LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **CHEMISTRY**

FIFTH SEMESTER – **APRIL 2025**

UCH 5503 – SPECTROSCOPY

Date: 02-05-2025 Dept. No. Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

	SECTION A - K1 (CO1)	
	Answer ALL the Questions	**(10 x 1 = 10)**
1.	**State True or False**	
a)	The most useful dispersing devices in a monochromator are prisms and gratings.	
b)	Transition of high probability are called forbidden transitions.	
c)	Raman radiation is always optically polarised.	
d)	If I=0, the nucleus does not spin and hence cannot be observed by NMR spectroscopy.	
e)	Neutral fragments and molecules do not reach the detector in mass spectrometer.	
2.	**Multiple Choice Questions**	
a)	The region in which the rotational transitions observed is (i) microwave (ii) infrared (iii) UV-visible (iv) radiowave	
b)	The trace elements in food samples can be detected by (i) infrared spectroscopy (ii) atomic absorption spectroscopy (iii) ^{1}H NMR spectroscopy (iv) mass spectrometry	
c)	The number of fundamental vibrations for triatomic linear carbon dioxide molecule is (i) 4 (ii) 2 (iii) 3 (iv) 6	
d)	How many ^{1}H NMR signals would you expect from cyclohexane? (i) one (ii) two (iii) three (iv) four	
e)	The most intense peak in the mass spectrum of a compound is known as (i) meta stable peak (ii) isotopic peak (iii) base peak (iv) parent ion peak	
	SECTION A - K2 (CO1)	
	Answer ALL the Questions	**(10 x 1 = 10)**
3.	**Answer the following**	
a)	State nitrogen rule.	
b)	What is K-band?	
c)	What is meant by Rayleigh scattering?	
d)	How many ^{13}C NMR signals are expected in n-propyl chloride?	
e)	What is signal to noise ratio?	
4.	**Fill in the blanks**	
a)	The relative population of the probable transitions is given by _____ law.	
b)	The shift of absorption maximum to a longer wavelength is known as _____.	
c)	Stokes' lines are ____ intense than anti-Stokes' lines.	
d)	The number of lines in the EPR spectrum of methyl radical is _____.	
e)	The common technique for the production of ions in the mass spectrometer is by the bombardment of _____.	

SECTION B - K3 (CO2)		
Answer any TWO of the following		**(2 x 10 = 20)**
5.	(a) Discuss the various regions of electromagnetic spectrum and their associated nature of transitions.	(5)
	(b) State and explain Franck Condon principle.	(5)
6.	(a) Discuss any two factors affecting the fundamental vibrational frequencies.	(6)
	(b) Explain the term 'vicinal coupling'.	(4)
7.	Define chemical shift and explain the factors affecting the magnitude of chemical shift.	(10)
8.	Discuss the various fragmentation patterns in mass spectrometry.	(10)
SECTION C – K4 (CO3)		
Answer any TWO of the following		**(2 x 10 = 20)**
9.	Explain the factors affecting the width and intensity of spectral lines.	(10)
10.	Derive Beer-Lamberts law and mention the deviations and limitations of the law.	(10)
11.	(a) Distinguish between Raman and infra-red spectroscopy.	(5)
	(b) With the block diagram explain the components of mass spectrometer.	(5)
12.	Discuss the factors influencing the coupling constant.	(10)
SECTION D – K5 (CO4)		
Answer any ONE of the following		**(1 x 20 = 20)**
13.	(a) Calculate the frequency and energy of the radiation having a wavelength of 300 nm. (Planck's constant, $h = 6.626\times10^{-34}$ Js)	(5)
	(b) Define and differentiate auxochromes and chromophores with examples.	(7)
	(c) Describe the different sampling techniques applied for recording the infrared spectrum of solid and liquid samples.	(8)
14.	(a) Discuss the hyperfine splitting of benzene radical.	(6)
	(b) Write the advantages and disadvantages of TMS and DSS in NMR spectroscopy.	(8)
	(c) Discuss the peaks in the mass spectrum of n-pentane.	(6)
SECTION E – K6 (CO5)		
Answer any ONE of the following		**(1 x 20 = 20)**
15.	(a) Predict the λmax for the following compounds using Woodward- Fieser rule.	(4+4)
		
	(b) Distinguish between absorption and emission spectra.	(6)
	(c) Write the principle of EPR spectroscopy.	(6)
16.	(a) Explain the various types of electronic transitions.	(5)
	(b) State and explain the mutual exclusion principle.	(5)
	(c) Discuss the mechanism of McLafferty rearrangement with an example.	(10)
