M.Sc. Semester-I, Examination, November, 201 5
Inorganic Chemistry, Paper I, Subject code: 2761

Time: 2.5 hrs] [Marks: 70

N.B. (i) Attempt all questions
(ii) All questions carry equal marks

Q.1. Answer the following questions. 14
(a) Explain the third postulate of quantum mechanics.
(b) Explain step up and step down operators of quantum mechanics.
(c) Prove: If $\hat{B}$ is an operator which commutes with an operator $\hat{A}$ (both being Hermitian), Ψ_1 and Ψ_2 are the eigenfunctions of $\hat{A}$ and a_1 and a_2 are the corresponding eigen values respectively, then the integral $\int \Psi_1^* \hat{B} \Psi_2 \, d\tau = 0$.

OR

Q.1. Answer the following questions. 14
(a) Explain Unitary, Laplacian and Hermitian operators.
(b) State first and second postulates of quantum mechanics.
(C) Prove that $[L^2, Lx] = 0$.

Q.2. Answer the following questions. 14
(a) Find out the values of wave function ψ and energy E for a particle moving in a one dimensional box.
(b) State variation principle. Prove that $\bar{E} \geq E$.
(c) Solve φ equation.

OR

Q.2. Answer the following questions. 14
(a) Find out the values of wave function ψ and energy E for rigid rotator of a diatomic molecule.
(b) Solve R(r) equation.
(c) Explain Harmonic Oscillator.

Q.3. Answer the following questions. 14
(a) Find out the bond angle for sp hybridization.
(b) Explain valance bond theory for H_2 molecule.
(c) Explain The Born-Oppenheimer Approximation.

OR

Q.3. Answer the following questions. 14
(a) Find out the bond angle for sp^2 hybridization.
(b) Explain molecular orbital theory for H_2^+ molecule.
(c) Explain Self-Consistent Field (SCF) Method.

Q.4. Answer the following: 14

(a) Give an account on polymerization of alkenes using Zeigler-Natta catalyst.

(b) Discuss the manufacture of acetic acid with help of $Co_2(CO)_8$ catalyst.

OR

Q.4. Answer the following: 14

(a) Explain Lowry-Bronsted Theory of acids and bases. Write the conjugate acids of:
(i) PH_3 (ii) ClO_4^-

(b) Explain the algebra of the following operators: (i) Multiplication (ii) Laplacian

(c) Prove that $\hat{L}_+\hat{L}_- = \hat{L}^2 - \hat{L}z^2 + \hbar\hat{L}z$.

(d) Explain the physical significance of integrals H_{AA}, H_{AB}, S_{AA} and S_{AB}.

Q.5. Answer the following: 14

(a) What is K_a? Derive a relation between ionization constant K_a and the concentration C_o and H_3O^+ of phenol in the aqueous solution.

(b) Calculate the *pH* of 0.01 M solution of CH_3COOH. Ka of CH_3COOH at 298 K is 1.8×10^{-5}.

(c) Calculate the oxidation number of underlined elements:
(i) $Na_2[\underline{Fe}(CN)_5(NO)]$ **(ii)** $[\underline{Cr}(CO)_6]$

(d) Give the IUPAC of the following:
(i) $Na_3[Co(CN)_6]$ **(ii)** $K_4[Cr(CN)_5(NO)]$

(e) Give the formula of complexes as shown below:
(i) Sodium hexanitrito cobaltate (II) **(ii)** Tris (ethylene diamine) manganese (III) chloride

OR

Q.5. Answer the following: 14

(a) What is K_b? Derive a relation between ionization constant K_b, OH^- and the concentration Co of ammonia in the aqueous solution.

(b) The ionization constant of methyl amine is 5.0×10^{-4}. Calculate the *pH* is 0.04 *M* methyl amine.

(c) Calculate the oxidation number of underlined elements:
(i) $[\underline{Cr}(H_2O)_4\ Cl_2]\ Br$ (ii) $K_4\ [\underline{Ni}(CN)_4]$

(d) Give the IUPAC of the following:
(i) $[Pt(NH_3)_4(SO_3)]Br_2$ (ii) $Zn_2[Fe(CN)_6]$

(e) Give the formula of complexes as shown below:
(i) Dichloro bis (ethylene diamine) chromium (III) nitrate
(ii) Carbonato tetraammine cobalt (III) chloride.