Date: 17th July, 2015   Time: 10.00-13.00 hrs.

Duration: 3 Hours   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.   Select the right answer from the given alternatives :

(i)   Most important criteria of a polymer to form strong fibre is
       a) Partially crystalline   b) amorphous
       c) highly crystalline   d) highly atactic

(ii)   Copolymer of styrene and butadiene which is used in car tyre is
       a) SBR   b) SEBS   c) SBS   d) SIS

(iii) Gutta-percha is a
       a) Natural polymer   b) Synthetic polymer
       c) Artificial polymer   d) Regenerated polymer

(iv)   PET is a
       a) Polyamide   b) Polyether   c) Polyimide   d) Polyester

(v)   EVA is a
       a) Homopolymer   b) Copolymer
       c) Terpolymer   d) Highly crystalline polymer

(vi)   Polymers show rubbery properties
       a) Above T_g b) Below T_g
       c) Both below and above T_g d) None of the above

(vii) Glass transition temperature (T_g) of a polymer is determined by
       a) Viscometer   b) Dilatometer
       c) Osmometer   d) Rheometer

(viii) Which polymerization produces living polymer ?
       a) Radical polymerization   b) Anionic polymerization
       c) Polycondensation polymerization d) Polyaddition polymerization

[Turn Over]

(ix) In radical polymerization, AIBN (azo-bisisobutyronitrile) is used as

    a) Inhibitor   b) Initiator

    c) Co-catalyst   d) Chain transfer agent

(x) The rubber which shows strain-induced crystallization is

    a) NR   b) Silicone rubber   c) CR   d) NBR

(xi) In butyl rubber (IIR) the comonomer used is

    a) Butadiene   b) Isoprene c) Styrene   d) Dicyclopentadiene

(xii) EPDM is a

    a) Homopolymer   b) Copolymer

    c) Terpolymer   d) Fibre

(xiii) Light scattering technique is used to determine

    a) Viscosity average molecular weight   b) Weight average molecular weight

    c) Number average molecular weight   d) Z-average molecular weight

(xiv) Which of the following is a branched chain polymer?

    a) HDPE   b) PP   c) LDPE   d) PS

(xv) Dicumyl peroxide is an example of

    a) Plasticizer   b) Crosslinking agent   c) Initiator   d) Peptizer

(xvi) Example of a good weather resistant polymer is

    a) NR   b) BR   c) SBR   d) EPDM

(xvii) Nylon is a

    a) Polyester   b) Polyamide c) Polyolefin   d) None of the above

(xviii) Resorcinol-formaldehyde resin is an example of

    a) Natural polymer   b) Semi-synthetic polymer

    c) Thermoplastic polymer   d) Thermosetting polymer

(xix) Aluminum chloride is used as a catalyst for

    a) Free radical polymerization   b) Cationic polymerization

    c) Anionic polymerization   d) Stereospecific polymerization

(xx) The rubber modulus is

    a) Same as Young's modulus   b) Stress at specified elongation

    c) Ratio of stress by strain   d) None of the above.

20x1 = 20

[Turn Over]

2. a) Define the terms (i) mer (ii) monomer and (iii) polymer with a suitable example.

b) Explain the basic differences with example between addition and condensation polymer

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) What do you mean by "polydispersity" and "polydispersity index (PDI)" ?

$$3+4+4+6+3 = 20$$

3. Distinguish between the following pairs with suitable examples:

a) Short stop and Inhibitors

b) Homopolymer and Copolymer

c) Thermoplastics and Thermosets

d) Isotactic and Syndiotactic Polymers

e) Termination by coupling and termination by disproportionation.

$$5 \times 4 = 20$$

4. Name the repeating unit and its chemical structure for the following polymers

i) Poly (vinyl chloride) ii) Neoprene iii) BR iv) Nylon 6,6 v) NBR vi) Teflon vii) NR viii) Silicon rubber ix) Butyl rubber x) SBR

$$10 \times 2 = 20$$

Group – B

5. (a) Select the right match

i) Butadiene	A) Innertube of a tyre
ii) Ethylene oxide	B) Outdoor application
iii) Nylon 6,6	C) Ring opening polymerization
iv) Butyl rubber	D) Condensation polymerization
v) EPDM	E) Ziegler-Natta polymerization

(b) Draw the stress-strain curves in the same plot for the following:

i) rubber ii) rigid plastic iii) fibre

(c) Give one example with structure of repeat unit for each of the following:

i) A linear polymer which does not contain any hydrogen and useful for insulating purpose.

ii) A terpolymer which is useful for making automotive window seal.

iii) A polar homopolymer which is useful for making adhesives.

iv) A rigid homopolymer which can be made flexible even at room temperature and useful in cable industry

v) A highly crystalline polymer used very much in tyre industry.

vi) A copolymer which is used as a oil and solvent resistant rubber and does not crystallize on stretching.

$$5+3+12 = 20$$

6. (a) What do you mean by glass transition temperature (T_g) of a polymer? Explain this with an example.

(b) Describe one method by which you can determine T_g of a polymer ?

(c) How can you distinguish a rubber and a plastic in terms of their T_g? Explain this with an example in each case ?

(d) What are the factors on which T_g of a polymer depends?

(e) What do you mean by T_m of a polymer ? Explain this with an example.

$$4+3+4+5+4 = 20$$

7. a) What do you mean by average molecular weight and molecular weight distribution of a polymer ?

b) Give the mathematical expressions of different molecular weights averages in polymers.

c) Describe one method by which you can determine number average molecular weight of a polymer.

d) A polymer sample contains mixture of molecules of the same chemical type; fraction A with 540 molecules having molecular weight 1000 each and fraction B with 360 molecules having molecular weight 9000 each. Calculate the number and weight average molecular weight of the polymer sample.

$$4+6+5+5 = 20$$

8. Write short notes (with suitable example) on any **Four** of the following :-

a) Creep and stress relaxation.

b) Tacticity in polymer.

c) Step growth polymerization.

d) Block copolymer.

e) Living polymer and dead polymer.

f) Non-Newtonian fluids.

$$5 \times 4 = 20$$