ECE 3011	**ECE Design Fundamentals**
Course Coordinator	Brothers, Tim
Class/ Studio Hours	1 hour of class and 2 hours of studio per week for 2 hours total (1:1:0:2)
Prerequisites	ECE2031 AND ECE2040 AND (ECE2035 OR ECE2036)
Corequisites	None
Catalog Description	This course teaches system-level design, including both software and hardware. Through activities and projects, students gain exposure to entrepreneurship, product lifecycle management, prototyping, and testing. Use of this class towards BS EE and BS CmpE degrees.
Textbook(s)	None

Instructors

Prof. Tim Brothers
Email: timothy.brothers@ece.gatech.edu
Dr. Ben Yang
Email: byang92@gatech.edu
See Canvas for Office Hours

Learning outcomes:

At the end of the term, students will be able to

- development documentation for the lifecycle of a product
- perform task decomposition
- develop and conduct a validation plan
- select appropriate components based on end use and economic and energy considerations
- work in teams to design engineering systems
- perform a needs analysis to determine the demand for a product
- understand the fundamentals of design and be able to conduct a design and build of a product from the fundamental requirements through testing

Course objectives:

As part of this course, students are expected to demonstrate skills aligning with the following Student Outcomes:

ABET Outcome 1: Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

1. This outcome is not covered in this course.

ABET Outcome 2: 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

Primary

1. The student will consider the engineering design process as related to human factors specifically examining health, safety, and welfare of the end user as well as the global and environmental impact of their design.
2. The student will design a top-level block diagram for an engineering system that will meet specific customer needs as well as examine the system impact from a cultural, social, environmental, and economic viewpoint.

ABET Outcome 3: Communicate effectively with a range of audiences

Moderate

1. The student will demonstrate communication to a technical audience by creating a video presenting their final design project.
2. The student will demonstrate communication to a non-technical audience by creating a video for their final exam focusing on an entrepreneurial project.

ABET Outcome 4: 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

Primary

1. After watching the Incident at Morales video (commissioned by the National Institute for Engineering Ethics) the student will be able to identify and list possible ethical situations.
2. After watching the Incident at Morales video (commissioned by the National Institute for Engineering Ethics) the student will be able to examine a situation and determine professional responsibilities of an engineer for global, economic, environmental, and societal responsibility.

ABET Outcome 5: Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

Primary

1. Student will be able to identify behavior that is harmful to a team dynamic.
2. Student will list methods of creating an inclusive environment.
3. Student will create a draft schedule for a design project
4. Student will self-evaluate how he/she was able to meet objectives over the course of the semester after the completion of the design project.

ABET Outcome 6: Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

1. This outcome is not covered in this course.

ABET Outcome 7: Acquire and apply new knowledge as needed, using appropriate learning strategies.

Primary

1. The student will demonstrate the ability to solder or debug an electrical circuit.
2. The student will demonstrate the ability to independently learn one of the following skills:
    a. Project Management
    b. Surface Mount Soldering
    c. PCB Fabrication
    d. Machine Shop Certification
    e. Laser Cutting
    f. 3D Printing
    g. CAD Design

Past Projects:
Explore past project at the following site:
https://sites.gatech.edu/ece-design-fundamentals-museum/

Topical Outline:

- Design Processes
  - Requirements Decomposition
  - System-level thinking and task decomposition
  - Design patterns
  - Design methods
- Software Design
  - Software Decomposition
  - Simulation
- Effective Team Dynamics
- Hardware Design and Prototyping
  - Protection/ Safety
  - Parts selection
  - Prototyping Skills
  - Schematic / Printed Circuit Board design
- Ethical Considerations in Engineering Design
- Human-Centered Design and Introduction to Entrepreneurship
  - Design Thinking
  - Human Factors

Grading:

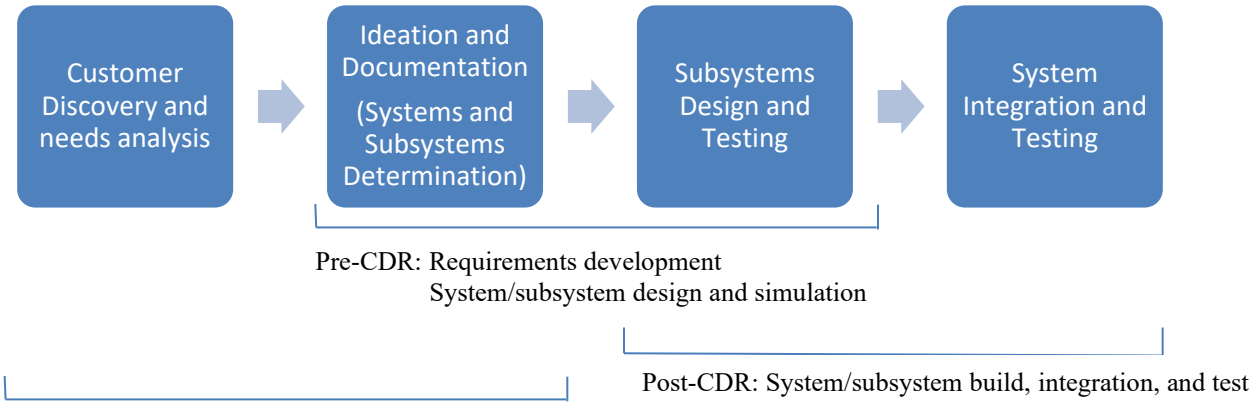
Task	Topic	Percent Grade
Design Project	Preliminary Design Review	10
	Critical Design Review	15
	Final Demonstration and Reports	30
Entrepreneurial Project	Final Exam	10
Skills	Basic Skill	2.5
	Advanced Skill	2.5
Attendance and Assignments	Assignments	20
	Attendance and Knowledge Checks	10

Note, in place of a final, students will present their Entrepreneurial Project in via a pre-recorded video during the final exam period.

"Students must be graded against a set of standards, not solely on their performance relative to their classmates," according to Rule V of the Rules and Regulations. Thus, no curve will be applied to the class. For more information, consult the Catalog: https://catalog.gatech.edu/rules/5/.

Grade as Reported in CANVAS	Letter Grade
≥ 90	A
≥ 80 *and* < 90	B
≥ 70 *and* < 80	C
≥ 60 *and* < 70	D
< 60	F

Overview of Projects:
A rough view of the design process includes the following steps along with the part of the process that the three main stages of the class address. Where CDR stands for Critical Design Review.



Overview of Skills:

To receive credit for this class every individual is required to complete a set of skills. Each member of the class must complete the one basic skill and at least one advance skill.

Basic Skills	**Advanced Skills**	
Soldering (ECE)	Project Management (Group Lead)	Laser Cutting (IDC)
Debug Circuit (ECE)	Surface Mount Soldering (ECE Shop)	3D Printing (IDC)
	PCB Fabrication (IDC)	CAD Design (Individual)
	Machine Shop Certification(s) (ECE or IDC)	

Class Cadence:

Attendance is required for ECE 3011 and does not support remote students. ECE 3011 has a lecture portion and a studio period. The studio time is mostly dedicated to working on team projects throughout the semester. We will break the class into teams of between 3-5 students. The project expectations will be greater for teams with larger number of students. ECE 3011 shall have a weekly rhythm as follows.

- **Prior week to class:** A lecture video shall be posted to CANVAS. Make sure to watch the video BEFORE class.
- **Class Lecture:** We shall start the class with a simple quiz (knowledge check) to ensure that each student has watched the lecture video prior to class. The Knowledge Check quiz opens 5 minutes before class the class start time and closes 5 minutes after the class start. You will have 5 minutes to complete the quiz after you initiate it. These are hard start/stop times that track attendance and measure your preparation. No exceptions will be made. Classes will be held in-person though they will be recorded and archived for future viewing.
- **Studio Time:** We will meet in-personal or virtually with the design teams. Scheduling will vary over the semester given the current activity. Check CANVAS for the weekly schedule.
- **Team Projects:** This course will focus on two projects over the course of the semester. A design project that entails design, fabrication, integration, and demonstration. Followed by an entrepreneurial project where a market survey is conducted to examine the viability of a product.
- **Attendance:** We will be taking attendance for the class time as well as studio time.
- **Final Exam:** Shall be a power-point and a video submission detailing the entrepreneurial project. The professor will meet with the team in-person or virtually.

Course Expectations & Guidelines

Absence and Late Policy

We will abide by the Institute policy on attendance, see http://catalog.gatech.edu/rules/4/. The following policies apply to this course: Students are required to complete all course assignments and in-class activities. Please discuss all absences with the course instructors, prior to the absence if it is planned. If not an excused absence, credit will be deducted from project work and other assignments will not be accepted late.

- Students are required to complete all course assignments and in-class activities
- Covid-related guidance: ECE3011 will allow for excused absences that follow the Georgia Tech guidance for circumstances that require isolation and quarantine.
- All other cases for missing class are at the discretion of the instructor for allowing students to make up all or part of the work. To allow for these types of absences on a broad basis, ECE3011 will drop the two lowest Knowledge Check grades. Please contact the instructor as soon as possible to request consideration.
- If not an excused absence or the instructor has not allowed for the work to be made up, credit will be deducted from project work, and other assignments will not be accepted late.

Religious Considerations

If you are going to miss class due to religious observances, you must provide a letter with the dates of the absences within the first two weeks of class in accordance with the Rules and Regulations article IV section B.5 http://catalog.gatech.edu/rules/4/. The instructors will work with the students on an individual basis to make accommodation.

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 or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Use of Large Language Models (LLM) or Artificial Intelligence (AI)

It is your responsibility to learn the skills, knowledge, and critical thinking required for this course. Over-reliance on AI can hinder your learning process. You are accountable for the content of any assignments or projects you submit. While you are not allowed to use generative AI to write your answers or complete reflections in assignments, you may use it for editorial assistance to improve your writing. In general, use AI as a tool to assist you in this class, such as for editorial help, brainstorming feedback, and surveying existing methods. Always acknowledge the use of AI in any assignment or project.

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/, and http://disabilityservices.gatech.edu/content/welcome-accommodate 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.

Collaboration & Group Work

The projects must be done by a team of students. Students will have some time during class period to work on their projects but must also plan to work with their teams outside of class time. All students will be working in groups for the projects and many in-class activities. All students are expected to participate substantially. If a student is not contributing to the group, the instructor should be informed immediately. There will be a group meeting with the instructor to try to address the issues. If the issues continue the offending student shall be removed from the group and will complete the remaining work of the semester individually. At all times students are expected to follow the Academic Honor Code (http://www.catalog.gatech.edu/policies/honor-code/)

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.