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

00651   **Term-End Examination**

June, 2019

BIME-034 : HEAT AND MASS TRANSFER

Time : 3 hours   *Maximum Marks : 70*

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

1. (a)   What is critical thickness of insulation for a cylinder ? Derive an expression for the same.

    (b)   Sun emits maximum radiation at wavelength of $\lambda = 0.52$ micron. Assuming sun as a black body, find the surface temperature of the sun and emissive power at that temperature.   *5+5*

2. (a) Insulation boards are made up of three layers of materials of conductivities k_1, k_2 and k_3 of thickness x_1, x_2 and x_3 respectively. They are bolted together by metal bolts of cross-section area A_1 m^2 per m^2 of board area. Metal conductivity is k_4. If temperatures on either side of board are t_1 and t_4, determine an expression to find the heat flow per m^2 of area of board.

(b) Distinguish between laminar and turbulent flow with the help of a suitable example. *5+5*

3. (a) Define Reynolds, Nusselt, Prandtl and Stanton numbers. Explain their importance in convective heat transfer.

(b) Prove that the shape factor of hemi-spherical bowl of diameter D with respect to itself is 0·5. *5+5*

4. (a) Explain the concept of black body and grey body in radiation terminology.

(b) Define absorptivity, reflectivity and transmissivity. *5+5*

5. (a) Define Fick's first and second law of diffusion. Describe the various mechanisms of mass transfer.

(b) What is convective mass transfer coefficient and what are its units ? Also explain the physical significance. *5+5*

6. (a) What is condensation ? Explain in brief the dropwise condensation.

(b) The thermal conductivity k, the density ρ, and the specific heat C of steel are 61 W/(mK), 7865 kg/m^3, and 0·46 kJ/kg K, respectively. Calculate the thermal diffusivity of the material. *5+5*

7. (a) Prove that the thermal resistance offered by a hollow long cylinder of constant thermal conductivity is given by

$$R_{cyl} = \frac{ln\left(\dfrac{r_2}{r_1}\right)}{2\pi\,L\,K}.$$

(b) Discuss overall heat transfer coefficient. Obtain an expression for overall heat transfer coefficient based on inner diameter of a hollow cylinder. *5+5*

8. (a) What are the different modes of mass transfer ? Give examples of industrial applications where mass transfer takes place.

(b) (i) What is heat exchangers ? Where are they used ?

(ii) What do you mean by fouling factor ? State the causes of fouling. *5+5*