01995

BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

Term-End Examination

June, 2012

BME-027 : HEAT AND MASS TRANSFER

Time : 3 hours *Maximum Marks : 70*

Note : *(i)* *Answer **any seven** questions.*

(ii) *All questions **carry equal** marks.*

(iii) *Use of calculator is **permitted**.*

1. (a) What is meant by Heat Transfer ? Explain the different modes of Heat Transfer. 6

   (b) Explain the "Stefan - Boltzmann" law of radiation. 4

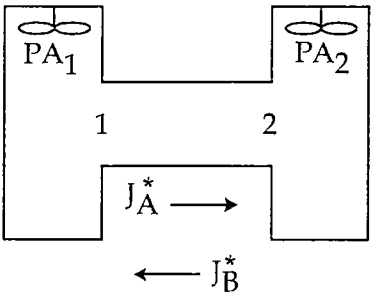
2. (a) What are the types of evaporators ? Explain them briefly. 5

   (b) Ammonia gas (A) is diffusing through a uniform tube 0.10m long containing N_2 gas (B) at 1.0132×10^5 Pa and 298K. The diagram is given below. At point 1, $PA_1 = 1.013 \times 10^4$ Pa and at point 2, $PA_2 = 0.507 \times 10^4$ Pa. The diffusivity $D_{AB} = 0.230 \times 10^{-4}$ m^2/Sec. 5

Calculate :

(i) The flux J_A^* at steady state.

(ii) Repeat for J_B^*.



3. (a) How the Heat Exchangers are classified ? Explain any one of them. 5

(b) In a single-pass shell and Tube heat exchanger the inlet and outlet temperatures for the hot fluid are respectively $T_{h,i} = 260°C$ and $T_{h,O} = 140°C$; for the cold fluid, they are $T_{c,i} = 70°C$ and $T_{c,O} = 125°C$. Calculate the logarithmic mean temperature difference for : 5

(i) Counter flow and

(ii) Parallel-flow arrangements.

4. (a) Explain about "Fire Tube Boiler" with a diagram. 5

(b) What is a fin ? Explain with examples of fins and their necessity to attach in a Heat exchanger. 5

5. (a) It was found during a test in which water flowed with a velocity of 2.44 m/s through a tube (2.54 cm inner diameter and 6.08 m long), that the heat lost due to friction was 1.22 m of water ? Estimate the surface heat transfer coefficient based on Reynolds analogy. Take $\rho = 998$ kg/m^3 and Cp = 4.187 KJ/kg K. 5

(b) Explain about "Kirchoff's law". 5

6. (a) What is meant by convection ? Explain the types of convection. 3

(b) Explain the methods of evaluation of Heat transfer coefficient. 7

7. (a) What is Prandtl Mixing Length theory ? Explain. 4

(b) A surface emits as a black body at 2000 K. What is the rate per unit area (w/m^2) at which it emits radiation in directions corresponding to $0° \leq \theta \leq 60°$ and in the wavelength interval $3\ \mu m \leq \lambda \leq 5\ \mu m$? 6

8. (a) Explain the errors that commonly occur in numerical solutions of Heat conduction problems. 5

(b) A load of peas at a temperature of 25°C is to be cooled down in a room at a constant air temperature of 1°C.

(i) How long the peas will require to cool down to 2°C, when the surface heat transfer coefficient of the peas is 5.81 W/m^{2}K ? 5

(ii) What is the temperature of the peas after a lapse of 10 min from the start of cooling ? (Given dia of peas = 8mm, density is 750 kg/m^3 and sp. heat = 3.35 KJ/kg K.)

9. (a) What is meant by evaporation ? Explain working principle of single effect evaporator with sketch. 5

(b) Discuss about "Planck's Law". 5

10. (a) What are the different regimes of "Pool-Boiling" ? Explain any one of them. 5

(b) What will be the concentration of oxygen dissolved in water at 298 K when the solution is in equilibrium with air at 1 atm. pressure ? The Henry's law constant is 4.38×10^4 atm/mol fraction. 5