

MSE 4410: Capstone Engineering Design I

Credit hours and contact hours: 2-0-3-3

Instructor: Dr. Sundaresan Jayaraman

Textbook: K.T. Ulrich and S.D. Eppinger, *Product Design and Development*, McGraw-Hill, 6th Edition, 2016.

Specific course information

Catalog description: A capstone engineering design course covering the principles of concurrent product/process design and development. Team-based projects will explore product/process design and development.

Prerequisites: Senior Standing

Course: Required

Specific goals for the course

Outcomes of instruction:

1. Complete an open-ended team-based design project that will culminate in a project report and a final oral presentation.
2. Integrate knowledge of mathematics, science, and engineering to the design of a materials engineering system.
3. Apply and integrate knowledge from the structure, properties, processing, and performance of materials to solve materials selection and design problem.
4. Design a system, component, or process to specified performance objectives and needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
5. Appreciate diversity in design projects.
6. Identify, formulate, and solve materials engineering problems.
7. Understand the professional and ethical responsibility as a materials engineer.
8. Communicate effectively in both written reports and oral presentations.
9. Demonstrate a broad understanding of the impact of materials engineering solutions in a global, economic, environmental, and societal context.
10. Recognize the need for, and the ability to engage in, life-long learning.
11. Demonstrate knowledge of contemporary issues.

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 for 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.
- (7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topics covered:

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)
5. Fundamentals of Concurrent Engineering
6. DFX: Design for Manufacturability, Modularity, Quality, Affordability, Usability, Safety, Maintainability ...
7. ECD: Environmentally-Conscious Design
8. Industrial Design
9. Information Technology in Engineering Design
10. Design Management including Planning, Budgeting and Reporting
11. Intellectual Property: Strategies and the Protection Process Including Patents
12. Engineering Ethics and Professional Responsibilities as an Engineer

Correlation between Outcomes of Instruction and Student Outcomes:

Outcomes of Instruction	Student Outcomes						
	1	2	3	4	5	6	7
1. Complete an open-ended team-based design project that will culminate in a project report and a final oral presentation.	X	X	X	X	X		X
2. Integrate knowledge of mathematics, science, and engineering to the design of a materials engineering system.	X	X					
3. Apply and integrate knowledge from the structure, properties, processing, and performance of materials to solve materials selection and design problem.	X	X					
4. Design a system, component, or process to specified performance objectives and needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.		X		X			
5. Appreciate diversity in design projects.				X	X		
6. Identify, formulate, and solve materials engineering problems	X				X		
7. Understand the professional and ethical responsibility as a materials engineer.				X			
8. Communicate effectively in both written reports and oral presentations.			X				
9. Demonstrate a broad understanding of the impact of materials engineering solutions in a global, economic, environmental, and societal context.				X			
10. Recognize the need for, and the ability to engage in, life-long learning.					X		

School of Materials Science and Engineering 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 for 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.