Heat Transfer
(ME-303, May 2007)

Time: 3 Hours Max. Marks: 60

Note: Question No. 1 is compulsory. Attempt any four questions from section B and two questions from section C.

Section-A

1. (a) Intensity of radiation.
   (b) Differentiate grey and colored body in terms of wavelength.
   (c) Shape factor for radiation between two bodies.
   (d) Define fin efficiency.
   (e) Differentiate emissive power and monochromatic emissive power.
   (f) Write note on Critical diameter of bubble.
   (g) Define Grashof number & Fourier number.
   (h) Write the equation for Plank's law for radiation heat transfer.
   (i) Define thermal diffusivity & its physical significance.
   (j) Discuss factors affecting thermal conductivity of a material.

Section-B

2. Derive the relationship between efficiency & effectiveness of a fin.
3. Discuss nucleation & its different theories.
4. In a certain double pipe heat exchanger, hot water flows at a rate of 5000 kg/hr and gets cooled from 95°C to 65°C. At same time 5000kg/hr of cooling water at 30°C enters the heat exchanger. The flow conditions are such that overall heat transfer coefficient remains constant at 2270 W/m K. Determine the heat transfer area required and the effectiveness, assuming the two streams are in parallel flow. Assume for both the streams C_P=4.2 J/kg.
5. A plane brick wall, 25 cm thick, is faced with 15 cm thick concrete layer. If the temperature of the exposed brick face is 70°C and that of the concrete is 25°C, find out the heat lost per hour through wall of 15 m x 10 m. Also, determine the interface temperature. Thermal conductivity of the brick and concrete are 0.7 W/m and 0.95 W/m K respectively.
6. Derive the correlation by dimensional analysis for forced convective heat transfer.

Section-C

7. Derive the equation for mean temperature difference for parallel flow heat exchanger.
8. (a) KA body having emissivity = 0.8, area = 5m^2, temperature of body = 500 K. How much energy does the body radiate in 10 minutes?
   (b) Define critical thickness of insulation. Derive the condition for critical thickness of cylindrical body.
9. (a) A hot plate 1m x 1.5 m is maintained at 300°C. Air at 25°C blows over the plate. If the surface heat transfer coefficient is 20W/m^2°C, calculate the rate of heat transfer.
   (b) Derive the equation for radiation heat transfer between two bodies.