(ATOMIC AND MOLECULAR PHYSICS) Marks-100

Unit-I

One Electron Atom:

Introduction: Quantum States; Atomic orbital; Parity of the wave function; Angular and radial distribution functions.

Hyperfine structure:

Review of Fine structure and relativistic correction, Lamb shift. Hyper ne interaction and isotope shift; Hyper fine splitting of spectral lines; selection rules.

Many electron atom:

Independent particle model; He atom as an example of central field approximation; Central field approximation for many electron atom; Slater determinant; L-S and j-j coupling; Equiva-lent and nonequivalent electrons; Energy levels and spectra; Spectroscopic terms; Hunds rule; Lande interval rule; Alkali spectra.(13)

Unit-II

Molecular Electronic States:

Concept of molecular potential, Separation of electronic and nuclear wavefunctions, Born-Oppenheimer approximation, Electronic states of diatomic molecules, Electronic angular mo-menta, Approximation methods for the calculation of electronic Wave function, The LCAO approach, States for hydrogen molecular ion, Coulomb, Exchange and Overlap integral, Symmetries of electronic wave functions; Shapes of molecular orbital; and bond; Term symbol for simple molecules.

Rotation and Vibration of Molecules:

Solution of nuclear equation; Molecular rotation: Non-rigid rotator, Centrifugal distortion, Symmetric top molecules, Molecular vibrations: Harmonic oscillator and the anharmonic oscillator approximation, Morse potential.(12)

Unit-III

Spectra of Diatomic Molecules:

Transition matrix elements, Vibration-rotation spectra: Pure vibrational transitions, Pure ro-tational transitions, Vibration-rotation transitions, Electronic transitions: Structure, Franck-Condon principle, Rotational structure of electronic transitions, Fortrat diagram, Dissocia-tion energy of molecules, Continuous spectra, Raman transitions and Raman spectra.

Vibration of Polyatomic Molecules:

Application of Group Theory Molecular symmetry; Matrix representation of the symmetry elements of a point group; Reducible and irreducible representations; Character tables for C 2v and C 3v point groups; Normal coordinates and normal modes; Application of group theory to molecular vibration.(15)

BOOKS:

B.H. Bransden and C.J. Joachain: Physics of Atoms and Molecules

- C. Cohen-Tannoudji, B. Dier, and F. Laloe: Quantum Mechanics vol. 1 and 2
- R. Shankar: Principles of Quantum Mechanics
- C.B. Banwell: Fundamentals of Molecular Spectroscopy
- G.M. Barrow: Molecular Spectroscopy
- K. Thyagarajan and A.K. Ghatak: Lasers, Theory and Applications
- O. Svelto: Principles of Lasers
- B.H. Eyring, J. Walter and G.E. Kimball: Quantum Chemistry
- W. Demtroder: Molecular Physics
- H. Herzberg: Spectra of Diatomic Molecules
- J.D. Graybeal: Molecular Spectroscopy
- M.C. Gupta: Atomic and Molecular Spectroscopy
- B.B. Laud: Lasers and Non-linear Optics
 A. Thorne, U. Litzen and J. Johnson: Spectrophysics