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(FOR THE CANDIDATES ADMITTED DURING THE ACADEMIC YEAR 2021–2022 ONLY)

SUBJECT CODE 21PPS310

REG.NO. :

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

END-OF-SEMESTER EXAMINATIONS: DECEMBER – 2022

M.Sc.- PHYSICS **MAXIMUM MARKS: 70**

III SEMESTER **TIME : 3 HOURS**

MOLECULAR SPECTROSCOPY

SECTION - A (10 X 1 = 10 MARKS)

ANSWER THE FOLLOWING QUESTIONS.
MULTIPLE CHOICE QUESTIONS. (K1)

1. Which of the following statement is related to the inversion center in group theory?

   a) Inversion takes place due to reflection in the plane
   b) Inversion of all atoms through the center
   c) One or more rotations about the negative axis
   d) A plane must pass through a body, not be outside

2. Microwave rotational spectroscopy uses microwave radiation to measure the energies of rotational transitions for _____.

   a) Atoms and molecules which are microwave active
   b) Ions which causes polarization
   c) Atoms having dipole moment
   d) Molecules in the gas phase

3. Fourier Transform Infrared spectrometer is a _____ type of instrument and is used for repetitive analysis.

   a) Non-dispersive
   b) Dispersive
   c) Destructive
   d) Constructive

4. Which of the following is used as detector crystal in ESR spectrometer?

   a) Silicon rectifier
   b) Silicon tungsten rectifier
   c) Silicon boron rectifier
   d) Silicon quartz rectifier

5. ESR spectroscopy is an absorption spectroscopy which involves the _____

   a) Emission of radiation in the ultraviolet region
   b) Absorption and emission of radiation in the visible region
   c) Absorption of radiation in the microwave region
   d) Emission of radiation in the visible region

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ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES. (K2)

6. What is a symmetry operation?
7. What is the working principle of microwave spectroscopy?
8. What is a simple harmonic oscillator?
9. How is NMR used for imaging?
10. What is the significance of Fortrat parabola diagram?

SECTION – B (5 X 4 = 20 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.

(K3)

11. a) What is point group in symmetry operation? How do you determine the symmetry point group of a molecule?

(OR)

b) What are proper and improper rotations in group theory? Explain with an example.

12. a) Describe the spectrum of non-rigid rotator using microwave spectroscopy.

(OR)

b) Write short notes on rotational symmetries of a linear and symmetric top molecules.

13. a) How do you calculate vibrational energy of a diatomic molecule using IR spectroscopy? Explain with an example.

(OR)

b) Using Raman spectroscopy write short notes on, (i) Raman activity of vibrations (ii) Rule of mutual exclusion

14. a) Give an account of resonance conditions in NMR spectroscopy.

(OR)

b) Write a brief note on chemical shift in NMR spectroscopy.

15. a) Write short notes on half integral and integral spins in NQR spectroscopy.

(OR)

b) Briefly explain the Frank-Condon principle.

SECTION - C (4 X 10 = 40 MARKS)

ANSWER ANY FOUR OUT OF SIX QUESTIONS
(16th QUESTION IS COMPULSORY AND ANSWER ANY THREE QUESTIONS (FROM Qn. No : 17 to 21) (K4 (Or) K5)

16. With relevant theory explain the structural determination of a molecule using Raman and IR spectroscopy.
17. Discuss the representations of a group using Great orthogonality theorem and highlight its consequences.
18. Write a brief note on the rotational spectra of rigid diatomic molecules and explain the effect of isotopic substitution.
19. What is Raman effect? Briefly explain classical and quantum theory of Raman effect.
20. With relevant theory deduce Bloch equations for NMR spectroscopy.
21. Explain Mossbauer Effect and discuss the experimental set up for Mossbauer spectra along with theory.

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