

Enrollment No./Seat No.:

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**Bachelor of Engineering - SEMESTER - III EXAMINATION - WINTER 2025**

**Subject Code: 3132306**

**Date: 31-12-2025**

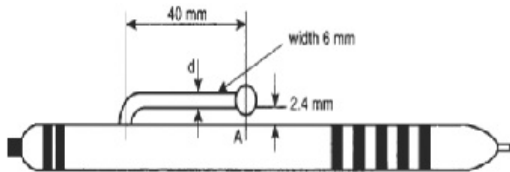
**Subject Name: Applied mathematics in Plastic Industry**

**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.**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Marks</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>Q.1 (a)</b> Define: Stress, Strain and Modulus                                                                                                                                                                                                                                                                                                                                                                                                   | <b>03</b>    |
| <b>(b)</b> Explain Hook's model for elastic behavior with graph.                                                                                                                                                                                                                                                                                                                                                                                    | <b>04</b>    |
| <b>(c)</b> Explain the mathematical model using Maxwell model for Viscoelastic behavior.                                                                                                                                                                                                                                                                                                                                                            | <b>07</b>    |
| <b>Q.2 (a)</b> Give types of reinforcements and types of matrix used in polymer composites.                                                                                                                                                                                                                                                                                                                                                         | <b>03</b>    |
| <b>(b)</b> Explain Newton's model for viscous behavior with graph.                                                                                                                                                                                                                                                                                                                                                                                  | <b>04</b>    |
| <b>(c)</b> Give classification of Non-Newtonian fluids with suitable examples.                                                                                                                                                                                                                                                                                                                                                                      | <b>07</b>    |
| <b>OR</b>                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |
| <b>(c)</b> Explain the analysis of heat transfer during polymer processing.                                                                                                                                                                                                                                                                                                                                                                         | <b>07</b>    |
| <b>Q.3 (a)</b> Discuss the concept of stress concentration.                                                                                                                                                                                                                                                                                                                                                                                         | <b>03</b>    |
| <b>(b)</b> Discuss about Concentric Cylinder Viscometer with suitable diagram.                                                                                                                                                                                                                                                                                                                                                                      | <b>04</b>    |
| <b>(c)</b> Explain deformation behavior of Polymeric materials using Burger Model.                                                                                                                                                                                                                                                                                                                                                                  | <b>07</b>    |
| <b>OR</b>                                                                                                                                                                                                                                                                                                                                                                                                                                           |              |
| <b>(a)</b> Discuss about short term testing of plastics.                                                                                                                                                                                                                                                                                                                                                                                            | <b>03</b>    |
| <b>(b)</b> A ball-point pen made from polypropylene has the clip design shown in Fig. When the pen is inserted into a pocket, the clip is subjected to a deflection of 2 mm at point A. If the limiting strain in the material is to be 0.5% calculates (i) a suitable thickness, $d$ , for the clip (ii) the initial stress in the clip when it is first inserted into the pocket. The short-term modulus of polypropylene is $1.6 \text{ GN/m}^2$ | <b>04</b>    |
|                                                                                                                                                                                                                                                                                                                                                                  |              |
| <b>(c)</b> Explain Swelling Ratios Due to Shear Stresses in long capillary.                                                                                                                                                                                                                                                                                                                                                                         | <b>07</b>    |
| <b>Q.4 (a)</b> Define coefficient of thermal expansion. Derive equation to determine coefficient of thermal expansion.                                                                                                                                                                                                                                                                                                                              | <b>03</b>    |

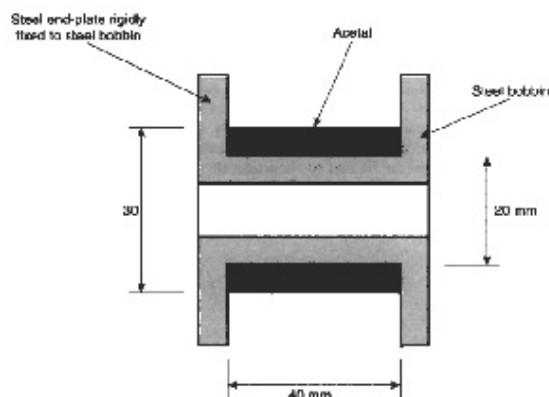
- (b) The density of a composite made from unidirectional glass fibers in an epoxy matrix is  $1950 \text{ kg/m}^3$ . If the densities of the glass and epoxy are known to be  $2540 \text{ kg/m}^3$  and  $1300 \text{ kg/m}^3$ , calculate the weight fraction of fibers in the composite. 04
- (c) Explain cone and plate viscometer to obtain flow data on polymer melts. 07

**OR**

- (a) Explain Viscoelastic Behavior of Plastics. 03
- (b) Explain Ram extruder to obtain flow data on polymer melt with diagram. 04
- (c) Describe about analysis of continuous fiber composite having the longitudinal properties. 07

**Q.5** (a) Define: Rheology, Viscosity and Shear rate. 03

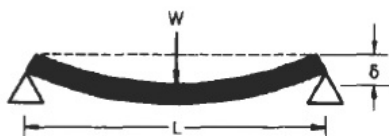
- (b) The bobbin shown in Fig. has been manufactured by sliding the acetal ring on to the steel inner and then placing the end-plate in position. At  $20^\circ\text{C}$  there are no stresses in the acetal and the distance between the metal end-plates is equal to the length of the acetal ring. If the whole assembly is heated to  $100^\circ\text{C}$ , calculate the axial stress in the acetal. It may be assumed that there is no friction between the acetal and the steel. The coefficients of thermal expansion for the acetal and the steel are  $80 \times 10^{-6} \text{ }^\circ\text{C}^{-1}$  and  $11 \times 10^{-6} \text{ }^\circ\text{C}^{-1}$  respectively. The modulus of the acetal at  $100^\circ\text{C}$  is  $1.5 \text{ GN/m}^2$ . 04



- (c) Derive Rheological models for Polymer melt flow. 07

**OR**

- (a) A polypropylene beam is 100 mm long, simply supported at each end and is subjected to a load  $W$  at its mid-span. If the maximum permissible strain in the material is to be 1.5%, calculate the largest load which may be applied so that the deflection of the beam does not exceed 5 mm in a service life of 1 year. For the beam  $I = 28 \text{ mm}^4$  and Modulus is  $347 \text{ MN/m}^2$ . 03



- (b) Discuss Relaxation and Residence time. 04
- (c) Explain the Kelvin-Voigt model with mathematical expression. 07

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