22PHP209N

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION DECEMBER 2025
(Second Semester)

Branch - **PHYSICS**

GROUP THEORY AND 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	What is the order of the symmetry axis, if the angle of rotation is 60 °? a) 2 b) 3 c) 4 d) 6	K1	CO1
	2	All the elements of a group can be generated from one element is called ---- a) Abelien group b) Non-abelien group c) Cyclic group d) order	K2	CO1
2	3	Water has the ----- symmetry. a) C_{2v} b) C_1 c) C_2 d) C_s	K1	CO2
	4	The character of the matrices corresponding to the symmetry operations reflection is ---- a) 3 b) 1 c) -3 d) 0	K2	CO2
3	5	What is meant by ATR? a) Absorption transmission reflection b) Attenuated transmission resonance c) Attenuated total reflectance d) Absorption total reflectance	K1	CO3
	6	Raman shifts depends on a) Incident wavelength of the light b) Intensity of the incident light c) Resolving power of the telescope d) Molecular energy levels of the scatterer.	K2	CO3
4	7	Lambert's law states that ----- a) Increase in intensity of the radiation with thickness is proportional to the intensity of radiation. b) Decrease in intensity of the radiation with thickness is proportional to the intensity of the radiation c) Decrease in intensity of the radiation with thickness is inversely proportional to the intensity of the radiation d) Increase in intensity of the radiation with thickness is inversely proportional to the intensity of radiation	K1	CO4
	8	The transition σ to σ* involves transition from ----- a) Non- bonding molecular orbital to anti-onding sigma orbital b) Non- bonding molecular orbital to anti-bonding pi orbital c) Bonding sigma orbital to anti-bonding sigma orbital. d) Bonding sigma orbital to anti-bonding pi orbital	K2	CO4
5	9	The approximate value of methyl proton in NMR is--- a) 1.3 b) 1.5 c) 2.5 d) 0.9	K1	CO5
	10	Signal splitting in NMR arises from a) Shielding effect b) Spin-spin decoupling c) Spin-spin coupling d) Deshielding effect	K2	CO5

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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.	Define (i) abelien, (ii) non-abelien and (iii) cyclic group.	K2	CO1
		(OR)		
	11.b.	Explain briefly about reducible and irreducible representations.		
2	12.a.	Construct a character table for ammonia.	K3	CO2
		(OR)		
	12.b.	State (i) Great orthogonality theorem, (ii) Mutual exclusion principle.		
3	13.a.	Discuss the types of molecular vibrations with example.	K4	CO3
		(OR)		
	13.b.	Outline the theory and principle of Raman spectroscopy.		
4	14.a.	Write a note on chromophores and auxochromes.	K3	CO4
		(OR)		
	14.b.	Explain the applications of UV-Visible spectroscopy.		
5	15.a.	What do you mean by chemical shifts? Explain the factors affecting the chemical shifts.	K4	CO5
		(OR)		
	15.b.	Explain briefly about relaxation processes.		

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 various symmetry operation and symmetry elements with example.	K4	CO1
2	17	Discuss the normal modes of vibration of water molecule.	K4	CO2
3	18	Describe the sampling techniques and instrumentation details of IR spectroscopy.	K5	CO3
4	19	Explain the Woodward-Fisher rules for calculating adsorption maximum in aromatic systems.	K4	CO4
5	20	Give the theory and principle of NMR spectroscopy.	K5	CO5

Z-Z-Z END