

**Engineering Sciences 190**  
**Introduction to Materials Science and Engineering**  
**Spring Semester, 2024**

**Pierce 209**

**9 AM - 10:15 AM Tuesday/Thursday**

**Instructor:** Prof. Xin Li  
Office: 210 Pierce Hall  
lixin@seas.harvard.edu

The lecture is held in Pierce 209, but it will also be recorded and uploaded on Canvas after each lecture.

Weekly office hour: T/Th 10:30 – 11:30am, W 2:30 – 3:30pm  
*You can also email me to schedule a personal meeting in my office or on Zoom.*

**Sections and Office Hours:**

**TF Sections:**

T 3 – 4pm MD G125

Th 4:30 – 5:30pm Cruft 309

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**TF Office Hours:**

M 3 – 4pm Pierce 301

F 1-2pm MD G125

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**Course Description:** Introduction to the structure, properties, and applications of materials. Crystal structure and defects. Structure property relations and crystal symmetry. Phase transformations, phase diagrams, diffusion. Principles and examples for a variety of engineering applications of electrical, optical, and especially energy storage and conversion materials.

**Recommended Prep:** Math 21a and 21b (or equivalents).

**Recommended readings (You don't have to buy, as all the related chapters will be on Canvas):**

Introduction to Materials Science for Engineers, 8<sup>th</sup> edition, James F. Shackelford  
Properties of Materials, Robert E. Newnham  
Elements of X-ray diffraction, B. D. Cullity and S.R. Stock, 3<sup>rd</sup> edition  
Electronic properties of materials, Rolf E. Hummel, 4<sup>th</sup> edition  
Introduction to solid state physics, Charles Kittel  
Electrical, Electronic and magnetic properties of solids, Springer series in materials science Vol. 207

### **Course Administration:**

*Lecture, Mailing List, and COVID related policies*

This course uses the Canvas online system for notification and posting course materials to the students. Students in isolation due to COVID can schedule the Zoom lecture with me.

#### *Assignments*

There are approximately 8 assignments throughout the semester, plus 2 lab reports.

#### *Midterm Exams*

Two written take-home exams. Open book. But students are not supposed to search online. Students are also not supposed to discuss with other people in-person or online.

Tentatively scheduled:

Tuesday, Mar 19<sup>th</sup>

Tuesday, April 23<sup>th</sup>

#### *Final Exam*

The final exam is a course project that includes a final presentation (~ 10 min) on April 29, and a course paper that is due on May 03 (2 pages). More details will be provided during the semester.

#### *Labs*

ES 190 is a course also supported by the Active Learning Labs at SEAS. To be able to participate in lab activities, you will need to finish the online AL Labs General Safety Training after your enrollment before doing any labs. Lab instructions will be posted online.

### **Grades**

Activity	Percentage
Assignments	25%
Exam 1	25%
Exam 2	25%
Final Exam (Course Project)	25%

### **Academic Honesty**

Cheating is prohibited. Harvard's academic honesty policy can be found at:

[http://static.fas.harvard.edu/registrar/ugrad\\_handbook/current/chapter2/academic\\_dishonesty.html](http://static.fas.harvard.edu/registrar/ugrad_handbook/current/chapter2/academic_dishonesty.html)

## **Approximate Course Outline**

1. Atomic bonding and crystalline structure
2. Symmetry of crystalline materials
3. Tensors and physical properties
4. Defects in crystalline and non-crystalline structures
5. Diffusion
6. Mechanical property
7. Thermal property
8. Energy storage materials (Li-ion batteries, next generation batteries, etc.)
9. Phase diagram
10. Electronic materials
11. Optical materials
12. Energy conversion materials (Silicon based solar cell materials)
13. Superconductive materials