Curriculum of M.Tech. (Mechanical Engineering)

SPECIALIZATION: DESIGN

FIRST SEMESTER

A. THEORY						
Serial No	**Subject Code**	**Subject**	**L-T-P**			**Credits**
			L	**T**	**P**	
1	MED101	Theory of Elasticity & Plasticity	4	0	0	4
2	MED102	Principle of Machine Design	4	0	0	4
3	MED103	Mechanical Vibration	4	0	0	4
4	MED104	Advance Engineering Mathematics	3	1	0	4
5	MED105	Elective-I	4	0	0	4
			Total			**20**

A. LABORATORY/PRACTICAL						
Serial No	**Subject Code**	**Subject**	**L-T-P**			**Credits**
			L	**T**	**P**	
1	MED191	Design Practice Lab-I	0	0	3	2
2	MED192	CAD/CAM Lab	0	0	3	2
3	MED181	Seminar-I	0	2	0	1
					Total	**5**

Electuve-I :

MED105A	Design of Bearing & Shaft
MED105B	Computer Aided Design
MED105C	Finite Element Method

SECOND SEMESTER

A. THEORY						
Serial No	**Subject Code**	**Subject**	**L-T-P**			**Credits**
			L	**T**	**P**	
1	MED201	Advance Machine Design	3	1	0	4
2	MED202	Mechatronics & Product Design	3	1	0	4
3	MED203	Design of Mechanisms	3	1	0	4
4	MED204	Elective-II	4	0	0	4
5	MED205	Elective-III	4	0	0	4
			Total			**20**

A. LABORATORY/PRACTICAL						
Serial No	**Subject Code**	**Subject**	**L-T-P**			**Credits**
			L	**T**	**P**	
1	MED281	Seminar-II	0	2	0	1
2	MED291	Design Practice Lab-II	0	0	3	2
					Total	**3**

Electuve-II :

MED204A	Advance Engineering Design
MED204B	Design and Metallurgy of Welded Joints
MED204C	Introduction to Nano Technology

Electuve-III :

MED205A	Computer aided Vehicle Design
MED205B	Design of Pollution Control Equipments
MED205C	Fracture Mechanics-

THIRD SEMESTER

Serial No	Subject Code	Subject	L-T-P	Credits
1	MED381	Pre submission Defense of Dissertation	0-0-0	4
2	MED382	Dissertation (Part-I)	0-0-0	18
			Total	**22**

FOURTH SEMESTER

Serial No	Subject Code	Subject	L-T-P	Credits
1	MED481	Post submission Defense of Dissertation	0-0-0	6
2	MED482	Dissertation (Part-II)	0-0-0	18
3	MED483	Comprehensive Viva Voce	0	4
			Total	**28**

MED 101 THEORY OF ELASTICITY AND PLASTICITY
MED101

Elasticity: Two dimensional stress analysis - Plane stress - Plane strain - Equations of compatibility - Stress function - Boundary conditions.
Problem in rectangular coordinates - Solution by polynomials - Saint Venent's principles - Determination of displacement - Simple beam problems.
Problems in polar coordinates - General equations in polar coordinates - Stress distribution symmetrical about axis - Strain components in polar coordinates - Simple and symmetric problems.
Analysis of stress and strain in three dimensions - Principle stresses - Homogeneous deformations - Strain spherical and deviatoric stress - Hydrostatic strain.
General theorems: Differential equations of equilibrium and compatibility - Displacement - Uniqueness of solution - Reciprocal theorem.
Bending of prismatic bars - Stress function - Bending of cantilever beam - Beam of rectangular
cross-section - Beams of circular cross-section.
Plasticity: Plastic deformation of metals - Structure of metals - Deformation - Creep stress relaxation of deformation - Strain rate condition of constant maximum shear stress - Condition of
constant strain energy - Approximate equation of plasticity.
Methods of solving practical problems - The characteristic method - Engineering method - Compression of metal under press - Theoretical and experimental data drawing.

References:
1. Theory of Elasticity by Timoshenko, S.P. and Goodier, J.N./Koakusha Publishers
2. An Engineering Theory of Plasticity by E.P. Unksov/Butterworths
3. Applied Elasticity by W.T. Wang.
4. Theory of Plasticity by Hoffman and Sacks.

5. Theory of Elasticity and Plasticity/Sadhu Singh/ Khanna Publishers
6. Theory of Elasticity and Plasticity/Harold Malcolm Westergaard/Harvard University Press

PRINCIPLES OF MACHINE DESIGN
MED102

Engineering Design; steps in designing, tasks and activities, varieties of engineering, design process and role of designer, iteration, decision making, resource conversion, systems and devices and variety of needs, need analysis, feasibility study, preliminary design, detail design, revision. Information for need and problems associated with information, variety of information.
Fundamentals of Technical Systems; system approach fundamentals, assemblies and components, interrelationships, creativity as means to synthesis of alternatives, estimating the order of magnitude, design records.
Product Planning and Development; life cycle from production to consumption and disposal, description of tasks, description of design specification and activities,
Conceptual Design; abstraction, modeling of an engineering problem; iconic, analog and symbolic models; determination of dimensions, graphics, visualization and synthesis, characteristics of a good model, value system and criterion function.
Embodiment Design; steps, rules and principles, mechanical connections, modular products, design for quality and cost. Optimization, optimum vs. optimal. optimum and robust design.
Communication and reporting, preparing and presenting the report, oral vs. written communication, aids.

Text Book(s):
1. Introduction to Engineering Design by T T Woodson; McGraw-Hill Book Co., Kogakusha Co. Ltd.
2. Mechanical Design Process by DJ Ullman; McGraw-Hill Book Co.
3. Engineering Design by GE Dieter; McGraw-Hill Book Co.

Reference Book(s):
1. Conceptual Design for Engineers by Michael French; Springer
2. The Principles of Design by NP Suh; Oxford

MECHANICAL VIBRATIONS
MED103

Fundamentals; review of single degree freedom system, response to arbitrary periodic excitation,
Duhamel's integral impulse response function, Lagrange's equation, single degree freedom forced
vibration with elastically coupled viscous dampers, system identification from frequency response, Laplace formulation.
Two Degree of Freedom System; free vibration of spring-mass coupled system, bending vibration of two degree of freedom system, forced vibration, vibration absorption and isolation.
Multi Degree of Freedom System; normal mode of vibration, flexibility matrix and stiffness matrix, engine values and vectors, orthogonal properties-modal matrix analysis, matrix inversion method, modal damping in forced vibration, numerical methods.
Vibration of Continuous Systems; systems governed by wave equations, vibration of strings and rods, Euler equation for beams, effect of rotary inertia and shear deformation, vibration of plates.
Experimental Methods; vibration exciters and measuring devices, vibration tests and analysis, tests on free and forced vibration with examples, vibration monitoring and diagnosis, case studies.

Text Book(s):
1. Theory and Practice of Mechanical Vibration by JS Rao and K Gupta; New Age Publications.
2. Mechanical Vibrations by Den Hartog; Dover Publications.

Reference Book(s):
1. Theory of Vibration with Applications by W. T. Thomson; CBC Publishers.
2. Theory of Machines by T Bevan; Longmans and Green.

ADVANCED ENGINEERING MATHEMATICS
MED104

Module 1
Special functions: Power series solutions of ODE – Legendre's equation – Legerdre's polynomial – Frobenius method – generating function – Bessel's equation – Bessel's function – Recurrence relations and orthogonality property.

Moodule 2
Applications partial differential equations: Linear partial differential equation of second order – elliptic, parabolic, hyperbolic equations – solution of Laplace, one-dimensional heat & wave equations.
Numerical solution of partial differential equation: Finite difference method – solution of Laplace equation – solution of one-dimensional heat equation – Crank Nicholson method – solution of one-dimensional wave equation.

Module 3
Tensor analysis: Range and summation conventions – transformation of co-ordinates centra variant, covariant, mixed, metric and conjugate tensors, fundamental operations with Tensors – Christopher's symbols.

Module 4
Analysis of variance: One way and two way classification (single observation per cell) – basic principles of experimentation – role of randomization, replication, local control – basic designs – CRD, RBD, LSD.

References:
1. B. S. Grewal, "Higher engineering mathematics", Khanna Publishers, 2000
2. Michael E. Greenberg, "Advanced engineering mathematics", Pearson Education
3. Erwin Kreyszig, "Advanced engineering mathematics"
4. E. Balagurusamy, "Numerical methods", Tata McGraw Hill, 1995
5. Sokol Nikof, "Tensor analysis", John Wiley, New York, 2000
6. Richard A. Johnson, "Miller & Freund's probability & statistics for engineers", Prentice Hall of India, 2006
7. Jay L. Devore, "Probability and statistics for engineering and sciences"
8. B. S. Grewal, "Numerical methods in engineering and sciences", Khanna Publications

DESIGN OF BEARINGS AND SHAFT
MED105A

Sliding contact bearings :
Bearing classification; tribology and hydrodynamics; factors affecting choice of bearing; characteristics; types of friction in sliding element bearing; viscosity of lubricants; types of sliding contact bearings; Petroffs relation for power loss; unstable and stable lubrication; hydrodynamic theory of bearing: load carrying capacity of bearing; heating of bearings;

practical bearing design; finite length bearings; pressure fed bearing; bearing materials: bearing bronzes, babbits, copper lead alloys, aluminium tin alloy, other bearing materials; bearing types; design of journal bearing.

Rolling contact bearings :
Types of rolling contact bearing: radial ball bearings, angular contact ball bearings, roller bearings; friction torque due to load; frictional torque due to viscous churning of lubricants; heating of roller bearing; rolling bearing geometry; stress and deformation in rolling element; bearing deflection; permanent deformation in bearings; fatigue of rolling bearing; selection of bearing; load on bearing; combined bearing load; bearing life; equivalent load; bearing dimension code.

Shafts :
Materials for shafts; strength of shafts under torsion and bending; factor of safety in shafts: fatigue strength reduction factors, modified moments of inertia of shaft section; stiffness of shafts: factors affecting shaft deflection. Complete design calculation and checking of stress concentration, shafts for power transmission through belts and gears. Shaft vibrations.

Text Book(s):
1. Machine Design by Abdul Mubeen; Khanna Publishers
2. Machine Design by Shiegley; McGraw Hill
3. Design of Machine Elements by Bhandari, McGraw Hill Education

Reference book(s):
1. Machine Design by Black And Adams, McGraw Hill Education
2. Design of Machine Elements by Spotts

COMPUTER AIDED DESIGN
MED105B

Transformation and Manipulation of Objects:
Introduction, Transformation Matrix, 2D transformation, Arbitrary Rotation about the origin, Rotation by different angles, Concatenation, 2D transformation, Projection on to a 2D plane, Overall scaling, Rotation about an Arbitrary Point, 2D Reflection, 3D Transformation, 3D scaling, 3D Rotation of Objects, 3D Rotation about an arbitrary Axis, 3D Visualisation reconstruction of Three Dimensional Images.

Description of Curves and Surfaces:
Line Fitting, Non Linear Curve Fitting with a Power Function, Curve Fitting with a High Order Polynomial, Chebyshev polynomial Fit. Fourier Series of Discrete Systems, Cubic Spines, Parabolic Cubic Splines, Non Parametric Cubic Spline, Boundary Conditions, Bezier Curves, Differentiation of Bezier Curve Equations, B-Spline Curve, Non Uniform Rational B-Spline(NURBS), Surface creation, Coons patch, tensor product surfaces, Bezier surface, relational parametric surface, parametric spline surface, Lofted surfaces, spline blended surfaces, Tangent and Twisted vectors, Blended surfaces, Application Software.

Solid Modeling:
Introduction, solid models and entities, solid representation, regularized Boolean operation, Half-spaces, B-Rep and CSG modeling techniques, analytic solid modeling, solid manipulations.

Data exchange Formats:
Shape based formats; product data based formats, ISO standards, IGES- data representation, file structure and formats, processors, PDES- data representation, STEP-architecture and implementation, ACIS and DXF, creating IGES, STEP, ACIS and DXF Files.

Mechanical Assembly analysis:

Assembly modeling- parts modeling and representation, Hierarchical relationships, Mating conditions, Representation schemes- Graph structure, location Graph, virtual link, generation of assembly sequences: precedence diagram, liaison sequencing analysis, precedence Graph, assembly analysis.Hidden line and Hidden surface removal algorithms: Visibility techniques-mini-max test, containment test, surface test, edge interactions, homogeneity test, sorting, coherence, Warnock algorithm, The priority or z- Buffer algorithm, Watkinson Scan line algorithm, Ray tracing algorithm.

Text Book(s):
1. CAD/CAM Theory and Practice by Ibrahim-Zeid; Tata McGraw Hill

Reference Book(s):
1. Principles of Computer Aided Design and Manufacturing by Farid Amirouche; Pearson Prentice
Hall.
2. CAD/CAM/CIM by P Radhakrishnan; New Age International.
3. Mathematical Elements of Computer graphics by Rogers and Adams; McGraw Hill
4. Computer Aided Design by Besant and Lui; Prentice Hall.

FINITE ELEMENT METHOD
MED105C

1 Introduction to FEA, General FEM procedure, Approximate solutions of differential equations: FDM method, W-R technique, collocation least square sub-domain and Galerkin method
Numerical integration, Gauss quadrature in 2-D and 3-D Structure of FEA program, Pre and Post processor, commercially available standard packages, and desirable features of FEA packages.
Principal of minimum total potential, elements of variational calculus, minimization of functional, Rayleigh-Ritz method, Formulation of elemental matrix equation, and assembly concepts.

2 One Dimensional FEM:
Coordinate system: Global, local, natural coordinate system.Shape functions: Polynomial shape functions, Derivation of shape functions, Natural co-ordinate and coordinate transformation, Linear quadratic and cubic elements, Shape functions using Lagrange polynomials. Convergence
and compatibility requirement of shape functions. One dimensional field problems: structural analysis (step-bar, taper-bar). Structural analysis with temperature effect, Thermal analysis, heat transfer
from composite bar, fins. Fluid network and flow through porous medium, analysis of electrical network problems by FEA Trusses, Thermal effects in truss members, Beams.

3.Two dimensional finite elements formulations, Threenoded triangular element, Four-noded rectangular element, Four-noded quadrilateral element, derivation of shape functions: natural coordinates, triangular elements, and quadrilateral elements. Six-noded triangular elements, Eight-noded quadrilateral elements, Ninenoded quadrilateral element. Strain displacement matrix for CST element

4.Penalty Method, Lagrange methods, Multipoint Constraints Concept of Master/Slave entities
Examples of Contact problems. Iso-parametric concepts, basic theorem, Iso-parametric, super-parametric, sub-parametric elements, Concept of Jacobian

5 Finite element formulation of Dynamics, application to free-vibration problems, Lump and consistent mass matrices, Eigen value problems.

Transient dynamic problems in heat transfer and solid mechanics. Introduction to time-integration methods: Implicit and Explicit methods, Convergence, Impact of Mesh quality on convergence

6 Three dimensional elements: Tetrahedron, Rectangular prism (brick), Arbitrary hexahedron. Three Dimensional polynomial shape functions, Natural co-ordinates in 3D, Three dimensional Truss(space trusses) Introduction to material models: Introduction to plasticity (Von-Mises Plasticity), Hyper –elasticity. Generating and using experimental data to model material behaviour. Errors in FEA, sources of errors, method of elimination, Patch test.

References:

1. O.C.Zienkiewicz, R.L.Taylor&J.Z.Zhu, "The Finite Element Method its Basis and Fundamentals", Butterworth-Heinemann,Elsevier
2. Reddy J. N., "Finite Element Method", McGraw-Hill
3. S.S.Rao, "The Finite Element Method in Engineering" , 4th Edition, Academic Press, Elsevier
4. U.S.Dixit, "Finite Element Methods for Engineers",Cengage Learning
5. P.Seshu, "Textbook of FE Analysis", Prentice Hall
6. Desai and Abel, "Introduction to Finite Elements Methods", CBS Publication
7. Tirupati R. Chandrupatla and Ashok D.Belegundu, "Introduction to Finite Elements in ngineering"
8. Erik Thompson, "Introduction to Finite Element Methods", Wiley India
9. H. Kardestuneer, "Finite Elements Hand Book"
10. R.D.Cook, "Concepts & Applications of Finite Element Analysis"
11. Bathe K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall of India
12. Huebener K.H., Dewhirst D.D., Smith D.E. and Byrom T.G., "The Finite Element Method for Engineers", John Wiley, New York
13. Logan, "Finite Element Methods" Cengage Learning
14. George Buchanan, "Finite Elements Analysis", McGrawHill
15. C.S.Krishnamoorthy, "Finite Elements Analysis", Tata McGraw-Hill
16. RobertCook,

DESIGN PRACTICE LAB
MED191

Design of parts of IC Engine – crankshaft, connecting rod, piston, valve gears. Drafting with the help of standard CAD software.

CAD/CAM LAB
MED192

Section-I

1. Develop a general purpose code to carry out the rotation of an object about an axis through two points.
2. Develop a general purpose code to carry out: Orthogonal projection, Dimetric projection (given foreshortening factor Fz), Isometric projection, Perspective projection given Zc, _, _.
3. Develop a general purpose code, given two arbitrary projections and the respective transformation
matrices and the reconstructed coordinates of the vertices of the object.
4. Develop a general purpose code to carry out the reflection of an object about an arbitrary plane
passing through three points.

Section-II

1. Develop a general purpose code for integrated:

Cubic spline with differential boundary conditions, Bezier curve, B- spline- Its various types and
best fit B-spline.
Given Coordinates of the control points, boundary conditions, order of the curve, if required, and
Match the output to projected image of any CAD/CAM package.

Section-III
1. Develop an optimized tool path for economic machining and generate the same in GUI IDEAS/ProE/CAD software) for interpretation.
2. Study of graphics formats and conversion from one format to another.
3. Generate the meshing of the conical cylindrical surface using any simulation package.
4. Study of Open GL programming for the customization of any CAD package.
5. Development of the following surface patches: Bilinear Coons Patch, Tensor Product Bezier surface.

ADVANCED MACHINE DESIGN
MED201

Statistical consideration in design : Frequency distribution -Histogram and frequency polygon- Normal distribution -Units of measurement of central tendency and dispersion - standard variable -population combinations- Design and natural tolerances -Mechanical reliability and factor of safety.
Design for Manufacture: General principles of design for manufacture and assembly (DFM & DMFA). Principles of design of casting and forging-Design for machining-Design for powder metallurgy Design for welding.
Optimum design: Objective of optimum design - Johnson 's method of Optimum Design (MOD). Adequate and optimum design . Primary , subsidiary and limit equations. Optimum design with normal specification of simple machine elements like tension bar, transmission shaft, helical spring-Introduction to optimum design with redundant specification.
Aesthetic and ergonomic consideration in design of products : Basic types of product forms-Designing for appearance -Shape , features , materials and finishes, Ergonomic consideration -Relation between man, machine and environmental factors. Design of display and controls.Practical eg. Of product or equipments using ergonomic and aesthetic design principles.

Books recommended:
1. Shigley J.E. and Mischke C.R. “Mechanical Engineering Design"
2. Spotts M.F. and Shoup T.E. "Design of Machine Elements"
3. Bhandari V. B. "Design of machine Elements"
4. Black P. H. and O. Eugene Adams, -"
5. William C. Orthwein , " Machine components Design"
7. Juvinal R.C. " Fundamentals of Machine Components Design"
8. Hall A. S. Holowenko A. R. and Laughlin H. G. “Theory and problems of Machine Design"'
9. Johnson R.C. Mechanical Design Synthesis with optimization applications

MECHATRONICS AND PRODUCT DESIGN
MED202

Introduction to Mechatronics systems and components. Principles of basic electronics - Digital logic. Number system logic gates. Sequence logic flip Hop system. JK flip Hop. D-flip flop.

Microprocessors and their applications – Microcomputer computer structure/microcontroller. Integrated circuits-signal conditioning processes, various types of amplifiers, low pass and High pass filters.

Sensors- Sensors and transducers, displacement. Position proximity sensors. Velocity, force sensors Fluid presence temperature. Liquid level and light sensors. Selection of sensors. Actuators, Pneumatic and Hydraulic systems. Mechanical actuation system. Electrical actuation system. Other Electrical/ electronic hardware in mechatronics system.

Principles of Electronic system communication- Interfacing. AD and DA converters. Software and hardware principles and tools to build mechatronic systems. Basic system models.
Mathematical models. Mechanical and other system building blocks.

System models- Engg. Systems. Rotational, translation. Electro mechanical: Hydraulic mechanical system. System transfer functions, first - second order system in series.

Design and selection of Mechatronics statements namely sensors line encoders and revolvers, stepper and servomotors ball screws, solenoids, line actuators and controllers with application to CNC system. Robots. Consumer electronics products etc. Design of a mechatronic product using available software CAD packages. MATLAB and SIMULINK.

Text Book(s):
1. Computer Control Manufacturing Systems, by Yoram Koren; McGraw Hill ISBN-007Y663793.

Reference Book(s):
1. Mechatronics, by W. Bolton; Pearson Education; Low Price Edition.
2. Automation Production System and CIMS, by Mikel P Groover; Prentice Hall.

DESIGN OF MECHANISMS
MED203

MOBILITY ANALYSIS – degree of freedom (DOF) mixed mobility, total, partial and fractional DOF, closed and open chain systems, structural analysis and synthesis of mechanisms.

Alternative design solutions, coding, evaluation and selection of optimum mechanism, type synthesis,
number synthesis and design of mechanisms.

Indexes of merit, graphical, algebraic and optimization techniques, matrix methods of design and analysis, design of function, path and motion generators, structural and mechanical error, design and analysis using software like ADAMS.

Manipulators – Classification, actuation and transmission systems, coordinate transformation – DH
notations, inverse and forward kinematics, manipulator dynamics from Lagrange and Newtonian point of view.

Text Book(s):
1. Mechanism Design Vol – 1,2 by George N Sandor and Arthur G Erdman; Prentice Hall.

Reference Book(s):
1. Theory of Mechanism and Machines by Amitabha Ghosh and AK Mallik; EWLP, Delhi.
2. Theory of Mechanisms by JE Shigley and JJ Vicker; McGraw Hill.

3. Design of Machinery by RL Norton; McGraw Hill.
4. Mechanisms & Machines (Analysis & Synthesis) by Arthur Erdman.
5. Robot Engineering an Integrated Approach by RD Klafter, TA Chmielewski and M Negin; Prentice
Hall.
6. Robotics Technology and Flexible Automation by SR Deb; Tata McGraw Hill.

ADVANCED ENGINEERING DESIGN
MED204A

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

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

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

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

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

Team work and Ethics in engineering design: Team formation, functioning, discharge, team dynamics, Ethical issues considered during engineering design process

Product Design: Product strategies, Product value, Product planning, product specifications, concept generation, concept selection, concept testing.

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

References:

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

7. Fundamentals of machine elements/ Hamrock, Schmid and Jacobian/ 2nd edition /McGraw- Hill International edition.

DESIGN AND METALLURGY OF WELDED JOINT MED204B

Weld defects: common weld defects like weld cracks, LOP, LOF, porosity, blow holes etc., remedies and control, welding symbols.

Cost analysis of welded joints: costing factors of welding jobs- fabrication cost, material cost, preparation cost, finishing cost, overhead cost etc., economy in preparation and welding a job, labour accomplishment factor, cost calculation of welded jobs.

Prediction and control of distortion: calculation of longitudinal contraction, transverse contraction angular contraction due to single weld pass, control of welded distortion, and calculation of shrinkage.

Residual stresses: introduction, types, effect of thermal stresses, control of residual welding stresses.

Destructive and non destructive testing of welds: destructive tests, equipment required and test piece
geometry for tensile test, bend test, impact test, hardness test, brittle and fatigue failure tests, non
destructive tests for welds: dye penetrate inspection, magnetic particle inspection etc.

Weldability tests: definition and concept of weldabilily, purpose and types of weldability tests such as hotcracking test, root cracking tests, hydrogen induced cracking test, cruciform test.

Weld ability of metals: welding techniques, preparation of joints and electrode types for gray cast iron
welding, aluminium welding, austenitic steels, titanium and its alloys.

Welding metallurgy: thermal effect of welding on parent metal, structure of fusion welds, effect of cooling rate, weld metal solidification and heat affected zone.

Automation in welding: introduction and concept, classification of welding automation, economics of
welding automation.

Text Book(s):
1. Welding Technology by RS Parmar
2. Welding Technology by AC Devis.
3. Welding and Welding Technology by Little; Tata McGraw Hill.

Reference book(s):
1. Modern Welding Technology by HB Carry; Prentice Hall.
2. AWS Welding Handbook (IV-VI edition)
3. Elements of Machine Design by Pandya and Shah.

INTRODUCTION TO NANO TECHNOLOGY MED204C

Introduction: Importance of Nano-technology, Emergence of Nano-Technlogy, Bottom-up and Top-down approaches, challenges in Nano Technology.

Properties of low dimensional system: Transport properties: quantization of conductance, density of states, Coulomb blockade, Kondo effect. Hall, quantum Hall, fractional quantum hall effects Vibrational and thermal properties: phonons, quantization of phonon modes, heat capacity and thermal transport, Optical properties: Collective oscillation (Gustav-Mie explanation), surface plasmon resonance, interactions between Nanoparticles, coupled-dipole approximation, Linear and Nonlinear optical properties.

Zero dimensional nano-structures: Nano particles through homogenous nucleation; Growth of nuclei, synthesis of metallic nano particles, Nano particles through heterogeneous nucleation; Fundamentals of heterogeneous nucleation and synthesis of nano particles using micro emulsions and Aerosol.

One dimensional nano-structure, nano wires and nano rods: Spontaneous growth: Evaporation and condensation growth, vapor-liquid-solid growth, stress induced recrystallization. Template based synthesis: Electrochemical deposition, Electrophoretic deposition. Electro spinning and Lithography.

Two dimensional nano-structures: Fundamentals of film growth. Physical vapour Depostion (PVD): Evaporation molecular beam epitaxy (MBE), Sputtering, Comparison of Evaporation and sputtering. Chemical Vapour Depostion (CVD) : Typical chemical reactions, Reaction kinetics, transport phenomena, CVD methods, diamond films by CVD.

Thin films: Atomic layer deposition (ALD), Electrochemical deposition (ECD), Sol-Gel films, Advantages, Disadvantages and Applications of Thin Fils

Transport phenomena: Confinement and Transport in nanostructure, Current, Reservoirs and Electron channels, Conductance formula for nanostructures, Quantized conductance. Local density of states. Ballistic transport, Coulomb blockade, Diffusive transport, Fock space.

References:

1. Nano structures and Nano materials: Synthesis, properties and applications by Guozhong Cao, Imperial College press.
2. Quantum wells, Wires & Dots,: Theoretical & Computational Physics of Semiconductors Nanostuructures, Paul Harrison
3. Handbook of nanotechnology : Bhushan.
4. Nano optoelectronics : M.Grundman.
5. Nanophotonics : Paras N.Prasad.
6. Brian J. Kirby, Micro- and Nanoscale Fluid Mechanics, Cambridge University Press.

COMPUTER AIDED VEHICLE DESIGN
MED205A

Vehicle Frame and Suspension: Study of Loads-Moments and Stresses on Frame Members. Computer Aided Design of Frame for Passenger and Commercial Vehicles. Computer Aided Design of Leaf Spring- Coil Springs and Torsion Bar Springs.

Front Axle Steering Systems: Analysis of Loads- Moments and Stresses at different sections of Front Axle.Determination of Bearing Loads at Kingpin Bearings. Wheel Spindle Bearings. Choice of Bearings. Determination of Optimum Dimension and properties for Steering Linkages ensuring minimum error in Steering.

Drive Line and Real Axle: Computer Aided Design of Propeller Shaft. Design of Final

Drive Gearing. Design of full-Floating., Semi-Floating and Three Quarter-Floating, Rear Axle Shafts and Rear Axle Housings.

Clutch: Torque capacity of Clutch. Computer Aided Design of Clutch Components. Design details of Roller and Spring type of Clutches.

Gear Box: Computer Aided Design of Three Speed and Four Speed Gear Boxes.

A. Body structure analysis for aero-dynamic shape [using Computational Fluid Dynamics]
B. Brakes – Computer Aided Design for different components of Drum and Disc brakes.
C. Design of Shock Absorber

Text Book(s):
1. Dean Averns, Automobile Chasses Design, llliffe Books
2. Heldt, P.M., Automotive Chasses, Chilton Co., New York

Reference Book(s):
1. Steeds. W., Mechanics of Load Vehicles, llliffe Books Ltd., London.
2. Giles, J.G. Steering, Suspension and Tyres, llliffe Books Ltd., London.
3. Newton, Steeds & Garret, Motor Vehicle, llliffe Books Ltd., London.
4. Heldt, P.M. Torque Converter, Chilton Books Co., New York.

DESIGN OF POLLUTION CONTROL EQUIPMENTS
MED505B

Environmental pollution; Air, water and soil pollution, environment protection, abatement of emission of gas and water and soil pollution. Hazardous substances and risk analysis.

Production, emission, transfer and removal of pollutants, analysis of industrial plants, path of pollutants and carrier fluids, measures specific to plant, process and equipment.

Separation of Dust Particles from Gas Stream; harmful effects of dust, properties size distribution and movement of single particle, efficiency of separation, dry and wet processes, processes and equipment for removal of gaseous pollution. Particulate fluid dynamics, mechanism of separation, separation and fractional separation efficiency. Cyclone design, computer application in design. Single cyclone and multiple cyclone arrangement.

Wet Dust Scrubber; application in steel, foundry and chemical industries, dust particle collection-gas liquid interface, liquid jet and drops and bubbles. Column, jet, vortex, rotating disc and Venturi scrubbers. Comparison and selection of wet scrubber.

Fabric Filters; fundamentals of dust collection in fabric, effect of inertia forces, sieve effect, diffusion effect, electrostatic forces, combined effect, three dimensional and two dimensional fabric filters. Pressure drop in filters, cost of filtration. Examples of industrial applications.

Electrostatic Precipitators; fundamentals of electrostatic precipitation, elements of precipitator. Generation and transfer of electric charges, corona onset voltage, diffusion and field charging and their combination. Collection efficiency, migration velocity of dust particles, dust resistivity, design calculation.

Text Book(s):
1. Air pollution Control Equipment by H Brauer and YBG Varma; Springer Verlag.

FRACTURE MECHANICS
MED205C

History of failure by Fracture; failure of structures, bridges, pressure vessels and ships, brittle fracture, development of testing for failure, identification of reasons for failure, existence of

crack, Griffith crack and experiment, energy release rate and stress for failure in presence of crack.

Stress Field around Crack Tip; revision of theory of elasticity, conformal mapping, Airy's stress function for crack tip stress field with crack emanating from straight boundary, stress state in crack tip vicinity, modes of crack face deformation, stress intensity factor and Irwin's failure criterion, fracture toughness.

Determination of Stress Intensity Factor, different specimen configuration, numerical techniques- boundary collocation and boundary integral, finite element method, experimental method- reflection and refraction polariscopy, Determination of fracture toughness.

Energy Consideration; potential energy, surface energy, plastic deformation around crack tip, energy release rate, compliance and correlation with fracture toughness, crack opening displacement (COD),COD as fracture criterion, experimental determination of COD, use of fracture toughness and COD as design criteria.

Crack Propagation; law of fatigue crack propagation, life calculation when a crack is present and loaded, microscopic aspects of crack propagation, elastic crack and plastic relaxation at crack tip.

Text Book(s):

1. Elementary Engineering Fracture Mechanics by David and Bruck; Norelco.
2. Fracture and Fatigue Control in Structure by ST Rolfe and JM Barson; Prentice Hall.

Reference Book(s):

1. Fracture Mechanics Fundamentals and Applications by TL Anderson; CRC Press.
2. Fracture of Structural Materials by AS Tetelman and AJ McEvily; John Wiley and sons.
3. Macine Design by Abdul Mubeen; Khanna Publishers.

DESIGN PRACTICE LAB-II
MED291

Design of parts of IC Engine – crankshaft, connecting rod, piston, valve gears.
Drafting with the help of standard CAD software.