Code No: **R32033** **R10** **Set No. 1**

III B.Tech II Semester Supplementary Examinations, November – 2017

HEAT TRANSFER

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks
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1 a) Explain the scope of the study of heat transfer. [7M]

b) A solar panel, 1 m x 1.25m receives solar radiation 1500 watts, Calculate surface temperature of the panel if the ambient temperature is 25^0C and the convective heat transfer coefficient of the air film over the surface of panel is 12.5W/m^2-^{0}C. [8M]

2 a) A brick wall 25 cm thick is faced with concrete of 5 cm thick. The thermal conductivity of the brick is 0.7 W/mK while that of the concrete is 0.9 W/mK. If the temperature of the exposed brick face is 30^0C and that of the concrete is 5^0C, find the heat loss per hour through a wall of 10 × 5m. [8M]

b) Aluminum fins of rectangular profile are attached on a plane wall with 5 mm spacing. The fins have thickness 1 mm, length = 10 mm and the normal conductivity K = 200 W/mk. The wall is maintained at a temperature of 200^0C and the fins dissipate heat by convection into ambient air at 40^0C, with heat transfer coefficient = 50 W/m^2k. Find the heat loss. [7M]

3 a) A long 20cm diameter cylindrical shaft made of stainless steel 304 comes out of an oven at a uniform temperature of 600^0C. The shaft is then allowed to cool slowly in an environment chamber at 200^0C with an average heat transfer coefficient of h = 80 W/m^2 ^{0}C. Determine the temperature at the centre of the shaft 45 min. after the start of the cooling process. Also, determine the heat transfer per unit length of the shaft during this time period. [9M]

b) Explain the significance of Heisler charts in solving transient conduction problems. [6M]

4 a) Show by dimensional analysis that data for convection may be correlated by an equation of the form: Nu= φ (Re, Gr, Pr)where Nu is Nusselts Number, Re is Reynolds number, pr is Prandtl Number and Gr is Grashoft Number. [8M]

b) Define and explain the significance of dimension less numbers. [7M]

5 a) A vertical plate at 100^0C is 1 m wide and 20 cm high. It rests in still air at 1 atm and 20^0C. Determine the local heat transfer coefficient at 10 cm from the leading edge of the plate. The properties of the air at film temperature may be taken as: [8M]
Thermal conductivity is 0.03 W/(m.K)
Viscosity is 2.03× 10^{-5} PaS
Density is 1.00 kg/m^3.
Specific heat 1.01 kJ/(kg.K)

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b) Crude oil at 160^0C is flowing through a 0.075 m diameter tube at the rate of 1600 kg/h. The pipe is 20m long and its surface temperature is maintained at a temperature of 100^0C. The properties of oil are: [7M]
Thermal conductivity is 0.1163 W/m^{0}K
Kinematic viscosity is 5×10^{-6} m^2/s
Density is 800 kg/m^3
Pr = 80
μ at 100^0C = 4×10^{-3} kg/m.s
μ at 100^0C = 8.9×10^{-3} kg/m.s

6 a) A heated polished copper plate is immersed in a pool of water boiling at atmospheric pressure. If the surface of the copper plate is maintained at a temperature of 125^0C, find the surface heat flux and the evaporation rate per unit area of the plate. [8M]

b) Discuss briefly about Film wise and drop wise condensation. [7M]

7 a) Hot oil (Cp=5.2 kJ/kg.k) with a capacity rate of 2800 Kg/min flows through a double pipe heat exchanger. It enters at 380°C and leaves at 300°C. Cold oil (Cp = 4.8 kJ/kgk) enters at 30°C and leaves at 200°C. If the overall heat transfer coefficient is 1000 W/m^{2}K, determine the heat transfer area required for [8M]
i. Parallel flow and
ii. Counter flow

b) Give comparison of parallel flow and counter flow heat exchangers. Why are counter flow heat exchangers mostly used? [7M]

8 a) Two equal discs of diameter 200 mm each are arranged in two parallel planes 400 m apart. The temperature of the first disc is 500°C and that of the second disc is 300°C. Determine the radiating heat flux between them, if these are [8M]
i. Black
ii. Gray with emissivities 0.3 and 0.5 respectively.

b) What are the factors that influence the radiant heat exchange between two bodies? [7M]

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