# SYLLABUS

# FOR

# B.TECH. PROGRAMME

# IN

# MECHANICAL ENGINEERING

## INSTITUTE OF TECHNOLOGY

**ZAKURA CAMPUS**
**UNIVERSITY OF KASHMIR**
**SRINAGAR J&K, 190006**

## COURSE STRUCTURE

### B.Tech 5th Semester in Mechanical Engineering

### Zakura Campus, University of Kashmir

**B.Tech. III. Year**

**Semester-V**

| Course Code | Course Title | Teaching Classes Per Week | | | Credits |
|---|---|---|---|---|---|
| | | L | T | P | |
| MEE-5117 | Machine Design-I | 3 | 1 | 0 | 4 |
| MEE-5217 | Manufacturing Technology-II | 3 | 0 | 0 | 3 |
| MEE-5317 | Industrial Engineering-II | 3 | 0 | 0 | 3 |
| MEE-5417 | Engineering Mathematics-V | 3 | 1 | 0 | 4 |
| MEE-5517 | Measurement and Instrumentation | 3 | 1 | 0 | 4 |
| MEE-5617 | Introduction to Mechanical Vibrations | 3 | 1 | 0 | 4 |
| MEE-5217L | Manufacturing Technology-II Lab | 0 | 0 | 2 | 1 |
| MEE-5317L | Industrial Engineering-II Lab | 0 | 0 | 2 | 1 |
| MEE-5617L | Introduction to Mechanical Vibrations Lab | 0 | 0 | 2 | 1 |
| | Total | 18 | 4 | 6 | 25 |

## COURSE STRUCTURE
## B.Tech 6th Semester in Mechanical Engineering
## Zakura Campus, University of Kashmir

**B.Tech. III. Year**
**Semester-VI**

| Course Code | Course Title | Teaching Classes Per Week | | | Credits |
|---|---|---|---|---|---|
| | | L | T | P | |
| MEE-6117 | Automatic Control | 3 | 1 | 0 | 4 |
| MEE-6217 | Machine Design-II | 3 | 1 | 0 | 4 |
| MEE-6317 | Heat Transfer | 3 | 1 | 0 | 4 |
| MEE-6417 | Linear Optimization in Engineering | 3 | 1 | 0 | 4 |
| MEE-6517 | Fluid Machinery | 3 | 1 | 0 | 4 |
| MEE-6617 | Seminar | 0 | 0 | 6 | 3 |
| MEE-6317L | Heat Transfer - Lab | 0 | 0 | 2 | 1 |
| MEE-6517L | Fluid Machinery-Lab | 0 | 0 | 2 | 1 |
| | Total | 15 | 5 | 10 | 25 |

## Course Code: MEE-5117
## Machine Design-I
## Course Credits: 04

| S.No: | Topic | No. of Hrs |
|---|---|---|
| 1. | Introduction to design, need of design, types of loads, Failure criteria for fatigue loading, design of machine elements using Soderberg criteria, Gerber criteria, Goodman criteria. | 09 |
| 2. | Rivets and welding: Loading, bending, direct shear, axial and bending, eccentric loading. | 08 |
| 3. | Design of threaded fasteners and power screws, thread forms and threaded fastener types and materials, power screws, bolt tightening and initial tension, static and fatigue loading in bolts, bending and axial loading on a group of bolts. | 08 |
| 4. | Design of springs: Spring materials, helical compression and extension springs, design for fatigue, loading, leaf springs, levers. | 09 |
| 5. | Design of shafts, keys, pins and splines. | 08 |
| 6. | Flanged joints, cotter joint, Knuckle joint, gib and cotter joint. | 08 |
| | **Total number of Hours** | 50 |

| S.No: | Text Books Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Machine elements in Mechanical Design | Robert. L. Mott | Pearson Education, 2012 |

| S.No: | References Recommended | Author | Publisher |
|---|---|---|---|
| 1. | The Mechanical Design Process | David. G. Ullman | Tata McGraw Hill, New Delhi, 2001 |
| 2. | Design of Machine Elements | Bhandari. V.B | Tata McGraw Hill, New Delhi, 2007 |

## Course Name: MEE-5217
## Manufacturing Technology-II
## Course Credits: 03

| S.No: | Topic | No. of Hrs |
|---|---|---|
| 1. | Brief history of NC and CNC machines, Introduction, open loop & closed loop CNC machines, classification of CNC machines, advantages of CNC machines, setup time reduction, introduction to CNC programming, adaptive control, machining parameters selection. | 06 |
| 2. | Introduction to robotics and automated guided vehicles(AGV's), introduction to flexible manufacturing systems (FMS), elements of FMS and its advantages, cellular manufacturing, expert systems in manufacturing & simulation, maintenance automation. | 06 |
| 3. | Mechanical working of materials, Hot and cold working, theory and principles, press forging, general principles of die design, forging defects, principles of metal rolling, hot and cold extrusion indirect and impact extrusion processes. | 06 |
| 4. | Wire drawing and tube drawing and spinning, welding, selection of welding process, arc welding, resistance welding, submerged arc welding. GMAW, GTAW, thermit and friction welding technique. | 08 |
| 5. | Introduction to unconventional machining processes, abrasive jet machining (AJM), abrasive water jet machining (AWJM), advantages and applications, ultra sound machining(USM), process variables and advantages, electro discharge machining (EDM). | 06 |
| 6. | Process variables, metrology, limits, fits and tolerances, hole basis and shaft basis system, unilateral and bilateral system, Taylor's principles of gauge design, sine bars and gauge blocks manufacturing method and their applications, use of Dial indicators, comparators and coordinate measuring machine (CMM). | 07 |
| **Total number of Hours** | | 39 |

| S.No: | Text Books Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Manufacturing science | Amitabh Ghosh and Asok kumar Mallik | Ellis Horwood Ltd, 1995 |

| S.No: | References Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Fundamentals of Modern Manufacturing | Grover.P | Pearson Publications, 2001 |
| 2. | Production Engineering | Sharma.P.C | S. Chand Publication, 2005 |

## Course Code: MEE-5317
## Industrial Engineering-II
## Course Credits: 03

| S.No: | Topic | No. of Hrs |
|---|---|---|
| 1. | Factory organization, Introduction to plant organization, principles of organizational structure, organization charts, types of organizations, developing an organization structure, results of good organization, informal organization, advantages and disadvantages, location and layout analysis. | 06 |
| 2. | Introduction to Facility location problems, factors affecting the plant location, break even analyses and their application, subjective, qualitative and semi-quantitative techniques of facility location, single facility location problem, mini max location problem, gravity problem and their applications. | 07 |
| 3. | Line balancing, Introduction to facility layout and their objectives, Classification of Layouts, with advantages and disadvantages of each, Layout design procedures(CRAFT,CORELAP,ALDEP), Material handling systems, Make or Buy decisions, Planning and control of Batch Production,. Characteristics of Batch Production, Determination of Batch size, Minimum Cost batch Size, Maximum Profit Batch size, Sequencing and scheduling for Batch Production, Line of Balance technique. | 08 |
| 4. | Inspection and quality control: Concept and Definition of Quality, Concepts of Inspection and quality control, Objectives of inspection, Function of Inspection and their types, Concept of statistical quality control (SQC), Process variation, Sampling inspection. Concepts and types of Control charts, Acceptance sampling, application of control charts and sampling plans. | 08 |
| 5. | Materials management and inventory control, Integrated materials management and their components, functions and objectives of material management, introduction and concepts of inventory management, purchase model with instantaneous replenishment and without shortage, manufacturing model without shortages, purchase model with shortages, manufacturing model with shortages, probabilistic inventory concepts with lead time, selective inventory management- ABC , FSN, VED analyses. | 10 |
| | **Total number of Hours** | 39 |

| S.No: | Text Books Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Production and Operations Management | Everett. E.A and Ronald J.E | Prentice Hall of India, 1996 |

| S.No: | References Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Statistical Quality Control | Grant. E.L and Leavenworth R.S | Tata McGraw Hill, 1998 |

## Course Code: MEE-5417
## Engineering Mathematics-V
## Course Credits: 04

| S.No: | Topic | No. of Hrs |
|---|---|---|
| 1. | Complex numbers, functions, limits and continuity. | 08 |
| 2. | Analytic functions, harmonic function, necessary and sufficient condition for a complex function to be analytic, polar form of Cauchy Riemann equations, construction of analytic functions. | 10 |
| 3. | Power series, absolute convergence, some tests for convergence of power series, radius of convergence of a power series, sum function of a power series, Cauchy Hadamard Theorem. | 10 |
| 4. | Complex Integration, Complex line integral, Cauchy's theorem, Cauchy's integral formula, Poisson's integral formula, Morera's theorem, Cauchy's inequality, Tailor's theorem, Liouvilles theorem, Laurents theorem and its uniqueness. | 10 |
| 5. | Singularities, zero of a function, types of singularities, poles and zeros, limiting point of poles and zeros. | 5 |
| 6. | Calculus of residues, residue at a pole, residue at infinity, Cauchy's residue theorem, residues at finite pole, conformal mapping, transformation, Jacobian of transformation, bilinear transformations, critical points, fixed points, cross ratio. | 7 |
| | **Total number of Hours** | 50 |

| S.No: | Text Books Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Functions of a complex variable | Sharma. J.N | Krishna Prakashan Media, 1996 |

| S.No: | References Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Complex variables and applications | Brown. J.W and Churchill. R.V | McGraw Hill, 2008 |

## Course Code: MEE-5517
## Measurements and Instrumentation
## Course Credits: 03

| S.No: | Topic | No. of Hrs |
|---|---|---|
| 1. | Measurement and Instrumentation; definitions, significance, Fundamental methods, generalized measurement system, Functional elements, Types of input quantities, standards, calibration, uncertainty, Errors, Classification of instruments, Input-output configuration, Interfering and modifying inputs, methods of correction, Generalized performance characteristics, static characteristics, static calibration, Dynamic characteristics, zero and first order instruments, time constant, Second-order instruments, transient response characteristics. | 08 |
| 2. | Relative and absolute motion devices, relative displacement, Resistive potentiometers, bridge circuit, LVDT, Variable inductance and variable capacitance pick-ups, Piezoelectric transducers, fibre optic displacement transducer, Resistance strain gage, Relative velocity-translational and rotational, Mechanical revolution counters and timers, stroboscopic method, Moving coil and moving magnet pickups, DC and AC tachometers, Eddy current drag-cup tachometer, acceleration measurement. | 10 |
| 3. | Hydraulic and pneumatic load cells, flapper nozzle principle, Force transducers with elastic members, Proving ring transducer, cantilever beam transducer, electromagnetic balance, Dynamometers – Absorption, driving and transmission type, reaction forces in shaft bearings, prony brake, eddy current brake dynamometer. | 10 |
| 4. | Instruments for high, mid and low pressure measurement, dead weight and null type, Elastic element gages, Differential pressure cell, high pressure measurement, Low pressure measurement , Pirani gages & McLeod pressure gauge. Orifice meters, Venturimeter, Pitot tube, Flow nozzle, Variable area meters, rotameter, design and accuracy. | 05 |
| 5. | Positive displacement flow meter, turbine flow meter, Electromagnetic flow meter, ultrasonic flow meters, Temperature sensing techniques, liquid-in-glass and bimetallic thermometers, Pressure thermometers, electrical resistance thermometers, Thermistors, Thermocouples, thermopiles, Radiation pyrometers, Optical pyrometer. | 06 |
| | **Total number of Hours** | 39 |

| S.No: | Text Books Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Mechanical Measurements | Beckwith. B | Pearson Education International, 2008 |

| S.No: | References Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Instrumentation, Measurements & Analysis | Nakra. B.C | Tata McGraw Hill, 2000 |

## Course Code: MEE-5617
## Introduction to Mechanical Vibrations
## Course Credits: 04

| S.No: | Topic | No. of Hrs |
|---|---|---|
| 1. | Force analysis of mechanisms, D'Alemberts principle, dynamic force analysis, equivalent dynamic system, dynamic analysis of reciprocating engines. | 06 |
| 2. | Amplitude and phase angle of vibratory motion, phenomena of beats, non harmonic motions, harmonic analysis and analysis of free vibration. | 06 |
| 3. | Forced vibration of systems without damping, equilibrium and energy methods for determining natural frequency, Rayleigh's Methods, equivalent systems, systems with compound springs, free vibrations of systems with viscous damping. | 08 |
| 4. | Forced vibrations of system with viscous damping, equivalent viscous damping, power consumption in vibrating system, excitation of supports, transmissibility, vibration isolation and commercial isolators, principles of vibration, measuring instruments amplitude and phase shift response. | 07 |
| 5. | Free un-damped vibration of two degree of freedom systems static and dynamic coupling, un-damped dynamic vibration absorber friction damper, approximate solution of vibration problems of light flexible shafts with and without damping. | 08 |
| 6. | Free longitudinal vibrations of prismatic bars, torsional vibrations of circular shafts and transverse vibration of beams. | 08 |
| 7. | Balancing of four-bar linkage and slider crank mechanism balancing of radial, in line, V-and locomotive engines. | 07 |
| | **Total number of Hours** | 50 |

| S.No: | Text Books Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Mechanical Vibrations | Grover. G.K | Nem Chand and Bros, 1996 |

| S.No: | References Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Theory of Vibrations with applications | Thomson. W.T | Pearson Education, 2010 |
| 2. | Elements of vibration analysis | Meirovitch | McGraw Hill, 2011 |

## Course Credits: MEE-5217L
## Manufacturing Technology-II Lab
## Course Code: 01

| S.No: | Topic |
|---|---|
| 1. | Safety precautions and study of CNC lathe machine. |
| 2. | Performing step turning on CNC lathe machine. |
| 3. | Performing taper turning on CNC lathe machine. |
| 4. | Performing radius turning on CNC lathe machine. |
| 5. | Performing multiple turning cycles on CNC lathe machine. |
| 6. | Performing pattern repetition cycle operation on CNC lathe machine. |
| 7. | Performing linear cuts and circular cuts on CNC milling machine. |
| 8. | Performing linear and circular cuts using subroutines. |
| 9. | Performing pocket milling. |
| 10. | Use of sine bars and slips gauges for angle measurement. |
| 11. | Use of bevel protector and dial gauges. |

**Course Credits: MEE-5317L**
**Industrial Engineering-II Lab**
**Course Code: 01**

| S.No: | Topic |
|---|---|
| 1. | To study the layout of a shop in an organization and draw existing and proposed layouts. |
| 2. | To measure the variable characteristics (diameter of pins, with micrometer) and prepare a frequency histogram. Calculate values of X bar and sigma. |
| 3. | Verify that when random samples are taken from a lot with a certain percentage of defective, same %age lands to appear in random sampling by using Shewart's kit. |
| 4. | Simulate an inspection situation with the help of a Schewhart's bowl and plot X bar, and R charts using computed data. |
| 5. | To conduct Process capability study of a machine tool and to specify the tolerances for a job. |
| 6. | To verify the theorem "the standard deviation of the sum of any number of independent variables is the square root of the sum of the squares of the S.Ds of the independent variable. Determine statistically, the permissible tolerance of mating components, when the tolerance of the assembly is given. |
| 7. | To draw control chart for percent defectives after inspecting a sample and sorting out the defective units. |

## Course Code: MEE-5617L
## Introduction to Mechanical Vibrations-Lab
## Course Credits: 01

| S.No: | Topic |
|---|---|
| 1. | Study of whirling of shafts |
| 2. | To verify the relation $t = 2\pi l\sqrt{g}$ |
| 3. | To verify radius of gyration 'K' of given pendulum. |
| 4. | To verify the radius of gyration of given bar by using Bi-linear suspension. |
| 5. | To study longitudinal vibrations of helical spring and to determine the frequency or period of vibrations (oscillation) theoretically and actually by experiment. |
| 6. | To study the undamped free vibration of equivalent spring mass system. |
| 7. | To study the forced vibration of equivalent spring mass system. |
| 8. | To study the torsional vibration (undamped) of single rotor shaft system. |
| 9. | To study the free vibration of two rotor system and to determine the natural frequency of vibration theoretically and experimentally. |
| 10. | To study the damped torsional excitations and determine the damping coefficient. |
| 11. | To study the forced lateral vibrations of the beam for different damping. |

## Course Code: MEE-6117
## Automatic Control
## Course Credits: 03

| S.No: | Topic | No. of Hrs |
|---|---|---|
| 1. | Introduction to Control Systems, Examples of Control Systems, Closed-Loop Control Versus Open-Loop Control. | 01 |
| 2. | Mathematical Modelling of Control Systems, Inertial and Non-inertial frames of reference. | 04 |
| 3. | Transient and Steady-State Response Analyses First-Order Systems, Second-Order Systems, Higher-Order Systems, Performance characteristics of control systems. | 06 |
| 4. | Basic Control Actions Effects of Proportional, Derivative and Integral Control actions on system performance, Steady-State Errors in Unity-Feedback Control Systems. | 08 |
| 5. | Stability Asymptotic Stability, Bounded Input Bounded Output (BIBO) Stability, Routh's Stability Criterion. | 06 |
| 6. | Control Systems Analysis and Design by the Root-Locus Method. | 06 |
| 7. | Control Systems Analysis and Design by the Frequency-Response Methods | 08 |
| | **Total number of Hours** | 39 |

| S.No: | Text Books Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Modern Control Engineering | Ogata. K | Prentice Hall, 2010 |

| S.No: | References Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Automatic Control | Raven. F | McGraw Hill, 1998 |

## Course Code: MEE-6217
## Machine Design-II
## Course Credits: 04

| S.No: | Topic | No. of Hrs |
|---|---|---|
| 1. | Couplings, rigid couplings, muff couplings, flange couplings and flexible couplings. | 10 |
| 2. | Design of sliding bearings, bearing materials, fluid viscosity, hydrodynamic lubrication, Petroff's equation, Raimondi and Boyd chart, Heat dissipation. Rolling elements bearings: Types, catalogue information (Timken and SKF bearings), bearing life radial and thrust loads. | 10 |
| 3. | Rope drive, belt drive and chain drive. | 05 |
| 4. | Gear design, spur, helical and worm gears, gear tooth profile, gear geometry, module, contact ratio, gear train, gear tooth bending strength, gear tooth surface fatigue analysis, gear material. | 15 |
| 5. | Clutches and brakes: Single and multiple plate clutch, wear and constant pressure theories for plate clutches, materials, and shoe drum brakes, internal and external shoe brakes. | 10 |
| | **Total number of Hours** | 50 |

| S.No: | Text Books Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Mechanical Engineering Design | Shigley. J.E and Mitchell. L.D | Tata MCGraw Hill, International, 2011 |

| S.No: | References Recommended | Author | Publisher |
|---|---|---|---|
| 1. | A Text Book of Machine Design | Khurmi. R.S and Gupta. J.K | S Chand & Co. Ltd., New Delhi, 2010 |
| 2. | Machine Design | Qasim. S.Z | Khanna Publishers (P) Ltd., Delhi, 1998 |

## Course Code: MEE-6317
## Heat Transfer
## Course Credits: 04

| S.No: | Topic | No. of Hrs |
|---|---|---|
| 1. | Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer; combined heat transfer mechanism. Boundary conditions of 1st, 2nd and 3rd kind Conduction: Derivation of general three dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems (No derivation). One dimensional conduction equations in rectangular, cylindrical and spherical coordinates for plane and composite walls. Overall heat transfer coefficient. Thermal contact resistance. | 09 |
| 2. | Derivation for heat flow and temperature distribution in plane wall. Critical thickness of insulation without heat generation, Thermal resistance concept & its importance. Heat transfer in extended surfaces of uniform cross-section without heat generation, Long fin, and short fin with insulated tip and without insulated tip and fin connected between two heat sources. Fin efficiency and effectiveness. Conduction in solids with negligible internal temperature gradient (Lumped system analysis). | 09 |
| 3. | Flow over a body velocity boundary layer; critical Reynolds number; general expressions for drag coefficient and drag force; thermal boundary layer; general expression for local heat transfer coefficient; Average heat transfer coefficient; Nusselt number. Flow inside a duct- velocity boundary layer, hydrodynamic entrance length and hydro dynamically developed flow; flow through tubes (internal flow discussion only). Numerical based on empirical relation given in data handbook. Free Or Natural Convection: Application of dimensional analysis for free convection- physical significance of Grashoff number; use of correlations of free convection in vertical, horizontal and inclined flat plates, vertical and horizontal cylinders and spheres. | 10 |
| 4. | Applications of dimensional analysis for forced convection. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro dynamically and thermally developed flows inside a duct, use of correlations for flow over a flat plate, over a cylinder and sphere. | 08 |
| 5. | Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD, Effectiveness-NTU methods of analysis of heat exchangers.Types of condensation (discussion only) Nusselt's theory for laminar condensation on a vertical flat surface; use of correlations for condensation on vertical flat surfaces, horizontal tube and horizontal tube banks; Reynolds number for condensate flow; regimes of pool boiling, pool boiling correlations. | 08 |
| 6. | Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's law and Wein's displacement law. Radiation heat exchange between two finite surfaces-configuration factor or view factor | 06 |
| | **Total number of Hours** | 50 |

| S.No: | Text Books Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Fundamentals of Heat and Mass Transfer | Incropera and Dewitt | John Wiley, 2009 |

| S.No: | References Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Fundamentals of Heat and Mass Transfer | Kothandaraman. C.P. | New Age International Publishers, 2007 |
| 2. | Fundamentals of Engineering Heat and Mass Transfer | Sachdeva. K.C | New Age International Publishers, 2009 |
| 3. | Heat Transfer | Holman. J.P | Tata McGraw Hill, 1998 |

## Course Code: MEE-6417
## Linear Optimization in Engineering
## Course Credits: 04

| S.No: | Topic | No. of Hrs |
|---|---|---|
| 1. | Overview of Operations Research (OR), OR Methodology and techniques, Introduction to Linear Programming (LP), Application of LP techniques in Production management, graphical solutions, the simplex method. | 10 |
| 2. | Duality and Sensitivity analysis, transportation model problems and their variants, assignment model problems. | 10 |
| 3. | Project planning and scheduling, CPM & PERT, Project crashing and recourse allocation problems. | 08 |
| 4. | Decision theory, steps in decision making, decision making under uncertainty and under risk, marginal analysis, decision trees. | 08 |
| 5. | Flow shop scheduling, Job shop scheduling, Queuing theory and their applications. | 08 |
| 6. | Waiting line models and their applications, introduction and basic concepts of Simulation. | 06 |
| | **Total number of Hours** | 50 |

| S.No: | Text Books Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Operation Research- an Introduction | Taha. H.A | Prentice Hall of India, 2000 |

| S.No: | References Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Introduction to Operations Research | Joseph Ecker and Michael K | John Wiley & Son, 1998 |

## Course Code: MEE-6517
## Fluid Machinery
## Course Credits: 04

| S.No. | Topic | No. of Hrs. |
|---|---|---|
| 1. | Introduction to Turbo machinery, Types of Turbo machines, Equations Governing the Behavior of Turbo machines, Continuity Equation, Linear Momentum Theorem, Angular Momentum Equation, the Energy Equation, and dimensional Analysis. Dimensionless Groups and Specific Speed, Graphical Correlations for Specific Speed. Efficiency of Compressors, Polytropic or Small-Stage Efficiency, Nozzle Efficiency, Diffuser Efficiency. | 05 |
| 2. | Turbines: Classification of Turbines, Impulse Turbines-Pelton Wheels, Reaction turbine, Francis turbine, main components, design of spiral casing guide vanes, runner and number of runner blades, types of Francis runners, Kaplan turbine, velocity diagram power and efficiency calculations, draft tube, cavitation factor, Governing of reaction turbines. Principles of similarity: unit and specific quantities, performance characteristics, selection, of water turbines, hydro-electric power plants. | 06 |
| 3. | Radial-Flow Turbines, Propeller and Kaplan Turbines Effects of Rotor and Guide-vane Angle Selection of Speed and Runner Dimensions, Turbine Characteristics. | 06 |
| 4. | Inlet and Outlet Elements of Turbine, Surge Tanks, Basic Equations for Differential Surge Tanks, Spiral casing, Instability of the Surge Tank, Draft Tubes. | 02 |
| 5. | Radial-flow Pumps, Geometry, Power Theoretical Head, Energy Losses, Head Losses, Leakage Losses, Disk Friction Loss, Mechanical Losses, Specific Speed and Impeller Geometry Modeling of Flow through an Impeller, Axisymmetric Flow, Net Positive Suction Head (NPSH), Slip Factors, Effect of Blade Number, Outlet Blade Angle, and Circulation in Blade Passages, Choice of Blade Number and Blade Overlap . | 06 |
| 6. | Mixed-flow Pumps, Axial and Semiaxial Pumps, Pump Characteristics of Centrifugal Pumps, Series and Parallel Connections, Displacement Rotary Pumps, Flow Control, Reciprocating Pumps. | 03 |
| 7. | Inlet and Outlet Elements of pumps, Volute Design, Velocity Distributions in Different Volute Cross Sections, Design of a Volute, Relation between Volute Velocity and Specific Speed | 02 |
| 8. | Head Losses in Components of Turbine and Pump Systems, Pipes , Friction Factor, Hydraulic Diameter, Cavitation in Turbines and Pumps, Water Hammer. | 05 |
| 9. | Centrifugal Compressors and Fans: Centrifugal Compressor, The Effect of Blade Shape on Performance, Velocity Diagrams, Slip Factor, Work Done, Diffuser, Compressibility Effects, Mach Number in the Diffuser, Centrifugal Compressor Characteristics, Stall, Surging, Choking. | 05 |
| 10. | Axial Flow Compressors and Fans: Velocity Diagram, Degree of Reaction, Stage Loading, Lift-and-Drag Coefficients, Cascade Nomenclature and Terminology, Consideration, Multi-Stage Performance, Axial Flow Compressor Characteristics. | 05 |
| 11. | Reciprocating Compressors, Reciprocating Compressors including Clearance, Volumetric efficiency, Multi-stage compression, Steady flow Analysis. | 05 |
| | **Total number of Hours** | 50 |

| S.No: | Text Books Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Incompressible Flow Turbomachines | Round. G.F | Elsevier, 1990 |

| S.No: | References Recommended | Author | Publisher |
|---|---|---|---|
| 1. | Principles of Turbomachinary | Turton. R.K | Chapman and Hall, 1993 |
| 2. | Turbomachinery Design and Theory | Rama S. R. Gorla, Aijaz A. Khan | Marcel Dekkeirnc, 2003 |
| 3. | Hydraulic Machines: Turbines and Pumps | Grigori Krivchenko | Lewis Publishers, 2004 |
| 4. | Mechanics of Fluid | Massey. B.S | Van Nostrand Reinhold co, 1968 |
| 5. | Hydroelectric Engineering Practice | Guthrie and Brown | CBS Publishers, New Delhi, 1993 |

**Course Code: MEE-6317L**

**Heat Transfer Lab**

**Course Credits: 01**

| S.No: | Topic |
|---|---|
| 1. | Determination of fin efficiency and effectiveness of a pin fin in forced convection and natural convection. |
| 2. | Determination of thermal conductivity of a plate by two slab guarded hot plate method. |
| 3. | Determination of thermal conductivity of pipe insulation and insulation powder. |
| 4. | Determination of thermal conductivity of a liquid by the guarded hot plate method. |
| 5. | Determination of thermal conductivity of a good conductor of heat (metal rod). |
| 6. | Determination of overall resistance of a composite wall. |
| 7. | Determination of heat transfer coefficient in forced convection through a horizontal tube. |
| 8. | Determination of heat transfer coefficient for heat vertical cylinder in natural convection. |
| 9. | Determination of LMTD and NTU in parallel flow and counter flow heat exchanger. |
| 10. | Determination of Stefan Boltzmann's constant. |
| 11. | Determination of emissivity. |

**Course Code: MEE-6517L**

**Fluid Machinery-Lab**

**Course Credits: 01**

| S.No: | Topic |
|---|---|
| 1. | Study of Pelton Turbine. |
| 2. | Study of Francis Turbine. |
| 3. | Study of Hydraulic pumps. |
| 4. | Study of different types of compressors. |