Georgia Institute of Technology

MSE 4410 – Capstone Engineering Design I

Fall 2026
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Learning Objectives: The learning objectives for the course are as follows:

1. Learn concepts of engineering design including integrated product/process development, Quality Function Deployment (QFD) and DFX (Design for *functionality*, *usability*, *inclusivity*, *manufacturability*, *sustainability*, *maintainability, quality*, *affordability*, etc.).
2. Learn to apply analysis and synthesis skills by utilizing knowledge and fundamentals learned from other courses in the curriculum to work on *open-ended* design projects; the word "design" applies to a product, process, system, or material, among others.
3. Gain an appreciation for team-oriented activities through work on design teams exploring the various facets of product/process design and development in materials – polymers, fibers, ceramics, metals, and textiles.
4. Learn to contribute effectively to multidisciplinary design teams in the real world.
5. Develop skills to communicate technical information effectively.
6. Learn the importance of engineering ethics in the practice of the engineering profession.

Approach: The course is designed to provide you the opportunity to learn, understand and experience the *total* engineering design process. The best way to learn design is by *designing* and not by just reading about design.

Class Format and Participation: The lecture hours will be spent in discussions on various topics related to the engineering design process. Since we want to simulate the real world, e.g., your future workplace, it is necessary that you read the relevant parts of the textbook before coming to class. You are expected to attend class and lab unless you have a compelling reason not to do so. Your participation in the class discussion is required. Assessment of class participation will be based on attendance, the degree of participation, and quality of your contributions to the class discussion.

Project: You will be working on a group project during the semester. You will be producing several deliverables during the course of the design process (see attached table). Engineering Design is iterative and a continuum until you realize the final design. The deliverables during the semester are designed to enable you to plan, organize, and track your progress towards realizing the final design specifications by the end of the semester. The deliverables are NOT like typical science/engineering lab reports. You are expected to incorporate the input received on the deliverable submissions as you move forward on the project.

The Design Lab/Studio Sessions will start during the first week of classes.

Logbook: You will be doing creative and original work during the semester. It is important that you learn to protect the "intellectual property" you will be creating. You can do this by maintaining a continuous record of all your activities on the project during the semester. The suggested format for the log book is as follows:

Date	Activity	Other Participants

This logbook will be reviewed periodically and will be used for grading during and at the end of the semester. Each member can choose to maintain their own separate log or one single log can be maintained collectively for the team. It should be maintained online and it should be accessible anytime to the TA and Instructor.

Teamwork: In the real world, you will be working in teams with each member bringing their background and experience to the design project. You will be responsible for assessing the performance of your fellow members on the team! Your evaluation will be considered in assigning the final grade; so, please take this responsibility seriously and do your best.

Team Formation: To give you the opportunity to learn to work with those with whom you have not interacted before – as happens in the real world – team assignments will be made during the first week of classes. There is a possibility that new students will sign-up during the first week of classes and a few currently enrolled students might choose to take it at a later date; however, such changes will be minimal and we will address them as they arise on a team-by-team basis.

Textbook: Product Design and Development by K.T. Ulrich, S.D. Eppinger, and M.C. Yang, McGraw-Hill, **Seventh Edition**, 2020 [Bookstore]. Please see this link for additional details on the textbook:

https://www.mheducation.com/highered/connect/ebook-flash-sale-instructors

Useful Resources: Regular reading of design-related publications and articles given during the course.

Grading

- Final Group Project Report: 45%
- Engagement in Class Discussion: 10%
- Deliverables from Design Studio: 35%
- Final Presentation: 10%

Your final grade will be assigned as a letter grade according to the following scale:

A – 90-100%
B – 80-89%
C – 70-79%
D – 60-69%
F – 0-59%

Use of Generative AI

Generative AI (GenAI) is beginning to transform various aspects of society, including engineering design and practice. GenAI Tools, such as ChatGPT, DALL-E, Google Bard, and others, are being used increasingly in the field. However, it is important to know that the material generated by these programs may be inaccurate, incomplete, or otherwise problematic. These tools may also stifle your own independent thinking and creativity.

You are permitted to use them in the course, but with the following requirements:

GenAI Usage Documentation

All submissions that incorporate AI assistance must include a dedicated section titled "AI Usage Documentation" that includes:

- Tools Used: Specify which tools were used
- Purpose and Scope: Clearly describe which parts of your work involved AI assistance and for what purpose
- Prompts and Interactions: Provide a summary of the key prompts or queries you used
- Human Contribution: Explain how you modified, refined, or built upon the AI-generated content
- Critical Reflection: Briefly assess the strengths and limitations of the AI assistance for this particular task

Guidelines for Appropriate Use

- Conceptual Understanding: GenAI tools should supplement, not replace, your understanding of core course concepts. You are responsible for comprehending all content in your submissions, regardless of how it was generated.
- Original Thinking: AI should be used to enhance your creative process, not substitute for critical thinking or original design decisions.
- Attribution: You may not submit any work generated by a GenAI tool as your own. Using AI-generated content without proper documentation will be considered a violation of Georgia Tech's academic integrity policies and Honor Code.

Topical Outline: We will cover the following key topics during the course (they are ***not*** in chronological order).

1. Design as a Competitive Advantage
2. Design and Product Life-Cycle
3. The Engineering Design Process: Key Steps from Concept to Market
4. Understanding & Translating the Customer's Needs: Principles of Quality Function Deployment (QFD) and Design for X (Functionality, Usability, Inclusivity, Manufacturability, Sustainability, Quality, Affordability, etc.)
5. Environmentally-Conscious Design: Sustainable Design vis-à-vis UN SDGs
6. Ergonomics and Industrial Design
7. Engineering Ethics: Professional Responsibility
8. Protection of Intellectual Property
9. Commercialization of Product/Design Concepts → Transition of Technology
10. Communication – Written and Presentation

! ! ! ! ! ! ! Let Us Have Fun Designing! ! ! ! ! !

Capstone Senior Engineering Design I	
MSE 4410	
Reading Schedule - Fall 2026	
Chapter	**Complete Reading By**
Chapter 1 Introduction	24-Aug-26
Chapter 2 Product Development Process and Organization	29-Aug-26
Chapter 19 Project Management	29-Aug-26
Chapter 3 Opportunity Identification	31-Aug-26
Chapter 4 Product Planning	5-Sep-26
Chapter 5 Identifying Customer Needs	12-Sep-26
Chapter 6 Product Specifications	19-Sep-26
Chapter 7 Concept Generation	26-Sep-26
Chapter 8 Concept Selection	3-Oct-26
Chapter 9 Concept Testing	5-Oct-26
Chapter 10 Product Architecture	10-Oct-26
Chapter 11 Industrial Design	17-Oct-26
Chapter 12 Design for Environment	24-Oct-26
Chapter 13 Design for Manufacturing and Supply Chain	31-Oct-26
Chapter 14 Prototyping	7-Nov-26
Chapter 16 IP - Patents	14-Nov-26

Use of Mobile Devices and Laptops during Class: As research on learning shows, unexpected noises and movement automatically divert and capture people's attention, which means you are affecting everyone's learning experience if your cell phone, laptop, etc. makes noise or is visually distracting during class. With this in mind, you are permitted to use your laptops **solely** for the purpose of taking notes, but request that you turn the sound off so that you do not disrupt other students' learning. Use of laptops for other purposes is not permitted.

Student-Faculty Expectations: The Georgia Tech community believes that it is important to continually strive for an atmosphere of mutual respect, acknowledgement, and responsibility (https://catalog.gatech.edu/rules/22/).

Academic Honor Code: You are committing to uphold the ideals of honor and integrity by refusing to betray the trust bestowed upon you as a member of the Georgia Tech community (https://policylibrary.gatech.edu/student-life/academic-honor-code).

Office of Disability Services: The disability services offered at Georgia Tech can be found at https://disabilityservices.gatech.edu/.

CRSH: Help Create Resistance to Sexual Harassment in MSE

- Creating Resistance to Sexual Harassment (CRSH) is an initiative and committee dedicated to creating a community that actively resists sexual and gender harassment. For more information about CRSH, contact Dr. Mark Losego at losego@gatech.edu.

- MSE is committed to a community that actively resists sexual and gender harassment. If you see or experience any of the following: sexual harassment, domestic and dating violence, sexual assault and stalking, resources are available:
  - **Confidential VOICE Advocates** (www.voice.gatech.edu) can provide support 24/7 and explore resources and options. If after hours, call GTPD dispatcher at 404-894-2500 and ask to speak to the On-Call VOICE Advocate. You do not need to make a report nor provide any information other than your phone number for a VOICE advocate to contact you.
  - Sexual violence or harassment can be reported directly to Georgia Tech's **Title IX Coordinator**, James Newsome, (404) 385-5583 burnsnewsome@gatech.edu.

- Faculty, Staff and TAs are mandatory reporters and are required to inform the Title IX Coordinator should they become aware that you or any student has experienced sexual violence or sexual harassment.

Website: MSE CRSH: https://www.mse.gatech.edu/values/crsh

The Group Design Project

The primary objective behind the project is to learn and apply the principles of engineering design and design methodology while working on an "open-ended" design problem that will lead to the design of a product, process, material, system, etc. The word "design" is used to encompass ***all*** facets of a product design and development process – from concept to market; it includes the following:

- Understanding user requirements
- Translating subjective user requirements into objective metrics
- Generating product concepts
- Selecting materials and manufacturing processes
- Developing design specifications that consider industrial design, environmental sustainability, societal, and ethical considerations, among others.

Project Themes

To help you select a design project, we have specified the following four "themes" or product families for you. A few examples in each category are provided to spark your creativity.

Theme 1: Sports/Athletic Performance Gear

Materials play a critical role in the performance of athletes, whether it is gaining that microsecond in the 100m freestyle in swimming or enduring the 26-mile Boston Marathon. With that in mind, design athletic gear for performance in any sports.

Theme 2: Camping Gear

Camping is fun and presents excellent opportunities for materials and design. With that in mind, design camping gear, such as a tent, sleeping bag, cookware, clothing, etc.

Theme 3: First Responder Gear

First responders – firefighters, paramedics, and law enforcement officers – rely on materials and design to keep the public safe while protecting themselves! With that in mind, design the First Responder's protective gear including uniform, body armor, gloves, shoes, etc.

Theme 4: Disaster Relief Products

Natural disasters, such as hurricanes, floods, earthquakes, and wildfire have a significant impact on people's lives. People rely on products to keep them safe and recover from disasters. With that in mind, design products (e.g., shelters, clean water dispensation, sanitation facilities, food dispensation, clothing, etc.) that can be deployed to provide disaster relief.

Theme 5: Cosmetic Products

Consumers use lipsticks, make-up, moisturizers, mascara, and other cosmetic products on a regular basis and rely on them to keep them safe while meeting their aesthetic and other needs. With that in mind, design a consumer cosmetic product.

Guidelines for Selecting a Project

- Select a project from one of the five themes.
- As MSE majors, it is important for us to make our products sustainable!
- The product should be a physical materials-based project. It should not be a service or software development project.
- There should be a demonstrable need for the product in the market. It should meet a specific set of needs – current or anticipated.
- If it is a variant of an existing product, it should clearly demonstrate how it addresses the challenges associated with current products and how it is better than them.

Design Studio Schedule for the Senior Capstone Engineering Design Project (MSE 4410) - Fall 2026		
Week #	Project Activity During Lab Session	Deliverable Due by End of Design Studio Session
1	Two Project Ideas and Team Formation	Two Projects Ideas for Team
2	Meet as a Team and Select Top Two Ideas with Pros/Cons	Finalize Project Topic
3	Develop and Finalize Mission Statement (Exhibit 4-11)	Mission Statement (Exhibit 4-11)
4	Gather and Create List of User Needs (Engineering Design Methodology JTI Paper Figure 9) Create Super Groups / ITYs	List of User Needs & ITYs/ Super Groups
5	Identify Metrics and Develop Needs-Metrics Matrix (Exhibit 6-5)	Final version of Needs-Metrics Matrix
6	Generate Concepts using the ITYs as the basis (Exhibit 6-8)	Metrics with Ideal + Marginally Acceptable Values (Exhibit 6-8)
7	Finalize Concepts based on the ITYs and Priorities; Concept Selection (Chapter 8: Appendix A and Appendix B)	Final Concept Screening/Scoring Matrix (Chapter 8: Appendix A and Appendix B)
8	Material Selection using CES EduPack based on Decision Criteria: All ITYs including Sustainability, Manufacturability, Affordability, Societal, Ethical, etc.	Begin Material Selection with Decision Matrices
9	Mid-term Presentations	
10	Product Architecture, Materials Selection using CES EduPack based on Decision Criteria: All ITYs including Sustainability, Manufacturability, Affordability, Societal, Ethical, etc.	Materials Selection with Decision Matrices
11	Manufacturing Method Selection, Industrial Design (Exhibits 11-3 and 11-11),	Industrial Design Charts (Exhibit 11-3 and Exhibit 11-12)
12	Design for Sustainability (12 Principles of Green Engineering Paper and UN SDGs); Work on Cost Estimate	Design for Sustainability Chart (12 Principles Framework + UNSDGs)
13	Review and Finalize Materials, Manufacturing Methods, and Design	Near-Final Product Specifications
14	Finalize Product Specifications and Compile Final Project Report	Final Product Specifications
15	Compile Final Project Report and Prepare for Final Presentation	Final Project Report