Roll No. | | | | | | | | | | | | |

Total No. of Pages : 03

Total No. of Questions : 09

B.Tech.(BT) (2012 to 2017) (Sem.–3)

TRANSPORT PHENOMENON

Subject Code : BTBT-305

M.Code : 55075

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 is the driving force for momentum, heat and mass transport?

b) Categorize different types of Non-Newtonian fluids.

c) What are the units of thermal and mass diffusivity?

d) What is the significance of Nusselt and Prandtl number?

e) Write Newton's law of viscosity.

f) How does the diffusion of gases vary with temperature?

g) What are the various mechanisms of transport?

h) Write down the units for rate of heat and momentum flux.

i) What is Hagen Poiseullie's equation?

j) What is Biot number? What is its significance?

SECTION-B

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

3. The potential for a flow around a cylinder of radius a is given by $\phi = ux\left[1+\frac{a^2}{x^2+y^2}\right]$

Where x and y are the rectangular coordinates with the origin at the middle. Derive an expression for stream function ψ.

4. 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.

5. Consider an incompressible liquid in a cylindrical vessel which has been undergoing constant angular motion for a time interval which is of such a duration that the liquid has assumed a fixed orientation in the vessel. Show that at steady-state, the free surface forms a paraboloidal surface given by $Z - Z_0 = (\omega^2 / 2g)\, r^2$. Assume that the viscosity of the fluid is constant.

6. Heat is generated in a rectangular heating element of dimensions 1 m × 1 m × 0.5m of thermal conductivity 120 W/m K at rate of 18×10^3 W/m^3. Calculate maximum temperature in the wall if the surface temperatures are 120°C. Also calculate the heat flux at the surface.

SECTION-C

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

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

8. A 15 cm long copper fin of diameter 3 mm 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 700 W/m^2 K and conductivity of fin material is 450 W/m K. Calculate

   a) Heat loss from fin,

   b) Fin efficiency

   c) Fin effectiveness.

9. 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.

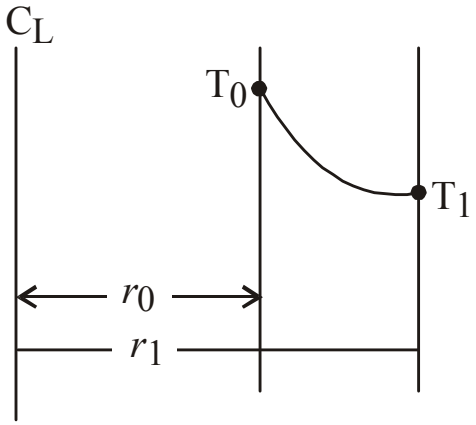

FIG.1

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.