

**Note:**

1. Question **No. 1** is compulsory.
2. Attempt **any three** questions out of remaining **five** questions.
3. Assume suitable data wherever necessary.
4. Figures to right indicate full marks.

- Q.1 Answer the following ( **Any four**)
- a. Discuss convection with suitable example. 5
  - b. What is the selection criteria for insulating material if it is used to be in electrical operations? 5
  - c. Discuss Stefan- Boltzmann law in detail. 5
  - d. Explain Two film theory in detail. 5
  - e. Discuss the role of diffusion in dairy industry. 5
- Q.2
- a. Differentiate between feed forward and feed back multiple effect evaporators. 10
  - b. Alcohol vapor diffusing through a layer of water vapor under equimolar counter diffusion at 35°C and 1 atm pressure. The modal concentrations of alcohol on the two sides of the gas film (water vapor) 0.3 mm thick are 80% and 10 % respectively. Assuming the diffusivity of alcohol-water vapor to be 0.18 cm<sup>2</sup>/s, Calculate the rate of diffusion of alcohol and water vapor in kg/hr through an area of 100 cm<sup>2</sup>. Molecular weight of alcohol is 46. If the water vapor layer is stagnant, estimate the rate of diffusion of alcohol vapor. 10
- Q.3
- a. A furnace is constructed with a 230 mm thick layer of fire brick, 115 mm thick layer of insulating brick and followed by a 230 mm thick layer of building brick. The inside temperature of the furnace is 1213 K and the outside temperature is 318 K. The thermal conductivities of fire brick, insulating brick and building brick are 6.047, 0.581 and 2.33 W/m.K. Find the heat loss per unit area and the temperature at the interface. 10
  - b. Derive the expression for heat flow through composite cylinder. 10

- Q.4 a. Evaluate the inside heat transfer coefficient of heavy oil flows at a rate of 10  
0.5kg/s through a tube of 19mm inside diameter, length of tube is 1.5m and is  
heated from 311K to 327 K by condensing stream at 373 K. 10  
**Data:** Properties of oil at 319K  
 $k_{oil} = 0.14 \text{ w/m.k}$ ,  $C_{p_{oil}} = 2.1 \text{ kJ/ kg.K}$ , Viscosity of oil = 154 (mN.s)/m<sup>2</sup>,  
viscosity of water = 87 (mN.s)/m<sup>2</sup>
- b. What is the purpose of using radiation field? Prove that insertion of one 10  
radiation shield between two parallel plane surfaces , the radiation heat transfer  
rate reduces to half of the initial rate.
- Q.5 a. Derive the equation for LMTD. Explain LMTD correction factor. 10  
b. Give the classification of heat exchangers. 10
- Q.6 Write a short note
- a. Knudsen diffusion 5  
b. Application of heat exchanger 5  
c. Multiple effect evaporator 5  
d. Antifoaming agents 5