Dr.M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
UNIVERSITY
(Decl. U/S 3 of UGC Act 1956)
DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech – Design Engineering (Full Time)
Curriculum and Syllabus
2013 Regulation

I SEMESTER						
S.No	**Subject Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	MMA130002	Applied Mathematics For Design Engineers	3	1	0	4
2	MME13D001	Concepts of Engineering Design	3	0	0	3
3	MME13D002	Computer Aided Design and Manufacturing	3	1	0	4
4	MME13D003	Advanced Finite Element Analysis	3	1	0	4
5	MME13D004	Design for Manufacturing and Assembly	3	1	0	4
6	MME13D005	Advanced Materials Technology	3	0	0	3
7	MME13DL01	Design Analysis Lab	0	0	4	2
Total			**18**	**4**	**4**	**24**

II SEMESTER						
S.No	**Subject Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	MME13D007	Advanced Mechanism Design	3	1	0	4
2	MME13D008	Mechanical Vibrations	3	1	0	4
3	MME13D009	Advanced Strength of Materials	3	1	0	4
4	MME13D010	Creep, Fatigue and Fracture	3	1	0	4
5	MME13DEXX	Elective I	3	1	0	4
6	MME13DEXX	Elective II	3	1	0	4
7	MME13DL02	Vibration Analysis Lab	0	0	4	2
Total			**18**	**6**	**4**	**26**

III SEMESTER						
S.No	**Subject Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	MME13D012	Design of Material Handling Equipments	3	1	0	4
2	MME13DEXX	Elective III	3	0	0	3
3	MME13DEXX	Elective IV	3	0	0	3
4	MME13DL03	Project Phase I	0	0	6	3
Total			**9**	**1**	**6**	**13**

IV SEMESTER						
S.No	**Subject Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	MME13DL04	Project Phase II*	0	0	24	12
Total			**0**	**0**	**24**	**12**

*Student should have presented a paper on the project area in National or International Conference/Journals and should attach the certificate in proof and the published paper in the project report.

TOTAL NO. OF CREDITS : 75

List of Electives (Elective – I & II)						
S.No	**Subject Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	MME13DE01	Design and Analysis of Experiments	3	1	0	4
2	MME13DE02	Optimization in Design	3	1	0	4
3	MME13DE03	Computational fluid Dynamics	3	1	0	4
4	MME13DE04	Tribology in Design	3	1	0	4
5	MME13DE05	Advanced Machine Tool Design	3	1	0	4
6	MME13DE06	Product Design and Development Strategies	3	1	0	4

List of Electives (Elective – III & IV)						
S.No	**Subject Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	MME13DE07	Robotics and Sensors	3	0	0	3
2	MME13DE08	Composite Materials and Mechanics	3	0	0	3
3	MME13DE09	Mechatronics in Manufacturing Systems	3	0	0	3
4	MME13DE10	Theory of plasticity	3	0	0	3
5	MME13DE11	Product Life Cycle Management	3	0	0	3
6	MME13DE12	Quality Engineering and Non Destructive Testing	3	0	0	3

MMA130002 APPLIED MATHEMATICS FOR DESIGN ENGINEERS 3 1 0 4

OBJECTIVES: At the end of this course the student will learn

- Analytical functions and different transform methods
- To solve the differential equations using finite difference methods

UNIT I: ANALYTIC FUNCTIONS **12Hrs**

Analytic functions – Cauchy Riemann equations – Construction of analytic functions – Conformal Mapping – Simple Transformations – Standard transformations : $\mathbf{w = z^2}$, $\mathbf{w = e^z}$, **w = sin z, w = cosh z –** Bilinear transformations.

UNIT II: TRANSFORM METHODS **12Hrs**

Laplace Transform methods for one dimensional wave equation – Displacements in a string – Fourier Transform methods – One dimensional heat conduction problems in infinite and semi- infinite rod.

UNIT III: CALCULUS OF VARIATIONS **12Hrs**

Variation and its properties – Euler's equations – Functionals dependent on First and higher order derivatives – Functionals depend on functions of several independent variables – Problems with moving boundaries – Direct methods – Ritz and Kantorovich methods.

UNIT IV: FINITE DIFFERENCE METHODS **12Hrs**

Finite difference methods – Solution of Laplace and Poisson equation – Leibmann's iteration process – Solution of heat equation: Schmidt explicit formula – Crank-Nicolson implicit scheme – Solution of wave equation.

UNIT V: FAST FOURIER TRANSFORMS **12Hrs**

Discrete Fourier transform – linearity and periodicity – Inverse N-point DFT – DFT approximation of Fourier coefficients – Sampled Fourier series – Approximations of Fourier Transform by an N-point DFT – FFT – Computational efficiency of FFT.

Total No. of Hrs : 60

REFERENCES

1. Grewal, B.S. (2012) *Higher Engineering Mathematics*. Khanna Publishers
2. Kreyszig, E. (2011) *Advanced Engineering Mathematics*. 9th.Ed. John Wiley & Sons
3. Sneddon, I.N. (2006) *Elements of Partial Differential Equations*. Dover Publications
4. SankaraRao, K. (2010) *Introduction to Partial Differential Equations*. 3rd.Ed. Prentice Hall of India
5. Gupta, A.S. (2004) *Calculus of variations with applications*. Prentice Hall of India
6. James, G. (2007) *Advanced modern Engineering Mathematics*. 3rd.Ed. Pearson
7. Sastry, S.S. (2003) *Introductory Methods of Numerical Analysis*. Prentice Hall of India

MME13D001 CONCEPTS OF ENGINEERING DESIGN 3 0 0 3

OBJECTIVE: At the end of this course the student will learn

- Process and methods of designing and quality management and quality tools

UNIT I: DESIGN PROCESS **9Hrs**

The Design Process - Morphology of Design - Design Drawings - Computer Aided Engineering - Designing of Standards - Concurrent Engineering - Product Life Cycle - Technological Forecasting - Market Identification - Competition Benchmarking - Systems Engineering - Life Cycle Engineering - Human Factors in Design -Industrial Design.

UNIT II: DESIGN METHODS **9Hrs**

Creativity and Problem Solving - Product Design Specifications - Conceptual Design - Decision Theory - Decision Tree - Embodiment Design - Detail Design - Mathematical Modeling - Simulation - Geometric Modeling - Finite Element Modeling - Optimization - Search Methods - Geometric Programming - Structural and Shape Optimization.

UNIT III: MATERIAL SELECTION – DESIGN AND PROCESSING **9Hrs**

Material Selection Process - Economics - Cost Vs Performance - Weighted Property Index - Value Analysis - Role of Processing in Design - Classification of Manufacturing Process - Design for Manufacture - Design for Assembly - Design for Castings, Forging, Metal Forming, Machining and Welding - Residual Stresses - Fatigue, Fracture and Failure.

UNIT IV: ENGINEERING STATISTICS AND RELIABILITY **9Hrs**

Probability - Distributions - Test of Hypothesis - Design of Experiments - Reliability Theory - Design for Reliability – Reliability Centered Maintenance.

UNIT V: QUALITY ENGINEERING **9Hrs**

Total Quality Concept - Quality Assurance - Statistical Process Control - Taguchi Methods - Robust Design – Failure Mode and Effect Analysis.

Total No. of Hrs : 45

REFERENCES

1. Pahl, G. and Beitz, W. (1984) *Engineering Design*. Springer - Verlag
2. Karl Ulrich, T. and Eppinger Steven, D. (2000) *Product Design and Development*. McGraw Hill Edition
3. Dieter George, E. (1991) *Engineering Design - A Materials and Processing Approach*. McGraw Hill,
4. International Editions, Mechanical Engineering Series
5. Suh, N.P. (1990) *The principles of Design*. Oxford University Press
6. Ray, M.S. (1985) *Elements of Engg. Design*. Prentice Hall Inc

MME13D002 COMPUTER AIDED DESIGN AND MANUFACTURING 3 1 0 4

OBJECTIVES: At the end of this course the student will learn
- Various mathematical approaches to design
- Manufacturing, planning and control

UNIT I: INTRODUCTION 12Hrs

Definition, Interactive Computer Graphics-Line and Circle plotting algorithm (DDA & Bresenham's), Transformation, Translation, Rotation, Scaling & Mirroring, Concatenated Transformation, Clipping Algorithm, Hidden Line Removal, Explicit and implicit equations, parametric equations.

UNIT II: SPLINES AND CURVES 12Hrs

Cubic Splines-Algebraic and geometric form of cubic spline, tangent vectors, parametric space of a curve, blending functions, four point form, reparametrization, truncating and subdividing of curves.
Graphic construction and interpretation, composite pc curves.
Bezier Curves-Bernstein basis, equations of Bezier curves, properties, derivatives. B-Spline basis, equations, knot vectors, properties, and derivatives.

UNIT III: SURFACES AND SOLIDS 12Hrs

Bi-cubic surfaces, Coon's surfaces, Bezier surfaces, B-Spline surfaces, surfaces of revolutions, Sweep surfaces, ruled surfaces, tabulated cylinder, bilinear surfaces, Gaussian curvature.
Tri-cubic solid, Algebraic and geometric form.3Dwire frames, Boundary representation, Half space modeling, spatial cell, cell decomposition, classification problem.

UNIT IV: PRODUCTION PLANNING AND CONTROL 12Hrs

Group Technology, Computer Aided Process Planning: Retrieval & Generative CAPP, Production Planning, Material Requirement Planning (MRP), mechanism of MRP, benefits, and Capacity Planning. Production Control, Factory Data Collection system, Just-in-Time, Automated Material Handling System, Data Flow in Manufacturing System, Product Data Management System.

UNIT V: COMPUTER NUMERICAL CONTROL 12Hrs

Introduction to NC, Principles and Classifications of CNC, DNC, Part Programming, Adaptive control machining systems, adaptive control optimization system, adaptive control constraint system, applications to machining processes, computer process monitoring, hierarchical structure of computers in manufacturing, and computer process control.

Total No. of Hrs : 60

REFERENCES
1. Ibrahim Zeid, *CAD/CAM*. Tata McGraw Hill
2. Roger and Adams, *Elements of Computer Graphics.* Tata McGraw Hill
3. Micheal Mortenson, E. *Geometric Modeling*. McGraw Hill Publishers
4. Lalit Narayan, K. MallikarjunaRao, K. and Sarcar, M.M.M. *Computer Aided Design and Manufacturing*, PHI Publishers

MME13D003 ADVANCED FINITE ELEMENT ANALYSIS 3 1 0 4

O**BJECTIVE:** At the end of this course the student will learn

- Formulation and modelling of a problem and analyzing the dynamic, fluidics and heat transfer problems

UNIT I: BENDING OF PLATES AND SHELLS **12Hrs**

Review of Elasticity Equations-Bending of Plates and Shells-Finite Element Formulation of Plate and Shell elements-Conforming and Non Conforming Elements - Co and C1 Continuity Elements-
Application and Examples

UNIT II: NON-LINEAR PROBLEMS **12Hrs**

Introduction-Iterative Techniques-Material non-Linearity-Elasto Plasticity-Plasticity-Visco plasticity-Geometric Non linearity-large displacement Formulation-Application in Metal Forming Process and contact problems

UNIT III: DYNAMIC PROBLEM **12Hrs**

Direct Formulation - Free, Transient and Forced Response - Solution Procedures- Subspace Iterative Technique - Houbolt, Wilson, Newmark - Methods - Examples

UNIT IV: FLUID MECHANICS AND HEAT TRANSFER **12Hrs**

Governing Equations of Fluid Mechanics- Inviscid and Incompressible Flow-Potential Formulations-
Slow Non-Newtonian Flow-Metal and Polymer Forming-Navier Stokes Equation-Steady and Transient Solutions.

UNIT V: ERROR ESTIMATES AND ADAPTIVE REFINEMENT **12Hrs**

Error norms and Convergence rates- high refinement with adaptivity-Adaptive refinement

Total No. of Hrs : 60

REFERENCES

1. Zeinkiewicz, O.C. and Taylor, R. L. (1991) *The Finite element Method*. Fourth Edition, Volumes 1 & 2, McGraw Hill International Edition, Physics services
2. Cook R.D. (1989) *Concepts and Applications of Finite Element Analysis*. John Wiley & Sons Inc
3. Bathe K.J. (1990) *Finite Element Procedures in Engineering Analysis*. Prentice Hall

MME13D004 DESIGN FOR MANUFACTURING AND ASSEMBLY 3 1 0 4

OBJECTIVE: At the end of this course the student will learn

- Rules and requirements of designing to ease manufacturing and assembly

UNIT I: INTRODUCTION 12Hrs

General design principles for manufacturability - strength and mechanical factors, Process capability - Feature tolerances - Geometric tolerances - Assembly limits -Datum features - Tolerance stacks.

UNIT II: FORM DESIGN - CASTING 12Hrs

Production methods on form design - Casting considerations - Requirements and rules - Redesign of components for castings and Case studies.

UNIT III: FORM DESIGN - FORGING 12Hrs

Forging considerations - Requirements and rules - Redesign of components for forging and Case studies.

UNIT IV: FORM DESIGN - MACHINING 12Hrs

Machining considerations - Requirements and rules -Redesign of components for Machining and Case studies.

UNIT V: DESIGN FOR ASSEMBLY METHODS 12Hrs

Approaches to design for assembly - Qualitative evaluation procedures, knowledge based approach, Computer aided DFA methods. Assemblability measures. Boothroyd - Dewhurst DFA method - Redesign of a simple product - Case studies.

Total No. of Hrs : 60

REFERENCES

1. Harry Peck, (1983) Design *for Manufacture*. Pittman Publication
2. Alan Redford and Chal, (1994) *Design for Assembly - Principles and Procedures*. McGraw Hill International
3. Robert Matousek, (1963) *Engineering Design - A Systematic Approach*. Blackie & Sons Ltd
4. James G. Bralla, (1986) *Hand Book of Product Design for Manufacturing*. McGraw Hill Co
5. Swift, K.G. (1987) *Knowledge Based Design for Manufacture*.

MME13D005 ADVANCED MATERIALS TECHNOLOGY 3 0 0 3

OBJECTIVE: At the end of this course the student will learn

- Properties and characteristics of different types of materials

UNIT I: INTRODUCTION TO FERROUS MATERIALS. **9Hrs**

Plain carbon steels, their properties and application: plain carbon steels, effects of alloying elements in plain carbon steels. Alloy steels, tools steels, stainless steels, low and high temperature resisting steels, high strength steels, selections, specifications, form and availability of steel. Cast irons-white, grey, modular malleable and alloy cast irons. Recognised patterns of distribution of graphite flakes in grey cast iron

UNIT II: NONFERROUS MATERIALS **9Hrs**

Ultra light materials. Properties and application, brasses, bronzes, cupro-nickel alloys, aluminium, magnesium and titanium alloys, bearing materials. Heat treatment of nonferrous materials– soputionizing, Aging and precipitations hardening.

UNIT III: NANOMATERIAL **9Hrs**

Introduction to Nanomaterials-types-Nano powder-Nanodots-Nanotubes- Nano fluids-Fullerene-Different shape-properties and characteristics and applications. Refractory materials and coatings for high temperature applications. Smart Materials-introduction, types and applications. Thin film shape memory alloys

UNIT IV: BIO-MATERIALS AND COMPOSITES **9Hrs**

Classes and application of materials in medicine and dentistry. Stress strain behaviour of bone. The mechanical properties including elasticity, hardness, viscoelasticity, surface and fatigue properties of skin; soft tissues; bone; Biocompatible materials and its applications. The effects of degradation and corrosion. Composites- metal, polymers and ceramics- applications

UNIT V: NUCLEAR MATERIALS **9Hrs**

Introduction to nuclear materials. Materials for nuclear fuel in fission and fusion reactors, Fissile and fertile materials. Control & Construction Materials for Nuclear reactors, Moderators, Heat Exchangers. Radiation proof materials. Brief discussion of safety and radioactive waste disposal.

Total No. of Hrs : 45

REFERENCES

1. Buddy Ratner, D. Hoffman, A.S. and Lemons, J.E. (2004) *Biomaterials Science- An Introduction to Materials in*
1. *Medicine*. Second Edition, Academic Press
2. Joon Park, B. & Lakes Roderic, S. (1992) *Biomaterials: An Introduction.* Second Edition, Plenum Press
3. Edited by Davis, J. R. (2003) *Handbook of Materials for Medical Devices*. ASM international
4. Lamarsh, J.R. *Introduction to Nuclear Engineering*
5. Callister, W.D. Jr, *Material Science & Engineering Addition*. Wesley Publishing Co
6. Van Vlack, *Elements of Material Science & Engineering.* John Wiley & Sons

MME13DL01 **DESIGN ANALYSIS LAB** **0 0 4 2**

OBJECTIVE: At the end of this course the student will learn

- Design , modeling and analysis using computer softwares and tools

I MODELLING:

- Introduction to modelling techniques- Type of modelling- wire frame, surface and solid modelling — constructive solid modelling and B-rep modelling- Feature based and parametric modelling etc.
- Generation of surfaces of revolution, surfaces of extrusion, surfaces by skinning operation etc.
- Creation of different views-importing models from other soft wares-Data base management.

(Exercises will be given using packages like PROE/CATIA/ Unigraphics etc.)

II. ANALYSIS:

- Introduction to FEM-Analysis softwares -ANSYS / NASTRAN/NISA/COSMOS/I-DEAS etc.
- Structural and fluid analysis.- One dimensional, Two dimensional and Three dimensional Elements Based Problems.
- Thermal Analysis - Conduction, Convection and Radiation heat transfer Problems.

III. MATLAB

- Introduction to MATLAB
- Study of different MATLAB tools
- Arithmetic and logical operators
- Matrix operation using MATLAB
- Mathematical equations solution
- Generation of trigonometrically wave functions
- Introduction to SIMULINK
- Flow control statements and graphs

Total No. of Hrs : 60

MME13D007 ADVANCED MECHANISM DESIGN 3 1 0 4

OBJECTIVE: At the end of this course the student will learn

- Different types of advanced mechanisms, analyze and synthesize mechanisms

UNIT I: INTRODUCTION TO KINEMATICS 12Hrs

Review of fundamentals of kinematics--Mobility, kinematic inversion, Graphical position analysis, algegric position analysis, position analysis techniques, displacement difference between two points, rotation and translation, apparent displacement and absolute displacement.

UNIT II: VELOCITY AND ACCELERATON 12Hrs

Velocity and acceleration of simple and complex mechanisms using graphical method.

UNIT III: SYNTHESIS 12Hrs

Type, Number and. Dimensional synthesis - Function generation , path generation, body guidance. Two position synthesis of crank and rocker mechanism. Crank and rocker mechanism with optimum transmission angle. Three position synthesis, Four position synthesis, point precision reduction, precision position, structural error, chebychev spacing.

UNIT IV: SYNTHESIS OF LINKAGES 12Hrs

Coupler curve synthesis, cognate linkages, Robert-Chebychev theorem, Blocks method of synthesis, Freudenstein's equation, Analytical synthesis using complex algebra, Synthesis of dwell mechanisms.

UNIT V: SPATIAL MECHANISM 12Hrs

Introduction, exception in the mobility of mechanisms, the position analysis problem, Velocity and acceleration analysis.

Total No. of Hrs : 60

REFERENCES

1. Sandor, G.N. and Erdman, A.G. (1984) *Advanced Mechanism Design Analysis and Synthesis*. Prentice Hall
2. Shigley, J.E. and Uicker, J.J. (1995) *Theory of Machines and Mechanisms. McGraw Hill*
3. Amitabha Ghosh and Ashok Kumar Mallik, (1999) *Theory of Mechanism and Machines*. EWLP
4. Nortron R.L. (1999) *Design of Machinery*. McGraw Hill
5. Kenneth Waldron, J. and Gary Kinzel, L. (1999) *Kinematics, Dynamics and Design of Machinery*. John Wiley & sons

MME13D008 **MECHANICAL VIBRATIONS** **3 1 0 4**

OBJECTIVE: At the end of this course the student will learn

- Various types of vibration and their analysis

UNIT I: FUNDAMENALS OF VIBRATION **12Hrs**

Review of Single degree freedom systems - Response to arbitrary periodic executions - Duhamel's integral - Impulse response function - Virtual work - Lagrange's equations - Single degree freedom forced vibration with elastically coupled viscous dampers - System identification from frequency response - Transient vibration - Laplace transformation formulation.

UNIT II: TWO DEGREE FREEDOM SYSTEM **12Hrs**

Free vibration of spring-coupled system - Mass coupled system - Bending variation of two degree freedom system - Forced vibration - Vibration Absorber - Vibration isolation.

UNIT III: MULTI DEGREE FREEDOM SYSTEM **12Hrs**

Normal mode of vibration - Flexibility matrix and stiffness matrix - Eigen value and Eigen vector – Orthogonal properties - Modal matrix - Modal analysis - Forced vibration by matrix inversion - Modal damping in forced vibration - Numerical methods of fundamental frequencies.

UNIT IV: VIBRATION OF CONTINUOUS SYSTEMS **12Hrs**

Systems governed by wave equations - Vibration of strings - Vibration of rods - Euler 's equation for beams - Effect of Rotary inertia and shear deformation - Vibration of plates.

UNIT V: EXPERIMENTAL METHODS IN VIBRATION ANALYSIS **12Hrs**

Vibration instruments - Vibration exciters Measuring Devices - Analysis - Vibration Tests - Free and Forced Vibration tests. Examples of vibration tests - Industrial case studies.

Total No. of Hrs : 60

REFERENCES

1. Rao, J. S. & Gupta, K. (1984) *Ind. Course on Theory and Practice Mechanical Vibration*. New Age International (P) Ltd
2. Thomson, W.T. (1990) *Theory of Vibration with Applications*. CBS Publishers and Distributers
3. Den Hartog, J.P. (1990) *Mechanical Vibrations*. Dover Publications
4. Rao, S.S. (1995) *Mechanical Vibrations*. Addison Wesley Longman

MME13D009 ADVANCED STRENGTH OF MATERIALS 3 1 0 4

OBJECTIVE: At the end of this course the student will learn

- Behaviour of the material under different types of loads

UNIT I: INTRODUCTION 12Hrs

Load-Stress and Load-Deflection, Stress-strain relations, Failure and limits on design
Theories of Stress and Strain- Definition of stress at a point, Stress notation, Symmetry of the stress array and stress on an arbitrarily oriented plane, Transformation of stress, Principal stresses, Differential equations of a deformable body, Deformation of a Deformable body, Strain Theory, Transformation of strain, Principal strains, Small displacement theory, Strain measurement

UNIT II: TORSION 12Hrs

Torsion of Prismatic bar of circular cross section, Saint-Venant's semi inverse method, Linear elastic solution, Narrow rectangular cross section, Hollow thin-wall torsion members, Multiply connected cross section, Thin wall torsion members with restrained ends, Numerical solution of torsion problems

UNIT III: BENDING 12Hrs

Definition of shear centre in bending, Symmetrical and non-Symmetrical bending, Bending stresses in beams subjected to non-Symmetrical bending, Deflections of straight beams subjected to non-Symmetrical bending, Effect of Inclined loads

UNIT IV: CURVED BEAMS 12Hrs

Introduction, Circumferential stresses in a curved beam, Radial stresses in curved beams, Correction of circumferential stresses in curved beams, Deflection of curved beams, Statically indeterminate curved beams, Closing ring subjected to a concentrated load

UNIT V: CONTACT STRESSES 12Hrs

Introduction, the problem of determining contact stresses, Geometry of the contact surface, Notation and meaning of terms, Expressions for Principal stresses, Method of computing contact stresses, Deflection of bodies in point contact, Stress for two bodies in line contact, Loads normal to contact area and Tangent to contact area, Problems

Total No. of Hrs : 60

REFERENCES

1. Arthur Boresh, P. *Advanced Mechanics of Materials*. John Wiley& sons, Inc
2. Egor Popov, P. (1997) *Engineering Mechanics of Solids*. Prentice Hall of India
3. Srinath, L.N. *Advanced Mechanics of Solids*. Tata McGraw Hill Publishing Company Ltd
4. Junarkar, S.B. (1995) *Mechanics of Structures*. Vol.1, 21st Edition, Charotar Publishing House

MME13D010 CREEP, FATIGUE AND FRACTURE 3 1 0 4

OBJECTIVE: At the end of this course the student will learn

- The analyse the fracture mechanism under various conditions

UNIT I: ELEMENTS OF SOLID MECHANICS 8Hrs

The geometry of stress and strain, elastic deformation, plastic and elastoplastic deformation-limit analysis

UNIT II: CRACK GROWTH 13Hrs

Two dimensional elastic fields-Analytical solutions- Yielding near a crack front-Irwins approximation-plastic Zone size-Dugdaale model-J integral and its relation to crack opening displacement. Griffth analysis-Linear Fracture Mechanics-Crack opening displacement-Dynamic energy balance-crack arrest

UNIT III: CREEP 13Hrs

Mechanics of creep, inter-granular, trans-granular creep, Creep test, Creep strain rate-time curves, Deformation mechanism map; High temperature properties of materials; Long time creep-stress-time relations; Creep contribution to the fracture mechanism; DVM, DVL German-standard, Hatifield time yield test.

UNIT IV: FATIGUE CRACK GROWTH CURVE 13Hrs

Empirical relation describing crack growth by Fatigue-Life calculations for a given load amplitude-effects of changing the load spectrum-Effects of Environment

UNIT V: ELEMENTS OF APPLIED FRACTURE MECHANICS 13Hrs

Examples of crack-growth Analysis for cyclic loading-leak before break- crack initiation under large scale yielding-Thickness as a Design parameter-crack instability in Thermal or Residual-stress fields.

Total No. of Hrs : 60

REFERENCES

1. David Broek, (1978) *Elementary Engineering Fracture Mechanics*. Fifthoff and Noerdhoff International
1. Publisher
2. Kare Hellan, (1985) *Introduction to Fracture Mechanics*. McGraw Hill Book Company
3. Preshant Kumar, (1999) *Elements of Fracture Mechanics*. Wheeler Publishing
4. Thomas Courtney, H. (2000) *Mechanical Behaviour of Materials*. 2nd. Ed. Long Grove, Waveland Press, Inc
5. William Hosford, F. (2010) *Mechanical Behaviour of Materials*. 2nd. Ed. Cambridge University Press
6. Keith Bowman, *Mechanical Behaviour of Materials*. John Wiley & Sons
7. http://www.elsevier.com/locate/enfracmech

MME13DL02 **VIBRATION ANALYSIS LAB** **0 0 4 2**

OBJECTIVE: At the end of this course the student will learn

- To measure and analyse various types of mechanical vibrations

VIBRATION TYPES AND MEASUREMENTS:

Study of types of vibration-Longitudinal, transverse and torsional vibration - degree of freedom.

1. Damped free vibration of a single degree of freedom spring mass system.
2. Transverse Free vibration of a cantilever beam.
3. Transverse free vibration of a simply supported beam.
4. Determination of critical speed of a shaft.
5. Torsional vibration of a single rotor system.
6. Balancing of rotating masses using Dynamic balancing Machine.
7. Lab view for vibration and noise.

VIBRATION ANALYSIS USING FFT ANALYSER IN THE FOLLOWING AREAS:

1. Power train.
2. Motor, Pumps.
3. Machine tools like Lathe, Milling, drilling etc.,

Total No. of Hrs : 60

MME13D012 DESIGN OF MATERIAL HANDLING EQUIPMENTS 3 1 0 4

OBJECTIVE: At the end of this course the student will learn

- Design of different types of material handling systems used for engineering and process industries

UNIT I: INTRODUCTION TO MATERIALS HANDLING EQUIPMENT 12Hrs

Overview - consideration in material handling system design, ten principles of material handling. Types of material handling equipments-trolleys, industrial trucks, AGV, monorails and other rail guided vehicles, conveyors, cranes, hoists and elevators.

UNIT II: DESIGN OF HOISTS 12Hrs

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types.

UNIT III: DRIVES OF HOISTING GEAR 12Hrs

Hand and power drives - Travelling gear - Rail travelling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

UNIT IV: CONVEYORS 12Hrs

Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

UNIT V: ELEVATORS 12Hrs

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.

Total No. of Hrs : 60

***NOTE:** Use of Approved Data Book is permitted in examination

.

REFERENCES

1. Rudenko, N. (1970) *Materials handling equipment*. ELnvee Publishers
2. Mikell Groover, P. (2006) *Automation, Production system and computer integrated Manufacturing*. Second
3. Edition, Prentice Hall of India Pvt. Ltd
4. Alexandrov, M. (1981) *Materials Handling Equipments*. MIR Publishers
5. Boltzharol, A. (1958) *Materials Handling Handbook*. The Ronald Press Company
6. P.S.G. Tech, (2003) *Design Data Book*. Kalaikathir Achchagam
7. Lingaiah. K. and Narayana Iyengar, (1983) *Machine Design Data Hand Book*. Vol.1 & 2, Suma Publishers
8. Spivakovsy, A.O. and Dyachkov, V.K. (1985) *Conveying Machines*. Volumes I and II, MIR Publishers

MME13DL03	**PROJECT PHASE I**	**0**	**0**	**6**	**3**

- Students should select the area of the project work and complete the literature survey.
- Student should identify the problem of study and start the work.
- Students are expected to do the project work individually.
- A guide will be allotted to each student based on the area of the Project work.
- Project reviews will be conducted once in a fortnight to assess the development of the project work.
- At the end of the semester students should submit a report of the work completed and should appear for a Project Viva-voce examination conducted by the internal examiner.
- Continuous assessment mark (50 marks) will be awarded based on the performance in the reviews.
- End semester mark (50 marks) will be awarded for project viva voce examination.

MME13DL04	**PROJECT PHASE II**	**0**	**0**	**24**	**12**

- Students are expected to do a Project work either in an Industry or at the University in the area of specialization individually.
- Each student will be allotted a guide based on the area of Project work

Number of reviews will be conducted during the semester to monitor the development of project. Students have to submit the thesis at the end of the semester and appear for the Project Viva-Voce examination conducted by one internal examiner and one external examiner.

It is mandatory that the student should have presented his project work as a technical paper in National/international conference /Journals. A copy of the certificate in proof of paper presentation should be enclosed in the project report.

50% weightage (100 marks) will be given for the continuous assessment and 50% weightage (100 marks) for the Project viva a voce examination.

MME13DE01 DESIGN AND ANALYSIS OF EXPERIMENTS 3 1 0 4

OBJECTIVE: At the end of this course the student will learn

- To analyse the experiments using statistical tools

UNIT I: EXPERIMENTAL DESIGN FUNDAMENTALS 9Hrs

Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression model.

UNIT II: SINGLE FACTOR EXPERIMENTS 12Hrs

Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests.

UNIT III: MULTIFACTOR EXPERIMENTS 13Hrs

Two and three factor full factorial experiments, 2^K factorial Experiments, Confounding and Blocking designs.

UNIT IV: SPECIAL EXPERIMENTAL DESIGNS 13Hrs

Fractional factorial design, nested designs, Split plot design, Introduction to Response Surface Methodology, Experiments with random factors, rules for expected mean squares, approximate F- tests.

UNIT V: TAGUCHI METHODS 13Hrs

Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, case studies.

Total No. of Hrs : 60

REFERENCES

1. Montgomery, D.C. (2003) *Design and Analysis of experiments*. John Wiley and Sons
2. Nicolo Belavendram, (1995) *Quality by Design; Taguchi techniques for industrial experimentation*. Prentice Hall
3. Phillip Rose, J. (1996) *Taguchi techniques for quality engineering*. McGraw Hill

MME13DE02 **OPTIMIZATION IN DESIGN** **3 1 0 4**

OBJECTIVE: At the end of this course the student will learn

- Optimization techniques and its application in design and manufacturing

UNIT I: CLASSICAL OPTIMIZATION TECHNIQUES **12Hrs**

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

UNIT II: NUMERICAL METHODS FOR OPTIMIZATION **12Hrs**

Nelder Mead's Simplex search method, Gradient of a function, steepest descent method, Newton's method, types of penalty methods for handling constraints.

UNIT III: GENETIC ALGORITHM (GA) **12Hrs**

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, multi–objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems.

UNIT IV: APPLICATIONS OF OPTIMIZATION IN DESIGN AND MANUFACTURING SYSTEMS **12Hrs**

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.

UNIT V: INTRODUCTION TO NEURAL NETWORKS **12Hrs**

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate and- Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch- Pitts Model, Historical Developments, Potential Applications of ANN.

Total No. of Hrs : 60

REFERENCES

1. Jasbir Arora, *Optimal design*. McGraw Hill (International) Publishers
2. Kalyanmoy Deb, *Optimization for Engineering Design*. PHI Publishers
3. Rao, S.S. *Engineering Optimization*. New Age Publishers
4. Johnson Ray, C. (1990) *Optimum Design of mechanical elements*. John Wiley & Sons
5. Kalyanmoy Deb, *Multi objective Genetic algorithms*. PHI Publishers
6. Hertz, Krogh and Palmer, *Introduction to the theory of Neural Computation*
7. Yegnanarayana, B. *Artificial Neural Networks*. PHI Publishers
8. David Goldberg, E. (1989) *Genetic Algorithms*. Addison Wesley

MME13DE03 COMPUTATIONAL FLUID DYNAMICS 3 1 0 4

OBJECTIVE: At the end of this course the student will learn

- Formulation and analysis of problems on fluid dynamics

UNIT I: GOVERNING DIFFERENTIAL EQUATIONS AND FDM 12Hrs

Classification, Initial and Boundary Conditions, Initial and Boundary value problems. Finite Difference Method, Central, Forward, Backward Difference, Uniform and Non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT II: CONDUCTION HEAT TRANSFER 12Hrs

Steady one-dimensional conduction, Two and Three dimensional Steady state problems, Transient One dimensional and Two dimensional problems**.**

UNIT III: INCOMPRESSIBLE FLUID FLOW 12Hrs

Governing Equations, Stream function – Vorticity Method, Determination of Pressure for Viscous flow, Simple procedure of Patankar and Spalding, Computation of Boundary layer flow, Finite Difference Approach**.**

UNIT IV: CONVECTION HEAT TRANSFER AND FEM 12Hrs

Steady One Dimensional and Two Dimensional Convection-Diffusion, Unsteady One Dimensional Convection-Diffusion, Unsteady Two Dimensional Convection – Diffusion – Introduction to Finite Element Method-Solution of Steady Heat Conduction by FEM- Incompressible flow – Simulation by FEM.

UNIT V: TURBULENCE MODELS 12Hrs

Algebraic models –One Equation model, K-I Models, Standard, High and Low Reynolds Number models, Prediction of Fluid flow and Heat transfer using Standard Codes.

Total No. of Hrs : 60

REFERENCES

1. Muralidhar, K. and Sundararajan, T. (1995) *Computational Fluid Flow and Heat Transfer*. Narosa Publishing House
2. Ghoshdasdidar, P.S. (1998) *Computer Simulation of Flow and Heat Transfer*. Tata McGraw Hill Publishing Company Limited
3. Subhas, V. Patankar, (1980) *Numerical Heat Transfer Fluid Flow*. Hemisphere Publishing Corporation
4. Taylor, C. and Hughes, J.B. (1981) *Finite Element Programming of Navier Stoke Equation*. Pine Ridge Press Ltd
5. Anderson, D.A. Tannehill, J.C. and Pletcher, R.H. (1984) *Computational Fluid Mechanics and Heat transfer*. Hemisphere Publishing Corporation
6. Fletcher, C.A.J. (1987) *Computational Techniques for Fluid Dynamics-Fundamental and General Techniques*. Springer –Verlag
7. Fletcher, C.A.J. (1987) *Computational Techniques for Different Flow Categories*. Springer –Verlag
8. Bose T.K. (1997) *Numerical Fluid Dynamics*. Narosa Publishing House

MME13DE04 **TRIBOLOGY IN DESIGN** **3 1 0 4**

OBJECTIVE: At the end of this course the student will learn

- Influence of behaviour of friction, wear and lubrication on design

UNIT I: SURFACES,FRICTION AND WEAR **12Hrs**

Topography of the surfaces - Surface features - Surface interaction - Theory of Friction - Sliding and Rolling Friction, Friction properties of metallic and non-metallic materials - friction in extreme conditions - Wear, types of wear - Mechanism of wear - Wear resistance materials - Surface treatment - Surface modifications -Surface coatings.

UNIT II: LUBRICATION THEORY **12Hrs**

Lubricants and their physical properties, lubricants standards - Lubrication regimes- Hydrodynamic lubrication - Reynolds Equation, thermal, inertia and turbulent effects - Elasto hydrodynamic and plasto hydrodynamic and magneto hydrodynamic lubrication - Hydro static lubrication .

UNIT III: DESIGN OF FLUID FILM BEARINGS **12Hrs**

Design and performance analysis of thrust and journal bearings - Full, partial, fixed and pivoted journal bearings design - Lubricant flow and delivery - power loss, Heat and temperature, rotating loads and dynamic loads in journal bearings - Hydrostatic Bearing design.

UNIT IV: ROLLING ELEMENT BEARINGS **12Hrs**

Geometry and Kinematics - Materials and manufacturing processes - contact stresses - Hertzian stress equation - Load divisions - Stresses and deflection - Axial loads and rotational effects, Bearing life capacity and variable loads - ISO standards - Oil films and their effects - Rolling Bearings Failures.

UNIT V: TRIBO MEASUREMENT IN INSTRUMENTATION **12Hrs**

Surface topography measurements - Electron microscope and friction and wear measurements - Laser method - Instrumentation - International standards -Bearings performance measurements - Bearing vibration measurement.

Total No. of Hrs : 60

REFERENCES

1. Cameron, A. (1981) *Basic Lubrication Theory*. Ellis Herward Ltd.
2. Hulling, J. (Editor), (1984) *Principles of Tribology*. MacMillan.
3. Williams, J.A. (1994) *Engineering Tribology*. Oxford Univ. Press.
4. Neale, M.J. (1995) *Tribology Hand Book*. Butterworth Heinemann.
5. http://www.csetr.org/link.htm
6. http://www.me.psu.edu/research/tribology.htm

MME13DE05 ADVANCED MACHINE TOOL DESIGN 3 1 0 4

OBJECTIVE: At the end of this course the student will learn

- Designing of different types of machine tools and their drives and controls
- Testing of machine tools under erection and commission.

UNIT I: INTRODUCTION 10Hrs

Introduction to Metal Cutting Machine tools, Kinematics, Basic Principles of Machine tool design, estimation of drive power.

UNIT II: DESIGN OF MACHINE TOOLS-I 13Hrs

Design of Machine tool spindle and bearings, Design of power Screws - Static deformation of various machine tool structures - thin walled box structures with open and compliant cross sections – correction coefficients.

UNIT III: DESIGN OF MACHINE TOOLS-II 13Hrs

Design of beds, columns, tables and supports. Dynamics of cutting forces - tool chatter - design of slideways. Concepts of aesthetics and ergonomics applied to machine tools, latest trends in Machine Tool Design, Introduction to CAD techniques

UNIT IV: DESIGN OF DRIVES AND CONTROL MECHANISMS 17Hrs

Design considerations of electrical, mechanical and Hydraulic drives in machine tool, stepped and stepless arrangements and systems. Design of control mechanisms - selection of standard components - Dynamic measurement of forces and vibrations in machine tools - Stability against chatter - use of vibration dampers.

UNIT V: TESTING AND STANDARDISATION 7Hrs

Acceptance tests and standardization of machine tools - machine tools re-conditioning.

Total No. of Hrs : 60

REFERENCES

1. Mehta, N.K. (1989) *Machine Tool design*. Tata McGraw Hill
2. Koenisberger, F. (1964) *Design Principles of Metal cutting Machine Tools*. Pergamon Press
3. Acherkan, N. (1968) *Machine Tool Design*.Vol.3 & 4, MIR Publishers
4. Sen, G and Bhattacharya, A. (1973) *Principles of Machine Tools*. Vol.2, NCB

MME13DE06 PRODUCT DESIGN AND DEVELOPMENT STRATEGIES 3 1 0 4

OBJECTIVE: At the end of this course the student will learn

- Product design considerations and strategies of innovative product development

UNIT I: INTRODUCTION 11Hrs

Essential factors of product design- requirements of good design- factors affecting product design- product development process tools- Design by evolution and innovation- Asimow's model- Journeys in product development- product engineering – nature and scope- Product design practice in industry.

UNIT II: CREATIVITY 12Hrs

Creative thinking and organizing for product innovation criteria – method and tools for directed creativity – challenges of quality management – Case studies – Mumbai's Dabbawalas – creativity by less learned- Creativity on wheel chair – MARICO (case study)- Patent –design patents- patent application steps – sale of patent rights.

UNIT III: DESIGN CONSIDERATIONS 14Hrs

Functional and production design – form design – influence of basic design, mechanical loading and material on form design – Design for manufacture and assembly – Design for robustness – Design for production – Design for stiffness and rigidity – strength consideration in product design – optimization in design – Project analysis – Mechanical estimating and costing.

UNIT IV: PRODUCT DEVELOPMENT STRATEGIES 11Hrs

Planning and preparation – Resources – Talent –striving, thinking, relating – Quality assurance in product design – Strategy for product development – Case studies.

UNIT V: HUMAN AND VALUE ENGINEERING 12Hrs

Human beings as applicator of forces – Anthropometry – design of controls and displays – man/machine information exchange – aesthetic and ergonomic considerations – Value engineering – maximum value-Normal degree of value – value analysis of job plan – Idea generation check-list – Cost reduction through value engineering case study on tap switch control assembly – Economic factors influencing design – Material and process selection.

Total No. of Hrs : 60

REFERENCES

1. Kavin & Krishn, *Product Design Techniques in reverse engineering & New product development*, Pearson
1. Education
2. Paul Plsek, E. *Creativity, Innovation and Quality*. Prentice - Hall of India Private Limited
3. Jones, J.C. (1970) *Design Methods.* Interscience
4. Buhl, H. (1960) *Creative Engineering Design.* Iowa State University Press
5. Dieter, G.E. (1983) *Engineering Design.* McGraw Hill
6. Niebel, B.W. & Draper, A.B. (1974) *Product Design and Process Engineering.* McGraw Hill
7. Harry Peck, (1973) *Designing for Manufacturing.* Sir Issac Pitman and Sons Ltd

MME13DE07 **ROBOTICS AND SENSORS** **3 0 0 3**

OBJECTIVE: At the end of this course the student will learn

- Concepts, design, application and control of robotics

UNIT I: INTRODUCTION **9Hrs**

Basic concepts-Robot anatomy-robot configurations-Basic Robot motions-Types of drives-Applications-Material Handling-Processing-Assembly and Inspection -Safety considerations.

UNIT II: TRANSFORMATIONS AND KINEMATICS **9Hrs**

Vector operations-Translational transformations and Rotational transformations-Properties of transformation Matrices-Homogeneous transformations and Manipulator-Forward solution-Inverse solution

UNIT III: CONTROLS AND END EFFECTORS **9Hrs**

Control system concepts-Analysis-control of joints-Adaptive and optimal control-End effectors-Classification-Mechanical-Magnetic-Vacuum-Adhesive-Drive systems-Force analysis and Gripper design

UNIT IV: ROBOT PROGRAMMING **6Hrs**

Methods -Languages-Computer control and Robot Software-VAL system and Language

UNIT V: SENSORY DEVICES **12Hrs**

Non-optical and optical position sensors-Velocity and Acceleration-Range-Proximity-touch-Slip-Force-Torque-Machine vision-Image components-Representation - Hardware-Picture coding-Object recognition and Categorization-Software consideration- Case Studies

Total No. of Hrs : 45

REFERENCES

1. Fu, K.S. Gonzalez, R. and Lee, C.S.G. (1987) *Robotics control, sensing, vision, and Intelligence*. McGraw Hill Book Co
2. Klafter, R.D. Cmielewski, T.A. and Negin, M. (1994) *Robot Engineering an Integrated approach*. New Prentice Hall of India
3. Deb, S.R. (1994) *Robotics Technology and Flexible Automation*. Tata McGraw Hill Publishing Co, Ltd
4. Craig J.J. (1999) *Introduction to Robotics Mechanics and Control*. Addison Wesley
5. Groover, M.P. (1995) *Industrial robotics Technology, programming and applications*. McGraw Hill Book Co
6. http://www.robotics.com

MME13DE08 COMPOSITE MATERIALS AND MECHANICS 3 0 0 3

OBJECTIVE: At the end of this course the student will learn

- To understand the properties, manufacturing and mechanics of composite materials

UNIT I: INTRODUCTION **9Hrs**

Definition of Composite materials- Need – General characteristics – Classifications – Applications

UNIT II: CONSTITUENT MATERIALS **9Hrs**

Fibres – Matrices – Fibre reinforced plastics – Thermoset polymers –Coupling agents –Filters and additives –Metal matrix and ceramic composites.

UNIT III: MANUFACTURING **9Hrs**

Bag moulding – Compression moulding – Pultrusion – Filament winding – Other manufacturing processes – Quality inspection and testing.

UNIT IV: MECHANICS AND PERFORMANCE **9Hrs**

Introduction to micro mechanics – Unidirectional laminar – inter laminar stresses – static mechanical properties, fatigue properties – impact properties – Environmental effects – Fracture –damage and failures.

UNIT V: DESIGN **9Hrs**

Failure predictions-Design considerations – Joint design – Codes – Design examples

Total No. of Hrs : 45

REFERENCES

1. Mallick, P.K. (1993) *Fiber-Reinforced composites:Materials. Manufacturing and Design* , Marcel Dekker Inc
2. Halpin, J.C. (1984) Primer *on Composite Materials, Analysis.* Techomic Publishing Co
3. Agarwal, B. and DandBroutman, L.J. (1990) *Analysis and Performance of Fiber Composites.* John Wiley and Sons
4. Mallick, P.K. and Newman, S. (1990) *Composite Materials Technology: Processes and Properties* .
5. Hansen Publisher

MME13DE09 MECHATRONICS IN MANUFACTURING SYSTEMS 3 0 0 3

OBJECTIVE: At the end of this course the student will learn

- Usage of combination of mechanical and electronic systems in manufacturing

UNIT I: INTRODUCTION **8Hrs**

Introduction to Mechatronics - Systems - Mechatronics in Products - Measurement Systems - Control Systems - Traditional design and Mechatronics Design

UNIT II: SENSORS AND TRANSDUCERS **9Hrs**

Introduction-Performance terminology-Displacement, position and proximity - Velocity and Motion-Fluid pressure-Temperature sensors - Light sensors - Selection of sensors-Signal processing-Servo systems

UNIT III: MICROPROCESSORS IN MECHATRONICS **12Hrs**

Introduction-Architecture-Pin configuration-Instruction set-Programming of Microprocessors using 8085 instructions-Interfacing input and output devices-Interfacing D/A Converters and A/D Converters- Applications-Temperature control-Stepper motor control-Traffic light controller

UNIT IV: PROGRAMMABLE LOGIC CONTROLLERS **8Hrs**

Introduction-Basic structure-input/output processing-programming-Mnemonics Timers, Internal relays and counters-Data handling-Analog input/output-Selection of PLC.

UNIT V: DESIGN OF MECHATRONICS SYSTEM **8Hrs**

Designing-Possible design solutions-Case studies of Mechatronics systems

Total No. of Hrs : 45

REFERENCES

1. Michael, B.H. and David, G.A. (1999) *Introduction to Mechatronics and Measurement Systems*. McGraw Hill International Editions
2. Bradley, D.A. and Dawson, D. (1993) *Mechatronics*. Chapman and Hall
3. Gaonkar, R.S. (1998) *Microprocessors Architecture, Programming and Applications*. Wiley Eastern
4. Lawrence J.K. (2000) *Understanding Electro-Mechanical Engineering, an Introduction to Mechatronics*. Prentice Hall
5. Ghosh, P.K. and Sridhar, P.R. (1995) *0000 to 8085 Introduction to Microprocessors for Engineers and Scientists*. Second Edition, Prentice Hall
6. Http://www.cs.indiana.edu.

MME13DE10 **THEORY OF PLASTICITY** **3 0 0 3**

OBJECTIVE: At the end of this course the student will learn

- To understand the concepts and theories of elastic and plastic deformation

UNIT I: INTRODUCTION **9Hrs**

Modeling Uniaxial behaviour 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 **9Hrs**

Cauchy's formulae for strains, principal strains, principal shear strains, derivative strain tensor. Strain-displacement relationships. Linear elastic stress strain relations, GeneralizedHooke's law, nonlinear elastic stress strain relations

UNIT III: STRESS STRAIN RELATIONSHIPS **9Hrs**

Prandtl-Reuss material model.J2 deformation theory, Drucker-Prager material, General Isotropic materials. Drucker's stability postulate, normality, convexity and uniqueness for an elastic solid. Incremental stress strain relations.

UNIT IV: CRITERIA FOR LOADING AND UNLOADING **9Hrs**

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.

UNIT V: THEORY OF PLASTICITY AND BOUNDING SURFACES **9Hrs**

Loading surface, Hardening rules. Flow rule and Druckers stability postulate. Concept of effective stress and effective strain, mixed hardening material. Problems.
Uniaxial and multiaxial loading anisotropic material behaviour, Theorems of limit analysis, Statically admissible stress field and kinematically admissible velocity field, Upper and lower bound theorems, examples and problems.

Total No. of Hrs : 45

REFERENCES

1. Chens, W.F. and Han, D.J. (1987) *Plasticity for structural engineering*. Springer – Verlag.
2. Victor E.S. *Mechanics of Materials –II*.

MME13DE11 PRODUCT LIFE CYCLE MANAGEMENT 3 0 0 3

OBJECTIVE: At the end of this course the student will learn

- To understand the concepts and theories of product life cycle.

UNIT I: INTRODUCTION 9Hrs

Introduction to Product Data Management (PDM) – Present Market Constraints – Need for Collaboration – Internet and Developments in Server – Client Computing.

UNIT II: COMPONENTS OF PDM 9Hrs

Components of a Typical PDM Setup – Hardware and Software Document Management – Creation and viewing of Documents - Creating Parts – Version and Version Control of Parts and Documents – Case Studies.

UNIT III: CONFIGURATION MANAGEMENT 9Hrs

Base Lines – Product Structure – Configuration Management – Case Studies. Automating Information Flow - Work Flow – Creation of Work Flow Templates - Work Flow Integration.

UNIT IV: CHANGE MANAGEMENT 9Hrs

Change Management : Change Issue – Change Request – Change Investigation – Change Proposal – Change Activity – Case Studies.

UNIT V: IMPORTANCE OF PLM 9Hrs

Emergence of PLM- pre-PLM environment, paradigm, grid- Corporate challenges- service industry in PLM – a challenging project – importance, benefits & applications.

Total No. of Hrs : 45

REFERENCES

1. David Bedworth, Mark Henderson & Philip Wolfe, (1991) *Computer Integrated Design and Manufacturing*, Tata McGraw Hill Inc
2. John Stark, (2011) *Product Life Cycle management 21st century paradigm for product realization*. 2nd edition, Springer
3. Antti Saaksvuori & Anselmi Immonen, (2008) *Product life cycle management*. 3rd edition, Springer

MME13DE12 QUALITY ENGINEERING AND NON DESTRUCTIVE TESTING 3 0 0 3

OBJECTIVES: At the end of this course the student will learn

- TQM and its implementations
- Non destructive testing methods

UNIT I: STATISTICAL QUALITY CONTROL **9Hrs**

Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - Reliability and life testing.

UNIT II: TQM SYSTEMS AND IMPLEMENTATION **9Hrs**

Quality policy deployment, quality function deployment, standardization, designing for quality, manufacturing for quality. TQM IMPLEMENTATION - Steps, KAIZEN, 5S, JIT, POKAYOKE, Taguchi methods, case studies. Total Productive Maintenance (TPM) : Philosophy and Implementation Benchmarking- Type - Applications.

UNIT III: LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS **9Hrs**

Characteristics of liquid penetrants -different washable systems-Developers-applications -Methods of production of magnetic fields - Principles of operation of magnetic particle test -Applications – Advantages and Limitations.

UNIT IV: RADIOGRAPHY **9Hrs**

Sources of ray-x-ray production - properties of d and x rays- film characteristics - exposure charts -contrasts - operational characteristics of x ray equipment - applications.

UNIT V: ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES **9Hrs**

Production of ultrasonic waves - different types of waves - general characteristics of waves-pulse echo method - A,B,C scans - Principles of acoustic emission techniques - Advantages and limitations - Instrumentation - Applications.

Total No. of Hrs : 45

REFERENCES

1. Rose, J.E. (1993) *Total Quality Management*. Kogan Page Ltd
2. Barry Hull and Vernon John, (1988) *Non Destructive Testing*. MacMillan
3. (1976) *American Society for Metals, Metals Hand Book*. Vol. II
4. (1990) *Progress in Acoustic Emission*. Proceedings of 10th International Acoustic Emission Symposium, Japanese society for NDI
5. Http://www.sisndt.com
6. Http://www.iuk'tu-harburg.de