

MSE 4592: Materials Research & Design Capstone 1

Instructor Name:

Year and Term: 2024 Fall

Level: 4th Year Undergraduate

Prerequisites:

- MSE Major, 4th year standing, APMA 3110, MSE 2101, 3050, 3060, 3070, 3101
- Co-requisite: STS 4500

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: (ASH 2) M.F. Ashby, *How to Write a Paper*, 7th Edition, August 2011.

Degree Program Impact: Required MSE course

Schedule: T/TR, 11:00 – 12:15, MEC 206

Course Description:

This course is the first semester of the capstone experience where groups of students bring together their fundamentals and laboratory practice skills to develop solutions to a major engineering design problem. Students will examine fundamental principles in engineering, materials design and selection, as well as develop project management and team building skills. Students will begin a two-semester project and prepare technical reports and presentations of the results. This course directly supports MSE program education outcomes.

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

Tentative Course Topics:

1. Engineering Design and Concept Generation
Presentation and Discussion of Design Examples (DL Chapters 1-2)
Problem Background, Definition (DL Chapter 3)
The Design Process: (DL Chapter 5)
2. Materials and Design
3. Engineering Materials and Their Properties
4. Material Property Charts
5. Material Selection – The Basics
6. Failure in Engineering Ethics/ Design Safety (DL Chapter 6, 8; UE Chapter 13)
7. Processes and their effect on Properties
8. Processes Selection and Cost
9. Materials and the Environment

Date	Activity	Assignment Due	Comments
Tuesday 8/27	Lecture	Eng. Des Part 1	
Thursday 8/29	Lecture	Eng. Des Part 1 Due	
Tuesday 9/3	Lecture		
Thursday 9/5	Lecture	Eng. Des Part 2 Due	
Tuesday 9/10	Lecture		
Thursday 9/12	Team Building		
Thursday 9/17	Lecture		
Thursday 9/19	Team Building		
Tuesday 9/24	Lecture	Concept Report Due	Revised Date 10.3.24
Thursday 9/26	Lecture		
Tuesday 10/1	Lecture		
Thursday 10/3	Lecture		
Tuesday 10/8	Lecture		
Thursday 10/10	Lecture		
Thursday 10/17	Lecture		
Tuesday 10/22	Lecture		
Thursday 10/24	Lecture		
Tuesday 10/29	Lecture	Preliminary Design Due	
Thursday 10/31	Lecture		
Thursday 11/7	Lecture		
Tuesday 11/12	Lecture		
Thursday 11/14	Lecture		
Tuesday 11/19	Lecture		
Thursday 11/21	Lecture	Detailed Design Due	
Tuesday 11/26	Lecture		
Tuesday 12/3	Lecture		
Thursday 12/5	Lecture		
Tuesday 12.10.24	-----	Final Presentation	12.10.24
<u>Examinations</u> December 9, 2024 - December 17, 2024 <u>Reading Days</u> December 12 - 15, No Classes			

Industrial Visits, Conference Calls, and Outreach Fall 2024			
<i>Date</i>	<i>Topic</i>	<i>Companies</i>	<i>Attendees</i>

Estimated Grade Weighting Factors (subject to change)

1) Homework / Quiz	(Individual)	15 %
2) Conceptual Design	Written Report (Team)	20 %
3) Preliminary Design	Written Report (Team)	20 %
4) Detail Design	Written Report (Team)	25 %
4) Summary Presentations	Oral (Team)	20 %
<u>Total:</u>		100%

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.

Format and Requirements for Presentations and Reports

- Potential Case Study Group Presentations: ~20 minutes long followed by questions and answers. Teams will be assigned case studies
- Oral Presentation (plan/approach): 20 minutes + 5 minutes for questions and answers - This presentation summarizes relevant introductory literature, design criteria, and preliminary experiments for the group project.
- Written Reports (Preliminary and Detailed): The fundamental information contained within these documents will be used extensively in Design 2 the following semester.

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.