

B.Tech. Degree V Semester Examination in Polymer Science and Rubber Technology, March 2007

PTF 1502 POLYMER PHYSICS
(New Scheme)

Time : 3 Hours

Maximum Marks : 100

PART A
(Answer **ANY FIVE** questions)

- I Define spherulites? What are different types of spherulites? How spherulites size is related to the mechanical properties of polymers? (2+2+1)
- II Write down Flory Huggins equation for polymer solutions. Explain Flory's interaction parameter and give its importance. (2+3)
- III Estimate the contour length and root mean square end-to-end distance of polypropylene (PP) chain with DP=5000. The end-to-end distance between carbon atoms is 0.126 nm. (5)
- IV What are polyelectrolytes? Explain viscosity behaviour of a polyelectrolyte in water and aqueous salt solution. (2+3)
- V Define permittivity and dielectric loss. Comment on the effect of chemical constitution of polymers on dielectric loss. (2+3)
- VI How are X-ray diffraction studies helpful to elucidate the crystalline structures of polymers? (5)
- VII What are plasticizers? What is the mechanism of action of plasticizers? Comment on the effect of chemical constitution, size and shape of plasticizer molecules of plasticizer efficiency. (2+3)

PART B
(Answer **ANY FIVE** questions)

- VIII State what the zero shear rate viscosity, η_0 , is by answering the following questions:
- i) How is the viscosity related to the shear stress and the shear strain rate?
 - ii) How is η_0 extrapolated from experimental values η ?
 - iii) How does η_0 empirically behave with molecular weight?
 - iv) What is the temperature dependence of η_0 ?
 - v) How is η_0 related to the relaxation time? (5x3)

(Turn Over)

- IX Explain the following:
- Conformation and Configuration in polymers
 - Crystalline and Amorphous polymers
 - First order and Second order transitions in polymers
 - Brittle and Ductile polymers
 - Creep and Stress relaxation in polymers
- (5x3)
- X Write short note on following:
- Secondary bonding forces in polymers
 - Free volume theory of glass transition in polymers
 - Flory Krigbaum theory of polymer solutions
 - Linear elastic fracture mechanics
 - Conducting polymers
- (5x3)
- XI Explain briefly the following factors that affect the solubility of polymers.
- Good solvent
 - Poor solvent
 - θ solvent
 - Selective solvent
 - Hildebrand's regular solvent
- (5x3)
- XII Draw schematically the stress strain behaviour and comment on (with example)
- Fibre
 - Elastomer
 - Soft and weak polymer
 - Hard and brittle polymer
 - Hard and tough polymer
- (5x3)
- XIII Give reasons for following:
- Polymers are viscoelastic
 - Polymers are not 100% crystalline
 - Most polymer mixtures are immiscible
 - The chemical reactions shown by polymers are few compared to those by low molecular weight substances
 - Some polymers are transparent while others are opaque.
- (5x3)
- XIV a) What is glass transition temperature (T_g)? Give its significance in determining polymer properties? (5)
- b) Account for the following:
- T_g of polyethylene (PE), PP and polystyrene (PS) are in the order $PE < PP < PS$
 - T_g Polyethylene oxide is less than to PE
 - T_g of PS is less than that of poly α methyl styrene
 - T_g of nylon 66 is about the double to that of polyester of comparable chain
 - T_g of polyethyl methacrylate is lower than that of polymethyl methacrylate.
- (5x2)