PHYS 402 **NUCLEAR PHYSICS** **Spring, 2019**

SYLLABUS

Instructor: **Dr. Laszlo Takacs**

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Place and Time: PHYS 2226, TuTh10:00-11:15 am

Office hours: After class or make appointment

Text: Nuclear Physics, Principles and Applications
by John Lilley
John Wiley and Sons, Ltd. ISBN 0-471-97936-8 (paper)

Content

In The first half of this course will review the fundamental structure, properties and transformations of the nucleus, including radioactivity and nuclear reactions. The interaction of radiation with matter will also be discussed. The second half of the semester will be spent on applications. There are many, from energy, to medicine, and most areas of science and technology. The exact choice and the depth of coverage will depend on the interest of the class. Three subjects will be covered in the form of student lectures.

Course Objectives

This course will provide an overview of the main subjects in nuclear physics and technology.

At the end of the course, you will:

- understand the basic properties and transformations of nuclei;
- be familiar with how radiation interacts with matter;
- know about several important applications of nuclear physics, such as nuclear reactors, medical diagnostics and radiation treatment, age determination in archaeology and geology, etc.
- understand the benefits and dangers of ionizing radiation.

Course Format

PHYS 402 was originally designed as a traditional lecture course. However, given the small class size, a format based on directed reading and class discussions will be adopted, as it can more easily accommodate the differences in student background and interest. Detailed instructions will be given regularly on the reading material. It is essential that students come to class well prepared in order to participate in informed discussions.

A tentative schedule is attached to this Syllabus. The details may change, but the course will surely start with general subjects followed by a midterm exam before spring break. The second half of the semester will be dedicated to applications.

Homework

There will be a homework assignment every week. The solutions will be due in hard copy on Tuesdays before the lecture. Most problems will include numerical evaluation, thus keep a basic scientific calculator at hand.

Some problems will be directly from the book. They have hints or results in the back of the book. But what is found there is not a complete solution and cannot be accepted as such. Your solution should include the details, so that it is clear that you understood the calculation not only copied the result from the book.

Bcommunication

Ideally, we would communicate mostly via Blackboard. At the moment my access is not working, therefore I will send course material directly as an email attachment. I will let you know if this situation changes.

Student lectures

Three applications (or groups of applications) will be covered in the form of student lectures. The topics will be decided early to give you ample time to research the subject. The lectures themselves will be given close to the end of the semester.

Grades will be determined based on the following:

Class participation	15%
Midterm test	15%
Final exam	30%
Homeworks (~10)	20%
Student lecture	20%

The tests will be open source (book, notes, etc.) but be aware that you will not have enough time to learn the material during the test. You can look up a fact or an equation quickly, but you need to know what you are looking for and approximately where to find it.

Academic Integrity

"By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating on a test could result in disciplinary action that may include, but is not limited to, suspension or dismissal." More on the requirements of academic integrity can be found at http://www.umbc.edu/gradschool/procedures/integrity.html

Applied to this course, a proven case of misconduct during a test or a blatant copy or plagiarism of a homework solution "earns" zero on the assignment in question. A second offence will result in failing the course.

On my end, I promise well-prepared lectures, careful and timely grading, and openness.

Questions and Comments

if you have any question, concern, or suggestion during the semester, do not hesitate to talk to me. Comments on the blue sheets can only be taken into consideration the next time course is offered.

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TENTATIVE SCHEDULE

Date	Reading for next time	Subject
1.29.	1.1-4	Introduction, basic principles; quantum mechanics
1.31	1.5	Radioactivity, decay rates, radioactive dating
2.5.	1.6, 2.1-2	; Nuclear reactions. Structure of the nucleus: liquid drop model
2.7.	2.3-4	Structure of the nucleus: shell model
2.12.	3.1-3	Gamma transition; beta decay
92.14.	3.4	Alpha emission
2.19.	4.1-3	Nuclear reactions
2.21.	4.5-6	Compound nucleus reactions
2.26.	5.1-5	Radiation-matter interaction: charged particles, photons, neutrons
2.28.	6.1-3	Gas and scintillation detectors
3.5.	6.4-7	Semiconductor detectors, spectrum from a single photon, neutrons
3.7.	6.8	Particle accelerators
3.12.	7.1-6	Biological effects of radiation, dosimetry , risk assessment
3.14.		Midterm exam
3.19.		SPRING BREAK
3.21.		SPRING BREAK
3.26.	9.1-5	Medical imaging
3.28.	9.6	Radiation therapy
4.2.		To
4.4.		be
4.9.		Determined.
4.11.		To
4.16.		be
4.18.		Determined.
4.23		To
4.25.		be
4.30.		Determined.
5.2.		To
5.7.		be
5.9.		Determined.
5.14.		Student lecture.