

- b) What is the pool boiling? How is forced 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

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ME - 605**B.E. VI Semester**

Examination, June 2014

Heat and Mass Transfer*Time : Three Hours**Maximum Marks : 70*

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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 $K = 98.6 \text{ W/m} \cdot \text{deg}$, 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:
 $h_i = 14200 \text{ W/m}^2 \cdot \text{deg}$ on vapour side
 $h_o = 2325 \text{ W/m}^2 \cdot \text{deg}$ 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

[2]

- b) A steam pipe, 10cm I.D and 11cm O.D is covered with an insulating substance ($k = 1 \text{ m/mk}$). 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 $8 \text{ W/m}^2\text{K}$. 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 infinitely long Fin ($l \rightarrow \infty$) 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/m^3 , specific heat 850 J/kg and conductivity 1.5 W/m-deg .

10

Unit - III

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

6

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[3]

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

8

OR

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

4

- b) A nuclear reactor with its core constructed of parallel vertical plate 2.25 m high and 1.5 m 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