BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

01551

Term-End Examination

December, 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 are the conditions for validity of lumped capacitance method ? 5

(b) Determine the heat transfer rate from the rectangular fin of length 20 cm, width 40 cm and thickness 2 cm. The tip of the fin is not insulated and the fin has a thermal conductivity of 150 w/m.K. The base temperature is 100°C and the fluid is at 20°C. The Heat transfer co-efficient between the fin and the fluid is 30 $w/m^2.K$. 5

2. (a) What is meant by condensation ? Explain the classification of condensers. 5

(b) Explain the mass transfer process with at least 5 examples. 5

3. (a) Brief about the following : 6

(i) Radiosity

(ii) Spectral Intensity and

(iii) Emission

(b) Determine the view factor F_{12} and F_{21} for the following geometries 4

(i) Sphere of diameter D, inside a cubical box of length L = D.

(ii) Diagonal partition within a long square duct.

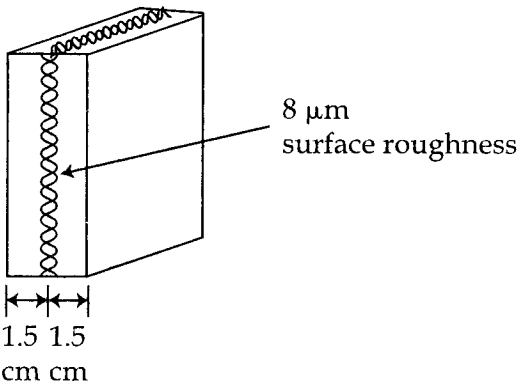
4. (a) What is the friction factor for flow in a tube related to the pressure drop ? 4

(b) Air at 20°C and 1 atm flows over a flat plate at 40 m/s. The plate is 80 cm long and is maintained at 60°C. Assuming unit depth in Z-direction, calculate the heat transfer rate from the plate. 6

Properties of air at 40°C are : Pr = 0.7
K = 0.02723 w/mK, Cp = 1.007 KJ/KgK and $\mu = 1.906 \times 10^{-5}$ kg/ms.

5. (a) Explain about 'Rothemule Heat Exchanger' with diagram. 5

(b) Two large Aluminium plates (K = 250 w/mK) each 3 cm thick, with 8 μm surface roughness are placed in contact under 10^5 N/m^2 pressure in air as shown in figure 5



The temperature at the outside surface are 420°C and 450°C. Calculate

(i) The heat flux

(ii) The temperature drop due to the contact resistance.

(Given $R_i = 2.65 \times 10^{-4}$ m^2K/w)

6. (a) What is Henry's constant ? How do you find Henry's constant for gases ? 5

(b) What do you understand by surface property ? How does radiation varies with surface properties ? 5

7. (a) Steel ball bearings ($K = 50$ w/m, $\alpha = 1.3 \times 10^{-5}$ m^2/s) having a diameter of 40 mm are heated to a temperature of 650°C and then quenched in a tank of oil at 55°C. 6

If the heat transfer coefficient between the ball bearings and oil is 300 w/m^2 K. Determine

(i) the duration of time the bearings must remain in oil to reach a temperature of 200°C

(ii) the total amount of heat removed from each bearing during this time.

(b) What do you mean by a semi-infinite solid ? What is its speciality ? 4

8. (a) Why counter flow heat exchanger is preferred to a parallel flow exchanger ? 5

(b) Explain the classification of Steam Boilers. 5

9. (a) Explain briefly the types of separation processes. 5

(b) A counter flow shell and Tube heat exchanger is used to heat water at a rate of $m = 0.8$ kg/s from $T_i = 20°C$ to $T_O = 80°C$, with hot oil entering at 120°C and leaving at 85°C. The overall heat transfer co-efficient is $U = 125$ $w/(m^2.°C)$. Calculate the heat transfer area required. 5

10. (a) The quantity of radiation received by earth from the sun is 1.4 kw/m^2 (solar constant). Assuming that sun is an ideal radiator. Calculate the surface temperature of the sun. The ratio of the radius of earth's orbit to the radius of the Sun is 216. 6

(b) Write about the following : 4

(i) Eddy Viscosity and Kinematic Viscosity.

(ii) Laminar and Turbulant Boundary layer.