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

MSE 487: MATERIALS FOR NANOTECHNOLOGY
3-credit and 4- credit option available
Spring 2026

Instructor: Prof. Chris Anderson, 270 MRL, cpand@illinois.edu
Lecture/Contact hours: Tu-Th 9:30-10:50 am, 305 Materials Science & Engineering Building. In person.
Duration: This is a full semester, 16 week class.
Office Hours: By appointment. Please email to schedule any time. To discuss any aspect of the class.

Teaching Assistant: Puquan Pan, 474 MRL, puquanp2@illinois.edu
Office Hours: By appointment. Please email to schedule. The TA is primarily in charge of grading and managing assignments and can answer questions pertaining to that.

Website: https://canvas.illinois.edu/courses/64961

Extensive readings from the current literature will be assigned over the semester.
Course Outline: (may revise as the course progresses)

Lecture 1: Nanotechnology, CNTs, Quantum Dots
Lecture 2: Microscopy at the nanoscale, x-ray, optical (virtual demos)
Lecture 3: Electron microscopy, APT (virtual demos)
Lecture 4: Scan probe microscopy (virtual demos)
Lecture 5: Environmental impacts
Lecture 6: Health impacts
Lecture 7: Nanoelectronics
Lecture 8: Nanolithography
Lecture 9: Nanomagnetics
Lecture 10: Nanophotonics
Lecture 11: Quantum nanoscience
Lecture 12: Mechanics and the nanoscale
Lecture 13: Self-assembly
Lecture 14: Fraud and misconduct, ethics

Grading: **1000 points total.**

300 points: 5 Critical paper reviews (50 pts. each), and assessments (10 pts. each)
300 points: 4 Breakout group presentations (75 pts. each).
20 points: Final presentation/Guest lecture attendance.
50 points: Class participation.
3 Credit Option: Term paper (**300 pts.**) Abstract (**30 pts.**)
4 Credit Option: In-class research proposal presentation (**100 pts.**) & written proposal (**200 pts.**). Abstract (**30 pts.**)

- Students are expected to participate in guest lectures, breakout group discussions/presentations, and final presentations. **Attendance is mandatory on those days and is tracked.** Attendance at the final presentations/guest lectures is worth *20 pts.* Attendance during guest lectures (if any) will be weighted heavily, these faculty have taken time out of their busy schedules to be with us.
- Participation in lecture will be determined by the instructor by tracking engagement with digital and in-person activities (i.e. speed-reads) and is worth *50 pts* spread over the semester.
- Grades will be assigned using the following scale:

A+: 98 and above
A: 94-97
A-: 90-93

B+: 87-89
B: 83-86
B-: 80-82

C+: 77-79
C: 73-76
C-: 70-72 D+: 67-69
D: 60-66
F: 59 and below

COURSE GOALS/LEARNING OBJECTIVES

Our goal is to develop broad literacy in the fields of nanotechnology, nanoscience, and nanomaterials. Summarization, reading, and presenting skills will be honed with respect to reviewing journal articles. The evaluation of literature articles and the referee process will be introduced and practiced. Each class, students will rapidly review a literature paper which is followed by a quiz worth participation points. Students will explore the societal and ethical implications of nanotechnology. Students will develop new research proposals in written form. The combination of these goals and skills prepares students for successful careers in industry and graduate work.

PREREQUISITES

Physics 214. For this class, students should have a basic understanding of electricity, light, waves, quantum, solid-state physics/electronic materials/semiconductors. Please contact the instructor if you have questions. Equivalent classes in other departments may be accepted.

ABSENCE POLICY

If you know that you will be absent from class for religious or other reasons that can be known in advance, please let me know. If you must miss class due to sickness or family emergencies, please let me know. Remember that attendance/participation is a part of your grade.

LEARNING MANAGEMENT SYSTEM

This course requires students use the Canvas course website often. All assignments (unless otherwise noted) will be submitted using Canvas. Lecture slides and other resources will be posted on Canvas. If you have issues accessing Canvas, please contact the instructor.

COURSE ASSIGNMENTS

1. **Critical reviews (starting week 3)**

- A list of about ten published papers will be assigned to each student to review. You will select one paper of your choice from the list provided each review assignment. There are five critical reviews, such that you can pick your five favorite/most interesting out of the ten. You will 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. Examples are found on Canvas. **Each is worth 50 pts.** If one of the papers has already been presented on or covered in class, please do not choose it.

  o This assessment mirrors the skillset needed to referee papers and synthesize scientific literature.

2. **Review assessments (starting week 4)**

- You will submit a written critical assessment of your classmate's reviews, including an overall grade, and personal comment(s) prompted by your reading supported by literature sources. **This is worth 10 pts**.

  o This assessment simulates the role of a journal editor and encourages further reading of literature.

3. **Group discussion and in-class reports (starting week 2)**

- You will be divided into a fixed groups of 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).*

- Your team will be responsible for leading in-class discussion of an assigned paper, and should include prior work, background and motivation, methods, results, etc. You should be researching relevant papers, discussing the techniques, contextualizing/explaining the results. You will need answer questions about the paper. See Canvas for team assignments and schedule below.

  o You are responsible for staying on time, setting up A/V systems without delay, etc. Failure to do so will result in points off. **Each presentation should be 20 minutes.** We will leave time for questions.

- Teams will be asked to perform peer evaluation 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).

  o These activities develop teamwork and presentation skills.

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

- **There are two credit options for this course. The 3-credit option is intended for undergraduates, and the 4-credit option is intended for graduates. <u>The only difference is in the format of the final paper.</u>**
- 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. Examples are on Canvas. **The rubric is posted, please follow it!**
  o **Terms papers are more of a review/overview style of a specific sub-area.**

- o **Proposal papers need to be original research directions, supported by previous literature.**
  - o This proposal and paper assessment develops scientific writing skills.
- All thesis MS and PhD students must list their research advisor's name on their research proposal or term paper. The paper 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 **Tuesday April 7.**
- Abstracts should be less than 500 words and contain *appropriate citations* (not included in word limit). There are examples on Canvas.
- Term papers/proposals will be due on Canvas the day scheduled for the course final, **Tuesday May 12.**
- **Presentations on the research proposal for 4 Credit students will occur during the last two to three days of class.**
  - o Presentations are 20 minutes and 5 minutes for questions.
  - o Develops presentation skills and defending/explaining scientific ideas.

- **<u>There will be no final exam.</u>**

MSE 487 Course Schedule (subject to revision)

Week 1
January 20:   Lecture 1
January 22:   Lecture 2 Breakout papers assigned

Week 2
January 27:   Lecture 3
January 29:   Breakout groups (Groups 1-3, presentation 1), Breakout papers assigned

Week 3
February 3:   Lecture 4 Critical review 1 due
February 5:   **TA-** Breakout groups (Groups 4-6, presentation 1), Breakout papers assigned

Week 4
February 10:   Lecture 5 Critical review 1 assessments due
February 12:   Breakout groups (Groups 7-9, presentation 1), Breakout papers assigned

Week 5
February 17:   Lecture 6 Critical review 2 due
February 19:   Breakout groups (Groups 1-3, presentation 2), Breakout papers assigned

Week 6
February 24:   Lecture 7 Critical review 2 assessments due
February 26:   Breakout groups (Groups 4-6, presentation 2), Breakout papers assigned

Week 7
March 3:   Lecture 8 Critical review 3 due
March 5:   Breakout groups (Groups 7-9, presentation 2), Breakout papers assigned

Week 8
March 10:   Lecture 9 Critical review 3 assessments due
March 12:   Breakout groups (*New* groups 1-3, presentation 1), Breakout papers assigned

March 14-22: SPRING BREAK

Week 9
March 24:   Breakout groups (*New* groups 4-6, presentation 1), Breakout papers assigned
March 26:   Lecture 10 Critical review 4 due

Week 10
March 31:   Breakout groups (*New* groups 7-9, presentation 1), Breakout papers assigned
April 2:   Lecture 11 Critical review 4 assessments due

Week 11
April 7:   Breakout groups (*New* groups 1-3, presentation 2), Breakout papers assigned, abstracts due
April 9:   Lecture 12 Critical review 5 due

Week 12
April 14:   **TA –** Breakout groups (*New* groups 4-6, presentation 2)*,* Breakout papers assigned
April 16:   Lecture 13 Critical review 5 assessments due

Week 13
April 21:   Breakout groups (*New* groups 7-9, presentation 2)
April 23:   Lecture 14

Week 14
April 28:   **TA -** 4-credit student research proposal presentations
April 30:   **TA -** 4-credit student research proposal presentations

Week 15
May 5:   **TA - Alternate final presentation date/Guest lecture/No class**, **last day of class**

Week 16
May 12:   **Research proposals/term papers due.**

GRADING POLICY

All assignments due on Canvas by midnight of the due date. Assignments uploaded after this until noon the following day will receive 25% pts off. Assignments submitted by midnight the follow day with receive half credit. Assignments will not be accepted after that. If you have professional engagements (e.g. interviews) or significant personal issues (e.g. illness), contact the TA and I via email for accommodations.

You are expected to have read the Student Code section related to Academic Integrity (http://admin.illinois.edu/policy/code/article1_part4_1-401.html). All infractions listed in the Student Code, including cheating and plagiarism, will result in penalties in accordance with the Student Code. If you have any question regarding what constitutes an infraction, contact me.

Plagiarism will be treated very seriously. If you do not understand what constitutes plagiarism, talk with me. For example, you cannot copy text from published papers without marking it as "copied from" or equivalent. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding.

PAPER SELECTION FOR CRITICAL REVIEWS

I will post in advance a list of papers published in Nature Nanotechnology, Nano Letters, and other journals to Canvas. Each student will be assigned a number that determines which papers they can select from (instructions will be shared). The number **should be kept secret. (blind)**

Important: You should only pick <u>original scientific</u> <u>articles</u>, not <u>commentaries</u> or <u>review articles</u>. If in doubt, send me the pdf of the paper you select, and I will inform you if it is suitable. Your review must be substantive. Follow the procedures indicated.

GENERATIVE AI (ADAPTED FROM CITL)

Generative AI, such as ChatGPT, Microsoft Copilot, and Gemini, can answer questions and generate text, images, and other media. The appropriate use of generative AI varies from course to course. In MSE 487, there are times when generative AI may be useful in the course. If you choose to use generative AI as permitted below, you must document and attribute all AI contributions to your coursework and take full responsibility for the contributions including the accuracy of the information and reliability of sources. When using generative AI, keep a journal documenting prompts, AI responses, and your usage. **I may ask you to provide this documentation.**

You may use generative AI in MSE 487 for the following:

- o Proofing text
- o Guiding understanding

You MAY NOT use generative AI in MSE 487 for the following:

- o Reviewing/summarizing papers
- o Assessing your peer's reviews
- o Generating text, references, ideas for final papers

If you have a question about the use of Generative AI, please reach out. Failure to abide by these guidelines is a violation of academic integrity. We will investigate suspected uses of generative AI that do not follow these guidelines and apply sanctions as outlined in the University of Illinois Student Code.

Much of the learning in this course occurs through direct, personal experience of the writing process, from first drafts to final revisions.

DISABILITY-RELATED ACCOMMODATIONS

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail disability@illinois.edu or go to https://www.disability.illinois.edu. If you are concerned you have a disability related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting "Request an Academic Screening" at the bottom of the page.

DIVERSITY (ADAPTED FROM PROF. PERRY & LEAL)

I greatly value the diversity that students bring to the classroom, particularly in a discussion/presentation-heavy class such as MSE 487. I learn a lot from your questions, ideas, interests, and comments. Together as a class, our perspective on the science and applications is greatly broadened when everyone participates. More generally, it's clear that diverse participation in engineering is needed to ensure that (nano)technology is designed to serve and be accessible to the whole population rather than a narrow subset. In science, diverse perspectives and lenses benefit the whole community through increasing creativity and innovation. Further, in the context of increasing globalization, students need to be well prepared for teamwork and communication in a diverse and international setting to address challenges. My goal is to create an inclusive classroom environment where all students can take risks to fully participate and thereby grow and learn. If you have suggestions for the instructor on improving the course environment and culture from a diversity perspective, please do reach out.

I encourage all students to learn more about DEI activities in MatSE and MatSE's DEI committee here: https://matse.illinois.edu/dei. (Make sure to scroll down to see all content!). More generally, aspects of DEI in the UIUC community are well covered by the IDEA institute: https://idea.illinois.edu.

INCLUSIVITY STATEMENT FROM THE COLLEGE

The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (https://bart.illinois.edu/). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

SEXUAL MISCONDUCT REPORTING OBLIGATION

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement option. A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: wecare.illinois.edu/resources/students/#confidential. Other information about resources and reporting is available here: wecare.illinois.edu.

RELIGIOUS OBSERVANCES

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regards to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at https://odos.illinois.edu/community-of-care/resources/students/religious-observances/ to request appropriate accommodations. This should be done in the first two weeks of classes.

FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT (FERPA):

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See https://registrar.illinois.edu/academic-records/ferpa/ for more information on FERPA.