D 121307 **(Pages : 2)** **Name.....**

Reg. No.....

FOURTH SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, APRIL 2025

(CBCSS)

Physics

PHY 4C 12—ATOMIC AND MOLECULAR SPECTROSCOPY

(2019 Admission onwards)

Time : Three Hours Maximum : 30 Weightage

Section A

(8 *Short questions, each answerable within* 7.5 *minutes*)

(Answer **all** *questions, each question carries weightage* 1)

1. Draw the schematic diagram of a microwave spectrometer
2. What are the parts of Raman spectrometer ?
3. Define mono chromator ?
4. Define depolarization ratio of Raman scattered light
5. What are the two directions of rotations of a symmetric top ?
6. List out some industrial applications of Raman spectroscopy.
7. Explain the importance of Raman effect for phase transition studies.
8. What is isomer shift ?

(8 × 1 = 8 weightage)

Section B

(4 *Essay questions, each answerable within* 30 *minutes*)

(*Answer any* **two** *questions. Each question carries weightage* 5)

9. Define Raman effect. Derive and explain rotational Raman spectra with figure
10. Explain diatomic vibrating rotator.

Turn over

11. Explain rotational fine structure of electronic vibration spectra. Explain P, Q and R branches.

12. Explain with figure the instrumentation of IR spectrometer. Explain the techniques used for recording the spectra ?

(2 × 5 = 10 weightage)

Section C

(7 *problem questions, each answerable within* 15 *minutes*)

(*Answer any* **four** *questions. Each question carries weightage* 3)

13. Draw and explain Fortrat parabola.

14. Explain nuclear magnetic resonance condition.

15. Rotational and centrifugal distortion constants of HCl molecule are 10.593 cm^{-1} and 5.3×10^{-4} cm^{-1} respectively. Estimate the vibrational frequency and force constant of the molecule

16. Derive the expression for the frequencies of stark components of J = 1 to J = 2 states.

17. Irradiation of carbon tetrachloride by 4.358Å radiation gives Raman lines at 4400, 4419, 4447 Å Calculate the Raman shift for each of these lines in cm^{-1}.

18. With figure write a note on Raman microscopy.

19. With necessary details explain Paschen back effect ?

(4 × 3 = 12 weightage)