CENTURION UNIVERSITY OF TECHNOLOGY & MANAGEMENT
SCHOOL OF ENGINEERING & TECHNOLOGY, (JITM)
DEPARTMENT OF MECHANICAL ENGINEERING
ACADEMIC YEAR (2015-2016)

Course Structure for M.Tech (Design &Manufacturing)

1st Semester						2nd Semester					
Code	Subject	L	T	P	Credits	Code	Subject	L	T	P	Credits
MTDM 1104	Computer Aided Design	3	1	0	4	MTDM 2101	Advanced Mechanics of Solids	3	1	0	4
MTDM 1105	Computer Aided Manufacturing	3	1	0	4	MTDM 1204	Modern Manufacturing techniques	3	1	0	4
DMPE 1202	Finite Element Methods in Engg.	3	1	0	4	DMPE 1204	Computational Fluid Dynamics	3	1	0	4
Elective-1 (Any One)						Elective-3 (Any One)					
DMPE 1101	Tribology	3	1	0	4	DMPE 1201	Mechanical Vibrations	3	1	0	4
DMPE 1102	Fatigue , Fracture & Fracture Analysis	3	1	0	4	DMPE 1104	Composite Materials	3	1	0	4
DMPE 1103	Condition Monitoring	3	1	0	4	MTDM 1205	Design for Manufacture	3	1	0	4
Elective-2 (Any One)						Elective-4 (Any One)					
MTDM 1107	Industrial Robotics	3	1	0	4	DMPE 1112	Mechatronics	3	1	0	4
MTDM 1108	Optimizations Techniques	3	1	0	4	DMPE 1212	Tool Design	3	1	0	4
DMPE 1114	Lasers Applications in Manufacturing	3	1	0	4	MTDM 1206	Processing of Plastics	3	1	0	4
Practice						Practice					
MTDM 1109	Non Traditional Machining Lab	0	0	3	2	MTDM 1207	CAE Lab	0	0	3	2
DMPT 1108	Seminar-1	0	0	3	2	DMPT 1208	Seminar-2	0	0	3	2
Semester Credits					24	Semester Credits					24
3rd Semester						4th Semester					
Code	Subject	L	T	P	Credits	Code	Subject	L	T	P	Credits
MTDM 1203	Experimental Stress Analysis	3	1	0	4	DMPT 2201	Thesis Part-II				20
MTDM 2103	Advanced Casting & Welding Design	3	1	0	4						
DMPT 2107	Thesis Part-1				10						
DMCV 2108	Comprehensive Viva				2						
Semester Credits					20	Semester Credits					20
Total Credits: 24+24+20+20 =											88

* Red Indicates change in Subject Name; Yellow Indicates New Subjects; others reshuffled without changes in syllabus

1ST SEMESTER

COMPUTER AIDED DESIGN

Module – 1: Basic concepts (10hrs.)
Introduction: contents & tools, definition of CAD/CAM tools, industrial look at CAD/CAM
Hardware: types of systems, system evaluation criteria, I/O devise
Software: graphic standards, basic definitions, user interface, software modules, modelling & viewing
Module – 2: Geometric Modelling (14hrs.)
Representation of curves: wire frame models, wire frame entities, representation of analytic & synthetic curves. Representation of surfaces: models and entities, parametric representation of analytic & synthetic surfaces. Representation of solids: set theory, half – spaces, boundary representations, CSG, sweep representation, analytic solid modelling.
Module-3 (16 hrs) Line CLIPPING: Simple visibility algorithm, Cohen-Sutherland subdivision line clipping algorithm, mid point sub division algorithm.
Polygon clipping: polygon clipping, reentrant polygon clipping – Sutherland – Hodgeman algorithm, character clipping, 3D- clipping.
Transformations: Cartesian and homogeneous coordinate systems two dimensional and threedimensional transformations – scaling, rotation, Shearing, Zooming, viewing transformation, reflection, rotation about an axis, concatenation.

TEXT BOOKS:
1. CAD/CAM – A Zimmers& P. Groover/PE/PHI
2. CAD/CAM Theory & Practice/Ibrahim Zeid/TMH
3. CAD/CAM – P.N. RAO

REFERENCES:
1. Automation, production systems & Computer integrated manufacturing/Groover/ P.E
2. CAD/CAM/CIM/ Radhakrishnan and Subramanian/ New age
3. Principles of Computer Aided Design and manufacturing/FaridAmirouche/Pearson

COMPUTER AIDED MANUFACTURING

MODULE-1 (15 Hrs)
Introduction: Fundamental concepts in Manufacturing and Automation, Automation Strategies,Economic analysis in production, fundamentals of CAD / CAM, product cycle and CAD/CAM,Automation and CAD/CAM, Scope of CIM, Automated flow lines, Transfer mechanisms, methodsof Line balancing.
Numerical control machines: Introduction- basic components of an NC system-the NC procedure-NC coordinate system, NC motion control system- application of numerical control- Economics ofNumerical control.
NC part programming: Introduction – NC coding system, manual part programming, part programming with APT, NC part programming using CAD/CAM, manual data input.
Computer controls in NC: NC controllers' technology - Computer Numerical Control (CNC),Direct Numerical control (DNC).
Group Technology: Part families, parts classification and coding, production flow analysis, Composite part concept, Machine cell design, benefits of GT.

MODULE-2 (15 Hrs)
Introduction to CNC Machine tools: Evolution of Computerized control in manufacturing, Components, Working principle of CNC, DNC and Machining centers.
Constructional features of CNC machine tools: Introduction, Spindle drives, Transmissionbelting, axes feed drives, Slide ways, Ball screws.
Accessories: Work tables, Spindles, Spindle heads, Beds and Columns, Tooling – Automatic Tool changer (ATC).**APT programming:** APT language structure, APT geometry, Definition of point, time, vector,circle, plane, patterns and matrices. APT motion commands: setup commands, point-to point motioncommands,

continuous path motion commands, post processor commands, control commands,Macro subroutines, Part programming preparation for typical examples.

Economics and Maintenance of CNC machine tools: Introduction, factors influencing selection ofCNC machines, Cost of operation of CNC machines, Maintenance features of CNC machines,Preventive maintenance, Documentation, Spare parts, Training in Maintenance.

MODULE-3 (15Hrs)

Introduction: Need for the compression in product development, History of RP system, Survey of applications, Growth of RP industry and classification of RP system.

Stereo Lithography System: Principle, Process parameter, Process details, Data preparation, Data files and machine details, Applications.

Fusion Decomposition Modeling: Principle, process parameter, Path generation, Applications.**Solid ground curing:** Principle of operation, Machine details, Applications,

Laminated Object Manufacturing: Principle of Operation, LOM materials, Process details, Applications.

TEXT BOOKS:

1. CAD/CAM – A Zimmers& P. Groover/PE/PHI
2. CAD/CAM – P.N. RAO

REFERENCES:

1. Automation, production systems & Computer integrated manufacturing/Groover/ P.E
2. CAD/CAM/CIM/ Radhakrishnan and Subramanian/ New age
3. Principles of Computer Aided Design and manufacturing/FaridAmirouche/Pearson

FINITE ELEMENT METHODS IN ENGINEERING 3-1-0

Module – I (10 hours)

Fundamental Concepts: Introduction, Historical background, Outline of presentation, Stresses and Equilibrium, Boundary conditions, Strain-Displacement relations, Stress-Strain relations, Plane stress, Plane strain problems, Temperature effects, Potential energy and equilibrium. The Rayleigh-Ritz method, Hamilton's principle.Galerkin's method, Saint Venant's principle.

Module – II (10 hours)

One-dimensional Problems: Introduction, Finite element modeling, Coordinates and Shape functions. The potential energy approach.The Galerkin approach, Assembly of the global stiffness matrix- mass matrix and load vector, Treatment of boundary conditions, Quadratic shape functions, Temperature effects. Trusses: Introduction, Plane trusses, Three-dimensional trusses, Assembly of global stiffness matrix for the Banded and Skyline solutions.

Module – III (10 hours)

Two-dimensional Problems Using Constant Strain Triangles: Introduction, Finite element modeling, Constant strain triangle, In plane and Bending, problem modeling and boundary conditions.

Axisymmetric Solids Subjected to Axisymmetric Loading: Introduction, Axisymmetric formulation, Finite element modeling, Triangular element, Problem modeling and boundary conditions.

Module – IV (10 hours)

Two-dimensional Isoparametric Elements and Numerical Integration: Introduction, The four-node quadrilateral, Numerical integration, Higher-order elements. Beams and Frames: Introduction, Finite element formulation, Load vector, Boundary considerations, Shear force and bending moment, Beams on elastic supports, Plane frames.

Text Book:

1. Introduction to Finite Elements in Engineering, by Tirupathi R. Chandrupatla, Ashok D.Belegundu (chapters 1 to 8 only).

References:

1. Introduction to Finite Element Method, by S.S.Rao
2. Finite Element Method, by O.C. Zienkiewicz.
3. Concepts and Applications of Finite Element Analysis, by Robert D. Cook.
4. Introduction to Finite Element Method, by J.N.Reddy.

TRIBOLOGY 3-1-0

Module I

Introduction-Historical background, Bearing concepts and typical applications. Lubricant and lubrication, Types of bearings, properties and testing of lubricants, Basic equations: Generalized Reynolds equation, Flow and Shear Stress, Energy equation, Equation of state. Viscous flow concepts-Conservation of laws and its derivations: continuity, momentum (N-S equations) and energy, Solutions of Navier-Strokes equations. Order of magnitude analysis, General Reynolds equation-2D and 3D (Cartesian and Cylindrical)

Module II

Hydro dynamic lubrication : Mechanism of pressure development and load carrying capacity, Plane-slider bearing, Idealized slider bearing with a pivoted shoe, Step bearing, Idealized journal bearing. – infinitely long journal bearing, Petroffs equation for a lightly loaded bearing, narrow bearing, Oil flow and thermal equilibrium - Heat balance of lubricants

Hydrostatic Bearing **:**Principles, Component of hydrostatic lubrication , Hydrostatic circular thrust bearing , calculation of pressure, load carrying capacity, flow rate , power loss in bearing due to friction.

Concept of gas lubricated bearing Concept of Elasto-hydrodynamic lubrication, Design and selection of antifriction bearing

Module III

Friction and wear of metals : Theories of friction, surface contaminants, Effect of sliding speed on friction, classification and mechanism of wear, Wear resistant materials.

Wear and wear types. ; Mechanisms of wear - Adhesive, abrasive, corrosive, erosion, fatigue, fretting, etc., Wear of metals and non-metals. Wear models - asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage. Wear in various mechanical components, wear controlling techniques.

Text Books:

1. Introduction to Tribology of Bearings B.C.Majumdar, S.Chand
2. Fundamentals of fluid film lubricant Bernard J.Hamrock, ,McGraw-Hill Co.,1994

Reference Books:

1. Basic Lubrication theory, A. Cameron, John Wiley & sons
2. Lubrication Fundamentals, D.M.Pirro and A.A.Wessol, CRC Press
3. Theory and Practice of Lubrication for Engineers**,** Fuller, D., New York company 1998
4. Principles and Applications of Tribiology**,** Moore, Pergamaon press 1998
5. G Bayer, Mechanical wear prediction and prevention,-Marcel Dekkar. Inc. New York
6. P.Sahoo, Industrial Tribology Tata McGraw Hill
7. Dr S.P.Srivastava, Lubricants Additives & Tribology, 2008, Tech book international,New Delhi

FATIGUE, FRACTURE & FRACTURE ANALYSIS

Module – I

Fatigue: Types of fatigue loading and failure, endurance limit and S-N diagram; Fatigue under combine stresses; Notch sensitivity, Fatigue test methods; Various failure relations; Factors influencing fatigue strength; Influence of stress concentration; Fatigue crack growth initiation and propagation. Fatigue failures: characteristics of fatigue, unidirectional bending fatigue, torsion fatigue facture, contact fatigue fracture, thermal fatigue failure.

Module – II

Creep: 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.Creep-stress-time temperature relations, Mechanics of creep in tension, bending, torsion, creep buckling. Members subjected to creep and combined stresses

Module – III

Fracture: Basic modes of fracture, Griffith of brittle fracture, Irwin's theory of fracture in elastic-plastic materials. Theories of linear elastic fracture mechanics, stress intensity factors, fracture toughness testing. Mechanisms of crack growth and fracture; Basic modes of fracture; Stress Concentration factor.

Text Books

1. Strength and Resistance of Metals - J. M. Lessels, John Wiley and Sons, Inc., 1954.
2. Mechanical Behaviour of Engineering Materials - Joseph Marin, PHI, 1966.
3. Fatigue Testing and Analysis - Y. Lee, J.Pam, R.B. Hathaway & M.E. Barkey Elsevier Press

Reference Books

1. Mechanical Metallurgy - G. E. Dieter, Mc-Graw Hill Book Co., 1961
2. Engineering Fracture Mechanics - S. A. Meguid, Elsevier Press, 1989.
3. Introduction to Fracture Mechanics, - K. Hellan, McGraw-Hill.

CONDITION MONITORING 3-1-0

MODULE-I

Introduction : Principles, Economics and Application; Condition Monitoring Methods. Economics of Condition Monitoring, Setting up a CM Activity, Implementation of Condition Based Maintenance, Consequences of implementation of CBM. Information System, Selection of Monitoring Methods, Assessment of monitoring techniques.Case studies.

Vibration Monitoring and analysis: Introduction, Machinery signatures, Selection of Transducers. Analysis of techniques, Machine failure modes, Measurement location, Vibration severity criteria, Vibration frequency analysis.Permanent Monitoring, Case studies.

Vibration Monitoring of ball and roller bearings: Introduction, Shock pulse method, SPM for testing Antifriction bearings, Manual Monitoring, Continuous monitoring, The Kurtosis method, Fiber optics system, Vibration signature analysis, Contact resistance method, Case studies. SPM and its Applications.

MODULE-II

Specialized techniques of condition monitoring:

Acoustic imaging: Ultra sonic triangulation fault location Acoustic emission technique (AET)- Instrumentation, Transducers, Preamplifier and filter, Main amplifier and Signal processing/ Display unit, Signals and processing, Magnetic testing Methods, Current flow Magnetisation, Induction Magnetic Flow Method, Induction Threading bar method, Induction Magnetising Coil method, Induced Current flow method, Magnetic particle Inspection Inks, Strippable Magnetic film, Eddy Current apparatus,

Thermography- Thermographic Equipment, Application of Thermography,

Corrosion monitoring: Need for corrosion monitoring, Fields of application, Monitoring Techniques, Resistance techniques. Other probe techniques-Analytical technique and others.

Performance Trend monitoring: Introduction, Thermodynamic and Fluid dynamic analysis, Primary and Secondary, performance parameter, Steam turbine performance parameters, Case examples.

MODULE-III

Mechanical Fault Diagnosis By Wears Monitoring & Lubricant Analysis: Introduction, Source of Contamination, Significant oil contaminants, Used oil Contamination-time trends, Changes in the carrier fluid, Ferratic wear debris. Wear process monitoring techniques- Direct debris detection methods, Debris collection methods. Lubricant sampling & analysis-Sampling, Lubricant sampling methods, Lubricant analysis methods, Interpretation of results, Indications from the amount of debris present, Indication from the size distribution of debris, Application of chemical analysis of debris, Wear detection using proximity monitors, Case examples.

Text Books:

1. R.A., Caollacatt Chapman "Mechanical Fault Diagnosis and Condition Monitoring", Chapman and hall 1977.

References: 2. L.F.Pau Marcel Deker "Failure Diagnosis and Performance Monitoring". 3. Update CEP ISTE New Delhi "Condition Monitoring and condition based maintenance".

INDUSTRIAL ROBOTICS 3-1-0

MODULE-I

Introduction: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system.

Components of the Industrial Robotics: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom. Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

Motion Analysis: Homogeneous transformations as applicable to rotation and translation – problems.

MODULE-II

Manipulator Kinematics: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems. Differential transformation and manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion – straight line motion.

MODULE-III

Robot Programming: Robot languages: AL, AML, RAIL, RPL, VAL, Demonstration of points in space: Continuous path (CP), Via points (VP), Programmed points (PP).

Robot actuators and Feed back components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors. Feedback components: position sensors – potentiometers, revolvers, encoders – Velocity sensors.

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

TEXT BOOKS :

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K &Nagrath I J / TMH.

REFERENCES :

1. Robotics / Fu K S/ McGraw Hill.
2. An Introduction to Robot Technology, / P. Coiffet and M. Chaironze / Kogam Page Ltd. 1983 London.

OPTIMIZATION TECHNIQUES

Module I (12 hours)

Introduction: Engineering Applications; Statement of the Optimal Problem: Classification; Optimization Techniques. Classical Methods: Single Variable Optimization; Multivariable Optimization without any Constraints with Equality and Inequality Constraints.

Module II (12 hours)

One-Dimensional Minimization Methods: Uni-model Function; Elimination Methods – Dichotomous Search, Fibonacce and Golden Section Methods; Interpolation Methods – Quadratic and Cubic Interpolation Methods. Unconstrained Minimization Methods: Univariate, Conjugate Directions, Gradient and Variable Metric Methods.

Constrained Minimization Methods: Characteristics of a constrained problem; Direct Methods of feasible directions; Indirect Methods of interior and exterior penalty functions.

Geometric Programming : Formulation and Solutions of Unconstrained and Constrained geometric programming problems.

Module III (12 hours)

Dynamic Programming: Concept of Sub-optimization and the principle of optimality; Calculus, Tabular and Computational Methods in Dynamic Programming; An Introduction to Continuous Dynamic Programming.IntegerProgramming :Gomory's Cutting Plane Method for Integer Linear Programming; Formulation & Solution of Integer Polynomial and Non-linear problems.

Text Books :

1. Optimization (Theory& Applications) – S.S. Rao, Wiley Eastern Ltd., New Delhi.

2. Optimization Concepts and Applications in Engineering – Ashok D.Belegundu and Tirupathi R Chandrupatla — Pearson Education.

Reference Books :

1. Optimization: Theory and Practice, C.S.G. Beveridge and R.S. Schechter, MGH, New York.

LASERS IN MANUFACTURING 3-1-0

Module – I (15 hours)

Laser Fundamentals: spontaneous & stimulated emission/absorbtion, population inversion & pumping, cavity design , coherence and interference. Common industrial lasers and their output characteristics: CO2, Ruby, Nd-YAG, Nd-glass, excimer& He-Ne.
Overview of laser Applications: Laser application in various fields, advantages & disadvantages, economics.
Laser processing fundamentals: beam characteristics, optical components and design of beam delivery systems, absorption characteristics of materials, heat flow theory and metallurgical considerations. Cutting and drilling: Process characteristics, material removal modes, development of theoretical models and practical performance.

Module – II (15 hours)

Welding: Process mechanisms like keyhole & plasma, development of theoretical models, operating characteristics and process variation. Surface modification: heat treatment, rapid solidification, alloying and cladding, surface texturing, development of theoretical models, LCVD, LPVD.

Module – IV (15 hours)

Introduction to interferometry: working principles of Michelson interferometer and Fabry-Perot interferometer and elementary holography. Special topics: detection and measurement of radiation, laser safety.

Text Books:

1. Steen W.M. ; Watkins. K. Laser Material Processing 3rd Edition, Springer London, 2003

2. Cartisan. C. L. Laser cutting Guide for Manufacturing Society of Manufacturing Engineers, USA.

NON TRADITIONAL MACHINING LABORATORY

1. Tool Path generation using CAM -3 JOBS
2. Experiments on EDM-2 Jobs
3. Experiments on WEDM- 2 Jobs
4. Machining using CNC Miller-3 Jobs
5. Machining using CNC Lathe- 3 Jobs

2ND SEMESTER

MTDM 2101 ADVANCED MECHANICS OF SOLIDS 3-1-0

MODULE I

Analysis of Stresses and Strains in rectangular and polar coordinates. 3D Equilibrium equations: Cauchy's formula, Principal stresses and principal strains, 3D Mohr's Circle of stresses and strains. Ellipse of stress and strain, Octahedral Stresses State of pure shear, Plane stress and plane strain, compatibility conditions. Introduction to curvilinear coordinates. Generalized Hooke's law and theories of failure.

MODULE II

Energy methods: Work done by forces and elastic strain energy stored. Reciprocal relations, Theorem of virtual work, Castigliano's theorems.Bending of symmetric and un-symmetric straight beams. Curved effect of shear stresses, Shear center and shear flow, Shear centre in thin walled section with symmetric and un-symmetric thin walled beams, shear in closed thin walled sections. Bending of curved beams, curved beam theory, Winkler Bach formula for circumferential stress, radial stress in curved beams. Stress distribution in beam with rectangular, circular and trapezoidal cross section, stresses in crane hooks, ring and chain links.

MODULE III

Torsion of prismatic bars- Saint Venant's semi inverse and Prandtl's stress function approach, Torsion of Straight bars: Circular, Elliptic and Equilateral triangular cross section – Torsion of narrow rectangular section. Thick walled cylinder subjected to internal and external pressures, Compound cylinders, Shrink fit, Lame's theory, Rotating disks and cylinders, Thick spherical shells.

Text book:

1. L. S. Srinath, Advanced Mechanics of Solids, 2nd Edition, TMH Publishing Co. Ltd., New Delhi, 2003.
2. Theory of elasticity by Timoschenko S.P. and Goodier J.N. McGraw-Hill Publishers 3rd Edition
3. Strength of Materials by S.S.Rattan, Tata McGraw Hill

Reference book:

1. Advanced Mechanics of Materials :Siley and Smith
2. Strength of Materials Vol.II, by S.Timoshenko
3. Strength of Materials by G. H. Ryder, Macmillan Press
4. Mechanics of Materials by Beer and Johnston, Tata McGraw Hill
5. Mechanics of Materials by R.C.Hibbeler, Pearson Education
6. Mechanics of Materials by James M. Gere, Thomson Learning
7. Advanced Mechanics of Materials, Boresi.A.P.,Schimidt. R.J. John Wiley
8. Strength of materials & Theory of structures (Vol I & II) by B.C Punmia
9. Strength of materials by Sadhu singh

MODERN MANUFACTURING TECHNIQUES

Module-I

Need Of Non Traditional Machining And Forming Processes. Abrasive jet machining, ,Water Jet Machining,Abrasive Water Jet Machining , Ultra Sonic Machining proceses, variables of performance, applications

Module -II

Electric Discharge Machining -process ,variables affecting Material Removal Rate, applications, power circuits, wire Electric Discharge Machining - Electro Chemical Machining process, Variables affecting Material Removal Rate, ,Chemical Machining ,Plasma Arc Machining, Electron Beam Machining, Laser Beam Machining.

Module-III

HIgh energy rate forming techniques, explosive forming, electro hydraulic forming,magnetic pulse forming,hydro static extrusion processes- advantages

Text books

1.v.k.jain- advanced machining processes , new age publishers
2.nagpal:metal forming processs, khanna publishers

COMPUTATIONAL FLUID DYNAMICS 3-1-0

MODULE-I Introduction: Basic tools of CFD, Numerical Vs experimental tools. ; Mathematical Behavior of PDEs: Parabolic, Hyperbolic and Elliptic PDEs.Methodology of CFDHT: Discrete representation of flow and heat transfer domain: Grid generation,Solution of 1-D/2-D steady/unsteady: Diffusion problems, Solution of Navier-Stokes Equations for Incompressible Flows; Special Topics in CFDHT: Numerical Methodology for Complex Geometry, Multi-block structured grid system, Solution of phase change Problems.

MODULE-II Finite difference schemes: backward,central and forward schemes.stability analysis, Finite volume method for incompressible flows , Vertex centered and cell centered FVM , Treatment of convection term – Upwind, hybrid, upwind least square reconstruction and QUICK schemes ,staggered and collocated grids, solution algorithms for both types ,

MODULE-III Evaluation of velocity field – SIMPLE, SIMPLER, and projection methods – Time dependent problems – Implicit, Crank-Nicolson and Explicit schemes –Finite volume method for compressible flows-Treatment of convection terms – Flux vector splitting method – Artificial diffusion – Structured and unstructured grids – Solution of system of equations – Tridiagonal matrix algorithm – Line by line solver.

TEXT BOOKS

1. S.V. Patankar, Numerical Heat Transfer and Fluid Flow, Taylor and Francis, ISBN-10: 0891165223.
2. H. K. Versteeg and W. Malalasekra, Introduction to Computational Fluid Dynamics: The Finite Volume Method, Prentice Hall (2nd Edition), ISBN-10: 0131274988.

REFERENCE BOOKS

1. Jr. D. A. Anderson, Computational Fluid Mechanics and Heat Transfer by McGraw-Hill Education
2. M. N. Ozisik, Finite Difference Method, CRC (1st Edition).
3. Computational fluid dynamics, T. J.Chung, Cambridge University press,2002.
4. C A J Fletcher : Computational Techniques for Fluid Dynamics – Vol 1 & 2, Springer Verlag, 1988

MECHANICAL VIBRATION 3-1-0

Module I

Review of vibration fundamentals for SDOF systems. Model study through single degree of freedom analysis:Un-damped free Vibration : Equilibrium method, Energy method, Raylegh's method, Stiffness of spring elements. Damped Vibrations : Viscous damping, Laws of damping, Logarithmic decrement. Forced vibrations ;coulomb damping; Response to harmonic excitation; Steady state solution with viscous damping, method of complex algebra rotating unbalance and support excitation ;Vibration isolation and transmissibility. Energy dissipated by damping. Equivalent viscous damping, structural damping, sharpness of resonance.

Module II

Two degrees and Multidegree of freedom systems with applications: Two degree of freedom systems : Generalized Derivation of Equation of motion, Normal mode vibration, coordinate coupling, Langrange's equations, Dynamic Vibration absorber. Multi-degree of freedom system : Derivation of Equations, influence co-efficients, modal analysis, orthogonality of normal modes. Torsional Vibration multi-rotor systems and branched system.

Module III

Vibration of continuous system. Vibration of strings, membranes, rods and beams with different end conditions Euler-Bernoulli equation for beams.

Vibration Measuring Instruments: Vibrometers, velocity meters & accelerometers, Vibration testing equipments. Critical speeds without and with damping.

Text Books:

1. Theory of Vibration with Applications, W. T. Thomson, CBS Publ., 1990.
2. Mechanical Vibration analysis, P. Srinivasan, TMH.1995

Reference Books

1. Elements of Vibration Analysis, L. Meirovitch, TMH, Second edition, 2007
2. Mechanical Vibration, S.S.Rao, Pearson, 2004
3. Theory and Problems of Mechanical Vibrations, WillamW.Seto, TMH
4. Introductory course on Theory and Practice of Mechanical Vibrations, J.S. Rao&K.Gupta, New Age Pub

COMPOSITE MATERIAL 3-1-0

Module-I.

Introduction to Composite Materials – Classification and characteristics of composite materials, 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, Thermosetting, Metal matrix and ceramic composites.

Module- II

Micromechanical 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.

Module III

Micromechanical 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.

Text Books:

1. R. M. Jones, Mechanics of Composite Materials. Taylor & Francis.
2. K.K. Chawla, *Composite Materials – Science & Engineering*, Springer-Verlag, New York, 1987.
3. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley- Interscience, New York, 1980.

References:

1. L. R. Calcote, Analysis of Laminated Composite Structures, Van NostrandRainfold, New York, 1969.
2. F.L. Matthews and R.D. Rawlings, *Composite Materials: Engineering and Science*, Chapman & Hall, London, 1994.
3. M.W.Hyer, *Stress analysis of fibre reinforced composite materials*, Tata McGraw Hill.
4. J. N. Reddy, *Mechanics of laminated composite plates ,Theory and analysis*, CRC Press.

DESIGN FOR MANUFACTURING 4-0-8

MODULE - I

Introduction: Design philosophy-steps in design process-general design rules for manufacturabilitybasicprinciples of designing for economical production-creativity in design.Materials: Selection of materials for design-developments in material technology-criteria formaterial selection-material selection interrelationship with process selection-process selection charts.Machining processes: Overview of various machining processes-general design rules for machiningdimensionaltolerance and surface roughness-Design for machining – ease –redesigning ofcomponents for machining ease with suitable examples. General design recommendations for
machined parts.

MODULE-II

Metal casting: Appraisal of various casting processes, selection of casting process,-general designconsiderations for casting-casting tolerance-use of solidification, simulation in casting designproduct
design rules for sand casting.Metal joining: Appraisal of various welding processes, factors in design of weldments – generaldesign guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of
brazed joints.

MODULE-III

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

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

Plastics: Visco elastic and creep behavior in plastics-design guidelines for plastic componentsdesignconsiderations for injection moulding – design guidelines for machining and joining ofplastics.

Text Books:

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

Reference Books:

1. ASM Hand book Vol.20

MECHATRONICS 3-1-0

Module – I (10 hours)

INTRODUCTION : Definition – Trends - Control Methods: Standalone , PC Based (Real Time Operating Systems, Graphical User Interface , Simulation) Applications: SPM,Robot,CNC,FMS,CIM. SIGNAL CONDITIONING : Introduction – Hardware - Digital I/O , Analog input – ADC , resolution , sped channels. Filtering Noise using passive components – Resistors, capacitors - Amplifying signals using OP amps – Software - Digital Signal Processing – Low pass , high pass , notch filtering PRECISION MECHANICAL SYSTEMS : Pneumatic Actuation Systems - Electro-pneumatic Actuation Systems - Hydraulic Actuation Systems - Electro-hydraulic Actuation Systems - Timing Belts – Ball Screw and Nut - Linear Motion Guides - Linear Bearings - Harmonic Transmission - Bearings- Motor / Drive Selection.

Module – II (10 hours)

ELECTRONIC INTERFACE SUBSYSTEMS : TTL, CMOS interfacing - Sensor interfacing-Actuator interfacing – solenoids , motors Isoation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors/ mosfets ELECTROMECHANICAL DRIVES : Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives –Drive System load calculation

Module – III (10 hours)

MICROCONTROLLERS OVERVIEW : 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly , C (LED Blinking , Voltage measurement using ADC). PROGRAMMABLE LOGIC CONTROLLERS : Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling -Analog input / output - PLC Selection - Application.

Module – IV (10 hours)

PROGRAMMABLE MOTION CONTROLLERS : Introduction - System Transfer Function -Laplacetransform and its application in analysing differential equation of a control system - Feedback Devices : Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers- P , PI , PID Control - Control modes – Position , Velocity and Torque - Velocity Profiles – Trapezoidal- S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear ,Circular - Core functionalities – Home, Record position , Go to Position - Applications : SPM, Robotics.

TEXT BOOKS : 1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005. 2. Mechatronics/M.D.Singh/J.G.Joshi/PHI.

REFERENCES : 1. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai. 2. Mechatronics – N. Shanmugam / Anuradha Agencies Publisers. 3. Mechatronics System Design / Devdasshetty/Richard/Thomson.

TOOL DESIGN 3-1-0

Module I (15 hours)

Basic Features and Kinematics of Machine Tools: Features of basic machine tools construction and operation, types of machine tools, machine tools motions, transmission-rotation in to rotation, rotation in to

translation, kinematic-structures of machine tools: elementary, complex and compound structure, kinematic-features of gear shapers and gear hobbing machine.
Design of gear boxes- need for variation of speed, selection of speed range, laws of stepped regulation, standardization of speeds, speed diagram, analysis of productivity loss, kinematic advantage of GP, structural diagrams, ray diagram and speed chart. Gear Drives: Belt and cone pulley, slip gear type, north gear drive, draw key gear drive, clutch type, mechanical step less drives, electrical drives; hydraulic drive.

Module II (10 hours)

Design of Metal working Tools: Design of press working tools, shearing, piercing, blanking, dies, compound die design principles for forging dies, bending, forming drawing dies, tooling for forging-design principles for forging dies, drop forging, upset forging, design principles and practice for rolling, roll press design.

Module III (20 hours)

Design of Jigs and Fixtures: Principles of location, locating method and devices, principles of clamping, clamping devices, drilling jigs, types, drill bushes, fixture and economics, types of fixture, milling, grinding, broaching, assembly fixtures indexing jig and fixtures, indexing devices. **Design of Gauges and Inspection Features:** Design of gauges for tolerance for dimensions and form inspection; dies and mould design for Ppastics& rubber parts: compression molding, transfer molding, blow molding.

Tool Engineering and Machine Tools

References: 1. Mehta N.K.; Machine Tool Design and Numerical Control; TMH 2. Sen G.C, Bhattacharya A; Principles of Machine Tools; New Central Book Agency. 3. Donaldson; Tool Design T.M.H. 4. Jain KC and Chitale AK; Text Book Of Production Engineering; PHI Learning 5.Juneja, Sekhon and Seth; Fundamentals of Metal Cutting and Machine Tools; New Age. 6. Krar SF, Gill AR, Smid P; Technology of Machine Tools;TMH 7. Sharma P.C; Production Engineering; Chand S 8.Wilson; Fundamentals of Tool Design; ASTME 9.Paqwin J.R; Die Design Handbook; The Industrial Press-NY 10. ASTME; Die Design Hand Book; McGraw Hill 11.Archinov; Metal Cutting & Cutting Tool Design; MIR

PROCESSING OF PLASTICS

Module1: plastics &polymers , engineering applications, polymerization, additives in plastics, manufacture of plastic products.
Module2 :casting, compression moulding, transfer moulding, injection moulding
Module3: extrusion,blow moulding, rotomoulding,laminating methods, calendering,machining and joining of plastics

Text books

1.kalpakjian: manufacturing engg and technology, pearson education
2.engg materials :dieter, macmillan publishers

CAE LAB

Two Experiments for Each

1. General Practice on APDL & Workbench Interface
2. Structural Analysis
3. Thermal Analysis – Steady State, Transient
4. Modal Analysis
5. Analysis using Fluent – Fluids

3rd SEMESTER

MTDM 1203 INSTRUMENTATION & EXPERMENTAL STRESS ANALYSIS

Module-I

Basic elasticity theory, Stress analysis by strain measurement: Principal stresses and strains. Basic Characteristics of a Strain Gauge, Types of Shell Gauge; Mohr's circle-measurement of strains-Strain gauges-Electric Resistance strain gauges, semiconductor strain gauges, Grid Method of Strain Analysis, Factors Influencing Strain sensitivity in Metallic Alloys, Gauge Construction Temperature Compensation, Factors-Influencing Gauge Section Gauge Sensitivity and Gauge Factor, Correction for transverse Strain Effects, strain gauge circuits, transducer applications, recording instruments for static and dynamic applications

Module-II

Photo elasticity: Photo elasticity – Polariscope – Plane and circularly polarized light, Bright and dark field setups, Photo elastic materials – Isochromatic fringes – Isoclinics. 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.

Module-III

Gauges. Rosette Analysis - three element rectangular Rosette, the three and Four Element Delta Rosette, The Stress Gauge, Strain Circuits, Potentiometer Circuits, The Wheatstone Bridge. Brittle Coating Method: Coating Stresses, Failure Theories. Brittle Coating Crack Patterns Produced by Direct Loading, refrigeration Techniques and Releasing the Load. Double Crack Pattern, Crack Detection, Load-Time Relation and Its influence on the threshold Strain Effects of a Biaxial stress Field.

Text Books:

1. J.W. Dally and W.F. Riley, *Experimental Stress Analysis*, 2nd Ed. MGH.
2. MubinKhanna, *Experimental Stress Analysis*, 2003.

Reference Books:

1. R. C. Dove and P. H. Adams Experimental Stress Analysis and Motion Measurement PHI, 1965.
2. A. J. Durelli Applied Stress Analysis PHI, 1970.
3. Srinath et.al. *An Introduction to Experimental Stress Analysis* - MGH

ADVANCED FOUNDRY & WELDING TECHNOLOGY

Module I(18 Hours)

Moulding: Development of metal castings- Materials for moulding- Foundry sand control- Different types of cores- Core making processes- Materials for core making- Moulding and core making machines. Recent developments in core mould making- Cold set process- Investment process- Shell moulding- Hot box method-Shaw process. Vacuum moulding- moulding for mass production.

Melting and Solidification: Furnaces used in foundry for melting ferrous and nonferrous metals- principals of operation of cupola and charge calculations. Family of cast irons- Production of malleable and S.G. Irons-Methods of alloying and inoculants and their effects on the structure and properties of cast iron. Principles of Solidification: Nucleation- Crystal growth- Morphology and structure of cast metals and alloys- Pure metals-Single phase alloys and eutectics. Solidification in sand and chill moulds.

Module II(18Hours)

Foundry Mechanization: Layout for ferrous and nonferrous foundries- Description of equipment used for mechanization- Sand conditioners- Conveyors- Cranes- Equipment for handling moulds, Cores and molten metal- Knock out of moulds- Fettling equipment.

Special Welding Processes: Resistance welding processes- Spot, Seam, Projection, Flash butt welding - Machine cycle for resistance welding- Parameters in resistance welding- Electrodes for resistance welding – Solid State Welding: Cold welding – Forge welding - Ultrasonic welding Diffusion welding – Radiation welding: Laser Beam Welding, Electron Beam Welding – Automatic welding systems.

Module III(12 Hours)

Weldability of Metals: Factors influencing weldability of metals- Welding of Cast steels, Carbon steels, Stainless steels and Cast iron. Weldability of Cu and its alloys, Al and its alloys- Ti and its alloys- Mg and its alloys- Temperature changes in welding and their effects on mechanical properties. Absorption of gases by welds and their effects- Residual stresses and distortion- Heat treatment of welded parts.

Welding Joints, Weld Symbols and Joint Design principles: Types of joints – types of welds – Variants of joints and weld types - Welding symbols – principles of weld joint design and evolving of good weld designs.

Text Books:

1. Foundry Technology, by Jain P.L.
2. Welding Engineering and Technology, by R.S. Parmar.

References:

1. Foundry Engineering, by Agarwal.
2. Foundry Engineering, by Taylor F. & Others.
3. Principles of Metal Castings, by Heine & Others.
4. Modern Welding Technology, by H.B. Cary.
5. Welding Technology, by Koenisburger.
6. Welding Metallurgy, S.Kou, 2ndedition, John Wiley and Sons, New York, NY (2003).