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ECH801

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : **151801**

Roll No.

B. Tech.

(SEM. VIII) THEORY EXAMINATION, 2014-15

TRANSPORT PHENOMENA

Time : **3** Hours] [Total Marks : **100**

Note:(1) Attempt all questions.

(2) Assume suitable data if missing.

1 Attempt any four parts of the following : [5×4=20]

(a) What are analogies in different Transport processes?

(b) Explain the principle of conservation of momentum.

(c) Differentiate between absolute viscosity and kinematic viscosity.

(d) What is concept of continuum?

(e) What is meant by term "Non-Newtonian"? What types of substances exhibit this behavior?

(f) Describe the differential driving forces for momentum, heat and mass transports.

2 Attempt any four parts of the following : [5×4=20]

(a) How does the viscosity vary with temperature and pressure for gases and liquids?

(b) Discuss all the boundary conditions used in the momentum transfer problems.

(c) Derive equation of continuity in Cartesian coordinates.

(d) An oil has a kinematic viscosity of $2x10^{-4}$ m^2/sec and density of $0.8x10^3$ kg/m^3. What should be the mass rate of flow of this film down a vertical wall in order to have a film thickness of 2.5mm? calculate N_{Re} also.

(e) One method of determining the radius of a capillary tube is to measure the rate of flow of a viscous fluid through the tube. Find the radius of a capillary from the following flow data:

Length of capillary = 50.02 cm, kinematic viscosity of fluid = 4.03×10^{-5} m^2/sec

Density of fluid = 0.9552×10^3 kg/m^3, Pressure drop across tube = $4.829x10^5$ N/m^2 Mass flow rate through tube = 2.997×10^{-3} kg/sec

(f) State the assumptions made in the development of Hagen-Poiseuille law.

3 Attempt any two parts of the following : [10x2=20]

(a) Derive an expression for flow of a falling film. Also discuss the maximum and average velocities.

(b) A copper wire has radius of 2 mm and length of 5 m. For what voltage drop would the temperature rise at the wire axis be 10^0C, if the surface temperature of wire is 20^0C ? For copper the Lorenty No. is 2.23×10^{-3} Volt ^{2}/K^2.

(c) Show that for a packed column, the friction factor is

$$f = [(1-\varepsilon)^2 / \varepsilon^3](75\mu / D_P G_0)$$

4 Attempt any **two** parts of the following : [10×2=20]

(a) Derive an expression to obtain the temperature distribution for heat conduction with an electrical heat source. Also find the maximum and average temperature rise.

(b) Derive an expression for heat flow through composite cylindrical wall.

(c) Differentiate between free and forced convection. Also define and give the physical significance of various dimensionless numbers involved in these operations.

5 Attempt any **two** parts of the following : [10×2=20]

(a) Derive an expression to obtain the concentration profile for diffusion through a stagnant gas film.

(b) In a gas diffusion experiment chloropicrin (CCl_3NO_2) is kept in a cylindrical test tube A gas is passed through the open end of the tube. What is the rate of evaporation (g/hr) in air at 25^0C?

Total pressure = 770 mm Hg, Diffusivity = 0.088 cm^2/ sec,

Vapor pressure = 22.81 mm Hg, Distance from liq. Level to top of tube = 11.14 cm Density of chloropicrin = 1.65 gm/cm^3. Surface area of liq. Exposed to air = 2.29 cm^2

(c) In an oxygen nitrogen mixture at 10 atm and 25^0C, the concentration of oxygen at two places 0.2 cm apart are 10 and 20 volume percent respectively. Calculate the rate of diffusion of oxygen expressed as gm/cm^2hr for the case of unicomponent diffusion (nitrogen non diffusing). Value of diffusivity is 0.181 cm^2/sec.