
Atomic and Molecular Physics
Contents

1. The Structure and Spectra of Hydrogenic Atoms.....	(1-20)
1.1 Atomic Spectra	
1.2 Spectral Atomic Hydrogen	
1.3 Bohr's Model of Hydrogen Atom	
2. Electron Spin.....	(21-28)
2.1 Electron Spin	
2.2 Orbital and spin magnetic moment	
3. Fine Structure of Hydrogen Atoms.....	(29-43)
3.1 Relativistic corrections in kinetic energy	
3.2 Spin-orbit interaction energy	
3.3 Darwin Term	
3.4 Fine Structure of Hydrogen Atom	
3.5 The Lamb Shift	
4. LS and JJ Coupling.....	(44-67)
4.1 LS Coupling Scheme & Spectroscopic Term	
4.1.1 Spectroscopic Terms for non-equivalent electrons	
4.1.2 Spectroscopic Terms for equivalent electrons	
4.1.3 Equivalent and non-equivalent electrons	
4.2 j-j Coupling Scheme and Spectroscopic Term	
4.3 JJ Coupling Scheme & Spectroscopic Term	
5. Zeeman Effect.....	(68-86)
5.1 Introduction	
5.2 Normal Zeeman Effect	
5.3 Anomalous Zeeman Effect	
5.4 Paschan Back Effect	
6. Hyperfine Structure and Isotopic Effect.....	(87-94)
6.1 Isotopic Effect	

6.2 Hyperfine structure	
7. Width of Spectral line.....	(95-102)
7.1 Natural Broadening	
7.2 Doppler Broadening	
7.3 Collision (Pressure) Broadening	
7.4 Atoms in solid	
8. Molecular Spectroscopy-Microwave Spectroscopy	(103-132)
8.1 Introduction of Molecular Spectroscopy	
8.2 Rotation of Molecules	
8.3 Rotational Energy Spectrum of Diatomic Molecules	
8.3.1 Rotational Energy Levels of Rigid Diatomic Molecules	
8.3.2. The Intensities of Spectral Lines	
8.3.3. The Effect of Isotopic Substitution	
8.3.4. The Centrifugal Distortion	
8.4 Rotational Energy Levels of Polyatomic Molecules	
9. Vibrational Spectroscopy.....	(133-157)
9.1 The Vibrating Diatomic Molecule	
9.1.1 The Energy of a Diatomic Molecule	
9.1.2 The Simple Harmonic Oscillator	
9.1.3 The Anharmonic Oscillator	
9.2 The Diatomic Vibrating Rotator- Fine Structure of Infra-red Bands	
10. Electronic Spectroscopy	(158-166)
10.1 Electronic Spectra	
10.2 Absorption Spectra by Electronic Transition	
10.3 Franck – Condon Principle	
11. Raman Scattering and Spectra	(167-181)
11.1 Introduction	
11.2 Classical Theory of Raman Spectroscopy	
11.3 Quantum Theory of Raman Spectroscopy	
11.3.1 Vibrational Raman Spectroscopy	

11.3.2 Rotational Raman Spectroscopy

12. Nuclear Magnetic Electron Spin Resonance.....(182-189)

12.1 Nuclear Magnetic Resonance (NMR)

12.2 Electron Spin Resonance (ESR)

13. LASER.....(190-218)

13.1 Spontaneous and Stimulated Emissions

13.2 Population Inversion

13.3 Main component of the Laser

13.4 Einstein Coefficients and Optical Amplification

13.5 Optical Resonators

13.6 Cavity Lifetime

13.7 The Line Shape Function

13.7.1 Doppler broadening

13.7.2 Natural broadening

13.7.3 Collisional broadening

13.8 The Ruby Laser

13.9 The He-Ne Laser

13.10 Rate Equations

13.10.1 Rate Equations for a Two-Level System

13.10.2 Three Level Laser

13.10.3 Rate Equations for a Three Level System

Practice Set (Atomic Physics).....(219-226)

Practice Set (Atomic Physics) Solution.....(227-245)

Practice Set (Molecular Physics).....(246-253)

Practice Set (Molecular Physics) Solution.....(254-270)