

Reg. No. :

Name :

II Semester M.Sc. Degree (CBSS – Reg./Supple./Imp.) Examination, April 2022
(2018 Admission Onwards)
PHYSICS

PHY2C09 : Spectroscopy

Max. Marks : 60

Time : 3 Hours

SECTION – A

Answer **both** questions (Either a or b).

1. a) Discuss the alkali metal spectra with energy level diagram. In what respect do they differ from the spectra of hydrogen ?
OR
- b) With schematic diagram, explain the working of microwave spectrometer.
2. a) Discuss the anharmonicity of vibrational energy of a diatomic molecule.
OR
- b) Derive the Larmour equation using quantum theory. With a block diagram list the basic requirements of a basic NMR spectrometer. (2×12=24)

SECTION – B

Answer **any four** (1 mark for Part a, 3 marks for Part b, 5 marks for Part c).

3. a) What is Lande g factor ?
b) A state is denoted as $^4D_{5/2}$ state. What are its values of L, S and J ? What is the minimum number of electrons which could give rise to this ? Suggest a possible electronic configuration.
c) Write a note on Paschen back effect.
4. a) Distinguish between symmetric and asymmetric top molecules.
b) Outline the effect of isotopic substitution on the rotational spectra of molecules.
c) The fundamental band for HCl is centered at 2886 cm^{-1} . Assuming that the intermolecular distance is 1.276 \AA , Calculate the wave number of the first two lines of each of the P and R branches of HCl.

P.T.O.

5. a) What is Raman shift ?
b) Explain the structure determination using IR and Raman spectroscopy in molecules of type XY_2 .
c) The rotational Raman spectrum of hydrogen gas is found to consist of a series of stokes and antistokes lines the first of which appears at 3459 cm^{-1} relative to the source of excitation. Calculate the bond distance of hydrogen.
6. a) What are v' and v'' progressions ?
b) Calculate the ESR frequency of an unpaired electron in a magnetic field of 0.3 Tesla.
c) Explain Fortrat parabolae.
7. a) Give the expression for resonance condition of ESR.
b) Explain chemical shift with examples. Distinguish between δ and τ chemical shifts.
c) A system of protons at a temperature of 25°C is placed in a magnetic field of 2 T. What is the ratio of number of proton spins in the lower state to the number in the upper state ?
8. a) Give two applications of Mossbauer spectroscopy.
b) A Mossbauer nucleus ^{57}Fe makes the transition from the excited state of energy 14.4 KeV to the ground state. What is its recoil velocity ?
c) Outline briefly the magnetic hyperfine interaction in Mossbauer spectroscopy. (4×9=36)