



102

Polymer Science

TIME : 3 HOURS

MAXIMUM MARKS : 300

INSTRUCTIONS :

1. *All questions are compulsory.*
 2. *Question Paper may be divided into 4 (four) Sections from Section-A to Section-D and carry marks as under :*
 - a. *Section - A - Total 3 Questions having two parts, i.e. (a) and (b) each questions carries 12 marks × 3 Questions = Total 36 Marks.*
 - b. *Section - B - Total 3 Questions having two parts, i.e. (a) and (b) each questions carries 20 marks × 3 Questions = Total 60 Marks.*
 - c. *Section - C - Total 3 Questions having two parts, i.e. (a) and (b) each questions carries 28 marks × 3 Questions = Total 84 Marks.*
 - d. *Section - D - Total 3 Questions having two parts, i.e. (a) and (b) each questions carries 40 marks × 3 Questions = Total 120 Marks.*
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SECTION - A

(Each question is of 12 marks and each sub part (a) and (b) are of 6 marks each)

- 1 (a) Write the structure of the monomers used for the synthesis of nylon-46, poly (ethylene terephthalate) and nitrile rubber.
(b) When two monomers react to form a copolymer, state the conditions under which they form a random, alternating and block copolymer.
- 2 (a) Write the role of each of the following additives in rubber technology :
 - (i) Pentachlorothiophenol
 - (ii) Mercaptobenzothiazole
 - (iii) Paraffin wax

- (b) Identify the process by which the following plastic products are manufactured :
- (iv) disposable cups
 - (v) water bottle
 - (vi) chair
- 3 (a) How are poly organophosphazenes synthesized ?
- (b) What is EPDM rubber ? Give structures of the common dienes that are used in the synthesis of EPDM rubbers.

SECTION - B

(Each question is of 20 marks and each sub part (a) and (b) are of 10 marks each)

- 4 (a) What are the various thermodynamic factors influencing the miscibility of two polymers ? Why does polyethylene and polypropylene form an immiscible blend ?
- (b) How much of a low molecular weight plasticizer with $T_g = -80^\circ\text{C}$ should be added to a film of nylon 66 in order to reduce the T_g from 50°C to 25°C .
- 5 Write short notes on :
- (a) Reaction Injection Molding
 - (b) Thermoforming
- 6 (a) What is glass transition temperature ? What are the various methods used to determine glass transition temperature ?
- (b) Explain why T_g of polyethylene is less than that of polypropylene which is less than that of polystyrene.

SECTION - C

(Each question is of **28** marks and each sub part **(a)** and **(b)** are of **14** marks each)

- 7 Explain the following :
- (a) Biaxially oriented polypropylene films are transparent.
 - (b) HIPS has a higher toughness than polystyrene.
- 8 Give formulation for the following specifying the approximate range of each ingredient :
- (a) PVC based general purpose insulation compound
 - (b) Truck tire thread
- 9 (a) State the essential requirements to be fulfilled so that the molecular weight of a particular polymer can be estimated by end group analysis.
- (b) 2.7 g of a linear polyester containing acid groups at both ends requires 15 mL of 0.1N potassium hydroxide for complete neutralization. Calculate \overline{M}_n of the polyester ?

SECTION - D

(Each question is of **40** marks and each sub part **(a)** and **(b)** are of **20** marks each)

- 10 (a) 5g of a monodisperse polystyrene sample of molecular weight $10,000 \text{ gmol}^{-1}$ was mixed with 10g of a monodisperse polystyrene sample of molecular weight $20,000 \text{ gmol}^{-1}$. Calculate the polydispersity index of the mixture ?
- (b) Show that in an Ubbelohde viscometer, the relative viscosity is equal to the ratio of the time of flow of the polymer solution to that of a solvent between two appropriate marks.

- 11 (a) In a unidirectional carbon fibre/epoxy composite, the modular ratio is 40 and fibres take up 50% of the cross-section. Calculate the percentage of applied force taken by the fibres.
- (b) Calculate the maximum and average fibre stresses for glass fibres which have a diameter of $5 \mu\text{m}$ and a length of 2.5 mm. The interfacial shear strength is 4 MN/m^2 and $l_t/l=0.3$ (l_t is the load transfer length and l is the fibre length).
- 12 (a) Explain the significance of the following in polymer science :
- (i) polydispersity
 - (ii) solubility parameter
 - (iii) loss tangent in dynamic mechanical analysis
 - (iv) X-ray diffraction technique
- (b) The density of crystalline polyethylene is 0.996 g cm^{-3} and the density of amorphous polyethylene is 0.866 g cm^{-3} . Calculate the percentage crystallinity in a sample of linear polyethylene of density 0.970 g cm^{-3} ?
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