Heat Transfer
(ME-303, Dec. 2006)

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) What are the factors on which thermal conductivity of gases depend?
   (b) Discuss the significance of thermal diffusivity.
   (c) List four applications, where fins are used.
   (d) Define the efficiency of fin.
   (e) Explain Kirchoff's law of radiation.
   (f) Define radiation shape factor.
   (g) Explain the difference between free and forced convection.
   (h) Define 'Grashof' and 'Prandtl number'.
   (i) Describe the phenomenon of dropwise condensation.
   (j) Which of the arrangement of Heat exchanger is better.
   (i) Parallel flow (ii) Counter flow
   Explain the reasons.

Section-B

2. A 8 mm thick metal plate, having thermal conductivity (K=98.6 W/m-deg) is exposed to vapour at 100ºC on one side and cooling water at 30ºC on the opposite side. The heat transfer coefficients are
   hi = 14200 W/m^2-deg on the vapour side
   ho = 2325 W/m^2-deg on the water side
   Determine the rate of heat transfer, drop in temperature at each side of heat transfer.
3. One end of a long rod is inserted into a furnace and the other end projects into the surroundings air at 20ºC. Under state conditions, the temperature of the rod measured at two points 100 mm apart, was found to be 120ºC and 100ºC respectively, if the diameter of the rod is 25 mm and the thermal conductivity of the fin material is 120 W/m-deg, make calculations, for the surface heat transfer coefficient.
4. Prove that the intensity of normal radiation is 1/π times the total emissive power.
5. A restaurant grill 1.0 m x 0.8 m is maintained at 135ºC, while the room temperature is 25ºC. Calculate the heat load generated by the grill. Nusselt number is given by
   $N_u = 0.14 (G_r . P_r)^{1/2}$
   And the relevant properties at mean film temperature of 80ºC are:
   K = 0.0304 W/mk, υ = 21.09 x 10^{-6} m^2/s and P_r=0.692
6. Discuss the Filmwise condensation. What are the assumptions made, while analyzing Filmwise condensation on a vertical?

Section-C

7. Define effectiveness of a heat exchanger. Derive the expression of effectiveness in terms of capacity ratio and number of transfer units (NTU) in case of parallel flow heat exchanger.
8. A 2cm thick steel plate of thermal conductivity 50 W/m-deg has a uniform volumetric heat generation of 40 x 10^6W/m^3. The temperature at the one surface of the plate is 160ºC and at the other is 100ºC. Workout the temperature distribution across the plate, valve and position of the maximum temperature and the flow of heat from each surface of the plate. Neglect the end effects.
9. Write short notes on any two of the followings:
   (a) Critical thickness of insulation
   (b) Mechanism of bubble formation & collapse in pool beiling.
   (c) Wien's displacement law of radiation, and its significance; Gray body