

Materials Physics

Bulletin Description: This course provides the scientific foundation for interdisciplinary graduate study in materials/nanotechnology and condensed matter physics. It is structured around an equal broad treatment of “soft” materials (colloids, polymers and biology) and “hard” materials (metals, semiconductors and magnetism).

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Lectures: TTh 11:00-12:15 PM
South Engineering, Rm. 221

Office Hours: TTH 2:30-3:30 PM

Text: All lectures are created by the instructor and will be electronically posted with references. Recommended textbooks - Soft Condensed Matter (Richard A. L. Jones); Electronic Properties of Materials (Rolf E. Hummel). Electronic versions of both texts will be accessible through NDSU Blackboard, which is the recommended and endorsed approach.

Objectives: The objective of the course is to develop the quantitative methods that are critical to a working knowledge of materials and nanotechnology. The course also serves as an introduction to condensed matter physics. It assumes an understanding of classical calculus-based physics at the level of Physics 251-253, and then develops the necessary formalisms of statistical mechanics, quantum mechanics, continuum mechanics, condensed matter physics and chemical engineering within the context of materials and nanotechnology. Emphasis will be placed on a quantitative description of material properties directly relevant to measurement and applications, with regular connection to contemporary topics in materials and nanotechnology.

Grading: Grading will be based on a combination of attendance and homework (30 %), two midterm exams (20 % each for a total of 40 %), and a final exam (30%). The grading scale will be > 85 % (A), 75 - 85 % (B), 65 - 75 % (C), 55 - 65 % (D), < 55 % (F). Additional problems will be required for 681 students.

Topics: Week 1 (Jan. 10, 12); Intro, rheology, phase behavior (Jones, Ch. 2)
Week 2. (Jan. 17, 19); Phase transitions and statistical mechanics (Jones, Ch. 3)
Week 3. (Jan. 24, 26); Colloids (Jones, Ch. 4)
Week 4 (Jan. 31, Feb. 2); Polymers (Jones, Ch. 5)
Week 5 (Feb. 7, 9); Percolation, gelation and crystallization (Jones, Ch. 6-8)
Week 6. (Feb. 14, 16); Surfactants and block copolymers
Week 7 (Feb. 21, 23); Self-assembly and biology (Jones, Ch. 9, 10)/**Midterm I**

Week 8 (Feb. 28, March 2); Introduction to quantum mechanics (Hummel, Ch. 2-4)
Week 9 (March 7, 9); Band structure (Hummel, Ch. 5)
Week 10 (March 14, 16); Spring Break
Week 11 (March 21, 23); Metals (Hummel, Ch. 6-7)
Week 12 (March 28, March 30); Semiconductors (Hummel, Ch. 8)
Week 13 (April 4, 6); Optical properties I, **Midterm II** (Hummel, Ch. 10, 11)
Week 14 (April 11, 13); Optical properties II (Hummel, Ch. 12, 13)
Week 15 (April 18, 20); Phonons and thermal properties (Hummel, Ch. 18-22)
Week 16 (April 25, 27); Magnetism (Hummel, Ch. 14-17)
Week 17 (May 2, 4); The soft-hard interface & future directions
Week 18 (**Final**)

All work in this course must be completed in a manner consistent with [NDSU University Senate Policy, Section 335: Code of Academic Responsibility and Conduct](#).

Students must make arrangements with the Instructor if there is a need to accommodate missed lecture time or virtual lectures.

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 accommodations in this course are invited to share these concerns or requests with the instructor and contact the Disability Services Office as soon as possible. Veterans and student service members with special circumstances or who are activated are encouraged to notify the instructor as soon as possible and are encouraged to provide Activation Orders.

Your personally identifiable information and educational records as they relate to this course are subject to FERPA.