sem V / mech / 16-06-10 / Heat & mass Transfer.

P4-Con No-56

Con. 3761-10. **(REVISED COURSE)** **AN-4168**

(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** out of remaining **six**.
(3) Make **suitable** assumption, if **necessary**.

1. **Solve any Five :-** **20**

a) Two pin fins are identical except that the diameter of one is twice that of other. For which fin will (i) Fin Effectiveness (ii) Fin Efficiency be higher?

b) What is lump system analysis? What are the assumptions made in the lumped system analysis and when is it applicable?

c) Differentiate between the mechanism of filmwise and dropwise condensation.

d) Classify the Heat Exchangers.

e) Explain Hydrodynamic and Thermal Boundary Layer.

f) State & Explain Kirchoffs law.

2. **a)** Derive an expression for heat transfer rate and Overall heat transfer coefficient for composite cylinder (Two Layers). **10**

b) It is required to heat the oil to 300^0C for frying purpose. A long ladle is used in frying pan. The section of the ladle is 5mm x18mm. The surrounding air is at 30^0C. The thermal conductivity of the material is 205 W/mK. If the temperature at a distance of 380 mm from the oil should not exceed 40^0 C, Determine convective heat transfer coefficient. **10**

3. **a)** In a counter flow heat exchanger capacity flow rate of hot fluid is less than that of cold fluid. Derive an expression for the effectiveness of heat exchanger in terms of the fractional ratio of capacity flow rate and the Number of transfer Units. **10**

b) A solid cylinder, 100 mm in diameter generating heat at a uniform rate of $7x10^6$ W/m^3. The thermal conductivity of solid is 190 W/mK and its surface temperature is maintained at 100^c C. Calculate **10**

i) Temperature at the center of cylinder.

ii) Temperature at the distance 25 mm from the center.

iii) Temperature gradient at 25 mm radius.

iv) Heat flux at the surface.

4. **a)** Write short note on any two of the following :- **20**

i) Heisler Charts.

ii) Boiling curves and various regimes of boiling.

iii) Heat Pipe.

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b) A wall 30 cm thick of size 5 m x 3 m made of red bricks (k = 0.35 w/m.k). It is covered on both sides by the layers of plaster 2 cm thick(k=0.6 W/m.k). The wall has a window of size 1 m x 2 m. The window door is made of glass, 12mm thick having thermal conductivity 1.2 W/m.K. Estimate the rate of heat flow through the wall. Inner and outer surface temperatures are 10^0C and 40^0 C, respectively. **10**

5. a) Explain Shape factor & its properties. Find the shape factor of a cylindrical cavity of diameter D and depth H w.r.t. itself. **7**

b) Assuming a man as a cylinder of 40 cm diameter and 1.72 m high with a surface temperature of 37^0C. Calculate the heat lost from its body, while standing in wind flowing at 20 km per hour at 17^0C. Use the relation: $Nu_d = 0.027\ Re_d^{0.805}\ Pr^{1/3}$. **8**

The properties of air at 27^0 C are

$\mu = 184.6 \times 10^{-7}$ Ns /m^2, $K_f = 0.0263$ W/m.k, Pr = 0.707, $\varsigma = 1.1614$ Kg/m^3, Cp = 1.007 KJ/ Kg K

c) Calculate the net radiant heat interchange per m^2 for two large parallel plates maintained at 800^0C and 300^0C.The emissivities of two plates are 0.3 and 0.6, respectively. **5**

6. a) For transit conduction, with negligible internal resistance, with usual notations, show that: **7**

$\frac{\theta}{\theta_0} = \exp\left(-B_i . F_o\right)$ Also state the significations of 'B_i' and 'F_o

b) Hot water at 2.5 kg/s and 100^0C enters a concentric tube counter flow heat exchanger having a total area of 23 m^2. Cold water at 20^0 C enters at 5.0 kg/s and the overall heat transfer coefficient is 1000 W/m^2. K. Determine the total heat transfer rate and the outlet temperature of hot and cold fluids. **8**

c) Distinguish between Specular and diffuse radiation. **5**

7. a) Explain Equimolal counter diffusion. State and explain Fick's law of diffusion & Compare it with Fourier's law of conduction. **6**

b) Estimate the heat transfer rate from a 100 W incandescent bulb at 140^0C to an ambient at 24^0C. Approximate the bulb as 60 mm diameter sphere. Calculate the percentage of power lost by natural convection. Use following correlation and air properties: **8**

$N_u = 0.60\ (Gr\ Pr)^{1/4}$

The properties of air at 82^0 C are

$\nu = 21.46 \times 10^{-6}$ m^2 /s, $K_f = 30.38 \times 10^{-3}$ W/m.k, Pr = 0.699

c) Temp Profile for Parallel flow, Counter Flow, Condenser & Evaporater. **6**
