

Duration: 2:30Hrs.

- N.B.:**
- 1) All questions are compulsory.
 - 2) Figures to the right indicate full marks.
 - 3) Symbols have their usual meanings.
 - 4) Use of non-programmable calculator is allowed.

- Q.1** A) Attempt any ONE. 08
1. State and explain hydrogen fine structure?
 2. Explain Hyperfine structure of spectral line and state Isotopic shift?
- B) Attempt any ONE. 04
1. What is Pauli's exclusion principle and write application of Pauli's exclusion principle?
 2. Explain Stark effect and explain $\frac{3}{4}$ features of stark effect. 08
- Q.2** A) Attempt any ONE. 04
1. Explain the central field approximation of multi-electron atom.
 2. Explain Thomas Fermi potential in details. 04
- B) Attempt any ONE. 08
1. Express steps for net potential $V(r)$ through self-consistent treatment.
 2. Explain L-S coupling approximation of angular momentum. 08
- Q.3** A) Attempt any ONE. 04
1. Explain the photoelectric effect of charged particles.
 2. Explain the line shapes and widths of electromagnetic radiation. 04
- B) Attempt any ONE. 08
1. Explain the absorption of electromagnetic field.
 2. Evaluate the dipole approximation of one electron atom. 08
- Q.4** A) Attempt any ONE. 04
1. Explain the principle of NMR and obtain the resonance condition.
 2. Derive the rotational spectra of rigid diatomic molecules. 04
- B) Attempt any ONE. 08
1. Distinguish between Raman Spectra and IR spectra.
 2. Explain in short classification of molecules. 04

Q.5

Attempt any four.

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1. Difference between Normal and Anomalous Zeeman effect.
2. The double splitting of the first excited state $2P_{3/2}$, $2P_{1/2}$ of H atom is 0.365 cm^{-1} . Calculate the corresponding separation for Li^{++} .
3. The wavelength of emission is 7000 \AA and the coefficient of spontaneous emission is 10^8 S^{-1} . Find the coefficient of simulated emission. (Given $h = 6.626 \times 10^{-34} \text{ Jsec}$)
4. Explain J-J coupling and draw vector model for the angular momenta.
5. Define stimulated emission of electromagnetic radiation.
6. Define density of states of one electron atom.
7. Write an application of Raman effect.
8. Write the list the basic requirements of ESR.
