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*


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

Quantum Mechanics, Richard W. Robinett