Sl. No. of Question Paper: 6146

Unique paper code: 1141301

Name of Paper: Polymer Rheology

Name of course: B.Tech. Polymer Science F-5

Semester: III

Duration: 3 hours

Maximum Marks: 75

Instructions for candidates: Attempt any 5 question in all. Question No.1 is compulsory. Use of simple calculator is allowed.

Q.1 a) Draw the shear stress vs shear rate plots for

a) Viscoplastic fluid

b) Thixotropic fluid

c) Bingham plastic

b) Compare velocity component for flow of fluid through tapered rectangular cross section and horizontal slit

c) Describe Ellis model.

d) Explain Plug convective mixing.

e) Polymer melts are non-Newtonian and behave like thermoplastics explain.

f) Derive expression for tan δ in terms of G′ and G″ for viscoelatic material being subjected to a strain .

g) At low shear rate, $\eta_e=3\eta_o$. Prove it.

h) Describe the usefulness of elongational viscosity.

i) Explain the effect of temperature and molecular weight on viscosity of polymer melt

(9X 3)

Q2.a) Aactic polystyrene has a T_g of 100°C. What are the relative rates of stress relaxation of this polymer at 150°C and 125°C?

b) Discuss bagley correction in capillary rheometer.

c) Explain the degree of mixing for perfect and unmixed state. **(5+4+3)**

Q3.a) Viscosity of the polymer melt at different shear rates were measured using a capillary rheometer. The capillary is 4 mm in diameter and 40 mm long. For volumetric flow rates of $85x10^{-8}$ m^3/s and $190\ x10^{-8}$ m^3/s, the pressure measured just before the entry to the capillary are 5 MN/m^2 and 6.5 MN/m^2 respectively. Determine the rheological characteristics of the polymer.

b) Discuss wire calendering process.

c) Explain rod climbing phenomena. **(5+4+3)**

Q4. a) Examine response of Maxwell model for creep behaviour with the suitable curve

b) Illustrate significance of relaxation time in cone and plate rheometer.

c) Explain importance of breaker plate in twin screw extruder. **(5+4+3)**

Q5. a) Derive the working expression of torque in cone and plate viscometer when the cone is rotated at angular speed of Ω.

b) Explain heating and cooling system of calender rolls.

c) Describe the importance of screw size in single screw extruder. **(5+4+3)**

Q6.a) The data from a cone & plate (R=25mm, θ=2°) viscometer for nylon6 is as follows

rpm	**τ (Pa)**	**N_1 (Pa)**
30	1000	75
60	300	125

Calculate die swell and relaxation time for the polymer

b) Derive the expression for forward and backward transition of the mill band in two roll mill.

c) Explain strain distribution function in twin screw extruder. **(5+4+3)**