

[Time: 2 ½ Hours]

[Marks: 60]

Please check whether you have got the right question paper.

N.B: 1. All questions are compulsory.

2. Figures to the right indicate full marks.

1. a) Attempt **ANY TWO** of the following

- i) Draw a molecular orbital diagram for triiodide ion and explain its structure and bonding 4
- ii) By applying the concept of hybridization, derive the wave functions for the hybrid orbitals of beryllium difluoride molecule. 4
- iii) Define resonance energy? Draw the resonating structures of nitrate ion. Calculate the formal charge on N and O atoms in any one resonating structure. 4
- iv) What are ion-dipole and dipole-dipole interactions? Give suitable examples. 4

b) Attempt **ANY ONE** of the following.

- i) On the basis of hybridization explain the structure and bonding of iodine hepta fluoride. 4
- ii) Explain any two significance and limitations of valence bond theory. 4

2. a) Attempt **ANY TWO** of the following

- i) Obtain matrix representation for rotation operation. 4
- ii) On the basis of group theory, explain optical activity in a molecule. 4
- iii) Explain Abelian and non-Abelian point group with the help of suitable example of each. 4
- iv) Construct group multiplication table for symmetry operations for C_{2v} point group. 4

b) Attempt **ANY ONE** of the following.

- i) On the basis of Symmetry Adapted Linear Combination (SALC), draw the molecular orbital diagram for ammonia molecule. 4
- ii) What are irreducible representations? State their characteristics. 4

3. a) Attempt **ANY TWO** of the following

- i) Explain the following terms with respect to Band theory 4
a) Valence Band b) Conduction band c) Intrinsic semiconductor d) Forbidden band.
- ii) Discuss structural details of solid TiO_2 . Mention coordination number of it. 4
- iii) Define nanomaterials. Discuss with suitable examples, the biological method for the preparation of nanomaterials. 4
- iv) Draw the structure of Rutile compound. State the salient features of the structure. 4

b) Attempt **ANY ONE** of the following.

- i) Explain the terms Fermi Energy and Fermi Level. 4
- ii) Discuss the microwave method for preparation of nanomaterials 4

4. a) Attempt **ANY TWO** of the following
- i) Schematically represent the expression of the term Stepwise formation constant. 4
 - ii) How the formation of precipitate and magnetic measurements helps for indication of complex? 4
 - iii) Draw the Orgel diagram for $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$. Assign the electronic transitions. 4
 - iv) State Jahn-Teller theorem. Discuss the interpretation of ESR spectra of octahedral complex of Cu(II) . 4
- b) Attempt **ANY ONE** of the following
- i) Explain Job's method for the determination of formation constant. 4
 - ii) With respect to complex formation, explain dissolution of an insoluble compound in presence of complexing agent. 4
5. Answer **ANY FOUR** of the following.
- a) Explain in brief any two methods for the detection of hydrogen bonding. 3
 - b) Draw a molecular orbital diagram for diatomic vanadium molecule. 3
 - c) Discuss the criteria for a set of elements to form a group by giving suitable example. 3
 - d) Define subgroup. Give its characteristics. 3
 - e) Give the merits and demerits of sol-gel method. 3
 - f) Discuss the co-precipitation method for preparation of nanomaterials 3
 - g) Write a note on applications of ESR spectra in inorganic chemistry. 3
 - h) Derive the expression for the term thermodynamic equilibrium constant. 3
