Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV (New) EXAMINATION – WINTER 2019

Subject Code: 2142305 **Date: 16/12/2019**

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.**

			MARKS
Q.1	**(a)**	Give detail classification of Non Newtonian fluids.	**03**
	(b)	Derive Rheological models for Polymer melt flow.	**04**
	(c)	Explain cone and plate viscometer to obtain flow data on polymer melts.	**07**
Q.2	**(a)**	Explain short term testing of Plastics.	**03**
	(b)	Discuss Hooke model and Newton Model showing Elongation –Time and Stress-strain behavior.	**04**
	(c)	Explain the mathematical model using Maxwell model for Viscoelastic behavior.	**07**
		OR	
	(c)	Explain the radius of gyration of linear ideal chain.	**07**
Q.3	**(a)**	Define drag flow, pressure flow, leakage flow.	**03**
	(b)	Discuss Swelling ratios due to Shear Stresses for long capillary.	**04**
	(c)	In a particular extruder screw the channel depth is 2.4 mm, the screw diameter is *50*mm, the screw speed is 100 rev/min, the flight angle is 17°42' and the pressure varies linearly over the screw length of 1000 mm from zero at entry to 20 MN/m^2 at the die entry. Estimate (a) the drag flow (b) the pressure flow (c) the total flow. the plastic has a viscosity of $210Ns/m^2$	**07**
		OR	
Q.3	**(a)**	The output of polythene from an extruder is 30 $x10^{-6}$ m^3/s. If the breaker plate in this extruder has 80 holes, each being 4 mm diameter and 12 mm long, estimate the pressure drop across the plate assuming the material temperature is 170°C at this point. The shear stress is 1.2 x 10^5 N/m^2	**03**
	(b)	Draw the creep curve and explain its various stages.	**04**
	(c)	With neat diagram explain Ram extruder to obtain flow data on polymer melt.	**07**
Q.4	**(a)**	Which are the different forms of Fiber reinforcement in composites? Discuss.	**03**
	(b)	Applying the Carreau model to PP, the following constants are known at 190ºC. η_0=2350 Ns/m^2, A_T=0.05, n=0.33, Estimate the viscosity of PP at 230 ºC and a shear rate of 1000 s^{-1}. The glass transition temperature for the PP is -10 ºC.	**04**
	(c)	Derive the expression for drag flow in detail for analysis of flow in extruder.	**07**
		OR	
Q.4	**(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 mm^4 and Modulus is 347 MN/m^2.	**03**
	(b)	Write a note on: Kelvin/Voigt model	**04**
	(c)	Explain the analysis of heat transfer during polymer processing.	**07**

Q.5 **(a)** Discuss Residence Time and Relaxation 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**

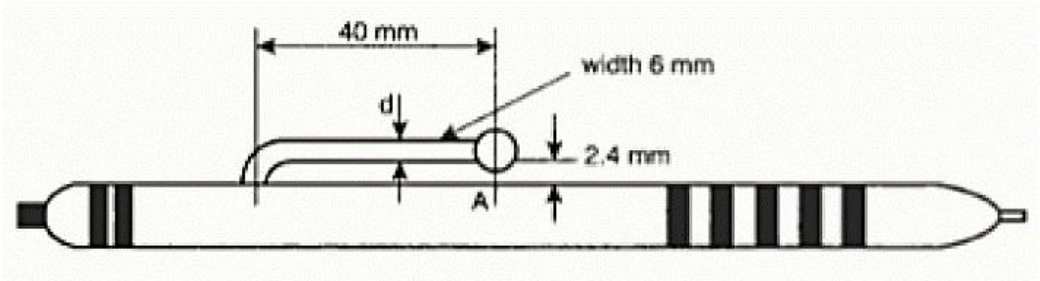
(c) Describe the analysis of continuous fiber composite having the longitudinal properties. **07**

OR

Q.5 **(a)** PEEK is to be reinforced with 30% 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. **03**

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

(b) A ball-point pen made from polypropylene has the clip design shown in Figure. 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% calculate (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 GN/m^2. **04**



(c) Explain: Iso thermal flow in channels: Non Newtonian fluids -flow of power law fluid along a channel of uniform circular cross-section. **07**