

**P-105**

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## **MSCPH-507**

### **Spectroscopy**

M.Sc. Physics (MSCPH)

2nd Semester Examination, 2023 (June)

**Time : 2 Hours]**

**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 answer to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

### **SECTION–A**

#### **(Long Answer Type Questions)**

**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.

(2×19=38)

1. 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  $w_e$ ).

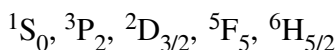
2. Write short notes on :
  - (a) Soft X-ray spectra.
  - (b) Emission and absorption spectra of X-rays.
  - (c) Origin of characteristic X-ray emission spectra.
3. Discuss the salient features of the spectrum of alkaline elements and discuss the effect of spin orbit coupling on them.
4. Give an account of the main features in the electronic spectrum of a diatomic molecule. Discuss the conditions under which the band-heads are degraded towards violet or red in the electronic spectrum.
5. What is Zeeman effect? Give the quantum mechanical explanation of Zeeman effect. Illustrate with specific reference to sodium D-lines.

**SECTION-B**  
**(Short Answer Type Questions)**

**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. (4×8=32)

1. A transition involves an energy change of 0.005 eV. Find by calculation to which region of spectrum does the radiation lie.

2. Explain the isotope effect in Rotational spectra.
3. What is quadratic Stark effect? What happens to the sodium D-lines when the strength of electric field is increased ?
4. State and explain Pauli's exclusion principle. Apply it to determine the maximum number of electrons that can exist in a shell.
5. Find S, L and J values that correspond to each of the following states:



6. State and explain the three kinds of width of spectral lines qualitatively.
  7. The values of  $\omega_e$  and  $\omega_e x$  are  $1580.36 \text{ cm}^{-1}$  and  $12.07 \text{ cm}^{-1}$  for the ground state of  $O_2$ . Calculate the zero point energy and expected Raman vibrational displacement.
  8. What is Photo-acoustic effect? Explain it with its applications.
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