CREATE-X Capstone Design
ME4723-X/X01, CS4723-X/X01, ECE4853 X/LX, BME4723-X/X01, ISYE 4106
Capstone Design CREATE-X (1-6-3)

Prerequisites: Identical to existing major specific requirements
(i.e., for ME students, ME 2110, ME 3180 or ME 4315, ME 3210 (co-req) – SAME AS ME 4182,
for BME students, BMED 3610 (co-req), BMED 2310,
for ECE students, ECE 3882 and {ECE3020 and ECE3030 or ECE3025 and ECE3084)
for CS students, CS2340
for ISyE students, ISYE 3024, ISYE 3133, ISYE 3044, ISYE 4800

Course Description: Seniors will work in teams to apply a systematic design process to real multidisciplinary problems. Problems selected from a broad spectrum of interest areas, including computational, 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. The course consists of faculty and guest lectures, prototyping in design studios, and a multidisciplinary team project.

Textbook: No text.

Reports: Regular oral progress reports, project design notebooks, written reports and final project documentation (described below) are to be written and/or presented. The final project documentation should be done in appropriate modeling and drawing software. Deliverables and grading criteria are described in detail below.

Attendance: Each student is **required** to participate in the oral presentations during the semester and Capstone Design Expo at the end of the semester. Failure to attend may, at the instructor's discretion, result in a failing grade in the course. Attendance is strongly encouraged at all group meetings / work sessions, class lectures, and class presentation sessions.

Topics Covered:
1. Business thesis
2. Marketing sizing/research
3. Evidence based entrepreneurship
4. Value proposition
5. Business model canvas
6. Minimum viable product
7. Project selection
8. Specification formulation within given constraints
9. Project planning, budgeting
10. Product and patent research
11. Industrial design
12. Manufacturing considerations
13. Proof-of-Concept methods
14. Societal, environmental and sustainability considerations
15. Ethics, safety, product liability
16. Codes and standards and regulatory affairs
17. Professional licensure, FE/PE exams

Interactions with Sponsors & Mentors: Students will be required to provide weekly updates on their interactions with sponsors and mentors and their feedback on the projects.

Course Objectives:

1: As part of this course, students give oral technical presentations and written technical reports.
2: As part of this course, students work in interdisciplinary teams to meet a common senior design project goal.
3: As part of this course, students provide regular written reports and attend regular team meetings with a faculty advisor.
4: As part of this course, students attend and present at the Senior Design Capstone Design Expo at the end of the semester.
5: As part of this course, students apply the knowledge gained from their undergraduate courses towards a culminating senior design project.

Course Outcomes:

1: Students are capable of synthesizing knowledge and skills acquired in their undergraduate curriculum, in the context of a realistic design project.

1.1 Students identify relevant topics from earlier courses and apply them to their design project.
1.2 Students critically evaluate designs using engineering criteria and predictive usage.

2: Students develop the ability to address a broad range of requirements, including most of the following: performance, economic, marketing, intellectual property considerations, manufacturing at various rates, ethical, and safety.

2.1 Students demonstrate an ability to identify and specify design requirements, from general problem descriptions within the applicable realistic constraints.
2.2 Students systematically develop a design from the problem statement to a detailed, proof-of-concept design meeting all of the specifications.

3: Students are prepared for the professional design environment by learning how to learn, through teamwork and by enhancing student's communication abilities.

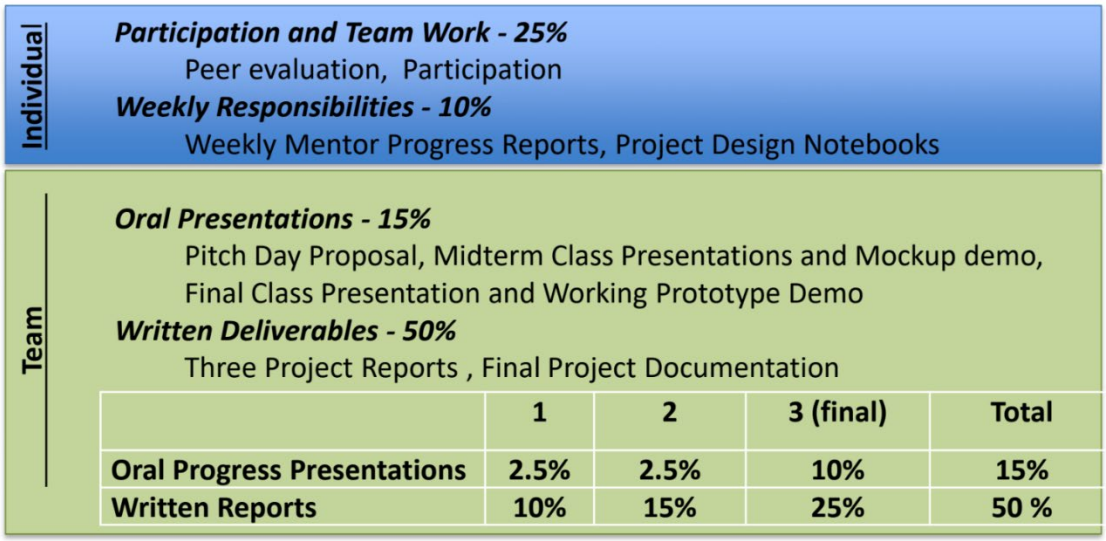
3.1 Students clearly communicate design ideas and information.
3.2 Students work collaboratively and responsibly as a team.
3.3 Students demonstrate the ability to facilitate their learning by identifying design issues and questions that require additional investigation, then formulating appropriate courses of action.

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 accommodation, 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 accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

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 me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Deliverables and Grading Criteria:



	1	2	3 (final)	Total
Oral Progress Presentations	**2.5%**	**2.5%**	**10%**	**15%**
Written Reports	**10%**	**15%**	**25%**	**50 %**

Participation and Team Work - 25%

Peer evaluation – Each design team should participate in a formal peer review process to assess both team and individual performance at both the project proposal and the project completion stages. These peer evaluations will be used by the mentors and instuctors to calibrate the final course grades.

Participation and Professionalism– The participation score is computed from a combination of mentor feedback, filling out in-class critique forms on presentations, presence at presentations, attendance at team meetings, time input throughout the semester, and attendance at classes and the expo. Not attending the required Capstone Expo will result in a zero in the participation category.

Weekly Responsibilities - 10%

Weekly Mentor Progress Reports – Periodic progress reports are presented to your mentor wherein each report must include both team and individual contributions. Success in this category requires attendance at weekly mentor meetings and clear concise discussion on team and individual progress each week.

Project Design Notebooks – Each individual or each team may keep a project design notebook to capture salient project design concepts, meeting notes, experimental measurements, etc. Successful teams in the past have accomplished this, for example, with a shared Google Doc, updated with notes from every meeting and pictures of any sketches or prototyping. These notebooks may be collected and individually graded by the project advisor/TA during the semester, and should be used to help in the writing of the final reports.

Written Deliverables - 50%

Three Project Reports – Each design team must submit 2 formal, written intermediate reports (10 and 15%) and 1 final report (25%) that, in connection with the oral presentations and project design notebooks, supplies sufficient information to allow project replication by a suitable engineering team, or, if appropriate, project continuation by another student team. Reports must include Customer Discovery information, detailed discussion of the initial problem, intermediate solutions, and final solution that the team creates, in accordance with the outline provided for each report. Hand Sketches and pencil calculations are NOT suitable for formal reports. Use of AI as a tool to improve report quality is **encouraged**, however, *a poorly written report found to be AI generated will receive harsher penalty than a poor student-written report*.

Final Project Documentation – Complete project documentation package must be submitted electronically to receive a grade for the course. This documentation, in conjunction with the final report, **must contain,** as a minimum, sufficient information for a different team to **completely replicate the project**, including, but not limited to **all written code, diagrams, bill of materials, CAD drawings, and/or instructional manuals**. This submission will be reviewed for proficiency and checked for plagiarism as we assess your work.

Oral Progress Presentations - 15%

Pitch Day Proposal (Presentation 0) – The first oral presentation will happen near the beginning of the semester and will describe the proposed project in a short pitch. Acceptance and certification of the design project by the faculty advisor, including the incorporation of any requested adjustments is required to achieve a passing grade for this assignment. Project scope may be changed, i.e., narrowed or expanded, with the concurrence of the mentoring faculty member.

Midterm Class Presentations (Presentation 1&2)– Two oral presentations worth 2.5 % of your grade each will occur mid-semester and are the chance to receive honest feedback from peers and mentors to help the team recalibrate and push the project forward. Success includes convincing discussion on customer discovery, the problem the team intends to solve and directed discussion on the solution space, as well as the team's solution.

Mockup demo – At Presentation 2, each team must show a low fidelity mockup of their chosen design concept, whether physical or vitual (if software based). This is a non-functional model intended to convey to the audience some aspects of the form of the solution.

Final Class Presentation (Presentation 3) – The last oral presentation worth 10% of your grade will happen in the final week of the course. A successful presentation should discuss the problem with a nod to customer discovery, and highlight the solution with an in-person demo of a **working prototype** of the team's solution.

Working prototype demo – Prior to the end of the semester, each team must demonstrate their project to their faculty advisor and compare functional results with project design goals and specifications. This demonstration should take place live during both the prototype demo presentation as well as during the final presentation. If the prototype is not suitable for a demonstration at the final presentation, then some visual representation of project functionality should appear in the final presentation but may result in grade deduction. It is not appropriate to rely on videos, powerpoint slides, animations or Figma app mockups to serve as a working protoype demo.

Incidentally, separately, the prototype will also be shown at the Capstone Expo.

Grade Assignment

Participation and Team Work grades are assessed based on the peer evaluation results and the observations of the faculty mentor. Grades in both categories are assigned to each individual student by the faculty mentor. Students may receive deductions up to and including a ZERO in this grade category should their participation and team work be deemed insufficient, or unprofessional and the mentor maintains the right to deduct points in other categories to reflect a deficit in effort by an individual student, should this be necessary. Participation score is often based on the percent of hours a student likely worked based on the expectation of a 12 hour/week commitment. Ex) 6 hours a week will get you a 50% in the participation category.

Oral Progress Presentations are graded by taking an average of the grades assigned by all mentors in attendance at the presentations. Faculty Mentors receive a short survey, which they fill out during the presentation to assign a grade to each team. Mentors are encouraged to evaluate the team grades comparitively against their peers. Teams who polish their presentation and make coherent, evidence based arguments to back up their claims receive better scores. The Faculty grades and comments are sent to each team in order to help them improve for future presentations. The assigned grades are averaged to yield the final presenation grade of the team.

Report Grades are assessed using a common rubric, but the *person who assigns* the grade differs between majors.

ME, CS, ECE, BME

Report grades and feedback will be assigned by the faculty mentor of the team, following a common provided rubric. Grade disputes or questions can be discussed directly with the faculty mentor.

ISYE Only

A separate Faculty Evaluator assigns report grades and feedback, in keeping with ISYE guidelines. This avoids biases in grading so that the person advising the team on a project is not the same as the one assigning grades to the project. The evaluators follow the same common rubric as the rest of the class. Grade disputes or questions should be discussed with the evaluator, rather than the faculty mentor.

Teams with ECE Students

All teams having at least one ECE student must choose a project having a physical embedded electrical component as part of the design. The electrical and/or computer engineering aspects of the design must be thoroughly analyzed and documented in the reports.

****All grades are submitted to and reviewed by the instructor on record for the course. Extensive grade disputes may be mediated and dealt with before the end of the semester by the instructor on record.*

Course Timeline: topics, deliverables, and goals

The detailed course schedule provided on Canvas will be followed in the course. The timeline below summarizes its key topics, deliveables, and goals to assist you with planning and action.

Week	In-Class Topic	Deliverables & Action Items	Project Completion Goal
1	Intro, Expectation, Team Formation, Idea Generation	Team Forming	Form Team, begin Customer Interviews
1.5	Customery Discovery, Business Thesis	Customer Interviews	Start narrowing down Problems of Interest
2	Evidence-based Entrepreneurship	Thesis Testing Results	Test business thesis with customers
3	Labor Day	Mentor Meeting	Hone in on Final problem, begin considering solutions
4	Minimum Viable Product, Market Strategy	Pitch Day	Make short speech to Pitch the problem, suggest one possible solution
5	Design ideation and specifications	Report 1 Due	Narrow solution space using feedback, Create Presentation 1
6	Presentation 1		Design Ideation, start prototyping
7	After the Class		Hone in on Solution, order supplies
8	Patents		Mid-Fidelity Prototype Finished
9	Finding Capital	Report 2 and Presentation 2 Due	Initial Mockup/ Low Fidelity Prototype, Finish Report
10	Prototyping	Report 2 Due	Presentation 2
11			Begin Ideation on Final Prototype
12			Finish up Final Prototype
13		1:1 Demo Prototype Session	Final High-Fidelity Prototype due, Polish Final Presentation
14	Team Presentations	Final Presentation and Demo	Final Adjustments to Prototype due, Polish Final Report
15		Final Report	Make Poster and Design Expo Setup
	Tuesday, Dec 5th	Capstone Expo	

Each Week for the first half of the semester we will cover a topic for in-class lecture. These classes will help to orient the teams and teach important entrepreneurial concepts. Additionally, each week the team will meet with their mentor for a 30-minute window. This meeting should allow the team to build their project and direct the team onto the best path. This meeting should help the team present, finish, and polish their deliverables and keep them on track.