SOLID-STATE PHYSICS
FOR ENGINEERS AND SCIENTISTS
Physics 5701, Spring 2016

Instructor: Natalia Perkins
Office: MCNAMARAC 147
email: nperkins@umn.edu
Office hours: Tu-Th 11.30 AM-12.30 PM
Lectures: Tu-Th (10:10AM-11:25 AM) in Physics & Nanotechnology 120
Prereq: Grad or advanced undergrad in physics or engineering or the sciences
Course materials:
Required Text Book: The Oxford Solid State Basics by Steve Simon
Recommended: Solid State Physics by N.W. Ashcroft and N.D. Mermin
Recommended: Quantum Theory of Solids by C. Kittel
Recommended: Principles of the Theory of Solids by J.M. Ziman
Lecture Notes:
I will post my handwritten notes on the webpage at the end of each week, but I suggest that you take notes in class.
Class Description:
The course will more or less follow The Oxford Solid State Basics by Steve Simon. This is the required text. Although the book is slightly less advanced than is ideal, it presents all important material we need to cover. The lectures may therefore be a little more advanced to compensate, and I may supplement the basic material with suggested reading. I strongly recommend to have access to the now-classic Solid State Physics by N.W. Ashcroft and N.D. Mermin. It is a very expensive book to buy but this is a canonical textbook that often proves to be useful beyond the classroom and I will use it a lot. Finally, there are older books that you might find illuminating: Principles of the Theory of Solids by J.M. Ziman, and Quantum Theory of Solids by C. Kittel.
Steve Simon's book also contains a brief list of other texts with comments on their pros and cons, which you might find useful.

I plan to cover the following topics - possibly not all of them, most likely not in this order.

1. Specific Heat of Solids
2. Electrons in Metals
3. Basic Chemistry of the Solid State
4. Types of Matter
5. Electrons in d=1, tight-binding, Peierls distortion
6. Geometry of solids; crystal structure
7. Reciprocal lattice, Brillouin zones, waves in crystals
8. Neutron and X-Ray Diffraction
10. Electrons in Periodic Potentials II: Bloch's Theorem
11. Graphene Basics
12. Semiconductor Physics & Devices
13. Semiclassical Electron Dynamics
14. 'Quantum Oscillations'
15. Landau Levels and the (Integer) Quantum Hall Effect
16. Superconductivity
17. Magnetism

**Mid-term and Final Exam:** There are two in-class mid-term exams throughout the semester. The tentative dates for the mid-term exams are March 1 and April 19. There are no make-up quizzes. If you have a University approved reason to miss a mid-term exam, please talk with me in advance. The final exam is home-taken. The final exam covers the entire material of the semester.

**Homeworks:** Bi-weekly homework assignments will be posted on the class website. Your solutions to the problem set are due in Lecture on Thursday at the end of the two-week period. Work in groups on the homework will not be discouraged. I will grade the HW based on the following scheme: 3 -- essentially correct, 2 – strong effort, 1 -- some
progress, 0 --little or no progress. The same grading scheme will be used in Mid-term and Final exam.

**Grading:**
Your Final Grade for the class will be calculated as follows: Homework - 40 %, 2 Mid-term exams - 20% each, Final Exam - 20%. The total grade will be calculated according to the following scheme: 90 percent and higher will be A, 85-90 will be A-, 80-85 will be B, 75-80 will be B-, 70-75 will be C, 65-70 will be C-.

**DEPARTMENTAL POLICIES**
**Athletes:** must provide their official University of Minnesota athletic letter containing the approved competition schedule to their instructor and the staff in office WMSONH 145 (office). Away exams will be arranged with the athletic adviser traveling with the team. Accommodations will be made for official university sports only (i.e. no accommodations will be made for intramurals, club sports, etc.)

**Disability services:** If you have accommodations for this course, please provide the staff in office WMSONH 145 with a copy of your accommodation letter for the current semester. Exams will be arranged according to accommodations and sent to the testing center for administration.

**MANDATORY POLICY INFORMATION**
Student conduct code
http://www1.umn.edu/regents/policies/academic/Student_Conduct_Code.html
Disability Accommodations
http://ds.umn.edu/student-services.html
Use of Personal Electronic Devices in the Classroom
http://policy.umn.edu/Policies/Education/Education/CLASSROOMPED.html
Makeup Work for Legitimate Absences
http://policy.umn.edu/Policies/Education/Education/MAKEUPWORK.html
Appropriate Student Use of Class Notes and Course Materials
http://policy.umn.edu/Policies/Education/Education/CLASSNOTESSTUDENTS.html
Grading and Transcripts
http://policy.umn.edu/Policies/Education/Education/GRADINGTRANScripTS.html
Sexual Harassment
http://www1.umn.edu/regents/policies/humanresources/SexHarassment.html
Equity, Diversity, Equal Opportunity, and Affirmative Action
http://www1.umn.edu/regents/policies/administrative/Equity_Diversity_EO_AA.html
Mental Health and Stress Management
http://www.mentalhealth.umn.edu