Phys 315: Radiation Science Dr. Ostrovskii Fall-2013

- **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 Paul A. Tipler, Ralph A. Liewellyn, 6th edition.**

ISBN-13: 978-1-4292-5078-8; ISBN-10: 1-4292-5078-X

We will cover Chapters 1 through 6, AND Ch. 11. → ***PLEASE, READ THE BOOK***

- **Additional reading**:

1) Experiment in Modern Physics, by Adrian Melissinos and Jim Napolitano, 2nd edn. Academic Press. ISBN-13: **978-0124898516** ; ISBN-10: **0124898513**

- **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, presentation, tests, and final examination:

Home works ----- 15%
Presentation ----- 5%
Three tests ------- 45% (#1=15%, #2=15%, #3=15%)
Final exam ------- 35%
100 points

- Tests and Final examination schedule:

Test 1 (Class # 10), Chapters 1, 2, 3 -------- Thursday, September 26

Test #2 (Class # 17), Chapters 4, 5 ----- Tuesday, October 22

Test #3 (Class # 24), Chapters 6, 11A ----- Thursday, November 14

- **FINAL EXAMINATION ------ Thursday, December 12, 8:00 a.m. to 11 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 8.5x11 inch with no torn or tattered edges.
   HW-papers should be stapled.
4. **Show all your work**; the answer alone is not worth anything.
5. ***To be qualified for a high grade:***
   TEST papers and HW-papers must include the initial statements/questions (in short), definitions ("what is what"), diagrams, equations, calculations, enough English /explanations, final answers.
6. **The answers should have units** and a reasonable number of significant digits.
7. **Circle the finale answers that you want to be graded.**
8. ***The students are requested to keep all exams and home works for "proof of grade" purposes.***

- **COURSE CONTENTS**

CHs. 1 & 2. RELATIVITY I AND II. [4.5 classes]

- Experimental basis of relativity.
- Einstein's postulates of special relativity.
- The Lorentz transformation.
- Time dilation, length contraction, Doppler effect.
- Relativistic momentum and energy, conservation laws.

CH. 3. QUANTIZATION OF CHARGE, LIGHT, ENERGY [3.5 classes]

- Quantization of electric charge.
- Black body radiation.
- Photoelectric effect.
- X-Rays and Compton effect.

Test 1 (Class # 10), Chapters 1, 2, 3 -------- Thursday, September 26 [1 class]

CH. 4. THE NUCLEAR ATOM [3 classes]

- Atomic spectra.
- Rutherford's nuclear model.
- The Bohr atom.
- X-Ray spectra.
- The Frank-Hertz experiment.

CH. 5. THE WAVELIKE PROPERTIES OF PARTICLES [3 classes]

- The waves de Broglie.
- Particle wavelengths.
- Wave packets.
- The probabilistic interpretation of the wave function.
- The uncertainty principle.
- Wave-particle duality.

Test #2 (Class # 17), Chapters 4, 5 ----- Tuesday, October 22 [1 class]

CH. 6. THE SCHRODINGER EQUATION. [4 classes]

- Equation in one dimension.
- The Infinite square well. The Finite square well.
- Expectation values and Operators.
- The simple harmonic operator.
- Reflection and Transmission of Waves.

CH. 11A. NUCLEAR PHYSICS - I (Sns. 11.1 through 11.4) [2 classes]

- The composition of the nucleus.
- Ground-state Properties of nuclei.
- Radioactivity.
- Alpha, Beta, and Gamma Decay.

Test #3 (Class # 24), Chapters 6, 11A ----- Thursday, November 14 [1 class]

CH. 11B. NUCLEAR PHYSICS – II (***STUDENT PRESENTATIONS***: Sns. 11.5 - 11.9) [4.5 classes]

- The nuclear force.
- The shell model.
- Nuclear reactions.
- Fission and Fusion.
- Applications.

REVIEW (Last class # 28) [0.5 class]

- **FINAL EXAMINATION ----- Thursday, December 12, 8:00 a.m. to 11 a.m.**

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

BUT NOT THE FINAL EXAMINATION DATE.