d) Draw a schematic diagram of an FT-IR instrument with a clear depiction of Michaelson interferometer. 2

e) A grating monochromator is made of 500 lines/cm. What should be the appropriate length of the grating block to separate sodium D light lines at 589·5 nm and 589·0 nm in the first order spectrum? 2

B. Sc. (Chemistry) Examination, 2022

(3rd Year, 6th Semester, CBCS Syllabus)

Chemistry (DSE)

Paper – DSE/Chem/Th/01

Time : Two hours Full Marks : 40

UNIT: 6012-I

1. a) 1 mL of ^{51}Cr was injected into the patient's body with a count $1{\cdot}9\times10^4$ cpm/mL. After 2 hours 1 mL of blood was drawn from patient's body and count was obtained. The count of Cr in blood is 9·5 cpm/mL. Find out the total amount of blood in patient's body. 2

   b) What is ESCA and what are its utilities? 2+1

   c) What is the energy of an electron ejected from a C(1s) orbital of binding energy 294 eV by Al K_α radiation having a photon energy of 11·87 eV? What is the velocity of such an electron? (1 eV = $1{\cdot}60218 \times 10^{-19}$ J; mass of electron $9{\cdot}109 \times 10^{-31}$ kg). 3

   d) What is meant by relaxation? Enumerate the effects of relaxation on NMR spectral line shapes. 2

2. a) Give the composition of a pH electrode. What is the impact of pH on the acceptability of data collected from a pH electrode? Write the constitution of a fluoride (F^-) sensing electrode. 3

b) How do you maintain diffusion conditions for an ion to join in the exchange process of electron transfer on the electrode surface? 2

c) Explain the origin of colour in flame test in the qualitative analysis of unknown inorganic samples. 2

d) Draw a schematic diagram of AES and explain the role of the different units. Mention the characteristic feature of an atomic emission spectrum. 3

Or

e) Explain the role of magnetic field and electric field in mass spectrometry. State the limitations of McLafferty rearrangement rule in mass spectrometry. 2+1

3. **Answer *any four* questions taking *two* from either parts A and B.**

A. i) Differentiate between normal phase and reversed phase liquid chromatography. What led to the development of reversed phase chromatography? $1\frac{1}{2}+1$

ii) What do you understand by "preparative chromatography"? Using a practical application highlight the utility of this form of chromatography. $1\frac{1}{2}+1$

iii) With a suitable example of your choice highlight the need for chiral chromatography. What are the two approaches that help us achieve separation during chiral chromatography? $1+1\frac{1}{2}$

B. i) Draw the mass spectrum of CH_3CH_2Cl. What is the significance of the molecular ion peak in mass spectrometry and where is it located in a mass spectrum? $1\frac{1}{2}+1$

ii) With suitable examples highlight two applications of mass spectrometry. $2\frac{1}{2}$

iii) What is the basis for the separation of fragments generated from a compound subjected to mass spectrometry? Comment on role of the ion collector in identifying fragments. $1\frac{1}{2}+1$

4. a) Briefly describe the basic principle of photoacoustic IR spectroscopy. 2

b) Explain why a photomultiplier tube (PMT) detector has significantly higher signal strength than a vacuum phototube detector. 2

c) What are the advantages of FT-IR spectrometer over dispersive IR spectrometer? 2