Ministry of Higher Education and Scientific Research

Salahaddin University-Erbil

College of Education

Department of Physics

(Coursebook) 4th stage

Subject: Nuclear Physics

Academic year: 2023-2024

Instructor Information:

Assist. Prof. Dr. Hiwa Hamad Azeez
Physics department
E-mail: hiwa.azeez@su.edu.krd
Phone: +9647504544604

Lectures:

Wednesday, (Group A) from 08:30 - 10:30 Am. in Hall 10

Tuesday, (Group B) from 08:30 - 10:30 Am. in Hall 11

Course overview:

Nuclear Physics is an undergraduate course on nuclear Physics. The importance of the nuclear physics lab is to let students have practical information about nuclear radiation physics and nuclear radiation detection and see the instruments which are used in the nuclear labs. This module also provides a better understanding of nuclear physics and a number of topics in it and to know some nuclear sources. They must make the differences between Particles, atoms and nuclear. To know something about nuclear radiation and to know the effect of radiation on human bodies.

Course Description:

The main topics of this course are nuclear properties, nuclear radiation, nuclear radioactivity, nuclear reaction, and nuclear fission and fusion.

Course Objectives and Expected Outcomes:

This course aims to provide students with

- Good understanding of nuclear radiation detection practically.
- To give information about nuclear radiation and its effect on human bodies.
- Understanding of the decay of some sources and why they decay.
- To understand detectors, how are they designed and how do they work?
- To see how the gamma-ray, alpha and beta particles are generated and what happens when they interact with human bodies.

Student learning outcome:

After successful completion of the module, the students should have:

- Knowledge of Nuclear physics.
- Understanding of the basic idea of Atoms and making the differences between particles, atoms and nuclear physics.
- Knowledge of Nuclear sources and how they decay?
- Understanding of detectors, why are they used? and how they work.
- Understand the gamma-ray, alpha and beta particles and make the differences between them.
- Learn how to protect their bodies from radiation.
- Knowledge of the statistical nature of radiation. etc

- Information about the effect of magnetic and electrical fields on the particles.

The Syllabus of Nuclear Physics

First semester

1. Operating Plateau for the Geiger Tube.
2. Poisson's distribution and Gaussian distribution of radioactive decay.
3. Diffraction of nuclear radiation in a statically magnetic field.
4. Absorption coefficient for gamma rays.
5. Determination of dead time (resolving time) of G.M. counters by two–source method.

Second semester

Names of experiments that will be done this semester are:

6. Foundation of material height in closed containers.
7. Determination of Operating Voltage for Scintillation Detector
8. Energy calibration of the scintillation detector and energy determination of the unknown gamma emitter source.
9. Activity measurement of unknown source using rad lab.
10. Verification of Inverse square law for Gamma- Ray.
11. Spectrum analysis of some standard source using scintillation Detector and MCA.
12. The study of Compton scattering for gamma rays using MCA.

Chapter Four: Radioactivity and Radioactivity Laws

4-1) Introduction (Radiation and Radioactive decay)
4-2) Radioactivity Decay Law

7.8 Fission Chain Reaction

7.9 Nuclear weapon design:

7.10 Nuclear Fusion

7.11 Cosmic Rays

Chapter Eight: Nuclear Reactor

8.1 Introduction:

8.2 Components of nuclear reactors

8.3 A Simple Reactor Design:

8.4 Control of Power Level

References:

- Elements of Nuclear Physics Walter E. Meyerhof.
- Concepts of Modern Physics Arthur Beiser.
- Modern Physics (Third Edition) Raymond A. Serway
- Schum's Outline of Modern Physics