A-0590

MSCPH–507

M.Sc. PHYSICS (MSCPH)

(Spectroscopy)

2nd Semester Examination, Session December 2024

Time : 2:00 Hrs.   Max. Marks : 70

Note **:–** This paper is of Seventy (70) marks divided into Two (02) Sections 'A' and 'B'. Attempt the questions contained in these Sections according to the detailed instructions given therein. ***Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.***

Section–A

Long Answer Type Questions   2×19=38

Note **:–** Section 'A' contains Five (05) Long-answer type questions of Nineteen (19) marks each. Learners are required to answer any *two* (02) questions only.

1. What do you understand by fine structure of Hydrogen atom ? Discuss the various effects'involved in it.

2. Discuss the salient features of molecular electronic spectra. Explain the formation of electronic spectra in absorption band and its intensity distribution on the basis of Franck-Condon principle.

3. What is Stark effect ? Discuss energy level diagram of a linear stark effect for H_α line of the Hydrogen atom. Illustrate the applications of Stark effect.

4. Show that the structure of hetero-nuclear molecule can be illustrated using vibrational -rotational spectroscopy. Discuss the effect of presence of isotopes on the rotational spectrum of a molecule.

5. Write short notes on any *three* of the following :

    (a) Applications of photo-acoustic effect

    (b) Progression and sequences

    (c) Paschen-back effect

    (d) Non-rigid rotator

    (e) Spectroscopic terms

Section–B

Short Answer Type Questions 4×8=32

Note :– Section 'B' contains Eight (08) Short-answer type questions of Eight (08) marks each. Learners are required to answer any *four* (04) questions only.

1. What is vector atom model ? Mention its important uses.

2. Explain clearly why spectral lines have some width. Discuss the various factors causing the line broadening.

3. Using classical physics explain the cause of normal and anomalous Zeeman effect.

4. Explain L-S and J-J coupling schemes with examples.

5. X-rays of wavelength 0.3 A° are incident on a crystal for which the lattice spacing is 0.5 A°. Calculate the angles at which the first two Bragg diffraction are observed. Explain clearly.

6. How is Raman spectroscopy useful in determining molecular structure ?

7. A substance shows a Raman line at 4567 A° when exciting line 4358 A° is used. Deduce the positions of stokes and anti-stokes line for the same substance when the exciting line 4047 A° is used.

8. Explain and comment on the following :

    (a)   Homonuclear diatomic molecules such as H_2, N_2 etc. do not exhibit pure rotational spectra.

    (b)   In atomic spectra selection rules do not permit transitions between levels having different multiplicities. These inter combination lines, despite being forbidden, appear in some spectra. What are the conditions under which such lines are observed ?

    (c)   In the vibrational spectra of diatomic molecules zero point energy appears, where as it does not appear in rotational spectra of the same molecules. Why ?

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