PHYSICS 412/512 – SOLID STATE PHYSICS & APPLICATIONS
SPRING 2022

Instructor: Patrick Vora, Rm 237 Planetary Hall, pvora@gmu.edu
Lectures: Friday, 10:30 – 1:00 pm
Location: Planetary Hall 112
Office Hours: Mondays, 1:00 – 3:00, Tuesdays 1:00 – 3:00, or by appointment
Prerequisites: C in PHYS 402 or B- in PHYS 502.
Required Text: *Introduction to Solid State Physics*, Kittel, 8th Edition
Recommended Text: *Solid State Physics*, Ashcroft and Mermin.

Course Goals:

In this course we will focus on understanding the theory of solid-state physics. This field is one of the most important in modern science and occupies a unique niche where fascinating physics intersects with revolutionary technologies. We will construct crystal lattices and understanding how the geometry and choice of atom in a lattice affect the mechanical, thermal, electronic, and optical properties of the solid. Emphasis will be placed on connecting the topics covered in class to technological applications and cutting-edge research.

512 versus 412:

Both 412 and 512 cover the same material, however the difficulty of the exams and homework for 412 students will be lower to account for the undergraduate nature of that course. 412 students may do 512 level work for extra credit.

Exam Etiquette:

Both the Midterm and Final are take-home exams, one week allowance. Open notes and open book. Do not look up solutions. The only valid excuse for missing an exam is a documented medical emergency.

Homework:

Homework assignments will be posted two weeks prior to their due date. Late HW is deducted half a letter grade each day. Obtaining solutions from the internet is a GMU Honor Code violation.

Grading Breakdown:

Homework: 30%, *Midterm:* 30%, *Final Exam:* 30%, *Attendance:* 10%

Grading Scale

A	A-	B+	B	B-	C+	C	C-	D	F
100 - 93.33	93.32-90	89.99-86.67	86.66-83.33	83.32-80	79.99-76.67	76.66-73.33	73.32-70	69.99-60	<60

Course Schedule, Format, and Pre-Lecture Reading:

Solid state physics is an incredibly broad topic that is learned best with through practice. Lectures will focus heavily on providing examples of the theory outlined in the assigned readings. For this method to be successful, please review the assigned readings prior to class. My optimistic assignments are below. They are subject to revision.

January 28th	Kittel, Ch. 1 Crystal Structures	HW1 assigned

February 4th	Kittel, Ch. 2 The Reciprocal Lattice and Scattering	
February 11th	Kittel, Ch. 3 Crystal Binding and Elasticity	HW1 due, HW2 assigned
February 18th	Kittel, Ch. 4 Phonons I	
February 25th	Kittel, Ch. 5 Phonons II	HW2 due, HW3 assigned
March 4th	Kittel, Ch. 6 Free Electrons	
March 11th	Spring Break – No Class	
March 18th	Kittel, Ch. 7 Energy Bands	HW3 due, Take-Home Midterm assigned
March 25th	Kittel, Ch. 8 Semiconductors	Take Home Midterm due, HW4 assigned.
April 1st	*Squid-wrangling 101* or Kittel, Ch. 9 Fermi Surfaces and Metals	
April 8th	Kittel, Ch. 10 Superconductivity	HW4 due, HW5 assigned
April 15th	Kittel Ch. 11 Diamagnetism and Paramagnetism	
April 22nd	Kittel Ch. 12 Ferromagnetism and Antiferromagnetism	HW5 due, HW6 assigned
April 29th	Buffer Class	
May 6th	Buffer Class	HW 6 due, Take-Home Final Exam assigned, due on May 13th

Safe Return to Campus:

All students taking courses with a face-to-face component are required to follow the university's public health and safety precautions and procedures outlined on the university Safe Return to Campus webpage (https://www2.gmu.edu/safe-return-campus). Similarly, all students in face-to-face and hybrid courses must also complete the Mason COVID Health Check daily, seven days a week. The COVID Health Check system uses a color code system and students will receive either a Green, Yellow, Red, or Blue email response. Only students who receive a "green" notification are permitted to attend courses with a face-to-face component. If you suspect that you are sick or have been directed to self-isolate, please quarantine or get testing. Faculty are allowed to ask you to show them that you have received a Green email and are thereby permitted to be in class.

Students are required to follow Mason's current policy about facemask-wearing. **As of August 11, 2021, all community members are required to wear a facemask in all indoor settings, including classrooms.** An appropriate facemask must cover your nose and mouth at all times in our classroom. If this policy changes, you will be informed; however, students who prefer to wear masks will always be welcome in the classroom.

Academic Accommodations:

Please see me and contact the Office of Disability Services at 703 993 2474. All academic accommodations must be arranged through that office. Students must inform the instructor at the beginning of the semester, and the specific accommodation will be arranged through ODS.

Academic Integrity:

GMU is an Honor Code university; please see the University Catalog for a full description of the code and the honor committee process. Honor Code: To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set forth this honor code: Student members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.