Code No: 156BC

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, August/September - 2021

HEAT TRANSFER

(Mechanical Engineering)

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

Answer any five questions

All questions carry equal marks

1.a) What is the significance of different modes of heat transfer? Explain with suitable examples.

b) A certain building wall consists of 0.25 m of concrete (k = 1.8 W/m K), 0.05 m of fiber glass insulation and 15 mm of gypsum board (k = 0.03 W/m K). The inside and outside convection coefficient is 15 W/m^2 K and 40 W/m^2 K respectively. The outside air temperature is – 8 ^{0}C and the inside temperature is 28 ^{0}C. Calculate the overall heat transfer coefficient for the wall, the R value, and the heat loss per area. [8+7]

2.a) Explain the need of boundary conditions in solving heat conduction problems? Discuss different types of boundary conditions.

b) A long hollow cylinder has its inner and outer surfaces maintained at temperatures T_b and T_a respectively. The inner and outer radii are b and a respectively. Calculate the temperature profile in the solid section of the cylinder and determine the flux at both surfaces. Assume steady state condition. [7+8]

3. A hair dryer may be idealized as a circular duct through which a small fan draws ambient air and within which the air is heated as it flows over a coiled electric resistance wire. If a dryer is designed to operate with an electric power consumption of 1000 W and to heat the air from an ambient temperature of 25^{0}C to a discharge temperature of 50^{0}C, at what volumetric flow rate should the fan operate? Heat loss from the casing to the ambient air and the surroundings may be neglected. If the duct has a diameter of 75 mm, what is the discharge velocity of the air? The density and specific heat of the air is 1.1089 kg/m^3 and 1005 J/kg K. [15]

4. A brass rod in the form of a fin 100 mm long and 5 mm in diameter extends horizontally from a casting which is at 200^{0}C. The air temperature is 20^{0}C and provides a heat transfer coefficient of 30 W/m^2-K. What is the heat transfer from the rod? Evaluate the temperature of the rod at 50 mm from the base and at the free tip. Now, if this fin is replaced by two identical fins of 50 mm length. All other parameters and dimensions remain the same. What is the heat transfer from this combination? Evaluate the temperature of the fin at the tip. [15]

5.a) Under what conditioning a small mass can be considered as lumped body for unsteady state condition? Explain.

b) Engine oil at 40^{0}C flows with a velocity of 1 m/s over a 2 m long plate plate whose surface is maintained at uniform temperature of 80^{0}C. Determine the local and average heat transfer coefficients. [8+7]

6.a) A horizontal fluorescent tube which is 3.8 cm in diameter and 120 cm long stands in still air at 1 atm. and 20^0C. If the surface temperature of the tube is 40^0C and radiation is neglected, what percentage of power is being dissipated by convection? Take properties of air as $\nu = 16.19 \times 10^{-6}$ m^2/sec., K air = 0.02652 W/m K, Pr = 0.706, $\rho = 1.02$ kg/m^3, $C_p = 1.004$ kJ/kg K

b) Explain with neat sketch development of velocity boundary layer on hot and cold vertical plate subjected to Natural Convection. [8+7]

7.a) Discuss the different processes of condensation of vapour on solid surface with suitable diagrams.

b) In an oil cooler, oil enters at 160^0C. If water entering at 35^0C flows parallel to oil, the exit temperature of oil and water are 90^0C and 70^0C respectively. Determine the exit temperature of oil and water if the two fluids flow in opposite directions. Assume that the flow rates of the two fluids and U_o remain unaltered. What would be the minimum temperature to which oil could be cooled in parallel flow and counter-flow operations? [8+7]

8.a) What is a gray body? How does its emissivity value will vary for the real surface?

b) An enclosure measures 1.5 m × 1.7 m with a height of 2 m. The walls and ceiling are maintained at 250^0C and the floor at 130^0C. The walls and ceiling have an emissivity of 0.82 and the floor 0.7. Determine the net radiation to the floor. [8+7]

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