Seat No.

CBI1324

* 2 6 3 0 *

Heat & Mass Transfer (New)
(1010)

P. Pages : 3

Time : Three Hours

Max. Marks : 100

Instructions to Candidates :
1. Do not write anything on question paper except Seat No.
2. Answersheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory. Solve **any two** bits from (a, b, c).
5. Use of non-programmable calculator, steam table and heat transfer data book is allowed.
6. Neat diagrams must be drawn, if necessary.
7. Assume suitable data, if necessary.

UNIT - I

1. a) State Fourier's law of heat conduction. Define thermal conductivity and give its significance. **10**

b) A plane wall of thickness 0.2m and thermal conductivity of 25w/m°k having uniform volumetric heat generation of $0.3 mw/m^3$ is insulated on one side while other side is exposed to a fluid at 92°C. The convective heat transfer coefficient between plane wall and the fluid is $500 w/m^2$-k. Determine the maximum temperature in the wall. **10**

c) Derive an expression for heat conduction through hollow and composite cylinders. **10**

UNIT - II

2. a) i) Define fin efficiency and fin effectiveness. **4**

ii) Calculate the amount of energy required to solder together two very long pieces of base copper wire 1.5mm in diameter with solder that melts at 190°C. The wires are positioned vertically in air at 20°C. Assume that the heat transfer coefficient on the wire surface is $20 w/m^2$-°C and thermal conductivity of wire alloy is 330 w/m -°C. **6**

CBI1324

b) Calculate the following quantities for an industrial furnace (black body) emitting radiations at 2650°C. **10**

i) Spectral emissive power at $\lambda = 1.2\mu m$.

ii) Wavelength at which the emissive power is maximum.

iii) Maximum spectral emissive power.

iv) Total emissive power.

v) Total emissive power of the furnace, if it is treated as a gray and diffuse body with an emissivity of 0.9.

c) Define the following terms - **10**

i) View factor

ii) Emissivity

iii) Radiosity

iv) Irradiation

v) Gray body.

UNIT - III

3. a) Define and explain the significance of following terms - **10**

i) Prandtl number,

ii) Nusselt Number,

iii) Reynolds Number,

iv) Grashoff's Number,

v) Stanton Number.

b) Prove that $N_u = f(R_e, P_r)$ with the help of dimensional analysis. **10**

c) i) Prove that for a fluid for which $P_r = 1$ the stanton number S_t equals to one half of the skin friction coefficient for turbulent flow over flat plate. **4**

ii) Explain the term critical heat flux and principle of boiling phenomenon. **6**

UNIT - IV

4. a) i) Derive an expression of LMTD for counter flow heat exchanger. **8**

ii) Explain fouling factor. **2**

b) The flow rates of hot and cold water streams running through a parallel flow heat exchanger are 0.2kg/s and 0.5kg/s respectively. The inlet temperatures on the hot and cold sides are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. If the individual heat transfer coefficients on both sides are $650 w/m^2$- °C. Calculate the area of the heat exchanger. **10**

c) Explain NTU method in case of heat exchangers and define heat capacity ratio. **10**

CBI1324

UNIT - V

5. a) Compare Newton's law of viscosity, Fourier law of heat conduction and Fick's law of diffusion. **10**

b) A tray 50cm wide is full of water. Air at 30°C flows over the tray along the length at 2m/s. The moving air is at 1.013 bar and the partial pressure of water in the air is 0.007 bar.
Calculate the rate of evaporation. If the temperature of water is 25°C. Take for air $\rho = 1.2 kg/m^3$, $\gamma = 1.5 \times 10^{-6} m^2/s$, $P_s = 3.169 kpa$,
$D_{AB} = 0.145 m^3/n$, $\rho_s = 0.0231 kg/m^3$. **10**

c) Using dimensional analysis for forced convection mass transfer prove that
$Sh = f(R_e, S_c)$
where Sh = Sherwood number.
Sc = Schmidt number. **10**

****