

VILLANOVA UNIVERSITY
Physics Department

PHYSICS 6600
QUANTUM MECHANICS AND ATOMIC STRUCTURE

SPRING 2003
M. BESSON

This is a course on the determination of the structure of atoms and their interactions with radiation. The first one-third is a development of the basic quantum mechanical techniques needed. The main part is the application to atomic electronic structure and radiation. Additional topics will be covered, time permitting.

Prerequisites: Modern Physics (PHY 2416), Mathematical Physics I & II (PHY 4200 & 4202), or equivalent.

Reference Text: *Modern Physics and Quantum Mechanics*, by Elmer Anderson (ISBN: 0-7216-1220-2).

Exams: There will be a midterm and a final exam of equal weight (100 points). The topics on the final exam will be mostly on the material from the second half of the course.

Assignments will be made every several weeks. These will be collected, graded and returned. The total number of points on all the assignments will be worth the equivalent of one exam (100 points).

Quantum Mechanics:

- The limits of classical physics
- Wave packets and the uncertainty relations
- The Schrödinger wave equation
- Eigenfunctions and eigenvalues
- One-dimensional potentials
- The three-dimensional Schrödinger equation

Applications:

- The hydrogen atom and hydrogen-like ions
- Interaction of electrons with the electromagnetic field
- The radiation of atoms
- Radiative transition rates, selection rules, lifetimes of excited states, line shapes
- Perturbation theory: the ground state and excited states of helium
- Electron spin and fine structure
- The electronic structure of many-electron atoms, the Pauli principle
- The addition of angular momenta