

MSE 523

Structural and Mechanical Properties of Materials

Fall 2019

Lectures	Mon Wed 12:15 pm – 1:30 pm ECG 236	Grading	
Instructor	Prof. Qing Hua Wang Office hours: Tues 4:00 – 5:15 pm		Homework 20% Midterms (3 x 20%) 60% Project 20% Surveys (bonus) 1.5%

Course description

This course aims to link the structure of materials (including crystal structure and defect structure) with their properties. Students will learn basic concepts in symmetry, crystal structure, diffraction, crystal imperfections, tensors, tensor properties of materials, and mechanical behaviors such as elasticity, fracture, and creep.

Learning objectives

After taking this course, students will be able to: describe the classification of crystal structures by their symmetry; relate materials properties to crystals by their symmetry and tensor descriptions; relate crystal structures to diffraction and microscopy data; understand types of structural defects and their effects on mechanical properties; interpret and analyze structure and mechanical property measurements; and read and assess research literature related to and making use of materials structures and properties.

Textbooks and resources

Textbooks are optional, but suggested as useful resources. Additional readings, handouts, and resources will be provided through the course either in class or on Canvas.

[D&M] Marc De Graef and Michael E. McHenry, Structure of Materials, 2nd edition

[Nye] J.F. Nye, Physical Properties of Crystals

[M&C] M. Meyers and K. Chawla, Mechanical Behavior of Materials, 2nd edition

Grading Policies and Details

1. Homework (6 assignments, drop lowest score, 5 x 4% each, total 20%)

Homework assignments will have a combination of quantitative problem solving and qualitative questions and are due in class at the start of lecture at 12:15 pm. Solutions will be posted to Canvas after all assignments are handed in.

2. Midterms (3 x 20% each)

Midterms will be held during class periods, with a review session in class before each midterm. They will be closed book and closed notes, but reference sheets of equations and data will be provided, and calculators will be allowed. You can also bring a 1-sided 8.5"x11" sheet of your own notes. More details will be announced later in the semester. Questions will be both quantitative and qualitative.

3. Final project (20%)

The final project will be a **choice** of an in-class **presentation** or a **written paper** in the form of a mini literature review on a topic of your choice relating to some element of the course topics. You will work in teams of three (3) students to submit a project outline with topic description and list of references, which will be graded, and then either the in-class presentation or the paper. The grading will also include peer review of presentations. Additional details for the project will be discussed later in the semester.

4. (Bonus) Surveys (4 of 5 surveys, 0.375% each, 1.5% maximum bonus)

Surveys will be held at the start and end of the course, and after each midterm to gauge their effectiveness and to help you reflect on your experiences of them. They will be counted for completion for bonus points, but your answers will be anonymous.

5. Late Submissions

Late assignments (homework and project) will be subjected to a 20% penalty per day (24 hrs), up to 3 days, after which they will not be accepted.

6. Requests for Regrading

Homework assignments and midterms can be re-graded by request, but the entire work will be subject to review, not just the particular question in dispute. Errors in adding up or recording points can be fixed immediately.

7. Final grades

The final letter grades will be assigned according to the following general scale for the minimum values needed at each grade. There will be +/- grades (e.g. B-, B, B+), but the cut-offs between different +/- grades may change. You can download a spreadsheet on Canvas to help you estimate your grade.

≥ 100	A+
≥ 90	≥ A-
≥ 80	≥ B-
≥ 70	≥ C-
≥ 60	≥ D
0-59	F

Class policies

1. Communications

Announcements, handouts, lectures slides, homework, midterm information, and project file submissions will be handled through the **Canvas** site for this course. We will use the integrated **Piazza** Q&A board for this course for you to ask questions about the course and help each other with answers. You are also encouraged to come to office hours to ask questions and receive help.

2. Classroom Behavior

Cell phones should be silenced during class to avoid causing distractions. The use of recording devices is not permitted during class. Any violent or threatening conduct by an ASU student in this class will be reported to the ASU Police Department and the Office of the Dean of Students.

Please do not eat or drink anything that is disruptive to the class. Laptops and tablets can be used for taking notes. If you need to arrive late or leave early, please do so quietly without disrupting the class. Please treat all members of the class including instructor, grader, and students with respect and courtesy.

3. Academic integrity and Copyright Laws

Academic Integrity

Students in this class must adhere to ASU's academic integrity policy, which can be found at <https://provost.asu.edu/academic-integrity/policy>. Students are responsible for reviewing this policy and understanding each of the areas in which academic dishonesty can occur. In addition, all engineering students are expected to adhere to both the ASU Academic Integrity [Honor Code](#) and the Fulton Schools of Engineering [Honor Code](#). All academic integrity violations will be reported to the Fulton Schools of Engineering Academic Integrity Office (AIO). The AIO maintains record of all violations and has access to academic integrity violations committed in all other ASU college/schools.

Specific academic integrity rules for this class are that these policies apply to all homework assignments, midterms, and project. Any violations such as plagiarism, cheating, misrepresentation of work, etc., will be reported to the dean of students and will also result in a zero score for the assignment, and may result in a failing grade for the course.

Copyright

Course content, including lectures, are copyrighted materials and students may not share outside the class, upload to online websites not approved by the instructor, sell, or distribute course content or notes taken during the conduct of the course (see [ACD 304-06](#), "Commercial Note Taking Services" and ABOR Policy [5-308 F.14](#) for more information).

You must refrain from uploading to any course shell, discussion board, or website used by the course instructor or other course forum, material that is not the student's original work, unless the students first comply with all applicable copyright laws; faculty members reserve the right to delete materials on the grounds of suspected copyright infringement.

4. Policy against threatening behavior, per the Student Services Manual, SSM 104-02

Students, faculty, staff, and other individuals do not have an unqualified right of access to university grounds, property, or services. Interfering with the peaceful conduct of university-related business or activities or remaining on campus grounds after a request to leave may be considered a crime. All incidents and allegations of violent or threatening conduct by an ASU student (whether on- or off-campus) must be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students.

5. Disability Accommodations

Suitable accommodations will be made for students having disabilities. Students needing accommodations must register with the ASU Disabilities Resource Center (DRC) (<https://eoss.asu.edu/drc>) and provide documentation of that registration to the instructor. Students should communicate the need for an accommodation in sufficient time for it to be properly arranged.

6. Absence and Make-Up Policies

Accommodations will be made for religious observances provided that students notify the instructor at the beginning of the semester concerning those dates. Students who expect to miss class due to officially university-sanctioned activities should inform the instructor early in the semester. Alternative arrangements will generally be made for any examinations and other graded in-class work affected by such absences. The preceding policies are based on [ACD 304-04](#), "Accommodation for Religious Practices" and [ACD 304-02](#), "Missed Classes Due to University-Sanctioned Activities."

That is, if you need to reschedule a midterm or presentation due to these reasons or due to personal emergencies, please contact me as soon as possible. Make-up midterms and presentations will not generally be given for any other reasons.

7. Harassment and Sexual Discrimination

Arizona State University is committed to providing an environment free of discrimination, harassment, or retaliation for the entire university community, including all students, faculty members, staff employees, and guests. ASU expressly prohibits discrimination, harassment, and retaliation by employees, students, contractors, or agents of the university based on any protected status: race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, and genetic information.

Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at <https://sexualviolenceprevention.asu.edu/faqs>.

Mandated sexual harassment reporter: As an employee of the University I am considered a mandated reporter and therefore obligated to report any information regarding alleged acts of sexual discrimination that I am informed of or have a reasonable basis to believe occurred. ASU Counseling Services, <https://eoss.asu.edu/counseling>, is available if you wish to discuss any concerns confidentially and privately.

8. Syllabus and Schedule Changes

The syllabus and schedule of lecture topics may change slightly during the semester. Any updates or changes in schedule will be posted on Canvas and announced in class. The key dates (midterms, homework deadlines, project deadlines) will stay the same, but covered topics may be shifted depending on the classroom pace.

Course Schedule

Date	Lec	Topics	Suggested readings	Evaluations
8/26/19	M	1	Syllabus; Context and motivation of course; intro to structure and properties	D&M Ch. 1; M&C Ch. 1 (HW 1 assigned)
8/28/19	W	2	Crystals: definition, Bravais lattices, Miller indices	D&M Ch. 3, 4, 5; M&C Ch. 1
9/2/19	M	<i>Labor Day – No class</i>		
9/4/19	W	3	Diffraction and reciprocal space - part 1	D&M Ch. 11, 12, 14 HW 1 due
9/9/19	M	3	Diffraction and reciprocal space - part 2	D&M Ch. 11, 12, 14 (HW 2 assigned)
9/11/19	W	4	Symmetry operations	D&M Ch. 8
9/16/19	M	Review for Midterm 1		HW 2 due
9/18/19	W	MIDTERM 1		
9/23/19	M	5	Midterm 1 solutions; Discuss project Point groups	D&M Ch. 8, 9 (Project assigned), (HW 3 assigned)
9/25/19	W	6	Plane groups, space groups, crystallography tables	D&M Ch. 6, 10
9/30/19	M	7	Introduction to stress and strain, tensors, and symmetry	M&C Ch. 2; Nye Ch. 1, 2 Project sign-ups due
10/2/19	W	8	Stress and strain tensors	Nye Ch. 5, 6 HW 3 due
10/7/19	M	9	Conductivity, polarization, magnetic susceptibility tensors	Nye Ch. 3, 4, 9, 11 (HW 4 assigned)
10/9/19	W	10	Piezoelectricity and elasticity tensors	Nye Ch. 7, 8
10/14/19	M	<i>Fall Break – No class</i>		
10/16/19	W	Review for Midterm 2		HW 4 due
10/21/19	M	MIDTERM 2		
10/23/19	W	Midterm 2 solutions; how to do presentations		
10/28/19	M	11	Plasticity and yield	M&C Ch. 3 Project outline due
10/30/19	W	12	Point and line defects	M&C Ch. 4 (HW 5 assigned)
11/4/19	M	13	Interfacial and volume defects	M&C Ch. 5
11/6/19	W	14	Deformation, slip, strengthening mechanisms	M&C Ch. 6, 10
11/11/19	M	<i>Veterans Day – No class</i>		
11/13/19	W	15	Fracture	M&C Ch. 7, 8, 9 HW 5 due
11/18/19	M	16	Creep	M&C Ch. 13 (HW 6 assigned)
11/20/19	W	17	Fatigue	M&C Ch. 14
11/25/19	M	PRESENTATIONS		
11/27/19	W	PRESENTATIONS		
12/2/19	M	PRESENTATIONS		HW 6 due
12/4/19	W	Review for Midterm 3		
12/6/19	F	PAPERS DUE		
12/11/19	W	(12:10 - 2:00 PM) MIDTERM 3		