

St Aloysius College (Autonomous)
Mangaluru

Semester III– P.G Examination – M.Sc. Chemistry
November/December -2023

Organometallic, Bioinorganic and Coordination Chemistry

Time: 3 Hrs.

Max. Marks:70

Part A

1. Answer any **FIVE** sub divisions of the following: (5X2=10)
- a. Describe the structural characteristics of a typical transition metal complex with pi ligands.
 - b. Describe the structure of a metal carbyne complex.
 - c. Name a catalyst used in Monsanto acetic acid synthesis.
 - d. Mention the advantages of water gas shift reaction.
 - e. How does ceruloplasmin contribute to the regulation of copper levels in the body? Provide an overview of its role.
 - f. How elements in the biological system are classified?
 - g. What is cis-platin? How it is synthesized?
 - h. What are non-complimentary reactions? Give example.

ST.ALOYSIUS COLLEGE
PG Library
MANGALORE-575 003

PART B

Answer any **FIVE** of the following questions choosing (5X12=60)
at least one full question from each unit.

UNIT -I

2.
 - a. Write a note on classification of organometallic compounds. (4)
 - b. Discuss the preparation and bonding in Fischer carbene complex. (4)
 - c. Explain the structure and bonding in ferrocene. (4)
3.
 - a. How do ligands influence the reactivity and selectivity of organometallic catalysts? (4)
 - b. Discuss preparation and bonding in metal - alkene complex (4)
 - c. Explain preparation and structure of organoberyllium compounds. (4)

UNIT-II

4.
 - a. Explain the role of cocatalyst such as aluminum alkyls in Ziegler-Natta polymerization reactions. How do they enhance the catalyst's activity? (4)
 - b. What is Wilkinson catalyst? Demonstrate its application with any one example. Mention the selectivity exhibited by this catalyst. (4)
 - c. Can you name some common homogeneous catalyst used in organometallic catalysis? (4)
5.
 - a. Write a note on industrial applications of organometallic complexes. (4)
 - b. Describe the mechanism of Fischer – Tropsch synthesis (4)
 - c. Can you describe the key chemical reactions involved in the Wacker process including the catalysts and reactants used? (4)

UNIT -III

6. a. Write any four applications of nitrogen fixation. (4)
b. Explain the cause and consequences of 'blue baby syndrome'. (4)
c. Compare and contrast the structural differences between Hemocyanin and Hemerythrin, and explain how these differences relate to their oxygen-binding mechanisms. (4)
7. a. What are the structural features of cytochrome P-450? Discuss its mechanism. (4)
b. Describe a scenario where the activity of the calcium pump (Ca^{2+} -ATPase) in muscle cells is critical for muscle contraction. How does the calcium pump function in this context? (4)
c. Compare and contrast the roles of ion channels and ionophores in regulating ion transport across cell membranes. Highlight their similarities and differences. (4)

UNIT -IV

8. a. What is base hydrolysis? Explain its mechanism. (4)
b. What are anation reactions? Discuss their mechanism. (4)
c. Design two-step syntheses of cis-and trans- $[\text{PtCl}_2(\text{NO}_2)(\text{NH}_3)]^-$ starting from $[\text{PtCl}_4]^{2-}$. (4)
9. a. Explain the factors that influence lability and inertness in octahedral complexes. (4)
b. Explain inner-sphere electron transfer reactions with an example. Point out its main characteristics. (4)
c. Square planar complexes are generally labile. Explain. (4)

ST.ALOYSIUS COLLEGE
PG Library
MANGALORE-575 003

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

St Aloysius College (Autonomous)

Mangaluru

SEMESTER III- P.G Examination – M.Sc. Chemistry

November/December -2023

ELECTROCHEMISTRY AND THERMO-ANALYTICAL METHODS

Time : 3 hours

Max marks : 70

PART-A

1. Answer any **FIVE** sub divisions of the following: (5x2=10)
- In the context of the electrical double layer, what does the Guoy-Chapman model describe?
 - What is ion-solvation?
 - Explain the principle of amperometry and how it is applied in titration experiments.
 - What are polarograms in the context of polarography, and how do they relate to the measurement of polarographic currents?
 - What is the feature that distinguishes a photogalvanic cell from a regular galvanic cell.
 - What is the primary source of energy for solar energy systems?
 - How can localized corrosion be detected and monitored in industrial equipment?
 - Name the components of the DSC instrument

PART-B

Answer any **FIVE** of the following choosing at least one full question from each unit: (5x12=60)

UNIT-I

- Explain in detail 'electrode-electrolyte interface" in electrochemistry. Provide an example. (4)
 - Analyze the thermodynamics of an electrified interface, considering the role of electrostatic potential, work, and entropy in the context of charge separation. (4)
 - What approaches would you employ to study ion-solvent interaction? (4)
- What are the different methods used to study ion-dipole interaction? (4)
 - Compare and contrast the structural treatment of ion-solvent interaction in the Born model and the ion-quadruple model. Highlight the main differences between the two. (4)
 - Explain the NMR approach to study ion solvation. Compare advantages with therodynamical approaches. (4)

UNIT-II

- What is a compound electrode? Explain electrode to detect carbon dioxide. (4)
 - Compare and contrast constant current coulometry and controlled potential coulometry in coulometric titrations. (4)
 - With a neat diagram explain how a polarographic experiment is conducted. (4)

5. a. What are the primary sources of polarization in voltammetric techniques? Provide brief explanations for each. (4)
- b. What is the primary function of a reference electrode in electrochemical measurements, and why is it crucial? (4)
- c. Explain in detail working of cycle voltammetry (4)

UNIT-III

6. a. Analyze the advantages and disadvantages of Kolbe's synthesis compared to other methods for alkane production. (4)
- b. Draw a neat diagram of photogalvanic cells and explain the working function. (4)
- c. Explain band bending in case of n-type and p-type semiconductor. (4)
7. a. Illustrate the principle and procedure with the help of a reaction mechanism, the electro-inorganic synthesis of fluorine. Explain in detail solid state electrodes and how they are different from conventional electrodes. (4)
- b. Analyse the advantages and the applications of reserve batteries. (4)
- c. Analyse the disadvantages of a primary battery. (4)

UNIT-IV ST. ALOYSIUS COLLEGE

8. a. Explain the kinetics of corrosion. PG Library MANGALORE-575 003 (4)
- b. What are thermometric titrations and what is the principle underlying the titrations. (4)
- c. How would you apply Differential Scanning Calorimetry (DSC) to determine the heat of fusion of a crystalline substance? (4)
9. a. Analyse the applications of photoelectrochemical cells. (4)
- b. Explain the sacrificial anode technique for prevention of corrosion. (4)
- c. Evaluate the advantages and disadvantages of using passivation as a corrosion prevention method for stainless steel in the food processing industry. (4)

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

St Aloysius College (Autonomous)

Mangaluru

SEMESTER III- P.G Examination – M.Sc. Chemistry

November/December -2023

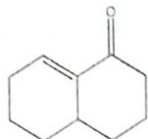
MOLECULAR SPECTROSCOPY

Time: 3 Hours

Max. Marks: 70

PART – A

1. Answer any **SEVEN** sub-divisions of the following: (7×2=14)
- How does NMR spectroscopy assist in determining the relative stereochemistry of stereoisomeric compounds?
 - How does the choice of solvent influence chemical shift?
 - Describe the differences between an AX and an AB system in NMR spectroscopy. What molecular characteristics lead to these distinct patterns?
 - Explain why chlorobenzene has no nitrogen based on nitrogen rule.
 - How does the presence of double bonds affect the mass spectrometry fragmentation pattern compared to alkanes?
 - Determine the λ_{\max} of the following organic compound:



ST. ALOYSIUS COLLEGE
PG Library
MANGALORE-575 003

- Discuss the relationship between the strength of a chemical bond and its contribution to the vibrational frequency in an IR spectrum.
- How do alkene compounds differ from alkanes in terms of the absorption bands observed in the IR spectrum?
- List the electronic factors affecting the Vibrational frequencies of an organic compound

PART – B

Answer any **FOUR** of the following choosing at least one full question from each unit. (4×14=56)

UNIT-I

- What is the difference between continuous wave (CW) NMR and pulsed (FT) NMR? (4)
 - An organic compound with molecular formula: $C_8H_8O_2$ has a mass of 136 and exhibited the following data: IR (cm⁻¹): 820, 1230, 1670, 2740, 2850, 3050 PMR: 3.9 s (3H), 6.9 d (2H), 7.8 d (2H), 9.8 s (1H) MS (m/z): 29, 51, 77, 92, 135, 136. Elucidate the structure with proper explanation (5)
 - Compare and contrast T_1 and T_2 techniques in NMR spectroscopy. When is each method preferred, and why? (5)

Contd...2

3. a) Explain how the sensitivity of ^{13}C NMR spectroscopy differs from ^1H NMR spectroscopy. What strategies are employed to enhance the sensitivity of ^{13}C NMR experiments? (4)
- b) Explain shielding effect in NMR spectroscopy. How is chemical shift value affected by shielding effect? Elaborate with examples. (5)
- c) Discuss how the J-coupling constant (scalar coupling constant) between two nuclei can provide information about the dihedral angle (torsion angle) between their respective chemical bonds in a molecule, and how this information is applied in the study of conformational isomerism using NMR spectroscopy. (5)

UNIT-II

4. a) Meta-stable ions are often observed in mass spectra. Discuss the formation of meta-stable ions during the ionization process and their importance in mass spectrometry. (5)
- b) Explain the Retro Diels Alder Reaction. (5)
- c) Briefly discuss the effect of substituents on the absorption maximum. (4)
5. a) Benzaldehyde shows prominent peaks at 114, 105, 77, 51 respectively. Explain. (4)
- b) Explain the concept of steric hindrance and its influence on reaction pathways and fragmentation. Provide examples of molecules where steric hindrance plays a crucial role (5)
- c) Explain mode I, mode II and mode III of homolytic cleavage. (5)

UNIT-III

6. a) Explain the IR spectrum of
(i) Acetophenone (ii) Benzaldehyde (5)
- b) Give the characteristic vibrational frequencies of alcohol with any two examples. (4)
- c) Identify the significance of Fermi resonance in IR spectroscopy (5)
7. a) Explain the IR spectrum of 1-Hexene and Toluene (4)
- b) Explain the characteristic vibrational frequencies of Ketones with any two examples. (5)
- d) Write a note on FIR spectroscopy & NIR spectroscopy. (5)
