

- (b) How can you distinguish between phenyl acetate and methyl benzoate by IR spectroscopy? What types of cells are used for liquid samples in IR spectrometer? 2+1
- (c) Explain Column is the heart of Gas Chromatography. 2
- (d) What are the light sources used in fluorescence spectroscopy? 1
- (e) How is DNA detected using gel electrophoresis? 2
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2022

5th Semester Examination  
CHEMISTRY (Honours)

Paper : DSE 2-T

[CBCS]

Full Marks : 40

Time : Two Hours

*The figures in the margin indicate full marks.  
Candidates are required to give their answers  
in their own words as far as practicable.*

[Analytical Methods in Chemistry]

Group - A

Answer any *five* from the following questions :

2×5=10

1. (a) Distinguish between Accuracy and Precision.
- (b) What is Q-test?
- (c) What are the fundamental laws of Spectroscopy?
- (d) Calculate the molar absorptivity of  $0.4 \times 10^{-3} \text{M}$  solution which has an absorbance of 0.15 when pathlength is 1.3 cm.
- (e) What are the basic differences between TGA and DTA?
- (f) What is the basic principle of pH metric titration?

P.T.O.

- (g) What is the role of internal standard used in GLC technique?
- (h) Good Precision does not assure good accuracy. — Explain the fact.

**Group - B**

Answer any *four* from the following questions :  $5 \times 4 = 20$

2. (a) Differentiate between systematic error and random errors by giving suitable example.
- (b) The results of an analysis are 46.95 gm. Compared with the accepted value of 47.02 gm. What is the relative error in parts per thousand? 2+3
3. (a) The result of TGA analysis of a mixture of CaO and CaCO<sub>3</sub> indicates that mass of the sample decreases from 250.6 mg to 190.8 mg only between 600°C and 900°C. Calculate the percentage of calcium carbonate in the mixture.
- (b) What are the common sources of error in TG analysis? — Explain. 3+2
4. What is meant by the term  $R_f$  value? On what factors does the  $R_f$  value of a compound depend? What is the physical significance of  $R_f = 0$  and  $R_f = 1$ .
5. (a) What is meant by racemic mixture of enantiomers?
- (b) A sample of S-(+) enantiomers of a compound has an observed rotation of + 19.2°. If the specific rotation of the pure enantiomer is + 24° then what

is the optical purity of the sample? What is the composition of the mixture? 2+3

6. (a) What do you mean by thermogram?
- (b) What are the physical significance of the horizontal and the curved regions of a thermogram? 2+3
7. (a) Describe potentiometric method to determine the pH of a solution using the quinhydrone electrode.
- (b) Give an example of metallochromic indicator.
- (c) What is optical rotation? 3+1+1

**Group - C**

Answer any *one* from the following question :  $10 \times 1 = 10$

8. (a) How is the standard deviation related to accuracy?
- (b) The following masses were recorded for 12 different coins (all given in grams)
- 5.683, 5.549, 5.548, 5.552, 5.620, 5.536, 5.539, 5.648, 5.551, 5.552, 5.554, 5.632
- Report the mean, median, range, standard deviation and variance for these data.
- (c) In what different ways a masking agent can help in achieving selectivity in metal ion separations? 2+5+3

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9. (a) What are the different types of detectors used in GC technique?
- (b) How will you determine the equivalence point for each of the following combinations by conductometric titration?
- (i) weak acid Vs strong base.
  - (ii) strong acid Vs weak base.
- (c) Why IR spectroscopy is also called as the vibrational spectroscopy? What do you mean by fingerprint region in IR spectroscopy?

3+(2+2)+(2+1)

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OR

**[Instrumental Methods of Chemical Analysis]**

**Group - A**

Answer any *five* questions :  $2 \times 5 = 10$

1. (a) What is spin-spin splitting? Define coupling constant (J).
- (b) What KBr is used in IR spectroscopy?
- (c) What is Reverse Phase Liquid Chromatography (RPLC)?
- (d) State the energy range for IR, UV and flame emission spectroscopy?
- (e) Which of the following atom is / are NMR active ( $^{12}\text{C}$ ,  $^{19}\text{F}$ ,  $^2\text{H}$ )?
- (f) What is Red and Blue shift in UV-Vis spectroscopy?
- (g) What is  $R_f$  value? Discuss its significance in chromatography separation.
- (h) Name the detectors used in X-ray spectroscopy.

**Group - B**

Answer any *four* questions :  $5 \times 4 = 20$

2. (a) What do you mean by chemical shift? Explain the factors influencing the 'Chemical shift'?  $1+2$

- (b) A compound with molecular formula,  $C_7H_7OCl$  shows three-proton singlet at  $\delta$  3.80, two proton doublet at  $\delta$  6.55 and also two proton doublet at  $\delta$  7.35. Identify the compound. 2
3. (a) Explain the differences between potentiometry and voltammetry. Draw cyclic voltammogram of  $Ru(II)/Ru(III)$  couple. 2+2
- (b) What is most important source of IR light? 1
4. (a) Draw a block diagram of double beam UV-Vis spectrometer. Discuss with an example how does UV technique help to distinguish equatorial and axial conformations? 2+1
- (b) The mass spectrum of 3-butyne-2-ol shows a large peak at  $m/z = 55$ . Draw the structure of the fragment and explain why it is particularly stable. 2
5. (a) What are the advantages of Fourier Transform in Infrared Spectroscopy? 2
- (b) Name the electrodes used in potentiometry citing one example for each. 2
- (c) What are the two types of pumps used in HPLC? 1
6. (a) Explain the working principles of Atomic Absorption Spectrometry (AAS). 2
- (b) Outline how Mercury can be determined by Cold-Vapor AAS? 2

- (c) What type of species can be separated by HPLC but not by GC? 1
7. (a) Indicate the order of elution of the following compounds from a reversed-phase packed HPLC column : 3
- (i) benzene, diethyl ether, *n*-hexane.
- (ii) acetone, Dichloroethane, acetamide.
- (b) What are the applications of Molecular Mass Spectrometry? 2
- Group - C**
- Answer any *one* question : 10×1=10
8. (a) Give a schematic diagram for a tandem mass spectrometer (MS/MS). 3
- (b) What are the advantages of carbon  $^{13}C$  NMR over proton NMR? 2
- (c) Why tetramethyl silane (TMS) is used as internal standard in NMR spectroscopy? 2
- (d) Write down the feasible structures of this compound : 3-methyl-2-butanol,  $m/z$  43, 45, 71, 73, 88. 3
9. (a) Why pyrolytic graphite tubes are used in Graphite Furnace Atomic Absorption Spectrometry (GFAAS)? 2