(3 Hours) **(Total 75 marks)**

Attempt all six questions.

Answer of both sections must be written in same answer book.

1. a) Describe the periodic system of elements in detail. 12
b) Discuss Lamb shift experiment in detail.

OR

2. Discuss the correction for fine structure of hydrogen atom in detail. 12

3. Discuss the selection rule for radioactive transition in an atom considering transition in which single photon is emitted or absorbed. 13

OR

4. How does electromagnetic field interacts with an atom? Starting from scalar and vector potential, derive the equation for the intensity of the radiation. Calculate the intensity of a laser of 1mW power with monochromatic emission of 638nm and beam diameter of 5mm. Also find number of photons emitted per second. 13

5. Describe Hydrogen Molecular ion with the help of Molecular Orbital theory. 13

OR

6. a) Compare the MO and VB theories. 06

b) Discuss the working of ESR spectrometer. 07

Section2

7. a) Write a short note on: i) Threshold conditions ii) Absorption of radiation. 08

b) Assume that an atom has two energy levels separated by energy corresponding to the frequency $4.7*10^{14}$Hz.All the atoms are located in one or other of these two states. Calculate the fraction of atoms in the upper state at room temperature T=300K. 05

OR

8. Explain the Longitudinal and transverse modes. 13

9. a)What is Plasma? What is the criterion for considering ionized gas as plasma? 06
b) What is Debye's radius? Find Debye's radius for a glow discharge with n= $10^{16}/m^3$ and energy of 1.5eV. 06

OR

10. a) Discuss concept of Ambipolar diffusion. 06

b) What is Larmor radius?Find Larmor radius of a 5KeV electron in the magnetic field of $10x10^{-5}$ T. 06

11. Explain in detail how He-Ne laser works? 12

OR

12. a) Name methods which are used to determine Plasma parameters? Explain one of them in detail.

b) Show that for plasmas in the stellar interiors and for electron gas in metals with density in the range of 10^{22}- 10^{25} per cm^3, the plasma frequency lies in the visible and far from the ultraviolet part of the electromagnetic spectrum. 12