(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) By applying the concept of hybridization, derive the wave function for the hybrid orbitals of methane molecule. — 4
   (ii) Explain the concept of Molecular Orbital Theory for the formation of an electron rich molecule by using a suitable example. — 4
   (iii) What is hydrogen bonding ? Describe any two of its properties. — 4
   (iv) State and explain Curie-Weiss Law for ferromagnetic and paramagnetic substances. — 4

   (b) Attempt any **one** of the following :–
   (i) Obtain the wave functions for the hybrid orbitals of Beryllium dihydride molecule. — 4
   (ii) On the basis of molecular orbital theory, explain the formation of diborane molecule. — 4

2. (a) Attempt any **two** of the following :–
   (i) Construct a character table for C_{3v} point group. — 4
   (ii) Explain the abelian and non-abelian point group using a suitable example. — 4
   (iii) Derive a matrix representation for reflection operation on the basis of group theory. — 4
   (iv) Construct group multiplication table for symmetry operation of ammonia molecule. — 4

   (b) Attempt any **one** of the following :–
   (i) Write a note on Mulliken notation for the irreducible representation with an example. — 4
   (ii) Define subgroup. Give the subgroups of D_{2h} point group. — 4

3. (a) Attempt any **two** of the following :–
   (i) Discuss the sources, biochemical effects, toxicology and toxicity of copper. — 4
   (ii) Give the classification and origin of geothermal energy. — 4
   (iii) Write a short note on wind energy as indirect utilization of solar energy. — 4
   (iv) Discuss the toxic effect and treatment for lead poisoning. — 4

   (b) Attempt any **one** of the following :–
   (i) Write a note on "itai-itai" disease. — 4
   (ii) Discuss the effects of radioactive pollution on human cells — 4

4. (a) Attempt any **two** of the following :–
   - (i) Discuss the T-R transition in haemoglobin molecule.   4
   - (ii) Describe the reactions catalysed by Cytochrome P-450 enzyme.   4
   - (iii) What are ionophores ? Explain their role in the transport of metal ion across   4
     the cell membrane.
   - (iv) Explain the destruction mechanism of cancerous cells by cis-platin.   4

   (b) Attempt any **one** of the following :–
   - (i) Discuss the reaction catalysed by the enzyme Nitrogenase.   4
   - (ii) Give the mechanism of activity by Superoxide Dismutase in biological system.   4

5. Attempt any **four** of the following :–   12
   - (a) With the help of suitable examples, explain any two types of Van der Waals forces.
   - (b) Discuss, the antiferromagnetic behaviour observed in substances, using suitable examples.
   - (c) Explain the symmetry restrictions on the dipole in a molecule.
   - (d) Discuss the optical activity in a molecule on the basis of group theory.
   - (e) Give the advantages of Natural gas.
   - (f) Explain biochemical methylation and illustrate the propagation of mercury in food chain.
   - (g) What is the role of hemocyanin and hemerythrene in the biological system.
   - (h) Write a note on transferrin.