# SIR PADAMPAT SINGHANIA UNIVERSITY

## Udaipur

## SCHOOL OF ENGINEERING

## Course Structure of 2-Year M.Tech. Degree Programme in Mechanical Engineering (Specialization: Production Engineering) (Batch: 2018-20)

## Credit Structure

| M.Tech Core | | M.Tech. Elective (PE) | |
|---|---|---|---|
| **Category** | Credits | **Category** | Credits |
| Departmental Core Subjects | 41 | Departmental Electives (Specialization) | 15 |
| Basic Sciences (BS) | 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–II | 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-563 | Mechanical Behavior of Materials | 3 | 0 | 0 | 3 |
| 2 | ME-564 | Computer Aided Design-Computer Aided Manufacturing | 3 | 0 | 0 | 3 |

## List of Departmental Elective(s) – II

| S.No | Course Code | Course Title | L | T | P | Credit |
|---|---|---|---|---|---|---|
| 1 | ME-565 | Advance Manufacturing Processes | 3 | 0 | 0 | 3 |
| 2 | ME-566 | Operation Research | 3 | 0 | 0 | 3 |

## List of Departmental Elective(s) – III

| S.No | Course Code | Course Title | L | T | P | Credit |
|---|---|---|---|---|---|---|
| 1 | ME-567 | Metal Casting | 3 | 0 | 0 | 3 |
| 2 | ME-568 | Ergonomics of Industrial Manufacturing | 3 | 0 | 0 | 3 |

## List of Departmental Elective(s) – IV

| S.No. | Course Code | Course Title | L | T | P | Credit |
|---|---|---|---|---|---|---|
| 1 | ME-568 | Flexible Manufacturing System | 3 | 0 | 0 | 3 |
| 2 | ME-569 | Production and Inventory Control | 3 | 0 | 0 | 3 |

## List of Departmental Elective(s) – V

| S.No. | Course Code | Course Title | L | T | P | Credit |
|---|---|---|---|---|---|---|
| 1 | ME-570 | Machine Tool Design | 3 | 0 | 0 | 3 |
| 2 | ME-571 | Product Design and Development | 3 | 0 | 0 | 3 |

# Detailed Syllabus for M.Tech. Degree Programme
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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. Srinath L. 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. & Shan H. 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. McGeoughJ. 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. Shaw M. C. Oxford Press. 2004.
2. Principles of Abrasive Processing. Shaw M. 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 and their 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 analysis of 2-D problems: finite element modelling of single variable problems, triangular and rectangular elements; Applications in heat transfer, fluid mechanics and solid mechanics; Numerical considerations: numerical integration, error analysis, mesh refinement. Plane stress and plane strain problems; Bending of plates; Eigen value and time dependent problems; 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. CookR D., Malkus D S & Plesha M E 3rd Ed. John Wiley. 1989.
3. Finite Element Procedures in Engineering Analysis. BatheK.J. Prentice-Hall, Englewood Cliffs. 1982.
4. The Finite Element Method. Hughes T.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 heat sources; 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. MesslerR. W. John Wiley and Sons. 1999.
4. Metallurgical modelling of welding. GrongO. 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. Wood head Publishing Limited.2007.

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## Semester - II

## (Departmental Elective - I)

ME-563 L-T-P-C
Mechanical Behavior of Materials 3-0-0-3

**Objective:** *To develop understanding of behavior of materials for engineering design.*

**Course Content**

Introduction: review of elastic and plastic behavior and crystal structure of materials; Isotropic and anisotropic properties of cubic and noncubic crystals; Crystal plasticity: dislocation geometry and energy, dislocation mechanics, slip system, hardening, yield surface, micro-to-macro plasticity; Strain-rate and temperature dependence of flow stress, super plasticity; Mechanical Twining, Martensitic transformation, Shape memory and super elasticity; Hardening mechanisms in metals; Concept of fatigue, fracture, creeps and stress rupture; Rheological behavior: Viscoelasticity; Residual stress; Flow and deformation behavior of polymer, ceramics and glasses; Deformation behavior of metal sandwich plate and metal-matrix composite material

**Text/Reference Books**


1. Mechanical Behaviour of Materials. Hosford W.F. Cambridge University Press. 2005.
2. Mechanical Behaviour of Materials. Meyers M. A. & Chawla K.K. Cambridge University Press. 2008.
3. Basic Engineering Plasticity. Rees D W A.Elsevier. 2008.
4. Fudamentals of Physical Metallurgy. Verhoeven J D. Wiley. 1975.
5. Mechanical Behaviour of Materials. Courtney TH. McGraw-Hill International. 2000.

6. Modelling of Engineering Materials.Rao C L.& Deshpande A P. Ane Books Pvt. Ltd. 2010
7. Mechanical metallurgy.G E Dieter.3rd Revised Ed. Mgh. 1989.
8. The Science and Engineering of Materials.Askeland D.R., Fhulay P.P. & Wright W.J. 6th Ed. Ceagage Learning Inc. 2010.
9. Theory of plasticity. Chakrabarty J.3rd Ed. Elsevier India. 2009.

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## Semester - II

## (Departmental Elective - I)

ME-564 L-T-P-C
Computer Aided Design-Computer Aided Manufacturing 3-0-0-3

**Objective:** *The main objective of the course is to bring the detail application of CAD.*

**Course Content**

Introduction and components of Computer aided design (CAD)/Computer aided manufacturing (CAM)/Computer aided engineering (CAE) systems; Basic concepts of graphics programming; Transformation matrix; Rendering; Graphical user interface; Computer aided drafting systems; Geometric modeling systems – wireframe, surface and solid modeling systems; Non manifold systems; Assembly and web-based modeling systems; Representation and manipulation of conic sections; Hermite, Bezier, and B-spline curves and surfaces; Introduction to optimization; CAD/CAM integration; Numerical control – Concepts for manual and computer assisted part programming; Virtual engineering – components and applications.

**Text/Reference Books**


1. Principles of CAD/CAM/CAE systems. Lee K. Addison Wesley. 1999.
2. CAD/CAM/CAE systems: justification, implementation and productivity measurement. Coticchia M.E., Crawford G.W.& Preston E.J. 2nd Ed. Marcel Dekker. 1993.
3. CAD/CAM: principles: practice and manufacturing management. Macmahon C.& Browne J.2nd Ed. Addison Wesley. 1998.
4. CAD/CAM: Computer aided design manufacturing. Groover M.P. & Zimmers E W. Prentice Hall. 1996.
5. CAD/CAM/CIM. Radhakrishnan P., Subramanyan S. & Raju V. 2nd Ed. New Age. 2000.

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## Semester - II

## (Departmental Elective - II)

| | |
|---|---|
| ME-565 | L-T-P-C |
| Advanced Manufacturing Processes | 3-0-0-3 |
| Pre-requisite | ME-262 |

**Objective:** *The objective of the course is to expose the students to the various advanced manufacturing processes, their needs, evolution, capabilities, and applications.*

**Course Content**

Advanced Casting Processes: Non-ferrous mould casting, continuous casting, squeeze casting, vacuum mould casting, evaporative pattern casting, ceramic shell casting, etc. Advanced Joining Processes: Details of electron beam welding (EBW); laser beam welding (LBW), ultrasonic welding (USW), Explosive welding, Plasma arc welding (PAW), Infrared welding, microwave welding, etc. Advanced Forming Processes: Details of high energy rate forming (HERF) processes such electro-magnetic forming, explosive forming, electro-hydraulic forming; Stretch forming; Contour roll forming; Laser bending, etc. Additive Manufacturing Processes: Concept of reverse engineering (RE), rapid prototyping (RP), and rapid tooling (RT); Various RP process such as Liquid based RP methods – Stereolithography apparatus (SLA), Solid Ground Curing (SGC), Solid Creation System (SCS), etc. Solid based RP methods: Fused Deposition Modeling (FDM), Laminated Object Manufacturing (LOM), etc. Powder based RP methods– Selective Laser Sintering (SLS), 3D printing (3DP), Ballistic Particle Manufacturing (BPM), etc.

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**Text/Reference Books**


1. Nontraditional Manufacturing Processes. Benedict G.F. Marcel Dekker Inc. 1987
2. Principles of Metal casting. Heine & Rosenthal. Tata McGraw-Hill Publishing Company Ltd. 1983.
3. Rapid Prototyping: Principles and Applications in Manufacturing. Chua C K.& Leong K.F. John Wiley & Sons. Inc. 1997.
4. Materials and Processes in Manufacturing. DeGarmo E.P., Black J.T.& Kohser R. A. 8th Edition Prentice Hall of India. 1997.
5. Modern Machining Processes. .Pandey P.C. & Shan H.S. Tata McGraw-Hill Publishing Company Ltd. 1980.
6. Advanced Machining Processes. Jain V.K. Allied Publishers. 2002.

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## Semester - II

## (Departmental Elective - II)

ME-566 L-T-P-C
Operation Research 3-0-0-3

**Objective:** *The course provides an in-depth knowledge to operations research techniques. The students would understand to model decision problems using operation research.*

**Course Content**

Introduction: Origin and development of operations research, general methodology of OR, applications of OR to industrial problems.

Linear Programming Problems: Different types of models, formulation of linear programming problems (LPPs), product-mix problems, deterministic models, graphical solution.

Simplex Method: Simplex algorithm, computational procedure in simplex method, applications of simplex technique to industrial problems.

Duality and Sensitivity: Duality and its concept, dual linear programming, application of elementary sensitivity analysis.

Linear Optimization Techniques: Integer programming problems (IPPs), assignment models: mathematical formulation, methods of solutions, transportation problems: methods of obtaining optimal solution degeneracy in transportation problems, transshipment problems.

Game Problems: Introduction and scope of game problems in business and industry, min-max criterion and optimal strategy, solution of two-person zero-sum game, game problem as a special case of linear programming.

Queuing Problems: Queuing systems and concepts, classification of queuing situations; Kendall‟s notation, solution of queuing problems, single channel, single stage, finite and infinite queues with Poisson arrival and exponential service time, applications to industrial problems.

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**Text/Reference Books**


1. An Introduction to Operations. Taha H. A. 6th Ed. Prentice Hall of India. 2001.
2. Introduction to Operations Research. Hillier F.J.& Lieberman G.J. 7thEd. Holden Day Inc.2001.
3. Principles of Operations Research. Wagner H.M. Prentice Hall of India. 1980.
4. Fundamentals of Queuing Theory.Gross D. &Harris C.M. 2nd Ed. John Wiely & sons. 1985.

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## Semester - II

## (Departmental Elective - III)

| | |
|---|---|
| ME-567 | L-T-P-C |
| Metal Casting | 3-0-0-3 |
| Pre-requisite | ME-262 |

**Objective:** *The course imparts the knowledge of casting process and its analysis.*

**Course Content**

Organization of process preparation, principal conditions for execution of an order and process design, stages of foundry process design, principal rules for design of castings. Bonding action of clays, properties of moulding sands, facing and cushion materials. Additives. Pattern layout and construction. Colours and storing of patterns. The design and location of feeder heads, feeder head size, shape and location. Design and economic considerations. The D process, investment casting from permanent patterns, unorthodox shaping techniques, techniques relating to metal structure and quality, antioch process, continuous casting.

Concept of solidification of metals, nucleation and growth. Coring. Fettling and salvaging of castings, heat treatment of castings. Casting Defects. Need for modernization and mechanization. Areas for mechanisation, plant lay out for foundries. Aluminum, copper and magnesium foundry practices.

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**Text/Reference Books**


1. Principles of Foundry Technology. Jain P.L. Tata Mc Graw Hill. 2001.
2. Principles of Metal Casting. Heine, Loper & Rosenthal. Tata Mc Graw Hill. 1996.
3. Text Book of Foundry Technology. Khanna O.P.& Lal M. Dhanpat Rai and Sons. 1993.
4. Casting Technology and Cast Alloys. Chakraborti A.K. Prentice hall India. 2005.

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## Semester - II

## (Departmental Elective – III)

ME-568 L-T-P-C
Ergonomics of Industrial Manufacturing 3-0-0-3

**Objective:** *This course discusses the need for human presence in various capacities in modern day manufacturing, and identifies the key issues concerning human integration in advanced manufacturing technology.*

**Course Content**

Ergonomics/Human factors fundamentals; Human-machine-environment interface; Application of ergonomics principles and criteria in industrial manufacturing; occupational health, safety and stress at workplace with specific reference to industrial manufacturing; VDU workstation; Engineering anthropometry and posture; Ergonomics of machine tool and systems design; Information processing and human error prediction; Users interface evaluation.

**Text/Reference Books**


1. Indian Anthropometric Dimensions for Ergonomic Design Practice. Chakrabarti D. National Institute of Design.1997,
2. A guide to the ergonomics of manufacturing. Helander. M. Taylor & Francis.1995.
3. Ergonomics in Manufacturing: Raising Productivity Through Workplace Improvement, Engineering & Management. Karwowski W. & Salvendy G. Norcross.1998.
4. Handbook of Human Factors and Ergonomics. Salvendy G. John Wiley &Sons Inc. 1997.
5. Health and Safety at Work: Key Terms. Tranks J. Butterworth-Heinemann.2003.

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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 anti symmetric 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-568 L-T-P-C
Flexible Manufacturing System 3-0-0-3

**Objective:** *An advanced course in FMS dealing with optimum use of flexibility. Recent advancements in scheduling and loading is also included.*

**Course Content**

Introduction: Introduction to Manufacturing Systems, Different types of manufacturing systems, Volume Variety relationships for understanding manufacturing systems

Flexibility and automation: Different types of flexibility in manufacturing, Different types of FMS building blocks. Work station, Storage retrieved system, material handling systems, computer control system.

Machining system of FMS: Horizontal machining Centers, Vertical machining Centers, Integrated Material Handling, Automated Guided Vehicles, Automatic Storage and Retrieved System

Group technology: Part classification and coding, production flow analysis, Machine Cell design, Computer Aided Process Planning. Layout consideration for flexible manufacturing, Scheduling of flexible manufacturing system. FMS simulation

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**Text/Reference Books**


1. Automation, Production Systems and Computer integrated Manufacturing. Groover M P. Tata Mc Graw Hill. 2011.
2. Hand-book of Flexible Manufacturing Systems Jha N.K. New Age Publications. 2008.

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## Semester - III

## (Departmental Elective - IV)

| | |
|---|---|
| ME-569 | L-T-P-C |
| Production and Inventory Control | 3-0-0-3 |

**Objective:** *This course is designed to discuss about forecasting and inventory control.*

**Course Content**

Production System, Types, Characteristic features and applications, Demand forecasting, Functions, Horizons, Techniques and applications, Error analysis, Production planning, Different production strategies, Aggregate planning, Master production scheduling, Material requirement planning, Supply chain management, Production control, Inventory control, Deterministic and stochastic models, Economic order quantity, Economic run length, Relationship with production control, Computer applications in production planning and control.

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**Text/Reference Books**


1. Operations Management (Processes and Value Chains). Krajewski L., J. Ritzman L. P. & Manoj, K. M. Prentice Hall of India. 2007.
2. Production and Operations Management – Manufacturing and Services, Chase.R.B. AquilanoN.J. & Jacob, S.R. McGraw Hill. 2008.
3. Operations Management: Theory and Problems. Monks, J.G. McGraw Hill.1987.
4. Production/Operations Management: Concepts, Models and Behaviour. Ebert R.J. & Adam E.E Prentice Hall of India. 1998.

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## Semester - III

## (Departmental Elective - V)

| | |
|---|---|
| ME-570 | L-T-P-C |
| Machine Tool Design | 3-0-0-3 |

**Objective:** *The scope of this course is to impart the knowledge of designing of different components of machine tool.*

**Course Content**

Introduction to Machine Tools and Mechanisms: General principles of machine tool design, working and auxiliary motions, machine tool drives, hydraulic and mechanical transmission and its elements, general requirements of machine tool design, layout of machine tools. Regulation of Speed and Feed Rates: Purpose, stepped regulation of speed-design of speed box, machine tool drives using multiple speed motors, developing the gearing diagram, step-less regulation of speed and feed rates.

Machine Tool Structure: Functions and requirements, design criteria, materials used and their properties, static and dynamic stiffness, cross-sectional shapes used for machine tool structures and basic design procedure for the design of beds, columns and other structural elements, model techniques used design, introduction to Finite Element Method(FEM).

Guide ways and Power Screws: Function and types, design considerations & procedure for slide ways, design of power screws.

Spindles and Spindle Supports: Functions and requirements, materials, effect of machine tool compliance on machining accuracy, design of spindles, bearings design/selection. Control Systems: Functions, requirements and classification, control systems for speeds, feeds & auxiliary motions, manualcontrolsystems,automatic control

systems, adaptive control systems, criteria and economic selection of machine tools, future trends in development of machine tools

.

**Text/Reference Books**


1. Tool Design. Donaldson C.TataMc-GrawHill.1980.
2. Tool Design. Pollack H.W. RestonPublishingCompanyInc.1966.
3. Principles of Jig and Tool Design. Kempster M.H.A. English University Press Ltd. 1968.
4. Machine Tool Design and Numerical Control. Mehta N.K. TataMc-GrawHill.2012.

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## Semester - III

## (Departmental Elective - V)

ME-571 L-T-P-C
Product Design & Development 3-0-0-3

**Objective:** *This course concentrates on the techniques associated with product design and development.*

**Course Content**

Product design objectives, concept, terminology, principles, requirements of a good product design, product types and design considerations for engineering, product life cycle, product specification and range, safety, liability and warranty aspects, patents and copy rights. Designing For Specific Requirements: Design features and requirements with regard to manufacturing and assembly, safety, ergonomics, energy conservation, storage, transportation and maintenance, quality and reliability as a factor in product design, quality v/s cost, packaging design, role of nationalandinternationalstandards.VisualDesign:Objectives,form,function,material and process, relationship, product graphics, role of color. Product Detailing: Need and objectives, considerations affecting detailing decisions, illustration of detailing. Product Development: Concept and objectives, information sources, role of innovation in product development and competitiveness, part approval process, advance product quality planning, design failure mode and effect analysis, use of computers in product design & development, introduction to reverse engineering and rapid prototype development. The CAD-CAM link.

**Text/ReferenceBooks**

1. Product Design and Development. Karl T. U. & Steven D. 5th Ed. Tata
2. McGraw Hill. 2008
3. Engineering of creativity: introduction to TRIZ methodology of inventive problem solving. Semyon D. S.CRC Press. 2000.
4. Inventive thinking through TRIZ: a practical guide.Michael A.Springer. 2006.
5. Systematic innovation: an introduction to TRIZ :Theory of inventive problem solving. John T. & Alla Z. CRC press 2010.

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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.

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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 defense 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.