ENG ME 460 Senior Design I
(Fall 2022)

Instructors:

Prof. Anthony Linn
ENG-408
ablinn@bu.edu
Office hours by appointment

Prof. Steve Chomyszak
730 Comm Ave., Room 202F
schomysz@bu.edu
Office hours by appointment

Prof. Frank DiBella
ENG-307
fdibella@bu.edu
Office hours by appointment

Prof. James Geiger
ENG-307
jgeiger@bu.edu
Office hours by appointment

Graduate Student Teacher(s)
None assigned

Class Meeting Places and Times: (Locations may be revised)

M/W	10:10 AM – 11:55 AM	ENG 302	Section A1,	Linn
M/W	10:10 AM – 11:55 AM	STH 441	Section A4,	Chomyszak
M/W	12:20 PM – 2:05 PM	ENG 302	Section A2,	Linn
M/W	12:20 PM – 2:05 PM	STH B20	Section A5,	Di Bella
T/R	1:30 PM – 3:15 PM	ENG 302	Section A3,	Linn
T/R	1:30 PM – 3:15 PM	WED 206	Section A6,	Geiger

Course Website:
Blackboard Learn. The website contains common folder with information applicable to all sections and separate folders for information that professors may create for their individual sections.

Catalog Course Description:
The course develops skills that are crucial to the successful completion of the Senior Capstone Design project. The core technical framework is electro-mechanical systems. Through lectures, workshops, and online materials, students gain practical experience in component and system design, project planning, and engineering communications. The course guides students through execution and documentation of the conceptual design stage of their Capstone projects. (4 cr., 1st sem.)

Hub Learning Outcomes
Because of the intensely collaborative nature of senior projects, students are expected to complete ME460 and ME461 within the same team and within one academic year. As an outcome of successful completion of this course sequence, students will be able to craft responsible, considered, and well-structured arguments in writing, through oral or signed communication, and the use of graphic and electronic media. They will understand the capabilities of various media and be able to apply them with discernment to the occasion at hand. Moreover, as a result of being coached through the execution of an extended engineering project, they will gain transferrable skills in research and information literacy by using standard research and problem-solving tools and techniques of the engineering discipline.

When both ME460 and ME461 are completed, these courses together will satisfy the following BU Hub areas:

Writing-Intensive Course #2	1 unit
Oral and/or Signed Communication	1 unit
Digital/Multimedia Expression	1 unit
Research and Information Literacy	1 unit

Prerequisites:
CAS WR 150, Writing, Research, & Inquiry
ME 302, Mechanics II
ME 360, Product Design.
Students who wish to work on an aircraft design related capstone project, including AIAA or NASA competition projects and Design, Build and Fly (DBF) Glider projects, must have completed or be concurrently enrolled in ME 408 - Aircraft Performance and Design. ME 408 is not required for general aerospace and aerodynamics capstone projects.

Extended Course Description:
ME 460 is the first semester of a two-semester sequence (ME460/ME461). During the first semester students complete the definition of requirements for the senior capstone design project. Most assignments, both those directly related to the teams' own projects, and those related to developing competencies more generally, will be completed collaboratively within the capstone teams.

The overall objective of the ME460/ME461 sequence is the completion of the capstone project. ME460 develops skills that are crucial to the successful completion of the project. The importance of your interaction with customers, peers, and technicians is emphasized through lectures, discussion, and class exercises that immerse you in realistic scenarios, with many of the design challenges discussed drawn from capstone projects of previous years.

The technical component of the course (math and physics based) will support your work in both the preliminary and the detail design stages. Lectures and assigned readings will expose you to principles, tools, and practices of electro-mechanical design. In-class experiential learning, through hands-on contact with the hardware, and short exercises, will reinforce these concepts.

As the term progresses, the emphasis will shift from the mastery of technical concepts to formulating the conceptual design and the project plan for the teams' capstone projects (to be completed in the spring semester in ME461). The final deliverable of the Fall term will be an oral presentation, a written report of the conceptual design, and a model (physical, analytical, or numerical) that demonstrates the feasibility of the design.

Course Outcomes:

Students successfully completing ME 460 will have:

1. Gained appreciation for the breadth of knowledge, skills, and effort required to solve complex engineering problems within technical, economic, and societal constraints.
2. Through coached practice, learned transferrable research skills for solving problems and troubleshooting systems by decomposing them into related parts and methodically working through a hierarchy of probable causes and corrections.
3. Applied engineering principles and methods to the design, selection and integration of electro-mechanical system components.

4. Identified and documented appropriate background material: benchmarks of similar problems and solutions, citations of publicly available information, interviews with experts, and summaries of private communications.
5. Applied analysis tools, common in engineering, to the design of productive investigations and the selection of efficient research paths for the solution of problems. Examples include Functional Decomposition, Function and Means Charts, Decision Matrices, Ishikawa Diagrams, and the Shewert Cycle (Plan-Do-Measure-Adjust).
6. Established the stages and activities of a design project, identified research objectives and unambiguously visible development milestones, and made informed estimations of the required resources.
7. Identified unambiguously visible milestones to gage the progress of the work.
8. Developed skills required to communicate effectively with a variety of constituencies, technical and non-technical, in a variety of scenarios associated with a design project.
9. Developed effective means for collaboration in a team whose members represent diverse skills and perspectives.
10. Documented the conceptual design stage of the Senior Capstone design project, including the background material listed as item 4.
11. Established the platform for rapid progress toward the completion of the Senior Design Project in the second semester.

Technical Topics Covered:
The list below represents a range of problems and devices commonly encountered in projects. In class we will introduce a subset of them, with the hope that you will then have enough of a start to continue learning what you need when you encounter a real application.

1. ME 302 Topics, Mechanics 2
2. ME 360 Topics, Product Design
3. ME 408 Topics, Aircraft Design, (aerospace projects involving aircraft design only)

Project Management Topics Covered:
Research and Information Literacy Topics Covered:

By working within an extended structured project experience to solve a non-trivial technical problem, students will gain a transferrable understanding of the overall research process and its component parts and be able to formulate good research questions or hypotheses, gather and analyze information, and critique, interpret, and communicate findings.

Moreover, project definition and reporting will require students to search for, select, and use a range of publicly available and discipline-specific information sources ethically and strategically to address research questions.

Specifically, students will have the experience of:
1. Definition of project objectives, goals, and constraints
2. Identification of critical questions to be answered or capabilities to be developed
3. Identification and summary of available information resources
4. Capture and documentation of customer and technical requirements
5. Collaboration and teamwork
6. Project planning and tracking
7. Resource management, where resources may be bibliographic, human, and material
8. Written, Oral, and Multi-media Communication
9. Application of proven methodologies and engineering-specific research tools to enhance productivity in the research and development effort.

Senior capstone projects
Project descriptions will be posted on the course Blackboard portal. It is the students' responsibility to organize themselves in teams of no more than 5 members to select and execute their project.
Projects will not be assigned until teams have been formed. In situations where more than one team indicates interest in a project, the course instructors, with input from project customers, will determine which team is a best match for it.

The following important dates should be observed for the selection and assignment of capstone projects and individual writing assignments:

Dates	**Capstone Project Assignments**
Sep 06-Sep 13	Read project descriptions posted online and identify projects of interest.
Sep 06 -Sep 13	Submit student proposals, if any, to Professor Linn. Send e-mail for an appointment if you wish to discuss with Prof. Linn
Sep 06-Sep 16	Form teams with peers interested in similar project areas, e.g. aero, machine design, manufacture, etc.
Sep 16	Each team indicates its top four project choices through an online form (link to be posted)
Sep 21	Capstone projects assigned to teams
	Ethics Case Study
Sep 8, 12	Ethics Case Study Assigned
Sep 26	Case Study Draft Due for Writing Center Review
Sep 26-30	Drafts reviewed by Writing Center
Oct 3-10	Drafts reviewed during group meetings with Writing Center Tutor, online This is mandatory
Oct 17	Revised Draft, Final Essay Due
Oct 24	Graded Ethics Case Study returned
	Resume
Sep 13	Personal Resume Due

Ethics Assignment

At the second meeting of your class section you will begin an "Ethics Case Study". Our guest lecturer will be Professor Hauser, previous course coordinator for ME460/461. This year we have enlisted the services of writing tutors from the BU Writing Center who will review your draft essays and provide both feedback and grading of this individual assignment. See assignment dates in the table above.

Resume Assignment, Application to your team

You will be required to write your own resume. This will be used to apply to your team. Your resume may also be made available to prospective sponsors who would like to see the qualifications of the teams that they would like to sponsor. This is an individual assignment. See assignment dates above.

Peer Review

You and your teammates will be required to provide a peer review of you team members. You will be assigned this task at mid-term and at the end of the semester. Detailed peer review instructions will be provided before this task is assigned. The peer review can affect the team portion of your grade, either raise, lower or no effect depending upon you score.

Google Drive Organization

Your team is required to setup a Google Drive accessible by your instructors. This drive must conform to the format that will be provided. A shared drive link and the drive format description will be provided. This is extremely important; the drive is where your instructors will review your work. **If we can't find your work, then you can't get a grade.**

Finding a Team and Team Members

A Capstone Partner Matching worksheet will be made available through BlackBoard. Here you will be able to enter your contact information and whatever interests, availability and concentration requirements you may have.

Books and Other Printed References

Some in-class exercises will require the availability of a laptop computer or tablet. At least one member of each team should have access to such a device.

The following texts are useful references, but are not required:

Clive L. Dim, Patrick Little, Engineering Design: A Project-Based Introduction, 3rd Edition, ISBN 9780470225967. Summary and examples of project management practices and tools for design projects.

Robert C. Juvinall, Kurt M. Marshek, Fundamentals of Machine Component Design, John Wiley and Sons, ISBN-13: 978-1118012895, any edition

Andre Sharon, Machine Design and Control – A Systems Level Approach, Custom Printing , John Wiley and Sons, any edition

Machinery's Handbook, 29th ed., Industrial Press, 2012, ISBN 9780831129002, Any recent edition is useful. Check for online availability.

Edward R. Tufte, The Visual Display of Quantitative Information, 2nd ed., ISBN 978-0961392147. The classic treatise on "how to communicate information through the simultaneous presentation of words, numbers, and pictures."

Courseware

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

Assignments and Grading

Research and Benchmarking Report	10%
Customer Interview Summary	5%
Conceptual & Preliminary Design Reports	15%
Ethics Case Study	10%
Final Presentation and Written Report	40%
Teamwork and class participation (individual), Peer Review, Google Drive (Design Record)	20%

Resources

- Abstracts of final reports, as well as video recordings of final presentations for the past several years, are available at the department website. They are indexed at the course website.
- Graduate Student Teachers will be available to support teams in mechanics, Matlab and Arduino programming environments, and use of CAD tools.
- We anticipate being able to assign each team its own project-storage locker space.

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:
The primary metric of responsible attendance will be the student's degree of contribution to the team. 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. Students will receive no credit for in-class exercises for which they are not present. 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.

While success of the capstone project relies heavily on the coherent effort of the team, the course requires evidence of contribution from each individual. Due dates for individual assignments, or identified individual contributions in team-produced documents, are indicated in the course calendar.