

Enrolment No./Seat No \_\_\_\_\_

## GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-VIII (NEW) EXAMINATION – WINTER 2024

Subject Code:2180507

Date:22-11-2024

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) State and discuss the different conservation law of transport processes.                                                                           | 03    |
|     | (b) Compare Newton's law of viscosity and Hooke's law of elasticity.                                                                                   | 04    |
|     | (c) Make a differential momentum balance and obtain the expression for the distributions of momentum flux and velocity for the flow of a falling film. | 07    |
| Q.2 | (a) Define viscosity. What are the SI units of viscosity and Kinematic viscosity?                                                                      | 03    |
|     | (b) Discuss the two parameter rheological models for Non-Newtonian fluid.                                                                              | 04    |
|     | (c) Derive the Navier-Stoke's equation in Cartesian coordinate.                                                                                        | 07    |
|     | OR                                                                                                                                                     |       |
|     | (c) Derive the expression for the distributions of momentum flux and velocity for the flow of two immiscible fluids flowing in a horizontal thin slit. | 07    |
| Q.3 | (a) State the general shell energy balance equation and all assumptions.                                                                               | 03    |
|     | (b) With suitable examples distinguish between free convection and forced convection heat transfer.                                                    | 04    |
|     | (c) Derive the equation for the temperature distribution, maximum temperature rise and average temperature for an electrical heat source.              | 07    |
|     | OR                                                                                                                                                     |       |
| Q.3 | (a) Discuss the Fourier's law of heat conduction.                                                                                                      | 03    |
|     | (b) Briefly explain temperature distribution for turbulent flow in tubes.                                                                              | 04    |
|     | (c) Derive the expression for the heat conduction with chemical heat source.                                                                           | 07    |
| Q.4 | (a) Cite any three industrial examples of convection heat transfer.                                                                                    | 03    |
|     | (b) State the significance of Prandtl and Nusselt number.                                                                                              | 04    |
|     | (c) Derive the equation for temperature distribution across the rectangular cooling fin.                                                               | 07    |
|     | OR                                                                                                                                                     |       |
| Q.4 | (a) Define energy, potential energy, kinetic energy and internal energy.                                                                               | 03    |
|     | (b) Cite any four examples of equimolar counter diffusion.                                                                                             | 04    |
|     | (c) Derive an expression for the diffusion through a stagnant gas film.                                                                                | 07    |

- Q.5** (a) Write the various equations and its significance for the temperature and pressure dependence of diffusivities. **03**
- (b) Prove the equivalence of  $D_{AB}$  and  $D_{BA}$ . **04**
- (c) With neat diagram derive the equation of Fick's law of binary diffusion along with all necessary assumptions. **07**

**OR**

- Q.5** (a) State the boundary conditions used for solving the mass transport problems. **03**
- (b) State the dimensionless groups to express relation between mass diffusivity, thermal diffusivity and momentum diffusivity along with their significance. **04**
- (c) With neat diagram derive an equation of molar flux for the diffusion with heterogeneous chemical reaction. **07**

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