

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VIII EXAMINATION – SUMMER 2025****Subject Code:2180507****Date:27-05-2025****Subject Name: Transport Phenomena****Time:10:30 PM TO 01:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
Q.1	(a) State the general equations associated with transport process.	03
	(b) State the relevance of transport phenomena in chemical Engineering.	04
	(c) Explain the analogy among Newton's law of viscosity, Fourier's law of conduction and Fick's law of diffusion.	07
Q.2	(a) Compute the viscosity of CO ₂ at 800 K and 1 atm. in terms of Lennard-Jones parameters. The Lennard-Jones parameters for CO ₂ are, $\epsilon/K = 190$ K, $\Omega_\mu = 0.9595$ and $\sigma = 3.996$ Å.	03
	(b) Discuss the Comparison between molecular and convective mechanisms for momentum transport.	04
	(c) Derive the equation for the temperature distribution in two concentric cylinders.	07
	OR	
	(c) State and discuss the Newton's law of viscosity along with supporting equations and schematic diagram.	07
Q.3	(a) Compare thermal conductivity, thermal diffusivity and heat capacity in terms of dimensionless number.	03
	(b) State the commonest of boundary conditions in molecular energy transport.	04
	(c) Discuss in brief the molecular theory of the viscosity of gases at low density depicting appropriate equations.	07
	OR	
Q.3	(a) Define mass and molar average velocities.	03
	(b) 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.	04
	(c) Derive equation for velocity profile and mass flow rate for flow of a falling film over a flat plate.	07
Q.4	(a) A copper wire has a radius of 2 mm and a length of 5 m. For what voltage drop would the temperature rise at the wire axis be 10°C, if the surface temperature of the wire is 20°C?	03

(b) State the boundary conditions associated with shell energy balance. **04**

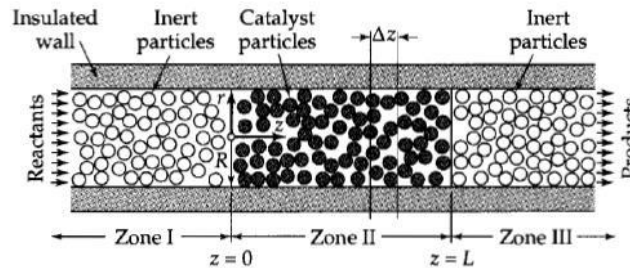
(c) Show that for equimolar counter diffusion $D_{AB} = D_{BA}$. **07**

OR

Q.4 (a) Discuss about binary diffusivity and self diffusivity. **03**

(b) Deduce the expression for diffusion through spherical shell. **04**

(c) For the fixed-bed axial flow reactor shown in figure, find the steady state axial temperature distribution. The fluid is flowing axially in plug flow with superficial velocity v_0 . The reactants enter at $z = -\infty$ and leave at $z = +\infty$. The reaction zone is from $z = 0$ to $z = L$.



Q.5 (a) State the shell mass balance equation and boundary conditions used for solving the mass transport problems. **03**

(b) Discuss in brief about heat conduction in a cooling fin. **04**

(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) Derive the relation for Fick's law of binary diffusion in terms of molecular mass transport with appropriate justification. **04**

(c) Discuss theory of diffusion in gases at low density. **07**
