

PH 501: ATOMIC AND MOLECULAR PHYSICS (3-1-0: 4)

One Electron Atom and Interaction of Radiation with Matter

Introduction: Quantum States, Atomic orbital, Parity of the wave function, Angular and radial distribution functions, Time dependent perturbation, Interaction of an atom with electromagnetic wave.

Fine and Hyperfine Structure

Solution of Dirac equation in a central field, Relativistic correction to the energy of one electron atom, Fine structure of spectral lines, Selection rules, Lamb shift. Stark, Zeeman and Paschen-Back effect, Hyperfine interaction and isotope shift, Hyperfine splitting of spectral lines, selection rules.

Many Electron Atom

Independent particle model, Central field approximation, L-S and j-j coupling, Energy levels and spectra, Spectroscopic terms, Hunds rule, Lande interval rule, Transition probabilities and intensity of spectral lines, Line broadening mechanisms, Alkali spectra.

Molecular Electronic States

Concept of molecular potential, Born-Oppenheimer approximation, Electronic states of diatomic molecules, Electronic angular momenta, The linear combination of atomic orbitals (LCAO) approach, States for hydrogen molecular ion, Symmetries of electronic wavefunctions, Shapes of molecular orbital, π and σ bond, Term symbol for simple molecules.

Rotation and Vibration of Molecules

Molecular rotation, Molecular vibrations, Morse potential, Pure vibrational transitions, Pure rotational transitions, Vibration- rotation transitions, Electronic transitions, Franck-Condon principle, Rotational structure of electronic transitions, Fortrat diagram, Dissociation energy of molecules, FTIR and Raman spectroscopy.

Text Books & References:

1. H. E. White, "Introduction to Atomic Spectra", Tata McGraw Hill.
2. C. B. Banwell, "Fundamentals of Molecular Spectroscopy", Tata McGraw Hill.
3. B. H. Bransden and C. J. Joachain, "Physics of Atoms and Molecules", Pearson Education.
4. G. M. Barrow, "Molecular Spectroscopy", Tata McGraw Hill.
5. B. H. Eyring, J. Walter and G. E. Kimball, "Quantum Chemistry", Wiley.
6. H. Herzberg, "Spectra of Diatomic Molecules", Springer.
7. J. D. Graybeal, "Molecular Spectroscopy", Tata McGraw Hill.