SIR PADAMPAT SINGHANIA UNIVERSITY

Udaipur

SCHOOL OF ENGINEERING

Course Curriculum of 2-Year M.Tech. Degree Programme in Mechanical Engineering (Specialization: Machine Design) (Batch: 2018-20)

Credit Structure

M.Tech Core		M.Tech. Elective (PE)	
Category	Credits	**Category**	Credits
Departmental Core Subjects	41	Departmental Electives	15
Basic Sciences Subjects	4		
Total	45	Total	15
		Grand Total	60

Distribution of Total Credits and Contact Hours in All 4 Semesters

S. No.	Semester Number	Credits/Semester	Contact hours/week
1	I	15	15
2	II	17	19
3	III	16	23
4	IV	12	24
	Total	**60**	**--**

Course Structure: M.Tech. 2018-20

Semester - I

S.No.	Course Code	Course Title	L	T	P	Credit(s)
1	ME-551	Mechanical Vibration	3	0	0	3
2	ME-552	Advanced Mechanics of Solid	3	0	0	3
3	ME-553	Advanced Machining Processes	3	0	0	3
4	ME-554	Mechanics of Machining	3	0	0	3
5	MA-555	Advanced Engineering Mathematics	3	0	0	3
					Total Credits	15
					Total Contact hours/week	15

Semester - II

S.No.	Course Code	Course Title	L	T	P	Credit(s)
1	ME-555	Finite Element Methods in Engineering	3	0	2	5
2	ME-556	Welding Science and Technology	3	0	0	3
3	ME-5XX	Departmental Elective–I	3	0	0	3
4	ME-5XX	Departmental Elective–II	3	0	0	3
5	ME-5XX	Departmental Elective–III	3	0	0	3
					Total Credits	17
					Total Contact hours/week	19

Semester - III

S.No.	Course Code	Course Title	L	T	P	Credit(s)
1	ME-557	Composite Materials	3	0	0	3
2	ME-558	Manufacturing Lab	0	0	2	2
3	ME-580A	Dissertation – I	-	-	-	5
4	ME-5XX	Elective – IV	3	0	0	3
5	ME-5XX	Elective – V	3	0	0	3
					Total Credits	16
					Total Contact hours/week	23

Semester - IV

S.No.	Course Code	Course Title	L	T	P	Credit(s)
1	ME-580B	Dissertation - II	-	-	-	9
2	ME-580C	Dissertation Viva Voce	-	-	-	3
					Total Credits	12
					Total Contact hours/week	24

List of Departmental Elective(s) – I

S.No	Course Code	Course Title	L	T	P	Credit
1	ME-571	Tribology of Bearings	3	0	0	3
2	ME-572	Nonlinear Vibrations	3	0	0	3

List of Departmental Elective(s) – II

S.No	Course Code	Course Title	L	T	P	Credit
1	ME-573	Fracture, Fatigue and Failure Analysis	3	0	0	3
2	ME-574	Optimization Methods in Engineering	3	0	0	3

List of Departmental Elective(s) – III

S.No	Course Code	Course Title	L	T	P	Credit
1	ME-575	Industrial Noise Control	3	0	0	3
2	ME-581	Mechanism: Design, Synthesis and Analysis	3	0	0	3

List of Departmental Elective(s) – IV

S.No.	Course Code	Course Title	L	T	P	Credit
1	ME-576	Condition Monitoring of Machines	3	0	0	3
2	ME-577	Fracture Mechanics	3	0	0	3

List of Departmental Elective(s) – V

S.No.	Course Code	Course Title	L	T	P	Credit
1	ME-578	Experimental Stress Analysis	3	0	0	3
2	ME-582	Mechanical System Design	3	0	0	3

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Semester - I

(Departmental Core Subject)

ME-551	L-T-P-C
Mechanical Vibration	3-0-0-3
Pre-requisite	ME-365

Objective: *Students will be introduced to finite and infinite degree of freedom system analysis techniques for vibratory systems subjected to excitations using different approaches and Vibration measurement .*

Course Content

Generalised co-ordinates, constraints, virtual work; Hamilton's principle, Lagrange's equations; Discrete and continuous system; Vibration absorbers; Response of discrete systems - SDOF & MDOF: free-vibration, periodic excitation and Fourier series, impulse and step response, convolution integral; Modal analysis: undamped and damped non-gyroscopic, undamped gyroscopic, and general dynamical systems. Effect of damping; Continuous systems: vibration of strings, beams, bars, membranes and plates, free and forced vibrations; Raleigh-Ritz and Galerkin's methods. Measurement techniques.

Text/Reference Books

1. Elements of Vibration Analysis. Meirovitch L. 2nd Ed. McGraw Hill. 1986.
2. Principles & Techniques of Vibrations. Meirovitch. PHI. 1997.
3. Theory of Vibration with Applications. Thomson W. T. CBS. 1990.
4. Mechanical Vibrations. Tse F. S., Morse I. E & Hinkle R. T. CBS. 1983.
5. Theory and Practice of Mechanical Vibrations. Rao J.S & Gupta K. New Age Publication. 1995.

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Semester - I

(Departmental Core Subject)

ME-552	L-T-P-C
Advanced Mechanics of Solids	3-0-0-3
Pre-requisite	ME-365

Objective: *This subject is designed to discuss the designing theories for different mechanical components*

Course Content

Analysis of Stresses and Strains in rectangular and polar coordinates: Cauchy's formula, Principal stresses and principal strains, 3D Mohr's Circle, Octahedral Stresses, Hydrostatic and deviatoric stress, Differential equations of equilibrium, Plane stress and plane strain, compatibility conditions. Introduction to curvilinear coordinates. Generalized Hooke's law and theories of failure. Energy Methods. Bending of symmetric and unsymmetric straight beams, effect of shear stresses, Curved beams, Shear center and shear flow, shear stresses in thin walled sections, thick curved bars. Torsion of prismatic solid sections, thin walled sections, circular, rectangular and elliptical bars, membrane analogy. Thick and thin walled cylinders, Composite tubes, Rotating disks and cylinders. Euler's buckling load, Beam Column equations. Strain measurement techniques using strain gages, characteristics, instrumentations, principles of photo-elasticity.

Text/Reference Books

1. Advanced Mechanics of Solids. SrinathL. S. 2nd Ed. TMH Publishing Co. Ltd. 2003.
2. Advanced Strength and Applied Stress Analysis. Budynas R.G. 2nd Ed. McGraw Hill Publishing Co. 1999.

3. Advanced Mechanics of Materials. Schmidt R. J. & Boresi A. P. 5th Edition John Willey and Sons Inc. 1993.
4. Theory of Elasticity. Timoshenko S. P. & Goodier J. N. 3rd Ed. McGraw Hill Publishing Co. 1970.
5. Solid Mechanics for Engineering. Raymond P. 1st Edition John Willey & Sons 2001.
6. Experimental Stress Analysis. Dally J. W. & Riley W. F. 3rd Edition McGraw Hill Publishing Co. 1991.

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Semester - I

(Departmental Core Subject)

ME-553	L-T-P-C
Advanced Machining Processes	3- 0- 0-3

Objective: *This course discusses gives the students in depth knowledge about the various modern manufacturing processes, their characteristics and process parameters.*

Course Content

General classification of unconventional machining processes; Abrasive jet machining, water jet and abrasive water jet machining, ultrasonic machining; Electric discharge machining and allied processes, laser beam machining, ion beam machining, plasma arc machining; Electrochemical machining (ECM) and allied processes, ECM tool design, chemical machining, photochemical machining; Elastic emission machining; Advanced finishing processes, abrasive flow finishing, magnetic abrasive finishing, magnetorheological finishing, chemomechanical polishing; Comparative evaluation of different unconventional machining processes; Analytical modeling of mechanical, thermal and electrochemical type nontraditional machining processes; Numerical modeling and simulation of unconventional machining processes; Computer aided process planning of non-traditional machining processes.

Text/Reference Books

1. Advanced Machining Processes. Jain V. K. Allied Publishers.2009.
2. Nontraditional Manufacturing Processes. Benedict Gary F. Taylor & Francis, 1987.

3. Advanced Methods of Machining. McGeough J. A. Springer. 1988.
4. Non Conventional Machining. Mishra P K. Narosa India Publication. 1997.
5. Advanced Machining Processes: Nontraditional and Hybrid Machining Processes. El-Hofy H. McGraw-Hill Med/Tech 2005.
6. Modern Machining Processes. Pandey P. C. & ShanH. S. Tata McGraw-Hill Education. 1980.
7. Modern Manufacturing Processes. James A. & Brown. Industrial Press. 1991.
8. Introduction to Micromachining. Jain V. K. Alpha Science International Limited.2010.
9. Micromachining of Engineering Materials. McGeough J. A. Taylor & Francis, 2001.

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Semester - I

(Departmental Core Subject)

ME-554	L-T-P-C
Mechanics of Metal Cutting	3- 0- 0-3
Pre-requisite	ME-352

Objective: *This course is designed to discuss analysis of machining process and tool failure.*

Course Content

Principles of metal cutting; Mechanics of chip formation; Geometry of cutting tools and tool signatures; Orthogonal and oblique cutting; Metal cutting models: Merchant model, Lee-Shaffer model, Oxley model; Forces in metal cutting; Tribology in metal cutting; Surface roughness in machining; Thermal aspects of machining; Tool wear, tool life, tool materials, tool coatings and coating techniques; Economics of machining; Machinability; Cutting fluids: properties, types, application techniques, emissions and its adverse effects; Recent advances in machining: hard turning, high seed machining, diamond turning, machining of advanced materials, machining with minimum quantity cutting fluids and cryogenic fluids; Grinding: mechanics, forces, specific energy, temperature, wheel wear and surface finish; Other conventional finishing processes: honing, lapping, super finishing; Applications of FEM and optimization to machining as well as finishing.

Texts/Reference Books

1. Metal Cutting Principles. ShawM. C. Oxford Press. 2004.
2. Principles of Abrasive Processing.ShawM. C. Oxford University Press. 1996.

3. Introduction to Machining Science. LalG. K. New Age International Publishers.2007.
4. Fundamentals of Machining and Machine Tools. Boothroyd G. & Knight W. A. CRC-Taylor & Francis. 2006.
5. Manufacturing Science. Ghosh A. .& Malik A. K. East West Press. 2010.
6. Processes and Materials of Manufacture. Lindberg R. A. PHI Learning 2013.
7. Metal Cutting Theory. Black P. H. McGraw Hill. 1961.

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Semester - I

(Basic Sciences Subjects)

MA - 555 L-T-P-C
Advanced Engineering Mathematics 3-0-0-3

Objective: *In this course certain advanced numerical techniques with probability & statistics will be discussed. These concepts play important role in mechanical & electrical engineering.*

Course Content

Vector & Tensor Analysis in Cartesian system, effect of rotation of coordinate systems. Review of ODEs; Laplace & Fourier methods, series solutions, & orthogonal polynomials. Sturm-Liouville problem. Review of 1st & 2nd order PDEs. Linear systems of algebraic equations. Gauss elimination, LU decomposition etc., Matrix inversion, illconditioned systems. Numerical Eigen solution techniques (Power, Householder, QR methods etc.).Numerical solution of systems of nonlinear algebraic equations; Newton-Raphson method. Numerical integration: Newton-Cotes methods, error estimates, Gaussian quadrature. Numerical solution of ODEs: Euler, Adams, Runge-Kutta methods, & predictor-corrector procedures; stability of solutions; solution of stiff equations. Solution of PDEs: finite difference techniques. Probability & Statistics - Probability Distribution, Bays Theorem, Parameter Estimation, Testing of Hypothesis, Goodness of Fit. Laboratory: Basics of programming. Numerical experiments with the algorithms covered in class.

Text/Reference Books

1. Advanced Engineering Mathematics. Kreyzig E. New Age International. 1996.
2. Fundamentals of Matrix Computations. Watkins D. S. John Wiley. 1992.
3. Numerical Methods for Scientific & Engineering Computation. Jain M.K., Iyenger S.R.K. & R.K. Jain. 3rd Ed., New Age International, 1993
4. Continuum Mechanics. Chandrashekaraiah D.S. & Debnath L. Academic Press. 1994.
5. Computational Methods for Partial Differential Equations. Jain M.K., Iyenger S.R.K. & R.K. Jain. New Age International. 1994.
6. Methods of Mathematical Physics. Courant R. & Hilbert D. Wiley. 1989.
7. Advanced Engineering Mathematics. O'Neil P.V. Cengage Learning. 2007.
8. Mathematical Methods for Physicists. Arfken G.B., Weber H.J. & Harris F. 5th Ed. Academic Press.

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Semester - II

(Departmental Core Subject)

ME-555	L-T-P-C
Finite Element Methods in Engineering	3- 0-2-5

Objective: *This course deals with finite element method as a tool for solving various engineering problems computationally.*

Course Content

Historical background, basic concept of the finite element method, comparison with finite difference method; Variational methods: calculus of variation, the Rayleigh-Ritzand Galerkin methods; Finite element analysis of 1-D problems: formulation by different approaches (direct, potential energy and Galerkin); Derivation of elemental equations andtheir assembly, solution and its post processing. Applications in heat transfer, fluid mechanics and solid mechanics. Bending of beams, analysis of truss and frame. Finite element analysisof 2-D problems: finite element modelling of single variable problems, triangular andrectangular elements; Applications in heat transfer, fluid mechanics and solid mechanics;Numerical considerations: numerical integration, error analysis, mesh refinement. Planestress and plane strain problems; Bending of plates; Eigen value and time dependentproblems; Discussion about preprocessors, postprocessors and finite element packages.

List of Experiments

1. Determination of load required to achieve a desired total extension of the spring
2. Stress analysis of tapered cantilever with two load cases
3. Simulation of tuning fork and to compute fundamental eigen mode of tuning fork

4. Simulation of swirl flow around a rotating disc
5. Modeling of air box around a device in order to model convective cooling in the box and to determine total heat flux on a boundary of heat sink.
6. Simulation of 1-D Heat transfer with radiation
7. Simulation of 2-D Heat transfer with convective cooling

Text/Reference Books

1. An introduction to the Finite Element Method. Reddy J N. McGraw-Hill.1993.
2. Concepts and Applications of Finite Element Analysis. Cook R D., Malkus D S & Plesha M E 3rd Ed. John Wiley. 1989.
3. Finite Element Procedures in Engineering Analysis. Bathe K.J. Prentice-Hall, Englewood Cliffs. 1982.
4. The Finite Element Method. HughesT.J.T. Prentice-Hall, Englewood Cliffs.1986
5. The Finite Element Method. Zienkiewicz O. C.& Taylor R.L. 3rd ed. McGraw-Hill.1989.

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Semester - II

(Departmental Core Subject)

ME-556 L-T-P-C
Welding Science and Technology 3-0-0-3

Objective: *The course is designed to give advanced knowledge on welding techniques and testing.*

Course Content

Introduction and classification of welding; Design principles of welded structures; Welding methods – shielded metal arc welding, gas tungsten arc welding, gas metal arc welding, flux cored arc welding, submerged arc welding, plasma arc welding, electro slag welding, electro gas welding, arc stud welding, synergic and pulsed welding, friction welding, Oxy-fuel gas welding, resistance welding, brazing, soldering; Types of power source and their characteristics; Physics of welding arc – characteristics of arc, mode of metal transfer, forces acting on a molten droplet; Welding fluxes and coatings - type and classification; Study and analysis of heat flow, cooling rates, models for welding heatsources; Testing of welds, fracture and fatigue of welded structures, welding metallurgy, heat treatment of welds, effect of alloying materials; Welding symbols, standards and codes; Welding process modeling using ANN and Fuzzy.

Text/Reference Books

1. Welding Handbook: Welding Processes Part. 1. Vol. 2 Brien O. AWS 2004.
2. The Physics of welding. LancasterJ. F. Pergamon. 1986.
3. Principles of Welding. Messler R. W. John Wiley and Sons. 1999.
4. Metallurgical modelling of welding. Grong O. 2nd Ed. IOM Publication. 1997.
5. Welding technology and design. RadhakrishnanV.M. New Age. 2002.

6. Computational welding mechanics. GoldakJ. A. Springer. 2005.
7. Computational welding mechanics. Lindgren L.E.Woodhead Publishing Limited.2007.

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Semester - II

(Departmental Elective - I)

ME-571 L-T-P-C
Tribology of Bearings 3-0-0-3

Objective: *This course discusses the theory of bearing and lubrication.*

Course Content

Introduction, Properties and Testing of Lubricants, Basic Equations, Idealized Hydrodynamic Bearings. Finite Bearings, Oil Flow and Thermal equilibrium, Bearing Design, Squeeze Film bearings, Hydrodynamic Instability. Externally pressurized Oil Bearings. Gas-lubricated Bearings. Elastohydrodynamic Lubrication, Surface Roughness Effect on Hydrodynamic Bearings and Elastohydrodynamic Line contacts. Ball Bearings, Roller Bearings. Friction of Metals. Wear of Metals.

Text/Reference Books

1. Introduction to Tribology of Bearings.Majumdar B.C. A. H. Wheeler & Co.Ltd. 1999.
2. Theory of hydrodynamic lubrication.Pinkus O. & Sternlicht, B. Mc Graw Hill Book Co. Inc. 1961.
3. Basic Lubrication TheoryCameron A.& Mc Ettles C.M. Wiley Eastern Ltd. 1987.

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Semester - II

(Departmental Elective - I)

ME-572	L-T-P-C
Nonlinear Vibrations	3-0-0-3
Pre-requisite	ME-551

Objective: *This course discusses the nonlinear vibration and its analysis.*

Course Content

Mechanical Vibrations Dynamics of conservative and non-conservative systems; Phase planes, fixed points; Local and global stability, Lyapunov theory; Analytical solution methods: Harmonic balance, equivalent linearization, perturbation techniques (Linstedt-Poincare, Multiple Scales, Averaging – Krylov-Bogoliubov-Mitropolsky); Damping mechanisms; self-excited systems, Van der Pol's oscillator. Forced oscillations of SDOF systems, Duffing's oscillator; primary-, secondary-, and multiple- resonances; period multiplying bifurcations; Poincare' maps, point attractors, limit cycles and their numerical computation, strange attractors and chaos; Types of bifurcations, Lyapunov exponents and their determination, fractal dimension. Parametric excitations, Floquet theory, Mathieu's and Hill's equations; effects of damping and nonlinearity; MDOF systems, solvability conditions, internal (autoparametric) resonances; Hopf bifurcation and panel flutter example. Application to continuous systems.

Text/Reference Books

1. Nonlinear Oscillations. Nayfeh, A. H. & Mook D. T. Wiley-Interscience. 1979.
2. Nonlinear Oscillations in Physical Systems.Hayashi C. McGraw-Hill 1964.
3. Resonance Oscillations in Mechanical Systems.Evan-Ivanowski R. M. Elsevier. 1976.

4. Applied Nonlinear Dynamics. Nayfeh A. H. & Balachandran B. Wiley. 1995.
5. From Equilibrium to Chaos: Practical Bifurcation and Stability Analysis.Seydel R. Elsevier. 1988.
6. Chaotic and Fractal Dynamics: An Introduction for Applied Scientists and Engineers. Moon F. C. Wiley. 1992.
7. Nonlinear Mechanical Vibrations. Srinivasan P. New Age International. 1995.
8. Advanced Theory of Vibration: Nonlinear Vibration and One-dimensional Structures. Rao J. S. New Age International. 1992.

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Semester - II

(Departmental Elective - II)

ME-573	L-T-P-C
Fracture, Fatigue and Failure Analysis	3-0-0-3

Objective: *This course discusses the fracture and propagation in detail with analysis.*

Course Content

Griffith's theory of brittle failures; Irwin's stress intensity factors; Linear elastic fracture mechanics: The stress analysis of crack tips, Macroscopic theories in crack extension, Instability and R-curves, Crack tip plasticity, K as a failure criterion, Mixed mode of fracture, Analytical and Experimental methods of determining K; Elastic plastic fracture mechanics: Crack tip opening displacement, J Integrals, Crack growth resistance curves, Crack tipconstraint under large scale yielding, creep crack growth; Microscopic theories of fracture: Ductile and cleavage fracture, ductile-brittle transition, inter-granular fracture; Fatigue crack propagation: Fatigue crack growth theories, crack closure, Microscopic theories of fatigue crack growth; Application of theories of fracture mechanics in design and materials development

Text/Reference Books

1. Fracture Mechanics Fundamentals and Applications. Anderson L.T. CRC Press. 1994.
2. Elementary Engineering Fracture Mechanics. Brock D. Maritinus Nijhoff Publishers. 1982.
3. Fracture and Fatigue Control in Structures.Rolfe S.T.& Barson J.M. PHI. 1977.

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Semester - II

(Departmental Elective - II)

ME-574 L-T-P-C
Optimization Methods in Engineering 3-0-0-3

Objective: *The objective of the course is to provide the students the basic concepts of optimization problems, decision analysis, non-linear optimization, non-traditional optimization and NP-Complete problems.*

Course Content

Introduction to optimization; Formulation of optimization problems; Classical optimization techniques; Linear Programming; Non-linear Programming; single variable, multi-variable and constrained optimization; Specialised algorithms for integer programming and geometric programming; Non-traditional optimization algorithms

Text/Reference Books

1. Optimization: Theory and Applications.Rao S.S. 2nd Ed. Wiley Eastern. 1984.
2. Optimization for Engineering Design-Algorithms and Examples. Deb K. Prentice-Hall India. 1995.
3. Introduction to Optimum Design. Arora J.S. MCGraw-Hill. 1989.
4. Engineering Optimization- Methods and Applications. Reklaitis G.V., Ravindran A. & Ragsdell K. M. Wiley. 1983.
5. Optimization Methods for Engineering Design. Fox R.L. Addison Wesley. 1971.

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Semester - II

(Departmental Elective - III)

ME-575	L-T-P-C
Industrial Noise Control	3-0-0-3

Objective: *This course discusses the noise measurement, sources and control in detail.*

Course Content

Principles of sound generation and propagation, sound attenuation, sound absorption, sources of industrial noise, effects of noise, noise measurement units and instruments, identification of source of noise, noise evaluation procedures, acoustical enclosures, design of reactive and absorptive mufflers, active noise control, designing for quieter machines and processes, case studies.

Text/Reference Books

1. Noise and Vibration Control. Beranek L. L. McGraw-Hill. 1971.
2. Industrial Noise and Vibration Control. Irwin J.D.& Graf E.R. Prentice Hall. 1979.
3. Handbook of Noise Control. Harris C. M. 2nd Ed. McGraw-Hill. 1979.
4. Noise Control in Internal Combustion Engines. Baxa Wiley. 1982.
5. Machinery Noise and Diagnostics. Lyon R.H. Butterworths. 1987.

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Semester - II

(Departmental Elective - III)

ME-581	L-T-P-C
Mechanism: Design, Synthesis & Analysis	3-0-0-3

Objective: *This course discusses various mechanism design and analysis procedures.*

Course Content

MechanismDesignPhilosophy:Stagesofdesign,thesynthesisprocess,Designcategoriesandmechanismparameters.IntroductiontoKinematicsandMechanisms:Motion,ThefourbarLinkage,ThescienceofRelativemotion,Kinematicdiagrams,six-bar chains, Degrees of freedom, Analysis vs. Synthesis. Mechanism analysis: Displacement and velocity analysis, acceleration analysis. Kinematic Synthesis of Mechanisms: Number synthesis- The associated linkage concept. Graphical methods, tools and computer programming for synthesis of mechanisms for two,three and four prescribed positions, path generation, prescribed and un-prescribed timings. Analytical Synthesis Techniques. Function and motion generation. Number of prescribed positions vs. Number of Free Choices. Dynamics of Mechanisms: Inertia forces, Kinetostatic Analysis by complex numbers, Superposition method, Matrix Method. Time response, modification of time response of mechanisms. Virtual work. Lagrange Equations of motion. Free vibration of systems with one degree of freedom. Forced vibrations of systems. Rotor balancing. Introduction to Force and Moment balancing of Linkages and its computer programming. Elastic beam element in Plane Motion. Spatial Mechanisms: Transformations for spatial mechanisms, Analysis of spatial mechanisms. Link and Joint Modeling with Elementary Matrices. Kinematic analysis of an Industrial Robot, position, velocity and acceleration analysis.

Text/ReferenceBooks

1. Kinematics- Dynamics, and Design of Machinery. Kenneth J., Waldron & Gary J. Kinzel, 2nd Ed., John Wiley& Sons Inc. 2004.
2. Design of Machinery. Norton R.L. 4th Ed. McGraw Hill. 2007.
3. Theory of Machines and Mechanisms. joseph E. Shigley, John J. & Vicker, J. 2nd Ed. McGraw Hill. 1995.
4. Mechanism Design - Analysis and Syntheses. Vol. 1. Arthur G., Erdman & George N.S. Prentice Hall. 1984.

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Semester - III

(Departmental Core Subject)

ME-557 L-T-P-C
Composite Materials 3- 0- 0-3

Objective: *The course deals processing and behavior of composite materials.*

Course Content

Introduction – classifications, terminologies, manufacturing processes (in brief). Macromechanical analysis of lamina – Hooke's law for anisotropic, monoclinic, orthotropic, transversely isotropic and isotropic materials–2D Unidirectional and angle ply lamina –Strength theories of lamina. Micromechanical analysis of lamina –Volume and mass fraction,density and void content – Evaluation of Elastic modulii, Ultimate strength of unidirectional lamina. Macromechanical analysis of laminates – Laminate code, Stress strain relations – Inplane and Flexural modulus,Hygrothermal effects. Failure Analysis and Design – Special cases of laminates, symmetric, cross ply, angle ply and antisymmetric laminates, failure criteria and failure modes.

Text/Reference Books

1. Analysis and Performance of Fiber Composites. Agarwal B. D. & Broutman, J. D. 3rd Ed. John Willey and Sons. 1990.
2. Fiber Reinforced Composites: Materials Manufacturing and Design. Mallik, P. K. 3rd Ed. Marcel and Dekker. 1993.
3. Mechanics of Composite Materials. Arthur K. K. C.R.C. Press. 1997.
4. Mechanics of Laminated Composite Plates. Reddy J. N. 2nd Ed. CRC Press. 1998.

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Semester - III

(Departmental Core Subject)

ME-558	L-T-P-C
Manufacturing Lab	0-0-2-2

Objective: *The objective of course is designed to train the students to find out various parameters of machining and also to teach them automation.*

List of Experiments

1. Determination of effect of cutting velocity on the wear and life of a cutting tool used for turning
2. Determination of effects of variations in the parameters of the machining process of turning on the surface finish of a work piece
3. Measurement of the shear angle under the given conditions
4. Measurement of the various forces acting during turning and to study the effect of the machining process parameters on the forces
5. Introduction to CNC part programming fundamentals
6. Part programming to machine component on CNC turning machine as per the given drawing
7. Study of performance of various types of controllers used to control the temperature of an oven
8. Study of performance characteristics of an analogue PID controller using simulated systems
9. Project on variable regulated power supply

Text/Reference Books

1. Manufacturing Technology: Metal Cutting and Machine Tools. Vol. 2. Rao P.N. Tata McGraw-Hill Publications. 2009.
2. Fundamentals of Metal cutting and Machine Tools. Juneja P.L., Sekhon G.S. & Set N. New Age International Publishers. 2003.
3. PLC Programming for Industrial Automation. Collins K.. Diggory Press. 2007.
4. Sensors and Transducers. Sinclair I. Newnes. 2001.
5. Materials Science and Engineering: An Introduction. Callister W.D. & Rethwisch D. G. John Wiley & Sons Inc. 2010.

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Semester - III

(Departmental Core)

ME-580A	L-T-P-C
Dissertation - I	X-X-X-5

The Dissertation for M.Tech programme consists of two parts: Dissertation-I and Dissertation-II. Dissertation-I is undertaken during the III Semester.

The Dissertation is by far the most important single piece of work in the post-graduate programme. It provides the opportunity for student to demonstrate independence and originality, to plan and organize a large Dissertation over a long period and to put into practice some of the techniques students have been taught in the course. Students will choose a dissertation, in consultation with a faculty member, who will act as the Supervisor. Dissertation involves a combination of sound background research, a solid implementation, or piece of theoretical work, and a thorough evaluation of the dissertation's output in both absolute and relative terms. The very best dissertations invariably covers some new ground, e.g. by developing a complex application which does not already exit, or by enhancing some existing application or method to improve its functionality, performance etc.

The student will prepare the Dissertation report as per the prescribed format/guidelines, and present the same as a seminar at the end of the semester.

The Dissertation will be evaluated continuously over the span of the III Semesters, as per the approved procedure.

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Semester - III

(Departmental Elective - IV)

ME-576 L-T-P-C
Condition Monitoring of Machines 3-0-0-3

Objective: *This course is intended to impart knowledge regarding the structural health monitoring based on acquired vibration signals.*

Course Content

Introduction to machinery maintenance, basic vibration theory, fundamentals of data acquisition, principles of condition monitoring, transducers for condition monitoring, fault diagnosis in rotating machines, NDT methods in condition monitoring, wear and debris analysis, case studies in condition monitoring.

Text/Reference Books

1. Vibration Monitoring and Diagnosis. Collacott R. A. Willey New York. 1979.
2. Practical Machinery Management for Process Plants. Vol. 1, 2, 3 & 4. Bloch H. P. & Geitner F. P. Gulf Publishing Company. 1983.
3. Shock and Vibration Handbook. Harris H. M. & Crede C. E. McGraw-Hill Book Company. 1994
4. Digital Signal Processing. Oppenheim A. V. & Shafer R.W. Prentice-Hall Inc. 1975.
5. Machinery Vibration Measurement and Analysis. Wowk V. McGraw-Hill.1991.
6. Frequency Analysis. Randall R. B. Bruel & Kjaer Publication. 1986.
7. Engineering applications of correlation and Spectral Analysis. Bendat J. S. & Piersol A. G. John Wiley & Sons. 1980.

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Mechanical Engineering
(Specialization: Machine Design)

Semester - III

(Departmental Elective - IV)

ME-577	L-T-P-C
Fracture Mechanics	3-0-0-3
Pre-requisite	ME-373

Objective: *This course discusses nucleation and propagation of cracks and prevention.*

Course Content

Fracture criteria, Introduction to linear elastic fracture mechanics, Analysis of simple crack problems, Nucleation and propagation of cracks, Correlation between microstructure and fracture behaviour in materials. Mechanisms of fracture, Mechanisms of fatigue crack initiation and propagation, Evaluation of fracture toughness, factors influencing fatigue strength, life prediction, prevention of fatigue failure

Text/Reference Books

1. Fracture and fatigue control in structures. Rolfe S.T. & Barson J.M. Prentice Hall. 1977.
2. Elementary Engineering Fracture Mechanics. 4th Ed. David & Bruck.Kellmer Academic Publishers. 1982.

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Semester - III

(Departmental Elective - V)

ME-578 L-T-P-C
Experimental Stress Analysis 3-0-0-3

Objective: *This course discusses the measurement and analysis methods for stress and strain.*

Course Content

Review of analysis of stress and strain – basic equations of elasticity. Introduction to ideal requirements of strain measuring devices – mechanical, optical and electrical strain gauges Electrical Resistance Strain Gauges -- Gauge Factor, Types, Gauge materials, Backing Materials, Adhesives, Protective Coatings, Bonding of Strain Gauges, Lead wires and connections, Semiconductor strain gauges Performance of Strain Gauges – Temperature compensation, Transverse sensitivity, Gauge Length, Response, Excitation level, Stability. Strain Gauge Circuits and recording instruments, Strain Gauge Rossetes analysis, Stress Gauge. Photoelasticity methods - behaviour of light, plane polarized and circular polariscope, isochromatic and isoclinic fringe patterns for two dimensional photoelasticity, three dimensional photoelasticity, model slicing and shear difference method, birefringent coating method. Introduction to brittle coating method and Moire Fringe technique.

Text/Reference Books

1. Experimental Stress Analysis. Dally J. W. & Riely W. P. McGraw-Hill Book Co.1991.
2. Experimental Stress Analysis. Srinath L. S.& Raghavan M. R. Tata McGraw-Hill. 1984.

3. Elements of Experimental Stress Analysis. Hendry A. W. Pergamon Press. 1977.

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Semester - III

(Departmental Elective - V)

ME-582 L-T-P-C
Mechanical System Design 3-0-0-3

Objective: This course deals with the design procedure of a mechanical system in totality.

Course Content

Engineering process and systems approach: Application of systems concepts in engineering, identification of engineering functions, systems approach, engineering activity matrix, defining the proposed effort, role of engineer, engineering problem solving, concurrent engineering. Problem Formulation: Nature of engineering problems, needs statement, hierarchical nature of systems, hierarchical nature of problem environment, problems cope and constraints. Case study. System Theories: System analysis view points, black box approach, state theory approach, component integration approach, decision process approach, case study.

System Modelling: Need for modelling, Modelling types and purposes, linear graph modeling concepts, mathematical modeling concepts. Case study. Linear Graph Analysis: Graph modelling and analysis process, path problem, network flow problem. case study. Optimisation Concepts: Optimisation process, motivation and freedom of choice, goals and objectives-criteria, methods of optimisation-analytical, combinatorial, subjective. Case study. System Evaluation Feasibility Assessment, planning horizon, time value of money, financial analysis. A case study. Calculus Methods for Optimization:

Modelwithoneormoredecisionvariables,modelequalityand/orinequalityconstraint, Case

study. Decision Analysis: Elements of a decision problem, Decision model probability, Expected monetary value, Utility value, Baye?s theorem. Case Study. System Simulation: Simulation Concepts, simulation models, Iconic, Analog, Analytical, Waiting line simulation, Simulation Process Problem definition, input model construction, solution process, limitations of simulation approach.

Text/ReferenceBooks:

1. Design and Planning of Engineering Systems. Reredith D.D.,Wong K.K., Woodhead R.W.& Worthman R.R.,PrenticeHallInc. 1985.
2. DesignEngineering. Dixon J.R.Tata McGraw Hill PublishingCo. 1966.
3. An Introduction to Engineering Design Methods.Gupta V. &Murthy P.N.Tata McGrawHill. 1980.
4. Principles of Design: Nam PS.Oxford Press.1992.

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Semester - IV

(Departmental Core)

ME-580B	L-T-P-C
Dissertation – II	X-X-X-9

After completion of Dissertation-I, students will undertake the Dissertation-II in the IV Semester. The idea conceived and progress made in the Dissertation-I shall be extended as Dissertation-II under the supervision of a faculty member. Students shall complete the theoretical and practical aspect of the project. Thereafter they will prepare a report, as per the prescribed format/ guidelines, incorporating the results, their analysis and interpretation. The report, duly certified by the Supervisor, should be submitted to the Head of the Department. The report should also be presented as a seminar at the end of the semester.

Progress made by the student will be continuously monitored throughout the semester and evaluated as per the approved procedure.

Detailed Syllabus for M.Tech Degree Programme
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Semester - IV

(Departmental Core)

ME-580C	L-T-P-C
Dissertation Viva Voce	X-X-X-3

Dissertation Viva Voce is the verbal defence of the dissertation carried out by the student in front of a panel of examiners. The objective of Viva Voce examination is to confirm that the piece of work submitted as a dissertation is student's own work, he/she has a sound understanding of the subject of the dissertation, aware of the recent works in the area of dissertation, methodology adopted, and importance/relevance/merits of the output in relation with the existing results in the area.