Code No. 6177 / O

FACULTY OF ENGINEERING

B. E. 3/4 (Mech.) II-Semester (**Old**) Examination, December 2009 / Jan., 2010

Subject : **Heat Transfer**

Time : 3 Hours

Max. Marks: 75

Note: Answer all questions of Part-A and any **Five** questions from Part-B.
Heat Transfer charts / tables are permitted.
Assume suitable data if required.

Part – A (25 Marks)

1. What is Conduction heat transfer? How does it differ from the Convective heat transfer? 3

2. State some essential features of Fourier's Law. 3

3. Define fin efficiency and fin effectiveness. 2

4. What is meant by lumped capacity? 2

5. What is dimensional analysis? What are dimension less numbers? 3

6. Define the terms Boundary layer thickness and energy thickness. 2

7. Define the terms Radiation and irradiation. 2

8. State Kirchoff's Law and Plank's Law of radiation. 2

9. Distinguish between Recuperators and Regenerators. 3

10. Enumerate the applications of boiling heat transfer. 3

Part – B (5 x 10 = 50 Marks)

11. An exterior wall of a house may be approximated by a 0.1m layer of common brick (K = 0.7 W/m ^{0}C) followed by a 0.04m layer of Gypsum plaster (K = 0.48 W/m ^{0}C). What thickness of loosely packed rock wool insulation (K = 0.065 W/m ^{0}C) should be added to reduce the heat loss or (gain) through the wall by 80 percent?

12. A 3 mm diameter stainless steel wire (K=20 W/m K, resistivity $\rho=10\times10^{-8}$ Ωm) 100 meter long has a voltage of 100 V impressed on it. The outer surface of the wire is maintained at 100^0 C. Calculate the centre temperature of the wire. If the heated wire is submerged in a fluid maintained at 50^0 C, find the heat transfer coefficient on the surface of the wire.

13. A solid Copper sphere of 10 cm diameter (ρ = 8954 kg/m^3; C_P = 383 j/kg K; K = 386 W/m K), initially at a uniform temperature t_i = 250^0 C, is suddenly immersed in wellstirred fluid which is maintained at a uniform temperature t_a = 50^0 C. The heat transfer coefficient between the sphere and the fluid is h = 200 W/m K. Determine the temperature of the Copper block at T= 5 min after the immersion.

14. Air at atmospheric pressure and 2000C flows over a plate with a velocity of 5 m/s. The plate is 15 mm wide and is maintained at a temperature of 120° C. Calculate the thickness of hydrodynamic and thermal boundary Layers and the local heat transfer coefficient at a distance of 0.5 m from the leading edge. Assume that flow is on one side of the plate. $\rho = 0.815$ kg/m^3 ; $\mu - 24.5 \times 10^{-6}$ Ns/m^2 ; Pr = 0.7 ; K = 0.0364 W/m K.

15. An electric heating system is installed in the ceiling of a room 5m (length) x 5m (width) x 2.5m (height). The temperature of the celing is 315 K where as under equilibrium conditions the walls are at 295 K. If the floor is non-sensitive to radiations and the emissivities of the celing and wall are 0.75 and 0.65 respectivley, calculate the radiant heat loss from the celing to the walls.

16. Water at the rate of 0.5 kg/s is forced through a smooth 25 mm ID tube of 15 m length. The inlet water temperature is 10° C and the tube wall is at a constant temperature of 40° C. What is the exit water temperature?

17. Vertical flate plate in the form of a fin is 600 mm in height and is exposed to steam at atmospheric pressure. If surface of the plate is maintained at 60° C, calculate the following :
    i) The film thickness at the trailing edge of the pin.
    ii) The overall heat transfer coefficient
    iii) The heat transfer rate, and
    iv) The condensate mass flow rate
    v) The condensate mass flow rate

    Assume Laminar flow conditions and unit width of the plate.

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