

**Physics 555: Structure of Matter (Graduate student version)
Spring 2019**

Particulars

Instructor	Prof. Michael Fitzsimmons
Office	JIAM 330
Office hours	MW 2:30-3:30 pm or by appointment
E-mail	mfitzsi1@utk.edu N.b., please allow 24 hours for a response. Please do not expect a response immediately before a homework assignment is due or a test is taken.
Class time	MWF 1:25-2:15 pm
Class location	Nielsen Physics building, room 304
Communication	Most communication will use the Canvas site.

Course Description and Goals

Overview: This course is an introductory course on the structure of matter and its relationship to materials properties. The principles governing assembly of crystals, glasses and polymers, *e.g.*, bonding, are discussed. Models of crystal structures will be built. The influence of structure on thermodynamic, electronic, magnetic and mechanical properties will be described.

The P555 and P342 (graduate and undergraduate) courses have been combined for this semester. Graduate students are expected to demonstrate additional proficiency than undergraduates. For example, by solving problems from more advanced textbooks, e.g., Kittel or Ashcroft and Mermin. Each graduate student will also present one 15 minute talk (including questions and answers) during the week of April 22 discussing a mutually acceptable contemporary paper relevant to the class.

- Objectives:**
- Identify important materials; names and chemical formulas.
 - Use crystallographic data bases to describe crystal structures of important materials and build models of them.
 - Understand how physical and chemical properties are related to crystal structure and microstructure.
 - Appreciate the engineering significance of structure-property relationships and how the relationships improve the quality of life.
- Outcomes:**
- Students should be able to write and balance chemical formulas.

- Students should be able to build crystal structures and describe how bond length, coordination and symmetry influence physical properties.
- Students should understand the influence of temperature, pressure, electric and magnetic fields, and change of composition on crystal structure.
- Students should understand how materials are chosen and designed for engineering applications.

Prerequisites: Previous exposure to basic quantum mechanics (*e.g.*, wave functions), thermodynamics and electricity and magnetism is desirable. I do not expect you to be expert on these topics. We will review as appropriate.

Required textbook: Trolier-McKinstry and Newnham, *Materials Engineering: Bonding, Structure and Structure-Property Relations* (ISBN 978-1-107-10378-8)

Other references: C. Kittel, *Introduction to Solid State Physics* (not required)
S. Simon, *The Oxford Solid State Basics* (not required)

Grading and Evaluation

Assignments: I will assign problem sets and/or lab exercises at regular intervals. The assignments will be turned in during class on the indicated date. If an assignment is turned in late, then I will reduce the mark for each 24-hour period it is overdue (unless you have made prior arrangements to turn the material in at a later time).

Midterm exam: About half way through the term we will have an in-class midterm exam, which will occur during one of the regular class meetings.

Final exam: We will have an in-class final exam at the end of the semester, which will occur during the assigned exam time.

Both exams will be open book; you will be allowed to bring the textbook, a calculator, writing implements, and a single-page single-sided sheet of notes. No other materials are permitted.

Grading: Your grade will be determined by the most favorable of the two distributions for you:
(1) 50%/20%/30% or
(2) 50%/10%/40% for assignments, midterm and final, respectively.
Your letter grade will be obtained from the chart.

Other information

Group work policy: I encourage students to work together and discuss the homework with each other. Such discussions are one of the most effective ways of assimilating the material. The work you turn in must be written up

by you and not a copy of your colleagues's or another source such as found on the Internet. Any homework assignment that is a direct copy of another person's work without attribution will count as plagiarism and will be dealt with accordingly. If you work in a group, then include a list of your colleagues.

For students with disabilities: If you require course adaptations or accommodations because of a documented disability, please contact the Office of Disability Services at 2227 Dunford Hall (telephone/TTY 865-974-6087; e-mail ods@utk.edu). This will ensure that you are properly registered for services. University Policy forbids me from making special accommodations without a letter from the Office of Disability Services.

Academic honesty and integrity: By taking this course you agree to the following statement: "An essential feature of the University of Tennessee, Knoxville is a commitment to maintaining an atmosphere of intellectual integrity and academic honesty. As a student of the university, I pledge that I will neither knowingly give nor receive any inappropriate assistance in academic work, thus affirming my own personal commitment to honor and integrity." Students are expected to perform all work in conformance with the University policies regarding Academic Honesty.

University civility statement: Civility is genuine respect and regard for others: politeness, consideration, tact, good manners, graciousness, cordiality, affability, amiability and courteousness. Civility enhances academic freedom and integrity. Civility is a prerequisite to the free exchange of ideas and knowledge in the learning community. Our community consists of students, faculty, staff, alumni, and campus visitors. Community members affect each other's well-being and have a shared interest in creating and sustaining an environment where all community members and their points of view are valued and respected. Affirming the value of each member of the university community, the campus asks that all its members adhere to the principles of civility and community adopted by the campus: <http://civility.utk.edu/>.