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Reg. No. : .....

Name : .....

Sixth Semester B.Tech. Degree Examination, March 2015
(2008 Scheme)
08.604 : HEAT AND MASS TRANSFER (MU)
(Special Supplementary)

Time : 3 Hours Max. Marks : 100

Instructions : 1) ***Use*** *of Heat and Mass Transfer Data Book is* ***permitted***.
2) *Answer* ***all*** *questions from Part* ***A***. ***Each*** *question carries* ***4*** *marks.*
3) *Answer* ***one*** *question from* ***each*** *Module in Part* ***B***. ***Each*** *question carries* ***20*** *marks.*

PART – A

1. Explain the variation of thermal conductivity of liquid and gases with temperature.
2. Explain why gases have a much lower thermal conductivity than liquids.
3. Explain the concept of velocity and thermal boundary layer.
4. How is heat transfer rate estimated in the case of conduction and convection ?
5. Explain Buckingham's π theorem.
6. What is meant by effectiveness of a Heat Exchanger ?
7. How is heat transfer rate estimated in the case of combined conduction and convection ?
8. Explain the working principle of a heat pipe.
9. What is the significance of Grashoff's number in natural convective heat transfer ?
10. Briefly explain analogy between heat and mass transfer. **(10×4=40 Marks)**

P.T.O.

PART – B

Module – I

11. a) The interior of a refrigerator having inside dimensions 0.6 m × 0.6 m base area and 1 m height is to be maintained at 6°C. The wall of the refrigerator are constructed of two mild steel sheets 3 mm thick. (K = 46.5 W/m°C) with 52 mm of glasswool insulation (K = 0.046 W/m°C) between them. If the average heat transfer coefficient at the outer and inner surfaces are 11.2 W/m^2°C and 14.2 W/m^2°C respectively, calculate the rate at which heat must be removed from the interior to maintain the specified temperature in the Kitchen at 25°C. **10**

b) A small cubical furnace 1m × 1m × 1m on inside is constructed of fireclay brick [K = 0.9 kcals/mm°C with a wall thickness of 10 cm. The inside of the furnace is maintained at 440°C and outside at 40°C. Calculate the heat loss by conduction through the wall/day. **10**

OR

12. a) Explain the significance of critical insulation thickness. **10**

b) A thin hollow tube with 6 mm outer diameter and 4 mm inner diameter carries a current of 1200A. Water at 35°C is circulated inside the tube for cooling. Estimate the surface temperature of the tube if its outer surface is insulated. Take heat transfer coefficient of the waterside as 35 kW/m^{2}K, K for tube material as 18 W/mk and electrical resistivity of the material as 0.1 Ω mm^2/m. **10**

Module – II

13. Air at atmospheric pressure and 220°C flows over a plate with a velocity of 5m/s. The plate is 15 mm wide and maintained at a temperature of 120°C. Calculate the thickness of thermodynamic and thermal boundary layer and the local heat transfer coefficient at a distance of 0.6 m from the leading edge. Assume that flow is on one side of the plate. **20**

OR

14. a) Derive an expression for the logarithmic mean temperature difference for a counter flow heat exchanger. **7**

b) A gas turbine blade 12 cm long and having a cross sectional area 5.4 cm^2 and perimeter 26 cm is made of a stainless steel (K = 23.3 W/mk). The temperature at the root is 510°C. The blade is exposed to a hot gas at 900°C. The heat transfer coefficient between the blade surface and gas is 450 W/m^{2}K. Determine the temperature distribution and rate of heat flow at the root of the blade. Assume the tip of the blade is insulated. **13**

Module – III

15. a) What is Stefan-Boltzmann Law ? Explain the concept of total emissive power of a surface. 8

    b) For a hemispherical furnace, the flat foor is at 800 K and has an emissivity of 0.5. The hemispherical roof is at 1000 K and has an emissivity of 0.25. Find the net redioactive heat transfer from the floor. 12

OR

16. a) Derive various mechanism of mass transfer. 8

    b) Air at 1 atm and 25°C containing small quantity of iodine flows with a velocity of 7.6 m/sec inside a 35 mm, diameter tubes. Calculate mass transfer coefft for iodine. Take knematic viscosity as 15.5×10^{-6} m^2/s and $D = 0.82 \times 10^{-5}$ m^2/s. 12
