<u>PHYSICS - 618</u>:

SPRING - 2005

MODERN PHYSICS II

• Instructor: Dr. Igor Ostrovskii

> Course objectives:

- 1. Introduce the physics major graduate students to 20-th century physics;
- 2. Advance an understanding of the ideas of quantum physics;
- 3. Expand an awareness of the current basis of knowledge in physics including quantum statistics, properties of solids, and basic properties of nuclei and particles;
- 4. Discuss the problems confronting physics in the 21-st century.
 - ★ Lecture: TTh 11:00 12:15, Room 126 Lewis Hall
 - ♦ Office: Room 207 Lewis Hall, Tel: 915-1536; Email: iostrov@phy.olemiss.edu
 - ♦ Office Hours: MWF 2:30 3:30 p.m. (207 Lewis Hall)

Texts*:

1) [K]: Introduction To Solid State Physics, by Charles Kittel, 7-th edition, 1996.

2) [L]: Principles of Modern Physics, by Robert B. Leighton, McGraw-Hill Book Company.

- 3) [M]: Condensed Matter Physics, by Michael P. Marder, John Wiley & Sons, 2000.
- 4) [G]: Introduction to Elementary Particles, by David Griffits, John Wiley & Sons.

* - Textbooks [K, L] are for main reading and [M] is recommended for additional reading.

• <u>Grading Scale</u>: A's ------ 90 - 100 B's ----- 80 - 89, etc.

Grades will be based on homework, tests, and the final examination:

Homework ------ 20% Three tests ----- 45% (#1=15%, #2=15%, #3=15%) Final examination ------ <u>35%</u>

Tests and Final examination schedule:

- Test 1 (Quantum Statistics, Electrons and Phonons in Solids): Chapters 4, 5, 6-A [K] & Ch. 10 [L] ------ Tuesday, February 22.
- Test 2 (Properties of Solid State): Chapters 6-B, 7, 8 [K] ----- Thursday, March 31.
- Test 3 (Crystal Defects, and Basic Properties of Particles) Chapters 11, 18 [K]; 20 [L]; 1, 2 [G] ---- Tuesday, April 28.

FINAL EXAMINATION ------ Thursday, May 12, 4 p.m.

- 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 <u>stapled</u>.
- 3. Show all your work; the answer alone is not worth anything. Homework problems must include <u>enough English</u> to be understandable.
- 4. Important: Circle the finale answers that you want to be graded.

SYLLABUS

1. QUANTUM STATISTICS [K: Appendix D; L: Ch. 10]: Three quantum distribution laws. Applications of the Maxwell-Boltzmann, Fermi-Dirac and Einstein-Bose distribution laws.	{3 classes}
2. PHONONS I: CRYSTAL VIBRATIONS [K: Ch.4]: Vibrations of crystals with monatomic basis, two atoms per primitive basis, Quantization of elastic waves, Phonon momentum, Inelastic scattering by phon	{3 classes}
3. PHONONS II: THERMAL PROPERTIES [K: Ch.5]: Phonon heat capacity, Anharmonic crystal interactions, Thermal conductivity	{2 classes}
4. FREE ELECTRON FERMI GAS I [K: Ch.6-A] Energy levels in one dimension, Effect of temperature on the Fermi-Dirac distribution Free electron gas in three dimensions, Heat capacity of the electron gas.	{2 classes} bution,
➢ TEST #1 (Class 11), L: Ch. 10; K: Chas. 4, 5, 6-A → Tuesday, February 22	
5. FREE ELECTRON FERMI GAS II [K: Ch.6-B] Electrical conductivity and Ohm's law, Motion in magnetic fields, Thermal conductivity of metals, Nanostructures.	{2 classes}
6. ENERGY BANDS [K : Ch. 7] Nearly free electron model, Bloch functions, Kronig-Penney model, Wave equat periodic potential, Number of orbitals in a band.	{4 classes} tions of electron in
7. SEMICONDUCTOR CRYSTALS [K: Ch. 8] Band gap, Equations of motion; Intrinsic carrier concentration, Impurity conduc Thermoelectric effects, Semimetals, Superlattices.	{2 classes} tivity,
➤ TEST #2 (Class 20) K: Chas. 6-B, 7, 8 → Thursday, March 31	
8. OPTICAL PROCESSES AND EXCITONS [K: Ch. 11] Optical reflectance, Excitons, Raman Effect in crystals, Energy loss of fast particles in a solid.	{4 classes}
9. POINT DEFECTS IN SOLIDS [K: Ch. 18] Lattice vacancies, Diffusion, Color centers.	{3 classes}
➢ TEST #3 (Class 28) K: Chas. 11, 18; → Thursday, April 28	
11. PARTICLES (REVIEW) [L: Ch. 20; G] Electrons and positrons, Photons, Protons, Neutrons, Neutrinos, Muons, Pions, K-mesons, Hyperons, Theoretical interpretation of particle properties.	{2 class}
FINAL EXAMINATION Thursday, May 12, 4 p.m.	

* - The dates of three tests are tentative, and may be changed.

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