PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION DECEMBER 2025
(Third Semester)

Branch - CHEMISTRY

MAJOR ELECTIVE COURSE – II : MOLECULAR SPECTROSCOPIC METHODS
AND ITS APPLICATIONS

Time: Three Hours   Maximum: 75 Marks

SECTION-A (10 Marks)
Answer ALL questions
ALL questions carry EQUAL marks $(10 \times 1 = 10)$

Module No.	Question No.	Question	K Level	CO
1	1	The effect of the ultraviolet radiation on organic compound is to cause a) bond vibrations in the molecule b) rotation in the molecule c) electronic transitions d) all of these	K1	CO1
	2	In Woodward Fieser rules, the basic value of 215 nm is given to: a) acyclic ketone b) six membered cyclic ketone c) α, β-unsaturated aldehyde d) α, β -unsaturated ester	K2	CO1
2	3	Select the molecule which is IR inactive but Raman active is: a) HCl b) SO_2 c) N_2 d) Protein	K1	CO2
	4	The absence of absorption bands near 1600, 1580 and 1500 cm^{-1} is a proof for the absence of: a) aromatic ring b) Carbonyl group c) –OH group d) Secondary amino group.	K2	CO2
3	5	Find the number of NMR signals in case of 1, 2 dichloropropane. a) 2 b) 3 c) 4 d) 5	K1	CO3
	6	Nuclear Overhauser effect helps in predicting the a) geometry of the molecule b) two different protons in close proximity c) protons on adjacent carbon atoms d) olefinic protons	K2	CO3
4	7	The time domain ^{13}C NMR spectrum is converted into frequency domain spectrum using a) Fourier transformation technique b) Pulse technique c) Double resonance technique d) Imaging technique	K1	CO4
	8	When the field strength is 100 MHz in ^{13}C NMR spectrum, 1δ is equal to? a) 100 Hz b) 10 Hz c) 100 MHz d) 1 Hz	K2	CO4
5	9	The ESR spectrum of Mn^{2+} ion in solution show _____ number of lines a) 4 b) 5 c) 6 d) 2	K1	CO5
	10	Moss Baur spectrum of sodium nitroprusside consists of a a) Singlet b) Doublet c) Triplet d) Quadruplet	K2	CO5

SECTION - B (35 Marks)
Answer ALL questions
ALL questions carry EQUAL Marks   (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	State Beer-Lambert's Law and explain its significance in UV-visible spectroscopy.	K3	CO1
		(OR)		
	11.b.	A solution of a compound in water shows an absorbance of 0.85 at a wavelength of 300 nm in a 1 cm cell. The molar absorption coefficient (ε) is 5000 L/mol.cm. Calculate the concentration of the solution.		
2	12.a.	Calculate the vibrational frequency of a molecule if the force constant of the bond is 400 N/m and the reduced mass of the system is 1.67×10^{-27} kg.	K3	CO2
		(OR)		
	12.b.	List three major differences between IR and Raman spectroscopy.		
3	13.a.	Consider a proton next to a carbonyl group (-C=O). How does the inductive effect influence the chemical shift of this proton in the ^{1}H NMR spectrum?	K4	CO3
		(OR)		
	13.b.	Examine how ring current in an aromatic compound can influence the chemical shift of protons on the aromatic ring compared to protons in an aliphatic environment.		
4	14.a.	Analyze how off-resonance decoupling in ^{13}C NMR can provide both chemical shift and coupling information, and compare it with a fully decoupled ^{13}C NMR spectrum.	K4	CO4
		(OR)		
	14.b.	What is chemical shift. Explain the factors influencing the chemical shift (any two).		
5	15.a.	Analyze the effect of Kramer's degeneracy on the ESR spectrum of a system with an odd number of unpaired electrons.	K5	CO5
		(OR)		
	15.b.	Discuss how hyperfine splitting in ESR spectroscopy can be used to determine the structure of [VO(SO$_3$)$_2$].		

SECTION -C (30 Marks)
Answer ANY THREE questions
ALL questions carry EQUAL Marks   (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Explain the types of transitions in uv-visible spectroscopy.	K4	CO1
2	17	Explain the following : (i) Finger print region in IR (ii) Fermi resonance with an example.	K4	CO2
3	18	Scrutinize the spin-spin coupling pattern expected for a vinyl group (CH=CH$_2$) in a ^{1}H NMR spectrum. Identify the coupling constants for both geminal and vicinal couplings.	K4	CO3
4	19	Explain (i) Spin – Spin coupling (ii) Nuclear over Hauser effect	K4	CO4
5	20	Determine how hyperfine splitting in Mössbauer spectroscopy can provide insights into the magnetic properties of an iron-containing complex.	K5	CO5

Z-Z-Z   END