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(FOR THE CANDIDATES ADMITTED DURING THE ACADEMIC YEAR 2024-2025 ONLY) **SUBJECT CODE 24 PPS 310** **REG.NO. :**

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI
END-OF-SEMESTER EXAMINATIONS : NOVEMBER – 2025
M.Sc. – PHYSICS **MAXIMUM MARKS: 75**
SEMESTER : III **TIME : 3 HOURS**

MOLECULAR AND SPECTROSCOPY

SECTION – A (10 X 1 = 10 MARKS)

ANSWER THE FOLLOWING QUESTIONS. (K1)

1. When there are several Cn axes of various orders in a molecule, the axis with the highest order is known as _____

   a) Principal axis b) Symmetry axis c)Inversion axis d)none of these

2. A molecule has all three moments of inertia are identical, it is called as a ___ molecule

   a) Symmetric top b) Spherical top c) Linear d) Asymmetric top

3. The selection rule for harmonic Oscillator Δv = ____

   a) -1 b) +1 c)±1 d)0

4. The interaction between a magnetic dipole and field of strength Bz along Z axis is ____

   a) $\mu_z B_z$ b) μ_z c) B_z d)0

5. NRQ Spectra can be obtained for _____

   a) liquids b) Solids c) gases d) halides

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

6. What do you mean by identity operation?
7. Write the condition for symmetric top molecules.
8. Define the equilibrium oscillation frequency.
9. Define relaxation time.
10. What do you mean by Massbauer effect?

SECTION – B (5 X 5 = 25 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS. (K3)

11. a) Write a short note on reflection about the plane of symmetry.

    (OR)

    b) Write the multiplication table for H_2O molecule.

12. a) Discuss the details of the rotational spectra in molecules.

    (OR)

    b) Explain the Isotopic substitution in diatomic molecules.

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13. a) Deduce the lowest vibrational energy of diatomic molecule using simple harmonic oscillator.

(OR)

b) Give the Quantum theory of Raman effect and discuss its implications in Molecular Spectroscopy.

14. a) Write short notes on chemical shift in NMR.

(OR)

b) Explain NMR imaging technique with diagrammatic representation.

15. a) Discuss the role of energy levels and selection rule in NQR spectroscopy.

(OR)

b) Write short notes on Fortrat diagram.

SECTION – C (5 X 8 = 40 MARKS)

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

(K4/K5)

16. a) Show that the set of all symmetry elements of a molecule groups under the operation multiplication.

(OR)

b) State and explain Orthogonality theorem. Write its consequences.

17. a) Evaluate the spectrum and energy levels of non-rigid rotator.

(OR)

b) Discuss the technique and instrumentation involved in microwave spectroscopy.

18. a) With a neat diagram, discuss technique and instrumentation of FT-IR Spectrometer.

(OR)

b) With a neat diagram, discuss technique and instrumentation of Raman Spectrometer.

19. a) Write Bloch equation and obtain their steady state solution.

(OR)

b) Describe principle and working of NQR Instrumentation with block diagram.

20. a) Discuss the intensity of vibrational – electronic spectra using the Frank-Condon principle.

(OR)

b) With a neat block diagram, explain the technique and instrumentation of ESR Spectrometer.

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