(Pages : 3) **1458**

Reg. No. : .....

Name : .....

Sixth Semester B.Tech. Degree Examination, April 2014
(2008 Scheme)
08.604 : HEAT AND MASS TRANSFER (MU)

Time : 3 Hours Max. Marks : 100

Instructions : *1) Answer **all** questions from Part **A** and **one full** question from **each** Module of Part **B**.*
*2) Heat and Mass Transfer data book is **permitted**.*

PART – A **(10×4=40 Marks)**

1. How does thermal conductivity vary with temperature for metals, alloys and insulators ?
2. Write down the general conduction equation is cylindrical coordinates and deduce equations for one dimensional steady heat conduction with and without heat generation and constant thermal conductivity.
3. Explain the importance and physical significance of Biot number in transient heat conduction.
4. Explain the principle of dimensional analysis.
5. Consider a parallel flow over an isothermal flat plate. Explain why the local heat transfer coefficient decreases in the direction of flow.
6. What are the influences of fin length and fin thickness on the efficiency of a fin ?
7. What is a heat pipe ? How does it work ?
8. Explain Kirchoff's law of radiation.
9. What is a radiation shield ? Where is it used ?
10. Define and explain the physical significance of Schmidt number and Sherwood number.

P.T.O.

PART – B

Module – 1

11. a) Derive the most general heat conduction equation in Cartesian coordinates. 12

    b) Determine the steady-state heat transfer rate per unit area through an 80 mm thick homogeneous slab with its two faces maintained at uniform temperatures of 40°C and 20°C respectively. The thermal conductivity of the material is 0.20 W/mK. 8

12. a) Derive the expression for temperature distribution in a solid cylinder with internal heat generation. 10

    b) A cubical furnace 0.5m×0.5m×0.5m on the inside is constructed of Firebrick (k = 1.04 W/mK) with a wall thickness of 100 mm. The temperature drop across the furnace wall is 300°C. Calculate the shape factor for the furnace and determine the heat loss by conduction. 10

Module – 2

13. a) What do you mean by 'overall heat transfer coefficient' ? Derive an expression for the same for the case of a composite cylinder of two layers, based on inside surface. 10

    b) A steam pipe 50 mm diameter and 2.5 m long has been placed horizontally and exposed to still air at 25°C. If the pipe wall temperature is 295°C, determine the rate of heat loss. 10

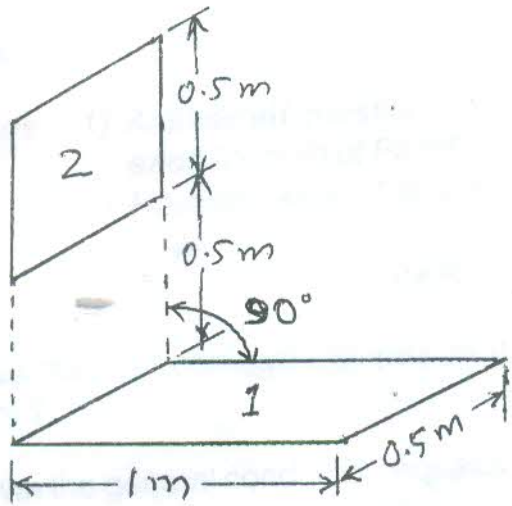
14. a) Air at 27°C is flowing across a tube with a velocity of 25 m/s. The tube could be either a square of 5 cm side or a circular cylinder of 5 cm diameter. Compare the rate of heat loss in each case, if the tube surface is at 127°C. Use the correlation : $Nu = C\ Re^n Pr^{1/3}$ where C = 0.027, n = 0.805 for cylinder and C = 0.102, n = 0.675 for square tube. 10

    b) It is desired to use a double pipe counter flow heat exchanger to cool 3 kg/s of oil (C_p = 2.1 kJ/Kg K) from 120°C. Cooling water at 20°C enters the heat exchanger at a rate of 10 kg/s. The overall heat transfer coefficient of the heat exchanger is 600 W/m^2 K and the heat transfer area is 6 m^2. Calculate the exit temperature of oil and water. 10

Module – 3

15. a) State and prove Stefan-Boltzmann law. 10

b) Determine the angle factor F_{12} for the configuration shown in figure. 10



16. a) Derive the equations for steady state equimolar counter diffusion. 10

b) Air at 25°C and 20% RH flows through a pipe of 25 mm ID with a velocity of 5.2 m/s. The inside surface is constantly wetted with water and a thin water film is maintained throughout. Determine the water evaporated per m^2 surface area. $D_{AB} = 0.26 \times 10^{-4}$ m^2/s. 10