, 1998

REFERENCES:

1. Selection and use of Engineering Materials 3e/Charles J.A/Butterworth Heiremann.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M. Tech – I year I Sem. (Machine Design)	**L**	**T**	**P**	**C**
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(17D15105) QUALITY CONCEPTS IN DESIGN
Elective-I

Course objectives:

To impart knowledge on various concepts in engineering design and principles of implementing quality in a product or service through tools such as quality houses, control charts, statistical process control method, failure mode effect analysis and various strategies of designing experiments, methods to uphold the status of six sigma and improve the reliability of a product.

To gather knowledge on fundamentals of design and its methods, robust design, embodiment principles, various methods in design of experiments, reliability, statistical tools and six sigma techniques.

UNIT I

DESIGN FUNDAMENTALS, METHODS AND MATERIAL SELECTION

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

UNIT II

DESIGN FOR QUALITY

Quality Function Deployment **-**House of Quality-Objectives and functions-Targets-Stakeholders-Measures and Matrices-Design of Experiments –design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design –testing noise factors- Running the experiments – Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

UNIT III

FAILURE MODE EFFECT ANALYSIS AND DESIGN FOR SIX SIGMA

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

DESIGN OF EXPERIMENTS

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

UNIT V

STATISTICAL CONSIDERATION AND RELIABILITY

Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams-Cause and Effect diagrams-Box plots- Probability distribution-Statistical Process control–Scatter diagrams –Multivariable charts –Matrix plots and 3-D plots.-Reliability-Survival and Failure-Series and parallel systems-Mean time between failure-Weibull distribution

Course outcomes:

It helps the design cum quality engineer to get familiarized with various concepts in design, quality and reliability principles in the design of an engineering product or a service.

REFERENCES

1. Dieter, George E., "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Editions, Singapore, 2000.
2. Product Design Techniques in Reverse Engineering and New Product Development, KEVIN OTTO & KRISTIN WOOD, Pearson Education (LPE), 2001.
3. Product Design And Development, KARL T. ULRICH, STEVEN D. EPPINGER, TATA McGRAW-HILL- 3rd Edition, 2003.
4. The Management and control of Quality-6th edition-James R. Evens, William M Lindsay Pub:son south-western(www.swlearning.com)
5. Fundamentals of Quality control and improvement 2nd edition, AMITAVA MITRA, Pearson Education Asia, 2002.
6. Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons, 2003.
7. Phillip J.Rose, Taguchi techniques for quality engineering, McGraw Hill, 1996.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

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(17D15106) TRIBOLOGY IN DESIGN
Elective-II

Course objective: Majority of mechanical equipment / mechanisms involve relative motion of links or parts. The course intends to impart concepts of friction, wear and lubrication and application of tribology in design of mechanical components is also introduce

Unit – I

Introduction: Nature of surfaces and contact-Surface topography-friction and wear mechanisms and effect of lubricants- methods of fluid film formation.

Selection of rolling element bearings: Nominal life, static and dynamic capacity-Equivalent load, probabilities of survival- cubic mean load- bearing mounting details, pre loading of bearings, conditioning monitoring using shock pulse method.

Unit – II

Hydrodynamic bearings: Fundamentals of fluid formation – Reynold's equation; Hydrodynamic journal bearings – Sommerfield number- performance parameters – optimum bearing with maximum load capacity – Friction – Heat generated and Heat dissipated. Hydrodynamic thrust bearings; Raimondi and Boyd solution for hydrodynamic thrust bearings- fixed tilting pads, single and multiple pad bearings-optimum condition with largest minimum film thickness.

Unit – III

Hydrostatic Bearings: Thrust bearings – pad coefficients- restriction- optimum film thickness- journal bearings – design procedure –Aerostatic bearings; Thrust bearings and Journal bearings – design procedure.

Dry rubbing Bearings: porous metal bearings and oscillatory journal bearings – qualitative approach only.

Unit – IV

Lubrication: Choice of lubricants, types of oil, Grease and solid lubricants- additives- lubrication systems and their selection – selection of pump, filters, piping design- oil changing and oil conservation.

Unit – V

Seals: different type-mechanical seals, lip seals, packed glands, soft piston seals, Mechanical piston rod packing, labyrinth seals and throttling bushes, oil flinger rings and drain grooves – selection of mechanical seals.

Failure of Tribological components: Failure analysis of plain bearings, rolling bearings, gears and seals, wear analysis using soap and Ferrography.

Course Outcome: After learning the course the students should be able to: 1. Understand the fundamentals of tribology and associated parameters. 2. Apply concepts of tribology for the performance analysis and design of components experiencing relative motion.

Text Books:

1. Rowe WW& O' Dionoghue,"Hydrostatic and Hybrid bearing design " Butterworths & Co.Publishers Ltd,1983.
2. Collacott R.A," Mechanical Fault diagnosis and condition monitoring", Chapman and Hall, London 1977.
3. Bernard J.Hamrock, " Fundamentals of fluid film lubricant", Mc Graw-Hill Co.,1994.

References:

1. 1.Neale MJ, (Editor) " Tribology hand Book"Neumann Butterworths, 1975.
2. 2.Connor and Boyd JJO (Editors) " Standard hand book of lubrication engineers " ASLE,Mc Graw Hill Book & Co.,1968
3. Shigley J, E Charles," Mechanical Engineering Design", McGraw Hill Co., 1989

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

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(17D15107) GEAR ENGINEERING
Elective-II
(PSG Design data Book to be used and allowed in Examinations)

Course objective:This course introduces all varieties of Circuit Breakers and Relays for protection of Generators, Transformers and feeder bus bars from over voltages and other hazards. It emphasis on Neutralgrounding for overall protection.

Unit – I

Introduction: Principles of gear tooth action, Generation of Cycloid and Involute gears, Involutometry, gear manufacturing processes and inspection, gear tooth failure modes, stresses, selection of right kind of gears.

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

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.

Unit – III

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 – IV

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

Gear failures

Analysis of gear tooth failures, Nomenclature of geartooth wear and failure, tooth breakage, pitting, scoring, wear, overloading,gear-casing problems, lubrication failures

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, Constraints in gear train design-space, interference, strength, dynamic considerations, rigidity etc. Compact design of gear trains, multi objective optimization of gear trains. Application of Traditional and non-traditional optimization techniques

Course Outcome: the study of different gear are necessary to have an idea while designing the spur gear, helical gear, worm gear and Optimal Gear design

Text Books:

1. Maleev and Hartman, Machine Design, C.B.S. Publishers, India.
2. Henry E.Merrit,Gear engineering ,Wheeler publishing,Allahabad,1992.
3. Practical Gear design by Darle W. Dudley, McGraw-Hill book company

REFERENCES:

1. Earle Buckingham, Analytical mechanics of gears, Dover publications, New York, 1949.
2. G.M.Maitha, Hand book of gear design, TaTa Mc.Graw Hill publishing company Ltd., New Delhi,1994.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M. Tech – I year I Sem. (Machine Design)	**L**	**T**	**P**	**C**
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(17D04105) DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS
ELECTIVE -II

Course objective: power in Industry. Also to impart knowledge on the methodology of basic and advanced design of pneumatics and hydraulics systems. It helps students to get knowledge on the need, use and application of fluid power and make

UNIT I

OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS

Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics.

UNIT II CONTROL AND REGULATION ELEMENTS

Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems.

UNIT III HYDRAULIC CIRCUITS

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits- design and selection of components - safety and emergency mandrels.

UNIT IV PNEUMATIC SYSTEMS AND CIRCUITS

Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design.

UNIT V INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS

Pneumatic equipments- selection of components - design calculations – application -fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

Course outcomes: them familiar to industrial design that lead to automation. To impart students on the science, use and application of hydraulics and pneumatics as fluid.

REFERENCES

1. Antony Espossito, “Fluid Power with Applications”, Prentice Hall, 1980.
2. Dudleyt, A. Pease and John J. Pippenger, “Basic fluid power”, Prentice Hall, 1987.

3. Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishing House, 1999. 4. Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997. 5. K.Shanmuga Sundaram, “Hydraulic and Pneumatic Controls: Understanding made Easy" S.Chand & Co Book publishers, New Delhi, 2006 (Reprint 2009).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

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(17D15108) SIMULATION LABORATORY

I. Modeling

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

II. Structural Analysis using any FEA Package for different structures that can be discretised with,2-D & 3-D elements

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

III. Thermal Analysis using any FEA Package for different structures that can be discretised with 1-D,2-D & 3-D elements

1. Steady state thermal analysis
2. Transient thermal analysis

IV. Transient analysis using any FEA Package for different structures that can be discretised with 1-D,2-D & 3-D elements

1. Linear
2. Non-Linear (Geometrical Non-linearity)

REFERENCES:

User manuals of ANSYS package Version 10.0
PRO/E,I-DEAS Package /UNIGRAPHICS,CATIA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

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(17D04201) ADVANCED OPTIMIZATION TECHNIQUES

CourseObjectives: Many real-world problems require advanced techniques to formulate and to solve, and sometimes new optimization algorithms and procedures need to be designed. The objective of this class is to help students become optimizers, who have solid understanding of basic theory and also practical skills to model and solve real-world problems. Students will learn • a deeper understanding of the key concepts, theory, and algorithms of linear optimization, integer optimization, and some modern convex optimization, • more advanced modeling techniques, • ways of solving optimization problems that are too hard, too large for direction solution, • ways of solving optimization problems faster when speed is essential, • ways to assess the quality of sub-optimal solutions.

UNIT - I

Integer programming- cutting plane method and branch and bound technique, mixed integer programming

UNIT - II

Classical optimization techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

Numerical methods for optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method.

UNIT - III

Genetic algorithm (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, solving differential equations using GP.

UNIT – IV

Multi-Objective Decision making: Introduction to goal programming , Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems .

Introduction to Analytical hierarchical process, analytical network process.

UNIT V

Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

Course outcomes:Understand the basic theory and some advanced topics in linear optimization, integer optimization, and convex optimization. 2. Identify the proper optimization technique(s) to attempt when problems are too large or too complicated to solve in a straightforward way. 3. Use optimization software and implement solution algorithms involving largescale optimization techniques.. 4. Handle large data sets that accompany real-world optimization problems.

Text Books:

1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers

2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers

3. Engineering Optimization – S.S.Rao, New Age Publishers

4. Operation Research by Hamdy A. Taha, Person publications

REFERENCES:

1.Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers

2. Genetic Programming- Koza

3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

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(17D15201) FRACTURE, FATIGUE & CREEP DEFORMATION

Course objectives: Provide an understanding of the mechanics and micro-mechanisms of elastic and plastic deformation, creep, fracture, and fatigue failure, as applied to metals, ceramics, composites, thin film and biological materials.
Provide a thorough introduction to the principles of fracture mechanics.
Provide practical examples of the application of fracture mechanics to design and life prediction methods and reporting.
Provide a basis for the use of fractography as a diagnostic tool for structural failures.

UNIT-I
Introduction: Prediction of mechanical failure. Macroscopic failure modes; brittle and ductile behaviour. Fracture in brittle and ductile materials – characteristics of fracture surfaces; inter-granular and intra-granular failure, cleavage and micro-ductility, growth of fatigue cracks, The ductile/brittle fracture transition temperature for notched and unnotched components. Fracture at elevated temperature.
Griffiths analysis: Concept of energy release rate, G, and fracture energy, R. Modification for ductile materials, loading conditions. Concept of R curves.

UNIT-II
Linear Elastic Fracture Mechanics, (LEFM). Three loading modes and the state of stress ahead of the crack tip, stress concentration factor, stress intensity factor and the material parameter the critical stress intensity factor.
The effect of Constraint, definition of plane stress and plane strain and the effect of component thickness. The plasticity at the crack tip and the principles behind the approximate derivation of plastic zone shape and size. Limits on the applicability of LEFM.

UNIT-III
Elastic-Plastic Fracture Mechanics; (EPFM). The definition of alternative failure prediction parameters, Crack Tip Opening Displacement, and the J integral. Measurement of parameters and examples of use.
The effect of Microstructure on fracture mechanism and path, cleavage and ductile failure, factors improving toughness,

UNIT-IV
Fatigue: definition of terms used to describe fatigue cycles, High Cycle Fatigue, Low Cycle Fatigue, mean stress R ratio, strain and load control. S-N curves. Goodmans rule and Miners rule. Micromechanisms of fatigue damage, fatigue limits and initiation and propagation control, leading to a consideration of factors enhancing fatigue resistance. Total life and damage tolerant approaches to life prediction.

UNIT-V

Creep deformation: the evolution of creep damage, primary, secondary and tertiary creep. Micro-mechanisms of creep in materials and the role of diffusion. Ashby creep deformation maps. Stress dependence of creep – power law dependence. Comparison of creep performance under different conditions – extrapolation and the use of Larson-Miller parameters. Creep-fatigue interactions. Examples.

Course outcomes: Ability to use simple continuum mechanics and elasticity to determine the stresses, strains, and displacements in a loaded structure.
Understanding and mathematical modeling of the elements of plastic deformation, with respect to continuum and microscopic mechanisms.
Ability to use creep data to predict the life of structures at elevated temperatures and the understanding of mechanisms of creeep deformation and fracture.
Use of fracture mechanics to quantitatively estimate failure criteria for both elastically and plastically deforming structures, in the design of life prediction strategies, and for fracture control plans, with examples from automotive, aerospace, medical, and other industries.
Understanding of fatigue and how this affects structural lifetimes of components.
Design of metals, ceramics, composites, and biological materials for optimal failure and fatigue analysis.

TEXT BOOKS:

1. T.L. Anderson, Fracture Mechanics Fundamentals and Applications, 2nd Ed. CRC press, (1995)
2. B. Lawn, Fracture of Brittle Solids, Cambridge Solid State Science Series 2nd ed1993.
3. J.F. Knott, Fundamentals of Fracture Mechanics, Butterworths (1973)
4. J.F. Knott, P Withey, Worked examples in Fracture Mechanics, Institute of Materials.
5. H.L.Ewald and R.J.H. Wanhill Fracture Mechanics, Edward Arnold, (1984).
6. S. Suresh, Fatigue of Materials, Cambridge University Press, (1998)
7. L.B. Freund and S. Suresh, Thin Film Materials Cambridge University Press,(2003).
8. G. E. Dieter, Mechanical Metallurgy, McGraw Hill, (1988)
9. D.C. Stouffer and L.T. Dame, Inelastic Deformation of Metals, Wiley (1996)
10. F.R.N. Nabarro, H.L. deVilliers, The Physics of Creep, Taylor and Francis, (1995)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M. Tech – I year II Sem. (Machine Design)	**L**	**T**	**P**	**C**
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(17D04202) INDUSTRIAL ROBOTICS & EXPERT SYSTEMS

Course objective: Create a team name and choose roles for each person on the team. You may use the roles we have in the class or create roles as a team. An explanation of roles must be described of your journal. Give an example of a task that role would perform and a quote of what they might say. (Be specific to robotics.) A list of who is assigned to each role will be on page 3 of the journa l. Remember, your grade will be based on how well you work together. All students have contributed equally.
We have the ability to use our hands and cognitive skills to work together. This course involves a cognitive understanding of the process of designing a robot. This class gives students a real life experience on what it takes to be a professional engineer.

UNIT I
INTRODUCTION AND ROBOT KINEMATICS
Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.
UNIT II
ROBOT DRIVES AND CONTROL
Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.
UNIT III
ROBOT SENSORS
Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.
UNIT IV
ROBOT CELL DESIGN AND APPLICATION
Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.

UNIT V

ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

Course outcomes: For each challenge you must design a blue print in your team log. This will allow you to see your original design and any changes you make in making sure your robot meet's its objective. Remember to label each part and explain how many you need of each part

Build the robot. You MUST create the blue prints while building the robot. This will enable you to see if you included everything you need on the blue print. If you find that as you are building your robot you need more parts, you also need to add those parts to the blue print.

TEXT BOOK: 1. K.S.Fu, R.C. Gonzalez and C.S.G. Lee, "Robotics Control, Sensing, Vision and Intelligence", Mc Graw Hill, 1987.

REFERENCES

1. Yoram Koren," Robotics for Engineers' Mc Graw-Hill, 1987.
2. Kozyrey, Yu. "Industrial Robots", MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S.R." Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey," Industrial Robotics Technology, Programming and Applications", Mc Graw-Hill, Int. 1986.
6. Timothy Jordanides et al ,"Expert Systems and Robotics ", Springer –Verlag, New York, May 1991.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

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(17D15202) MECHANICAL VIBRATIONS

Course Objectives: Upon successful completion of this course, you will be able to understand basic and intermediate concepts necessary for the analysis of the dynamics of complex structures under various loading conditions. In particular, you will be able to: Syllabus ME 56300 – Mechanical Vibrations: Explain and correlate the structural properties of complex structures to the overall vibration characteristics in order to design systems having required dynamical properties. Apply theoretical and numerical procedures to predict the dynamic response of discrete or continuous structural systems under the most diverse loading conditions. Develop reduced order models to treat systems with a large number of DOF. Understand and implement approximate methods for the numerical solution of distributed parameter systems. Understand the main features of the dynamics of nonlinear lumped parameters systems.

Unit I

Single degree of Freedom systems: Undamped and damped free vibrations: forced vibrations ; coulomb damping; Response to harmonic 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 Vibration measuring instruments : Vibrometers, velocity meters & accelerometers

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.

Unit IV

Numerical Methods: Rayliegh's, stodola's, Matrix iteration, Rayleigh-Ritz Method and Holzer's methods.

Unit V

Continuous systems: Free vibration of strings – longitudinal oscillations of bars-traverse vibrations of beams- Torsional vibrations of shafts.

Critical speeds of shafts: Critical speeds without and with damping, secondary critical speed.

Course outcomes: The course will cover fundamental concepts on the vibration of mechanical systems including, but not limited to, review of systems with one degree for freedom, Lagrange's equations of motion for multiple degree of freedom systems, introduction to matrix methods, transfer functions for harmonic response, impulse response, and step response, convolution integrals for response to arbitrary inputs, principle frequencies and modes, applications to critical speeds, measuring instruments, isolation, torsional systems, introduction to nonlinear problems.

Text books:

1. Elements of Vibration Analysis by Meirovitch.
2. Mechanical Vibrations by G.K. Groover.

REFERENCES:

1. Vibrations by W.T. Thomson
2. Mechanical Vibrations – Schaum series.
3. Vibration problems in Engineering by S.P. Timoshenko.
4. Mechanical Viabrations – V.Ram Murthy.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

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(17D15203) EXPERIMENTAL STRESS ANALYSIS
Elective-III

Course objective:
To bring awareness on experimental method of finding the response of the structure to different types of load.

Unit – I
Introduction: Theory of Elasticity, Plane stress and plane strain conditions, Compatibility conditions. Three-dimensional stress strain relations.
Strain Measurement Methods: Various types of strain gauges, Electrical Resistance strain gauges, semiconductor strain gauges, strain gauge circuits, effect of poission ratio strain gauge results, measurements of residual strain general applications.

Unit – II
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.

Unit – III
Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometrical approach to Moire-Fringe analysis, the displacement field approach to Moire-Fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of Moire-Fringes, experimental procedure and techniques.

Unit – IV
Photo elasticity: Photo elasticity – Polariscope – Plane and circularly polarized light, Bright and dark field setups, Photo elastic 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 Coatings
Introduction, Coating stresses and strains, coating sensitivity, coating materials, application of coatings, effects of coating thickness, Fringe-order determinations in coatings, stress separation methods.

Course outcomes: The course covers the basic aspects of experimental stress analysis that includes exhaustive treatment of the most versatile techniques like photoelasticity and strain gauges and also a brief introduction to the emerging techniques like digital image correlation. In addition it also provides the fundamental aspects of six different experimental techniques such as Moiré, Brittle Coatings, Holography, Speckle Methods, Thermoelastic Stress Analysis and Caustics.

TEXT BOOKS :

1. Theory of Elasticity by Timoshenke and Goodier Jr
2. Experimental stress analysis by Dally and Riley,Mc Graw-Hill

REFERENCES:

1. A treatise on Mathematical theory of Elasticity by Love .A.H
2. Photo Elasticity by Frocht

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

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(17D15204) THEORY OF PLASTICITY
Elective-III

Course objectives: Student acquires information on elementary theory of plasticity inclusive the relationship between the external loading and non-linear permanent straining of hardened metallic isotropic and anisotropic continuum. The student will understand the fundamentals of progressive methods of metal forming process design, namely modeling and finite element simulation.

Unit – I

Introduction: Modeling Uniaxial behavior in plasticity. Index notation, Cartesian tensors.Yield and failure criteria Stress, stress deviator tensors. Invariants, principal, mean stresses. Elastic strain energy. Mohr's representation of stress in 2 & 3 dimensions. Haigh-Westergaard stress space. Equilibrium equations of a body. Yield criteria: Tresca's, von Mises rules, Drucker-Prager criterion, anisotropic yield criteria.

Unit – II

Strain at point: Cauchy's formulae for strains, principal strains, principal shear strains, derivative strain tensor. Strain-displacement relationships. Linear elastic stress strain relations, Generalized Hooke's law, nonlinear elastic stress strain relations

Principle of virtual work and its rate forms: Drucker's stability postulate, normality, convexity and uniqueness for an elastic solid. Incremental stress strain relations.

Unit – III

Criteria for loading and unloading: Elastic and plastic strain increment tensors, Plastic potential and flow rule associated with different Yield criteria, Convexity, normality and uniqueness considerations for elastic–plastic materials. Expansion of a thick walled cylinder.

Incremental stress strain relationships: Prandtl-Reuss material model. J_2 deformation theory, Drucker-Prager material, General Isotropic materials.

Unit – IV

Deformation theory of plasticity: Loading surface, Hardening rules. Flow rule and Druckers stability postulate. Concept of effective stress and effective strain, mixed hardening material. Problems.

Finite element formulation for an elastic plastic matrix: Numerical algorithms for solving non linear equations, Convergence criteria, Numerical implementations of the elastic plastic incremental constitutive relations.

Unit – V -

Bounding surface theory: Uniaxial and multiaxial loading anisotropic material behaviour Theroms of limit analysis : Statically admissible stress field and kinematically admissible velocity field. Upper and lower bound theorms, examples and problems.

Course outcomes: This is a postgraduate course aimed towards providing strong conceptual foundations for developing continuum theories of plastic deformation. In addition we develop several important formulations of plastic flow which are of much practical use in current industrial applications.
The course begins with a broad overview of plasticity. Next, all the pertinent concepts from continuum mechanics and thermodynamics are introduced. The general theory of plastic flow is then developed using the theory of continuous distribution of dislocations and irreversible thermodynamics.
Next we discuss the special cases when elasticity is either infinitesimal or absent. The concepts of associative flow rule, hardening, uniqueness, and stability are discussed in detail. We finish the lectures with an introduction to plastic waves.

Text books/References:

1. Plasticity for structural engineering W.F.Chen s and D.J.Han, Springer verlag-1987.
2. Mechanics of Materials –II, Victor E. Saouma

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

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(17D15205) APPLIED ENGINEERING ACOUSTICS
Elective-III

Course objectives:
To impart knowledge on the fundamentals of acoustics, its characteristics, its transmission in different media, usage of sound measuring instruments and the various sound control methods.

UNIT I
BASIC CONCEPTS OF ACOUSTICS
Scope of Acoustics – Sound pressure – Sound intensity – Sound power level Sound power – Wave motion – Alteration of wave paths –Measurement of sound waves – sound spectra – Sound fields – Interference – Standing waves – Acoustic energy density and intensity – Specific acoustic impedance.

UNIT II
CHARACTERISTICS OF SOUND
One dimensional wave equation – Solution of 1D wave equation – Velocity in gaseous medium – Velocity of plane progressive sound wave through a thin solid rod – Velocity of plane wave in a bulk of solid – Transverse wave propagation along a string stretched under tension – Wave equation in two dimension.

UNIT III
TRANSMISSION PHENOMENA
Changes in media – Transmission from one fluid medium to another, normal incidence, oblique incidence - Reflection at the surface of a solid, normal incidence, oblique incidence – Standing wave pattern – Transmission through three media.

UNIT IV
INTRODUCTION TO THE ASSESSMENT AND MEASUREMENT OF SOUND
Introduction – Decibel scale for the measurement of sound power – Sound level meter – Weighted sound pressure level – Equal Loudness contours – Perceived noisiness – Loudness, Loudness level, perceived noise, perceived noise level – Equivalent sound level – Identified level – Frequency and Amplitude measurement.

UNIT V
BASICS OF NOISE CONTROL
Noise Control at source, path, receiver – Noise control by acoustical treatment – Machinery noise – Types of machinery involved – Determination of sound power and sound power level – Noise reduction procedures – Acoustic enclosures.

Course outcomes:

At the end of this course, the students would be in a position to understand the basics of sound engineering, working principle of sound measuring equipments and different ways of acoustic control in the engineering field as acoustics is recognized as the major problem in engineering field today.

REFERENCES

1. Lawrence E. Kinsler, Austin R. Frey, "Fundamentals of Acoustics "– John Wiley and Sons Inc., 1986.
2. Bies, David, A. and Hansen, Colin H., "Engineering Noise Control – Theory and Practice", E and FN Spon, Chapman-Hall, Second Edition, 1996.
3. Hansen C.H. and Snyder, S.D., "Active Control of Sound and Vibration", E and FN Spon, London 1996.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

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(17D04109) DESIGN FOR MANUFACTURING
Elective-IV

Course Objectives:

Internalize the attributes along which the success or failure of a manufacturing process, machine, or system will be measured: quality, cost, rate and flexibility.

Provide exposure to a range of current industrial processes and practices used to manufacture products in high and low volumes. Focus in depth on a few selected processes.

Apply physics to understand the factors that control the rate of production and influence the quality, cost and flexibility of processes.

Understand the impact of manufacturing constraints on product design and process planning.

Apply an understanding of variation to the factors that control the production rate and influence the quality, cost and flexibility of processes and systems.

UNIT – I

Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design.

Materials: Selection of materials for design-developments in material technology-criteria for material selection-material selection interrelationship with process selection-process selection charts.

UNIT – II

Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT – III

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

UNIT – IV

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

UNIT – V

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

Plastics: Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection moulding

Course outcomes: Manufacturing is how we satisfy human need and create wealth. The challenge is to create a product that is responsive to the customer with high quality and low cost. A graduate should have the tools and confidence to go into a manufacturing enterprise that is using an unfamiliar process to make a product he/she has not seen, and yet be able to make intelligent decisions.

Text Books:

1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,

REFERENCES:

1. ASM Hand book Vol.20

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

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(17D15206) PRESSURE VESSEL DESIGN
Elective-IV

Course objectives:

To give exposure to various types of process equipments and their design.
To understand the different types of stresses and their effects in pressure vessel.
To understand the piping layout and the stresses acting on it.

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 frettage of thick cylinders. Thermal stresses in Pressure Vessels.

Unit – II

Theory of rectangular plates: Pure bending-different edge conditions.

Theory circular plates: Simple supported 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.

Unit – IV

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, behaviour of steel beyond the yield point, effect of cold work or strain hardening on the physical properties of pressure vessel steels, fracture types in tension, toughness of materials, effect of neutron irradiation of steels, fatigue of metals, fatigue crack growth, fatigue life prediction, cumulative fatigue damage, stress theory of failure of vessels subject to steady state and fatigue conditions.

Unit – V

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 embrittlement of pressure vessel steels, brittle fracture, effect of environment on fracture toughness, fracture toughness relationships, criteria for design with defects, significance of fracture mechanics evaluations, effect of warm prestressing on the ambient temperature toughness of pressure vessel steels.

Design features: Localized stresses and their significance, stress concentration at a variable thickness transition section in a cylindrical vessel, stress concentration about a circular hole in a plate subjected to tension, elliptical openings, stress concentration, stress concentration factors for superposition, dynamic and thermal transient conditions, theory of reinforced openings, nozzle reinforcement, placement and shape, fatigue and stress concentration.

Course Outcomes: On completion of this course students will be able to: 1. Analyse thin plates and shells for various types of stresses. 2. Design shells, end closures and nozzles of pressure vessels using ASME codes. 3. Analyse piping systems.

Text Books:

1. Theory and design of modern Pressure Vessels by John F.Harvey, Van nostrand reihold company, New York.
2. Pressure Vessel Design and Analysis by Bickell, M.B.Ruizcs.

REFERENCES:

1. Process Equipment design- Beowll & Yound Ett.
2. Indian standard code for unfired Pressure vessels IS:2825.
3. Pressure Vessel Design Hand Book, Henry H.Bednar, P.E., C.B.S.Publishers, New Delhi.
4. Theory of plates and shells- Timoshenko & Noinosky.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

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(17D15207) MECHANICS OF COMPOSITE MATERIALS
Elective-IV

Course objectives: The objective for this course is to develop an understanding of the linear elastic analysis of composite materials. This understanding will include concepts such as anisotropic material behavior and the analysis of laminated plates. The students will undertake a design project involving application of fiber reinforced laminates.

UNIT-I

Introduction to Composite Materials: Introduction ,Classification: Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and applications .

Reinforcements: Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

Processing methods: Autoclave, contact moulding, compression moulding, filament winding, man layup, pultrusion, vaccum assisted RTM .

UNIT-II

Macromechanical Analysis of a Lamina :Introduction ,Definitions: Stress, Strain ,Elastic Moduli,Strain Energy. Hooke’s Law for Different Types of Materials, Hooke’s Law for a Two-Dimensional Unidirectional Lamina, Plane Stress Assumption, Reduction of Hooke’s Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina,

UNIT-III

Hooke’s Law for a Two-Dimensional Angle Lamina, Engineering Constants of an Angle Lamina, Invariant Form of Stiffness and Compliance Matrices for an Angle Lamina Strength Failure Theories of an Angle Lamina : Maximum Stress Failure Theory Strength Ratio,Failure Envelopes,Maximum Strain Failure Theory ,Tsai–Hill Failure Theory, Tsai–Wu Failure Theory, Comparison of Experimental Results with Failure Theories. Hygrothermal Stresses and Strains in a Lamina: Hygrothermal Stress–Strain Relationships for a Unidirectional Lamina, Hygrothermal Stress–Strain Relationships for an Angle Lamina

UNIT-IV

Micromechanical Analysis of a Lamina :Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi-Empirical Models ,Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of Thermal Expansion, Coefficients of Moisture Expansion.

UNIT-V

Macromechanical Analysis of Laminates: Introduction , Laminate Code , Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate , Hygrothermal Effects in a Laminate, Warpage of Laminates

Failure, Analysis, and Design of Laminates : Introduction , Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues

Course Outcomes:

Students who successfully complete the course will demonstrate the following outcomes by tests, homework, and design project.

1. An ability to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
2. An ability to predict the elastic properties of both long and short fiber composites based on the constituent properties.
3. An ability to rotate stress, strain and stiffness tensors using ideas from matrix algebra.
4. A basic understanding of linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior.
5. An ability to analyze a laminated plate in bending, including finding laminate properties from lamina properties and find residual stresses from curing and moisture.
6. An ability to predict the failure strength of a laminated composite plate.
7. A knowledge of issues in fracture of composites and environmental degradation of composites.
8. An exposure to recent developments in composites, including metal and ceramic matrix composites.
9. An ability to use the ideas developed in the analysis of composites towards using composites in aerospace design.

Text Books:

1. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
2. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley- Interscience, New York, 1980.
3. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), By Autar K. Kaw ,Publisher: CRC

REFERENCES:

1. 1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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

L	T	P	C
0	0	3	2

(17D15208) MACHINE DYNAMICS LABORATORY

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.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
M.Tech III semester (Machine Design)

L	T	P	C
4	0	0	4

(17D20301) RESEARCH METHODOLOGY
(Elective V-OPEN ELECTIVE)

UNIT I

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT II

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.
Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.
Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT III

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT IV

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT V

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

Text Books:

1. Research Methodology:Methods And Techniques – C.R.Kothari, 2nd Edition,New Age International Publishers.
2. Research Methodology: A Step By Step Guide For Beginners- Ranjit Kumar, Sage Publications (Available As Pdf On Internet)
3. Research Methodology And Statistical Tools – P.Narayana Reddy And G.V.R.K.Acharyulu, 1st Edition,Excel Books,New Delhi.

REFERENCES:

1. Scientists Must Write - Robert Barrass (Available As Pdf On Internet)
2. Crafting Your Research Future –Charles X. Ling And Quiang Yang (Available As Pdf On Internet)

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M.Tech III semester (Machine Design)

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(17D20302) HUMAN VALUES AND PROFESSIONAL ETHICS
(Elective V-OPEN ELECTIVE)

Unit I:
HUMAN VALUES:Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty - Courage- Co Operation – Commitment – Empathy –Self Confidence Character – Spirituality.

Unit II:
ENGINEERING ETHICS: Senses of Engineering Ethics- Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy –Kohlberg‟s theory- Gilligan‟s theory- Consensus and controversy – Models of professional roles- Theories about right action- Self interest - Customs and religion –Uses of Ethical theories – Valuing time –Co operation – Commitment.

Unit III :
ENGINEERING AS SOCIAL EXPERIMENTATION: Engineering As Social Experimentation – Framing the problem – Determining the facts – Codes of Ethics – Clarifying Concepts – Application issues – Common Ground - General Principles – Utilitarian thinking respect for persons.

UNIT IV:
ENGINEERS RESPONSIBILITY FOR SAFETY AND RISK: Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing riskSafety and the Engineer- Designing for the safety- Intellectual Property rights(IPR).

UINIT V:
GLOBAL ISSUES: Globalization – Cross culture issues- Environmental Ethics – Computer Ethics – Computers as the instrument of Unethical behavior – Computers as the object of Unethical acts – Autonomous Computers- Computer codes of Ethics – Weapons Development - Ethics .

Text Books :

1. “Engineering Ethics includes Human Values” by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.
2. “Engineering Ethics” by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.
3. “Ethics in Engineering” by Mike W. Martin and Roland Schinzinger – Tata McGrawHill– 2003.
4. “Professional Ethics and Morals” by Prof.A.R.Aryasri, Dharanikota Suyodhana-Maruthi Publications.
5. “Professional Ethics and Human Values” by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran , Laxmi Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
M.Tech III semester (Machine Design)

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(17D20303) INTELLECTUAL PROPERTY RIGHTS
(Elective V-OPEN ELECTIVE)

UNIT – I
Introduction To Intellectual Property: Introduction, Types Of Intellectual Property, International Organizations, Agencies And Treaties, Importance Of Intellectual Property Rights.

UNIT – II
Trade Marks : Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.

UNIT – III
Law Of Copy Rights : Fundamental Of Copy Right Law, Originality Of Material, Rights Of Reproduction, Rights To Perform The Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice Of Copy Right, International Copy Right Law.
Law Of Patents : Foundation Of Patent Law, Patent Searching Process, Ownership Rights And Transfer

UNIT – IV
Trade Secrets : Trade Secrete Law, Determination Of Trade Secrete Status, Liability For Misappropriations Of Trade Secrets, Protection For Submission, Trade Secrete Litigation.
Unfair Competition : Misappropriation Right Of Publicity, False Advertising.

UNIT – V
New Development Of Intellectual Property: New Developments In Trade Mark Law ; Copy Right Law, Patent Law, Intellectual Property Audits.
International Overview On Intellectual Property, International – Trade Mark Law, Copy Right Law, International Patent Law, International Development In Trade Secrets Law.

TEXT BOOKS & REFERENCES:

1. Intellectual Property Right, Deborah. E. Bouchoux, Cengage Learing.
2. Intellectual Property Right – Nleashmy The Knowledge Economy, Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.,