

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 3132306

Date: 21-11-2024

Subject Name: Applied mathematics in Plastic Industry

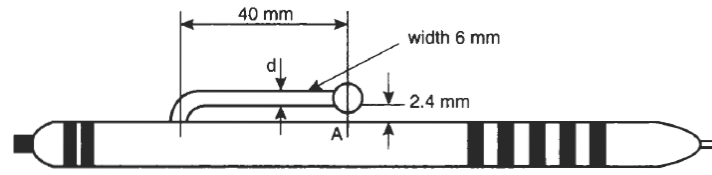
Time: 10:30 AM TO 01:00 PM

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.

		MARKS
Q.1	(a) Explain Hook's model for elastic behavior.	03
	(b) Give classification of Non-Newtonian fluids with suitable examples.	04
	(c) Explain the mathematical model using Maxwell Model for Viscoelastic behavior.	07
Q.2	(a) Explain Newton's model for viscous behavior.	03
	(b) Define: Rheology, Viscosity, Shear rate and Aspect ratio.	04
	(c) Explain Swelling Ratios Due to Shear Stresses in long capillary.	07
	OR	
	(c) Discuss about short term testing and long term testing of Plastics in brief.	07
Q.3	(a) Define coefficient of thermal expansion. Derive equation to determine coefficient of thermal expansion.	03
	(b) Swelling Ratios Due to Tensile Stresses in short capillary.	04
	(c) Explain cone and plate viscometer to obtain flow data on polymer melts.	07
	OR	
Q.3	(a) Discuss the concept of stress concentration.	03
	(b) Explain Ram extruder to obtain flow data on polymer melt with diagram.	04
	(c) Explain the mathematical model using Maxwell model for Viscoelastic behavior.	07
Q.4	(a) Discuss Relaxation and Residence time.	03
	(b) The density of a composite made from unidirectional glass fibers in an epoxy matrix is 1950 kg/m^3 . If the densities of the glass and epoxy are known to be 2540 kg/m^3 and 1300 kg/m^3 , calculate the weight fraction of fibers in the composite.	04
	(c) Describe Burger model for viscoelastic materials.	07
	OR	
Q.4	(a) Define: Stress, Strain and Modulus	03
	(b) Derive Rheological models for Polymer melt flow.	04
	(c) Explain the mathematical model using Kelvin or Voigt Model for Viscoelastic behavior.	07
Q.5	(a) Discuss forms of Fiber reinforcement in composites.	03
	(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 and (iii) the stress in the clip when it has been in the pocket for 1 week. The short-term modulus of polypropylene is 1.6 GN/m^2	04



Ball-point pen clip design

- (c) Explain the analysis of heat transfer during polymer processing.

07

OR

- Q.5 (a) Give types of reinforcements and types of matrix used in polymer composites.

03

- (b) PEEK is to be reinforced with 40 % by volume of unidirectional carbon fibers and the properties of the individual materials are given below. Calculate the density, modulus and strength of the composite in the fiber direction.

04

Material	Density (kg/cm^3)	Tensile Strength (GN/m^2)	Modulus (GN/m^2)
PEEK	1300	0.058	3.8
Carbon fiber	1800	2.1	400

- (c) Describe about analysis of continuous fiber composite having the longitudinal properties.

07
