Level Seven

Nuclear Physics

Course Code	Course Num.	Course Name	Credit Hours	Lec	Lab	Tut	Prerequisites
PHY	464	Nuclear Physics	3	3	0	1	PHY 312

Objectives:

On successful completion of this subject students will:

- demonstrate an understanding of the historical background to models of the nucleus, its stability, modes of decay and reactions
- be able to apply simple models to binding energies, radioactive decay processes
- describe techniques of measurement of nuclear properties

AIMS OF THE COURSE

An important objective of the course is to develop an understanding of 'core physics' at successively deeper levels, each stage revealing new phenomena and greater insight into the behavior of matter and radiation.

THE LECTURE COURSES

Details of the lecture courses are given in the synopses which follow. All students attend the same lectures.

PRACTICALS

Students attend a physics practical for once every week. The primary aim of the class is the development of experimental skills, which are important to all professional physicists. A second aim of the practical session is to illustrate ideas and concepts in physics. In addition, to prepare for each practical you are asked to carry out a brief exercise beforehand, which you will hand in to your demonstrator at the start of the practical class.

Syllabus:

Chapter 1:Structure and Static properties of Nuclei

No.	Topics	Notes
1.1	**Introduction**	
1.2	**Structure of nuclei: Basic Properties of Nuclei:**	
	Summary + Home Work (H. W)	
		(4 Lectures)

1.3	**Theories of Nuclear Composition**	
	Summary + Home Work (H. W)	
		(2 Lectures)
1.4	**Binding Energy**	
	Summary + Home Work (H. W)	(3 Lectures)
1.5	**Nuclear Force**	
	Summary + Home Work (H. W)	
		(3 Lectures)

Chapter 2: Nuclear Structure Models

No.	Topics	Notes
2.1	The Shell Model	
2.2	The Liquid Drop Model	
2.3	The Collective Model	
	Summary + Home Work (H. W)	
		(4 Lectures)

Chapter 3: Radioactivity

No.	Topics	Notes
3.1	**Basic Relations of Radioactivity**	
	Summary + Home Work (H. W)	
		(2 Lectures)
3.2	**Alpha Decay**	
	Summary + Home Work (H. W)	
		(1 Lectures)
3.3	**Beta (β) Decay**	
	Summary + Home Work (H. W)	
		(1 Lectures)
3.4	**Gamma (γ) decay**	
	Summary + Home Work (H. W)	
		(1 Lectures)

Chapter 4: Interaction of Ionizing Radiation with Matter

No.	Topics	Notes
4.1	**Interaction of X and γ -rays with matter**	
	Summary + Home Work (H. W)	

		(3 Lectures)
4.2	**Interaction of Charged Particle with Matter**	
	Summary + Home Work (H. W)	
		(3 Lectures)
4.3	**Interaction of Neutrons**	
	Summary + Home Work (H. W)	
4.4	Radiation Detection	
	Summary + Home Work (H. W)	(4 Lectures)

Chapter 5: Nuclear Reactions:

No.	Topics	Notes
5.1	**Nuclear Reactions In General** (Types of Reactions and Conservation Laws)	
	Summary + Home Work (H. W)	
		(3 Lectures)
5.2	**Nuclear Cross-section**	
	Summary + Home Work (H. W)	
		(3 Lecture)
5.3	**Classification of Nuclear Reactions**	
	Summary + Home Work (H. W)	
		(2 Lecture)
5.4	**Fusion and Fission Reactions**	
	Summary + Home Work (H. W)	
		(2 Lectures)
5.5	Accelerators Basics	
	Summary + Home Work (H. W)	
		(2 Lectures)
5.6	Reactor Basics	
	Summary + Home Work (H. W)	
		(2 Lectures)

References:

[1]. S. Krane. Kenneth, Introductory nuclear physics, John Wiley & Sons) (1988)

[2]. M. Jobes and W. Burcham, *Nuclear and Particle Physics*. Addison Wesley (1995).

[3]. Arthur Beiser, Concepts of Modern Physics, (McGraw-Hill Book Company (1987)

[4]. Glenn F. Knoll, Radiation Detection and Measurement, John Wiley & Sons, Aug 16, 2010

Methodology and Assessment

The course consists of 48 lectures supplemented by 4 lecture periods for coursework problems and other matters as they arise. Assessment is based on an unseen written examination (50%) and the best 4 of 5 coursework problem papers (50%).