B.Sc. Honours Examinations 2021
(Under CBCS Pattern)
Semester - V
Subject: CHEMISTRY
Paper: DSE 2-T & P

Full Marks : 60 (Theory-40 + Practical-20)
Time : 3 Hours

Candiates are required to give their answer in their own words as far as practicable.
The figures in the margin indicate full marks.

Analytical Methods In Chemistry

(Theory : Marks - 40)

Group - A

Answer any *three* questions from the following :					12×3=36

1. (a) What are **systematic** and **random** errors?					2

   (b) Write down the mathematical relation between optical density and transmittance. Draw the curve of transmittance vs. concentration. Mention the possible reasons for the deviation of the Lambert-Beer's law.					1+1+2=4

   (c) What type of transition(s) is/are responsible for the spectroscopic estimation of transition metal complex and what are the selection rule(s) for that predicted transition(s)?					1+2=3

(d) What is resonance line and atomic fluorescence? Which flames are usually used for atomizer in AAS analysis? 2+1=3

2. (a) The Job's plot shown here is for Fe(II) complexed with o-phen ligand. Based on the given figure, propose the possible metal-ligand stoichiometry (M:L ratio) for that complex. Explain how do you arrive at your answer. 03
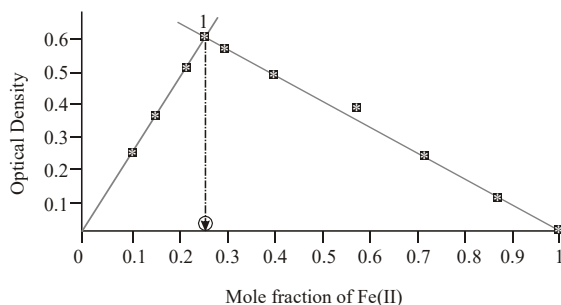
(b) (+)- Tartaric acid has a specific rotation of +12.0°. Calculate the specific rotation of a mixture of 75% (+)-tartaric acid and 25% (–) - tartaric acid and also find out the enantiomeric excess for this sample. 04

(c) Write a short note on Zeeman background correction used in flame atomic absorption spectroscopy. 03

(d) In chromatography, why the optimal flow rate becomes greater if the stationary phase particle size is smaller? 02

3. (a) What is cold or flameless technique in AAS? Why is it so called? Name the elements that can be analyzed by this method? 2+1+1=4

(b) What is known as 'extraction by chelation' and 'extraction by solvation'? Discuss the role of pH in solvent extraction process. (1+1)+2=04

(c) The IR spectrum of $Co(CO)_4H$ shows a significant band at 1934 cm^{-1} for the stretching of 'Co-H' bond. Find out the expected stretching frequency of $Co(CO)_4D$ (ν_{Co-D} in cm^{-1}). 02

(d) What is reverse phase liquid chromatography (RPLC)? 02

4. (a) Draw the curve with explanation for the conductometric titration of oxalic acid by NaOH solution. 02

(b) 'A set of experimental results with high precision does not always produce high accuracy'. Explain the statement with suitable example. 02

(c) What are physical and chemical interferences? How do you overcome these? 2+2=4

(d) What is thermogravimetry (TG) analysis? Draw the TGA thermogram of $CaC_2O_4.H_2O$ and hence explain its decomposition modes. 1+3=4

5. (a) If a sample containing a mixture of hydrocarbons namely pentane, isopentane and neopentane is subjected to injected into Gas Chromatography, then arrange the given hydrocarbons according to their decreasing retention time with proper justification. 3

(b) What is electrodeless discharge lamp (EDL) and how does it work? 3

(c) What are basic differences between the single and double beam UV-Visible spectro-photometer with respect to their basic structure and operating function? 3

(d) A loss of 0.3 mg Cu occurs during the course of the analysis of that sample. Find out percentage of relative error due to this loss, if the weight of Cu in the sample is 300 mg. 3

6. (a) What is ionization suppressant? Explain its function. 2

(b) Write down the comparison between HPLC and GLC. 2

(c) Explain the role of supporting electrolyte during voltammetry analysis of a redox reaction. 2

(d) A 2.5×10^{-4} M solution of a transition metal complex exhibits an absorption maximum at 630 nm with an absorbance of 0.88 when measured in a cuvette with a path length of 1.5 cm. Calculate the absorbance of 1.5×10^{-3} M solution of the same complex recorded in a cuvette with a path length of 0.2 cm. 3

(e) Write down the advantages of thin layer chromatography (TLC) over paper chromatography. Why spraying agent is required in the separation of ions through paper chromatography? 2+1=3

Group - B

Answer any *two* questions from the following : 2×2=4

1. Explain why indirect coulometric titration is more practical than direct one?

2. Why KBr pellet is used to measure infrared spectra (IR) in solid state?

3. What do you mean by adsorption partition chromatography?

4. What is the purpose of using Shift reagents in NMR?

(Practical : Marks - 20)

Answer any *one* from the following questions :   20×1=20

1. State the principle of HPLC and explain it uses with an example. Discuss the principle and methodology for the separation of a mixture of Sudan yellow and Sudan Red by TLC technique.   5+15=20

2. How does temperature affect pH? State the principle and procedure for determination of pH of soil.   5+15=20

3. What is Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) ? Write down the principle and methodology for determination of chemical oxygen demand (COD) using spectrophotometry.   5+15=20

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Or

**INSTRUMENTAL METHODS IN CHEMICAL ANALYSIS**

(Theory : Marks - 40)

Group - A

Answer any *three* questions from the following :   12×3=36

1. (a) How does gel electrophoresis technique is used to detect our DNA?

   (b) Why column is known as the heart of the gas chromatography?

   (c) What are the important criteria for selecting organic solvents for solvent extraction? Which is the most commonly used detector in high performance liquid chromatography (HPLC) and why?

   (d) What is the maximum and minimum value of R_f?   2½+2½+(2½+2½)+2

2. (a) The frequency of 'O-H' stretching in Phenol can be lowered by about 40-100 cm^{-1} when the spectrum is recorded in benzene solution compared to CCl_4. Explain why ?

   (b) Write down the various advantages of Fourier Transformation in Infrared Spectroscopy.

   (c) The IR spectra of Ethyl acetoacetate exhibits absorption three bands around 1748 cm^{-1}, 1725 cm^{-1} and 1650 cm^{-1}. Explain this fact with proper explanation.

   (d) Explain the following observation :

   $\upsilon_{co}\left(cm^{-1}\right)$: 1660   1705   1745
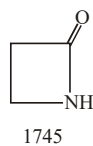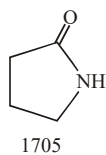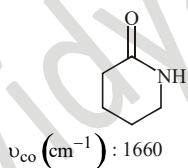
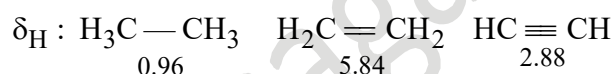   3+3+3+3

3. (a) What is wavelength dispersion ?

(b) Calculate UV absorption (λ_{max}) for the following compounds (A & B) and then explain the calculated results by corelating with particle in one dimensional box.

A   B
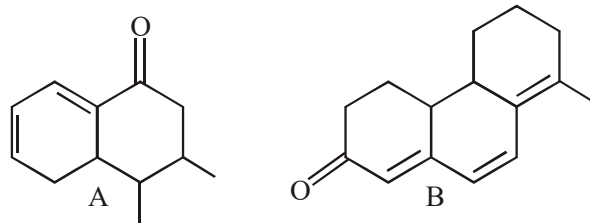
(c) Why π to $\pi*$ transition is stronger than n to $\pi*$ transition ? π to $\pi*$ transition in aniline appears at 230 nm in ethanol but this band is shifted to 203 nm in an acidic aqueous solution. Explain. [2+(1½+1½+2)+(2½+2½)]

4. (a) What do you mean by chemically and magnetically equivalent nuclei ? Explain with suitable examples.

(b) What do you mean by internal reference compound? Why TMS is use for that purpose?

(c) What do you mean by Chemical Shift? Explain the chemical shift value of the following compounds :

$$\delta_H : \underset{0.96}{H_3C-CH_3} \quad \underset{5.84}{H_2C=CH_2} \quad \underset{2.88}{HC\equiv CH}$$

(d) What are the factors to control the width of a NMR signal ? 3+3+3+3

5. (a) What is the difference between stable, unstable and metastable ions in mass spectrometry?

(b) Discuss the principle and applications of Mass spectroscopy.

(c) Fragmentation in mass spectrometry is a characteristic property of a compound. Explain. 3+5+4

6. (a) What are the difference sources used in X-ray spectroscopy ?

(b) What are the differences between Potentiometry and Voltametry related to electrochemical analysis?

(c) What is cyclic voltametry ? Discuss its various applications.

(d) What is the instrument used in radiometric method?

(e) What is the essential condition of photo-electron ejection from metal surface ?

2.5+2+3+2+2.5

Group - B

Answer any *two* questions from the following : 2×2=4

1. Why deuterated solvent use in NMR spectroscopy?

2. What is Fermi Resonance?

3. Distinguish between cation exchange resin and anion exchange resin.

4. Why is emission wavelength longer than excitation wavelength?

(Practical : Marks - 20)

Answer any *one* from the following questions : 20×1=20

1. What is the most common form of HPLC and why? Write down the principle and methodology for the determination of Caffeine in Beverages by HPLC.

5+15=20

2. Describe the principle of Atomic Absorption Spectroscopy (AAS)? Write down the methodology for the determination of Calcium, Iron and Copper in Food by Atomic Absorption. 5+15=20

3. State and explain the Lambert-Beer's law. Briefly describe the procedure for the determination of a mixture of Cobalt and Nickel by UV-V is spectroscopy.

5+15=20

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