PHYC 564 Quantum Mechanics 1

Course Description

DeBroglie's postulate, the uncertainty principle, the Schrodinger equation, the free particle, square well potentials, harmonic oscillator, the hydrogen atom, angular momentum and other selected wave mechanics problems. No regularly scheduled laboratory. (3 credit hours)

Prerequisite PHYC 260.

Not open to students who have credit in PHYC 464.

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 field.

Course Content, Format, and Bibliography

Content

- Identical particles
  - Two-particle systems
  - Atoms and solids
  - Quantum statistical mechanics
- Time-independent purturbation 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 purturbation 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

Krane, *Introductory Nuclear Physics*, 2nd Ed., ISBN 978- 0-471-80553-3

Introduction to Nuclear Physics, by Harald A. Enge

Intro. to Quantum Mechanics, 2nd Ed., David J. Griffiths Prentice Hall, ISBN 0-13-111892-7

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

Quantum Mechanics, Richard W. Robinett