Syllabus for Quantum Fundamentals

Course Name: Paradigms in Physics: Quantum Fundamentals
Course Number: PH 425
Course Credits: 3
Prerequisites: PH 213; coreqs: MTH 341

Course Catalog Description

Introduction to quantum mechanics through Stern-Gerlach spin measurements. Probability, eigenvalues, operators, measurement, state reduction, Dirac notation, matrix mechanics, time evolution. Quantum behavior of a one-dimensional well.

Student Learning Outcomes

Students shall be able to:

- Express a quantum state as a linear combination of eigenstates and interpret the expansion coefficients as probability amplitudes
- Express quantum states and perform quantum calculation in matrix, Dirac, or wavefunction notation, as appropriate
- Interpret and predict the probabilistic outcomes of sequential Stern-Gerlach experiments, including a quantum interferometer
- Calculate energy eigenvalues and eigenstates from a Hamiltonian
- Use commutation relations to identify an uncertainty relation between observables
- Use the Schroedinger equation to determine the time evolution of a spin quantum system or particles in an infinite or finite 1D potential well
- Qualitatively sketch a wavefunction in a 1D potential and describe important features such as boundary conditions, oscillatory/exponential behavior, amplitude, and wavenumber

Course Content

Physics:

- Quantum measurement and probabilities
- Dirac bra-ket and matrix representations
• Spin 1/2, spin 1 systems, and wave functions
• Hermitian operators and observables
• Schroedinger time evolution
• Particle in a box

Math:
• Complex numbers
• Matrix manipulations
• Eigensystems
• Properties of orthogonal, Hermitian, and unitary matrices

Learning resources

Required textbooks:
• Quantum Mechanics: A Paradigms Approach
  by David McIntyre

Evaluation of Student Performance

Students will be graded on weekly homework, lab reports, and midterm and final exams.

Statement Regarding Students with Disabilities

Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at http://ds.oregonstate.edu. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.

Link to Statement of Expectations for Student Conduct

http://oregonstate.edu/studentconduct/offenses-0