P507A - Graduate Solid State Physics I

P438 - Undergraduate Solid State Physics II

Fall 2025

Professor: Rogério de Sousa

Lectures

Mon, Thur: 10:00am - 11:20pm, **in-person** at Clearihue Building A221.

Lectures will also be broadcast in zoom to accomodate special situations such as sickness and travel. However, videos of past lectures will not be made available except under special circumstances.

All lecture materials and assignments are available in the course's Brightspace:

https://bright.uvic.ca/d2l/home/425137

In particular, the lecture boards used in class and my handwritten notes will be made available online. These can be found under "Lecture boards" and "Lecture notes" in the content link.

How to ask questions about content, assignments, etc

Use our P507A Discussion Forum - Questions about the course, assignments, etc. It can also be accessed from this link:

https://bright.uvic.ca/d2l/le/425137/discussions/List

I will be giving up to 10% bonus to the final grade for students who actively participate in class and in the forum.

Each of the 5 assignments carries 1% bonus associated to forum participation (5% total). For each assignment, you can get:

- 0.25 % for each question you ask;
- 0.50 % for each question you answer correctly;
- 1.00 % for an answer that I judge to be exceptional for the class.

I will also give extra credit for class participation. This will amount to 5% on the final grade depending on whether I felt that you asked questions and interacted with me and the class during the lectures.

Whenever you have questions about the material taught, please send messages or questions using the UVic brightspace forum. That way all students will have access to our conversation.

If you wish to send me a private message, please send it to my UVic email: rdesousa@uvic.ca .

Office hour

Wednesdays, 2:00-3:00 pm in-person at Elliott 117. Students can also attend virtually by entering my Zoom room:

https://uvic.zoom.us/j/3056080360?pwd=OFJBS3VXY1J0bEVldnVjeHpSQ3J4QT09

Textbook

David W. Snoke, "*Solid State Physics: Essential Concepts*", 2nd Ed.
(Cambridge Univ. Press, 2020).

Some sections of the course will closely follow this book, so I strongly recommend its purchase.

Other suggested books:

- C. Kittel, "Introduction to Solid State Physics" (Wiley, New York, USA 8th Ed. 2000). Introductory textbook -- Should be used whenever any concept discussed in the advanced book is not clear.

- N.W. Ashcroft and N.D. Mermin, "Solid State Physics" (Saunders College, USA 1976). The most well-known graduate textbook, masterful description of the phenomenology. Excellent for experimentalists and phenomenological theorists. Starting from metals, establishes the basic theory of electrons and phonons in crystals. Several illustrative examples of real materials.

- P.M. Chaikin and T.C. Lubensky, "Principles of Condensed Matter Physics" (Cambridge University Press, Cambridge, U.K. 1995). The modern point of view, a favourite of the theory community. Establishes the general framework for describing the phases of matter, based on symmetries and conservation laws.

- J.M. Ziman, "Principles of the Theory of Solids" (Cambridge University Press, Cambridge U.K. 1972). Elegantly written, excellent chapter on transport properties.

- C. Kittel, "Quantum Theory of Solids" (Wiley, New York, USA 1963; Second Revised Printing 1987). This is the book that I like to use when I teach graduate Solid State II; it gives a solid introduction to simple microscopic models, their quantum excitations, and how to probe them experimentally.

- E.M. Lifshitz and L.P. Pitaevskii, "Statistical Physics Part 2", Vol. 9 of Landau and Lifshitz's Course of Theoretical Physics (Butterworth-Heinemann, Oxford U.K. 1980). Great description of Fermi liquid theory, and of the phenomenological (Landau) theory of phases of matter.

- Michael Tinkham, "Introduction to Superconductivity" (McGraw-Hill, New York, USA 2nd Edition 1996). Great introduction to all aspects of superconductivity.

Topics to be covered

Electronic states in molecules and crystals, how to model and read band structure.
Quasiparticles: Excitations in metals, semiconductors, and insulators. Electronic devices made of junctions between materials.
Classical theory of lattice acoustic and optical waves.
Quantum theory of lattice acoustic and optical waves, the phonon.
Interactions between quasiparticles and applications to electrical and thermal resistivity.

Grading scheme

This is a joint undergraduate/graduate course and also a multidisciplinary one. To make it accessible to students of all levels I take into account the background and experience of each student when grading their assignment.

Assignments

Assignments	50%
Final course project	50%

There will be 5 assignments. All assignments are already posted on this website, with noted due dates on Friday at 6pm, e.g. Assignment 1 is due Sept. 26.

New this year: Undergraduate students registered in PHYS438 get to choose one problem out of each assignment to not be graded. Or they can solve all problems and will get the problem with lowest grade not counting towards their assignment grade. The assignment grade will be rescaled appropriately.

The assignments will be graded by Teaching Assistant Sanker Timsina, stimsina@uvic.ca. Questions about the grading should be directed to the TA.

After the due date, I will book an appointment for the student to "defend" their solutions. This will occur at the regular office hour. The grade will be based on both the student's written work as well as their defense. This gives an opportunity for students to learn how to discuss and defend their ideas in a collaborative environment. It also gives a chance for them to correct themselves if they made a mistake in the written part.

Assignment solutions will be available online a few days after the student's appointment.

Final course project

There are three options for the final presentation: Students can present either (1) a recent paper from the literature; (2) a classic paper from the literature, describing a groundbreaking discovery; (3) a review paper or a book chapter, describing an important topic not covered in class. Note that the deadline for choosing the paper or topic is October 20th. Students are welcome to discuss possibilities with me, and I am glad to suggest papers or topics.

Final letter grade: UVic's percentage grading system

A+	90-100	Exceptional performance.
A	85-89	Outstanding performance.
A-	80-84	Excellent performance.
B+	77-79	Very good.
B	73-76	Good.
B-	70-72	Solid.
C+	65-69	Satisfactory.
C	60-64	Minimally satisfactory.
D	50-59	Marginal performance.
F	0-49	Unsatisfactory performance.

How to succeed

- Attend classes;
- Start thinking about your final course project as early as possible. What would you like to learn or expand upon? What drives your curiosity?
- Most important: **Attempt the assignments by yourself, without looking at solutions first**. If you can't solve a problem, talk to your classmates, or attend the office hour. However, it is extremely important that you attempt to solve the problem by yourself first. Experience shows that students who copy solutions from others usually perform very poorly in the exams and fail the course.
- Common mistake: Some students do not study/review the book/notes before attempting the assignments. Instead, they "pick" the notes trying to find the material needed to solve a particular problem. Such method does not work because it leads to fragmented knowledge; the student does not understand the connection between the topics. Moreover, studying that way does not prepare for the oral defense, because there will be no book or notes to "pick" during that time.
- Suggestion on how to study: Do a subject review before attempting the assignment, by reading the lecture boards, notes, book.
  Start by reading the assignment fully, and then attempt the problem that appears to be easier (it is okay to briefly go back to the board during the assignment).
- Solve extra problems in order to gain confidence that you mastered the material.