A–0433

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MSCPH-507

Master of Science Physics (MSCPH)

Spectroscopy

Examination, June 2025

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. Discuss Franck-Condon principle for absorption and emission spectra of a diatomic molecule. What is Condon parabola ?

2. Describe the experimental arrangement for studying the Zeeman effect. Discuss the Zeeman pattern of sodium D-lines. What do you understand by anomalous Zeeman effect ?

3. Calculate the Lande's g factor and total magnetic moment of an atom in the states $D^2_{3/2}$, $D^3_{5/2}$ and $F^2_{7/2}$.

4. Explain the difference between infrared spectra and Raman spectra of diatomic molecules. Explain the quantum theory of Raman effect and on its basis explain the intensity distribution of stokes and anti-stokes lines.

5. Write short notes on any three :

   (a) Photoacoustic effect

   (b) Fortrat diagram

   (c) Born-Oppenheimer approximation

   (d) Hyperfine structure

   (e) Intensity rules of spectral lines

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. Explain in detail the Hydrogen fine structure when spin orbit interaction is coupled with relativistic correction.

2. Discuss how the study of vibrational spectrum of a diatomic molecule enables us to determine the anharmonicity constant and equilibrium frequency of vibration (x and ω_e) .

3. Discuss Stark effect and show that the first order Stark effect for the ground state of H-atom is zero.

4. What do you understand by Doppler half intensity breadth of spectral lines ? Calculate in A° Doppler half intensity breadth of Mercury green light at 5416 A° if light source is at 1000 K.

5. Discuss the statement "the occurrence of Raman spectrum depends on the polarizability of the molecule but is entirely independent of the presence of a permanent dipole moment"

6. Explain how the dissociation energy can be calculated using vibrational spectra ?

7. What are K, L and M series in X-ray spectra ? What is their origin ? How the emission and absorption X-ray spectra is different from optical spectra ?

8. Describe the main features of alkali spectra and discuss the effect of spin orbit coupling on them.

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