Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VIII (New) EXAMINATION – WINTER 2019

Subject Code: 2180507 **Date: 21/11/2019**

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.**

Q.1	**(a)**	Explain the Newton's law of viscosity.	**03**
	(b)	Discuss the two and three parameter rheological models to study the behaviour Non-Newtonian fluid.	**04**
	(c)	Make a differential momentum balance and obtain the expression for the distributions of momentum flux and velocity for the flow of a fluid through a circular tube.	**07**
Q.2	**(a)**	Give the physical significance of the three kinds of time derivatives used in the equation of change for momentum transport.	**03**
	(b)	State and explain Hagen-Poiseulle law with all assumptions.	**04**
	(c)	Derive the Navier-Stoke's equation in cartesian coordinate.	**07**
		OR	
	(c)	Determine the velocity and shear stress distributions in a couettee viscometer for the tangential laminar flow of an incompressible fluid flowing between two coaxial cylinders, the outer one of which is rotating with an angular velocity Ω_0.	**07**
Q.3	**(a)**	State and explain the general shell energy balance equation.	**03**
	(b)	Distinguish between free and forced convection heat transport phenomena.	**04**
	(c)	Derive the expression for the heat conduction with chemical heat source.	**07**
		OR	
Q.3	**(a)**	Define thermal conductivity and thermal diffusivity. What are its units?	**03**
	(b)	State the significance of Prandtl and Nusselt number.	**04**
	(c)	With neat diagram develop a formula for the overall heat transfer coefficient for the two concentric cylindrical pipe wall.	**07**
Q.4	**(a)**	Why fins are used in heat transfer? Give three examples of convection heat transport in chemical industry.	**03**
	(b)	Explain the various boundary conditions used to solve heat transport problems.	**04**
	(c)	Derive the expression for the heat conduction with a viscous heat source.	**07**
		OR	
Q.4	**(a)**	State the shell mass balance equation and boundary conditions used for solving the mass transport problems.	**03**
	(b)	Explain the molecular diffusion in gases with appropriate equations.	**04**
	(c)	Derive the relation for diffusion through a stagnant gas film.	**07**
Q.5	**(a)**	Compare Fick's law of diffusion with Fourier's law of heat conduction.	**03**
	(b)	Using the equation of combination of kinetic theory and corresponding states arguments estimate D_{AB} for the system of CO-CO_2 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 $a = 2.745 \times 10^{-4}$ and $b = 1.823$

(c) Derive an expression of molar flux for the diffusion with homogeneous chemical reaction as A + B → AB. **07**

OR

Q.5 **(a)** Discuss the various methods to calculate the self diffusivity of the binary mixture whose diffusivities are dependent on temperature and pressure. **03**

(b) Using the equation of theory of diffusion in gases at low density predict the value of D_{AB} for the system of CO-CO_2 at 296.1 K and 1 atm total pressure. The data is given as follows. **04**

Species	σ (Å)	ϵ/k (K)
CO (A)	3.590	110
CO_2 (B)	3.996	190

The collision integral for diffusion Ω_{DAB} = 1.067

(c) Derive an equation for the diffusion with heterogeneous chemical reaction. **07**

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