

**Mechanical Engineering Department**  
**National Institute of Technology Srinagar**  
Syllabus outline for PhD Entrance Exam, 2016

**Thermodynamics**

Zeroth law, First law & Second law of thermodynamics, air & vapor power cycles, nozzles, boilers, steam turbines, compressors, refrigeration and air-conditioning, internal combustion engines, gas turbines

**Theory of Machines**

Kinematics & kinetics of particles, lower pairs & higher pairs, mechanisms and DOF, inversions, velocity and acceleration analysis, instantaneous centre, governors, flywheels, gears & cams, torsional vibrations, various types of damping, forced harmonic vibration

**Mechanics of Materials**

Free body diagrams, section forces in beams, analysis of stress and strain, pressure vessels, mechanical properties of solids, symmetric & unsymmetrical beam bending, theories of elastic failure, columns, torsion of circular shafts, strain energy due to normal and shear stresses, castigliano's theorem, complementary energy theorem, slopes and deflections, theories of failure, stresses in hollow and solid discs, stresses in rotating disc of constant thickness, closed coiled helical springs, leaf springs, conical springs,

**Fluid Mechanics & Hydraulic Machinery**

Fluid at rest, manometers, hydrostatic pressure thrusts, buoyancy, flotation, stability, scalar and velocity fields, flow field and description of fluid motion, Continuity equation, Momentum equation, energy equation, Euler's equation, Bernoulli equation, Navier-stokes equation, boundary layer equations, momentum-integral equation of boundary layer, Turbulent flow, Work output and efficiency, water turbines, pumps, dimensional analysis

**Heat Transfer**

Fourier's law of heat conduction, three dimensional heat conduction equation in Cartesian, cylindrical and spherical coordinates, heat conduction with heat generation, fins, unsteady heat conduction with negligible internal temperature gradients, free and forced convection, thermal radiation, boiling heat transfer

**Machine Design**

Introduction to design, objectives of design, design process, concept of factor of safety in design, design of riveted joints, welded joints, screw jack, design of brakes, gear design, bearing design, Various types of loading in mechanical systems, stress concentration, endurance limit, SN curves and fatigue, manufacturing consideration in design, standardization of design of friction elements, design of internal combustion engine components, introduction to fracture mechanics based design

**Manufacturing Technology**

Introduction to basic manufacturing processes and engineering materials, casting technologies, introduction to metal cutting, machine processes and machine tools, metal forming, hot working and cold working, forging, extrusion, press-work operations, explosive forming, electromagnetic forming, fabrication of composites, welding, resistance welding, ultrasonic welding, laser beam welding, defects in welding

**Material science**

Classification of materials, modern and advanced materials, primary and secondary bonds and energy related concepts, structure of metals and ceramics, concept of unit cell and lattice arrangements, ceramic crystals and density computations, crystal systems, polycrystalline materials, and single crystalline material, atomic densities (linear and planar), x-ray diffraction, diffusion mechanism, deformation and strengthening mechanisms, phase diagrams

**Industrial Engineering**

Productivity, work study, facility layout & location, material management & its techniques, SQC, techniques of operation research

**Automatic Control**

Open and closed loop systems, servo-mechanisms, block diagram and transfer functions, system response, first and second order systems, response to step and pulse, ramp and sinusoidal inputs, modes of control, stability of control systems, Routh's criteria, frequency response analysis, Bode and Nyquist stability criteria

**Instrumentation**

Generalized measurement system, standards, calibration, uncertainty, errors, Hydraulic and pneumatic load cells, instruments for high, mid and low pressure measurement, flow measuring devices, temperature sensing techniques

**Mathematics**

Laplace transforms, numerical Methods, statistics and probability, complex variables, ordinary and partial differential equations, complex variables