



EEN-301001

Seat No. \_\_\_\_\_

M. Sc. (Sem. I) Examination

February-2022

CHE-401 : Inorganic Chemistry

Time : 3 Hours]

[Total Marks : 70

Note: All questions carry equal marks.

1 Answer the following questions.

(14)

- (a) Discuss the perturbation theory.
- (b) Calculate the commutator relationship between step up and step down operators of angular momentum i.e.  $[L_+, L_-]$ .

OR

- (a) Solve  $\Phi$  wave function equation for hydrogen atom.
- (b) Apply variation method to hydrogen atom and derive its energy equation.

2 Answer the following questions.

(14)

- (a) Explain symmetric matrix, orthogonal matrix and Hermitian matrix with suitable examples.
- (b) Taking wave function as the basis for irreducible representation for  $C_{3v}$  point group, considering  $2p_x$  and  $2p_y$  orbitals of the nitrogen atom in ammonia as the basis, calculate the values for  $\chi(E)$ ,  $\chi(C_3)$  and  $\chi(\sigma_v)$ .

OR

- (a) Obtain the matrices for  $C_n$ ,  $\sigma_h$  and  $S_n$  symmetry operations.
- (b) Find out the irreducible representations of direct product for (i)  $A_2 \times E$  and (ii)  $E \times E$  in  $C_{3v}$  point group.

3 Answer the following questions.

(14)

- (a) Write the statement of 'Lenz's law. Derive the equation for orbital magnetic moment:  $\mu = \sqrt{l(l+1)} B.M.$
- (b) Explain the terms ferromagnetism and anti-ferromagnetism. Distinguish between the properties of the compounds exhibiting such phenomenon.

OR

- (a) Discuss Curie and Curie Weiss law.
- (b) Discuss intramolecular antiferromagnetism with examples.

4 Answer the following questions.

(14)

- (a) Discuss the specific functions of Na and K in human life.
- (b) Write a note on (i) Antibacterial agents and (ii) MRI.

OR

- (a) Write a note on zinc-metalloenzymes.
- (b) Discuss in detail Haemoglobin and myoglobin.

**5 Answer the following questions in short.**

**(14)**

- (1) What is the value of linear momentum operator  $P_x$ ?
- (2) Which quantum number will be obtained on solving  $R(r)$  equation?
- (3) What is variation principle?
- (4) What is the value of total energy,  $E$ , for the simple harmonic oscillator?
- (5) Using the character table for point group  $D_{3h}$ , obtain a representation whose components are:  $E' + 2E''$ .
- (6) Define 'Zero' matrix.
- (7) Write  $3 \times 3$  matrix for  $C_s$  symmetry operation.
- (8) What is similarity transformation?
- (9) Define magnetic induction.
- (10) What is the relation between values of magnetic moment of ferromagnetic and antiferromagnetic compounds?
- (11) Define Neel temperature.
- (12) Which metal ions are used in MRI?
- (13) Write the biological function of sulfur.
- (14) Define enzymes.

**Some Character Tables**

$C_{3v}$	$E$	$2C_3$	$3\sigma_v$	
$A_1$	1	1	1	$Z, x^2 + y^2, z^2$
$A_2$	1	1	-1	$R_z$
$E$	2	-1	0	$(x, y)(R_x, R_y) (x^2 - y^2, 2xy)(xz, yz)$

$D_{3h}$	$E$	$2C_3$	$3C_2$	$\sigma_h$	$2S_3$	$3\sigma_v$		
$A_1'$	1	1	1	1	1	1		$x^2 + y^2, z^2$
$A_2'$	1	1	-1	1	1	-1	$R_z$	
$E'$	2	-1	0	2	-1	0	$(x, y)$	$(x^2 - y^2, 2xy)$
$A_1''$	1	1	1	-1	-1	-1		
$A_2''$	1	1	-1	-1	-1	1	$z$	
$E''$	2	-1	0	-2	1	0	$(R_x, R_y)$	$(xy, yz)$