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B. E. (Sixth Semester) Examination, April-May 2020

(New Scheme)

(Mech. and Automobile Engg. Branch)

HEAT & MASS TRANSFER

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *All questions are compulsory. Attempt any* ***two*** *from (b), (c) and (d). Part (a) is compulsory.*

(i) Steam Table are allowed.

(ii) Heat Transfer data book are allowed.

Unit-I

1. (a) Write any two difference between heat transfer and thermodynamics. 2

(b) A cylindrical cement tube of radii 0.05 cm and 1.0 cm has a wire embedded into it along its axis. To maintain a steady temperature difference of 120°C beween the inner and outer surfaces, a current of 5 ampere is made to flow in the wire. Make calculations for the amount of heat generated per metre length and the thermal conductivity of cement. Take resistance of wire equal to 0·1 ohm per cm of length. 7

(c) Derive a general heat conduction equation in cylindrical coordinates system for a constant thermal conductivity material. 7

(d) Explain overall heat transfer co-efficient with its importance. 7

Unit-II

2. (a) Define Fins. 2

(b) Derive the Heat Dissipation equation from an infinitely long fin $(l \to \infty)$. 7

(c) A steel rod (K = 30 W/m-deg) 1 cm in diameter and 5 cm long protrudes from a wall which is maintained at 100°C. The rod is insulated at its tip

and is exposed to an environment which h = 50 W/m^2-deg and t_a = 30 °C. Calculate the fin efficiency, temperature at the tip of fin and the rate of heat dissipation. 7

(d) Explain general system for unsteady state conduction (Lumped – parameter – analysis). 7

Unit-III

3. (a) Define Natural Convection. 2

(b) Show that the resistance R to the motion of a sphere of diameter D moving with uniform velocity V through a real fluid of density ϱ and viscosity μ is given by :

$$R = \varrho D^2 V^2 f\left(\frac{\mu}{\varrho VD}\right)$$

where f stands for a function of. 7

(c) Define Reyonolds Number, Grashof Number and Prandtl Number with its significance. 7

(d) A spherical heater of 20 cm diameter and its 60 °C is immersed in a tank of water at 20 °C. Determine the value of convective heat transfer coefficient. 7

Unit-IV

4. (a) What is condensation and when does it occur? 2

(b) In the design of condensers, which of two types of condensation is usually selected and why? 7

(c) State and explain different modes of heat transfer. 7

(d) State Fick's law of diffusion. Define various symbols used and give their units. 7

Unit-V

5. (a) List any two salient features of a black body radiation. 2

(b) Explain the term absorptivity, reflectivity and transmissivity of radiant energy. How are they related to each other for a black body and an opaque body? 7

(c) In a food processing plant, a barine solution in heated from $-12°C$ to $-65°C$ in a double pipe parallel flow heat exchanger by water entering at 35 °C and leaving at 20·5°C at the rate of 9 kg/min. Determine the heat exchanger area for an overall

heat transfer coefficient of 860 W/m^2 K. For water $C_p = 4{\cdot}186 \times 10^3$ J/kg K. 7

(d) Hot water having specific heat 4200 J/kgK flows through a heat exchanger at the rate of 4 kg/min with an inlet temperature of 100 °C. A cold fluid having a specific heat 2400 J/kgK flows in at a rate of 8 kg/min and with inlet temperature 20°C. Make calculations for the maximum possible effectiveness if the fluid flow conforms to (a) parallel flow arrangement (b) Counter flow arrangement. 7