Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2018

Subject Code:2142305 Date:12/12/2018

Subject Name:Applied Mathematics in Plastic Industry

Time: 02:30 PM TO 05:00 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)**	Define: Newtonian fluid, Shear stress and Shear Strain	**03**
	(b)	Give detail classification of Non Newtonian fluids along with example.	**04**
	(c)	Explain the mathematical model using Maxwell model for Viscoelastic behavior.	**07**
Q.2	**(a)**	Discuss short term test methods for Plastics.	**03**
	(b)	Write a note on: Swelling ratios due to Shear Stresses.	**04**
	(c)	Explain cone and plate viscometer to obtain flow data on polymer melts.	**07**
		OR	
	(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 $17^{o}42'$ 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**
Q.3	**(a)**	Discuss forms of Fiber reinforcement in composites.	**03**
	(b)	With neat diagram explain Ram extruder to obtain flow data on polymer melt.	**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**
		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)	Explain concentric cylinder viscometer to obtain flow data on polymer melts.	**07**
Q.4	**(a)**	Draw graphs for Hooke model, Newton Model and Voigt model showing Elongation –Time and Stress-strain behaviour.	**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)	Discuss Residence Time and Relaxation Time.	**07**

OR

Q.4 **(a)** Discuss about Melt fracture and Sharksin flow defects in polymer melt. **03**

(b) Write a short note on strength of composites for Fiber reinforced materials. **04**

(c) Explain the analysis of heat transfer during polymer processing. **07**

Q.5 **(a)** Define drag flow, pressure flow, leakage flow **03**

(b) Applying the Carreau model to PP, the following constants are known at 190ºC. η_0=2250 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) Explain the analysis of continuous fiber composite having the longitudinal properties. **07**

OR

Q.5 **(a)** PEEK is to be reinforced with 20% 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) Derive Rheological models for Polymer melt flow. **04**

(c) Explain the radius of gyration of an ideal branched polymer using Kramers Theorem. **07**

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