

GUJARAT TECHNOLOGICAL UNIVERSITY
BE –SEMESTER-VIII EXAMINATION- SUMMER 2020

Subject Code: 2180507
Date: 28/10/2020
Subject Name: Transport Phenomena
Time: 02:30 PM TO 05:00 PM
Total Marks: 70
Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

		MARKS
Q.1	(a) State the relevance of transport phenomena in chemical Engineering.	03
	(b) State and explain the laws of Conservation.	04
	(c) State and discuss various levels of transport phenomena.	07
Q.2	(a) Estimate the viscosity of N ₂ at 50 °C and 854 atm, given the molecular weight 28 g/g-mole, $p_c = 33.5$ atm, and $T_c = 126.2$ K	03
	(b) State the shell momentum balance equation and its boundary conditions.	04
	(c) State and discuss the Newton's law of viscosity along with supporting equations and schematic diagram.	07
	OR	
	(c) Glycerin at 26.5 °C is flowing through a horizontal tube 1 ft long and with 0.1 inch inside diameter. For a pressure drop of 40 psi, the volume flow rate (w/p) is 0.00398 ft ³ /min. The density of glycerin at 26.5 °C is 1.261 g/cm ³ . Find the viscosity of the glycerin and subsequent Reynolds no.	07
Q.3	(a) Give the physical significance of the three kinds of time derivatives used in the equation of change for momentum transport.	03
	(b) Discuss the general trends of viscosity with temperature and pressure for ordinary fluids.	04
	(c) Write a brief note on molecular theory of the viscosity of gases at low density.	07
	OR	
Q.3	(a) A plastic panel of area 1 ft ² and thickness 0.252 inch was found to conduct heat at a rate of 3 W at steady state with temperature $T_1 = 24$ °C and $T_2 = 26$ °C imposed on the two main surfaces. What is the thermal conductivity of the plastic in cal/cm.s.K at 25 °C.	03
	(b) State the boundary conditions associated with shell energy balance.	04
	(c) State and discuss various kinds of Navier-Stokes equation initiated from molecular arguments.	07

- Q.4** (a) Discuss the significance of momentum, thermal and mass diffusivities **03**
- (b) A copper wire has a radius of 2 mm and a length of 5 m. For what voltage drop what the temperature rise at the wire axis be 10°C , if the surface temperature of wire is 20°C ? **04**
- (c) Explain with appropriate equations the Fourier's law of molecular energy transport **07**

OR

- Q.4** (a) Write in short about Molecular Mass Transport. **03**
- (b) Show that only one diffusivity is needed to describe the diffusional behavior of a binary mixture. **04**
- (c) Derive the equation for temperature and heat flux distribution through cylindrical shell with an electric heat source. **07**
- Q.5** (a) Define thermal conductivity and thermal diffusivity. What are its units? **03**
- (b) Using the equation of combination of kinetic theory and corresponding states arguments estimate D_{AB} for the system of CO-CO₂ at 296.1 K and 1 atm total pressure. The data is given as follows **04**

Species	Tc (k)	Pc (atm)
CO	133	34.5
CO ₂	304.2	72.9

The values for constants are $a = 2.745 \times 10^{-4}$ & $b = 1.823$

- (c) Derive the relation for diffusion with a heterogeneous chemical reaction with suitable assumptions and notations. **07**

OR

- Q.5** (a) Compare convective and molecular molar fluxes. **03**
- (b) State the various equations of diffusivities for temperature and pressure dependence. **04**
- (c) Deduce the expression for diffusion through a stagnant gas film with appropriate schematic diagram. **07**
