

**INDIAN RUBBER INSTITUTE
PGDIRI EXAMINATION – 2018**

Paper – I

Date : 14th July, 2018
Duration : 3 Hours

Time : 10.00 – 13.00 hrs.
Full Marks : 100

Polymer Science

Answers should be illustrated with sketches wherever helpful
Total **FIVE** questions are to be answered. **Question number 1** is compulsory. Answer **FOUR**
from the remaining questions taking **TWO** from each group

GROUP – A

1. Multiple choice questions: Select the correct answer from the given alternatives:

- (i) EPDM is a
(a) Homopolymer (b) Copolymer
(c) Terpolymer (d) Fibre
- (ii) LDPE is
(a) Highly crystalline (b) Semi - crystalline
(c) Amorphous (d) None of the above
- (iii) Solubility parameter can be calculated from
(a) Crystallinity (b) Cohesive energy density
(c) Tacticity (d) Viscosity
- (iv) Silicone rubber shows its T_g at around
(a) -50°C (b) -70°C
(c) -100°C (d) -120°C
- (v) Light scattering is used to determine
(a) Viscosity average molecular weight (b) Weight average molecular weight
(c) Number average molecular weight (d) Z-average molecular weight
- (vi) S-B-S is an example of
(a) Block copolymer (b) Terpolymer
(c) Graft copolymer (d) None of the above
- (vii) Number of branches is minimum in
(a) LDPE (b) LLDPE
(c) HDPE (d) VLDPE
- (viii) Example of self-reinforcing rubber is
(a) NR (b) BR (c) SBR (d) EPDM

- (ix) Stereo – regular polymers are synthesized by using
 (a) Peroxide Catalyst (b) Ziegler – Natta Catalyst
 (c) Metal Oxide Catalyst (d) Heavy Metal Catalyst
- (x) Ring opening polymerization is related to
 (a) Isoprene (b) Caprolactam
 (c) Butadiene (d) Styrene
- (xi) Example of an oil resistant rubber is
 (a) NR (b) BR (c) NBR (d) PDMS
- (xii) Atactic PP is
 (a) Highly crystalline (b) Semi-crystalline
 (c) Amorphous (d) None of the above
- (xiii) Dicumyl peroxide is an example of
 (a) Plasticizer (b) Crosslinking agent
 (c) Initiator (d) Peptizer
- (xiv) The diene present in EPDM is
 (a) ENB (b) Butadiene
 (c) Heptadiene (d) None of the above
- (xv) Tg can be determined by
 (a) XRD (b) TGA (c) DSC (d) SEM
- (xvi) Toughness can be calculated from
 (a) Total area under stress-strain curve (b) Hystereris loop
 (c) Heat flow curve (d) Electrical properties
- (xvii) Nylon 66 is a
 (a) Addition polymer (b) Condensation polymer
 (c) Ring opening polymer (d) Stereo regular polymer
- (xviii) Example of a good weather resistant rubber is
 a) NR (b) BR (c) SBR (d) EPDM
- (xix) Tg of a copolymer can be determined using
 (a) Bragg Equation (b) Fox Equation
 (c) Hildebrand Equation (d) Carothers' Equation
- (xx) Example of a semi-synthetic polymer is
 (a) Cellulose nitrate (b) PF resin
 (c) Butyl rubber (d) Polycarbonate

(2 x 20) = 20

2. (a) Define the terms: (i) monomer (ii) functionality and (iii) polymerization
 (b) Explain the basic difference with examples between addition and condensation polymers.
 (c) How do you classify polymer based on thermal response? Give examples.
 (d) Explain with examples the difference between linear polymer, branched polymer and crosslinked polymer.
 (e) Show stress-strain plots of a fibre, a brittle plastic, a ductile plastic and an elastomer.

(3+4+3+5+5) = 20

3. (a) Define the term 'glass transition temperature (T_g)'.
 (b) Explain briefly the method of determined of T_g of polystyrene by a dilatometer (with a sketch).
 (c) Explain various factors that control T_g of polymers.
 (d) What is "strain – induced crystallization"? Explain with an example.

(2+6+8+4) = 20

4. Distinguish between the following with suitable examples:
 (a) Number Average and Weight Average Molecular Weight
 (b) Isotactic and Syndiotactic polymer
 (c) Random and Alternating Copolymers
 (d) Cationic and Anionic polymerization
 (e) Emulsion SBR and Solution SBR

4 x 5 = 20

GROUP – B

5. (a) What are the necessary molecular requirement for rubber-like elasticity?
 (b) Explain with figures the differences between Maxwell and Voigt Model.
 (c) Explain the differences between pseudoplastic and dilatant materials.
 (d) What is the Power law equation and explain its significance.

(4+6+4+6) = 20

6. (a) Explain the term 'toughness' with its significance.
 (b) What is shape factor? Explain its significance.
 (c) Explain the terms with figures: (i) stress relaxation and (ii) creep.
 (d) What is die swell?
 (e) Explain the term with a figure: polymer spherulite

(5+4+4+2+5) = 20

7. (a) What are the different techniques of polymerization? Discuss their relative advantages and disadvantages.
 (b) How do you control the degree of polymerization?
 (c) What is the function of an initiator? Give two examples.

(12+6+2) = 20

8. Write short notes on any four of the following
 (a) Polydispersity
 (b) Viscosity average molecular weight
 (c) Living polymer
 (d) Carothers' equation
 (e) Ring opening polymerization
 (f) Cohesive energy density (CED)

(4 x 5) = 20