

Physics 362 – Atomic and Molecular Physics
Fall Semester 2005
LL 311, MWF 11:10 – 12:00

Instructor: John Huennekens
Office LL 411
Lab LL 256
phone: 8-3926
email: JPH7@lehigh.edu
office hours: walk-in anytime or by appointment

Course Website: <http://www.lehigh.edu/~jph7/website/Physics362/Physics362Fall2005.html>

Textbook: Robert Eisberg & Robert Resnick, “Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles”,
2nd Edition, John Wiley & Sons, 1985
Chapters 5-10 and 12

Grading: Homework – 20%
Midterm I – 20%
Midterm II – 20%
Final Exam – 40%

Topics Covered:

Very Brief Review of Chapters 1-4

- Blackbody Radiation
- Photoelectric Effect
- Wave Nature of Matter
- Uncertainty Principle
- Early Atomic Models

Basic Quantum Mechanics (Chapter 5)

- The Schrödinger Equation
- Born’s Interpretation of the Wavefunction
- Expectation Values
- The Time-Independent Schrödinger Equation
- Properties of Eigenfunctions

Solutions to the Time-Independent Schrödinger Equation (Chapter 6)

- The Zero Potential
- The Step Potential
- The Barrier Potential
- The Square Well
- The Harmonic Oscillator

One-Electron Atoms (Chapter 7)

- Schrödinger Equation for a One-Electron Atom

Solutions of the Equation
Eigenvalues and Eigenfunctions
Orbital Angular Momentum
The Semi-Classical Vector Model

Magnetic Dipole Moments, Spin, and Transition Rates (Chapter 8)

Orbital Magnetic Dipole Moment
Stern-Gerlach Experiment and Electron Spin
Spin-Orbit Interaction
Total Angular Momentum \mathbf{J}
The effect of the Spin-Orbit Interaction on the Hydrogen Energy Levels
Transition Rates and Selection Rules

Multi-Electron Atoms (Chapter 9)

Identical Particles and the Pauli Exclusion Principle
Exchange Forces and the Helium Atom
Hartree Theory
Ground State Configurations of Multi-Electron Atoms
X-Ray Line Spectra

Optical Spectra of Multi-Electron Atoms (Chapter 10)

Atoms With Several Optically Active Electrons
LS Coupling
The Energy Levels of Carbon
The Zeeman Effect
The Paschen-Back Effect
The Stark Effect

Molecules (Chapter 12)

The Born-Oppenheimer Approximation
Bonding and Anti-Bonding Orbitals
Symmetry
Rotational Spectra
Vibration-Rotation Spectra
Electronic Structure and Spectra of Molecules
Franck-Condon Principle
Laser-Induced Fluorescence
Bound-Free Absorption and Emission
The Raman Effect
Nuclear Spin Effects

Accommodations for Students with Disabilities: If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of Academic Support Services, University Center 212 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.