Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE- SEMESTER–VIII (NEW) EXAMINATION – WINTER 2020**

**Subject Code:2180507 Date:19/01/2021**

**Subject Name:Transport Phenomena**

**Time:02:00 PM TO 04:00 PM Total Marks: 56**

**Instructions:**

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

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| **Q.1** | **(a)** | Why the momentum, heat and mass transport phenomena should be studied together? | **03** |
| | **(b)** | Briefly explain the physical significance of the three kinds of time derivatives used in the equation of change for momentum transport. | **04** |
| | **(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.2** | **(a)** | State the Hagen-Poiseuille law with all the necessary assumptions. | **03** |
| | **(b)** | Discuss the three parameter rheological models for Non-Newtonian fluid. | **04** |
| | **(c)** | With neat diagram derive the expression of equation of continuity in rectangular coordinate for the incompressible fluid. | **07** |
| **Q.3** | **(a)** | State any three industrial examples of convection heat transport phenomena. | **03** |
| | **(b)** | With suitable examples discuss the difference between free and forced convection heat transport phenomena. | **04** |
| | **(c)** | Derive the expression for heat conduction with chemical heat source in a fixed-bed flow reactor. | **07** |
| **Q.4** | **(a)** | Explain the Fourier's law of heat conduction. | **03** |
| | **(b)** | Discuss the different types of boundary conditions needed to solve heat transport problems. | **04** |
| | **(c)** | With neat sketch derive the equations of temperature distributions for the heat conduction with chemical heat source. | **07** |
| **Q.5** | **(a)** | Define thermal conductivity and thermal diffusivity with its unit. | **03** |
| | **(b)** | State the equation of Prandtl and Nusselt number with their significance. | **04** |
| | **(c)** | Derive the expression for the heat conduction with a viscous heat source. | **07** |
| **Q.6** | **(a)** | State the dimensionless groups to express relation between mass diffusivity, thermal diffusivity and momentum diffusivity along with their significance. | **03** |
| | **(b)** | Explain Fick's law of binary diffusion along with its supportive equations. | **04** |
| | **(c)** | With neat diagram derive an expression of molar flux for the diffusion with homogeneous chemical reaction. | **07** |

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| **Q.7** | **(a)** | Briefly discuss the theory of diffusion in gases at low density. | **03** |
| | **(b)** | Explain the boundary conditions for solving the mass transport problems. | **04** |
| | **(c)** | Write a note on diffusion of gases in porous media. | **07** |
| **Q.8** | **(a)** | State any two methods of prediction of the diffusivity for binary system. | **03** |
| | **(b)** | Explain the molecular diffusion in gases with appropriate equations. | **04** |
| | **(c)** | Derive the expression of flux for the diffusion of A through non diffusing B. | **07** |

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