Roll No. | | | | | | | | | | | | Total No. of Pages : 03

Total No. of Questions : 18

B.Tech. (BT) (2018 Batch) (Sem.–3)

TRANSPORT PHENOMENON

Subject Code : BTBT-305-18

M.Code : 76949

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.
4. Use of steam table is allowed.

SECTION-A

Write briefly :

1. Define Newton's law of viscosity.

2. Define average velocity. And how do you calculate average velocity?

3. What is power law model?

4. Define Reynold's number and Prandtl number.

5. What is Chilton Colburn analogy?

6. Define Navier Stokes equation.

7. What is Biot number for mass transfer? What do we conclude from Biot number is very small (<<1)?

8. Relation between maximum velocity and local velocity, when a fluid flows under laminar, steady state, incompressible Newtonian fluid, in a tube?

9. What are Bingham plastic fluids and pseudo plastic fluids? Explain with example.

10. What is Hagen Poiseullie's equation?

SECTION-B

11. An exothermic chemical reaction takes place in a 20 cm thick slab and the energy generation rate per unit volume is 1×10^6 W/ m^3 The steady-state heat transfer rate into the slab at the left-hand side, i.e., at x = 0, is 280 W. Calculate the heat transfer rate to the surroundings from the right-hand side of the slab, i.e., at x = L. The surface area of each face is $40cm^2$. Also calculate the heat flux at x = 0 and x = L.

12. Water at 20 °C is flowing past a flat plate at 0.914 m s. The plate is 0.305 m wide.

    a) Calculate the Reynolds number 0.305 m from the leading edge to determine if the flow is laminar.

    b) Calculate the boundary layer thickness at x = 0.152 and x = 0.305 m from the leading edge.

13. Heat is generated in a rectangular heating element of dimensions 1m × 0.5m × 0.1m of thermal conductivity 60 W/m K at rate of 15×10^3 W/m^3. Calculate maximum temperature in the wall if the surface temperatures are 100°C. Also calculate the heat flux at the surface.

14. The potential function for a two dimensional, irrotational. incompressible flow field is given as $\Phi = x^2-2y-y^2$. Find the stream function ψ and velocity components v_x and v_y.

15. Consider a solid cone of circular cross-section whose lateral surface is well insulated as shown in Figure 1. The diameters at x = 0 and x = L are 25cm and 5cm. respectively If the heat flux at x = 0 is 45W/m2 under steady conditions, determine the heat transfer rate and the value of the heat flux at x = L.

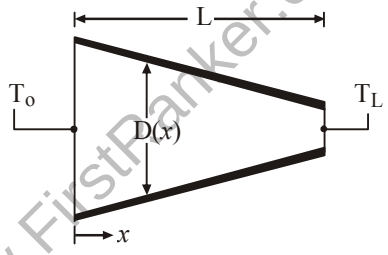

FIG.1

SECTION-C

16. A 10 cm long copper fin of diameter 6mm is attached to a vertical wall at 500 K and is projected in a room where air is at 300 K. The heat transfer coefficient at the fin surface is 300 W/m^2 K and conductivity of fin material is 390 W/m K. Calculate :

    a) Heat loss from fin.

    b) Fin efficiency

    c) Fin effectiveness.

17. Heat is flowing through an annular wall of inside radius r_0 and outside radius r_1. The thermal conductivity varies linearly with temperature from k_0 at T_0 to k_1 at T_1. Develop an expression for the heat flow through the wall.

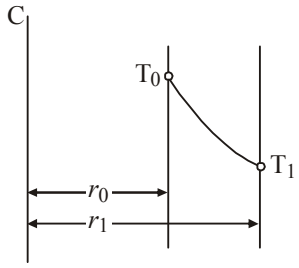

FIG.2

18. Consider the transfer of species *A* by diffusion through a slightly tapered slab as shown in Figure. Mass transport can be considered one-dimensional in the *z*-direction.

Determine the rate of molar transfer for the :

a) Constant diffusivity

b) Constant diffusivity and constant area

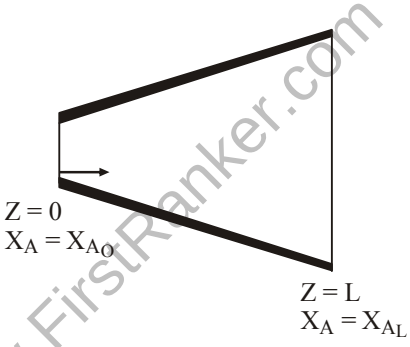

FIG.3

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.