B.Sc. 5th Semester (Honours) Examination, 2024 (CBCS)

Subject : Chemistry

Course : DSE-2

(Instrumental methods of Chemical Analysis)

Time: 2 Hours **Full Marks: 40**

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer *any five* questions from the following: 2×5=10

(a) What is the m/z ratio in mass spectrometry?

(b) Define Chromophore and Auxochrome.

(c) What is the main principle of NMR?

(d) Compare FAB-MS & ESI–MS.

(e) What is/are the advantage(s) of TLC as compared to column Chromatography?

(f) What is isosbertic point?

(g) What happens on the absorption of infrared and UV radiation by a molecule?

(h) Write the selection rules for rotational and vibrational spectra.

2. Answer *any two* questions from the following: 5×2=10

(a) Explain Lambert-Beer Law. Discuss the limitations of Lambert-Beer Law. 3+2

(b) What are the types of molecular spectroscopy? What are the advantages of ^{13}C-NMR? 3+2

(c) What are the factors affecting electrophoresis? What can cause faint or absent band in electrophoresis?

(d) The position of absorption of acetone shifts in different solvents: 279 nm in hexane, 272 nm in ethanol and 264.5 nm in water.— why? What is coupling constant (J)? 3+2

3. Answer *any two* questions from the following: 10×2=20

(a) What is the stationary and mobile phase in column chromatography? What is the significance of R_f value in chromatography? How DNA is detected after gel electrophoresis? (2+2)+3+3

(b) What is a chemical shift? Explain the factors that affect the chemical shifts in NMR spectroscopy. Which type of nuclei show magnetic properties in NMR spectroscopy? 3+4+3

(c) Draw the block diagram of an AAS instrument. How an anion can be measured in AAS? What is meant by 'Resonance Line Source' in connection to AAS? 5+3+2

(d) What is spin-spin coupling or splitting of signals? What are applications of electronic spectra? What is a bathochromic shift? State which of the following molecules have vibrational absorption spectra? 3+3+2+2

N_2, CO_2, OCS, H_2O, $CH_2{=}CH_2$, C_6H_6

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Course : DSE-2 (OR)

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1. Answer *any five* questions from the following: 2×5=10

(a) Why monochromatic light is used in UV-Vis. spectrophotometer?

(b) Write-down two important points to mention the role of computers in instrumental analysis.

(c) Write the fundamental law of UV-Visible spectroscopy.

(d) Mention the name of flame used in analysing elements like Na, Ca, K and Mg by Flame-absorption-atomic-spectra and indicate the temperature of the flame.

(e) Differentiate between systematic error and random error.

(f) Write two main application of Thin-layer-chromatography.

(g) Write two limitations of electroanalytical methods.

(h) Mention two sources of error in spectrophotometric analysis.

2. Answer *any two* questions from the following: 5×2=10

(a) (i) What is Enantiomeric excess? If there is a solution of tartaric acid with 0.3 M of the R-enantiomer and 0.1 M of the L-enantiomer, then calculate the enantiomeric excess (ee%).

(ii) What do you mean by "Optical Purity" of a tartaric acid solution? (2+1)+2

(b) (i) What is the basic principle of electro analytical methods? Write down the name of two electrode and their functions.

(ii) Mention the criteria for choice of solvent in solvent extraction process. (1+2)+2

(c) (i) What is the sources of chemical interference in Flame-atomic-absorption and emission methods?

(ii) Describe the methods to remove of chemical interference in Flame-atomic-absorption and emission process. 1½+3½

(d) (i) The following results were obtained in the replicate determination of the lead-content of a blood sample: 0·752, 0·756, 0·752, 0·751 and 0·760 ppm. Calculate the (a) Standard deviation, (b) the variance, (c) Relative standard deviation in ppt. 5

3. Answer *any two* questions from the following: 10×2=20

(a) (i) How will you determine the composition of a metal-complex by mole-ratio method using UV-Vis. spectrophotometer?

(ii) Write two important advantages of conductometric titration.

(iii) Why do we get two peaks in conductometric titration of oxalic acid with NaOH?

(iv) Justify the comment: "Precise results may not accurate but accurate results must be precise". 3+2+2+3

(b) (i) What do you mean by confidence interval and confidence level?

(ii) A chemist obtained the following data for the alcohol content in a blood sample as a percentage of C_2H_5OH: 0·089, 0·084 and 0·079. Calculate the 95% confidence interval for the mean assuming three results obtained are the only indication of the precision of the method. [Given; Z = 4·30 for two degrees of freedom and the 95% confidence level]

(iii) What are the relative and absolute errors? 3+4+3

(c) (i) Define optical density (O.D) in UV-Vis. spectroscopy. Show the O.D vs. Wavelength plot.

(ii) Write the importance of isotopic substitution technique in I.R. spectroscopy method. What are the effects of Isotopic substitution in it?

(iii) What is thermogravimmetric analysis (TGA)?

(iv) mention two important advantages and disadvantages of TGA. 2+(1+2)+1+4

(d) (i) What is the chiral shift reagent? Give two useful examples.

(ii) Write a short note on gas chromatography.

(iii) Define: Adsorption chromatography and partition chromatography. 3+4+3
