Master Syllabus Department of Physics and Astronomy



PHYC 463 Nuclear Physics

Course Description

The nucleus and nuclear interactions. Emphasizes experimental facts about nuclear processes in discussions of particle accelerators, detectors, radioactivity (alpha, beta, and gamma decay), interaction of radiation with matter, nuclear reactions, nuclear structure, nuclear models, and nuclear applications in science and technology. (3 credit hours)

Prerequisite: PHYC 260.

Course objectives

A course in nuclear physics at the intermediate level. The course provides an opportunity for the graduate students to prepare themselves for advanced studies in the field nuclear physics, particle physics, nuclear astrophysics, radiations physics, radiation biophysics, etc.

Course Rationale

The course provides an opportunity for the students who will look for employment in industry based on the applications of nuclear techniques and nuclear radiations. This course will be immensely helpful for students who want to pursue higher studies in nuclear physics or any related field.

Course Content, Format, and Bibliography

Content

Nuclear Properties

Nuclear Binding Energy

Nuclear Angular Momentum and Parity

Nuclear Electromagnetic Moments

Nuclear Excited States

The Force Between Nucleons

The Deuteron

Nucleon-Nucleon Scattering

Proton-Proton and Neutron-Neutron Interactions

Properties of the Nuclear Force

The Exchange Force Model

Nuclear Models

The Shell Model

Even-Z, Even-N Nuclei and Collective Structure

Compound Nucleus Model

More Realistic Nuclear Models

Radioactive Decay

The Radioactive Decay Law

Production and Decay of Radioactivity

Growth of Daughter Activities

Natural Radioactivity

Radioactive Dating V. Detecting Nuclear Radiations

Interaction of Radiation with Matter

Counters and Detectors of Nuclear Radiations

Gas Counters

Energy Measurements and Counting Statistics

Coincidence Measurements and Time Resolutions

Alpha, Beta, and Gamma Decays

Theory of Alpha Emission

Fermi Theory of Beta Decay

Gamma Ray Spectroscopy

Angular Momentum and Parity Selection Rules

Nuclear Reactions

Types of Reactions and Conservation Laws

Scattering Reaction Cross Sections

Optical Model

Compound-Nucleus Reactions

Nuclear Science and Technology

Neutron Physics, Fission, and Reactors

Nuclear Fusion

Nuclear Astrophysics

Format

Homework, examinations

Students may be assigned one or more of the following, at the instructor's discretion:

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

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.

Bibliography

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

Introduction to Nuclear Physics by Harald A. Enge