

UNIVERSITY OF ILLINOIS  
College of Engineering  
Department of Materials Science and Engineering

**MSE 487: MATERIALS FOR NANOTECHNOLOGY**  
Spring 2023

**Instructor:** Prof. Paul Braun, 2017 MRL, 244-7293, pbraun@illinois.edu  
**Lecture:** Tu-Th 9:30-10:50 am, 158 Loomis  
**Office Hours:** By appointment  
**Teaching Assistant:** Peilin Lu, 140 ESB, peilin2@illinois.edu  
**Office Hours:** Tues., 1-2 pm or by appointment  
**Website:** <https://canvas.illinois.edu/>

**Extensive readings from the current literature will be assigned over the semester.**

Course Outline: (note, may revise as the course progresses)

*Part I. Introduction to Nanoscience and Nanotechnology*

*Part II. Physical and Chemical Properties at the Nanoscale*

- Bonding and crystal structure
- Thermodynamics at the nanoscale
- Electronic properties
- Magnetic properties
- Optical properties
- Mechanical properties

*Part III. Synthesis and Characterization Methods*

- Thin film growth
- Self-assembly and self-organization
- Photolithography
- Examples of applications of characterization methods

*Part IV. Selected Applications of Materials for Nanotechnology (tentative)*

- Carbon nanotubes
- Metallic and semiconductor nanocrystals
- Ferroelectrics and multiferroics
- Nanostructuring by severe plastic deformation
- Nanomechanics of biological systems

Grading: **1000 points total (subject to revision if number of assignments changes).**

**420 points:** 2 homeworks (60 pts. each) and 5 critical paper reviews (60 pts. each).

**200 points:** breakout group presentations (20 pts. each).

**50 points:** Final presentation attendance.

*3 Credit Option:* Term paper (**330 pts.**)

*4 Credit Option:* In-class research proposal presentation (**180 pts.**) & written proposal (**150 pts.**)

Note: Students are expected to participate in guest lectures, breakout group discussions, and final presentations. Attendance is mandatory on those days. Attendance at final presentations worth 50 pts. spread over the presentation day(s).

## COURSE ASSIGNMENTS

### 1. Homework assignments (first two weeks).

### 2. Critical reviews (starting week 3).

- A list of published papers will be assigned every other week for review. You will select one paper from the list provided and submit a written critical review of the paper, adding personal comment(s) prompted by your reading, and supported by some additional source (e.g., papers cited by the article you summarized, papers you found by searching the literature...). A template to review the paper will be provided.

### 3. Review assessments (starting week 4).

- You will submit a written critical assessment of two of your classmate's reviews, including an overall grade, and personal comment(s) prompted by your reading supported by literature sources. Failure to complete this will result in you being assigned a grade of "0" for your review. Should your assessment be superficial or low quality, I reserve the right to significantly reduce your grade on your review.

### 4. Group discussion and in-class reports (Starting week 3).

- You will be divided into fixed groups of 5-10 students to critically analyze specific components of scientific research throughout the semester. Content for each round will be drawn from a recent guest lecture or an assigned paper important to nanotechnology (separate from the review process).
- Following the breakout time (first ~30 min of lecture on the indicated dates) your team will be responsible for leading in-class discussion on a different element of the assigned work (prior work, background and motivation, methods, results, or discussion) and you will create a short presentation to report in class. Rotating delegates will be chosen from each group for each presentation, ensuring every student will lead at least once.
- Teams will be asked to perform peer evaluation several times during the semester; if individuals on a team are not participating fully, points will be deducted from their scores (hopefully this will not need to happen).

### 5. Term paper (3-credit option) or Research proposal (4-credit option).

- Each student will prepare and submit either a term paper (3-credit option) or a research proposal (4-credit option). The paper/proposal should consist of 10 to 15 pages of text plus figures and references on a topic of your choice. Note, "science" focused papers/proposals are generally better than "technology" focused proposals.
- All thesis MS and PhD students must list their research advisor's name on their research proposal. The proposal must be different than your or your group's current research.
- Pre-proposal (graduate students) or term paper abstract (undergraduate students) will be due by **Thursday March 2rd**.
- Term papers will be due on Canvas by the start of class on **Tuesday May 2rd** (last day of class), but will be accepted without penalty until noon on the day scheduled for the course final, **Thursday May 11th**
- Research proposals will be due by noon on Canvas on the day scheduled for the course final, **Thursday May 11th**
- There will be no final exam.