

PHYC 565 Quantum Mechanics 2

Course Description

Review of barrier problems, the harmonic oscillator, and angular momentum using matrix methods. Problems involving perturbation theory, one-electron atoms, magnetic moments, spin, relativistic effects, symmetric and anti-symmetric wave functions, the helium atom, transition rates, and scattering theory. (3 credit hours)

Prerequisite: PHYC 464 or PHYC 564.

Not open to students who have credit in PHYC 465.

Course Objective

The objective of this course is to provide a deeper understanding of the quantum concept of nature and provide practice in working out specific examples using quantum mechanics methods.

It is also to offer the student a rigorous development of the outstanding concepts of quantum mechanics; to develop a background sufficient to allow the student a more knowledgeable reading of current research and background to attack problems in the workplace.

Course Rationale

By an emphasis upon quantum wave nature of physics as a method for attacking a great variety of problems in the physical sciences.

By understanding the behavior of quantum mechanical systems with examples from theory and multimedia-capable computer software.

This course will be immensely helpful for students who want to pursue their specific research areas such as nuclear physics, condensed matter physics, engineering, and any related fields.

Course Content, Format, and Bibliography

Content

- Identical particles

 - Two-particle systems

 - Atoms and solids

 - Quantum statistical mechanics

- Time-independent perturbation theory

 - Nondegenerate perturbation theory

- Degenerate perturbation theory
- The finite structure of hydrogen
- The Zeeman effect
- Hyperfine splitting
- The variational principle and WKB approximation
 - Variational method
 - The ground state of helium
 - The hydrogen molecule
 - The classical region and tunneling
- Time-dependent perturbation theory
 - Two-level systems
 - Emission and absorption of radiation
 - Spontaneous emission
- Scattering
 - Quantum scattering theory
 - Partial wave analysis
 - The Born approximation

Format

Course activities will center around the lectures and assigned problems. It will be expected that the student will study several references during the course. The computer-generated animations are used to introduce, motivate, and illustrate the concepts of quantum mechanics.

This course is taught as a dual undergraduate/graduate course. Students will be required to complete activities appropriate for the level of the course in which they are enrolled. Student performance on homework, exams and/or labs will be evaluated using different standards for undergraduate and graduate students.

Extra assignments for graduate level counterpart of taught/with course:

Graduate students in taught/with course will be assigned one or more of the following, at the instructor's discretion, commensurate with the higher requirements of the graduate component as compared with the undergraduate component:

Extra problem assignments
Course term paper
Individual experimental project
Extra or different examination requirements
Oral examination.
Class lecture on assigned topic
Assigned readings/report on the literature

Bibliography

Griffiths, *Introduction to Quantum Mechanics*, 2nd ed., Pearson (Prentice Hall), ISBN 0-13-111-892-7

Introductory Quantum Mechanics, 4th edition, Richard L. Liboff

Quantum Mechanics, Richard W. Robinett