

(FOR THE CANDIDATES ADMITTED

SUBJECT CODE **22PPS310**

DURING THE ACADEMIC YEAR 2022-2024 ONLY)

REG.NO.

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI

END-OF-SEMESTER EXAMINATIONS : NOVEMBER - 2023

M.Sc., PHYSICS

MAXIMUM MARKS: 50

III - SEMESTER

TIME : 3 HOURS

MOLECULAR SPECTROSCOPY

SECTION – A

(10 X 1 = 10 MARKS)

ANSWER THE FOLLOWING QUESTIONS.

(K1)

MULTIPLE CHOICE QUESTIONS.

- Which of the following is a symmetry operation for molecules?
a) Translation b) Rotation c) Heat exchange d) Chemical bonding
- Which type of molecule is more likely to exhibit non-rigid rotation in microwave spectroscopy?
a) Linear molecules. b). Spherical molecules.
c) Non-linear molecules. d). Symmetrical molecules.
- In IR spectroscopy, which type of molecular vibrations result in changes in dipole moment and are, therefore, observable?
a). Vibrations b). Translations c). Rotations d). Electronic transitions
- Which property of a nucleus is utilized in Nuclear Magnetic Resonance (NMR) spectroscopy?
a). Mass number b). Charge c). Atomic number d). Spin
- In the context of spectroscopy, particles with half-integral spin exhibit:
a). Fermi-Dirac statistics b). Bose-Einstein statistics
c). Maxwell-Boltzmann statistics d). None of the above

ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES

(K2)

- What is the significance of symmetry planes in molecular symmetry analysis?
- How does isotopic substitution affect microwave spectroscopy?
- What is the fundamental idea that underlies Raman spectroscopy?
- Give the resonance condition for resonance spectroscopy?
- In spectroscopy, what exactly is a quadruple nucleus?

(CONTD 2)

SECTION – B**(5 X 3 = 15 MARKS)****ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.**

11. a) Define groups and explain the concept of group multiplication tables.
(OR)
b) Examine the representations of a group in detail.
12. a) Discuss the intensities of spectral lines in microwave spectroscopy
(OR)
b) Discuss the rotational spectra of linear polyatomic molecules.
13. a) Deliberate about the diatomic vibrating rotator in IR Spectroscopy
(OR)
b) Explore the concept of molecular polarizability and its significance in understanding the Raman scattering phenomenon.
14. a) Derive the Bloch equations and explain their steady-state solutions.
(OR)
b) Describe the resonance condition in NMR spectroscopy.
15. a) Compare and contrast the transitions in axially and non-axially symmetric systems with relevant examples.
(OR)
b) Describe the instrumentation and working principle of Mössbauer spectroscopy.

SECTION – C**(5 X 5 = 25 MARKS)****ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.**

16. a) Discuss proper axes and proper rotation operations in group theory. Provide examples of molecules or crystals demonstrating proper rotational symmetries.
(OR)
b) Derive the great orthogonality theorem and explain its consequences
17. a) Discuss the dynamics of a Rigid diatomic molecule in spectroscopy with suitable theory.
(OR)
b) With a proper diagram, explain the instrumentation and techniques for Microwave spectroscopy.
18. a) Give a detailed account of structure determination by Raman and IR spectroscopy.
(OR)
b) Describe Raman Spectroscopy and explain its techniques and instrumentation with a proper diagram.
19. a) Provide a detailed account of NMR instrumentation with a proper diagram and list out its Applications.
(OR)
b) What is an ESR Spectrometer? Discuss its working principle and theory in detail with a proper block diagram.
20. a) Highlight the unique features and results of NQR Instrumentation
(OR)
b) Explain the Franck-Condon Principle and its significance in the context of vibronic transitions in electronic spectroscopy.