

PS1HPHC550

Reg. No. :

--	--	--	--	--	--	--	--	--	--

St Aloysius (Deemed to be University), Mangaluru

Semester II – P.G. Examination – M.Sc. Analytical Chemistry

April - 2025

**ADVANCED INORGANIC CHEMISTRY**

Time: 2 ½ Hours

Max. Marks: 60

**PART - A**

ST. ALOYSIUS COLLEGE

PG Library

MANGALORE-575 002

(5x2=10)

Answer any **FIVE** of the following:

1. Outline the key steps involved in the extraction and separation of lanthanides from their ores.
2. Mention the spectral properties exhibited by lanthanide and actinide complexes.
3. Mention any 2 limitations of Valence Bond Theory.
4. What is Nephelauxetic effect.
5. What are metal carbonylates? Give an example.
6. How does the presence of pi acceptor ligands influence the bonding in metal carbonyls?
7. State Curie- Weiss law.
8. What is quenching of magnetic moment.

**PART - B**

Answer any **FIVE** of the following

(5x10=50)

- 9.a) Explain Significance of Lanthanide contraction. (5)
- b) With the help of Ellingham diagram, discuss the relative merits of C and CO as reducing agents in the extraction of metals. (5)
- 10.a) Describe the methods involved in the reduction of oxide ores. (5)
- b) Explain Pourbaix diagram of water (5)
- 11.a) Explain the sigma bonding in tetrahedral complexes based on MO theory. (5)
- b) Explain the splitting of d-orbitals in square planar crystal field. (5)
- 12.a) How is the stability constant of metal complex determined by Job's method? (5)
- b) Explain the possible geometries of Coordination number 2, 4 and 6? Give an example for each. (5)
- 13.a) Discuss the chemistry of metal nitrosyls. (5)
- b) With an example, explain the structure and bonding of metal carbonyls. (5)
- 14.a) Enumerate the factors favouring M-M bond formation in metal carbonyls in metal clusters. (5)
- b) With 2 reactions each explain the preparation of metal carbonylates & metal carbonyl halides. (5)

Contd...2

- 15.a) In the spectra of  $[V(H_2O)_6]^{+3}$  two peaks are obtained at  $17300\text{cm}^{-1}$  and  $25600\text{cm}^{-1}$ , interpret the spectra, calculate the Racah parameter and wave number of missing transition. (5)
- b) Explain the different types of charge transfer spectra (5)
- 16.a) Justify  $d^n$  and  $d^{10-n}$  systems have same term symbol and same microstates. (5)
- b) Explain the difference between Orgel diagram and Tanabe-Sugano diagrams (5)

\*\*\*\*\*

ST. ALOYSIUS COLLEGE  
MANGALORE-575 003

PS1HPHC551

Reg No

--	--	--	--	--	--	--	--	--	--

St Aloysius (Deemed to be University)

Mangaluru

Semester II – P.G. Examination – M.Sc. Analytical Chemistry

April - 2025

**ADVANCED ORGANIC CHEMISTRY**

Time: 2 ½ Hours

Max. Marks: 60

**PART - A**

ST. ALOYSIUS COLLEGE

P.G. Library

MANGALORE-575 003

(5x2=10)

Answer any **FIVE** of the following

1. Explain effect of solvent in aliphatic nucleophilic substitution reaction
2. What are anchimeric assistance? Explain with example.
3. Explain E2 mechanism with example
4. Explain Hofmann exhaustive methylation reaction
5. Give an example for Michael addition.
6. Explain Anti-Markovnikov's rule with an example.
7. Depict the product form on Chlorination of Pyrazole.
8. Pyridine is aromatic in nature. Give evidences to prove the statement.

**PART - B**

Answer any **FIVE** of the following

(5x10=50)

- 9.a) Explain the mechanism Von-Richter rearrangement (5)
- b) Explain the mechanism of SE<sub>1</sub> and SE<sub>2</sub> reactions (5)
- 10.a) Discuss the mechanism and stereochemistry of SN1 and SNi reactions (5)
- b) Explain the factors affect the reactivity of nucleophilic substitution reaction (5)
- 11.a) Explain the mechanism of E<sub>2</sub> and E<sub>1</sub>CB reaction (5)
- b) What are neighbouring group participation? Explain with suitable example (5)
- 12.a) Write a note on orientation during elimination reactions (5)
- b) Explain the following with mechanism (5)
  - i) Chugaev reactions
  - ii) Hofmann degradation
- 13.a) Prove that anti addition to cis and trans isomer gives threo and erythro products respectively. (5)
- b) Write a note on Acid catalyzed transesterification reaction. (5)
- 14.a) Explain Perkin condensation reaction with a suitable mechanism. (5)
- b) Explain the reaction mechanism of A<sup>2</sup><sub>AC</sub> and B<sup>2</sup><sub>AC</sub> (5)
- 15.a) Explain Medelung synthesis of Indole. (5)
- b) Write a short notes on (i) Reformatsky reaction (ii) Wittig reaction (5)
- 16.a) Outline the mechanism of Photo Fries rearrangement. (5)
- b) Discuss the synthesis of coumarin using pechmann condensation. (5)

\*\*\*\*\*

PS1HPhC552

Reg. No. : 

--	--	--	--	--	--	--	--	--	--

St Aloysius (Deemed to be University), Mangaluru

Semester II – P.G. Examination – M.Sc. Analytical Chemistry

April - 2025

**ADVANCED PHYSICAL CHEMISTRY**

Time: 2 ½ Hours

Max. Marks: 60

ST. ALOYSIUS COLLEGE  
PG LIBRARY  
MANGALORE-575 003  
**PART - A**

Answer any **FIVE** of the following:

(5×2=10)

1. Are the energy levels of a quantum harmonic oscillator equally spaced?
2. Describe the fourth postulate of quantum mechanics concerning the time evolution of quantum states.
3. Why is oxygen paramagnetic according to molecular orbital theory?
4. How does spin-orbit coupling affect atomic energy levels?
5. What is meant by partial bond order in a conjugated system?
6. How does an aromatic conjugated system differ from a similar aliphatic system?
7. Give the conditions of uniform ensemble
8. Give the postulates of B-E distribution

**PART - B**

Answer any **FIVE** of the following

(5×10=50)

- 9.a) Describe the process and significance of normalization & orthogonality of a wave function. Provide an example with a simple wave function. (5)
- b) Derive the solution of the Schrödinger equation for a particle in a one-dimensional infinite potential well (box) and explain the physical significance of the quantization of energy levels. (5)
- 10.a) Solve the Schrodinger wave equation for particle in a ring (5)
- b) Explain the separation of variables for the S.W.E of hydrogen atom (5)
- 11.a) Illustrate with an example how bonding and antibonding orbitals are formed in a homonuclear diatomic molecule using the LCAO approach. (5)
- b) Describe the Perturbation method. (5)
- 12.a) Explain the concept of covalent bonding in the context of the Heitler-London model, using the hydrogen molecule as an example. (5)
- b) Analyze the conditions under which the Born-Oppenheimer approximation is valid and effective. (5)
- 13.a) Calculate the bond angle for  $sp^2$  hybridised carbon atom. (5)
- b) Compare and contrast the principles and assumptions of Valence Bond Theory and Molecular Orbital Theory in explaining the electronic structure and bonding in molecules. (5)
- 14.a) Give the bonding orbital diagrams of benzene molecule calculated using huckel theory (5)

Contd...2

- b) Evaluate the importance of charge density and free valence in determining the reactivity and stability of a three-carbon atom system (5)
- 15.a) Derive the partition function for translational motion of a molecule in three dimensions. (5)
- b) Calculate the characteristic rotation temperature and rotation partition function of  $H_2$  gas at  $2727^\circ C$ . (Given: Moment of Inertia,  $I = 4.6033 \times 10^{-48} \text{ kg m}^2$ ). (5)
- 16.a) Give a comparison of Simple and Extended Huckel theory. (5)
- b) Calculate the ratio of  $n_i/N$  for simple M-B distribution law. (5)

\*\*\*\*\*

ST.ALOYSIUS COLLEGE  
PG LIBRARY  
MANGALORE-575 001

--	--	--	--	--	--	--	--	--	--

**St Aloysius (Deemed to be University), Mangaluru**  
**Semester II- P.G Examination – M.Sc. Analytical Chemistry**  
**April -2025**

**MOLECULAR SYMMETRY AND MOLECULAR SPECTROSCOPY**

Time: 2 ½ Hours

Max. Marks: 60

**PART - A**

ST. ALOYSIUS COLLEGE  
 PG LIBRARY  
 MANGALORE-575 003

(5x2=10)

**Answer any FIVE of the following:**

1. Define subgroup. Give example.
2. Define plane of symmetry. Identify those present in  $\text{BCl}_3$ .
3. Predict whether the molecules possess centre of inversion:
  - i)  $\text{Cis N}_2\text{F}_2$
  - ii)  $\text{Trans N}_2\text{F}_2$
4.  $\text{HCl}$  molecule is microwave active while  $\text{H}_2$  and  $\text{Cl}_2$  are not. Why?
5. Define zero point energy. What is the zero point energy of a simple harmonic oscillator?
6. Differentiate between dispersion and diffraction
7. Mention any two advantages of Raman spectroscopy over IR.
8. What is mutual exclusion principle?

**PART - B**

**Answer any FIVE of the following**

(5x10=50)

9. a) Explain the systematic assignment of Schoenflies nomenclature to molecules. (5)  
 b) Construct the Group Multiplication Table for  $\text{C}_{3v}$  point group. (5)
10. a) What are irreducible representations? By using the properties of IRs construct character table for  $\text{C}_{2v}$  point group. (5)  
 b) Find the vibrational symmetry modes of  $\text{NH}_3$  molecule. (5)
11. a) What is Morse potential? Draw and explain the Morse potential energy diagram. (5)  
 b) Calculate the number of normal modes of vibration of  $\text{CO}_2$ . Sketch these normal modes and predict their IR activity with reasoning. (5)
12. a) Classify the molecules with examples according to the relative values of their three principal moments of inertia. (5)  
 b) Discuss in detail the rotational spectrum of a non-rigid diatomic molecule (5)
13. a) Explain the terms polarizability and polarizability ellipsoids. (5)  
 b) Describe the occurrence of Rayleigh, Stokes and anti-Stokes lines by applying quantum theory to Raman effect. (5)
14. a) Explain the effect of rotation on Raman shift (5)  
 b) Write a note on resonance Raman spectroscopy. (5)
15. a) The rotational spectrum of  $^{79}\text{Br}^{19}\text{F}$  shows a series of equidistant lines  $0.71433 \text{ cm}^{-1}$  apart. Calculate the rotational constant, the moment of inertia and bond length of the molecule. Determine the wave number of the  $J = 9$  to  $J = 10$  transition. Given, masses of  $^{19}\text{F} = 31.55 \times 10^{-24} \text{ g}$ ;  $^{79}\text{Br} = 131.03 \times 10^{-24} \text{ g}$ . (5)  
 b) Outline various components of an IR spectrometer. (5)
16. a) The rotational constant for  $\text{H}^{35}\text{Cl}$  is observed to be  $10.5909 \text{ cm}^{-1}$ . What are the values of rotational constant for  $\text{H}^{37}\text{Cl}$  and  $^2\text{D}^{35}\text{Cl}$  molecules? Given, masses of  $^1\text{H} = 1.673 \times 10^{-24} \text{ g}$ ;  $^2\text{D} = 3.344 \times 10^{-24} \text{ g}$ ;  $^{35}\text{Cl} = 58.06 \times 10^{-24} \text{ g}$ ;  $^{37}\text{Cl} = 61.38 \times 10^{-24} \text{ g}$ . (5)  
 b) Explain the utility of IR and Raman spectroscopy in elucidation of simple molecular structures. (5)

\*\*\*\*\*