Roll No. | | | | | | | | | | | | **Total No. of Pages : 02**

Total No. of Questions : 09

B.Tech. (Agriculture Engineering) (Sem.–1)

HEAT AND MASS TRANSFER

Subject Code : BTAG-107-22

M.Code : 92765

Date of Examination : 27-01-23

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 & C have FOUR questions each.**
3. **Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.**
4. **Select atleast TWO questions from SECTION - B & C.**

SECTION-A

1. Write briefly :

a) Define thermal diffusivity and explain its significance in heat transfer.

b) What is the logarithmic mean area for a hollow cylinder and sphere?

c) Why the heat transfer coefficient for natural convection is much less than that for forced convection?

d) Explain the concept of forced convection heat transfer mechanism.

e) Explain physical significance of Rayleigh number.

f) What do you understand by fouling of heat exchanger?

g) How do you define the emissivity of a body?

h) What is difference between black body and grey body.

i) Define velocity and thermal boundary layers?

j) State the Fick's law of diffusion.

SECTION-B

2. Derive an expression for heat transfer in a solid cylinder with heat generation.

3. 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

$$Nu_x = 0.04\ Re^{0.9}\ Pr^{1/3}$$

Where Nu_x is the local value of 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.

4. A thermocouple is used to measure the temperature of gas flowing through a duct, records, 280°C. If the emissivity of the junction is 0.4 and convection coefficient is 150W/m^2.K. Find the true gas temperature. The duct wall temperature is 140°C. What should be the emissivity of the junction in order to reduce the error by 30%?

5. By using dimensional analysis, develop a generalized empirical relation between Nusselt number, Reynolds number and Prandtl number for forced convection heat transfer.

SECTION-C

6. Derive the generalised mass diffusion equation in Cartesian coordinates.

7. The walls of a house, 4 m high, 5 m wide and 0.3 m thick are made from brick with thermal conductivity of 0.9 W/mK. The temperature of air inside the house is 20°C and outside air is at - 10°C. There is a heat transfer coefficient of 10 W/m^2K on the inside wall and 30W/m^2K on the outside wall. Calculate the inside and outside wall temperatures, heat flux and total heat transfer rate through the wall.

8. 91 kg of water is to be heated from 10°C to 77°C with hot gases at 166°C flowing at 364kg/hr. Taking specific heat of gases =1.05 kj/kg - K, of water = 4.187 kj/kg - K and the overall heat transfer coefficient = 114 W/m^2 - K, calculate the area of heat exchange surface required for a) parallel flow, b) counter flow.

9. Write short notes on the following :

   a) Mixed convection

   b) NTU method

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.