Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - 2015-16 Even Semester - May 2016

14FP2005 Heat and Mass Transfer

Set A

Time : 3 hrs
Total Marks: 100

1. i) Derive the expression for heat transfer through furnace wall made of three different materials in series. Assume k_1, $k_2$and k_3 be the thermal conductivities of materials and x_1, x_2 and x_3 be the respective thickness. Assume hot face and cold face temperatures be T_1 and T_2 respectively**.** (10 marks)

   ii) A 50 mm diameter pipe of circular cross section and with walls 3mm thick is covered with two concentric layers of logging. The inner layer having a thickness of 25mm and thermal conductivity of 0.08 (W/m K) and outer layer having thickness of 40 mm and thermal conductivity of 0.04 (W/m K) .Estimate the rate of heat loss per metre length of pipe and the temperature inside the pipe is 500K and outside surface temperature is 330K for pipe is 45(W/m K) (10 marks)

OR

2. i) A furnace is constructed with 225mm thick of fire brick, 120mm of insulating brick and 225 mm of the building brick. The inside temperature is 1200 K and the outside temperature is 330K. Find the heat loss per unit area and the temperature of the junction of the fire brick and insulation brick. Data: *Thermal conductivity of fire brick= 1.4 (W/m K), Thermal conductivity of insulating brick= 0.2 (W/m K) and Thermal conductivity of building brick= 0.7 (W/m K).* **(10 marks)**

   ii) Derive the expression of plane wall with variable thermal conductivity. **(10 marks)**

3. i) Find inside heat transfer coefficient using sieader –Tate equation for laminar flow. Data, I.D of tube = 20mm, NRe=15745, μ at mean temperature =$550x10^{-5}$ pascal. μ at wall temperature =$900\ x10^{-6}$ pas. Prandtle number=36,k=0.25W/mK. (10 Marks)

   ii) State and explain any three Radiations laws . (6 Mark)

   iii) Differentiate between the free convection and forced convection (4Marks)

OR

4. 1. Calculate the convective heat transfer coefficient when air at 90 ºC is passed thro a deep bed of green peas. Assume surface temperature of a pea to be 30 ºC .The diameter of each pea is 0.5cm.The velocity of air through the bed is 0.3 m/s. (10 marks)
   2. Describe the heat transfer by convection with neat sketch. **(**10 Marks**)**

5. 1. Discuss and derive the energy balance of various flow pattern in heat exchanger and write the merits and demerits. (10Marks)
   2. Water enter a two fluid in heat exchanger at 55ºC and leaves at 85ºC.Hot gases enter at 305 ºC and leaves at 160 ºC. If the total heat transfer area is 500 square metre and the overall heat transfer coefficient is 600 kcal/hrm^2ºC. Determine the total heat transferred per hour for (i) Parallel flow, (ii) counter flow. (10Marks)

OR

6. 1. Discuss about the design of shell and tube heat exchanger (1-1) with neat sketch. **(10 Marks)**
   2. Calculate the heat transfer area of 1-2 heat exchangers from the following data. Inlet and outlet temperature of hot fluid are 423K and 353K respectively. Inlet and outlet temperature of cold fluid are 303K and 318K respectively. Overall heat transfer coefficient = 4100 W/m^2 K . Q=407 KW, LMTD correction factor=0.84. **(10 Marks)**

7. Discuss in detail about the boiling mechanism of heat transfer with neat diagram **(20 Marks)**

OR

8. Explain the different condensation with neat diagram. **(20 Marks)**

9.
1. Discuss about the molecular diffusion mechanism with neat sketch. (8Marks)
2. Give the application of mass transfer in Bio and food process industries. (6 Marks)
3. A volatile organic compound (C_6H_6) costing Rs. 5 a kg is stored in a tank 10 m diameter and open at the top. A stagnant air film 10mm thick is covering the surface of the compound beyond which the compound is absent. If the temperature is 25ºC , vapour pressure of the compound 150mm Hg and its molal diffusivity 0.02 m^2 / hr . Determine the amount in Rs loss per day (6Marks)

Wishing you All the Best
