

Roll No.

(04/17-I)

5258

B. Sc. EXAMINATION

(Sixth Semester)

PHYSICS

Paper XI

PH-602

Atomic and Molecular Spectroscopy

Time : Three Hours

Maximum Marks : 40

Note : There are nine questions in this paper. All questions carry equal marks. Attempt *Five* questions in all. Q. No. **1** is compulsory. Attempt remaining *four* question by selecting only *one* question from each Unit. Use of scientific (non-programmable) calculator is allowed.

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P.T.O.

- 1. (a) What is Lande interval rule ? 2
- (b) Differentiate between electronic, vibronic and rotational spectra. 2
- (c) What is spin orbit interaction ? 2
- (d) What is the importance of Zeeman experiment ? 2

Unit I

- 2. (a) What are the quantum numbers associated with the vector atom model ? Give the physical interpretation of various quantum numbers required to define electronic configuration in an atom. 5
- (b) Discuss the shortcomings of Bohr's Sommerfeld theory. 3
- 3. (a) What is the correction to be applied in Bohr's theory for finite mass of the nucleus due to the motion of the nucleus ? 5
- (b) Calculate the ground state energy of electron in case of Li^{++} . 3

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Unit II

- 4. (a) What do you understand by Larmor precession ? Find an expression for Larmor frequency. 6
- (b) Differentiate between penetrating and non-penetrating orbits.
- 5. (a) How does the spin-orbit interaction when combined the relativity correction, explain the hydrogen fine structure ? Discuss its limitation. 6
- (b) The doublet splitting of the first excited state $^2P_{3/2} - ^2P_{1/2}$ of hydrogen is 0.365 cm^{-1} . Calculate the corresponding separation for Li^{++} . 2

Unit III

- 6. (a) Outlines the essential features of the spectra of alkaline-earth elements. How are they explained theoretically ? 6

- (b) Find the possible values of resultant angular momentum for two electrons with $j_1 = 3/2$ and other with $j_2 = 5/2$. 2
- 7. (a) What is LS coupling ? Find out the spectral terms arising due to sp configuration. https://www.cdluonline.com
- (b) The quantum numbers of two electrons in a two valance electron atom are $n_1 = 5, l_1 = 0, s_1 = 1/2$ and $n_2 = 4, l_2 = 0, s_2 = 1/2$. Assuming LS coupling, determine the possible value of J. 3

Unit IV

- 8. (a) Discuss the Zeeman pattern of a line due to transition : 6
 - (i) $^2P_{3/2} \rightarrow ^2S_{1/2}$
 - (ii) $^2D_{3/2} \rightarrow ^2P_{1/2}$.
- (b) Calculate the Lande g factor for the term $^2D_{3/2}$. 2

9. (a) What is Stark effect ? Discuss the weak-field of Stark effect in hydrogen. 5
- (b) Calculate the two-possible orientations of spin vector S with respect to a magnetic field direction. 3

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