Atomic and Molecular Structure
Physics 362
Department of Physics at Lehigh University
Fall 2016

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Text: Quantum Mechanics of Atoms, Molecules, Solids, Nuclei, and Particles, 2nd edition, Robert Eisberg and Robert Resnick, Wiley (1985)

General Course Requirements:

Requirements include: (i) reading assigned materials prior to class, (ii) attending all lectures, (iii) completing all homework problems on time, (iv) seeing the instructor if you are having trouble.

Grading:

Your numerical grade will be determined as follows:

Hour Exam 1	20%
Hour Exam 2	20%
Final Examination	30%
Homework	20%
Attendance	10%
TOTAL	**100%**

Primary Topics:

Review (Selections from Chaps. 1-4)
Schrodinger Theory and Interpretation (Chap. 5)
Solutions of Time-Independent Schrodinger Equation (Chap. 6)
One-Electron Atoms (Chap. 7)
Orbital and Spin Angular Momenta, and Transitions (Chap. 8)
Many-Electron Atoms (Chaps. 9,10)
Molecules (Chap. 12)

As Time Permits:

Quantum Statistics (Chap. 11)
Solids (Chap. 13)

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, Williams Hall, Suite 301 (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.

The Principles of Our Equitable Community:
Lehigh University endorses The Principles of Our Equitable Community...
[http://www.lehigh.edu/~inprv/initiatives/PrinciplesEquity_Sheet_v2_032212.pdf]. We expect each member of this class to acknowledge and practice these Principles. Respect for each other and for differing viewpoints is a vital component of the learning environment inside and outside the classroom.

Final Competencies:

Know how to set up the time-dependent and -independent Schrodinger equations in differential form appropriate to general systems characterized by potential energies. Understand the relationships between the time-dependent and time-independent wave functions. Develop a complete understanding of the concepts of linear combinations of solutions, and degeneracies.

Understand and apply the concepts of operator equivalents and commutators. Develop the ability to relate the Schrodinger differential framework of quantum mechanics, including commutators, to the expected outcomes of measurements, including spectra.

Determine solutions appropriate to one-dimensional piecewise continuous potentials, including the proper application of boundary conditions, and relate the results to measureable quantities.

Know how to set up and solve the Schrodinger equation for the time-independent harmonic oscillator problem, and understand the meaning of the time-independent and time-dependent solutions.

Know how to set up and solve the Schrodinger equations for the time-independent basic hydrogen-atom problem, and understand the meaning of the time-independent and time-dependent solutions.

Develop a working knowledge of the orbital angular momentum in differential form, and energy and angular momentum conservation laws. Understand the relationship between orbital angular momentum and symmetry, and the role they play in the hydrogen atom.

Understand the concept of electron spin and the role it plays in our understanding of the hydrogen atom.

Develop the capability of extending the treatment developed thus far to many-electron systems, and many-electron atoms in particular, with a focus on effective two-electron systems. Use this to characterize and understand observed atomic spectra in the LS coupling scheme. Understand the effects on many-electron atoms of the presence of magnetic fields, including the concept of time-independent perturbation theory.

Understand the origin of selection rules and develop the capability of applying them to simple basic atomic systems.

Understand how Schrodinger theory and our understanding of atoms is expanded to encompass a study of molecules, with applications primarily to diatomic systems. Predict and recognize the spectroscopic signatures associated with the electronic, vibrational, and rotation degrees of freedom. Recognize the nature of the approximations used in quantum-mechanical simulations of molecular systems.

This list is quite general and may in places suggest to the reader expectations greater than those I had in mind, and in some cases the opposite. And I may have omitted something important. However, prior to each exam, I will provide more specific lists of expectations appropriate to that exam.