b) What is the pool boiling? How is force convection boiling different from pool boiling. 7

OR

10. a) Show that shape factor for a cavity (general) of surface area A_1. and opening area A_2, with respect to its self is given by $F_{11} = 1 - A_2/A_1$. 4

b) Define emissive power. 3

c) Distinguish between black and gray surfaces. 3

d) Write short note on radiation shields. 4

ME - 605

B.E. VI Semester

Examination, June 2014

Heat and Mass Transfer

Time : Three Hours

Maximum Marks : 70

Note: Answer five questions, one from each unit. Use of steam table and HMT data book permitted.

Unit - I

1. a) Define thermal diffusivity and thermal resistance. 5

b) A 3mm thick metal plate, having thermal conductivity K = 98.6 m/m - deg, is exposed to vapour at 100°C on one side and cooling water at 30°C on the opposite side. The heat transfer coefficients are:

h_i = 14200 w/m² - deg on vapour side

h_o = 2325 w/m² - deg on the water side

Determine rate of heat transfer, the overall heat transfer coefficient and the drop in temperature at each side of heat transfer. 9

OR

2. a) Describe the mechanism of heat conduction in the metal. 5

b) A steam pipe, 10cm I.D and 11cm O.D is covered with an insulating substance (k = 1 m/mk). The steam temperature and ambient temperature are 200°C and 20°C, respectively. If the convective heat transfer coefficient between the insulation surface and air is 8W/m²K. Find the critical radius of insulation. For this value of radius calculate the heat loss per meter of pipe and outer surface temperature neglect resistance of the pipe material. 9

Unit - II

3. a) Derive an expression for heat dissipation from an infinitly long Fin $(l \to \infty)$ is $\phi_{fin} = \sqrt{phKAC}\,(t_0 - t_a)$. 9

b) Explain the significance of Fin effectiveness. 5

OR

4. a) What is meant by a lumped-capacity? What are the physical dimension necessary for a lumped unsteady state analysis to apply. 4

b) Glass spheres of 2mm radius and at 500°C are to be cooled by exposing them to an air stream at 25°C, make calculation for the maximum value of convection coefficient that is permissible and the minimum time required for cooling to a temperature of 60°C. Assuming the following property values. density 2250 kg/m³, specific heat 850J/kg and conductivity 1.5 W/m-deg. 10

Unit - III

5. a) Define Nusselt, prandtl and stanton numbers. 6

b) Air at 25°C is flowing along a heat flat plate at 140°C at a velocity of 3m/s. The plate is 2.5m long and 1.5m wide. Calculate skin friction coefficient and local heat transfer coefficient at 40cm from leading edge of the plate. 8

OR

6. a) Explain the criterion for deciding the type of convection (Free or Force) in any given situation. 4

b) A nuclear reactor with its core constructed of parallel vertical plate 2.25m high and 1.5m wide has been designed on free convection heating of liquid bismuth. Metallurgical consideration limit the maximum surface temperature of the plate to 975°C and the lowest allowable temperature of bismuth 325°C. Estimate maximum possible heat dissipation from both side of each plate. 10

Unit - IV

7. a) Derive an expression of effectiveness of parallel flow H.E in terms of NTU and 'C'. 10

b) Define heat exchanger effectiveness and explain its significance. 4

OR

8. a) Explain steady state diffusion through stationary medium? 7

b) Explain Fick's law of diffusion? and explain diffusion coefficients. 7

Unit - V

9. a) Explain Nusselt's theory for the laminar film condensation on vertical plate. 7