

Seat No. : _____

FA-135

February-2025

M.Sc., Sem.-I

CHE-401 : Chemistry (Inorganic Chemistry)

Time : 2:30 Hours]

[Max. Marks : 70

1. (A) Derive the equation for \hat{L}_z and prove that it is a hermitian operator. 7
(B) Derive the equation for wave function OR energy applying first order perturbation theory. 7

OR

1. (A) Show that Total angular momentum and its component are real and simultaneously defined. 7
(B) Show that ground state energy for hydrogen atom is $E_{\min} = \frac{-2\pi^2 me^4}{h^2}$. 7

2. (A) Explain "Conjugate Matrix" and their characteristics with example. 7
(B) Obtain the character for irreducible representation for C_{3v} point group with the help of 'The Great Orthogonality Theorem'. 7

OR

2. (A) Derive Matix for Improper axis of rotation 'Sn'. 7
(B) Which of the following vectors of Oh point group are orthogonal to A_{2g} ? 7

$A_{1g}, A_{2g}, E_{1g}, E_u$

3. (A) Explain structure and bonding in 4- π -electron donor organometallic compound. 7
(B) Explain the importance of Organometallic compound as a catalyst. 7

OR

3. (A) Discuss the bonding in π -metal olefin. 7
(B) Explain the structure & bonding in allylic complexes. 7

4. (A) Discuss limitations of CFT and tetragonal distortion in octahedral complex. 7
(B) Explain the splitting of d-orbitals in Tetrahedral, Trigonal-Bi-Pyramid, and Trigonal Prismatic Complex. 7

OR

4. (A) Describe important features of Ligand Field Theory. Discuss & draw the diagram for Octahedral Complex in presence of π -donor Ligand. 7
(B) Consider example of d^2 system and explain the rules for determination of Exact Terms which will have Symbol $3F, 3P, 1G$ and $1S$. 7

5. Answer any **seven** out of **twelve**.

- (i) Define commutation and commutator.
- (ii) Define condition for 'Orthogonality'
- (iii) Explain Hermitian matrix.
- (iv) Define un-shifted atoms with an example.
- (v) Write an equation of reduction formula.
- (vi) The character of matrix $\chi_{\sigma_{yz}}$ is
- (vii) Give the example of 5 electron donor OMC.
- (viii) What is OMC ?
- (ix) Give type of OMC catalyst and their example.
- (x) Write equation to find total microstates.
- (xi) Name the factors which affects the magnitude of Crystal field splitting parameter.
- (xii) The ligand co-ordinate through either of the atoms present is known as _____.

● **Some useful Character Tables :**

C_{2v} (2mm)	E	C_2	$\sigma_v(xz)$	$\sigma'_v(yz)$		
A_1	1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	-1	-1	R_z	xy
B_1	1	-1	1	-1	x, R_y	xz
B_2	1	-1	-1	1	y, R_x	yz

Oh	E	$8C_3$	$6C_2$	$6C_4$	$3C_2$ (= C_4^2)	i	$6S_4$	$8S_6$	$3\sigma_h$	$6\sigma_d$	
A_{1g}	1	1	1	1	1	1	1	1	1	1	$x^2 + y^2 + z^2$
A_{2g}	1	1	-1	-1	1	1	-1	1	1	-1	
E_g	2	-1	0	0	2	2	0	-1	2	0	$(2z^2 - x^2 - y^2)$ $(x^2 - y^2)$
T_{1g}	3	0	-1	1	-1	3	1	0	-1	-1	(R_x, R_y, R_z)
T_{2g}	3	0	1	-1	-1	3	-1	0	-1	1	(xy, xz, yz)
A_{1u}	1	1	1	1	1	-1	-1	-1	-1	-1	
A_{2u}	1	1	-1	-1	1	-1	1	-1	-1	1	
E_u	2	-1	0	0	2	-2	0	1	-2	0	
T_{1u}	3	0	-1	1	-1	-3	-1	0	1	1	(x, y, z)
T_{2u}	3	0	1	-1	-1	-3	1	0	1	-1	

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	$(x, y) (R_x, R_y)$	$(x^2 - y^2, 2xy) (xz, yz)$