MNT 732, PHYS 481/681 (3 credits) **Spring 2020**

Physical Properties of Materials
Condensed Matter 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).

Instructor: Erik K. Hobbie, Batcheller Technology Center, Rm. 251
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Lectures: TTh 11:00-12:15 PM
South Engineering, Rm. 221

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

Text: Textbooks - Soft Condensed Matter (Richard A. L. Jones); Electronic Properties of Materials (Rolf E. Hummel)

Goals: 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.

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/questions specific to students enrolled at the 600/700-level will be indicated and can be completed at the 400-level for extra credit.*

Topics: Week 1 (Jan. 14, 16); Scales of force, length and time (Jones, Ch. 2)
Week 2. (Jan. 21, 23); Phase transitions and statistical mechanics (Jones, Ch. 3)
Week 3. (Jan. 28, 30); Colloids (Jones, Ch. 4)
Week 4 (Feb. 4, 6); Polymers (Jones, Ch. 5)
Week 5 (Feb. 11, 13); Gelation and crystallization (Jones, Ch. 6-8)
Week 6. (Feb. 18, 20); Surfactants and block copolymers
Week 7 (Feb. 25, 27); Self-assembly and biology (Jones, Ch. 9, 10)/**Midterm I**
Week 8 (March 3, 5); Introduction to quantum mechanics (Hummel, Ch. 2-4)
Week 9 (March 10, 12); Band structure (Hummel, Ch. 5)

Week 10 (March 17, 19); Spring Break
Week 11 (March 24, 26); Metals (Hummel, Ch. 6-7)
Week 12 (March 31, April 2); Semiconductors (Hummel, Ch. 8)
Week 13 (April 7, 9); Optical properties I, **Midterm II** (Hummel, Ch. 10, 11)
Week 14 (April 14, 16); Optical properties II (Hummel, Ch. 12, 13)
Week15 (April 21, 23); Phonons and Thermal Properties (Hummel, Ch. 18-22)
Week 16 (April 28, 30); Magnetism (Hummel, Ch. 14-17)
Week 17 (May 5, 7); The Soft-Hard Interface
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 Instrcutor if there is a need to accommodate missed lecture time.

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 or other special needs, who need special accommodations in this course are invited to share these concerns or requests with the instructor 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.