Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–IV(NEW) – EXAMINATION – SUMMER 2019

Subject Code:2142305   **Date:25/05/2019**
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**
4. **Do not write anything on the question paper except seat no**

Q.1	**(a)**	Define, 1) Newtonian Fluid, 2) Bingham plastic, 3) viscoelastic fluid	03
	(b)	Write a short note on Residence and Relaxation Times	04
	(c)	Which are the different Mathematical Models available for Viscoelastic Behavior? Explain any one in detail.	07
Q.2	**(a)**	Describe Fourier number and temperature gradient	03
	(b)	State and explain Power law.	04
	(c)	Explain the Rheological model for polymer melt flow	07
		OR	
	(c)	Explain Enthalpy calculations for Injection moulding	07
Q.3	**(a)**	Write a short note on thermal conductivity on Plastics.	03
	(b)	Explain the radius of gyration of linear ideal chain	04
	(c)	Explain the radius of gyration of an ideal branched polymer(kramers theorem)	07
		OR	
Q.3	**(a)**	Derive the equation for Temperature Rise in Die, $\Delta T = \frac{P}{\rho C_p}$ where ρ is the density of the fluid and Cp is its specific heat.	03
	(b)	Explain Heat Transfer Phenomena in Plastic Processing.	04
	(c)	Write a short note on radius of gyration of rod polymer.	07
Q.4	**(a)**	Write a short note on strength of composites for Fiber reinforced materials.	03
	(b)	Write a short note on Creep.	04
	(c)	Describe Mathematical Models of Visco-elastic Behavior through Maxwell model.	07
		OR	
Q.4	**(a)**	Discuss the Stress Strain behaviour of plastic materials.	03
	(b)	Write a short note on Isometric and Isochronous graphs with neat sketch.	04
	(c)	Explain Kelvin Voigt Model.	07
Q.5	**(a)**	Define Drag flow, Pressure flow and Leakage flows.	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) A single screw extruder is to be used to manufacture a nylon rod 5 mm in diameter at a production rate of 1.5 ndmin. Using the following information, calculate the required screw speed. **07**

Nylon	Extruder	Die
Viscosity = 420 Ns/m2	Diameter = 30 mm	Length = 4 mm
Density (solid) = 1140 kg/m3	Length = 750 mm	Diameter = 5 mm
Density (melt) = 790 kg/m3	Screw flight angle = 17.7"	
	Metering channel depth = 2.5 mm	

Die swelling effects may be ignored and the melt viscosity can be assumed to be constant.

OR

Q.5 **(a)** Discuss the analysis of Blow moulding operation, **03**

(b) A polyethylene injection moulding is in the form of a flat sheet 100 mm square and 3 mm thick. If the melt temperature is 230°, the mould temperature is 30° and the plastics may be ejected at a centre line temperature of 90° estimate **04**

   a) The temperature of the material at the centre of the moulding after 7 seconds.

   b) The time taken for the centre of the moulding to reach the ejection temperature of 90°

   Take temperature gradient 0.58 and fourier number 0.59 & $\alpha = 1 \times 10^{-7} \; m^2/s$.

(c) A blow moulding die has an outside diameter of 30 mm and an inside diameter of 27 mm. The parison is inflated with a pressure of 0.4 MN/m2 to produce a plastic bottle of diameter 50 mm. If the extrusion rate used causes a thickness swelling ratio of 2, estimate the wall thickness of the bottle. Comment on the suitability of the production conditions if melt fracture occurs at a stress of 6 MN/m2 **07**

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