THE FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE

Department of Physics

PHY 531 – Nuclear and Particle Physics I

COURSE PARTICULARS

Course Code: PHY 531
Course Title: Nuclear and Particle Physics I
No. of Units: 3
Course Duration: Two hours of theory and one hour of tutorial per week for 15 weeks.
Status: Compulsory
Course Email Address: phy531@gmail.com
Course Webpage: http://www.phy.futa.edu.ng/courseschedule.php?coursecode=PHY%20531
Pre-requisite: PHY 305

COURSE INSTRUCTORS

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COURSE DESCRIPTION

Nuclear structure, nuclear properties: nuclear size, nuclear masses; nuclear models, nuclear forces, the deuteron neutron-proton and proton-proton scattering at low energies. Nuclear models. Radio-active Decay; Alpha, beta, gamma decays. Nuclear reactions, reaction cross sections, compound nucleus formation and break up.

COURSE OBJECTIVES

The objectives of this course are to:

- introduce students to the fundamental principles and concepts governing nuclear and particle physics and have a working knowledge of their application to real-life problems; and
- provide students with opportunities to develop basic knowledge and understanding of: scientific phenomena, facts, laws, definitions, concepts, theories, scientific vocabulary, terminology, conventions, scientific quantities and their determination, order-of-magnitude estimates, scientific and technological applications as well as their social, economic and environmental implications.

COURSE LEARNING OUTCOMES / COMPETENCIES

Upon successful completion of this course, the student will be able to:
(Knowledge based)

- Understand the fundamental principles and concepts governing classical nuclear and particle physics and have a working knowledge of their application to real-life problems,
- Demonstrate knowledge and understanding of: scientific phenomena, facts, laws, definitions, concepts, theories, scientific vocabulary, terminology, conventions, scientific quantities and their determination, order-of-magnitude estimates, scientific and technological applications as well as their social, economic and environmental implications,
- Demonstrate comprehension of physical reality through estimation, approximation, and mathematical modeling, and understand how a small number fundamental physical principles underlie a huge variety of interconnected natural phenomena;

(Skills)

- Think critically: naming something is NOT knowing something.
- Manipulate precise and intricate concepts to construct logical arguments,
- Acquire relevant information from a variety of sources and to be able to communicate (both verbally and in writing) scientific information in a clear, concise and logical manner.

GRADING SYSTEM FOR THE COURSE

This course will be graded as follows:

Class Attendance	5%
Assignments	15%
Test(s)	20%
Final Examination	60%
TOTAL	**100%**

GENERAL INSTRUCTIONS

Attendance: It is expected that every student will be in class for lectures and also participate in actively during the lecture and tutorial hours. Attendance records will be kept and used to determine each person's qualification to sit for the final examination. In case of illness or other unavoidable cause of absence, the student must communicate as soon as possible with any of the instructors, indicating the reason for the absence.

Academic Integrity: Violations of academic integrity, including dishonesty in assignments, examinations, or other academic performances are prohibited. You are not allowed to make copies of another person's work and submit it as your own; that is plagiarism. All cases of academic dishonesty will be reported to the University Management for appropriate sanctions in

accordance with the guidelines for handling students' misconduct as spelt out in the Students' Handbook.

Assignments and Group Work: Students are expected to submit assignments as scheduled. Failure to submit an assignment as at when due will earn you zero for that assignment. Only under extenuating circumstances, for which a student has notified any of the instructors in advance, will late submission of assignments be permitted.

Code of Conduct in Lecture Rooms: Students should turn off their cell phones during lectures. Students are prohibited from engaging in other activities (such as texting, watching videos, *etc*.) during lectures. Food and drinks are not permitted in the laboratories.

READING LIST

The course material is prepared majorly using:

- [1]Introductory Nuclear Physics, Kenneth S. Krane, Oregon State University.

Recommended additional reading

- [2]Any book collection on nuclear physics

Legend
1- Available as Personal Collection
2- Available in the Library

COURSE OUTLINE

Week	Topic	Remarks
1 & 2	Nuclear Properties	Students are expected to be taught the nuclear radius, mass and abundance of nuclides, nuclear binding energy, nuclear angular momentum and parity, nuclear electromagnetic moment and nuclear excited states.
3 & 4	The Force Between Nucleons	Students will be expected to know the deuteron, nucleon-nucleon scattering, proton-proton and neutron-neutron interaction, properties of the nuclear force and the exchange force model.
5 & 6	Nuclear Models	Students will be expected to know the shell model, even-Z, even-N nuclei and collective structure
7 & 8	Radioactive Decay	Students will be expected to know radioactive decay law, quantum theory of radioactive decay, production and decay of radioactivity, growth of daughter activities, types of decays, natural radioactivity, radioactive dating, and units for measuring radiation
9	Alpha Decay	Students will be expected to know why alpha decay occurs, basic alpha decay process, alpha decay systematics, theory of

		alpha emission, and angular momentum and parity in alpha decay.
10	Beta Decay	Students will be expected to know energy released in Beta decay, Fermi theory of Beta decay and angular momentum and parity selection rules.
11	Gamma Decay	Students will be expected to know energetics of Gamma decay, classical electromagnetic radiation, transition to quantum mechanics, angular momentum and parity selection rules, and internal conversion.
12	Nuclear Reactions	Students will learn types of nuclear reactions and conservation laws, energetics of nuclear reactions, and reactions cross sections.
13 & 14	Revision	This is the week preceding the final examination. At this time, evaluation will be done to assess how far the students' expectations for the course have been met.
15	Examination	Students will be examined on their appreciation of the course during the semester in order to evaluate the knowledge and critical skills learnt from the course.