

Solid State Physics

3 credits

Bulletin Description: Crystal structure and binding, reciprocal lattices and x-ray diffraction, lattice vibrations, thermal properties, free electron model, band theory, magnetism, superconductivity. Prereq. Phys 485/685.

Instructor: Andrei Kryjevski, South Engineering 318D
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Meetings: Tue Th 11:00-12:15 **Office Hours:** W 14:00-16:00
South Engineering 221 (or by arrangement)

Goal: To master the foundations of solid state physics, including fundamental concepts and basic theoretical methods.

Student Responsibilities: Complete assignments on time. Come prepared for discussion. Ask questions and give feedback.

This course has no single textbook: attending lectures and taking notes is encouraged.

Literature:

N. W. Ashcroft, and N. D. Mermin, **Solid State Physics**, (Brooks/Cole, 1976)
J. M. Ziman, **Principles of the Theory of Solids**, 2nd ed. (Cambridge, 1979)
C. Kittel, **Introduction to Solid State Physics**, (Wiley, 2004)

Major Topics:

- **Translational Symmetry in Periodic Solids**
- **Properties of the Reciprocal Lattice:** Miller Indices
- **Lattice Dynamics:** Properties of Lattice Waves, Brillouin Zone, Lattice Specific Heat, Debye Approximation
- **Classification of solids:** Covalent, Molecular, Ionic Crystals
- **Diffraction by an Ideal Crystal**
- **Electron States:** Adiabatic Approximation, One-electron approximation
- **Bloch's Theorem**
- **Approximating Electron States:** Free Electrons, The Nearly-free-electron Model, The Tight-Binding Approximation
- **Quasi-classical Dynamics**
- **Electrons and Holes in Crystals, Band Structure:** Donor and Acceptor Levels in Semiconductors, Excitons
- **Electron Surface States** (if time permits)
- **Electron-electron Interactions:** Screening, Plasma Oscillations (if time permits)

Evaluation: homework assignments (60%); 2 exams (midterm 15%, final 25%)

Homework and Lateness: Group discussion of homework is strongly encouraged, but written solutions must be your own. Late work will be accepted with a 20% penalty/day until next class.

Grading: A: 90-100%, B: 70-89.9%, C: 60-69.9%, D: 50-59.9%, F: < 50%

The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at www.ndsu.edu/academichonesty.

Any students with disabilities who need accomodation in this course are encouraged to speak with the instructor as soon as possible to make appropriate arrangements.

Health and Safety Expectations:

While masks are not required as we begin the 2022 fall semester, NDSU administration has determined that faculty may request mask use in their classroom. *At this time, in this class wearing a mask is optional.*

Where possible, please spread out within the classroom, to maximize social distancing.

Attendance Expectations:

Please do not come to class

- if you are feeling ill, particularly if you are experiencing COVID-19 symptoms,
- if you are infected, during your five-day isolation period.

You will still need to complete the assignments, exams, reading, *etc.* necessary to meet class learning objectives.

If you were exposed to COVID-19, please follow CDC guidance. If you tested positive for COVID-19, please follow CDC guidance. See <https://www.cdc.gov/>.

Rapid and PCR testing is available at the Student Health Service by appointment Monday through Friday during regular business hours for both symptomatic and asymptomatic students. Free testing kits are available at the NDSU Bookstore, Library or Student Health Service.

If public health conditions and directives from NDSU administration change, I will provide updates in writing (via NDSU email).