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

III B.Tech II Semester Supplementary Examinations, April -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 different modes of heat transfer with neat sketches. Write down the basic laws of heat transfer [5M]

b) Derive the one-dimensional, steady state heat conduction equation with internal heat generation by writing the energy balance for a differential equation volume element in cylindrical coordinate system [10M]

2 A furnace wall is made up of three layers of thicknesses 250mm,100mm and 150 mm with thermal conductivities of 1.65,k and 9.2 W/m^{0}C respectively. The inside is exposed to gases at 1250^{0}C with a convection coefficient of 25W/m^2 ^{0}C and the inside surface is at 1100^{0}C, the outside surface is exposed air at 25^{0}C with convection coefficient of 12W/m^2 ^{0}C. Determine [15M]

(i) The unknown thermal conductivity k

(ii) The overall heat transfer coefficient

(iii) All surface temperatures

3 a) What are Biot and Fourier's numbers? Explain their significance [5M]

b) An aluminum sphere weighing 7 kg and initially at a temperature of 260^{0}C is suddenly immersed in a fluid at 10^{0}C.If h=50W/m^{2}k, compute the time required to cool the sphere to 90^{0}C. [10M]
For aluminium: ρ=2707kg/m^3,c=9000 J/kg^{0}C,k=204W/m^{0}C

4 a) Distinguish between natural and forced convection heat transfer [5M]

b) The surface temperature of the steel wall (k=53.6W/mK)0.3 thick are maintained at 100^{0}C and 40^{0}C.water at a temperature of T_α=20^{0}C flows over the surface at 40^{0}C.Calculate the convection coefficient associated with the water flow. [10M]

5 Air flows through a long rectangular (30cm heightx60 cm width) air conditioning duct maintains the outer duct surface temperature at 15^{0}C.If the duct is insulated and exposed to air at 25^{0}C,calculate the heat gained by the duct per meter length, assuming it to n=be horizontal [15M]

6 a) Distinguish between film wise and drop wise condensation. Which of the two does give a higher heat transfer coefficient? Why? [5M]

b) A vertical tube 12.5 mm diameter and 1.7 m long is used for condensing steam at 0.4 bar. The tube surface temperature is maintained at 54^{0}C. Determine the average heat transfer coefficient in condensation. What would be the value of the heat transfer coefficient if the plate were held in horizontal position? [10M]

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7 a) When is the LMTD method is most suitable for heat exchanger design calculations [5M]

b) In a shell and tube heat exchanger with 8 tube passes through a shell, hot engine oil available at 160^0C flows through the shell and water through the tubes. Water at the rate of 2.5Kg/s is heated from 15^0C to 85^0C and there are ten tubes per pass. The diameter of each tube is 2.5 cm and the average convection coefficient h_0=400W/m^2K.Determine the flow rate of oil if its exit temperature is to be 100^0C.Also compute the length of the tubes [10M]

8 a) Define the terms absorptivity, reflectivity and tranmissivity [5M]

b) A long steel rod of 2 cm diameter (ε=0.6) is to be heated from 400^0C to 500^0C.For this purpose it is placed concentrically in a long cylindrical furnace having an inside diameter of 16 cm. The inside surface of the surface is at the temperature of 1100^0C and an emissivity of 0.85.Find the time required for the heating operation. The density of the steel is 5700kg/m^3 and its specific heat is 0.486KJ/kgK. [10M]

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