

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE- SEMESTER- VI EXAMINATION – SUMMER 2026****Subject Code:3162313****Date:22-05-2026****Subject Name:Kinetics and Rheology of Plastics****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) Define: Stress, Strain, rate of reaction                                                                                                                                                                      | <b>03</b> |
|            | (b) Explain working of Semi-batch reactor along with advantages and limitations.                                                                                                                                  | <b>04</b> |
|            | (c) Discuss working of Torque Rheometer with neat diagram and its applications.                                                                                                                                   | <b>07</b> |
| <b>Q.2</b> | (a) Define: Activation energy, Rheology, Rate constant                                                                                                                                                            | <b>03</b> |
|            | (b) State and discuss about Williams–Landel–Ferry (WLF) Equation.                                                                                                                                                 | <b>04</b> |
|            | (c) Explain Burger model for viscoelastic materials.                                                                                                                                                              | <b>07</b> |
|            | <b>OR</b>                                                                                                                                                                                                         |           |
|            | (c) Explain kinetics studies of free radical copolymerization.                                                                                                                                                    | <b>07</b> |
| <b>Q.3</b> | (a) Explain about the Power law.                                                                                                                                                                                  | <b>03</b> |
|            | (b) Discuss kinetics studies of cationic polymerization.                                                                                                                                                          | <b>04</b> |
|            | (c) Give basic principle, significance and working of Capillary Rheometer with neat diagram.                                                                                                                      | <b>07</b> |
|            | <b>OR</b>                                                                                                                                                                                                         |           |
| <b>Q.3</b> | (a) A linear amorphous polymer has a $T_g$ of $+10^\circ\text{C}$ . At $38^\circ\text{C}$ , it has a melt viscosity of $3 \times 10^8$ poise. Calculate the viscosity of polymer at its $T_g$ using WLF equation. | <b>03</b> |
|            | (b) Discuss the effect of molecular weight, molecular weight distribution and chain branching on viscosity.                                                                                                       | <b>04</b> |
|            | (c) Explain Kelvin-voigt model for viscoelasticity.                                                                                                                                                               | <b>07</b> |
| <b>Q.4</b> | (a) Give Difference between Elementary and non elementary reactions.                                                                                                                                              | <b>03</b> |
|            | (b) Define free volume. Explain the theory based on the concepts of free volume.                                                                                                                                  | <b>04</b> |
|            | (c) Write a note on: Zener model                                                                                                                                                                                  | <b>07</b> |
|            | <b>OR</b>                                                                                                                                                                                                         |           |
| <b>Q.4</b> | (a) Explain the behavior of pseudoplastic, dilatants and bingham plastic fluids.                                                                                                                                  | <b>03</b> |
|            | (b) Describe the Weissenberg effect in molten polymers with neat diagram.                                                                                                                                         | <b>04</b> |
|            | (c) Explain kinetics studies of free radical polymerization.                                                                                                                                                      | <b>07</b> |
| <b>Q.5</b> | (a) Define Kinetic chain length. Give equation showing correlation between (1) kinetic chain length and Degree of Polymerization and (2) Extent of reaction and degree of polymerization.                         | <b>03</b> |
|            | (b) Discuss kinetics studies of anionic polymerization.                                                                                                                                                           | <b>04</b> |
|            | (c) Explain Reactivity ratio and Copolymerization behavior.                                                                                                                                                       | <b>07</b> |

**OR**

- Q.5 (a)** The activation energy of a bimolecular reaction is about 9200 cal/mol. How much faster is this reaction takes place at 500 K than at 400 K?  $R=1.987 \text{ Cal/mol K}$ . **03**
- (b)** Write a note on (i) Die swell (ii) Melt fracture effect in plastic processing. **04**
- (c)** Explain working of Continuous stirred tank reactor (CSTR) along with its advantages and limitations. **07**

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