No. of Printed Pages : 4

BIME-034

B.Tech. – VIEP – MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

00953

December, 2016

BIME-034 : HEAT AND MASS TRANSFER

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **five** questions. All questions carry equal marks. Use of scientific calculator is permitted. Assume suitable missing data, if any.*

1. (a) What are the different modes of heat transfer ? Explain their potential for occurrence.

(b) Determine the heat flow across a plane wall of 10 cm thickness with a thermal conductivity of 8·5 W/m.K. When the surface temperatures are steady and at 200°C and 50°C, the wall area is 2 m^2. Also find the temperature gradient in flow direction. 7+7

2. (a) What do you mean by critical radius of insulation ? Explain its concept with the help of material and surface resistance.

(b) An ice box has a composite wall made up of 1 mm thick aluminium sheet on the inside surface, 3 cm thick wooden board on the outside and 5 cm cork insulation between the two. Ice at – 5°C is in contact with the aluminium surface. The unit surface conductance on the outside box is 11·61 W/m^2-K. The thermal conductivities of wood, cork and aluminium are 0·209, $4{\cdot}2 \times 10^{-3}$, 205·83 W/m-K respectively. The outside temperature is 27°C.

Calculate

(i) the thermal resistance of the composite wall, and

(ii) the rate of heat transfer per unit area. 7+7

3. (a) Explain Reynolds analogy between momentum and heat transfer.

(b) Derive an expression for Lambert's cosine law. 7+7

4. (a) Define the diffusion coefficient for a binary mixture. Is this coefficient dependent upon temperature, pressure and composition of the mixture ? Explain.

(b) Prove that the mean temperature difference in a parallel flow heat exchanger is given by

$$\text{LMTD } (t_m) = \frac{t_1 - t_2}{\log_e \left(\frac{t_1}{t_2} \right)}.$$ 7+7

5. (a) Derive an expression for temperature distribution in a slab of thickness 'L', when its two faces are at temperatures t_1 and t_2, the thermal conductivity varies linearly with temperature according to

$$K = K_0 (1 + at),$$

where 'a' is a constant. Assume one-dimensional steady state heat conduction with no heat generation.

(b) Explain the phenomenon of equimolar counter diffusion. Derive an expression for equimolar counter diffusion between two gases or liquids. 7+7

6. (a) Prove that the shape factor of a hemispherical bowl of diameter D with respect to itself is 0·5.

(b) Define the Fourier number, Biot number, Schmidt number, Sherwood number, Lewis number, Reynolds number and Prandtl number. 7+7

7. Write short notes on any ***four*** of the following : $4 \times 3\frac{1}{2} = 14$

(a) Transient Heat Conduction

(b) Heisler Charts

(c) Turbulent Flow

(d) Forced Convection

(e) Kirchhoff's Law

(f) Radiation Shields