Code: 15A03603 **R15**

B.Tech III Year II Semester (R15) Supplementary Examinations December/January 2018/19

HEAT TRANSFER

(Mechanical Engineering)

Use of heat transfer data book is allowed.

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Write the expression for overall heat transfer coefficient for composite wall with two different materials subjected to convection on both sides.

(b) Write different types of boundary conditions.

(c) Define fin efficiency. Write expression for fin efficiency for a fin with insulated tip.

(d) Write significance of Heisler charts in transient heat conduction.

(e) Write conservative form of energy equation.

(f) Define Prandtl number and Grashof number.

(g) Write different stages in a pool boiling.

(h) Counter flow heat exchanger is having higher effectiveness than the parallel flow heat exchanger. Justify.

(i) What is Wien's displacement law?

(j) What is shape resistance and surface resistance in a radiation heat transfer between two surfaces?

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 Derive the generalized three dimensional heat conduction equation in cylindrical coordinates. Reduce it into one dimensional steady state equation.

OR

3 The exposed surface ($x = 0$) of a plane wall of a thermal conductivity K is subjected to microwave radiation that causes volumetric heating to vary as:

$$\dot{q}(x) = \dot{q}_0 \left[1 - \frac{x}{L}\right]$$

where $\dot{q}_0$ (w/m^3) is a constant. The boundary at $x = L$ is perfectly insulated, while the exposed surface is maintained at a constant temperature T_0. Determine the temperature distribution $T(x)$ in terms of $x, h, K, \dot{q}_0$ and T_0.

UNIT – II

4 Derive the one dimensional heat conduction generalized equation for a rectangular fin. Consider fin base is at a temperature T_b and convection coefficient with surroundings fluid is h_∞. Reduce it to know the temperature distribution when the fin is assumed as long fin with infinite length.

OR

5 Carbon steel (AISI 1010) shafts of 0.12 m diameter are heat treated in a gas fired furnace whose gases are at 1250 K and provide a convection coefficient of 104 W/m^{2}K. If the shafts enter the furnace at 305 K, how long must they remain in the furnace to achieve a centre line temperature of 810 K.

Contd. in page 2

UNIT – III

6 Engine oil at a rate of 0.025 kg/s flows through a 4 mm diameter tube of 24 m long. The oil has an inlet temperature of 65℃, while the tube wall temperature is maintained at 100℃ by steam condensing on its surface: (i) Estimate the average heat transfer coefficient for internal flow of the oil. (ii) Determine outlet temperature of oil.

OR

7 Determine the average convection heat transfer coefficient for the 2.5 m high vertical walls of home having respective interior air and wall surface temperature of: (i) 20 and 10℃. (ii) 30 and 38℃.

UNIT – IV

8 Explain the different regions of pool boiling with neat diagram.

OR

9 A shell and tube exchanger (two shells, four tube passes) is used to heat 10,400 kg/h of pressurized water from 30℃ to 118℃ with 5100 kg/h water entering the exchanger at 290℃. If the overall heat transfer coefficient is 1540 W/m^{2}K, calculate the required heat transfer area.

UNIT – V

10 A long, thin walled horizontal tube 94 mm in diameter is maintained at 118℃ by the passage of steam through its interior. A radiation shield is installed around the tube, providing an air gap of 10 mm between the tube and shield and reaches a surface temperature of 32℃. The tube and shield are diffuse, grapy surfaces with emissivities of 0.82 and 0.14 respectively. Calculate the radiant heat transfer from the tube per unit length.

OR

11 Explain the following:

(a) Plank distribution law.

(b) Absorptivity, reflectivity and transmissivity.

(c) Emissivity.

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