Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VII EXAMINATION – WINTER 2025

Subject Code:3170511 Date:01-12-2025

Subject Name:Transport Phenomena

Time:10:30 AM 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)**	Differentiate between scaler, vector and tensor in context to transport phenomena.	**03**
	(b)	Give the analogy between heat, momentum and mass transport.	**04**
	(c)	Develop an expression for Navier-Stokes Equation in Cartesian Co-ordinate system.	**07**
Q.2	**(a)**	Compare and contrast the procedures for solving one dimensional and two dimensional momentum transport.	**03**
	(b)	Compare and contrast the molecular and convective mechanisms for heat transport.	**04**
	(c)	Develop the shear stress and velocity distribution profile for the laminar flow in the inclined plane. State assumptions made while deriving these expressions.	**07**
		OR	
	(c)	Develop the shear stress and velocity distribution profile for the downward laminar flow through pipe. State assumptions made while deriving these expressions.	**07**
Q.3	**(a)**	Define the following: (1) Biot no. (2) Brinkman number	**03**
	(b)	Compare the mechanism of free and force convection.	**04**
	(c)	Develop the heat flux and temperature distribution profile for heat conduction in with a viscous heat source. State assumptions made while deriving these expressions.	**07**
		OR	
Q.3	**(a)**	Differentiate between steady state and unsteady state heat conduction.	**03**
	(b)	Define the following: (1) efflux time (2) Fully developed flow (3) end effect (4) boundary layer	**04**
	(c)	Develop the heat flux and temperature distribution profile for heat conduction through composite wall. State assumptions made while deriving these expressions.	**07**
Q.4	**(a)**	Write in brief about Fick law of diffusion.	**03**
	(b)	What is the purpose of fins in heat exchange device? Classify various types of fins.	**04**
	(c)	Derive an expression for diffusion of liquid A evaporating in to non-diffusing gas B	**07**

OR

Q.4 **(a)** Distinguish between Molecular mass flux and Convective mass flux. **03**

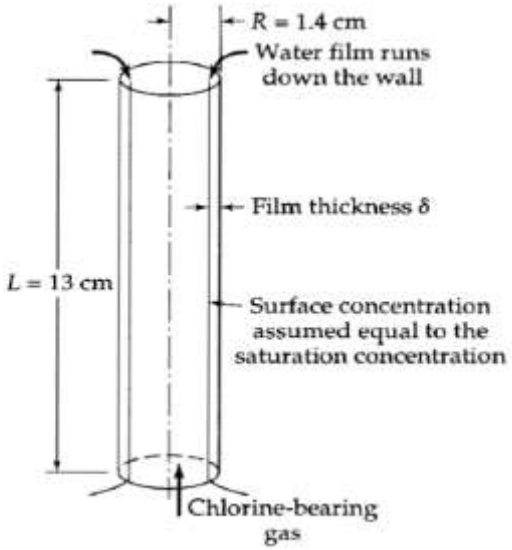
(b) What is the importance of boundary conditions? State commonly used boundary conditions in mass transport. **04**

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

Q.5 **(a)** Differentiate between diffusion-controlled reaction and chemical kinetics controlled reaction with suitable example. **03**

(b) What is importance of momentum, thermal and mass diffusivities? **04**

(c) Chlorine is being absorbed from a gas in a small experimental wetted-wall tower. **07**



The absorbing fluid is water, which is moving with an average velocity of 17.7 cm/s. The local mass flux of chlorine in water at interface is estimated by expression.

$$c_{A0}\sqrt{\frac{\mathcal{D}_{AB}v_{max}}{\pi z}}$$

What is the absorption rate in gmoles/hr, if the liquid-phase diffusivity of the chlorine-water system is $1.26 * 10^{-5}$ cm^2/s, and if the saturation concentration of chlorine in water is 0.823 g chlorine per 100 g water (at 16 ºC).

(Assumption: No chemical reaction between chlorine and water.)

OR

Q.5 **(a)** List out factors affecting diffusion of gas in solid. **03**

(b) Explain the Physical Interpretation of Mass Transfer Coefficient with suitable diagram. **04**

(c) Hydrogen gas is maintained at 3 bar and 1 bar on opposite sides of a plastic membrane, which is 0.3 mm thick. The temperature is 25°C, and the binary diffusion coefficient of hydrogen in the plastic is $8.7 * 10^{-8}$ m^2/s. The solubility of hydrogen in the membrane is $1.5 * 10^{-3}$ $kmol/m^3.bar$. What is the mass diffusive flux of hydrogen through the membrane? **07**

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