This question paper contains 4 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : **1615**

Unique Paper Code : **1141301** **F-3**

Name of the Paper : **Polymer Rheology**

Name of the Course : **B.Tech. Polymer Science**

Semester : **III**

Duration : **3 Hours** Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *Five* questions in all.

Question No. **1** is compulsory.

Use of simple calculator is allowed.

1. (*a*) Give stress-strain curve for the following at constant stress :

   (*i*) Ideal elastic spring

   (*ii*) Newtonian fluid

   (*iii*) Maxwell element.

   (*b*) Derive the velocity components for the annular flow.

   (*c*) Explain melt fracture of the polymer with suitable curve.

   (*d*) Illustrate steps of rubber-filler mixing.

P.T.O.

(*e*) Explain Troutons law.

(*f*) Compare Bingham model and Ostwald de Waele model.

(*g*) Theories of viscoelasticity of amorphous polymers cannot be valid for crystalline polymers. Justify.

(*h*) Explain the laminar convective mixing.

(*i*) State the importance of the channel depth in single screw extruder. 9×3=27

2. (*a*) Derive the volumetric flow rate equation when the fluid is passing through the capillary viscometer. 5

(*b*) Give merits and demerits of Maxwell viscoelastic model. 4

(*c*) Explain importance of kneading block in twin screw extruder. 3

3. (*a*) Calculate the die swell and relaxation time data of polystyrene from the following data obtained using a capillary rheometer : 5

$\gamma(sec^{-1})$	Polystyrene	
	$\tau_w(Pa) \times 10^{-4}$	P_{exit} (Pa) × 10^{-4}
100	7	13
500	13	21

(*b*) Explain dispersive mixing. 4

(*c*) A cone and plate rheometer (cone angle = 1.5°) operates at a rotational speed of 100 min^{-1}. What should be the speed to generate the same shear rate if the cone angle is doubled ? 3

4. (*a*) The following shear stress and shear rate data are available for polystyrene from the measurements carried out in capillary rheometers :

Shear rate (sec^{-1})	**Shear stress (Pa)**		
	210°C	**230°C**	**250°C**
500	1.5×10^5	1.0×10^5	0.5×10^5
5000	2.0×10^5	1.55×10^5	1.34×10^5

Estimate the variation of viscosity with the temperature. 5

(*b*) Explain the calendering defects in rubber and thermoplastics. 4

(*c*) Describe the F, I, Z types of calenders. 3

5. (*a*) Examine response of Maxwell model for stress relaxation behaviour with the suitable curve. 5

(*b*) Discuss distributive mixing with suitable schematic. 4

(*c*) Determine the shear rates at a rotational speed of 1000 min^{-1} in a cone and plate rheometer (radius = 25 mm, cone angle = 1.5°). 3

P.T.O.

6. (*a*) The following data were obtained for HDPE using a capillary viscometer (capillary dia : 4 mm)

	ΔP (M/m^2)	Q (cm^3/sec)
L/D = 4	2×10^6	0.25
	4×10^6	1.00

Calculate shear stress, shear rate and viscosity of the polymer. 5

(*b*) Describe pressure flow and leak flow. 4

(*c*) Describe parameters which estimate the complete mixing. 3