

Malaviya National Institute of Technology Jaipur

Mechanical Engineering Department

Syllabus for Ph.D. Admission

Specialisation: Thermal Engineering

Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids; boundary layer separation and the effect on drag and lift; vorticity and circulation; elementary turbulent flow, Potential flow, Lift, drag, and thrust; flow through pipes, head losses in pipes, bends and fittings.

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, Stefan Boltzmann law, Wien's displacement law, black and grey surfaces, view factors, radiation network analysis.

Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.

Applications: Power Engineering: Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. I.C. Engines: Air-standard Otto, Diesel and dual cycles. Refrigeration and air-conditioning: Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes, duct design, spray and dry coil design. Turbomachinery: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines.

Model Questions (Thermal Engineering)

Q1. A venturimeter, with a throat diameter of 50 mm, is used to measure water velocity in a horizontal pipe of 200 mm diameter. The pressure at the inlet of the venturimeter is 20 kPa and the vacuum pressure at the throat is 10 kPa. If the frictional losses are neglected, then flow velocity is

- a) 28 cm/s
- b) 24.2 cm/s
- c) 14 cm/s
- d) 48.5 cm/s

Q2. Surface resistance of a black body is

- a) Zero
- b) 1
- c) Infinite
- d) $\frac{1}{2}$

Q3. For same inlet and exit temperatures, LMTD of a counter flow heat exchanger isthan parallel flow heat exchanger

- a) Smaller
- b) Equal
- c) Greater
- d) Cannot be predicted

Q4. Refrigerator manufactured by a company works between 40 °C and -5 °C. The manufacturer claims that coefficient of performance of that refrigerator is 7.0. What is your take on his claim?

- a) Agree
- b) Disagree
- c) Possible in summer
- d) Possible in winter