

5SP-S 227

DEPARTMENT OF PHYSICS
ANDHRA UNIVERSITY

2009-2010

Common for M.Sc. Physics and M.Sc. Space Physics
II Semester
(w.e.f 2009-10 batch)

P203,SP203: ATOMIC AND MOLECULAR PHYSICS.

UNIT-I

12 Hrs

ONE ELECTRON ATOMS : Quantum numbers, Term values . Relation between Magnetic dipole moment and angular momentum of an orbiting electron. Stern-Gerlach experiment and electron spin . Spin- orbit interaction, relativistic kinetic energy correction and dependence of energy on J value only. Selection rules. Fine structure of Balmer series of Hydrogen and Fowler series of ionized Helium. Hyperfine structure of $H\alpha$ line of hydrogen ($I = \frac{1}{2}$).

ONE VALENCE ELECTRON ATOMS: Modified term values (quantum defect) due to lifting of orbital degeneracy by core penetration (penetrating orbits) and core polarization (non-penetrating orbits) by nl electrons. Term values and fine structure of chief spectral series of sodium. Intensity rules and application to doublets of sodium. Hyperfine structure of $^2P-^2S$ of sodium ($I = \frac{3}{2}$).

UNIT-II

10 Hrs

MANY ELECTRON ATOMS : Indistinguishable particles, bosons, fermions. Pauli's principle. Ground states. LS coupling and Hund's rules based on Residual coulombic interaction and spin-orbit interaction. Lande's interval rule. Equivalent and non-equivalent electrons. Spectral terms in LS and JJ coupling (ss, s^2, pp, p^2 configurations). Exchange force and Spectral series of Helium.

Lasers- spontaneous emission, stimulated emission, population inversion, Einstein coefficients, metastable levels, resonance transfer and population inversion in He-Ne laser.

UNIT- III

8 Hrs

ATOMS IN EXTERNAL MAGNETIC FIELD: Quantum theory of Zeeman and Paschen-Back effects and application to $^2P-^2S, ^3P-^3S$, transitions.

ATOMS IN EXTERNAL ELECTRIC FIELD: Linear stark pattern of $H\alpha$ line of hydrogen and Quadratic stark pattern of D_1 and D_2 lines of Sodium.

UNIT-IV

20 Hrs

DIATOMIC MOLECULES: Molecular quantum numbers. Bonding and anti-bonding orbitals from LCAO's. Explanation of bond order for N_2 and O_2 and their ions. Rotational spectra and the effect of isotopic substitution. Effect of nuclear spin functions on Raman rotation spectra of H_2 (Fermion) and D_2 (Boson). Vibrating rotator. Spectrum. Combination relations and evaluation of rotational constants (infrared and Raman). Intensity of vibrational bands of an electronic band system in absorption.(The Franck-Condon principle). Sequences and progressions. Deslandre's table and vibrational constants.

MOLECULAR VIBRATIONS : Symmetry operations and identification of point Groups of $HCN, CO_2, BH_3, NH_3, H_2O$ molecules. Properties of irreducible representations and C_{2v} character table. Reducible representation and symmetry of fundamental vibrations of H_2O .

BOOKS :

1. Atomic and Molecular Spectra
2. Fundamentals of Molecular Spectroscopy
3. Group Theory
4. Introduction to Atomic Spectra

- Rajkumar
- C.N.Banwell.
- K.V.Raman.
- H.E.White.

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A. V. Sanyal

CHAIRMAN

P G Board of Studies (Physics)

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