PHYSICS - 318: **SPRING - 2007**

INTRODUCTION TO MODERN PHYSICS II

- **Instructor: Dr. Igor Ostrovskii**

Course objectives:

1. Introduce the physics major students to the physics of 2nd half of 20-th century;
2. Expand an understanding of the ideas and results of the solid state physics and particle physics;
3. Develop an understanding of the current basis of broad knowledge in modern physic of 2nd half of 20-th century;
4. Enhance the critical thinking, analytical reasoning and problem solving skills;
5. Discuss the problems confronting modern physics including solid-state and particle physics in the 21-st century.

Learning objectives:

In this course, we introduce the physics major students to 2nd half 20th century 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 Physics of 2nd half of 20th century *including but not limited to* Atomic structure, Statistical physics, Molecular structure, Solid State physics, and Particle physics.
2. Understand the physical basis of numerous contemporary applications of Condensed Matter physics and Particle physics.
3. Understand the intuitive ideas of the Particle physics.
4. Students will develop a comprehension of the current basis of broad knowledge in Condensed Matter physics, which is integral part of Modern physics.
5. Learners will build on a critical thinking, analytical reasoning, and problem solving skills.
6. They will know about the problems confronting modern physics in 21st century.
7. Students will know how to use interactive methods and Internet for their independent learning on "Introduction to Modern Physics II" especially those part that describes the latest results in Solid State and Particle physics.

- **Lecture:** TTh 8:00 – 9:15, Room 109 Lewis Hall
- Office: Room 207 Lewis Hall; Email: iostrov@phy.olemiss.edu
- Office Hours: MWTh 3:00 – 4:00 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 8 – 12, 15.

- **Additional reading**: David Griffits. Introduction to Elementary Particles (Chapter 1).

PLEASE, READ THE BOOK

❖ GRADING:

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

- Grades will be based on homework, tests, and the 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 # 8), Chapters 8, 9 → Thursday, February 8.

Test 2 (Class # 19), Chapters 10, 11, 12-A → Tuesday, March 27.

Test 3: (Class #29) Chapters 12B, 15 → Tuesday, May 1.

➢ **FINAL EXAMINATION → Thursday, May 10, 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 CONTENTS:

Ch. 8. QUANTUM MECHANICS IN THREE DIMENSIONS [3 classes]

- Particle in a three-dimensional box.
- Central forces, angular momentum, space quantization.
- Atomic hydrogen and hydrogen-like ions.

Ch. 9. ATOMIC STRUCTURE [3 classes]

- Orbital magnetism, Normal Zeeman effect.
- The spinning electron, the spin-orbit interaction, exchange symmetry.
- The periodic table, X-ray spectra, Moseley's Law.

Test 1 (Class # 8), Chapters 8, 9 → Thursday, February 8.

Ch. 10. STATISTICAL PHYSICS [5 classes]

- The Maxwell-Boltzmann distribution.
- Quantum statistics.
- Applications of Bose-Einstein statistics.

- Application of Fermi-Dirac statistics.

Ch. 11. MOLECULAR STRUCTURE [3 classes]

- Bonding mechanisms.
- Molecular Rotation and Vibration.
- Molecular Spectra.
- Electron Sharing and the Covalent Bond.

Ch. 12-A. THE SOLID STATE I (Sections 12.1, 2, 3) [2 classes]

- Bonding in solids.
- Classical Free-Electron Model.
- Quantum Theory of Metals.

Test 2 (Class # 19), Chapters 10, 11, 12-A → Tuesday, March 27.

Ch. 12-B. THE SOLID STATE II (Sections 12.4, 5, 6, 7) [6 classes]

- Band Theory of solids.
- Semiconductor Devices.
- Superconductivity.
- Lasers.

Ch. 15. ELEMENTARY PARTICLES [4 classes]

- The fundamental forces in nature.
- Antiparticles. Mesons.
- Classification of particles.
- Conservation Laws.
- Quarks.
- Electroweak theory and the standard model.

TEST 3: (Class #29) Chapters 12B, 15 → Tuesday, May 1.

REVIEW [1 class]

❖ **FINAL EXAMINATION: Chapters 8 – 12, 15 → Wednesday, May 5, 8:00 a.m.**

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