

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-IV (NEW) EXAMINATION – SUMMER 2024****Subject Code:3142110****Date:20-07-2024****Subject Name: Introduction to 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     |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>Q.1</b> | (a) Enumerate application and usefulness of Transport Phenomena.                                                                                                                                                                                                                                                                           | <b>03</b> |
|            | (b) Determine mass density and specific weight of liquid having sp.gravity                                                                                                                                                                                                                                                                 | <b>04</b> |
|            | (c) Define fluid and classify fluid based on newton's law of viscosity.                                                                                                                                                                                                                                                                    | <b>07</b> |
| <b>Q.2</b> | (a) Define the following terms: (1) Mass density (2) Weight density (3) Specific gravity.                                                                                                                                                                                                                                                  | <b>03</b> |
|            | (b) Differentiate free convection and force convection                                                                                                                                                                                                                                                                                     | <b>04</b> |
|            | (c) State Euler's equation of motion. And derive Bernoulli's equation                                                                                                                                                                                                                                                                      | <b>07</b> |
|            | <b>OR</b>                                                                                                                                                                                                                                                                                                                                  |           |
|            | (c) Explain different type's fluid flows.                                                                                                                                                                                                                                                                                                  | <b>07</b> |
| <b>Q.3</b> | (a) Explain concept of black body.                                                                                                                                                                                                                                                                                                         | <b>03</b> |
|            | (b) Explain: absorptivity, reflectivity, transmissivity.                                                                                                                                                                                                                                                                                   | <b>04</b> |
|            | (c) Derive differential momentum balance equation.                                                                                                                                                                                                                                                                                         | <b>07</b> |
|            | <b>OR</b>                                                                                                                                                                                                                                                                                                                                  |           |
| <b>Q.3</b> | (a) Explain conduction, convection and radiation.                                                                                                                                                                                                                                                                                          | <b>03</b> |
|            | (b) Derive and explain thermal conductivity and its unit with help of Fourier's Law of heat conduction.                                                                                                                                                                                                                                    | <b>04</b> |
|            | (c) Derive differential equation of heat conduction in rectangular coordinate system                                                                                                                                                                                                                                                       | <b>07</b> |
| <b>Q.4</b> | (a) Explain Newton's law cooling.                                                                                                                                                                                                                                                                                                          | <b>03</b> |
|            | (b) Explain Fick's first law of diffusion & what its limitations are?                                                                                                                                                                                                                                                                      | <b>04</b> |
|            | (c) State and Explain Wien's displacement Law of radiation                                                                                                                                                                                                                                                                                 | <b>07</b> |
|            | <b>OR</b>                                                                                                                                                                                                                                                                                                                                  |           |
| <b>Q.4</b> | (a) Discuss Kirkindal effect.                                                                                                                                                                                                                                                                                                              | <b>03</b> |
|            | (b) Explain pseudo steady diffusion.                                                                                                                                                                                                                                                                                                       | <b>04</b> |
|            | (c) Derive Hagen-Poiseulle equation for fluid flowing through pipe.                                                                                                                                                                                                                                                                        | <b>07</b> |
| <b>Q.5</b> | (a) Air is blown over a hotplate of cross section area $2.5 \text{ m}^2$ and maintained at temperature difference of $180^\circ\text{C}$ . If plate receives heat of $780 \text{ W}$ , calculate coefficient of convective heat transfer.                                                                                                  | <b>03</b> |
|            | (b) A plane wall of $200 \text{ mm}$ thickness with cross sectional wall area $3 \text{ m}^2$ have its thermal conductivity $15 \text{ W/m}^\circ\text{C}$ . The wall surface temperatures are steady at $150^\circ\text{C}$ and $50^\circ\text{C}$ . Determine heat flow across the plane wall and temperature gradient in flow direction | <b>04</b> |
|            | (c) Derive equation of viscosity measurement by Stoke's method                                                                                                                                                                                                                                                                             | <b>07</b> |
|            | <b>OR</b>                                                                                                                                                                                                                                                                                                                                  |           |

- Q.5**    **(a)**    Calculate heat transfer per unit area through a copper plate 42 mm thick whose one face is maintained at 400 °C and other face is at 50 °C. Take thermal conductivity of copper as 380 W/m °C.    **03**
- (b)**    For a fluid of specific Gravity 0.87, calculate density and weight density. Calculate flow rate for water flowing through a pipe of 25 cm diameter at velocity of 4 m/sec.    **04**
- (c)**    Derive the general mass transfer equation in Cartesian coordinates.    **07**

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