SYLLABUS

PHYS 489/589/620: Introduction to Modern Materials

Fall 2008

Instructor:

Heinz Nakotte, Room Regents Row 101, phone: 646-2459

Instructors' Office Hours:

Every other Wednesday, 2:00-4:00 pm

Location and Schedule of the Course:

The course will be taught bi-weekly in two extended sessions of 2.5 hours each on Tuesdays and Thursdays.
The location and actual time are TBD.

Textbook:

There is no single graduate-level textbook covering all of the material that I intend to cover during this course. However, Philip Ball (an associate editor with *Nature*) has published an excellent book called "Made to Measure - New Materials for the 21st Century" (Princeton University Press, 1999, ~$20), which introduces a variety of advanced materials to the general audience. It should be noted that Ball's book is not written for physics students (there is not a single formula in the whole book); it is written such that it appeals to also to non-specialists. I would advice the students to purchase this book, even though it is not really needed for the class.
The physics of materials discussed in class will be extracted from other sources, since there is no particular textbook covering all of the material covered during this course. Therefore, I expect that students will take notes during class. In addition, I will deposit suitable textbooks on any given course objective in the Zuhl library for their review. However, students are not allowed to take these books from its location at the library, except for copying some of the material, if needed.

Course Objectives:

I intend to cover the physics and engineering aspects in a large variety of modern materials. The course will emphasize the microscopic mechanisms responsible for an improved performance of modern materials and we will also discuss experimental techniques for measuring materials properties. The main goal of this course is for students to identify and understand the microscopic mechanisms responsible for an improved performance of modern materials.

Pre-requisites, Co-requisites or Placement Exam:

PHYS489 students are required to have passed PHYS315 (Modern Physics) or equivalent. For PHYS589 and PHYS620 students, PHYS554 (Quantum Mechanics I) or equivalent is a pre- or co-requisite. A student that doesn't have those pre- or co-requisites can attend the course if he/she passes an oral exam with the instructor within the first week of classes.

Grade Basis and Calculation:

Performance in the various categories of work will count toward the final grade as follows:

class attendance and participation: 25%
pre-requisite test: 5%
homework: 30%
oral presentation: 40%

The final letter grades may be found from the following standard scale of percentage cutoffs for the grades:

94%: A+	***76%: B+***	***50%: C***
88%: A	***70%: B***	***below 50%: F***
82%: A-	***64%: B-***	

Class attendance and participation will be graded based on my impression of the quality and the extent of the participation in class. If, for a good reason (for example, illness, family emergency etc.), a student cannot attend all of the class meetings, he/she can discuss with me other arrangements to make up for class attendance and participation. Students will be deducted an equivalent of one half percent for every 10 minutes that they have been late for class. I will drop students who do not attend the course for an extended period. Although there is no final exam, the class will meet at the scheduled exam time during finals week.

A ***Pre-Requisite Test*** will be given at the end of the 2nd class period. It consists of 30 multiple-choice questions covering basic background in Modern Physics (PHYS 315). The test will count for 5% of the final grade.

There will be up to 6 ***homeworks***, and students are expected to provide solutions within two weeks after distribution (unless otherwise noted). If, for a good reason, a student cannot provide solutions within its allocated time frame, other arrangements can be discussed. On occasion, PHYS589 students and PHYS620 will be given additional and more challenging homework problems. Students are encouraged to discuss homework problems with each other, but every student has to submit his/her own work.

All students are asked to give an ***oral presentation*** on a selected topic, which fits into the frame of this course. The presentation should discuss some recent development in the area of modern materials. Most of the presentations will be held at the end of the semester.
For PHYS489 students, the length of the presentation should be about 20 minutes (including discussion).
The length of the oral presentation should be about 20 minutes in length for students taking the course as PHYS589.
PHYS620 (Magnetism) are required to give two presentations: a) teach the material of a particular objective in magnetism (~30 minutes), and b) the 30-minute presentation in the area of magnetism.

Students are expected to search and find suitable references that are needed for their presentation. Finally, students are encouraged to submit a written report on the topic of their presentation, although it is not required. Written reports will receive some extra credit (up to 5%).

Students with disabilities:

If you have or believe you have a disability and would benefit from any accommodations, you may wish to self-identify by contacting the Services for Students with Disabilities (SSD) Office located at Garcia Annex (phone: 646-6840). If you have already registered, please make sure that your instructor receives a copy of the accommodation memorandum from SSD within the first two weeks of classes. It is your responsibility to inform either your instructor or SSD representative in a timely manner if services/accommodations provided are not meeting your needs.

If you have a condition which may affect your ability to exit safely from the premises in an emergency or which may cause an emergency during class, you are encouraged to discuss any concerns with the instructor and/or Mr. Michael Armendariz, SSD Coordinator. Feel free to call Ms. Angela Velasco (Interim EEO/ADA and Employee Relations Director) at 646-3333 with any questions about the Americans with Disabilities Act (ADA) and/or Section 504 of the Rehabilitation Act of 1973. All medical information will be treated confidentially.

Academic and non-academic misconduct:

Examples of misconduct can be found on http://www.nmsu.edu/~vpss/03-04handbook.pdf. Any form of cheating or plagiarism is prohibited, and (if caught) the particular work will be graded with a zero. Students must turn off cell phones and beepers while in class.

Tentative Schedule

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Fall 2008

Thursday, August 21: Scheduling; Distribution of Syllabus

Tuesday, September 2: Pre-Requisite Test; Chemical Bonding and Bonding Anisotropy; Electrons in a Periodic Potential; Spin-Orbit Interactions

Thursday, September 4: Crystal Structures; Amorphous Materials and Polymers; Group Theory; Reciprocal Lattice; ***HW 1 (Structure and Bonding) distributed***

Thursday, September 16: Mechanical Properties; Lattice Imperfections and Defects; Microstructure: Texture, Grains and Grain Boundaries; Destructive Phenomena

Thursday, September 18: Alloys and Composites; Superhard Materials; Smart Materials; Shape-Memory Alloys; ***HW 1 due, Homework 2 (Materials and Processing) distributed***

Tuesday, September 30: Nanoscale Materials; Surface vs. Bulk Properties; Applications of Nanomaterials

Thursday, October 2: Semiconductor Physics; Photonics: Non-linear phenomena, LED's, Semiconducting Lasers and Fiber Optics; Photonic Switching and Computing, ***HW 2 due, HW 3 (Nanomaterials and Photonics) distributed***

Tuesday, October 14: Magnetic Transitions and Magnetic Ground States; Magnetic Domains

Thursday, October 16: Permanent Magnet Materials and Applications; ***HW 3 due, Homework 4 (Magnetism) distributed***

Tuesday, October 28: Magnetic Films; Magnetic Multilayers; Quantum Dot Arrays; Magnetic Recording; Giant Magnetoresistance Materials;

Thursday, October 30: Diamagnetism and Superconductivity; Magnetic Levitation; Magnetic Resonance Imaging and SQUID Magnetometry; ***HW 4 due, Homework 5 (Magnetic Recording and Superconductivity) distributed***

Tuesday, November 12: Foundations of Biomaterials; Electrostatic and Electrodynamic Interactions; Miscelles and Membranes

Thursday, November 14: Applications of Biomaterials; Drug Delivery; ***HW 5 due, Homework 6 (Biomaterials) distributed***

Tuesday, November 26: THANKSGIVING HOLIDAY

Thursday, November 28: THANKSGIVING HOLIDAY

Tuesday, December 2: Student Presentations

Thursday, December 4: Student Presentations ***HW 6 due***

Thursday, Dec. 9: Finals Week: General Discussion of the Course and PIZZA!