22PHP314BN

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION DECEMBER 2025
(Third Semester)

Branch - **PHYSICS**

MAJOR ELECTIVE COURSE – I : MOLECULAR SPECTROSCOPY

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	Which of the following molecule have infrared active vibrations? a) NO b) CH_4 c) H_2 d) NH_3	K1	CO1
	2	An IR spectrum of a sample has 3 IR peaks. Peak A has a 70 % transmittance, Peak B has a 65% transmittance, and Peak C has a 15% transmittance. Which peak has the greatest absorbance? a) Peak A and B b) Peak A c) Peak B d) Peak C	K2	CO2
2	3	Lines arising from $\Delta J = (-1)$ is called a) R branch b) P branch c) Q branch d) s branch	K1	CO2
	4	Raman effect is scattering of _____ a) Atoms b) Molecules c) Photon d) Protons	K2	CO1
3	5	The splitting of NMR peaks duo to spin – spin coupling provides information about a) The number of protons on neighboring atoms b) The energy level of electrons c) The polarity of the solvent d) The molecular weight of the compound.	K1	CO2
	6	Which of the following statements about ESR is correct? a) ESR can detect molecule with all paired electrons b) ESR uses visible light c) ESR is useful for studying free radicals d) ESR measures nuclear magnetic moments	K2	CO1
4	7	The main application of NQR spectroscopy is in a) Determining molecular weight b) identifying isotopic abundance c)studying the local environment of quadrupolar nuclei d)studying nuclear resonance	K1	CO2
	8	In microwave spectroscopy, isotopic substitution mainly affects a) Dipole moment b) Moment of inertia c) rotational energy d) Both Dipole moment and Moment of inertia	K2	CO1
5	9	Strain energy is defined as a) Total energy of molecule b) Heat content of molecule c) energy difference between strained and ideal conformation d) energy gained during bond	K1	CO2
	10	The parameter describing electron density at the nucleus in Mossbauer spectra is a) Quadrupole splitting b) magnetic hyperfine splitting c) chemical Shift d) Isomer shift	K2	CO1

Cont...

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.	Analyze the different modes of vibration of atoms in polyatomic molecules.	K4	CO1
		(OR)		
	11.b.	Outline the important applications of IR spectroscopy.		
2	12.a.	Discuss the theory of Raman activity of pure rotational spectra.	K2	CO2
		(OR)		
	12.b.	Explain the quantum theory of Raman effect.		
3	13.a.	Define chemical shift? Distinguish between δ and τ chemical shifts.	K3	CO2
		(OR)		
	13.b.	Give the theory of ESR.		
4	14.a.	Explain the principle of NQR spectroscopy.	K2	CO1
		(OR)		
	14.b.	Give a brief account on Quadrupole hyperfine interaction.		
5	15.a.	Describe how electrostatic interaction and Van der waals interaction are treated in molecular mechanics force field.	K3	CO2
		(OR)		
	15.b.	With theory explain the principle of Mossbauer spectroscopy.		

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 mathematical theory of IR absorption spectroscopy and show that all the vibrational lines are same frequency.	K3	CO1
2	17	Describe the Principle, construction and working of Laser Raman spectroscopy.	K3	CO2
3	18	Obtain Block equation for relaxation time.	K4	CO2
4	19	Discuss about experimental detection of NQR.	K4	CO1
5	20	How heats of formation and strain energies are evaluated in molecular mechanics.	K4	CO2

Z-Z-Z END