

## **MSE 495: Materials Design**

2 cr., Spring 2024

CRN: 75759

**Lecture:** 4025 Campus Instructional Facility, Mondays & Wednesdays 12:00 - 12:50 PM

### **Instructor:**

Dr. Matthew D. Goodman  
mgoodman@illinois.edu  
210 Ceramics Building  
217-244-9253

**Office Hour:** Fridays 1:00 – 2:00 pm, 210 Ceramics Building or by appointment.

**Prerequisites:** Credit for MSE 494.

### **Class Description**

Continuation of MSE 494. Design teams evaluate alternatives, finalize concepts, model and analyze solutions, build and test a final product (physical or digital), and present the results professionally. Solutions are based on the knowledge, skills, and design experience acquired in earlier course work and incorporate realistic constraints.

### **Learning Objectives**

1. Integrate knowledge and problem-solving skills acquired throughout the undergraduate curriculum to solve a design problem creatively; to develop, evaluate, and recommend alternative solutions, satisfying realistic constraints.
2. Utilize different communication styles and methods to effectively present elements of a design project.
3. Formalize team dynamics and interpersonal relationships in a project setting.

### **ABET Student Outcomes**

This course aligns with the following ABET Student outcomes:<sup>1</sup>

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.
3. an ability to communicate effectively with a range of audiences.
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.

---

<sup>1</sup> Student Outcomes wording taken directly from ABET.org.

**Weekly calendar and outline of topics:**

| Week | Topic  | Assigned   | Due <sup>#</sup>                | Learning Objective | ABET Outcome |
|------|--|--|---------------------------------|--------------------|--------------|
| 1    | Review of Human Centered Design              | Pre-survey; Team Contract; Literature Review Presentation                    | Pre-survey, Team Contract       | 1, 2, 3            | 1, 2, 3, 5   |
| 2    | Design topic* 1: Fundamental Equations       | Goals, Objectives, Constraints, Boundaries (GOCB) and Lab Experiment Request | Literature Review Presentations | 1                  | 1, 2, 3, 4   |
| 3    | Materials Simulation: Ansys Discovery        |  | GOCB Report                     | 1                  | 2, 4         |
| 4    | Design topic 2: Model Systems                | Lecture Worksheet (LW) 1   |                                 | 1                  | 1            |
| 5    | Design topic 3: Environmental Sustainability | LW 2   | Logbook review                  | 1, 3               | 2, 4, 5      |
| 6    | Presentation Skills                          |  | LW 2,                           | 2, 3               | 3            |
| 7    | Midterm Presentations                        | two-hour block, time TBD   |                                 | 2, 3               | 3, 5         |
| 8    | Midterm Presentations                        | two-hour block, time TBD   | Peer Review                     | 2, 3               | 3, 5         |
| 9    | Spring Break                                 |  |                                 |                    |              |
| 10   | Design topic 4: Unknown Variables            | LW 3   |                                 | 1                  | 2, 4         |
| 11   | Design topic 5: Business Feasibility         | LW 4   | LW 3                            | 1                  | 2, 4         |
| 12   | Design topic 6: Unintended Consequences      | LW 5   | LW 4                            | 1                  | 2, 4         |
| 13   | Design topic 7: Export/import Control        | LW 6   | LW 5                            | 1                  | 2, 4         |
| 14   | Project Work Week                            | Poster Presentations   | LW 6                            | 1, 3               | 2, 4         |
| 15   | What is Design? A review                     |  | Logbook Review                  | 1, 3               | 1, 2, 4      |
| 16   | Finals week                                  | Project Portfolio  | Post-survey, Peer Review        | 2, 3               | 3, 5         |

<sup>#</sup>Weekly progress reports are due every week.

\*Design topic lectures: See course format

**Course Format:** Lecture will be held for 50 minutes on Mondays and Wednesdays with attendance required. Students will be part of a project team for the semester with each team

assigned a design project. Teams will operate as an engineering group that has been organized to solve a particular problem. *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.* The team will be responsible for setting up meetings (including with advisors and sponsors), assigning individual responsibilities, defining project goals and objectives, managing project activities, performing analyses, achieving results, developing recommendations, preparing oral and written reports, and managing internal team dynamics.

Design topic lectures will be a short introduction into the topic of the day. There are many elements to design that must be taken into consideration. Lectures will be utilized to reinforce aspects of design thinking, relating to each teams' projects, and an in-class activity will be given to solidify the topic. Teams will evaluate their design project based on that day's topic, directed by lecture worksheets. The worksheets will be submitted for grading and will need to be incorporated into the project portfolio.

Project teams will meet bi-weekly with the instructor for individualized inquiries and design progress updates. The bi-weekly meetings will be team-led utilizing a meeting template to describe work completed, in-progress, and behind schedule, challenges the team is currently facing, and future steps in the design project (including any corrective action). For off-weeks, teams wanting feedback on their project are encouraged to utilize office hours. Teams will need to schedule their own meetings to complete work on the project. Teams will also meet periodically with the external sponsor/advisor. Teams will submit weekly progress reports. Expected outside of class time devoted to MSE 495 should be approximately 5 hours/week.

By the end of the semester, each team will have carried a design problem through the various stages of a project life cycle including problem definition, data collection, model building, analysis of alternatives, project decision-making, preparation of recommendations, development and testing of prototype, and delivery of project summary results in oral and written form.

**Required Text/Equipment**

- Course Logbook (U of I Bookstore)
- Canvas (<https://canvas.illinois.edu>)
- Ansys Academic Mechanical and Electromagnetic (available on UIUC webstore or in Ceramics 322)

**Suggested Text**

- *Materials Selection in Mechanical Design, 5<sup>th</sup> Edition*, Michael Ashby, 2017 Butterworth-Heinemann ISBN 0081005997
- *Useful solutions for standard problems, 9<sup>th</sup> Edition* Michael Ashby, 2011 PDF Download

**Grading Policies**

| Grade | Individual | Group | Description        | Possible Late Submission |
|-------|------------|-------|--------------------|--------------------------|
| 5%    | x          |       | Lecture Attendance |                          |
| 5%    |            | x     | Worksheets         | x                        |
| 2%    |            | x     | Team Contract      | x                        |

|     |   |   |  |   |
|-----|---|---|--|---|
| 5%  | x |   | Logbook                                    |   |
| 5%  |   | x | Literature Review                          |   |
| 8%  |   | x | Goals, Objectives, Constraints, Boundaries | x |
| 15% |   | x | Weekly Progress Reports                    | x |
| 15% |   | x | Midterm Presentation                       |   |
| 25% |   | x | Final Portfolio                            | x |
| 10% | x | x | Poster Presentation*                       |   |
| 5%  | x |   | Peer Review                                |   |

\*See Poster Presentation in Course Elements for details

### 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% |

### Course Elements:

#### Logbook Requirements and Guidance

Logbooks in industry are used for a variety of crucial reasons, chief among them the identification of intellectual property (IP). As a learning experience, the logbooks system will be used to help with project organization, assist each team in the management of its project, and document the technical progress of the project. Each student is required to maintain an engineering logbook. The logbook serves as a record of daily activities and important project information. For this reason, ink pen should be the only type of writing utensil used to fill out a logbook.

The purpose of having a logbook is to create a single-source repository of information for the design project. A hasty reconstruction of events over the past three or four weeks or the days just prior to the logbook review will not serve any purpose. To be effective, a logbook must be kept current at all times, and entries should be made continuously as the project progresses. Model development, calculations, and sketches should also be included in the logbook, where appropriate. You should also reference relevant filenames containing work documents on your computer with dates created or modified, and a brief statement of content.

Entries for any group meetings should include a list of members attending, in addition to any notes that you may take during that meeting. Because not everyone records the same things at a meeting, each project team member should make notes of meetings.

The preferred logbook for the course may be purchased at the Illini Union Bookstore. The book is hardbound, 10 3/8" × 8 3/8", numbered, lined pages. Each student is required to use the logbook to maintain an up-to-date record of project progress. Students are expected to have their logbooks with them at each class lecture and project meeting. Logbooks will be reviewed periodically throughout the semester; these reviews will contribute toward each student's individual final grade. A corresponding template and rubric will be posted to Canvas.

External sponsors may require possession of the logbooks at the end of the semester. Treatment of intellectual property will follow the guidelines put forth by the University for engineering

design courses.

**Worksheets:** Lecture worksheets will be assigned, 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:** The roles and responsibilities of each group member should be defined and agreed upon by all group members with respect to decision making, interactions, delegation, management, and accountability. *Note: the team contract from MSE 494 should be used unless a rationale is provided to the instructor.*

**Literature Review:** A 20-minute presentation to the faculty advisor outlining the problem statement, the relevant background necessary to address the problem, specific design goals, and a preliminary plan or approach. These presentations should utilize MSE 494 Literature Review paper as a starting point, refined and edited based on feedback, and present newly discovered background. A corresponding template and rubric will be posted to Canvas.

**Goals, Objectives, Constraints, Boundaries:** Report that frames the team's approach in terms of specific objectives, constraints, and boundaries that the project will be working under. Additionally, an approximately one-page report that outlines the team's request and rationale for lab experiment. If the project requires no lab experiment, this document should clarify why no experiment is necessary.

**Weekly Progress Reports:** Weekly Progress reports will be submitted online; these reports should be concise but specific and should primarily summarize old business (i.e., items discussed the previous week but with action deferred), current status (i.e., state the completion status of previous weeks' goals), and contain a list of tasks/goals for the upcoming week. The person or persons responsible for each task must be clearly identified. A progress report template will be provided on Canvas. Project groups will meet each week with either the instructor or the TA to discuss these reports.

**Midterm Report and Presentation:** The midterm presentation will be  $\approx 15$  mins. It will be presented to and partially evaluated by your peers. Therefore, it should provide sufficient background for the general materials scientist to understand and appreciate the project problem, design goals, and proposed work plan. It will describe the relevant background information related to your project, design goals, proposed future work, and relevant information related to standards used for assessment. The presentation will also be graded in part on the quality of the presentation material and its delivery. Presentation dates will be decided via surveys.

**Final Portfolio:** A detailed portfolio of the accomplishments made towards the design project during the semester including the relevant background, problem statement, design goals, and new progress made. The majority of the portfolio will be work accomplished throughout the semester (i.e., the weekly progress reports) and should only require minor edits. A corresponding template and rubric will be posted to Canvas.

**Poster Presentation:** A poster presentation will occur during the week of April 15-19. These

posters should be a transfer of key points and findings from the Portfolio and present them succinctly. Posters should be approximately 3' x 3' (templates provide). Posters will need to be professionally printed (course instructor will submit posters for printing). The poster session will be open to the public with voting on best poster. Poster presentation will be graded as a group regarding the content of the poster and individually regarding the style of presentation, e.g., professionalism, ability to answer questions, etc.

### **Peer Reviews and Team Member Firing**

All team members are expected to contribute to their project a certain portion of the total work, and each team should determine exactly what work is the responsibility of each team member. Additionally, all team members are expected to contribute equally in team meetings. However, the entire team is responsible for the final completion of the project. External and internal sponsors will not assess the group with any additional leniency if certain members are found not to have contributed fairly—but such issues should never be communicated to the sponsors!

If a team member is not contributing to the project or is generally an uncooperative team member whose presence is deleterious to the mission of the team, the team should consult with the instructor so that the problem can be resolved, if possible. If no resolution is achieved, the instructor may suggest the student be given a probationary period to make some meaningful contributions to the team. If there is no subsequent improvement at the end of the probationary period, then the instructor will make a final review of the case and notify the uncooperative student that they have been fired. Fired team members will be barred from further participation in the project and may receive a failing grade for the course.

Each team member will complete two confidential peer evaluations. Peer evaluations may be used to inform the instructor about the inner workings of the team members as they determine final semester grades.

**External Advisor Adjustment Score:** At the end of the semester, external advisors will provide feedback to the instructor on the student teams. This feedback will be based on contributions to project workload, proactive input at meetings, answering of questions at presentations, and an overall assessment of performance. Feedback will be utilized in determining the teams' final portfolio grade and individuals' peer review grade.

**Late Homework:** Late homework submissions will be accepted on selected assignments. There is a 1% penalty per hour late.

**Re-grading policy:** Any requests require a type-written explanation that includes your name, assignment, 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.

**COVID Policies:** Everyone is to adhere to the CDC recommendations and campus policy regarding covid mitigation. Violators will be removed from class and the misconduct reported.

### **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](http://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](mailto: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](mailto: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](https://wecare.illinois.edu/resources/students/#confidential).  
Other information about resources and reporting is available here: [wecare.illinois.edu](https://wecare.illinois.edu).