PHYS4262: Solid State Physics

Spring 2024, T/Th 9:30-10:45 am, Howey S107

Instructor: Prof. Zhigang Jiang
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Office hours: by appointment

Textbook: *Steven H. Simon, "The Oxford Solid State Basics", 2013 (2019 & 2020 reprints)*
Lecture videos available at https://podcasts.ox.ac.uk/series/oxford-solid-state-basics
Reference book:
Steven M. Girvin and Kun Yang, "Modern Condensed Matter Physics", 2019
Supriyo Datta, "Electronic Transport in Mesoscopic Systems", 1995 (2003 reprint)

Course Description

In this course, we introduce basic concepts in solid-state physics so that the students can read the literature, understand seminars, and follow the ongoing research in the field. The course aims for a balance between the broadness and depth of selected topics to form a comprehensive view of solid-state physics within one semester. The course focuses on qualitative understanding rather than numerics.

Pre-requisites

You are expected to be familiar with classical and quantum mechanics and electricity and magnetism at the level of PHYS3201, PHYS3143, and PHYS3123. Statistical mechanics (PHYS4124) is encouraged but not required.

Course Goals and Learning Outcomes

Upon successful completion of this course, you should be able to

- Familiar with the language and methodology of solid-state physics
- Connect the macroscopic material properties with the microscopic structure
- Know the basic experimental techniques in solid-state material research
- Basic understanding of semiconductor physics, magnetism, and superconductivity

Grading

The class will be highly interactive, with all students expected to actively participate in the discussion. The grades will be based on class participation (10%) as well as homework (50%), midterm (15%), final exam (20%), and two mini-projects (5%). You can discuss homework problems with each other, but the solutions have to be executed and submitted individually.

Class participation will be graded based on the following metrics reflecting critical assessment of the class material:

5-min review presentation: students are expected to do a 5-min review presentation about the lecture videos posted at https://podcasts.ox.ac.uk/series/oxford-solid-state-basics. The presentation will be graded based on the student's effort in understanding the video contents.

Original comments: comments insightful and constructive, appropriate terminology used. Comments balanced between general impressions, opinions, and specific, thoughtful criticisms or contributions.

Mini-projects. We will carry out two mini-projects to showcase the virtualization and data analysis skills often used in solid-state physics research. The project details and due dates are TBA.

Grading scale: A = 90-100%, B = 80-90%, C = 70-80%, D = 60-70%, F = 0-60%

Course Content

Course content can be found at https://podcasts.ox.ac.uk/series/oxford-solid-state-basics.

Attendance: Each student should be aware of the regulations that are listed in the student handbook. The class attendance policy, which the Georgia Tech regulations say shall be at the discretion of the instructor, will be as follows: There will be no prescribed maximum number of unexcused absences for this class. However, if it is apparent that lack of attendance at class may be impairing a student's performance in the course, the instructor may require that the student not miss more classes, under the penalty of failing the course. Please consult http://catalog.gatech.edu/rules/4/ for details on what constitutes an excused absence and other aspects of the Georgia Tech Attendance Policy.

Statement of Intent for Inclusivity

As a member of the Georgia Tech community, I am committed to creating a learning environment in which all of my students feel safe and included. Because we are individuals with varying needs, I am reliant on your feedback to achieve this goal. To that end, I invite you to enter into dialogue with me about the things I can stop, start, and continue doing to make my classroom an environment in which every student feels valued and can engage actively in our learning community.

Academic Integrity: Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit either of these links (one, two). Any student suspected of cheating or plagiarizing on an assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Individuals with Disabilities: If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404) 894-2563 or this link, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations: At Georgia Tech we believe that it is important to continually strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See this link for an articulation of some basic expectations – that you can have of me, and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech, while in this class.

Support Services and Resources
In your time at Georgia Tech, you may find yourself in need of support. Below you will find some resources to support you both as a student and as a person.

Academic support

- Center for Academic Success http://success.gatech.edu
    - 1-to-1 tutoring http://success.gatech.edu/1-1-tutoring
    - Peer-Led Undergraduate Study (PLUS) http://success.gatech.edu/tutoring/plus
    - Academic coaching http://success.gatech.edu/coaching
- Residence Life's Learning Assistance Program https://housing.gatech.edu/learning-assistance-program
    - Drop-in tutoring for many 1000 level courses
- OMED: Educational Services (http://omed.gatech.edu/programs/academic-support)
    - Group study sessions and tutoring programs
- Communication Center (http://www.communicationcenter.gatech.edu)
    - Individualized help with writing and multimedia projects

Personal Support
Georgia Tech Resources

- The Office of the Dean of Students: http://studentlife.gatech.edu/content/services; **404-894-6367**; Smithgall Student Services Building 2nd floor
    - You also may request assistance at https://gatech-advocate.symplicity.com/care_report/index.php/pid383662?
- Counseling Center: http://counseling.gatech.edu; **404-894-2575**; Smithgall Student Services Building 2nd floor
    - Services include short-term individual counseling, group counseling, couples counseling, testing and assessment, referral services, and crisis intervention. Their website also includes links to state and national resources.
    - *Students in crisis may walk in during business hours (8am-5pm, Monday through Friday) or contact the counselor on call after hours at **404-894-2204**.*
- Students' Temporary Assistance and Resources (STAR): http://studentlife.gatech.edu/content/need-help
    - Can assist with interview clothing, food, and housing needs.
- Stamps Health Services: https://health.gatech.edu; **404-894-1420**
    - Primary care, pharmacy, women's health, psychiatry, immunization and allergy, health promotion, and nutrition
- OMED: Educational Services: http://www.omed.gatech.edu
- **Women's Resource Center: http://www.womenscenter.gatech.edu; 404-385-0230**
- **LGBTQIA Resource Center: http://lgbtqia.gatech.edu/; 404-385-2679**
- **Veteran's Resource Center: http://veterans.gatech.edu/; 404-385-2067**
- **Georgia Tech Police: 404-894-2500**