Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – SUMMER 2024

Subject Code:3170511 Date:01-06-2024

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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Compare Scalar, Vector and Tensor.	**03**
	(b)	Examine the following velocity fields for the zero divergence and Irrotational vector. (bold indicates vector) a) $\mathbf{u} = by\mathbf{i} + 0\mathbf{j} + 0\mathbf{k}$ b) $\mathbf{v} = bx\mathbf{i} - bx\mathbf{j} + 0\mathbf{k}$ c) $\mathbf{w} = by\mathbf{i} + bx\mathbf{j} + 0\mathbf{k}$ d) $\mathbf{s} = -by\mathbf{i} + bx\mathbf{j} + 0\mathbf{k}$	**04**
	(c)	Estimate the thermal conductivity of following gas mixture at 1 atm and 293 K from given data on the pure components at same pressure and temperature	**07**

Species	α	Mole fraction x_α	Molecular Weight	$\mu_\alpha \times 10^7$ (gm/cm.s)	$k_\alpha \times 10^7$ (cal/cm.s.K)
CO_2	1	0.133	44.01	1462	383
O_2	2	0.039	32	2031	612
N_2	3	0.828	28.016	1754	627

Q.2	**(a)**	Oil has a kinematic viscosity of 2×10^{-4} m^2/s and a density of 0.8×10^3 g/m^3. If we want to have a falling film of thickness of 2.5 mm on a vertical wall, what should the mass rate of flow of the liquid be?	**03**
	(b)	Find $\boldsymbol{\tau} \cdot \mathbf{v}$ (dot product) and $\boldsymbol{\tau} \times \mathbf{v}$ (cross product). $\boldsymbol{\tau}$ is a tensor and $\mathbf{v}$ is vector	**04**
	(c)	Derive the expression for max velocity, avg. velocity and mass flow rate for a flow through circular pipe system.	**07**
		OR	
	(c)	A viscous fluid is in laminar flow in a slit formed by two parallel walls at a distance 2B apart. Make a differential momentum balance and obtain the expression for the distributions of momentum flux and velocity.	**07**

Q.3	**(a)**	Explain Newton's Law of Viscosity	**03**
	(b)	Give the significance of Total time derivative, Partial time derivative and Substantial time derivative with example.	**04**
	(c)	Derive Continuity equation and prove that for incompressible fluids divergence of velocity vector is zero i.e. $\nabla \cdot \mathbf{v} = 0$	**07**

OR

Q.3	**(a)**	State and explain the general shell momentum balance equation.	**03**
	(b)	State the significance of three dimensionless numbers having thermal, momentum and molar diffusivity. (viz. Pr. Sc. and Le.)	**04**
	(c)	A liquid is slowly flowing down an inclined flat plate of length L and width W. Find Velocity distribution as a function of the fluid film thickness. Also find maximum and average velocity. Neglect end effects.	**07**
Q.4	**(a)**	Explain Fourier's Law of heat conduction	**03**
	(b)	Compare thermal conductivity and thermal diffusivity with necessary equations	**04**
	(c)	For heat conduction with electrical source, construct the expression of Max. Temperature, Avg. Temperature and heat outflow at surface of electric wire	**07**

OR

Q.4	**(a)**	Explain the molecular and convective and total heat flux	**03**
	(b)	Explain the various boundary conditions used to solve heat transport problems.	**04**
	(c)	Construct the expression of effectiveness of Cooling Fin	**07**
Q.5	**(a)**	Explain Fick's law of binary diffusion.	**03**
	(b)	Explain Mass and Molar Fluxes, Convective Mass and Molar Fluxes.	**04**
	(c)	Develop the mass flux equation for steady-state diffusion of A through stagnant B with the liquid vapor interface maintained at a fixed position.	**07**

OR

Q.5	**(a)**	Explain Temperature and Pressure dependence of diffusivities.	**03**
	(b)	Explain Mass and Molar Concentrations, Mass Average and Molar Average Velocity.	**04**
	(c)	Develop mass flux equation for diffusion Into a Falling Liquid Film (Gas Absorption, Forced Convection Mass Transfer)	**07**

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