MSE 2001– Principles and Applications of Engineering Materials, Section C, Fall 2026
Georgia Tech, School of Materials Science and Engineering

Instructor: Prof. Wenshan Cai
Class Schedule and Location: Monday& Wednesday, 2:00 - 03:15 pm, Weber SST III Bldg., Rm. 2
Office Hours: Monday 3:40 - 4:30 pm, Pettit MiRC 213
Pre-requisites: D or better in Chem 1310 or Chem 1211K

Other Required Tools:

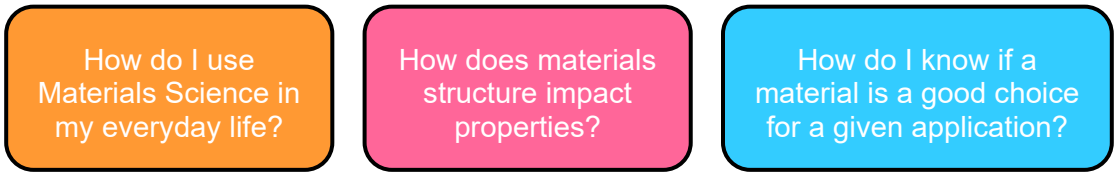
- Canvas – Course announcements, class notes, and HW assignments will be posted on Canvas
- Point Solutions – All students must be able to use Point Solutions responseware for this course to participate in in-class polling for participation credit. Please refer to the guide on Canvas "getting started with PointSolutions" to get set up.

Supplementary Texts (optional reading to enhance your learning):

- *Materials: Engineering, Science, Processing, and Design* by Ashby, *et al.* (2009).
  E-Book: https://learning.oreilly.com/library/view/materials-2nd-edition/9781856177436/
  (Sign in with your GT Email and verify with SSO)
- *Engineering Materials Science* by Ohring (1995).
  E-Book: https://www.sciencedirect.com/book/9780125249959/engineering-materials-science
- *Materials Science and Engineering: An Introduction* (any edition) by Callister and Rethwisch
  Available in GT Library Reserves or you can check online

Course Purpose

MSE 2001 will teach students the fundamental principles of process-structure-property relations to design engineering materials, including metals, ceramics, polymers, semiconductors, and composites. Students will learn the "vocabulary" of materials science and engineering to facilitate technical communication, broaden design vision, and establish a foundation for further study of the subject area (if desired).



Course Objectives

By the end of this course, students should be able to:

- Use an understanding of material properties to discuss and predict material performance upon subjection to external stimuli including mechanical stress, heat, electrical voltage, electrochemical potentials, magnetic fields, and/or optical illumination.
- Describe the structure of materials at the atomic and microstructural levels and explain how different structural features impact material properties.
- Describe and predict how defects will alter the properties of a material.
- Apply thermodynamic and kinetic principles to design materials processing schemes to achieve desired materials structures using tools such as phase diagrams and TTT diagrams.

Course Evaluation

- Participation: 10%
- Homework: 9%
- Projects: 6%
- 3 Exams: total 75% of grade; *nominally 25% each exam.*

However, the final exam is cumulative and provides opportunity for grade improvement. If the final exam grade is higher than either/both midterms, the final will be assigned a higher % of the overall grade. The student will receive the highest possible grade based on the following options:

Midterm 1 *material properties and classification*	25	15	25	15
Midterm 2 *material structure*	25	25	15	15
Final exam (cumulative) *properties, structure, and processing*	25	35	35	45

Course Grades

Score	89.5% - 100%	79.5% - 89.4%	69.5% - 79.4%	59.5% - 69.4%	≤ 59.5%
Grade	A	B	C	D	F

Student Expectations:

- Classes will involve active engagement; all students are expected to participate and will be actively called upon for discussions and responses. Attendance without engagement will not receive participation credit. *Listening to music, etc on headphones/earbuds is NOT allowed during class as it inhibits active participation.*
- Polling software will be used to determine attendance grades and to facilitate whole-class engagement in practice questions.
- Electronic devices (laptops, cell phones, etc.) are allowed as long as they do not audibly or visually disrupt the class and do not inhibit active involvement. (Policy subject to change.) Using such devices is encouraged for taking notes. All of these devices are banned during exams.
- During all course interactions, students are expected to act in a professional manner that is courteous to the instructor and their fellow classmates.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards and should refer to the Institute's policy on academic integrity found in the code of conduct (http://www.policylibrary.gatech.edu/student-affairs/code-conduct). It is the instructor's understanding and expectation that students neither give nor receive any unauthorized aid on exams or quizzes, including the use of unauthorized notes or other information on an electronic device. All cell phones, tablets, calculators, and laptops are banned during exam periods. While group discussion is encouraged on homework assignments, individuals are expected to submit their own version of the homework assignment. All cases of academic misconduct will be submitted to Office of Student Integrity.

Instructor's Commitment

You can expect your instructor to be courteous, punctual, well-organized, and prepared for lecture and other class activities; to answer questions clearly; to be available during office hours or to notify you beforehand if she is unable to keep them; to provide a suitable guest lecturer or lecture recording if she is traveling; and to grade all tests and assignments uniformly and objectively.

Students with Disabilities

The Office of Disability Services serves Georgia Tech students with documented qualifying disabilities. In accordance with Georgia Tech Policy, "Reasonable accommodations are provided to self-identified students with disabilities who meet the academic and technical standards requisite to admission or participation in the program of study. Consideration may be given to the substitution or modification of certain course requirements as long as such changes do not detract from the quality of the educational experience and the changes remain within the accreditation criteria for the degree program." More information can be found here: https://disabilityservices.gatech.edu. If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at 404.894.2563 or via their website as soon as possible to discuss your needs and obtain an accommodation letter. Self-identified students with disability should make an appointment with the instructor as soon as possible to discuss your learning needs, so that suitable arrangements can be organized.

Approximate Course Outline

I. Introduction to Materials Science

History / How does materials science fit in with other disciplines?

II. Properties of Materials

Economics of Materials
Mechanical Properties
Thermal Properties
Electronic Properties
Magnetic Properties
Optical Properties
Chemical Properties / Materials Degradation
Classifying Materials

Exam 1

III. Structure of Materials

Structure of an Atom
Atomic Bonding in Materials
Crystal Structure
Symmetry and Unit Cells
Close Packing
Lattice + Basis
Miller Indices
X-ray diffraction

Exam 2

III. Non-crystalline materials

Amorphous Solids: Inorganic
Polymers: structure, properties, and processing

IV. Defects in Materials

Defect classification
Dislocations & Strength of Materials
Fracture & Failure

V. Materials Processing

Phases & Phase Transformation
TTT Diagrams
Phase Diagrams

Comprehensive Final Exam