LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

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

FIFTH SEMESTER – **NOVEMBER 2024**

UCH 5503 – SPECTROSCOPY

Date: 14-11-2024 Dept. No. Max. : 100 Marks

Time: 09:00 am-12:00 pm

	SECTION A - K1 (CO1)	
	Answer ALL the Questions	**(10 x 1 = 10)**
1.	**Define the following**	
a)	Signal-to-noise ratio	
b)	Auxochrome	
c)	Stokes' lines	
d)	Vicinal coupling	
e)	Molecular ion peak	
2.	**Multiple Choice Questions**	
a)	A device in the spectrometer that converts spectral radiation in to an electric signal is _____ (i) modulator (ii) recorder (iii) detector (iv) analyser	
b)	The sample path length and concentration of the sample are directly proportional to the _____. (i) absorbance of the light (ii) refraction of light (iii) reflection of light (iv) intensity of the light	
c)	The number of vibrational modes for acetylene (C_2H_2) is _____ (i) 6 (ii) 7 (iii) 8 (iv) 4	
d)	Which of the following is NMR active? (i) C-12 (ii) C-13 (iii) H-2 (iv) O-16	
e)	Which of the following species is used to bombard with the sample for which mass spectroscopy has been performed? (i) Alpha particles (ii) Neutrons (iii) Electrons (iv) Protons	
	SECTION A - K2 (CO1)	
	Answer ALL the Questions	**(10 x 1 = 10)**
3.	**Fill in the blanks**	
a)	If the frequency of the microwave oven is 2450 MHz, then the wavelength is _____nm.	
b)	If the percentage transmittance (%T) is 80 then the absorbance will be _____.	
c)	The elastic scattering of photons is called as _____.	
d)	The number of lines in the EPR spectrum of CH_3• radical is _____.	
e)	The separation of ions in mass spectrometer takes place on the basis of _____.	
4.	**True or False**	
a)	The intensity of the spectral lines can be determined by Doppler broadening.	
b)	Hypsochromic shift leads to the decreased intensity of absorption.	
c)	In Raman spectroscopy, the radiation lies in the visible region.	
d)	In comparison to the frequency of the ESR transition, the NMR transition frequency is much higher.	
e)	Mass spectroscopy is the study of the effect of ionizing energy on molecules.	

SECTION B - K3 (CO2)		
Answer any TWO of the following		**(2 x 10 = 20)**
5.	(a) Explain the role of Boltzmann distribution in spectroscopy. (b) Write the principle of flame photometry.	(5) (5)
6.	Discuss any three factors affecting the fundamental vibrational frequencies.	(10)
7.	Explain the following: (i) Principle of ESR spectroscopy (ii) Hyperfine splitting of benzene radical.	(5+5)
8.	Draw the block diagram of mass spectrometry and explain.	(10)
SECTION C – K4 (CO3)		
Answer any TWO of the following		**(2 x 10 = 20)**
9.	(a) What are selection rules? Explain with an example. (b) Give the molecular formula of aromatic hydrocarbon cation with an m/z value of 91.	(5) (5)
10.	Derive Beer-Lambert's law and mention its limitations.	(10)
11.	(a) Give the differences between IR and Raman spectroscopy. (b) Sketch the vibrational modes of water and identify the type of vibrations.	(5) (5)
12.	(a) Write a note on deuterium labelling. (5) (b) What is the reference compound in proton NMR spectroscopy? Mention its significances. (5)	
SECTION D – K5 (CO4)		
Answer any ONE of the following		**(1 x 20 = 20)**
13.	(a) Predict the λ_{max} for the following compounds using Woodward- Fieser rule.  (b) In a UV-visible spectrophotometer of path length 1 cm, guanosine, having λ_{max} of 275 nm and ϵ = 8400 $M^{-1}cm^{-1}$, showed an absorbance (A) of 0.70. What is the concentration of guanosine? (5) (c) Explain the electromagnetic spectrum and their associated nature of transition. (7)	(4+4)
14.	(a) A compound shows a proton NMR peak at 240 Hz down-field from the TMS in a spectrometer operating at 60 MHz. Find out the chemical shift values in δ and τ scales in ppm. (5) (b) Discuss the various fragmentation patterns in mass spectrometry. (8) (c) Describe the different sampling techniques applied for recording the infrared spectrum of solid and liquid samples. (7)	
SECTION E – K6 (CO5)		
Answer any ONE of the following		**(1 x 20 = 20)**

15.	(a) Explain the factors affecting the width and intensity of spectral lines. (b) With the help of block diagram describe the double beam UV-visible spectrophotometer. (c) What is mutual exclusion principle? Give its significance	(10) (5) (5)
16.	(a) Discuss any two factors affecting chemical shift with examples. (b) Explain the following: (i) McLafferty rearrangement and (ii) Retro-Diels-Alder reaction.	(10) (10)
