

# KAMARAJ COLLEGE (Autonomous)

Accredited with A+ Grade by NAAC

(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)

(4 Pages)

Reg. No:.....

Question Code: 26E03307

Course Code : 24PEPH31

PG Degree - End Semester Examinations, April 2026

Third Semester

M.Sc., PHYSICS

Spectroscopy

(For those who joined in July 2024 onwards)

Time : 3Hours

Maximum : 75 Marks

## PART - A (10 × 1 = 10 Marks)

Answer ALL Questions

Choose the correct answer :

- CO:1 1. The Stark effect in microwave spectroscopy is used to measure  
K:2 (a) Bond length (b) Moment of inertia  
(c) Dipole moment (d) Reduced mass
- CO:1 2. Which one of the following molecules is classified as an oblate  
K:1 symmetric top?  
(a) CH<sub>3</sub>Cl (b) NH<sub>3</sub>  
(c) BCl<sub>3</sub> (d) CH<sub>4</sub>
- CO:2 3. What is the number of vibrational degrees of freedom for a non-  
K:1 linear molecule with 4 atoms?  
(a) 3 (b) 6  
(c) 9 (d) 12
- CO:2 4. According to Hooke's Law, vibrational frequency is directly  
K:2 proportional to  
(a) Atomic mass (b) Square root of bond strength/force constant  
(c) Reduced mass (d) Nuclear spin
- CO:3 5. Which transitions are involved in UV-Vis spectroscopy?  
K:1 (a) Vibrational (b) Nuclear  
(c) Electronic (d) Rotational

- CO:3 6. In a double-beam spectrophotometer, the beam is split into two  
K:2 paths using  
(a) Mono-chromator (b) Beam splitter  
(c) Detector (d) Diffraction grating
- CO:4 7. Which of the following statements about Stokes and Anti-Stokes  
K:1 lines is true?  
(a) Anti-Stokes lines are always more intense than Stokes lines.  
(b) Stokes lines are weaker than Anti-Stokes lines.  
(c) Anti-Stokes lines are weaker than Stokes lines.  
(d) Both have equal intensity.
- CO:4 8. The Raman shift ( $\Delta\nu$ ) in FT-Raman is independent of  
K:2  
(a) The molecular energy levels (b) The Stokes shift  
(c) The vibration frequency (d) The incident wavelength of the laser
- CO:5 9. What is the advantage of using a higher magnetic field in NMR?  
K:1  
(a) Higher resolution and sensitivity (b) Lower sensitivity  
(c) Fewer signals (d) Faster data collection only
- CO:5 10. ESR spectroscopy is used to study molecules with  
K:2  
(a) Even electrons (b) Unpaired electrons  
(c) Closed shells (d) No magnetic moment

**PART - B (5 X 5 = 25 Marks)**

**Answer ALL Questions choosing either (a) or (b).**

**Answer should not exceed 250 words.**

- CO:1 11. (a) Discuss the energy levels of Non-Rigid Rotator.  
K:4

**(OR)**

(b) Explain the factors affecting the Intensity of Spectral Lines.

- CO:2 12. (a) Explain the concept of Zero Point Energy and derive its  
K:3 expression.

**(OR)**

(b) Construct the diagram and explain the working principle of Double Beam Spectrometer.

CO:3 13. (a) Discuss the Origin of UV Spectra.

K:2 **(OR)**

(b) Outline the Applications of UV Spectroscopy.

CO:4 14. (a) Discuss the Quantum theory of Raman Effect and state its conclusions.

K:4

**(OR)**

(b) Examine the symmetric top Molecules in Raman Spectroscopy.

CO:5 15. (a) Define Chemical Shift. Distinguish between  $\delta$  and  $\tau$  Chemical Shift.

K:4

**(OR)**

(b) Analyze the basic Principle of Electron Spin Resonance.

**PART - C (5 X 8 = 40 Marks)**

**Answer ALL Questions choosing either (a) or (b).**

**Answer should not exceed 600 words.**

CO:1 16. (a) Derive the Rotational Energy levels and construct Rotational Energy Spectrum of a Rigid Diatomic Molecule.

K:4

**(OR)**

(b) Discuss Symmetric and Asymmetric top molecules in Microwave Spectroscopy.

CO:2 17. (a) Analyze the energy levels of a vibrating-rotating diatomic molecule.

K:5

**(OR)**

(b) Explain Fourier Transform Infrared Spectroscopy.

CO:3 18. (a) Explain the Lambert Beer Law and label the Molar Absorptivity in the equation.

K:5

**(OR)**

(b) Evaluate the Working Principle of a Double Beam UV Spectro Photometer with the help of neat block Diagram.

CO:4 19. (a) Discuss about i) Mutual Exclusion Principle and

K:6

ii) Determination of  $N_2O$  Structure

**(OR)**

(b) Elaborate the Principle and Theory of FT Raman Spectroscopy with a neat block diagram.

CO:5 20. (a) Analyze the Instrumentation Techniques of NMR  
K:4 Spectroscopy with neat Block Diagram.

**(OR)**

(b) List the Medical Application of an ESR Spectrometer.