PHYSICS 5455 — QUANTUM MECHANICS I
Syllabus — Fall 2009, CRN 94893

Instructor:	Uwe C. Täuber
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Office hours:	Monday, 1.30 - 2.30 p.m., Tuesday, Thursday 2.00 - 3.00 p.m., and by appointment.
Webpage:	`http://www.phys.vt.edu/~tauber/qumech.html`.
Recommended texts:	F. Schwabl, *Quantum Mechanics* (Springer, 4^{th} ed. 2007); R. Shankar, *Principles of Quantum Mechanics* (Springer, 2^{nd} ed. 1994); and others...
Lectures:	Tuesday, Thursday 5.00 – 6.15 p.m., Robeson 116. I will hand out copies of my lecture notes. Questions in class are always welcome !
Discussion session:	Friday, 1.15 - 2.25 p.m., Robeson 103. We will discuss homework problems and course material.
Homework:	About three to five problems will be assigned every week, due on Tuesdays. I encourage teamwork for solving the homework assignments, but solutions must be handed in separately. Should you encounter difficulties, please feel free to ask me for help (during office hours, the discussion meeting, or via email). Using sample solutions of any kind is *not* allowed. Your answers will be graded, and you will receive copies of my solutions.
Exams:	Midterms: Thursday, Sep. 24 and Oct. 29, 5.00 - 6.15 p.m. Final: Monday, Dec. 14, 7.00 - 9.00 p.m. (sorry!), comprehensive. The graduate honor code applies for all homework assignments, and both the midterm and final exams.
Grade distribution:	30 % homework, 20 % each midterm exam, 30 % final exam.

Course content: This is the first part of a two-semester graduate core course in quantum mechanics, which forms the basis of all modern physics. Starting from basic experimental facts, we will construct the fundamental mathematical structure of quantum theory. We shall cover various example and applications, first in one dimension. This semester will conclude with a discussion of angular momentum, and solutions to the Schrödinger equation in higher dimensions.

List of topics:

1. Foundations of Quantum Mechanics
   - 1.1 Review: classical mechanics and electrodynamics.
   - 1.2 Experimental foundations and historical developments.
   - 1.3 The postulates of quantum mechanics.
   - 1.4 The time-dependent and stationary Schrödinger equations.
2. The Mathematical Structure of Quantum Mechanics
   - 2.1 Mathematical foundations: Hilbert space and linear operators.
   - 2.2 Linear superposition, compatibility, and uncertainty relations.
   - 2.3 Basis representations and matrix mechanics.
   - 2.4 Heisenberg picture: classical limit and conservation laws.
3. Quantum Mechanics in One Spatial Dimension
   - 3.1 The one-dimensional stationary Schrödinger equation.
   - 3.2 Harmonic oscillator.
   - 3.3 Scattering states: potential steps and barriers, tunneling.
   - 3.4 Finite potential well: bound states, resonances.
   - 3.5 Periodic potentials and band structure.
   - 3.6 (*) "Supersymmetric" quantum mechanics.
4. Quantum Mechanics in Three Dimensions
   - 4.1 Angular momentum algebra and spherical harmonics.
   - 4.2 The quantum-mechanical two-body problem.
   - 4.3 The stationary Schrödinger equation in three dimensions.
   - 4.4 Bound states and the Coulomb potential.
   - 4.5 (*) Path integral representation of quantum mechanics.

(*) *Optional chapters, will not be subject of exams.*

Notice: If you need adaptations or accomodations because of a disability (learning disability, attention deficit disorder, psychological, physical, etc.), if you have emergency medical information to share with me, or if you need special arrangements in case the building must be evacuated, please contact me as soon as possible.