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

III B.Tech II Semester Supplementary Examinations, Dec - 2015

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) Derive the one-dimensional, steady state heat conduction equation with internal heat generation by writing the energy balance for a differential equation. [10]

b) Estimate the loss of heat through a red brick wall of length 5 m, height 4m and thickness 0.25 m, if the temperature of the wall surface are maintained at 110^0C and 40^0C respectively, k for red brick is equal to 0.70 W/mK. [5]

2 A heating unit is made in the form of a 1.2 m long,6 cm diameter cylinder is placed in an atmosphere of 18^0C. It is provided with 20 longitudinal straight fins 0.3 cm thick which produce 50 mm from the cylinder surface. The temperature of the base of the fins is 80^0C.The local heat transfer coefficient from the cylinder and fins to the ambient air are 9.3 W/m^2K and the thermal conductivity of the tube wall is 55.7W/mK. Calculate the rate of heat transfer from the finned wall to the surroundings. [15]

3 a) What are Heisler charts? Explain their significance in solving transient conduction problem. [7]

b) A mercury thermometer 0.3 cm diameter is used for measuring transient temperature of an air stream for which h=57W/m^2K. Calculate the time required for the temperature change to reach half its final value. For mercury k=8.9 W/mK, $\alpha=16.6x10^{-3}m^2/h$. [8]

4 a) What are the uses of dimensional analysis? [5]

b) In a straight tube of 60 mm diameter, water is flowing at a velocity of 12 m/s. The tube surface temperature is maintained at 70^0C and the flowing water is heated from the inlet temperature 15^0C to an outlet temperature of 45^0C.taking the physical properties of water at mean bulk temperature, calculate the following: [10]
(i) The heat transfer coefficient from the tube surface to water (ii) The heat transferred and (iii) the length of the tube.

5 a) Discuss briefly the effect of turbulence on boundary layers. [5]

b) Air at a temperature of 300^0C flows with a velocity of 10m/s over a flat plate of length 0.5 cm. Compute the cooling rate per unit width of the plate needed to maintain it at a surface temperature of 27^0C.Take the following properties of air at 437K: $Y=5.21x10^{-4}m^2/s$, k=0.0364W/mK. [10]

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6 a) Show that the average heat transfer coefficient for condensation on a vertical plate is 4/3 times its local value at the end of the plate. [7]

b) A heated polished copper plate is immersed in a pool of water boiling at atmospheric pressure. If the surface temperature of the copper plate is maintained at a temperature of 113^0C, determine the surface heat flux and the evaporation rate per unit area of the plate. [8]

7 a) Why is a counter flow heat exchanger more effective than a parallel flow exchanger? [5]

b) Water at the rate of 4080kg/h is heated from 35^0C to 75^0C by oil having a specific heat of 1900J/Kg K. The exchanger is of a counter flow double pipe design. The oil enters at 110^0C and leaves at 75^0C.determine the area of the heat exchanger necessary to handle this load if the overall heat transfer coefficient is 320W/m^2K. [10]

8 a) Explain in brief the concept of a black body. [5]

b) A 60 mm thick plate with a circular hole of 30 mm diameter along the thickness is maintained at uniform temperature of 277^0C. Find the loss of energy to the surroundings at 20^0C, assuming that the two ends of the hole to be as parallel discs and the metallic surfaces and surroundings have black body characteristics. [10]