M.Sc-I Chemistry (Additional) Semester-I,
Paper-IV, 03/08/2023

TIME: 2 ½ HOURS **MAX.MARKS:60**

N.B. 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of logarithmic table/non programmable calculator is allowed.
4) At. Wts: At. Wts: H=1, C=12, N=14, O=16, Na=23, Al=27, S=32, Cl=35.5, K=39, Ca=40, Ag=108, Ba=137, Pb=207, Mg= 24.3, F=19, Cu= 63.5, Cr = 52, Sn=118.7

Q.1 A) Attempt **Any two** of the following:

a) Define the following terms with respect to performance characteristics of an analytical instrument, **4**
1. Accuracy 2. Linear range 3. Sensitivity 4. Robustness

b) What factors should be taken into account for the proper method selection of an analytical method. **4**

c) Define "Sensor" with respect to analytical device. Discuss Piezoelectric effect. **4**

d) Describe the methods employed for the minimization of error in analysis. **4**

B) Attempt **any one** of the following:

a) Define: Data domain. What is electrical domain and non-electrical domain? **4**

b) Discuss Quality assurance and quality control with respect to quality management system in analytical laboratory. **4**

Q.2 A. Attempt **any two** of the following:

a) i) Assign oxidation number to Cl in the following compounds – **4**
a. $HClO_4$ b. Cl_2O
ii) Calculate the solubility product (K_{sp}) of AgCl, when its solubility in water at 25^0C is 1.43×10^{-3} g/dm^3.

b) Calculate the amount of HNO_3 (density =1.41 gm / cm^3, 89 % HNO_3 by weight) required to prepare 500 cm^3 of 4N HNO_3. **4**

c) Determine the mole fractions of both the substances in a solution containing 100 g water and 32 g methanol. **4**

d) 100 g of Na_2CO_3 reacts with 100 g of HCl. Calculate the amount of NaCl formed, in moles and in grams. Which is the limiting reagent? **4**

B. Attempt **any one** of the following:

a) Calculate pH of 2×10^{-3} Acetic Acid. K_a for Acetic Acid is 1.75×10^{-5}. **4**

b) A solution is prepared by adding 5000 mg of $SnCl_2$ to form 500 cm^3 solution. Find **4**
i) Molarity of the solution
ii) w/v% of $SnCl_2$.

Q.3 A. Attempt **any two** of the following:

a) With the help of schematic diagram, explain the working of Michaelson interferometer in FTIR. **4**

b) Explain the basic principle of diffuse reflectance spectroscopy. **4**

c) How are the 'Derivative Spectra' obtained in UV-visible spectrophotometry? Discuss the applications of derivative spectra in UV and visible regions. **4**

d) Discuss the principle and optical arrangement of a dual wavelength spectrophotometer. **4**

B Attempt any One of the following.

a) The spectrophotometric analysis of two elements X and Y at two different wavelengths gave the following results: **4**

[Given: b= 1cm]

Elements	Concentration (mol dm^{-3})	Absorbance	
		550nm	670nm
X	**2.1×10^{-3}**	**0.726**	**0.105**
Y	**7.3×10^{-3}**	**0.165**	**0.872**
X+ Y	-------	**0.450**	**0.428**

Calculate the molar concentration at X and Y.

b) Name the different IR sources and discuss any one in detail. **4**

Q.4 A. Attempt **any two** of the following:

a) Explain the application of differential scanning calorimetry (DSC) for: **4**

i. Determination of the glass transition temperature

ii. To monitor isothermal crystallization of polyethylene

b) With the help of a representative diagram, describe the power compensated DSC instrument. **4**

c) How is the DSC experiment performed? Describe the calibration of DSC systems. **4**

d) What is flow injection analysis? With reference to flow injection system, discuss: sample and reagent transport system. **4**

B. Attempt **any one** of the following:

a) Discuss the advantages of automated analysis. **4**

b) Discuss the role of multi layered films in automated analysis. **4**

Q.5 Attempt **any four** of the following: **12**

a) Discuss quantitative method of analysis with respect to calibration curve method.

b) Define: 1. Analysis 2. Determination 3. Measurement

c) Calculate the amount of $K_2Cr_2O_7$ that is required to prepare $2dm^3$ of a 100 ppm solution with respect to Cr^{+6}. How much volume of this solution will be required to prepare 5 dm^3 of a 100ppb solution.

d) Calculate the pH of a solution containing 0.01 M / dm^3 of CH_3COOH and 0.1 M / dm^3 of CH_3COONa. Given K_a for Acetic Acid is 1.75×10^{-5}.

e) With suitable examples explain the effect of solvents on the λ_{max} values in the UV-visible spectra.

f) Write short notes on Fingerprint region of IR spectra.

g) Describe briefly the different types of thermal methods.

h) Compare the techniques: discrete analyzers and continuous flow analyzers.