Phys 4021 **Quantum Physics II** **Fall 2019**

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Office hours: To be announced. (If my door is open, I can often field a question) or make an appointment.

Class M,Tu,W,F 10 am, MWAH 397.
Prerequisites Phys 3033.
Text *A Modern Introduction to Quantum Mechanics, 2nd edition*, by John Townsend .

Additional references A variety of other texts exists on the subject at a level comparable to the chosen text. These include *Introduction to Quantum Mechanics* by David Griffiths, *Quantum Mechanics, A Paradigms Approach* by David McIntyre.

Course content Catalog description: "Quantum wave mechanics with applications; Schrodinger equation, angular momentum, hydrogen atom, symmetries, identical particles." This course is a continuation of the study of quantum physics begun in PHYS 2021. The text chosen will introduce the formalism of quantum mechanics first through the simple spin-1/2 particle ('spins-first' approach) and the associated quantum state vector, extending this to angular momentum more generally, and on to the Schroedinger equation for the time evolution of quantum states and systems of two spin 1/2 particles. (Roughly chapters 1-5) The tools developed will then be used to explore wave mechanics in one dimension (e.g. particle in a box, harmonic oscillator chapters 6-7). Problems in three dimensions with central potentials and systems of identical particles will finish the course (chapters 9, 10, 11, and 12 as time permits.)

Learning objectives: Explain and apply the foundational principles and formalism of quantum mechanics: work with quantum state vectors, observables, and the idea of measurements, including normalizing quantum state vectors or wave functions; predict possible outcomes of a measurement and probabilities of various outcomes; change representations or basis states; Work with angular momentum appropriate to central potential problems; Use the Schroedinger equation and the Hamiltonian to evaluate the time evolution of quantum states; Describe quantum properties and analyze problems of wave mechanics for one-dimensional potentials including wells, steps, barriers, and harmonic oscillators; analyze and evaluate three-dimensional central potential systems via the time-independent Schroedinger equation; evaluate the roles qualitatively and quantitatively of perturbations; Characterize systems with multiple identical particles (multi-electron atoms to solids).

Grading Course grades will be based on these contributions and associated weights.

- Homework, assignments and in-class problems and participation: 50%
- Tests (2) 30%
- Final exam 20% (Monday, Dec. 9 10am)

The expected grading scale is: $> 88\%$ ⇒A-,A; $> 76\%$ ⇒B-,B,B+; $> 64\%$ ⇒C-,C,C+; $> 55\%$ ⇒D,D+.

Assignments / Homework Reading (often along with questions to discuss in class regarding the reading) and problem sets will be assigned periodically. Be prepared to discuss in class the assigned readings and questions. Little will be learned here without extensive practice through working problems. A subset of assigned problems will be designated for handing-in. Satisfactory homework solutions must include complete development of mathematical aspects and brief, clear English explanations of the reasoning that guides your method of solution. You are encouraged to discuss problems

with your classmates; all work you submit must, however, be your own - be prepared to explain it to others.

Submitting work based wholly or in substantial part on the work of others, including solution manuals or solutions posted in other ways is unacceptable. Infractions are governed by the campus-wide academic integrity policy.

Problem sets will be due by 5 pm on the due date. Late sets may be penalized 20% per day.

Individuals who have any disability, either permanent or temporary, which might affect their ability to perform in this class are encouraged to inform the instructor at the start of the semester. Adaptation of methods, materials, or testing may be made as possible to provide for equitable participation. Please contact the Office of Disability Resources to discuss and arrange reasonable accommodations. (KSC 258, 218-726-6130, or visit the DR website at www.d.umn.edu/access for more information.)

Please be familiar with these relevant campus policies:
https://www.d.umn.edu/evcaa/academic-policies/recommended-syllabi-policy-statements.
This syllabus may be amended from time-to-time at the discretion of the instructor.