ME4182/4723 Syllabus – Fall 2022

Capstone Design 0-2-6-3

Studios: Monday 12:30-2:25pm IC #103

Lab: Wednesday 12:30 – 3:15pm (Progress update by teams)

Office Hours: By appointment through https://go.oncehub.com/amitjariwala

Textbook: All required materials are available free to students through the Canvas LMS and online course websites (mecapstone.gatech.edu)

References:

Eugene A. Avallone, Theodore Baumeister, and Ali M. Sadegh, *Marks' Standard Handbook for Mechanical Engineers*, 11th Edition, McGraw-Hill, 2007.

Karl T. Ulrich and Steven D. Eppinger, *Product Design and Development*, 5th Edition, McGraw-Hill, 2011.

Harold Rothbart and Thomas H. Brown, *Mechanical Design Handbook*, 2nd Edition, McGraw-Hill, 2006.

Richard G. Budynas and J. Keith Nisbett, *Shigley's Mechanical Engineering Design*, 9th Edition, McGraw-Hill, 2011.

George E. Dieter and Linda C. Schmidt, *Engineering Design. A Materials and Processing Approach*, 5th Edition, McGraw-Hill, 2012.

ME 4315 Energy Systems Analysis and Design references.

General Information

Description

Seniors will work in teams to apply a systematic design process to real multi-disciplinary problems. Problems selected from a broad spectrum of interest areas, including biomedical, environmental, mechanical, industrial design, electrical and thermal/fluids. Projects must be based on the knowledge and skills acquired in earlier course work, and incorporate appropriate engineering standards and multiple realistic constraints. Emphasis is placed on the design process, the technical aspects of the design, and on reducing the proposed design to practice.

Pre- &/or Co-Requisites

Identical to existing major specific requirements for Capstone/Senior Design Class

For ME: ME 2110 Creative Decisions and Design, COE 3001 Mechanics of Deformable Bodies, ME 3017 System Dynamics, ME 3210 Design, Materials, and Manufacture, ME 3345 Heat Transfer, MATH 3670 Probability and Statistics with Applications, and (ME 3180 Machine Design or ME 4315 Energy Systems Design)

Course Outcomes:

Outcome 1: To enable students to synthesize the knowledge and skills acquired in their undergraduate curriculum, in the context of a realistic design project.

1.1 Students will be able to identify relevant topics from earlier courses, then apply them to their design project.

1.2 Students will be able to critically evaluate designs using engineering criteria and predictive usage.

Outcome 2: To develop in students the ability to address a broad range of requirements, including most of the following: performance, economic, marketing, environmental, sustainable, manufacturing, ethical, safety, social, and regulatory.

2.1 Students will demonstrate an ability to identify and specify design requirements, from general problem descriptions within the applicable realistic constraints.

2.2 Students will be able to systematically develop a design from the problem statement to a detailed, proof-of-concept design meeting all of the specifications.

Outcome 3: To prepare for the professional design environment, through teamwork and by enhancing student's communication abilities.

3.1 Students will be able to clearly communicate design ideas and information.

3.2 Students will be able to work collaboratively and responsibly as a team.

3.3 Students will demonstrate the ability to facilitate their learning by identifying design issues and questions that require additional investigation beyond their basic undergraduate curriculum knowledge, then formulating appropriate courses of action.

Correlation between Course Outcomes and ABET Student Outcomes:

ME 4723							
	Student Outcomes						
Course Outcomes	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Course Outcome 1.1	X	X					
Course Outcome 1.2	X	X		X			X
Course Outcome 2.1	X	X		X			X
Course Outcome 2.2	X	X		X			X
Course Outcome 3.1			X		X		
Course Outcome 3.2					X		
Course Outcome 3.3		X		X			X

ABET 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.

Course Requirements & Grading

1. Team component of grade (75%)
    a. Weekly lab team meetings, weekly deliverables* (10%)
    b. Oral presentations and written reports (65%)
2. Individual Component of Grade (25%)
    a. Peer evaluations (15%)
    b. Individual participation during weekly meetings and progress presentations (10%)

* All team members MAY not receive the same grade.

Weekly lab deliverables

Weekly deliverables are at the discretion of the faculty. They are advisory with respect to the project scope and team's progress. Following is a suggested guideline:

Week #	Suggested Lab Deliverable
1	Team Formation and Project Bid Submission
2	Problem statement and Organization
3	User Needs, Specifications, Codes and Standards
4	Market Research & Prior Art Analysis. Preliminary Ideation Report
5	**Interim Report Oral Presentation and Report Submission**
6	Project update, discussion and Feedback on Interim Report
7	Engineering Feasibility Analysis and Preliminary CAD
8	Engineering analyses, CAD and prototyping update
9	Engineering Risk Analysis
10	**Interim Report Oral Presentation and Report Submission**
11	Update on Engineering analyses and CAD
12	Update on Engineering analyses and CAD
13	Update on Engineering analyses and CAD
14	Institute Holiday
15	**Final Project Oral Presentation**
16	**Final Report Submission**

Studios

Experts from Industry and Academic will lead discussions on topics relevant to engineering design and the course. The topics may include the following:

1) *Problem definition.*
2) *Specification formulation within given constraints.*
3) *Review of design process and design ideation.*
4) *Human factors.*
5) *Market research.*
6) *Product and patent research.*
7) *Manufacturing considerations.*
8) *Safety and risk assessment.*
9) *Liability and ethics.*
10) *Environmental, sustainability, and societal considerations.*
11) *Proof-of-concept methods.*
12) *Codes and standards.*

Grading Scale

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%

In general, you are being graded on how you bring your knowledge as a graduating engineer to bear on a "real world" design problem. The best way to approach the project is to consider yourself either as part of a research and development group and/or an entrepreneur working on a new design. The deliverable is a report (with associated presentation and poster) in which you have to justify the correctness of your recommendations and proof of concept of the final design to your client. The faculty will be looking for well worked out (i.e., quantified) solutions. Faculty will place an emphasis on quantitative analyses that show that you are qualified to work as an engineer after graduation.

An A level final report meets two basic criteria: 1) a third party (e.g. another student or engineer) should be able to manufacture the design from the information present in your report, and 2) your report should provide proof and confidence that the design will work as you describe and expect it to.

Course Materials

All necessary reading materials will be posted on course website, https://mecapstone.gatech.edu/ and/or on CAVNAS. Each team may receive a reimbursement for their project prototyping expenses, only if the prototyping activity was approved by the team's faculty instructor. The team is expected to designate a team financial manager to collect receipts and submit reimbursement paperwork per posted instructions on the course website.

Course Expectations & Guidelines

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or http://www.catalog.gatech.edu/rules/18/.

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodations, contact the Office of Disability Services at (404)894-2563 or http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodation letter. Please also e-mail faculty as soon as possible in order to set up a time to discuss your learning needs.

Attendance and/or Participation

You will be working on teams to complete the course projects. Studios will reinforce engineering design concepts from earlier classes and discuss topics relevant for the course project. Students are strongly encouraged to attend and participate during all scheduled studios.

Students will meet as a team with the instructor during the supervised lab times. Attendance and active participation at these supervised lab meetings are mandatory.

Collaboration & Group Work

The course project deliverables are to be submitted as a team. Students are encouraged to seek advice and guidance from people and learning materials outside of the class. Students will be required to submit peer-evaluations as individuals to score the contribution from themselves as well as their team members.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See http://www.catalog.gatech.edu/rules/22/ for an articulation of some basic expectation that you can have of faculty and that faculty have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, we encourage you to remain committed to the ideals of Georgia Tech while in this class.

Campus Resources for Students

Visit this page https://ctl.gatech.edu/sites/default/files/documents/campus_resources_students.pdf for a list of relevant campus resources available to Georgia Tech students.

Mental Health & Wellness: As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, depression, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. GT offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know is experiencing any of the issues noted above, consider utilizing the confidential mental health services available on campus. I encourage you to reach out to GT CARE (www.care.gatech.edu, 404-894-3498) or the Counseling Center (www.counseling.gatech.edu, 404-894-2575) for support. An on-campus counselor or after-hours services are available to assist you.