

[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2061

L

Unique Paper Code : 6092011202

Name of the Paper : Polymer Rheology

Name of the Course : **B.Sc. (Hons.) Polymer Science (UGCF)**

Semester : II

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **Five** questions in all.
3. Question No. **1** is compulsory.
4. Draw neat and labelled diagram wherever necessary.
5. Scientific calculator is allowed.
6. Attempt **all** parts together.

1.

- (a) What is the Weissenberg effect, and how is it relevant to polymer processing?
- (b) Define viscoelasticity and its importance in polymer behaviour.
- (c) Explain methods to reduce die swell.
- (d) Explain the concept of relaxation time in polymers.
- (e) Explain the mechanism of adiabatic heating in an extruder.
- (f) What factors influence screw design in a single screw extruder?
- (g) What is the significance of the Deborah number in polymer flow?
- (h) How does shear rate affect polymer viscosity?
- (i) Define thixotropy and its relevance to polymers.
- (j) A cone and plate rheometer (cone angle 2.5°) operates at a rotational speed of 200 min^{-1} . What should be the speed to generate the same shear rate if the cone angle is doubled?

(10 × 3)

P.T.O.

2.

- (a) Describe the phenomenon of wall slip in polymer flow.
- (b) How does Ellis model help in finding out the rheological behaviour of polymer and rubber melts?
- (c) Explain the Bagley's correction factor. How it can be used to correct the apparent shear stress to give true value of shear stress?

(3 × 5)

3.

- (a) Compare low and high compression ratio screws with examples.
- (b) How does polymer architecture (linear vs. branched) affect rheology?
- (c) Compare the three types of flow (drag, pressure and leakage) in extrusion.

(3 × 5)

4.

- (a) In Static Creep test for the Voigt-Kelvin Model, derive the creep behaviour and draw creep response of the model. Explain the variation of this curve with suitable mathematical relations.
- (b) Describe the frequency dependence of polymer viscoelastic properties (G' , G'' , $\tan \delta$).
- (c) Derive the relation for dynamic modulus and dynamic viscosity for viscoelastic fluid behaviours.

(3 × 5)

5.

- (a) Derive the rheological relationship for Brookfield viscometer.
- (b) Explain the steps involved in rubber-filler mixing.
- (c) Describe the creep compliance function for a viscoelastic polymer.

(3 × 5)

6. Write short note on **any five**:

- (a) Stress relaxation
- (b) viscoelastic recovery
- (c) Laminar flow
- (d) Retardation time, Ψ_i
- (e) Melt flow index
- (f) Bambooning defect in extrusion

(5 × 3)