[Time: 2.5 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.

Q.1. a) Attempt ANY TWO of the following:

i) Considering the concept of hybridization, derive the wave function for hybrid orbitals formed in methane molecule. **4**

ii) What is resonance energy? Draw all possible resonating structures for nitrate ion. Calculate the formal charges for all the atoms in the ion. **4**

iii) On the basis of molecular orbital theory, explain the structure and bonding of triiodide ion. **4**

iv) What are van der Waals forces? Discuss any two types with suitable examples. **4**

Q.1. b) Attempt ANY ONE of the following:

i) By applying the concept of Valence Bond Theory, discuss the structure and bonding in Iodine pentafluoride and Xenon hexafluoride. **4**

ii) Draw orbital diagram for SF_6 molecule. Show the distribution of electrons Explain its bond order and magnetic property. **4**

Q.2. a) Attempt ANY TWO of the following:

i) Discuss the criteria for a set of elements to form a group by giving suitable example. **4**

ii) Construct the group multiplication table for C_{3v} point group. **4**

iii) Derive the matrix representation for reflection operation. **4**

iv) On the basis of Symmetry Adapted Linear Combination, draw the molecular orbital diagram for ammonia molecule. **4**

Q.2. b) Attempt ANY ONE of the following:

i) Explain the symmetry restrictions on the dipole moment in the molecule. **4**

ii) Define subgroup. Give its characteristics. Give the subgroups for C_{2v} point group. **4**

Q.3. a) Attempt ANY TWO of the following:

i) Explain the electrical property of magnesium metal on the basis of band theory. **4**

ii) Draw the structure of $CdCl_2$ and discuss its salient features. **4**

iii) Describe the ceramic method for the preparation of inorganic solids.Mention its merits and demerits. **4**

iv) Explain the Solvolthermal method for the preparation of nanomaterials. **4**

Q.3. b) Attempt ANY ONE of the following:

i) Discuss the origin of first Brillouin zone in inorganic solids. **4**

ii) Describe the Langmuir-Blodgett method for the preparation of nanomaterials. **4**

Q.4. a) Attempt ANY TWO of the following.

i) With respect to complex formation, explain the following evidences: **4**
1) conductance measurement 2) change in colour of the solution.

ii) Draw the Orgel diagram for $[Cr(H_2O)_6]^{3+}$. Assign the electronic transitions. **4**

iii) Rationalize the IR data for the following : **4**

Species	CO stretching frequency in cm^{-1}
CO	2145
$Mo(CO)_6$	2000
$Mo(CO)_3(NH_3)_3$	1855

iv) Derive the expression for stepwise formation constant in complexes. **4**

Q.4. b) Attempt ANY ONE of the following:

i) The ^{31}P NMR spectra shows 1 peak for trans $[PtClBr(PR_3)_2]$ & 2 peaks for the cis $[PtClBr(PR_3)_2]$. Justify. **4**

ii) Explain the Job's method for the determination of formation constant. **4**

Q.5. Attempt ANY FOUR of the following. **12**

a) Draw a molecular orbital diagram for diatomic vanadium molecule.

b) HF has a smaller heat of vaporization than water. Explain.

c) With the help of suitable example, explain non- Abelian point group.

d) Write a short note on irreducible representations.

e) Explain Fermi level in inorganic solids.

f) Discuss the synthesis of CdS quantum dots using microorganism.

g) The ^{13}C NMR of $Fe(CO)_5$ exhibit only one signal.Explain.

h) Write a note on Racah parameter.

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