In.M.Sc. Applied Physics, 5 years
10TH SEMESTER

FPYC-1001: 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; Equivalent 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 momenta, 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 rotational 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.

In.M.Sc. Applied Physics, 5 years

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