INDIAN RUBBER INSTITUTE
DIRI EXAMINATION – 2014

Paper – I

Date: 11 July, 2014 **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. From **"Group-A"** answer **THREE** questions out of which **Question No. 1** is compulsory and From **"Group-B"** answer **TWO** questions only.

GROUP – A

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

(i) Butyl rubber is a
(a) Homopolymer (b) Copolymer
(c) Terpolymer (d) Fibre

(ii) 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

(iii) Shellac is
(a) Natural resin (b) Synthetic resin
(c) Rubber (d) Fibre

(iv) The polymer having lowest coefficient of friction is
(a) NR (b) PVC (c) PTFE (d) EPDM

(v) Ring opening polymerization is related to
(a) Isoprene (b) Caprolactam
(c) Butadiene (d) Styrene

(vi) Benzoyl peroxide is an example of
(a) Plasticizer (b) Crosslinking agent
(c) Initiator (d) Peptizer

(vii) Example of an oil resistant polymer is
a) NR (b) IIR (c) NBR (d) EPDM

(viii) Tg of a polymer can be determined using a
(a) Dilatometer (b) Pyrometer
(c) Rheometer (d) Calorimeter

(ix) The following polymerization is called "living polymerization"
(a) Radical (b) Cationic (c) Anionic (d) Condensation

(x) Which one is a transparent polymer
(a) Nylon (b) NR
(c) NBR (d) Polystyrene

(xi) PET is a
(a) Polyester (b) Polyamide
(c) Polyolefin (d) None of the above

(xii) Functionality of propylene is
(a) One (b) Two
(c) Three (d) Four

(xiii) Cellulose nitrate is an example of
(a) Natural polymer (b) Semi-synthetic polymer
(c) Rubber (d) Fibre

(xiv) Ziegler Natta catalyst is used for
(a) Free radical polymerization (b) Cationic polymerization
(c) Anionic polymerization (d) Stereospecific polymerization

(xv) Cationic polymerization is generally used for making
(a) SBR (b) CR
(c) Nitrile rubber (d) Butyl rubber

(xvi) Glass transition temperature of silicone rubber is
(a) $+100^0C$ (b) 0^0C
(c) -120^0C (d) -70^0C

(xvii) 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.

(xviii) Polymer rheology is the science of
(a) Crystallinity (b) Toxicity
(c) Tacticity (d) Deformation and flow

(xix) Solubility parameter of a polymer depends on its
(a) Polarity (b) Tackiness
(c) Modulus (d) Hardness

(xx) Mechanical properties of polymer will be better if
(a) Molecular weight distribution is broader (b) Molecular weight distribution is narrower (c) Higher molecular weight (d) Glass transition temperature is higher.

(1 x 20) = 20

2.

(a) Distinguish between homopolymer, copolymer and terpolymer with suitable examples.
(b) How do you classify polymer based on line structure? Give examples.
(c) Explain with examples the difference between thermoplastic and thermosetting polymer.
(d) What is the significance of 'polydispersity'?
(e) Calculate the number average and the weight average molecular weight from the data shown below:

i	M_i	N_i
Interval No.	g/mole of chains in interval	No. of chains in interval
1	2,000	2
2	5,000	4
3	15,000	5
4	30,000	3
5	50,000	2
6	60,000	1

(3+4+3+4+6) = 20

3. Name the polymers used in each case with the structure of the corresponding monomer and polymer.
(a) A rubber which exhibits very good low temperature flexibility.
(b) A rubber which exhibits excellent weather resistant property.
(c) A heat resistant rubber.
(d) A rubber which shows strain induced crystallization.
(e) A polar rubber.

(1+3) x 5 = 20

4. Distinguish between the following (with suitable examples):
(a) Addition and condensation polymer
(b) Natural and synthetic polymer
(c) Block and graft copolymer
(d) Bulk and solution polymerization
(e) Inhibition and retardation

(5 x 4) = 20

GROUP – B

5.

(a) Write down a typical recipe for hot SBR by emulsion polymerization method and discuss the role of different ingredients used.
(b) Why this particular technique is often used for making rubbers?
(c) Explain why this polymerization is stopped much before 100% conversion.

(12 + 4 + 4) = 20

6. (a) What is meant by tacticity in polymers? Explain, with suitable example, the terms: isotactic, syndiotactic and atactic polymer.
   (b) What is a co-ordination catalyst? Name any two co-ordination catalysts commonly used.
   (c) Why stereo-regular polymers are so important?

(9+6+ 5) = 20

7. Explain the following terms as applied to polymers and rubbers:
   (a) Stress relaxation and creep
   (b) Hysteresis
   (c) Newtonian and non-Newtonian fluid
   (d) Die swell
   (e) Viscoelasticity

(5 x 4) = 20

8. Write short notes on **any four** of the following
   (a) Solubility parameter
   (b) Suspension polymerization
   (c) Glass transition temperature and its significance
   (d) Anionic polymerization
   (e) Ring opening polymerization
   (f) Shape factor

(4 x 5) = 20