Code :RR320306 **RR**

III B.Tech II Semester(RR) Supplementary Examinations, April/May 2011
HEAT TRANSFER
(Mechanical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE questions
All questions carry equal marks
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1. (a) Discuss the different modes by which heat be transferred. Give suitable example to illustrate your answer .
   (b) Write the fourier rate equation for heat transfer by conduction. Give the units and physical significance of each term appearing in this equation.

2. A refrigerant at -40^0C flows into a copper pipe (400 W/mK) of 10 mm ID and 14 mm OD. A 40 mm thick shell of thermo Cole (0.03 W/mK) is put on the pipe to reduce losses. Estimate the heat leakage to the refrigerant per meter length of pipe, if the ambient temperature is 40^0C. Assume the external and internal heat transfer coefficients are 5 W/m^2K and 500 W/m^2K respectively. Calculate the amount of refrigerant evaporated per hour taking its latent heat at -40^0C as 1390 kJ/kg.

3. A wall of thickness 100 mm is insulated on one side and other side is exposed to 0^0C. Determine the wall temperature insulated surface if the internal heat generation in the wall is at the rate of 10^6 W/m^3. Take k = 40 W/mK.

4. (a) Derive an expression relating, Reynolds, Prandtl, and Nusselt number for forced convection.
   (b) Calculate the heat transfer coefficient for water at 60^0C flowing through a 0.625 cm diameter tube with a velocity of 0.9 m/s. The tube wall temperature is 40^0C.

5. (a) Calculate the average co-efficient of heat transfer for natural convection for a vertical plate 30.48 cm high at 51.67^0C. The surrounding air is at 23.9^0C. Also calculate the boundary layer thickness at the trailing edge of plate.
   (b) What is the criterion for transition from laminar to turbulent flow in free convective heat transfer.

6. (a) A 10mm dia. ground and polished stainless steel tube ($\in = 0.05$) is maintained at a surface temperature of 300^0C while boiling water at atmospheric pressure. Identify the regime of pool boiling and calculate heat flux and heat transfer coefficient.
   (b) Estimate the heat flux required to maintain a brass plate at 120^0C. While boiling saturated water at 1 atm. What is the power requirement if the water is pressurized to 10 atm? At what fraction of the critical heat flux is the plate operating?

7. (a) What is intensity of radiation? State Lambert's cosine law related to intensity of radiation.
   (b) Using Planck's law of distribution, derive Wien's displacement law.
   (c) A furnace emits radiation at 2500^0C. Treating it as black body radiation, calculate,
      i. the monochromatic radiant heat flux at 1μ wave length.
      ii. the wave length at which emission is maximum and corresponding radiant flux.
      iii. total emissive power.

8. (a) Derive an expression for logarithmic mean temperature difference for the case of parallel flow of heat exchanger.
   (b) A hot fluid enters a heat exchanger at a temperature of 200^0C at a flow rate of 2.8 Kg/Sec (sp.heat 2.0 kJ/kg-K) it is cooled by another fluid with a mass flow rate of .7 kg/sec (Sp.heat 0.4 kJ/kg-K). The overall heat transfer coefficient based on outside area of 20m^2 is 250 W/m^2-K.Calculate the exit temperature of hot fluid when fluids are in parallel flow.

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