

MSE 495: Materials Design Thinking

1 cr., Fall 2025

CRN: 78450

Lecture: 3025 Campus Instructional Facility, Monday 12:00 - 12:50 PM

Instructor:

Dr. Matthew D. Goodman

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115B Materials Science and Engineering Building

217-244-9253

Office Hour: TBD.

Prerequisites: Credit for MSE 308

Class Description

Introduction to design methodologies in the context of Materials Science and Engineering. Topics include Human Centered Design (HCD), Statistical Modeling, Design Tradeoffs, Material Selection, Materials Design, and Team Management. Development of design projects for implementation in a subsequent course (MSE 495). Understanding of objectives and constraints such as economic, manufacturability, environmental, ethical, health and safety, sustainability, social, and political concerns as they relate to project design.

Learning Objectives

1. Understand, analyze, and evaluate design processes and approaches.
2. Analyze and evaluate team dynamics as it relates to design projects.
3. Use effective tools for material selection via tradeoffs and optimization in design projects.

ABET Student Outcomes

This course aligns with the following ABET Student Outcomes:¹

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

¹ Student Outcomes wording taken directly from ABET.org.

Course Format: Lecture will be held for 50 minutes on Mondays with attendance expected. In lecture, topics will be discussed and (typically) an in-class activity, worked in small groups, will be given to solidify the topic. It is expected that students subsequently finish and submit these activities for grading as homework scores. Expected work devoted to MSE 494 outside of class time should be 2 hours/week.

Design projects are solicited from external companies, alumni, current faculty members, and students. All design projects are reviewed by the course instructor to determine feasibility. Students will have the ability to rank their project preferences; the ranking will be used to create project teams of ~4 students, maximizing overall preferences. The design projects will be developed in the latter half of the semester and then implemented in the subsequent course, MSE 495. Except in rare circumstances, design teams and projects will remain the same between MSE 494 and MSE 495. Any change in the teams or projects requires instructor approval.

Required Text/Equipment

- Canvas (<https://canvas.illinois.edu>)
- Ansys Granta CES EduPack (available on UIUC webstore)

Suggested Texts

- *The 5 Dysfunctions of a Team*, Patrick Lencioni, 2006 John Wiley & Sons ISBN 0787960756
- *Materials and Design: The Art and Science of Material Selection in Product Design*, 3rd Edition, Kara Johnson and Michael F. Ashby, 2014 Butterworth-Heinemann ISBN 0080982050

Grading Policies

	Item	Due Date*
20%	Homework	Various
5%	Team Contract	Oct 8
20%	Literature Review	Nov 1
10%	Work Plan Document	Nov 15
5%	Budget Document	Dec 1
5%	Hazard Analysis Document	Dec 1
20%	Work Plan Presentation	Finals Week
5%	Peer Evaluation	Finals Week
10%	Attendance	Weekly

*Due Dates subject to change based on external factors; check Canvas for most up-to-date schedule.

Preliminary Grading Scheme

A+	97% and up	B+	87–89.99%	C+	77–79.99%	D+	67–69.99%
A	93.0–96.99%	B	83–86.99%	C	73–76.99%	D	63–66.99%
A-	90–92.99%	B-	80–82.99%	C-	70–72.99%	D-	60–62.99%

Homework: Homework will be assigned during lecture, and students will have approximately one week to complete them for full credit. These will be uploaded and submitted via Canvas. To earn full credit, students should show all work and state any assumptions.

Team Contract: Teams should complete a team contract (template given in class) with realistic expectations and sanctions.

Literature Review: A 5–6-page document outlining the problem statement and the relevant background necessary to address the problem. A detailed rubric will be given in class.

Work Plan Document: Document stating the specific design goals and a preliminary plan or approach. An initial work plan should be included with thought-out procedures, contingencies, and steps necessary to complete the project in the spring semester. A detailed rubric will be given in class.

Budget: Each team will create a budget document for their project, to be given to the instructor and department, detailing supplies, equipment time, and any other expenses that the project will incur. Teams will be required to manage this budget and track their actual expenses.

Hazard Analysis: From the initial work plan, a detailed hazard analysis needs to be completed outlining the steps teams will take to complete their project. Hazards should be identified, and necessary precautions outlined. A template will be provided.

Work Plan Presentation: During finals week, teams will present their work plan, providing enough literature background to understand the problem statement.

Attendance: Attending lectures, being actively engaged, and completing the exit ticket will result in receiving up to 5% to the student's grade. Excused absences are on a case-by-case basis and should be requested before the absence. If an emergency arises, please notify the instructor as soon as reasonably possible. All notifications and requests should be submitted through the link in Canvas.

Late Homework: Late homework will be accepted on some assignments (see individual assignments for exceptions) with a -10% penalty for every 24 hours late, to a maximum penalty of -60% if submitted before the final presentation.

Re-grading Policy: For simple addition/subtraction errors on points awarded, please bring up the assignment or exam after class or stop by during office hours. Any other requests require a type-written explanation that includes your name, assignment or exam, problem in question, and a written description describing the mis-grading and why a re-grading is warranted. Any attempt to “doctor” or manipulate the assignment will be dealt with under the Student Code.

AI Policy: The use of AI is broadly accepted for generating ideas and exploring options. Students must document the version of AI utilized and the input prompts. AI must not be used to create portions of reports or homework. The goal is for students to synthesize the AI output and create something new. Refer to specific assignments for details and discuss with the instructor with any questions or concerns.

Academic Integrity

Alleged misconduct is a violation of the Student Code and must be reported as an infraction of academic integrity. I reserve the right to take photographic evidence.

The University of Illinois Urbana-Champaign *Student Code* should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/>.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: <https://studentcode.illinois.edu/article1/part4/1-401/>.

Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Mental Health

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

- Counseling Center (217) 333-3704
- McKinley Health Center (217) 333-2700
- National Suicide Prevention Lifeline (800) 273-8255
- Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year) If you are in immediate danger, call 911.

*This statement is approved by the University of Illinois Counseling Center

Community of Care

As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (217-333-0050 or <http://odos.illinois.edu/community-of-care/referral/>). Based on your report, the staff in the Student Assistance Center reaches out to students to make sure they have the support they need to be healthy and safe.

Further, as a Community of Care, we want to support you in your overall wellness. We know that students sometimes face challenges that can impact academic performance (examples include mental health concerns, food insecurity, homelessness, personal emergencies).

Should you find that you are managing such a challenge and that it is interfering with your coursework, you are encouraged to contact the [Student Assistance Center \(SAC\)](#) in the Office of the Dean of Students for support and referrals to campus and/or community resources.

Students with Disabilities

If you have a disability, the university has several great resources that can be found at www.disability.illinois.edu. Please contact me if I can be of any assistance.

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor as soon as possible and provide the instructor with a Letter of Academic Accommodations from Disability Resources and Educational Services (DRES). To ensure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should apply for services with DRES and see the instructor as soon as possible. If you need accommodations for any sort of disability, please speak to me after class, or make an appointment to see me or see me during my office hours.

DRES provides students with academic accommodations, access, and support services. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 217-333-1970, e-mail disability@illinois.edu or visit the DRES website at <http://www.disability.illinois.edu/>. Here is the direct link to apply for services at DRES, <https://www.disability.illinois.edu/applying-services>.

Disruptive Behavior

Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (<https://conflictresolution.illinois.edu>; conflictresolution@illinois.edu; 333-3680) for disciplinary action.

Emergency Response Recommendations

Emergency response recommendations and campus building floor plans can be found at the following website: <https://police.illinois.edu/em/run-hide-fight/>. I encourage you to review this website within the first 10 days of class.

Religious Observances

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. Students should complete the [Request for Accommodation for Religious Observances form](#) should any instructors require an absence letter in order to manage the absence. In order to best facilitate planning and communication between students and faculty, students should make requests for absence letters as early as possible in the semester in which the request applies.

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 will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

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.