

ENG ME 360 A1 - Product Design Fall 2021

Instructor

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Teaching Assistant(s)

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Office hours : MW, 10:00 am-12:00 pm

Class Meeting Places and Times

Section A1	MW	6:30 pm – 8:15 pm	Room ENG 302
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Catalog Course Description:

The course focuses on the use of engineering principles, simulation and physical models in product design. Hands-on exercises allow students to propose solutions to practical problems and to develop their ideas through the construction and testing of physical prototypes. Topics include Arduino sensing and control, principles of efficient mechanical design, manufacturing techniques, CAE tutorials for product simulation and prototype testing. (4 cr., 1st sem.)

Prerequisites

Students enrolled in ME 360 must have completed ME 357, Computer Aided Design and Machine Components.

Extended Course Description

ME360 Product Design is a project-based course, in which the instructional objectives are achieved through hands-on assignments that emphasize the application of theoretical knowledge to the solution of practical problems.

The course is aimed at developing practical skills and judgement that will enable students to predict the behavior of systems with varying degrees of complexity, to modify such behavior through design decisions and to explain and eliminate deviations from the intended behavior through analysis and design.

The first sessions of the course are dedicated to problem definition and basic communication using sketches.

The design of components and systems with varying degree of complexity is taught using a combination of demonstrations, tutorials and design exercises. Systems include structures, mechanisms, machines and electromechanical systems, in which concepts of different types of design tools and concepts are applied: static, kinematic, dynamic and electrical simulation, construction and troubleshooting.

The Arduino UNO platform is used to provide basic skills for the use of sensors and actuators and to allow the students to implement control functions in electromechanical systems. Basic electronics and programming workshops allow students to achieve the practical goals of the projects, and to prepare them for subsequent design courses in which a deeper knowledge of electromechanical systems is developed.

The use of CAE tools for the design of mechanical components and systems supplements the knowledge acquired in basic engineering courses, and it facilitates the study and design of complex geometries and architectures that are difficult to analyze using analytical methods. Students are trained in the use of software for the thermal and elastic analyses of mechanical components, the design and analysis of multi-body systems and the evaluation of hydrodynamic drag forces on complex geometries. They apply the acquired skills in the design and construction of physical systems.

This course constitutes a link between the fundamental, analysis-based, engineering courses and the higher-level, synthesis-based, design courses in the Mechanical Engineering curriculum.

Course Outcomes:

Students successfully completing ME 360 will:

- 1 Communicate with peers, instructors and technicians using sketches, drawings, presentations, text and multimedia tools, to facilitate the accurate interpretation of ideas and the manufacture of physical components and devices.
- 2 Be able to design mechanical components given geometrical and motion constraints, such as dimensions, tolerances and degrees of freedom.
- 3 Apply knowledge of manufacturing processes to the design of mechanical components and joints.
- 4 Make use of CAE tools to support design decisions.
- 5 Design systems that require the integration of mechanical, electrical and control components.

Course topics:

1. COMMUNICATION
 - Sketching
 - Problem definition
 - Technical drawing interpretation
 - Mechanical metrology

2. STRUCTURAL COMPONENT DESIGN

Function and shape
Stress and strain analysis
Dynamic analysis
Materials selection

3. MECHANISM DESIGN

Degrees of freedom, joints
Analysis of mechanisms
Synthesis of mechanisms
Multi-body simulation

4. MACHINE DESIGN

Motion conversion
Machine components
Motor sizing

5. ELECTROMECHANICAL SYSTEMS DESIGN

Microprocessor basics and programming
Sensing
Motor control

6. DESIGN PROJECT**Courseware**

Course reading material and assignments will be distributed online through Blackboard Learn.

Assignments and Grading

Assignment/project	Grade %
Mechanical metrology	10
Structural design	20
Mechanisms and electromechanical design	20
Design project	35
Design portfolio	15

Course grades will be computed by multiplying the total Grade % for all assignments by a factor from 0-1 that will be determined based on each student's attendance and participation in class exercises.

Resources

Teaching assistants will be available to support teams in prototyping, Arduino programming and use of CAD tools.

Each team will be assigned a container to store components and equipment used in the course projects. The teams are responsible for the containers and their contents. The containers shall not be damaged or modified in any way and shall be returned to the classroom at the end of the course.

Academic Behavior Standards

Your behavior in this course is bound by the Boston University Academic Conduct Code found at the website <http://www.bu.edu/academics/academic-conduct-code>. You are responsible for understanding the requirements of this code. If you are in doubt about whether any contemplated action in the course would violate the code, ask your instructor before doing it. Since this course has few objective exams, opportunities for cheating are reduced, but any work presented as your own must in fact be your own, and any work quoted or otherwise reused from others must be explicitly acknowledged. The source of images included in reports or presentations must be referenced.

Attendance and Team Contribution:

Students will receive no credit for in-class exercises in which they do not participate. There will be no opportunity to make-up for missed class exercises.

Team projects will receive a project grade. Each team member will be awarded a percentage of that grade based on her/his participation in the project. The percentage will be determined based on peer and instructor assessments.

Members are expected to inform their peers in a timely manner if unavoidable circumstances prevent their participation in scheduled team meetings. Team assignments will require all students to identify their unique contribution. Non-contribution to the team's progress will result in a failing grade for a given assignment, and sustained non-contribution, after warning, will result in a failing grade in the course.

Course Calendar

Session No.	Date	Module	Topics
1	9/8	COMMUNICATION	Sketching/Problem definition
2	9/13		Assignment 1: CNC manufacture of a gasket
3	9/15		Drawing interpretation, tolerancing
4	9/20		Drawing interpretation/Gasket testing
5	9/22	STRUCTURES	Function, rational shaping, static design
6	9/27		Dynamic design: theory and practice
7	9/29		Dynamic design in Solidworks
8	10/4		Materials selection
9	10/6	MECHANISMS	DOFs, joints, basic mechanism simulation
10	10/12		Multi-body simulation
11	10/13		Synthesis of mechanisms, basic types
12	10/18		Synthesis of mechanisms, intermediate
13	10/20	MACHINES	Motor sizing / Skateboard demos
14	10/25		Transmissions and machine components
15	10/27		Basic transmission design and simulation
16	11/1	ELECTROMECHANICAL SYSTEMS	Arduino basics
17	11/3		Sensing
18	11/8		Motor control
19	11/10	DESIGN PROJECT	Kickoff
20	11/15		Team meetings
21	11/17		Team meetings
22	11/22		Team meetings
23	11/29		Team meetings
24	12/1		Team meetings
25	12/6		Team meetings
26	12/8		Prototype testing day
27	12/10		Open day demonstrations
	12/12	Design portfolios due	