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SBS - B.Tech. (Mechanical Engg.) (Sem–5)

HEAT TRANSFER

Subject Code : BTME-501-18

M.Code : 78247

Date of Examination : 08-06-2023

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. Write briefly :

a) Define thermal diffusivity and explain its physical significance.

b) Why is there negative sign in Fourier's law of heat conduction?

c) What is the boundary condition for a fin loosing heat at the tip?

d) What are assumptions made in lumped capacity analysis?

e) Define the local and average heat transfer coefficients.

f) What is physical significance of Rayleigh's number?

g) Define total hemispherical emissivity.

h) Why dimensionless numbers are used in heat transfer?

i) Differentiate between a black body and a grey body?

j) Differentiate between pool boiling and forced convection boiling.

SECTION-B

2. A spherical shaped orange ($k = 0.25\ W/m - K$), 90 mm diameter undergoes a ripening process and generates $5100\ W/m^3$ of energy. If the external surface of the orange is 8°C, calculate

a) The temperature at the centre of orange

b) Heat flow from the outer surface of the orange.

3. Derive an expression for temperature distribution and heat transfer from rectangular fin when the tip of the fin is insulated.

4. Experimental results for heat transfer over a flat plate with an extremely rough surface were found to be correlated by an expression of the form :

$$Nu_x = 0.04\ Re^{0.9} Pr^{0.33}$$

Where Nu_x is the local value of the Nusselt number at a position x measured from the leading edge of the plate. Derive an expression for ratio of average heat transfer coefficient to local heat transfer coefficient h*x*.

5. Explain the Pool boiling curve based on Nukiyama experiment in details.

6. Derive the expression of LMTD for a parallel flow heat exchanger.

SECTION-C

7. a) Show that

$$F_{12} = \frac{1}{1/\epsilon_1 + 1/\epsilon_2 + 1}$$

b) What do you mean by radiation shield? Where it is used Show that

$$\left(\frac{Q}{A}\right)_{with\ N\ sheilds} = \frac{1}{N+1}\left(\frac{Q}{A}\right)_{with\ sheilds}$$

8. Water is heated while flowing through a 1.5 × 3.5 cm rectangular cross-section tube at a velocity of 1.2 *m/s*. The water enters at 40°C and tube is maintained at 85°C. Determine the length of the tube required to raise the temperature of the water by 30°C. Take the following properties of water : $\rho = 985.5\ kg/m^3, k = 0.653\ W/m - K, v = 0.517 \times 10^{-6} m^2/s,$ $C_p = 4.19\ kj/kg - K$

9. **Write short notes on the followings :**

a) Critical thickness of insulation

b) Mechanism of bubble formation & collapse in pool boiling.

c) Wien's displacement law of radiation and its significance

d) NTU

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.