2/21

0205N159

Candidate's Seat No :_____

MSc Sem.-2 Examination

408

Polymer Science

May-2025

Time : 2-30 Hours] **[Max. Marks : 70**

General Instructions

1. ***All question is compulsory***
2. ***Draw neat figure wherever necessary***

Q-1(a) Define T_g and discuss the factors affecting T_g of polymers. **[7 Marks]**

Q-1(b) What is the practical significance of chain orientation, and what are some common processes that induce it? **[7 Marks]**

OR

Q-1(a) What are the kinetics of crystallization in polymers, and what factors influence it? **[7 Marks]**

Q-1(b) What are uniaxial and biaxial orientation, and how do they affect the properties of polymers? **[7 Marks]**

Q-2(a) How is the viscosity of polymer melts different from that of simple liquids, and what factors affect it? **[7 Marks]**

Q-2(b) What is the Power Law and how does it apply to the general treatment of isothermal viscous flow in tubes? **[7 Marks]**

OR

Q-2(a) What is zero-shear rate viscosity, and why is it important for polymer processing? **[7 Marks]**

Q-2(b) What is shear thinning and shear thickening, and how do they relate to polymer melts? **[7 Marks]**

Q-3(a) Write equations for (i) Contour length, (ii) Mean square end-to-end distance, (iii) Most probable end-to-end distance, (iv) Mean end-to-end distance, and (v) Radius of gyration of polymer chain **[7 Marks]**

Q-3(b) Define conformation and configuration. Give one example for each. **[7 Marks]**

OR

Q-3(a) Define optical and geometric isomerism of polymers with proper examples. **[7 Marks]**

Q-3(b) What is the difference between unperturbed and Gaussian chains in polymer science ? What is meant by a random coil in the context of polymer chains? **[7 Marks]**

Q-4(a) Discuss Maxwell model with systematic diagram and mathematical representation, along with stress-strain and elongation-time behavior. **[7 Marks]**

Q-4(b) What is creep in polymers, and how does it occur under constant stress? **[7 Marks]**

OR

Q-4(a) What is stress relaxation, and how does it occur in polymeric materials? **[7 Marks]**

Q-4(b) What is the time-temperature superposition principle (TTSP), and how is it applied to the mechanical behavior of polymers? **[7 Marks]**

QUESTION –5 ANSWER ANY SEVEN QUESTIONS OUT OF TWELVE

[Max. marks: 7×2=14 MARKS]

(i) What is the primary difference in potential energy between the staggered and eclipsed states in conformational analysis?

(a) The staggered state has higher potential energy due to steric hindrance.

(b) The eclipsed state has lower potential energy due to better overlap of orbitals.

(P.T.O)

(c) The staggered state has lower potential energy due to minimized steric strain.

(d) The eclipsed state has lower potential energy due to minimized steric strain.

(ii) An unperturbed chain refers to a polymer in its ideal, unstressed state, whereas a Gaussian chain is one that has been stretched (**True or False**)

(iii) Which of the following is a characteristic of viscoelastic materials?

(a) They exhibit both elastic and viscous behavior.

(b) They exhibit purely elastic behavior.

(c) They exhibit purely viscous behavior.

(d) They remain unchanged when subjected to stress.

(iv) The _____ behavior of a polymer results from both the time-dependent flow of the material (viscous) and the reversible deformation (elastic). (**Fill in the Blank**)

(v) Polymers behave elastically under all conditions, regardless of temperature and time. (**True or False**)

(vi) The Power Law model is typically used to describe the behavior of:

(a) Newtonian fluids

(b) Compressible fluids

(c) Non-Newtonian fluids

(d) Ideal gases

(vii) Zero-shear rate viscosity is defined as the viscosity at:._____ (**Fill in the Blank**)

(viii) Birefringence in oriented polymers is:

(a) The ability of a material to polarize light

(b) A measure of the crystal structure

(c) The double refraction of light due to anisotropy in the polymer

(d) A method to measure the glass transition temperature

(ix) The rate of crystallization in polymers is influenced by factors such as the polymer's molecular weight, cooling rate, and _____. (**Fill in the Blank**)

(x) The melting transition of a crystalline polymer is characterized by:

(a) A gradual decrease in viscosity with temperature

(b) A reversible transition from crystalline to amorphous state

(c) The polymer chains becoming entangled

(d) The polymer chains aligning more effectively

(xi) The WLF equation describes the temperature dependence of the viscoelastic properties of polymers. (**True or False**)

(xii) Define "Inelasticity".

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