PHYSICS 5456 — QUANTUM MECHANICS II
Syllabus — Spring 2010, CRN 14971

Instructor:	Uwe C. Täuber
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Office hours:	Monday, Tuesday, Thursday, 1.30 – 2.30 p.m., and by appointment.
Course webpage:	`http://www.phys.vt.edu/~tauber/gqumec.html`.
Recommended texts:	F. Schwabl, *Quantum Mechanics* (Springer, 4^{th} ed. 2007), *Advanced Quantum Mechanics* (Springer, 4^{th} ed. 2008); R. Shankar, *Principles of Quantum Mechanics* (Springer, 2^{nd} ed. 1994), and others.
Prerequisites:	PHYS 5455 – Quantum Mechanics I.
Lectures:	Tuesday, Thursday 3.30 – 4.45 p.m., Robeson 122. Questions in class are always welcome !
Discussion session:	Friday, 1.15 - 2.15 p.m., Robeson tba. 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:	Midterm: Thursday, February 18, 3.30 - 4.45 p.m. Final: Tuesday, May 11, 7.45 – 9.45 a.m. (sorry !), comprehensive. The graduate honor code applies to all homework assignments, the midterm, and the final exam.
Grade distribution:	30 % homework, 30 % midterm, 40 % final exam.

Course content: This is the second part of a two-semester graduate course in quantum mechanics, which forms the basis of all modern physics.

List of topics:

1. Quantum Particles in Electromagnetic Fields and Spin.
   1.1 Review: postulates; quantum mechanics in three dimensions.
   1.2 Charged particles in electric and magnetic fields.
   1.3 Gauge transformations, Aharonov–Bohm effect.
   1.4 Atoms in magnetic fields: Zeeman effect, spin.
   1.5 Angular momentum addition.
2. Relativistic Quantum Mechanics.
   2.1 Klein–Gordon equation.
   2.2 Dirac equation.
   2.3 Dirac equation with electromagnetic fields.
   2.4 Foldy–Wouthuysen transformation, relativistic corrections.
   2.5 Lorentz covariance and discrete symmetries.
3. Quantum Many-Particle Systems.
   3.1 Identical quantum particles: bosons and fermions.
   3.2 Quantum statistical mechanics.
   3.3 Degenerate Bose and Fermi gases.
   3.4 Fock space representation ("second quantization").
4. Approximative Methods for Stationary States.
   4.1 Time-independent perturbation theory.
   4.2 Atomic physics: Stark effect, fine structure, Zeeman effect.
   4.3 Variational approach, atoms.
   4.4 Born–Oppenheimer approximation, molecules.
   4.5 Wentzel–Kramers–Brillouin secmiclassical approximation.
5. Time-Dependent Problems, Scattering Theory, Measurement.
   5.1 Time-dependent perturbation theory.
   5.2 Interaction with the radiation field.
   5.3 The sudden and adiabatic approximations, Berry phases.
   5.4 Scattering theory, Born approximation.
   5.5 The measurement process in quantum mechanics.

Notice: If you need adaptations or accommodations 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.