

#### Section IV

7. (a) Write down the expression for second virial coefficient,  $B_2(T)$  in terms of configuration integral and from here derive  $B_2(T)$  in terms of Mayer  $f$ -function. Given that  $B_2(T) = -(2!V)^{-1} (Z_2 - Z_1^2)$ . **5**
- (b) How is energy of N-body system expressed in terms of radial distribution function of a fluid ? **7**
8. (a) Derive ideal gas equation from statistical considerations. **4**
- (b) Derive general expression ( $p \neq q$ ) for 1-D random walk probability distribution (for finite steps). **4**
- (c) Prove  $\int \rho g(r) 4\pi r^2 dr = N$  where N is total number of particles in a system and  $\rho$  is the bulk density of the system. **4**

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Total Pages : 03

LMDQ/M-24

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#### PHYSICAL CHEMISTRY SPECIAL-III CHEM-401 (OBES/LOCF)

Time : Three Hours]

[Maximum Marks : 60

**Note :** Attempt *Five* questions in all, selecting at least *one* question from each Section. All questions carry equal marks.

#### Section I

1. (a) What are biodegradable polymers ? How will you classify biodegradable polymers ? Give examples to illustrate. **5**
- (b) What are the characteristics properties and advantages of biodegradable polymers ? Explain with some suitable examples. How do they differ from synthetic polymers. **4**
- (c) What are the importance of glass transition temperature in polymer science ? **3**
2. (a) What are polymer composites ? Give examples to illustrate.

- (b) Give a brief account of the polyvinyl chloride and silicon polymers.
- (c) What are plasticizers ? Give two examples with their uses. 4,4,4

## Section II

3. (a) Define r.m.s. end-to-end distance and r.m.s. radius of gyration. How are they related ? 5
  - (b) Assume a polypropylene chain in its unperturbed state. It has a molecular weight of 4,20,000. Calculate the root mean square end to end distance and radius of gyration of the chain. (C-C bond length is 1.54 Å). 4
  - (c) For chains of equal lengths, end-to-end distance in nylon will be more than that in polyethylene. Give reasons. 3
4. (a) Derive the expression for free energy of mixing for the total number of ways of arranging  $n_2$  identical polymer molecules on the lattice consisting of  $n_0$  sites assuming each polymer molecule to consist of  $\sigma$  chain segments on the basis of Flory-Huggins theory. 8

- (b) Discuss the concept of excluded volume as applied to dilute polymer solution. Derive the equation for the osmotic pressure-molecular weight relationship of such a solution. 6

## Section III

5. (a) Explain, how number average molecular weight of polymer can be determined from Osmotic pressure method ? How does it from light scattering method ? 7
  - (b) What are the difference between sedimentation velocity and sedimentation equilibrium technique for determining the molecular weight of polymers ? 5
6. (a) Describe the  $Z_{im}$  plot for determining the molecular weight of polymers. Compare the Debye and  $Z_{imm}$  methods of determining the molecular weights of polymers. 7
  - (b) Discuss briefly the different types of light scattering techniques used in small molecules and polymer solutions and their applications. 5