

Course Information

Course Number: PHYS 617
Course Title: Solid State Physics
Time: MW 4:10-5:25
Location: MPHY 107

Instructor Details

Instructor: Joseph Ross
Office: 448 MPHY (office upstairs in physics building) and B03 Cain (research lab)
Phone: office 979-845-3842; lab phone 979-845-7823
E-Mail: jhross@tamu.edu
Office Hours: M 1:15-3 (MPHY), T 1-2 (Cain), R 1-2 (Cain). Monday office hours will be in 448 MPHY, and on TR at my lab desk in B03 Cain -- watch for announcements in case these locations are changed later in the semester. Other times are not a problem, but for extended help I suggest to email me to arrange a time. I am also happy to answer emailed questions.

Course Description

This course covers the physics of periodic crystals and their symmetries; electronic properties and the development of band structures; lattice vibrations, phonons, and thermal properties. Also scattering of X-rays, electrons, and neutrons, electrical and thermal transport, magnetism, semiconductor devices, and recent developments in the physics of solids.

Prerequisites

Phys 606 (quantum mechanics) and Phys 607 (stat. mech./thermodynamics). Or, equivalent preparation with instructor approval.

Learning Outcomes

- Become familiar with symmetry properties of solids and resulting electronic effects.
- Gain an understanding of electronic properties of solids and band structures.
- Learn about vibrational properties of solids and phonon excitations.
- Develop an understanding of scattering properties of crystalline materials.
- Become familiar with magnetic and optical properties of materials, and recent developments in the field.

Textbooks

- Ashcroft and Mermin, "Solid State Physics".
- I will also plan to assign other readings from Michael Marder, "Condensed Matter Physics" (2nd ed., Wiley, 2010) to cover some more recent developments. Note that the Marder text is available to read at our Library – a search of the library catalog will yield a link.

Grading Policy

- Overall course grade will be based on the following scheme:
 - Homework (most weeks): 20%
 - Exam 1 & Exam 2: 25% each
 - Final exam: 30%
- Assignment of final grades according to point totals calculated using the percentages above will follow the scale, 80-100 A, 70-80 B, 55-70 C, 45-55 D, <45 F.

Late Work Policy

- Late homework turned in before the solutions are given out will be awarded $\frac{1}{2}$ credit. This does not apply in the case of homework that is late due to an excused absence (approved by me).
- After solutions are posted, it will still be possible to get $\frac{1}{3}$ credit for homework turned in if I am convinced that the work was not copied from the solutions.

Course Schedule

Exams include: Exam 1 (2/18) & Exam 2 (4/8) at 7:30 PM, and the final exam, May 2, 3:30 PM.

The lecture schedule is below, with sections of Ashcroft and Mermin (AM) and Marder indicated. The times spent on each topic are my best estimate and may change.

- week 1, 1-13 to 1-15: Overview; Classical and quantum electron gas. AM ch. 1-2.
- week 2, 1-22: Crystal classification and symmetries, reciprocal lattices. AM ch. 3-5; parts of Marder ch. 5.
(MLK day: Jan. 20)
- week 3, 1-27 to 1-29: Symmetry properties continued; x ray and related scattering; AM ch. 6-7.
- week 4, 2-3 to 2-5: Electrons in crystals and Bloch states; nearly-free electrons; AM ch. 8-9.
- week 5, 2-10 to 2-12: Tight-binding and localized/Wannier states; band-structures, spin orbit and symmetry properties. AM ch. 10-11.
- week 6, 2-17 to 2-19: Hartree-Fock theory; Density functional theory and modern band methods. AM ch. 17, 19, Marder ch. 9-10.
- Exam 1: Tues. February 18, 7:30 PM**
- week 7, 2-24 to 2-26: Semiclassical electron dynamics; Fermi surface measurement. AM ch. 12.
- week 8, 3-3 to 3-5: Harmonic crystal, classical lattice vibrations; AM ch. 21, 22.
- week 9, 3-17 to 3-19: Quantized lattice vibrations & phonons; AM ch. 23, 24.
- week 10, 3-24 to 3-26: Phonon interactions; Boltzmann theory and transport properties in metals; AM ch. 16, 26, Marder ch. 17-18.
- week 11, 3-31 to 4-2: Semiconductors and device-related physics; AM ch. 28, 29, Marder ch. 19.
- week 12, 4-7 to 4-9: Optical properties: parts of Marder ch. 20-22.
- Exam 2: Tues. April 8, 7:30 PM**
- week 13, 4-14 to 4-16: Optical behavior continued & ferroelectricity; Magnetic behavior of solids. AM ch. 27, 33-34; parts of Marder ch. 24-25.
- week 14, 4-21 to 4-23: Magnetism continued.
- week 15, 4-28: continuation or review.

Final Exam Friday May 2, 3:30 PM

University Policies

These are the required statements and standard policies for all Texas A&M Courses:

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to [Student Rule 7](#) in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor. Please refer to [Student Rule 7](#) in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" ([Student Rule 7, Section 7.4.1](#)).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" ([Student Rule 7, Section 7.4.2](#)).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See [Student Rule 24](#).)

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" ([Section 20.1.2.3, Student Rule 20](#)).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact the Disability Resources office on your campus (resources listed below) Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

Disability Resources is located in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu.

Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see [University Rule 08.01.01.M1](#)):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, a person who is subjected to the alleged conduct will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns related to mental and/or physical health in a confidential setting are encouraged to make an appointment with [University Health Services](#) or download the [TELUS Health Student Support app](#) for 24/7 access to professional counseling in multiple languages. Walk-in services for urgent, non-emergency needs are available during normal business hours at University Health Services locations; call 979.458.4584 for details.

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's [Title IX webpage](#).

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors influencing a student's academic success and overall wellbeing. Students are encouraged to engage in healthy self-care practices by utilizing the resources and services available through [University Health Services](#). Students needing a listening ear can call the Texas A&M Helpline (979.845.2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends for mental health peer support while classes are in session. The [TELUS Health Student Support app](#) provides access to professional counseling in multiple languages anytime, anywhere by phone or chat, and the 988 Suicide & Crisis Lifeline offers 24-hour emergency support at 988 or [988lifeline.org](#).

Students needing a listening ear can contact University Health Services (979.458.4584) or call the Texas A&M Helpline (979.845.2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends while classes are in session. 24-hour emergency help is also available through the 988 Suicide & Crisis Lifeline (988) or at [988lifeline.org](#).