PG Even Semester Examination, May 2025

PHYSICS

(4th Semester)

Course No.: PHY-401

(Atomic and Laser Physics)

Full Marks: 70

Pass Marks: 28

Time: 3 hours

The figures in the right margin indicate full marks for the question.
Answer any five questions selecting one from each unit.

UNIT-I

1. (a) Explain Stern-Gerlach experiment and discuss the importance of the result obtained. 9

   (b) What is Larmor's precession? Derive an expression for its frequency. 5

2. (a) Write the success and limitations of Bohr's atomic model. 4

   (b) Explain the origin of hydrogen line spectra using the Bohr model of the atom. Also describe the different spectral series and mention the region of electromagnetic spectrum where they are found. 10

UNIT-II

3. What is spin-orbit coupling in the hydrogen atom? How does it contribute to the fine structure of hydrogen spectral lines? Derive

the expression for the spin-orbit interaction energy. 14

4. (a) Describe the theory of Back-Goudsmit effect and show how it leads to the determination of nuclear spin. 10

   (b) What do you mean by fine structure and hyperfine structure of spectral lines? 4

UNIT-III

5. Find out the spectral terms for the dd and d^2 electronic configuration under L-S coupling. Comment why the terms for these two electronic configurations are not same. 14

6. (a) Describe the procedure to determine the spectral terms for a multi-electron atom under jj-coupling scheme. Derive terms for 3p3d configuration under jj-coupling. 12

   (b) What is Lande interval rule? 2

UNIT-IV

7. Explain Hartree's SCF method. How is the total energy of an atom calculated by this method? Write its limitations. 14

8. Write short notes on : 2x7=14

   (i) X-ray spectra

   (ii) Zeeman effect

UNIT-V

9. (a) What are Einstein A and B coefficients? Derive the relations between the coefficients. 3+6=9

   (b) What is laser? Write the characteristics of laser light. 3

   (c) What is population inversion? 2

10. Explain the working principle of : 2x7=14

    (i) 3-level laser

    (ii) 4-level laser.

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