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

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

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 $J$
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.