

- **Instructor:**    Dr. Igor Ostrovskii
- **Lecture:** TTh 9:30 – 10:45, Room 109 Lewis Hall
- **Office:** Room 207 Lewis Hall; Email: iostrov@phy.olemiss.edu
- **Office Hours:** M, Th 4:30 – 5:30 p.m. (207 Lewis Hall) + by appointment
- **TEXT:** Modern Physics, by R.A. Serway, C.J. Moses and C.A. Moyer, 3<sup>rd</sup> edition.

Student's Edition ISBN: 978-0-53449339-4; International Student Edition ISBN: 978-0-534-40624-6

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

- **Additional reading:**
  - 1) P. A. Tipler, R.A. Llewellyn, Modern Physics, 5<sup>th</sup> 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. 2<sup>nd</sup> edition. Academic Press. (ISBN-13: 978-0124898516 ; ISBN-10: 0124898513 )
  - 3) Introduction to Elementary Particles, by David Griffiths, Chapter 1. (ISBN: 0-471-60386-4 )

**PLEASE, READ THE BOOKS.**

- **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 2<sup>nd</sup> 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 physics of 2<sup>nd</sup> 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 2<sup>nd</sup> half of 20<sup>th</sup> 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 21<sup>st</sup> 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 SCALE:**    A's ----- 90 – 100 (100-93 A; 90-92 A-)  
                                      B's ----- 80 – 89 (87-89 B+ ; 83-86 B ; 80-82 B-)  
                                      C's ----- 70 – 79 (77-79 C+ ; 73-76 C ; 70-72 C-)  
                                      D's ----- 60-69 D.

❖ **EVALUATION:** Grades will be based on the home works, presentation, tests, and final examination:

Home works ---- 15%  
 Presentation ---- 10%  
 Three tests ----- 45% (3x15%)  
 Final exam ----- 30%  
 TOTAL = 100 points

- Chapter Tests and Final Examination schedule:

Test 1 (Class # 8), Chapters 8, 9 → Tuesday, February 19.

Test 2 (Class # 16), Chapters 10, 11 → Thursday, March 21.

Test 3 (Class # 23), Chapter 12 → Tuesday, April 16.

**FINAL EXAMINATION → Tuesday, May 9, 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.**
7. Classroom Policies on **ABSENCES**: Please bring in a **document** that explains your absence. **Absence** may jeopardize your standing because **you are responsible for any in-class activities.**
8. **CONDUCT:**
  - 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.
  - Turn off your phones before class!
  - 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.

**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.

❖ **COURSE CONTENTS:**

Ch. 8. QUANTUM MECHANICS IN THREE DIMENSIONS [4 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 # 9; 75 min), Chapters 8, 9 → Tuesday, February 19.**

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 classes]

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

Ch. 12-A. THE SOLID STATE [1 class]

- Bonding in solids.

**Test 2 (Class # 16; 75 min), Chapters 10, 11 → Thursday, March 21.**

Ch. 12-B. THE SOLID STATE [6 classes]

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

**Test 3 (Class # 23; 75 min), Chapter 12 → Tuesday, April 16.**

Ch. 15A. ELEMENTARY PARTICLES [1 classes]

- The fundamental forces in nature.
- Antiparticles. Mesons.

Ch. 15B. ELEMENTARY PARTICLES [PRESENTATIONS] [3 classes]

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

REVIEW (Last class # 28) [1 class]

**FINAL EXAMINATION: Chapters 8 – 12, 15 → Tuesday, May 9, 8 a.m. -11 a.m.**

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