

C 61929

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Name.....

Reg. No.....

FOURTH SEMESTER M.Sc. DEGREE EXAMINATION, JUNE 2019

(CUCSS—PG)

Physics

PHY 4C 12—ATOMIC AND MOLECULAR SPECTROSCOPY

(2017 Admissions)

Time : Three Hours

Maximum : 36 Weightage

Section A

Answer all questions.

Each question carries weightage 1.

1. Find Lande's g factor of $^3P_{3/2}$.
2. Give the graphical representation of the Lande interval for a 3D term.
3. Give the intensity rule for the Zeeman effect.
4. With the help of schematic diagram describe the normal modes of water molecule.
5. What is Born Oppenheimer approximation ?
6. Describe Hyper Raman effect.
7. CO_2 molecule obeys the mutual exclusion principle. Illustrate. Why water molecule is active in both IR and Raman ?
8. What is dissociation energy of a diatomic molecule ? How does it differ from equilibrium dissociation energy ?
9. Illustrate progressions and sequences in the vibrational analysis of a spectrum.
10. How does Mössbauer spectrum split into due to quadrupole interaction ?
11. What is isomer shift ?
12. What is ESR ? Explain.

(12 × 1 = 12 weightage)

Section B

Answer any two questions.

Each question carries weightage 6.

13. With necessary theory, explain Stark effect in weak and strong fields for hydrogen atom.
14. Describe the instrumentation for Microwave and IR Spectroscopy.

Turn over

15. Describe with theory : (a) Rotational Raman spectrum of a symmetric top molecule ; and (b) vibrational Raman spectra.
16. Discuss the rotational structure of electronic-vibration spectra. What are the information derived from vibrational analysis ?

(2 × 6 = 12 weightage)

Section C

Answer any four questions.

Each question carries weightage 3.

17. Find the interaction energies between two sp (valence) electrons in LS coupling. Give the schematic representation.
18. Discuss the rotational spectra of CH₃ Cl molecule.
19. A molecule AB₂ has the following IR and Raman spectra. Discuss the molecular structure and assign the observed lines to molecular vibrations.

Frequency 3750 cm⁻¹ is very strong in IR but absent in Raman.

Frequency 3650 is strong in IR and strong and polarized in Raman.

Frequency 1595 is very strong in IR but absent in Raman.

20. Explain Fortrat parabolae and find band head and band origin.
21. In the NMR spectrum of ¹⁴N with I = 1, how many spectral lines will be observed ? Calculate the frequency required for the NMR line at an external field of 1.4 T. Given g_N = 0.403, μ_N = 5.051 × 10⁻²⁷ JT⁻¹, planck's constant = 6.626 × 10⁻³⁴ Js.
22. Describe the energy level diagram and the allowed transitions for an electron coupled to a nucleus of spin I = 1. Neglect I.B interaction.

(4 × 3 = 12 weightage)