SC

No. of printed pages: 3

(A-90) **SARDAR PATEL UNIVERSITY**

M.Sc. (Polymer Science Technology) Semester-IV Examination-2015

Saturday, 18th April-2015

02:30 P.M. to 05:30 P.M.

PS04CPST08: POLYMER RHEOLOGY

Total Marks: 70

Note: (1) Attempt all questions.
(2) Figures to the right indicate marks.

Q. 1 Answer the following multiple choice questions. **08**

(1) Chain _____ must have sufficient thermal energy for motion.

(1) segment (2) part (3) molecule (4) All.

(2) In Greek "rheo" meaning _____.

(i) flow (ii) slow (iii) viscosity (iv) melt.

(3) The ratio of stress to corresponding strain below proportional limit of material is known as _____.

(i) modulus (ii) modulus of elasticity (iii) elasto-viscous (iv) creep

(4) Polymer exhibits a time dependant strain response to a constant applied stress. This behavior is called _____.

(1) fatigue (2) creep (3) Bingham plastics (4) modulus.

(5) _____ have a lower apparent viscosity at higher shear rate.

(1) Newtonian fluid (2) Dilatants fluid (3) Bingham plastics (4) Pseudoplastic fluid.

(6) As pressure of polymer melt increases the melt viscosity will _____.

(i) increase (ii) decrease (iii) first increase and then decrease (iv) constant.

(7) Surface irregularity is known as _____.

(i) Die swell (ii) parison sag (iii) sharkskin (iv) All.

(8) $\tau =$ _____.

(i) $\frac{r}{R} \times \tau_w$ (ii) $r \times R \times \tau_w$ (iii) $\frac{rR}{\tau_w}$ (iv) $\frac{R}{r} \times \tau_w$

Q. 2 Attempt **any seven** of the following. **14**

(1) Define rheology and state its importance in processing of plastics materials.

(2) Give the reasons and assumption for deriving relationships for flow through channel of simple cross-section.

(3) Explain the flow properties of polyethylene.

(4) Explain in detail time dependent fluid.

(5) Write a note on torque rheometer.

(6) Why polymeric liquids are non-newtonian?

(7) How is Weissenberg effect observed? Explain.

(8) What do you mean by rheological equation of state and volume viscosity?

(9) Explain the term thixotropic and antithixotropic fluid.

Q. 3 (a) Derive Rabinowitch equation used for flow through capillary. **06**

(b) Answer following. **06**

1. Derive the relation used for the shear stress at the wall during flow through parallel plate.
2. Write a note on principle and working of a capillary rheometer

OR

(b) Answer the following. **06**

1. Define sharkskin. How it can be reduced during polymer processing?
2. What do you mean by die swell? How did it measured? Explain the effects of die swell in polymer processing.

Q. 4 (a) Discuss the effects of temperature and molecular structure on viscous flow of polymer melts. **06**

(b) Derive $Q = hVd - \frac{h^3}{12\eta}\frac{dp}{dx}$ for calendaring process. **06**

OR

(b) Solve the following. **06**

1. A rectangular box of 150mm long, 100mm wide, and 60mm deep is to be thermoformed from flat sheet of $150mm \times 100mm \times 2mm$. Estimate the average thickness of the walls of the final product if conventional vacuum forming is used.
2. Find the wall thickness of blow moulded container made using a parison die of inner diameter 40mm and outer diameter of 44mm. Parison wall thickness to die swell ratio is 2.3 and the container mould has a diameter of 100mm.

Q. 5 (a) What is melt fracture? How does it occur? Explain the effects of molecular weight distribution, branching, and die shape on melt fracture. **06**

(b) How strain enhancement under constant stress of viscoelastic materials can be understood using Kelvin-Voight model. **06**

OR

(b) Explain following. 06

1. Bingham plastics, Dilatant fluid and Pseudoplastic fluid
2. Cone-Plate Rheometer

Q. 6 (a) Write a note on melting, material transfer, shaping and finishing in polymer melt process **06**

(b) Discuss the flow properties of following polymers: **06**
(i) Polypropylene (ii) PVC (iii) Polyamide.

OR

(b) Explain the effects of chain stiffness, conformation and molecular weight distribution on flow properties of thermoplastic polymer. **06**

****