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

Total No. of Questions : 09

B.Tech.(BT) (2011 Onwards) (Sem.–3)

TRANSPORT PHENOMENON

Subject Code : BTBT-305

Paper ID : [A1153]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTION 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) What are Non Newtonian Fluids? Explain with example.

b) What is momentum transport and Newton's law of viscosity?

c) Differentiate between forced convection and free convection.

d) Define streamline and what is the equation of streamline in two dimension flow?

e) What is Hagen Poiseullie's equation?

f) Define Navier Stokes equation.

g) What is mass transport and Fick's law of diffusion?

h) Define thermal and mass diffusivity.

i) Define Fourier's law of heat conduction.

j) Verify that '*momentum per unit area per unit time*' has the same dimensions as '*force per unit area*'.

SECTION-B

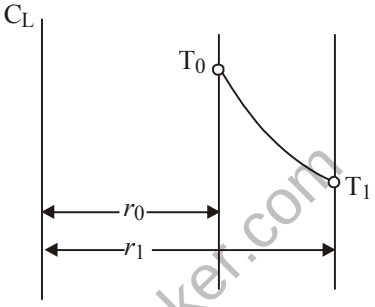
2. Water at 22°C is flowing down a vertical wall with Re = 20. Calculate (a) the flow rate, in gallons per hour per foot of wall width, and (b) the film thickness in inches. Kinematic viscosity of water at 22°C is 1.005×10^{-2} cm^2/sec.

3. Consider a horizontal pipe through which an incompressible Newtonian fluid is flowing in one dimensional, steady state, laminar flow. Flow is fully developed; apply the momentum shell balance to develop the following velocity profile.

$$v_x = \frac{P_O - P_L}{4\mu L} R^2 \left[1 - \left(\frac{r}{R} \right)^2 \right]$$

4. Heat is generated in a rectangular heating element of dimensions lm × 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.

5. 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.



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

SECTION C

7. 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 and (c) fin effectiveness.

8. Derive the following Navier Stokes equation for rectangular system, for x component only.

$$\rho\left(\frac{\partial v_x}{\partial t} + v_x \frac{\partial v_x}{\partial x} + v_y \frac{\partial v_x}{\partial y} + v_z \frac{\partial v_x}{\partial z} \right) = -\frac{\partial p}{\partial x} + \mu \left[\frac{\partial^2 v_x}{\partial x^2} + \frac{\partial^2 v_x}{\partial y^2} + \frac{\partial^2 v_x}{\partial z^2} \right] + \rho g_x$$

9. Consider a hollow sphere, through which heat conduction in one dimension is flowing. Show that temperature varies hyperbolically with the radius.