(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:
   (a) Derive the wave function for the hybrid orbitals formed in molecules involving sp^3 hybridisation considering only sigma bonding. 4
   (b) Discuss the bonding in triiodide ion based on LCAO - MO approach. 4
   (c) Describe the effect of hydrogen bonding on properties of compounds with suitable examples. 4
   (d) State and explain Curie-Weiss law for ferromagnetic and antiferromagnetic substances. 4

   (b) Attempt any **one** of the following:
   (a) Obtain the wave function for the hybrid orbitals of Beryllium dihydride molecule. 4
   (b) What are electron deficient species? Describe bonding in diborane molecule using LCAO-MO concept. 4

2. (a) Attempt any **two** of the following:
   (a) Construct the group multiplication table for the C_{2V} point group. 4
   (b) Explain the symmetry restrictions on the dipole moment in a molecule. 4
   (c) Define sub-group. Give the subgroups for ammonia. 4
   (d) Explain sigma and pi bonding in AB_4 tetrahedral molecule based on group theory. 4

   (b) Attempt any **one** of the following:
   (a) Obtain matrix representation for reflection operation on the basis of group theory. 4
   (b) Write the character table for C_{3V} point group and give the meaning of the symbols used in the table. 4

3. (a) Attempt any **two** of the following:
   (a) Give the biochemical effects, toxicology and toxicity of Arsenic. 4
   (b) Explain the effects and treatment of Mercury poisoning. 4
   (c) Discuss the indirect utilization of solar energy. 4
   (d) Write a note on the components of a nuclear reactor. 4

   (b) Attempt any **one** of the following:
   (a) Outline the harmful effects of radioactive pollution. 4
   (b) Name the element which leads to 'itai-itai' disease. Give the symptoms and effect of this disease on human system. 4

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4. (a) Attempt any **two** of the following:
   (a) With respect to the haemoglobin molecule explain the "Bohr effect". 4
   (b) Discuss the structural properties of peroxidase and comment on its enzymatic activity. 4
   (c) Explain the mechanism of nitrogen fixation by the Nitrogenase enzyme. 4
   (d) What are ionophores? Explain the structure and function of Nonactin. 4

   (b) Attempt any **one** of the following:
   (a) Describe the enzymatic reaction taking place in cytochrome P-450. 4
   (b) Explain the mechanism of action of cis-platin as an anti-cancer drug. 4

5. (a) Attempt any **four** of the following: 12
   (a) Discuss (i) ion-dipole interaction.
   (ii) dipole-dipole interaction.
   (b) Explain Faraday's method for determination of magnetic susceptibility.
   (c) Explain abelian point group with a suitable example.
   (d) Distinguish between reducible and irreducible representations.
   (e) Give the advantages of natural gas.
   (f) Explain "Wilson's disease".
   (g) Write a short note on Transferrin.
   (h) Discuss the role of hemerythrene in biological systems.
