

MSE 4592: Materials Research & Design Capstone 2

Instructor:

Year and Term: 2025 Spring

Level: 4th Year Undergraduate

Prerequisites: MSE 4592: Materials Research & Design Capstone 1

Credits: (3)

Textbooks and other materials:

1. (DL) *Engineering Design – A Project-based Introduction*, Dym and Little, John Wiley and Sons, Inc., ISBN 0-471-25687-0
2. (UE) *Product Design and Development*, Ulrich and Eppinger, McGraw-Hill Education ISBN-13: 978-0073404776.
3. (ASH 1) M. F. Ashby, *Materials Selection in Mechanical Design*, 5th Edition. Butterworth- Heinemann, Elsevier, 2017. Required Reading: M.F. Ashby, *How to Write a Paper*, 7th Edition, August 2011.
4. (ASH 2) M.F. Ashby, *How to Write a Paper*, 7th Edition, August 2011.

Degree Program Impact: Required MSE course

Schedule: T/R, 1100-1215, MEC 206

Course Description and Structure:

This course is the second semester of the capstone experience where groups of students bring together their fundamentals and laboratory practice skills to solve a major design or failure analysis problem. Students will examine fundamental principles in materials design and selection, as well as develop project management and team building skills. Students will conclude a two-semester project by conducting experimental and computational solutions as outlined in their first semester proposal document. During the course of the semester, technical milestone and final reports will be generated that will include ongoing results and discussions.

Given the amount of time required to rigorously execute the project, required class meetings will be minimized, limited to the online industry meetings (expectation of by-weekly) attended by the UVA faculty members. Other meetings may be scheduled as needed with both the faculty members, which may include reviews of project direction, ABET, JIT issues (specific discussions, special technical topics that you feel that you need), and guest speakers e.g. on professional development.

Research Equipment Charges:

For any research equipment / sample preparation charges in the MSE department, please use **MSE CAPSTONE** in place of the worktag.

Course Goals

The objectives of this course are to give the student the capability to design materials for a particular engineering application. Specifically, at the completion of this course, the student should be able to:

1. Analyze the application and identify essential and desirable materials properties, including but not limited to mechanical, thermodynamic, transport, and functional properties.
2. Identify and apply relevant national standards for this application.
3. Perform a literature search to identify current and proposed materials, evaluating the strengths and weaknesses of each material.
4. Identify external constraints, including cost, availability, durability, environmental, and overall sustainability issues associated with the application in general and the proposed materials specifically.
5. Quantitatively compare alternative materials based on both material properties and external constraints.
6. Design a material, based on the student's understanding of materials structure/property relationships, that can best satisfy the required properties within the external constraints.
7. Participate as part of a team (at times as a member and at other times as a leader) in the accomplishment of a shared technical goal.
8. Write a professional technical report describing the materials design project from start to finish.
9. Deliver professional oral presentations describing the materials design project from start to finish.

Student Outcomes:

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
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Estimated Grade Weighting Factors (subject to change)

a. Written Milestone Reports (Team)

1. **January 30th** 10%
2. **February 27th** 20%
3. **March 27th** 20%

b. Written Capstone Preliminary Report (Team): April 10th 10%

c. Written Capstone Final Report (Team): May 1st 20%

d. Final Capstone Presentation (oral, Team): May 3rd 2pm 20%

Total: 100%

In addition, there will be 2-3 short ABET assessments during the course of the spring semester.

A final composite score for each student is then converted to a letter grade using the following table as a guide:

92 – 100	A	72 – 77	C
90 – 91	A–	70 – 71	C–
88 – 89	B+	68 – 69	D+
82 – 87	B	62 – 67	D
80 – 81	B–	60 – 61	D–
78 – 79	C+	<60	F

Grading Procedures

The course instructor and project mentor(s) will perform the grading of the approach, presentations, written reports, and participation grades.

Additional Course Information

The UVA Honor Code

<https://honor.virginia.edu/statement>

I trust every student in this course to fully comply with all of the provisions of the University's Honor Code. By enrolling in this course, you have agreed to abide by and uphold the Honor System of the University of Virginia, as well as the following policies specific to this course.

All graded assignments must be pledged unless otherwise stated.

All suspected violations will be forwarded to the Honor Committee, and you may, at my discretion, receive an immediate zero on that assignment regardless of any action taken by the Honor Committee.

Please let me know if you have any questions regarding the course Honor policy. If you believe you may have committed an Honor Offense, you may wish to file a Conscientious Retraction by calling the Honor Offices at (434) 924-7602. For your retraction to be considered valid, it must, among other things, be filed with the Honor Committee before you are aware that the act in question has come under suspicion by anyone. More information can be found at <http://honor.virginia.edu>. Your Honor representatives can be found at: <http://honor.virginia.edu/representatives>.

Recording of Classroom Activities

The intent for this semester is to have all classes live and in-person. With that said, we may find the need to record specific lectures and other interactions as needed. Because these interactions may include fellow students, you and they may be personally identifiable on the recordings. These recordings may only be used for the purpose of individual or group study with other students enrolled in this class during this semester. You may not distribute them in whole or in part through any other platform or to any persons outside of this class, nor may you make your own recordings of this class unless written permission has been obtained from the instructor and all participants in the class have been informed that recording will occur. Please see Provost Policy 008 for additional details.

Artificial Intelligence Technologies

The ethical use of artificial intelligence technologies is strictly at the discretion of the course's professor and **is otherwise prohibited without the professor's explicit written or verbal permission.**

Students with Disabilities or Learning Needs

It is my goal to create a learning experience that is as accessible as possible. If you anticipate any issues related to the format, materials, or requirements of this course, please meet with me outside of class so we can explore potential options. Students with disabilities may also wish to work with the Student Disability Access Center to discuss a range of options to removing barriers in this course, including official accommodations. Please visit their website for information on this process and to apply for services online: sdac.studenthealth.virginia.edu. If you have already been approved for accommodations through SDAC, please send me your accommodation letter and meet with me so we can develop an implementation plan together.

Discrimination and Power-Based Violence

The University of Virginia is dedicated to providing a safe and equitable learning environment for all students. To that end, it is vital that you know two values that I and the University hold as critically important:

1. Power-based personal violence will not be tolerated.
2. Everyone has a responsibility to do their part to maintain a safe community on Grounds.

If you or someone you know has been affected by power-based personal violence, more information can be found on the UVA Sexual Violence website that describes reporting options and resources available - www.virginia.edu/sexualviolence.

As your professor and as a person, know that I care about you and your well-being and stand ready to provide support and resources as I can. As a faculty member, I am a responsible employee, which means that I am required by University policy and federal law to report what you tell me to the University's Title IX Coordinator. The Title IX Coordinator's job is to ensure that the reporting student receives the resources and support that they need, while also reviewing the information presented to determine whether further action is necessary to ensure survivor safety and the safety of the University community. If you wish to report something that you have seen, you can do so at the **Just Report It portal**. **The worst possible situation would be for you or your friend to remain silent when there are so many here willing and able to help.**

Religious Accommodations

It is the University's long-standing policy and practice to reasonably accommodate students so that they do not experience an adverse academic consequence when sincerely held religious beliefs or observances conflict with academic requirements. Students who wish to request academic accommodation for a religious observance should submit their request in writing directly to me. Students who have questions or concerns about academic accommodations for religious observance or religious beliefs may contact the University's Office for Equal Opportunity and Civil Rights (EOCR) at UVAEOCR@virginia.edu or 434-924-3200.