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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