Physics – 315 Radiation Science FALL - 2010

- **Instructor: Dr. Igor Ostrovskii**

SYLLABUS

- **Lecture:** T, Th 09:30-10:45, Room 109 Lewis Hall
- **Office**: Room 207 Lewis Hall; Email: iostrov@phy.olemiss.edu
- **Office Hours: M, Th 3:30 – 4:30 p.m. (207 Lewis Hall) + by appointment.**

- **Text**: Modern Physics, by R.A. Serway, C.J. Moses and C.A. Moyer, 3rd edition.

We will cover Chapters 1 – 7, 13, 14. → **PLEASE, READ THE BOOK**

- **Additional reading**:

1) Modern Physics, by Paul A. Tipler and Ralph A. Llewellyn, 5th edn., W.H. Freeman and Company.

2) Experiment in Modern Physics, by Adrian Melissnos and Jim Napolitano, 2nd edn. Academic Press.

COURSE OBJECTIVES:

1. To provide simple and clear explanations of main physical concepts and theories of the 20-th century.
2. To teach main ideas and results in Radiation Science that is an important part of Modern Physics.
3. To clarify these concepts and theories through a broad range of *current applications* and examples.
4. To liven up the text with brief sketches of the historical development of 20th-century physics.
5. Develop an understanding of the current basis of broad knowledge in Radiation Science.
6. Enhance the critical thinking, analytical reasoning and problem solving skills.
7. Discuss the problems confronting Radiation Science in the 21-st century.

COURSE LEARNING OBJECTIVES:

In this course, we introduce students to the developments in Physics and Radiation Science in the 20th century. In the learning objectives, we answer a question: "What will the students know and be able to do as a result of taking this class and passing the final examination."

- **The learning outcomes for students are as follow:**

1. Understand the intuitive ideas of the Relativity, Quantum physics, and Nuclear physics.
2. Understand the basic principles of 20th-century Physics and Radiation Science *including but not limited to* Einstein theory of Relativity, Quantum theory of light, Particle nature of matter, Quantum mechanics in one dimension, Basic ideas of nuclear physics and its applications.
3. Learners will develop a comprehension of the current basis of broad knowledge in Modern physics.
4. They will know about the problems confronting modern physics in the 21st century.
5. Learners will build on a critical thinking, analytical reasoning, and problem solving skills.
6. Students will know how to use interactive methods and Internet for their independent learning on "Radiation Science."
7. Students will be trained to prepare and make a scientific presentation.

GRADING SCALE: A's ---------- 90 – 100

B's ---------- 80 – 89

C's ---------- 70 – 79, Etc.

- **EVALUATION**: Grades will be based on the home works, presentations, chapter tests, and final examination:

Home works, Presentation	--- 20 %
Two tests	--- 40 % (#1=20%, #2=20%)
Final exam	--- 40%
	100 %

- Tests and Final examination schedule:

Test 1 (Class # 11), Chapters 1, 2, 3, 4 ---------- Tuesday, September 28

Test 2 (Class # 24), Chapters 5, 6, 7, 13 ----- Thursday, November 11

- **FINAL EXAMINATION ---------- Thursday, December 9, 8:00 a.m.**

- **Requirements of the course and Homework rules:**

1. **Absence** *may jeopardize your standing in class* because you are responsible for any in-class activities and for anything presented. Show up for class on time & do not leave class early.
2. Homework is assigned after some sections are covered and is due in a week.
3. Homework paper should be 8.5'' x 11'' with no torn or tattered edges. HW-papers should be stapled.
4. Show all your work; the answer alone is not worth anything.
5. HW-problems must include diagrams, equations, calculations, enough English to be understandable.
6. Homework answers should have units and a reasonable number of significant digits.
7. **Circle the finale answers that you want to be graded.**

- **COURSE CONTENTS**

CHs. 1 & 2. RELATIVITY I AND II. [4 classes]

- Special relativity, the principles of relativity, experiments.
- Postulates of special relativity, The Lorentz transformation.
- Relativistic momentum and energy, conservation laws.

CH. 3. THE QUANTUM THEORY OF LIGHT. [3 classes]

- Hertz's experiment. // Black body radiation and Planck's law.
- Photoelectric effect and associated phenomena.
- Particle-Wave Complementary.

CH. 4. THE PARTICLE NATURE OF MATTER. [3 classes]

- The atomic nature of matter, the composition of atoms.
- The Bohr atom. // Direct confirmation of atomic energy.

Test 1 (Class # 11), Chapters 1, 2, 3, 4 ---------Tuesday, September 28 [1 class]

CH. 5. MATTER WAVES. [4 classes]

- The waves de Broglie, The Davisson-Germer experiment.
- Wave groups and dispersion.
- The Heisenberg uncertainty principle.

- The wave-particle duality.

CH. 6. QUANTUM MECHANICS IN ONE DIMENSION. [3 classes]

- The Born interpretation, wave-functions.
- The Particle in a box, Finite square well, Quantum oscillator.
- Observables and operators.

CH. 7. TUNNELING PHENOMENA. [2 classes]

- The square barrier.
- Barrier penetration and some applications.

Ch. 13. NUCLEAR STRUCTURE [3 classes]

- Properties of nuclei. //Binding energy and nuclear forces.
- Radioactivity, Decay process, Natural radioactivity.

Test 2 (Class # 24), Chapters 5, 6, 7, 13 ----- Thursday, November 11. [1 class]

Ch. 14. NUCLEAR PHYSICS APPLICATIONS (PRESENTATIONS) [3 classes]

- Nuclear reactions, Reaction cross section, Interactions & Neutrons.
- Nuclear fission, Nuclear reactors.
- Nuclear fusion.
- Interaction of particles and matter, Radiation damage.
- Radiation detectors, Uses of radiation.

REVIEW (Last class # 28) [1 class]

- **FINAL EXAMINATION ----- Thursday, December 9, 8:00 a.m.**

- - The dates are tentative, and may be changed,

BUT NOT FINAL EXAMINATION DATE.