

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034



M.Sc. DEGREE EXAMINATION – PHYSICS

THIRD SEMESTER – NOVEMBER 2019

17/18PPH3MC02/PH 3815 – SPECTROSCOPY

Date: 31-10-2019

Dept. No.

Max. : 100 Marks

Time: 09:00-12:00

PART A

Answer all questions:

(10×2=20 marks)

1. Explain microwave active and microwave inactive molecules. Give one example for each.
2. What are the advantages of Gunn diodes over klystrons as microwave source in microwave spectrometers?
3. Define depolarisation ratio. Why it is important in Raman spectroscopy?
4. Explain Born – Oppenheimer approximation.
5. Calculate the frequency of NO molecule whose force constant is 1609 Nm^{-1} .
6. What is predissociation?
7. Give some applications of mass spectrometry.
8. Define the term: “Chemical Shift”
9. Write the principle of AFM.
10. Mention any two applications of TEM.

PART B

Answer any four questions:

(4×7.5 = 30 marks)

11. (a) Explain with example, the effect of isotopic substitution on the pure rotational spectra of a diatomic molecule. **(4.5)**
(b) The first rotational line of $^{12}\text{C}^{16}\text{O}$ is observed at 3.84235 cm^{-1} and that of $^{13}\text{C}^{16}\text{O}$ at 3.673377 cm^{-1} . Calculate the atomic weight of ^{13}C , assuming the mass of ^{16}O to be 15.9994 amu. **(3)**
12. (a) Describe briefly each section of an IR spectrometer. **(5)**
(b) The fundamental vibration frequency of HCl is 2989 cm^{-1} . Find the force constant of the HCl bond. **(2.5)**
13. Outline the theory of Raman Effect on the basis of quantum theory.
14. What is Fortrat parabola? Obtain expression for band head.
15. What is relaxation time? Obtain an expression for T_1 relaxation time.
16. With a neat schematic diagram discuss the principle of SEM

PART C

Answer any four questions:

(4×12.5 = 50 marks)

17. (a) Explain with theory, the spectrum of a symmetric top molecule. (8)
- (b) The three consecutive lines in the rotational spectrum of HBr are 84.544, 101.355 and 118.112 cm^{-1} . Find the values of rotational constant, centrifugal distortion constant and vibrational frequency. (4.5)
18. (a) Explain the vibration spectrum of a diatomic molecule. Deduce the effect of anharmonicity. (8)
- (b) The fundamental and first overtone transitions of $^{14}\text{N}^{16}\text{O}$ are centered at 1876.06 cm^{-1} and 3724.20 cm^{-1} . Evaluate the equilibrium vibration frequency, the anharmonicity constant, zero point energy and the force constant of the molecule. (4.5)
19. a) Outline the theory of Raman Effect on the basis of classical theory. (8.5)
- b) N_2O and NO_2 molecules exhibit three fundamental vibration frequencies in both IR and Raman spectra. The bands of N_2O show simple PR structure and those of NO_2 show complex structure. Comment on their structure. (4)
20. State Franck-Condon principle. Account for intensity of spectral lines and explain why the spectrum is discrete and not continuous.
21. Explain the principle of ESR. Sketch a neat diagram and explain the functioning of ESR spectrometer.
22. Explain the principle and instrumentation of Photo electron Spectroscopy.
