- **Instructor: Dr. Igor Ostrovskii**
- **Lecture: TTh 9:30 – 10:45, Room 109 Lewis Hall**
- **Office Hours: M, Th 3:00 – 4:00 p.m. (207 Lewis Hall)**
- **Office: Room 207 Lewis Hall; Email: iostrov@phy.olemiss.edu**
- **Text**: **Modern Physics, by R.A. Serway, C.J. Moses and C.A. Moyer, 3rd edition.**

Student's Edition ISBN: 978-0-53449339-4

International Student Edition ISBN: 978-0-534-40624-6

WE WILL COVER CHAPTERS 8 – 12, 14, 15.

- **Additional reading**:

1) P. A. Tipler, R.A. Llewellyn, Modern Physics, 5th edn, W.H. Freeman Company, New York, 2008.
ISBN-13: 978-0-7176-7550-8
ISBN-10: 0-7176-7550-6

2) Adrian C. Melissinos, Jim Napolitano. Experiments in Modern Physics. 2nd edition. Academic Press.
ISBN-13: **978-0124898516**
ISBN-10: **0124898513**

PLEASE, READ THE BOOK

- **Course learning objectives:**

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."

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.
6. Develop in learners an ability to present orally their scientific knowledge and findings, which will be achieved with the help of student scientific presentations.

- **The learning outcomes for students**:

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 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 that part that describes the latest results in Solid State and Particle physics.

❖ **GRADING:**

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

- 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 # 8), Chapters 8, 9 → Thursday, February 16

Test 2 (Class # 16), Chapters 10, 11, 12-A → Thursday, March 22

Test 3 (Class # 24), Chapters 12-B, 14 → Thursday, April 19

FINAL EXAMINATION: Chapters 8 – 12, 15 → Thursday, May 10, 8 a.m. -11 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 [3.5 classes]

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

Ch. 9. ATOMIC STRUCTURE [3.5 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; 75 min), Chapters 8, 9, 10 → Thursday, February 16.

Ch. 10. STATISTICAL PHYSICS [3 classes]

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

Ch. 11. MOLECULAR STRUCTURE [3.5 classes]

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

Ch. 12-A. THE SOLID STATE [0.5 classes]

- Bonding in solids.

Test 2 (Class # 16; 75 min), Chapters 10, 11, 12-A → Thursday, March 22.

Ch. 12-B. THE SOLID STATE [5 classes]

- Classical Free-Electron Model.
- Quantum Theory of Metals.
- Semiconductor Devices.
- Superconductivity.
- Lasers.

Ch. 14. Ch. 14. NUCLEAR PHYSICS APPLICATIONS [2 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 # 24; 75 min), Chapters 12-B, 14 → Thursday, April 19.

Ch. 15-A ELEMENTARY PARTICLES [1.5 classes]

- The fundamental forces in nature.
- Antiparticles. Mesons.
- Classification of particles.
- Conservation Laws.

Ch. 15-B. ELEMENTARY PARTICLES [***PRESENTATIONS***] [2 classes]

- Strange Particles and Strangeness.
- Production of Elementary Particles.
- The Eightfold Way.
- Quarks.
- Electroweak theory and the standard model.

REVIEW [0.5 class]

FINAL EXAMINATION: Chapters 8 – 12, 15 → Thursday, May 10, 8 a.m. -11 a.m.

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