Oct-22 /TE/Insem-574
T.E. (Mechanical /MechanicalSandwich)
HEAT AND MASS TRANSFER
(2019 Pattern) (Semester-I) (302042)

*Time : 1 Hour]*   *[Max. Marks : 30*

Instructions to the candidates:

1) *Solve Q.1 or Q.2, Q.3 or Q.4*
2) *Draw neat diagram wherever necessary.*
3) *Use of scientific calculator is allowed.*
4) *Assume suitable data if necessary.*
5) *Figures to the right indicate full marks.*

Q1) a)   Formulate following composite slab conduction system and equivalent electricla circuit. Let A be cross section area and surface area of composite area.   **[5]**
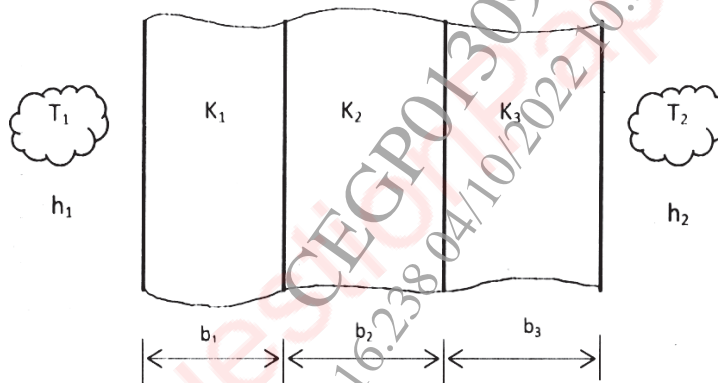
b)   Compare Heat by Conduction and Heat by Convection.   **[4]**

c)   A steel tube fo 5cm inner diameter and 8cm outer diameter (k=16W/mK), is covered with an insulation of 3cm thickness (k=0.3 W/mK). A hot gas at 350°C with h=400 W/m²K flows inside the tube. outer surface of the insulation is exposed to air at 30°C with h=60 W/m²K. Calculate the heat loss from the tube for 20 meter lenght.**[6]**

OR

Q2) a) Write differential equation of heat conduction in Cartesian co-ordinates and reduce it to Fourier's Equation and Unidirectional Poission's Equation. **[4]**

b) A plate having a thickness of 0.4cm has an internal heat generation of 200 MW/m^3 and a thermal conductivity of 25 W/mK. One side of the plate is insulated and the other side is maintained of 100°C. Calculate maximum temperature in the plate. What is the temperature at the centre of plate?

[7]

c) Explain the Temperature boundary condition and heat flux boundary condition with example. **[4]**

Q3) a) Write the equation for finding critical radius of cylindrical and spherical object. Why critical thickness is not significance in case of slab. **[5]**

b) Derive an expression for Heat flow rate and efficiency of an infinitely long fin. **[8]**

c) Enlist the applications of extended surfaces. **[2]**

OR

Q4) a) A cylindrical rod of 2cm diameter & 25cm long extended from a insulated steam vessel at 100°C in air at 30 °C. The free end of the rod is insulated. Determine the temperature at free end if rod is made of. **[7]**

i) Copper, K=330 W/mK

ii) Steel, K=49 W/mK

calculate heat transfer in each cases. Take h = 7W/m^{2}K. Also comment on result.

b) The purchase department of power plant is planning to purchase insulation for covering steam carrying pipe. The total insulation cost $25,000 and would have life of 10 years with zero salvage value. The expected annual cash inflow of the insulation is $10,000. Compute payback period of insulation and conclude whether or not the insulation would be purchased if the maximum desired payback period is 3 years. **[6]**

c) Explain the significance of Biot Number. **[2]**

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