Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(New) • EXAMINATION – WINTER 2016

Subject Code:2142305 **Date:24/11/2016**

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		**Short Questions**	**14**
	1	Define : Creep, Stress Relaxation	
	2	What is Drag flow?	
	3	What is Viscoelastic fluid?	
	4	What are Newtonian and Nonnewtonian fluids?	
	5	What are thixotropic fluids?	
	6	What does Maxwell model demonstrate?	
	7	What is bingham plastic?	
	8	What is Psuedoplastic fluid?	
	9	What is Kramers Theorem?	
	10	Why do Plastics Exhibit Average molecular weights?	
	11	What is Fouriers number?	
	12	Define Radius of Gyration	
	13	What is shear strain?	
	14	What is a leakage flow?	
Q.2	**(a)**	Discuss Maxwell model	**03**
	(b)	Explain the Viscoelastic behavior of plastics	**04**
	(c)	In a particular extruder screw the channel depth is 3 mm, the screw diameter is *60*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**
		OR	
	(c)	Determine the expressions of the creep, relaxation and recovery for the Kelvin-voigt model	**07**
Q.3	**(a)**	What is isometric and isochronous graph?	**03**
	(b)	Derive the expressions for the drag flow in detail for the analysis of flow in the extruder	**04**
	(c)	PEEK is to be reinforced with 30% by volume of unidirectional carbon fibres and the properties of the individual materials are given below. Calculate the density, modulus and strength of the composite in the fibre direction.	**07**

Material	Density (kg/cm3)	Tensile strength(GN/m2)	Modulus(GN/m2)
PEEK	1300	0.058	3.8

Carbon fiber	1800	2.1	400

OR

Q.3 **(a)** What weight of carbon fibers [density:1800 kg/m3] must be added to 1 kg of epoxy[density :1250 kg/m3] to produce a composite with a density of 1600 kg/m3. **03**

(b) **Explain the radius of gyration of linear ideal chain** **04**

(c) Determine the expressions of the creep, relaxation and recovery for the Kelvin-voigt model **07**

Q.4 **(a)** Explain stress relaxation curve **03**

(b) The density of a composite made from unidirectional glass fibres 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 fibres in the composite **04**

(c) Explain the isochronous and Isometric graphs for design methods for plastics using deformation data. **07**

OR

Q.4 **(a)** Explain creep curve **03**

(b) Explain the analysis of continuous fiber composite having the longitudinal properties. **04**

(c) In a plunger-type injection moulding machine the torpedo has a length of 40 mm, a diameter of 23 mm and is supported by three spiders. If, during moulding of polythene at 170°C, the plunger moves forward at a speed of 15 mm/s, estimate the pressure drop along the torpedo and the shear force on the spiders. The barrel diameter is 25 mm. assume that flow is isothermal. The gap between the torpedo and the barrel may be considered as a rectangular slit with $T = (\pi \times 24 \times 10^{-3})$m and $H = 1 \times 10^{-3}$ m. **07**

Q.5 **(a)** Explain the analysis of heat transfer during polymer processing **03**

(b) 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 **04**

(c) 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 mm4 and Modulus is 347 MN/m2 **07**

OR

Q.5 **(a)** Calculate the chain length and contour length of a PE sample, whose **03**

segment length is 1.54A°, bond angle is 109°28'. Assume segments as 1000.

(b) Explain the isothermal flow in channels of Non-Newtonian fluids having the flow of fluid along a channel of uniform circular cross-section. **04**

(c) Derive formulae for calculation of weight average and number average molecular weights. **07**

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