Phys 315: RADIATION SCIENCE Dr. Ostrovskii Fall-2015

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: Tu 11:00 a.m.-Noon; Th 3:30 – 4:30 p.m. + by appointment (207 Lewis Hall).**

- **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**

***IMPORTANT*: The UM requires that all students have a verified attendance at least during the first two weeks of the semester.**

Attendance and participation: Attendance is expected and may be recorded each day of class. To comply with attendance verification requirements, a report of your attendance will be made.

1. General description of the course's purpose

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

2. Learning objectives of the course

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

After completing this course, a student should be able to:

- Understand the intuitive ideas of the Relativity, Quantum physics, and Nuclear physics.
- Understand the basic principles of the 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 in Radiation Science.
- Develop a comprehension of the current basis of Modern physics and Radiation Science.
- Analyze the problems confronting modern physics in the 21st century.
- Significantly improve **critical thinking, analytical reasoning, and problem solving skills**.
- Cultivate a usage of interactive methods & Internet for independent course learning.
- Prepare and make a scientific presentation.

3. Description of examinations and other student requirements

- **Chapter Tests and Final examination schedule:**

  Test #1 (Class # 10), Chapters 1, 2, 3 -------- Thursday, September 24

  Test #2 (Class # 19), Chapters 4, 5 ----- Tuesday, October 27

  Test #3 (Class # 25), Chapters 6, 11A ----- Tuesday, November 17

  ❖ **FINAL EXAMINATION ------ Thursday, December 10, 8:00 a.m. to 11 a.m.**

- **Homework requirements:**

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.
3. Homework papers should be stapled allowing their reading and grading.
4. **Show all your work; the answer alone is not worth anything**.
5. **Homework papers must include**: diagrams, equations, derivations, calculations, and explanations of what you are doing / reasoning, ***enough English*** to be understandable.
6. Homework answers should have units and a reasonable number of significant digits.
7. **Encircle** the answers that you want to be graded. **(*Nothing encircled,- nothing graded*).**

4. Information about the grading process and standards

- **GRADING SCALE**: **A's ---------- 89 – 100**
  B's ---------- 79 – 88
  C's ---------- 69 – 78
  D's ---------- 59 - 68 .
- **EVALUATION**: Grades will be based on the home works, tests, presentation, class activity and final examination:

Home works ---12 points

Three tests --- 45 points (3 chapter tests x 15 points each)

Presentation --- 13 points

Class activity --- 10 points for zero university-unrelated absences,

(7 points for 1 absence; 5 - for 2 absences, 0 - for 3 absences; (- 2) points for each absence after 3**)**

Final exam ---20 points

TOTAL = 100 points

5. Outline of covered topics

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 24 [1 class]

CH. 4. THE NUCLEAR ATOM [4.5 classes]

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

CH. 5. THE WAVELIKE PROPERTIES OF PARTICLES [3.5 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 # 19), Chapters 4, 5 ----- Tuesday, October 27 [1 class]

CH. 6. THE SCHRODINGER EQUATION [4.5 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) [1.5 classes]

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

Test #3 (Class # 25), Chapters 6, 11A ----- Tuesday, November 17 [1 class]

CH. 11B. NUCLEAR PHYSICS II (***STUDENT PRESENTATIONS***: Sns. 11.5-11.9) [2.5 cls.]

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

REVIEW (Last class # 28) [0.5 class]

6. Other policies

- ***Attendance / absences***: Please bring in a **document** that explains your absence.
- **It is articulated and stressed the role of daily class participation in the learning process.**
- *Absence may jeopardize your standing because you are responsible for any in-class activities.*
- ***Class participation***: 10 points for zero university-unrelated absences, **(**7 points for 1 absence; 5 - for 2 absences, 0 points for 3 absences; (- 2) points for each absence after 3**)**
- ***Use of electronic devices***: Please, **Turn off your phone before class!**
- ***Academic integrity***: While in class, you are expected to attend to and participate in discussion; you are **NOT** allowed to engage in private conversation or other behaviors that would disrupt class activities. You are expected to be civil to others in the class.
- ***The University of Mississippi Regulations Governing All Examinations:***
  A student's failure to appear for an examination without an acceptable excuse, inability to present valid identification, absence from the room during the course of an examination without the consent of the examiner, or attempting any portion of an examination without submitting his or her answers shall result in failure of the examination. *Tardiness beyond 15 minutes forfeits a student's right to an examination.*
- ***Last Week Policy:*** During the period of Wednesday through Friday of the last week of class, instructors are not to give exams, tests, or quizzes that contribute more than 10% of the final grade for a class.
- ***UM Attendance guidelines:*** Faculty and staff who supervise student organizations and teams, including NCAA sports teams, are expected to schedule competitions and performances in such a way as to minimize the number of classes that students will miss. *Names of participating students and the dates of class conflicts should be provided to the students' instructors prior to participation*. In cases where absence from class results from travel delays or the unanticipated continuation of participation in a competition, the student or supervisor should inform the instructor within one business day so that reasonable accommodations for absences due to university-sponsored activities can be made.
- ***UM Attendance guidelines:*** If a student informs an instructor in advance about an anticipated absence and the instructor decides not to provide an accommodation for a major exam or assessment, the student may appeal to the department chair or program director (or dean, when the instructor is chair or program director) who oversees the course. An appeal must be based on **(a)** failure of the instructor to articulate a policy, **(b)** failure of the instructor to follow the articulated policy, or **(c)** failure by the instructor to offer a reasonable accommodation for a documented absence that caused a student to miss an assessment that is **worth 20% or more of the course grade**.
- Based on UM "Class Attendance Guidelines,"-
- **No accommodations for missed chapter tests will be made.**
- If the instructor articulates in the syllabus the role of daily class participation in the learning process, **reasonable grade deductions can be made for absences.**

- **FINAL EXAMINATION ----- Thursday, December 10, 8:00 a.m. to 11 a.m.**

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