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3 (Sem-5/CBCS) CHE HE 4/HE 5/HE 6

2023

CHEMISTRY

(Honours Elective)

Answer the Questions from any one Option.

OPTION-D

(Novel Inorganic Solids)

Paper :- CHE-HE-5046

OPTION-E

(Polymer Chemistry)

Paper : CHE-HE-5056

OPTION-F

(Instrumental Methods of Chemical Analysis)

Paper : CHE-HE-5066

Full Marks : 60

Time : Three hours

**The figures in the margin indicate
full marks for the questions.**

Contd.

OPTION-E

(Polymer Chemistry)

Paper : CHE-HE-5056

1. Answer the following questions : $1 \times 7 = 7$

(a) Which of the following is not a polymer ?

- (i) Sucrose
- (ii) Enzyme
- (iii) Cellulose
- (iv) Nucleic acid

(b) Functionality of phenol is

- (i) one
- (ii) two
- (iii) three
- (iv) four

(c) Tubeless tyres are co-polymers of isoprene and

- (i) neoprene
- (ii) isobutylene
- (iii) PAN
- (iv) silicones

(d) Which of the following polymers can have strong intermolecular forces ?

- (i) Nylon
- (ii) Polystyrene
- (iii) Rubber
- (iv) Polyesters

(e) The WLF Equation is :

- (i) a combination of Voigt and Maxwell models that describes creep
- (ii) a four-parameter model for stress relaxation
- (iii) an expression for the shift factor that is used in the time-temperature superposition principle
- (iv) the relationship between intrinsic viscosity and molecular weight

(f) Polypropylene produced commercially using a Ziegler-Natta catalyst is predominantly

- (i) atactic
- (ii) isotactic
- (iii) syndiotactic
- (iv) None of the three

(g) For a polymer to be completely miscible with a solvent at a given temperature (i.e. form a single-phase mixture at all compositions)

- (i) the free energy change ΔG_m must be negative and the second derivative of the free energy (with respect to composition) must be positive
- (ii) ΔG_m must be positive and the second derivative negative
- (iii) ΔG_m must be negative and the second derivative must also be negative
- (iv) they must both be positive

2. Answer the following questions : $2 \times 4 = 8$

- (a) Why does polymers do not have sharp melting point ?
- (b) Differentiate between rubbers and plastics on the basis of intermolecular forces.
- (c) Can nucleic acids, proteins and starch be considered as step growth polymers ?
- (d) A particular sample of polymer has 100 chains with molecular weight 1000, 200 chains with molecular weight 10000, and 200 chains with molecular weight 100000. Calculate the polydispersity of the sample.

3. Answer **any three** of the following questions : $5 \times 3 = 15$

- (a) Explain Flory-Huggins theory and enlist the assumptions.
- (b) Bring out the differences between chain growth and step growth polymerization.
- (c) Discuss the various factors which affect the crystallinity of polymers with suitable examples.
- (d) Write short notes on :
 - (i) Living radical polymerization
 - (ii) Biodegradable polymer

- (e) Explain the mechanism of anionic polymerization with suitable examples.

4. Answer **any three** of the following questions :
 $10 \times 3 = 30$

- (a) What is number average molecular weight and weight-average molecular weight of polymer? Derive an expression for it. Define degree of polymerisation and polydispersity index of a polymer sample. Draw the molecular weight distribution curves of three hypothetical polymer samples having same number-average molecular weight, but different polydispersities.
 $2 + 3 + 2 + 3 = 10$

- (b) Define glass transition temperature (T_g) and melting temperature (T_m) for polymers. What is the interrelationship between these two parameters? Explain with suitable diagram the dilatometric method for the determination of T_g in polymers.
 $2 + 2 + 6 = 10$

- (c) Describe the structure of Ziegler-Natta catalyst used in co-ordination polymerization of olefins. Write the mechanism of polymerization of olefins when Ziegler-Natta catalyst is used. How is it different from polymerization of olefins using free radical initiators?
 $2 + 5 + 3 = 10$

- (d) What do you mean by chain transfer in polymerization process? Derive an expression for kinetics of chain polymerization. Write a note on kinetic chain length in free radical polymerization.
 $2 + 5 + 3 = 10$

- (e) What are the different kinds of polymerization techniques? Citing advantages and limitations, describe the bulk and solution polymerization technique.
 $2 + 4 + 4 = 10$

- (f) Write the differences between thermosetting and thermoplastics. Discuss preparation, properties and uses of following polymer molecules (**any two**)

(i) Polyethylene

(ii) Synthetic rubber

(iii) Polycarbonates $2 + 4 + 4 = 10$