Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2022

Subject Code:3170511 Date:12-01-2023

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)**	Write the significance of momentum diffusivity.	**03**
	(b)	Discuss the three levels at which the transport phenomena is studied.	**04**
	(c)	Discuss in details the Newton's law of viscosity and write its equation in three dimensions.	**07**
Q.2	**(a)**	Define Prandtl number.	**03**
	(b)	Discuss about temperature dependency of thermal conductivity.	**04**
	(c)	Prove that for incompressible fluids divergence of velocity vector is zero i.e. $\nabla . v = 0$	**07**
		OR	
	(c)	Derive equation for momentum for a Newtonian incompressible fluid.	**07**
Q.3	**(a)**	Write general shell momentum balance equation.	**03**
	(b)	Explain the molecular momentum flux and write the components of the molecular momentum flux tensor.	**04**
	(c)	Derive velocity profile and mass flow rate for flow of a falling film formed by a Newtonian, incompressible fluid.	**07**
		OR	
Q.3	**(a)**	Define Reynold's number.	**03**
	(b)	A fluid of viscosity 0.7 cP is present between two parallel plates separated by a distance 0.001 ft. If the lower plate moves with the velocity 1ft/sec in positive x direction, compute the steady state momentum flux τ_{yx} in Pascal.	**04**
	(c)	Derive the equation for pressure drop for laminar flow of an Newtonian, incompressible fluid through a circular cross section pipe.	**07**
Q.4	**(a)**	Define the molecular heat flux.	**03**
	(b)	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^oC, if the surface temperature of wire is 20^oC? For copper, Lorentz No. $k/(k_e T_0)$ is 2.23×10^{-8} volt^2 /K^2	**04**
	(c)	Derive equation for temperature drop in a conductor wire for an electrical heat source The rate of heat production per unit volume is given by the expression $S_e = I^2/k_e$.	**07**
		OR	
Q.4	**(a)**	State the Fourier's law of heat conduction.	**03**
	(b)	Discuss different boundary conditions used for solving shell energy balance.	**04**
	(c)	Derive the equation for temperature distribution for chemical reaction as heat source.	**07**

Q.5	**(a)**	Define Mass and Molar Concentrations, Mass Average and Molar Average Velocities, Molecular Mass and Molar Fluxes	**03**
	(b)	Explain temperature and pressure dependency of diffusivity.	**04**
	(c)	Derive the relation for diffusivity in case of equimolar counter diffusion.	**07**

OR

Q.5	**(a)**	Define binary Diffusivity.	**03**
	(b)	Shortly explain the theory of diffusion in gases at low density.	**04**
	(c)	With neat diagram derive an equation of molar flux for the diffusion with heterogeneous chemical reaction as $2A \rightarrow B$.	**07**

****