

(3 Hours)

Total Marks: 80

N.B.: (1) Question No.1 is compulsory.

(2) Attempt any **Three** out of remaining **five** questions.

(3) Assume any suitable data if necessary and indicate it clearly.

1. (a) What is diffusivity? What is Fick's law of diffusion? If concentration gradient is parallel to the bulk motion of fluid, is diffusion possible in the direction of the gradient? (05)
- (b) Explain analogy between heat and momentum transfer. (05)
- (c) Define and explain three dimensional form of Newton's Law of Viscosity. (05)
- (d) Write procedure for setting up shell momentum balance for solving viscous flow problems and most commonly used boundary conditions. (05)
2. Derive the expression for heat conduction in a viscous heat source? (20)
3. Derive the expression for Momentum flux, Velocity, Maximum velocity, Avg. Velocity, Volumetric flow rate, film thickness for a flow through circular tube. (20)
4. (a) Derive the expression for diffusion into a falling liquid film. (10)
- (b) Derive the expression for diffusion through a stagnant gas film. (10)
5. (a) Heat is being generated uniformly by a chemical reaction in long cylinder of radius 91.44mm. The generation term is constant at 46.6 W/m^3 . The walls of cylinder are cooled so that wall temperature is held constant at 311K. The thermal conductivity is 0.865 W/m.K . Calculate the centreline temperature. (10)
- (b) An oil is flowing down a vertical wall having film thickness 1.7 mm. The oil density is 820 Kg/m^3 and the viscosity of oil is 0.20 Pa.sec . Calculate the mass flowrate per unit width of wall? Also calculate avg. Velocity. (10)
6. Derive expression for heat conduction with a chemical heat source. (20)
