PHYSICS 3250

Applied Nuclear Physics

Syllabus

Spring 2015

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The focus of PHYS3250 will be on applications of nuclear physics and nuclear energy. Lectures will be held every Tuesday and Thursday from 12:30-1:45pm, in Physics building room 205. Please see class website for the detailed calendar:

people.virginia.edu/∼xz5y/PHYS3250_Spring2015/

Textbook and Material

The **textbook** for the course is "Nuclear Physics: Principles and Applications", by J.S. Lilley, ISBN 978-0-471-97936-4, published June 2001 by John Wiley & Sons, Inc. This book will be available from the UVa bookstore. An electronic version can be purchased at http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118723325.html. We will also read excerpts (that I will provide) from "Introduction to Nuclear Engineering" by John R. Lamarsha and Anthony J. Baratta, other relevant books, and journals.

There will be articles related to the course topics posted every week. You are required to read these articles. At least one problem in each homework assignment will be based on these journal articles.

Grading

The **grading** will be based on homework, a midterm exam, and the final exam. There will be participation points from in-class clicker questions and a term-paper. Details of the term paper will be available around or after the midterm exam.

The final grade will be determined as follows:

- Homework: 20%
- Midterm: 30%
- Final Exam: 40%
- In-class participation and term paper: 10%

Class Outline

1. Introduction: particles and forces, quantum mechanics applied to the nucleus;
2. Nuclear structure: shell model, semi-empirical mass formula, nuclear binding energy;

3. Radioactivity;
4. Passage of radiation through matter;
5. Radiation creation and detection: particle detectors, particle accelerators, X-ray generators;
6. Biological effects of radiation;
7. Industrial applications of radiation;
8. Nuclear medicine: imaging, radio-therapy, NMR;
9. Nuclear energy – introduction;
10. Nuclear fission: neutron cycle, moderators, reactor basics, thermal reactors, fast-breeder reactors, nuclear waste management, advanced fuel cycle, reactor safety;
11. Nuclear fusion: fission vs. fusion, thermo-nuclear fusion, magnetic confinement, progress towards fusion power, ITER, inertial confinement fusion;
12. Fusion in stars: fusion in the early universe, stellar burning, super-novae, nucleosynthesis;
13. Nuclear proliferation.