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St Aloysius College (Autonomous)

Mangaluru

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

November- 2024

**ELECTROCHEMISTRY AND THERMO-ANALYTICAL METHODS**

Time : 3 hours

Max marks : 70

**PART-A**

1. Answer any **FIVE** sub divisions of the following: (5x2=10)
- What is electrical double layer at an electrode/electrolyte interface?
  - What is the primary focus of the Raman spectroscopic approach when studying ion-solvent interactions?
  - Explain the concept of an ion-selective electrode and how it selectively measures silver ions.
  - Explain the role of the saturated potassium chloride solution in a reference electrode, such as the calomel electrode.
  - What are the primary functions of an electrochemical energy system.
  - Differentiate between photovoltaic cells and solar thermal systems in terms of their energy conversion processes.
  - What is the role of paints in corrosion prevention?
  - Name the components of a TGA instrument

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**PART-B**

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

**UNIT-I**

- What is the structure of ion-dipole interface? What factors influence the same? (4)
  - Explain Helmholtz-Perin model of electrode/electrolyte interface. (4)
  - Explain the Born model of ion-solvent interaction. (4)
- Explain Guoy-Chapmann theory of electrical double layer. (4)
  - What are the different methods used to study ion-dipole interactions? (4)
  - Explain IR and NMR spectroscopic approaches to ion-solvent interaction. (4)

**UNIT-II**

- Explain in detail biamperometric instrumentation and its working. (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)

Contd...2

5. a. Analyze the advantages and limitations of using a glass electrode for measuring the pH of a solution. (4)
- b. Explain the principle and working of stripping analysis (4)
- c. Explain the working principle of CO<sub>2</sub> sensing membrane electrode. (4)

**UNIT-III**

6. a. Illustrate the principle and procedure with the help of a reaction mechanism, the electro-inorganic synthesis of ozone. (4)
- b. Describe the Leclanche dry cell (4)
- c. Explain the working of lead-acid battery. (4)
7. a. What are primary and secondary batteries? Explain. (4)
- b. Write a note on CH<sub>3</sub>OH-O<sub>2</sub> fuel cell. (4)
- c. What is the role of semi conducting electrodes in a photoelectrochemical cell? (4)

**UNIT-IV**

8. a. With suitable examples, explain the effect of temperature on hydrated organic and inorganic compounds. (4)
- b. Write a note on microbial corrosion. (4)
- c. Discuss the factors influencing the corrosion rate of metals. (4)
9. a. Discuss the principle and applications of complexometric titrations. (4)
- b. Evaluate the limitations of the galvanic series when selecting materials for corrosion-prone environments (4)
- c. Explain the instrumentation and working of a thermobalance. (4)

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**Mangaluru**

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

**November - 2024**

**MOLECULAR SPECTROSCOPY**

**Time: 3 Hours**

**Max. Marks: 70**

**PART – A**

1. Answer any **SEVEN** sub-divisions of the following: (7×2=14)
- How do you confirm the conversion of toluene to benzoic acid by  $^{13}\text{C}$  NMR analysis?
  - What are Larmor frequency and resonance phenomenon?
  - What are NMR reagents? Give examples.
  - 3-pentanone shows a peak at  $m/z$  57 in its EI-MS whereas, 2-pentanone gives a peak at  $m/z$  86. Comment on this.
  - How does the solvent effect influence in UV Spectroscopy ?
  - State nitrogen rule. Explain with an example.
  - What is metastable ion. Mention its significance.
  - How can you distinguish 1-hexene & 1-hexyne on the basis of IR spectroscopy?
  - cis*-1,2-dichloroethylene is IR active with respect to C=C double bond whereas *trans*-1,2-dichloroethylene is not. Give reasons.

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**PART – B**

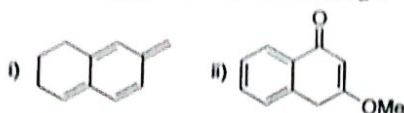
**Answer any FOUR of the following choosing at least one (4×14=56) full question from each unit.**

**UNIT-I**

- Explain the Magnetic anisotropic effect in molecules containing  $\pi$ -bond(s). (5)
  - Discuss the applications of NMR in medical fields. (4)
  - Why spin spin splitting occurs in PMR spectroscopy? Discuss the intensity and nature of peaks in 1,1,2-trichloroethane. (5)
- Explain the  $A_2X$  and  $AMX$  spin systems taking suitable examples and sketch their PMR spectra. (5)
  - Write the structures of all possible isomers of alcohol with the molecular formula  $C_4H_{10}O$  and predict the proton decoupled  $^{13}\text{C}$  NMR signals in each. (5)
  - What are the various methods of relaxation techniques seen in NMR experiment? Explain their significance and compare them. (4)

## UNIT-II

4. a) Predict the the
- $\lambda_{\max}$
- for the following.



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- b) Acrolein ( $\text{CH}_2=\text{CHCHO}$ ) absorbs at 217nm ( $\epsilon_{\max} = 16000$ ). What is the weight concentration (g/ml) required to observe an absorbance of 0.8 when the cell length is 1 cm? (4)
- c) Describe the working of mass spectrometer with a neat labelled diagram. (6)
5. a) Explain i) Mc Lafferty rearrangement  
ii) Retro Diels-Alder fragmentation (4)
- b) Write a short note on factors affecting reaction pathways. (4)
- c) Discuss the fragmentation pathways for the following systems with suitable examples. (6)
- i) Alcohols ii) Amines iii) Esters

## UNIT-III

6. a) Using IR spectroscopy, how would you determine whether the oxygen in an organic compound is present as a carbonyl, hydroxyl or ether linkage? (3)
- b) How would you distinguish between the following pairs by IR spectral studies? (6)
- i) Phenol & Cyclohexanol ii) Acetaldehyde & acetone  
iii) Primary amine & tertiary amine
- c) Discuss the factors which affect the band positions & intensities of peaks in IR spectroscopy. (5)
7. a) How can the following compounds be studied by using IR Spectroscopy? (6)
- i) Alkenes  
ii) Ethers  
iii) Ketones
- b) Predict the structures of compounds whose IR data is given below and assign the IR bands. (4)
- i)  $\text{C}_3\text{H}_6\text{O}$ ,  $1620\text{ cm}^{-1}$  ii)  $\text{C}_4\text{H}_6$ ,  $3300\text{ cm}^{-1}$  and  $2250\text{ cm}^{-1}$
- c) Deduce the structure of an organic compound that exhibited the following spectral data: Molecular Formula :  $\text{C}_{11}\text{H}_{12}\text{O}_2$   
Mass: 176, 131(base peak), 103, 77;  
IR ( $\text{cm}^{-1}$ ): 1714, 1639;  
PMR ( $\delta$ ): 1.31 (t, 3H,  $J=7.1\text{Hz}$ ), 4.2 (q, 2H,  $J=7.1\text{Hz}$ ), 6.43 (d, 1H,  $J=15.8\text{Hz}$ ), 7.24-7.57 (m, 5H), 7.67 (d, 1H,  $J=15.8\text{Hz}$ );  
CMR ( $\delta$ ): 14.3, 60.4, 118.4, 128.1, 128.9, 130.2, 134.5, 144.5, 166.8 (4)