Heat Transfer
(ME-303, Dec-07)

Note: Section A is compulsory. Attempt any four questions from Section B and any two from Section C.

Section-A
1. a) Define coefficient of convective heat transfer.
   b) Define Thermal diffusivity & its physical significance.
   c) Define Biot number & its physical significance.
   d) Define Effectiveness of heat exchanger.
   e) Critical thickness of insulation.
   f) Main difference between emmisivity & absorptivity.
   g) Nusselt number & Fourier number.
   h) Describe Newton heating of solids.
   i) State Stefan Boltzman Law of radiation heat transfer.
   j) Write a note on Wein displacement law.

Section-B
2. Derive an expression for the rate of heat transfer by conduction & convection through a composite plane wall consisting of three heterogeneous layers having thermal conductivity; K_1, K_2, and K_3 respectively.
3. Derive the condition for critical thickness of insulation for a spherical body.
4. A surface at 250°C exposed to the surroundings at 110°C convects & radiates heat to the surroundings. The convection coefficient and radiation factor are 75 W/m^2°C and unity respectively. If the heat is conducted to surface through a solid of conductivity 10W/m°C, what is the temp. gradient at the surface in the solid?
5. The effective temp of a body having an area 0f $0.12m^2$ is 527°C. Calculate
   (a) The total rate of energy emission (b) The intensity of total radiation
   (c) The wavelength of maximum monochromatic emissive power.
6. Define pool boiling. Describe heat transfer during pool boiling of liquid.

Section-C
7. Explain efficiency and effectiveness of fins. Which parameter out of these two is used for the designing of fins and why?
8. (a) A surface having an area of $1.5m^2$ and maintained at 300°C exchanges heat by radiation with another surface at 40°C. The value of factor due to the geometric location & emmisivity is 0.52. Determine (a) Heat loss by radiation (b) The value of thermal resistance
   (b) Derive the equation of Fourier's second law of conduction heat transfer for Cartesian coordinates.
9. (a) A parallel flow heat exchanger has to cool 2500kg/hr of oil from 70°C to 30°C. Cooling water enters the exchanger at 10°C and leaves at 20°C. Specific heat of oil is 2.1 kj/kg.K. Determine the effectiveness of heat exchanger and heat transfer capacity.
   (b) Derive the mean temperature difference for counter current flow heat exchanger.