

(2½ Hours)

[ Total Marks : 60

- N.B.** (1) All questions are compulsory.  
 (2) Figures to the right indicate full marks.

1. (a) Attempt any two of the following :-
- (i) Using the concept of hybridisation, obtain an expression for the wave functions of  $sp^2$  hybrid orbitals. 4
  - (ii) What do you mean by electron deficient molecules? Explain the nature of bonding in diborane on the basis of molecular orbital theory. 4
  - (iii) Define Hydrogen bonding. Discuss its various types with examples. 4
  - (iv) Explain the Faraday's method for the determination of magnetic susceptibility for paramagnetic material. 4
- (b) Attempt any one of the following :-
- (i) Derive expressions for magnetic susceptibility in diamagnetic and ferromagnetic materials. 4
  - (ii) Explain the various types of Van der Waal's forces. 4
2. (a) Attempt any two of the following :-
- (i) Construct the character table for  $C_{3v}$  point group and give the meaning of symbols used in the table. 4
  - (ii) Write a note on Mulliken's notation for the irreducible representation with one example. 4
  - (iii) Define the term, sub-group. What are the important conditions to form a subgroup? 4
  - (iv) With symmetry aspects of molecular orbital theory, describe the sigma and pi bonding in a tetrahedral molecule. 4
- (b) Attempt any one of the following :-
- (i) Obtain matrix representation for the reflection operation with a diagram. 4
  - (ii) With a suitable diagram, discuss the matrix representation for rotation operation. 4
3. (a) Attempt any two of the following :-
- (i) Discuss the natural gas as source of energy with respect to :- 4
    - (1) Classification and composition
    - (2) Any two advantages.
  - (ii) Write a note on sources, toxicology and toxicity of Cadmium as heavy metal pollutant. 4
  - (iii) How mercury enters in water? Give the distribution and speciation scheme of mercury in water. 4
  - (iv) Explain, how the solar energy is used for the production of electricity. 4

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(b) Attempt any one of the following :-

- (i) Discuss the sources, biochemical effects, toxicology and toxicity of arsenic. 4
- (ii) Mention the sources of radiation, pollution in water. Discuss the biological implications. 4

4. (a) Attempt any two of the following :-

- (i) Comment, "Oxygen binds cooperatively to the hemoglobin molecule." 4
- (ii) What is a mono oxygenase? Explain its reaction with an example. 4
- (iii) Describe, the structure and function of the various types of hydrogenases. 4
- (iv) Write a short note on 'Role of a metal complex in medicine.' 4

(b) Attempt any one of the following :-

- (i) Describe the reactions involved in the superoxide dismutase. 4
- (ii) Draw the structure of Valinomycin and discuss its function in a biological system. 4

5. Attempt any four of the following :-

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- (a) On the basis of molecular orbital diagram, explain bonding in  $I_3^-$  ion.
  - (b) Describe two properties of hydrogen bonding.
  - (c) Classify the point group, Give example of each group.
  - (d) Discuss the optical activity of a molecule on the basis of group theory.
  - (e) Give the toxic effects of copper metal and discuss the remedial measures.
  - (f) Write the merits and demerits of Geothermal energy.
  - (g) Explain the reactions of a peroxidase in a biological system.
  - (h) Write a note on Ferritin.
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