

Sl. No. of Question Paper: 1468

Unique Paper Code : 1141301

F-7

Name of the Paper : Polymer Rheology

Name of the Course : B.Tech. Polymer Science

Semester : III

Duration : 3 hours

Maximum Marks : 75 Marks

Instructions for Candidates :

1. Write your Roll No. on receipt of this question paper.
2. Attempt **five** questions in all.
3. Question No. 1 is compulsory.
4. Use of scientific calculator is allowed.

1.

- (a) What is intrinsic viscosity of a polymer solution? How is it determined?
- (b) How Ellis model help in finding out the rheological behavior of polymer and rubber melts.
- (c) Explain the phenomenon of die swell for the extrudate from the extruder die.
- (d) Determine the shear rates at a rotational speed of 5000 min^{-1} in a cone and plate rheometer (radius = 25mm, cone angle = 1.5°)
- (e) Explain I, F and Z type of calendars.
- (f) What is the asymptotic strain value in static creep test for Voigt-Kelvin (V-K) model?
- (g) Define retardation time, Ψ_i , for static creep behaviour in Maxwell model for the viscoelastic behaviour.
- (h) How does residence time is related in determining the molecular weight and molecular weight distribution in a single screw extruder.
- (i) Explain Weissenberg effect in viscous solutions.

(9 x 3)

2.

- (a) Differentiate between Pseudoplastic and Dilatant fluids by suitable curves. Also explain the cause of such behaviour for these Time-Independent fluids. Give suitable examples for each.
- (b) Write a short note on Banbury mixture and explain it with suitable diagram.
- (c) What do you mean by extensional flow? Explain different types of extensional flow behaviour in polymer melts.

(5 + 4 + 3)

3.

- (a) Explain the variation of solution viscosity versus
 - (i) Molecular weight
 - (ii) Concentration

- (b) Explain the Bagley's correction factor. How it can be used to correct the apparent shear stress to give true value of shear stress.?
- (c) Explain the phenomenon of melt fracture for the extruded melt.

(5 + 4 + 3)

4.

- (a) Derive the relationship to find out the apparent viscosity in a cone and plate viscometer.
- (b) Define creep compliance for viscoelastic behaviour of polymer melt. Name various terms involved in it.
- (c) Compare single screw and twin screw extruder in polymer processing applications.

(5 + 4 + 3)

5.

- (a) Describe parameters influencing polymer viscosity.
- (b) Describe creep behaviour of the following with the help of suitable curves.
(i) Viscous liquids (ii) Viscoelastic liquids (iii) Elastic liquids
- (c) A Voigt element has the following parameters- $E = 5 \times 10^8 \text{ N/m}^2$ and $\eta = 5 \times 10^{10} \text{ Ns/m}^2$. Determine compliance and retardation time for this element if the imposed constant stress is 10^8 N/m^2 .

(5 + 4 + 3)

6.

- (a) Explain the response of different materials (Elastic, Viscous and Viscoelastic) under stress relaxation test.

- (b) Describe the velocity components for the annular flow.
- (c) Explain the relationship between relaxation modulus and residual modulus.

(5 + 4 + 3)