PHYSICS-315: **FALL - 2006**

PHYS-315: RADIATION PHYSICS

- **Instructor: Dr. Igor Ostrovskii**

SYLLABUS

- **Course objectives:**
  1. Introduce the physics major students to 20-th century Radiation Physic;
  2. To teach main ideas and results in Radiation Physics that is an important part of Modern Physics;
  3. Expand an understanding of the intuitive ideas of the relativity and quantum physics;
  4. Develop an understanding of the current basis of broad knowledge in radiation physics;
  5. Enhance the critical thinking, analytical reasoning and problem solving skills;
  6. Discuss the problems confronting radiation physics in the 21-st century.

- **PHYS-315 Learning objectives:**

In this course, we introduce the physics major students to 20th century Radiation physics.
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 basic principles of the Radiation Physics including *but not limited to* Theory of Relativity, Light irradiation as a quantum process, Matter waves, Basics of one-dimensional Quantum mechanics, Tunneling phenomena, Main ideas of nuclear physics and nuclear physics applications.
2. Understand the intuitive ideas and mathematical descriptions of the Quantum processes of electro magnetic wave irradiation.
3. Students will build on the critical thinking and reasoning, and will be able to apply their new skills for problem solving.
4. Learners will develop a comprehension of the current basis of broad knowledge in Modern and Radiation physics.
5. They will be aware about the problems confronting modern Radiation Physics.
6. Students will know how to use interactive methods and Internet for their independent learning in the field of "Radiation Physics."

- **Lecture:** TTh 8:00 – 9:15, Room 109 Lewis Hall
- Office: Room 207 Lewis Hall; Email: iostrov@phy.olemiss.edu
- Office Hours: MWTh 3:30 – 4:30 p.m. (207 Lewis Hall)

- **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

- Grading Scale: A's ---------- 90 – 100
  B's ---------- 80 – 89
  C's ---------- 70 – 79, Etc.

- **EVALUATION**: Grades will be based on the homeworks, tests, and final examination:
  Homework ---------- 15 %
  Three tests ---------- 45 % (#1=15%, #2=15%, #3=15%)
  Final exam ---------- 40 %
  100 %

- Tests and Final examination schedule:

Test 1 (Class # 10), Chapters 1, 2, 3, 4 ---------- Thursday, September 21.
Test 2 (Class # 19), Chapters 5, 6, 7 ---------- Tuesday, October 24.
Test 3 (Class # 27), Chapters 13, 14 ---------- Thursday, November 28.

- **FINAL EXAMINATION ---------- Tuesday, December 5, 8:00 a.m.**

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

1. Homework is assigned after some sections are covered and is due in a week.
2. Homework paper should be 8.5 x 11 inches with no torn or tattered edges. Homework papers should be stapled.
3. Show all your work; the answer alone is not worth anything.
4. Homework problems must include diagrams, initial equations, calculations, enough English to be understandable.
5. Homework answers should have units and a reasonable number of significant digits.
6. **Circle the finale answers that you want to be graded.**

Course content:

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. [2.5 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. [2.5 classes]

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

Test 1 (Class # 10), Chapters 1, 2, 3, 4 ---------- Thursday, September 21.

CH. 5. MATTER WAVES. [3 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, wavefunctions.
- 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.

Test 2 (Class # 19), Chapters 5, 6, 7 ---------- Tuesday, October 24.

Ch. 13. NUCLEAR STRUCTURE [3 classes]

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

Ch. 14. NUCLEAR PHYSICS APPLICATIONS [4 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.

Test 3 (Class # 27), Chapters 13, 14 ---------- Thursday, November 28.

REVIEW (Particles): [1 class]

- **FINAL EXAMINATION ----- Tuesday, December 5, 8:00 a.m.**

* - The dates are tentative, and may be changed, **BUT NOT FINAL EXAMINATION**.