Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.Tech**

PCE5I101

5th Semester Regular / Back Examination 2019-20

TRANSPORT PHENOMENA

BRANCH : CHEM

Max Marks : 100

Time : 3 Hours

Q.CODE : HRB067

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.

The figures in the right hand margin indicate marks.

Part- I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) Define kinematic viscosity and its significance.

b) Differentiate between steady flow and laminar flow.

c) What is the effect of temperature on thermal conductivity of gases and liquids?

d) State Hagen- Poiseulle's equation and write its equation.

e) Write the generalized boundary conditions used in solving momentum transfer problems, using shell momentum balance equation.

f) Define diffusion phenomenon and explain the various factors that influences the diffusion of gases.

g) Explain the concept of Colburn Analogy.

h) How is the stream function defined and why it is useful?

i) What is the similarity between Newton's law of viscosity and Fourier's law of heat conduction?

j) Discuss the various Non-Newtonian fluids with the corresponding rheological equation.

Part- II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Explain about unsteady state one dimensional momentum and heat transfer?

b) Discuss about the theory of diffusion in gases at low density.

c) Write the comparison between free and forced convection in non-isothermal system.

d) Explain different models of turbulent flux.

e) Write the significance of Navier- Stokes equation.

f) Derive the expression for maximum velocity, average velocity, volumetric rate of flow and film thickness for flow of a falling film by setting up momentum balance.

g) An oil has a kinematic viscosity of $2x10^{-4}$ m^2/sec and a density of $0.8x10^3$ g/m^3. If we want a falling film of thickness 2.5 mm on a vertical wall, what should be the mass flow rate of the flowing liquid?

h) What is a composite wall? Derive the relevant equations for heat conduction through the composite wall.

i) Derive the equation of continuity of a component in multicomponent mixture.

j) How could the friction factor be defined for flow through an annulus and for transverse flow around a cylinder?

k) Derive the analogy between momentum, heat and mass transfer.

l) What are Fick's first and second laws? Under what circumstances are they applicable?

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Derive the expression for diffusion under isothermal steady state conduction through a spherical shell. Extend these results to describe the diffusion in a non-isothermal film in which the temperature varies radially as $T/T_1 = (r/r_1)^n$, where T_1 is the temperature at r_1. Also assume that D_{AB} varies as 3/2 power of temperature. **(16)**

Q4 How is binary diffusivity and self-diffusion defined? Give typical orders of magnitude of diffusivity of gases, liquids and solids. **(16)**

Q5 A fluid with density ρ and viscosity μ is placed between two vertical walls which are at a distance of 2b apart. The heated wall is maintained at a temperature of T2 at y=-b and the cold wall is maintained at a temperature T1 at y=+b. The plates can be assumed to be very long so that temperature and velocity are functions of y only. Derive the expressions for temperature and velocity distribution between the walls. **(16)**

Q6 **Write short notes on :** **(8 x 2)**

a) equation of continuity

b) Navier- Stokes Equation