

**ECE 3872****ECE Design Fundamentals**

**Course Coordinator** Brothers, Tim

**Class/ Lab Hours** 1 hour of class and 2 hours of studio per week (1:1:0)

**Prerequisites** ECE2026 AND 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

Office: Van Leer 329

Email: [timothy.brothers@ece.gatech.edu](mailto:timothy.brothers@ece.gatech.edu)

Phone: 404-894-2922

Dr. Benjamin B. Yang

Office: Van Leer 370

Email: [benjamin.yang@gtri.gatech.edu](mailto:benjamin.yang@gtri.gatech.edu)

Phone: 404-407-6737

\*See **CANVAS -> ECE 3872 -> Home -> Meetings** for office hour times.

**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:

<b>ABET Outcome 1:</b> Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
1. This outcome is not covered in this course.
<b>ABET Outcome 2:</b> 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.
<b>ABET Outcome 3:</b> 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.
<b>ABET Outcome 4:</b> 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.
<b>ABET Outcome 5:</b> 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.
<b>ABET Outcome 6:</b> 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.
<b>ABET Outcome 7:</b> 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
- Human-Centered Design
  - Design Thinking
  - Human Factors
- Ethical Considerations in Engineering Design
- Introduction to Entrepreneurship

**Grading:**

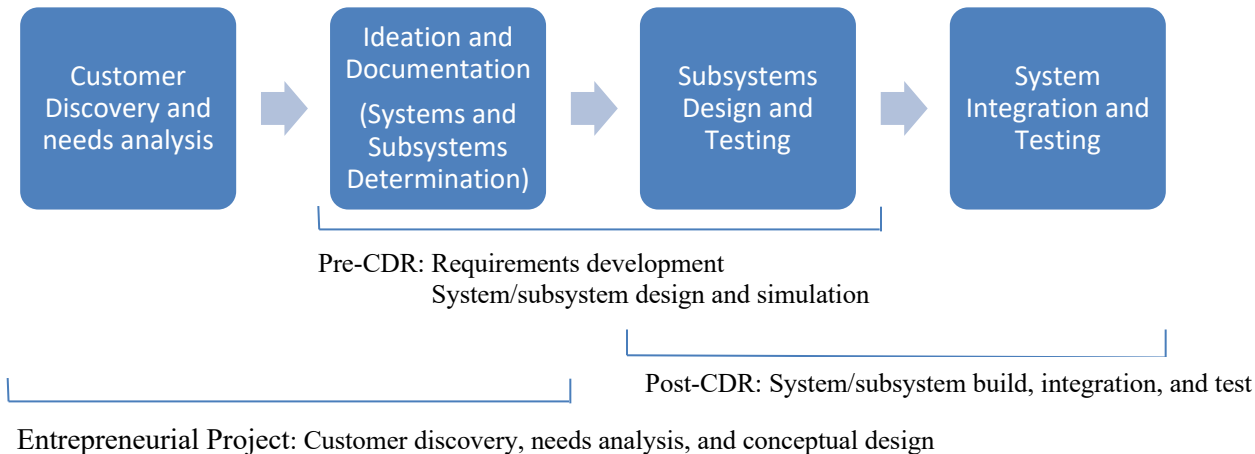
<u>Task</u>	<u>Topic</u>	<u>Percent Grade</u>
Design Project	Proposal & Preliminary Design Review	10
	Critical Design Review	15
	Final Demonstration and Reports	30
Entrepreneurial Project	Project and Final Exam	10
Skills	Basic Skill	2.5
	Advanced Skill	2.5
Attendance and Assignments	Assignments	20
	Attendance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

To be consider in attendance you must be present in BlueJeans with your web cam turned on and a working microphone. If you do not have a working web cam and/or microphone you will have points deducted from the attendance score.

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

### 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)	

### Considerations for Hybrid format:

ECE 3872 is being offered in hybrid format and does not support fully remote students. ECE 3872 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. To minimize classroom exposure, ECE 3872 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. Class will be held virtually in Bluejeans to work any sample problems and answer questions. As of this writing, 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 virtual Bluejeans class time as well as the in-person 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.

## **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. The instructors will work with the students on an individual basis to try to accommodate as best as possible.

## **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.

## **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. All students working in groups in the in-class activities and in the projects are expected to participate substantially. 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. At all times students are expected to follow the Academic Honor Code (<http://www.catalog.gatech.edu/policies/honor-code/>)

## Requirements and Guidelines Specific to COVID

This semester is especially challenging due to the Covid-19 pandemic and a growing awareness of racial inequities. The following information relates to specific services and guidelines for courses during this semester. The most up-to-date information on Covid-19 is on the [TECH Moving Forward](#) website and in the [Academic Restart Frequently Asked Questions](#).

### Expectations and Guidelines

Each of us has a responsibility to ourselves and our fellow Yellow Jackets to be mindful of our shared commitment.

- We are all required to wear a face covering while inside any campus facilities/buildings, including during in-person classes, and to adhere to social distancing of at least 6 feet. If an individual forgets to bring a face covering to class or into any indoor space, there will be a clearly marked supply of these in each building. If a student fails to follow Georgia Tech's policies on social distancing and face coverings, they will initially be reminded of the policy and if necessary, asked to leave the class, meeting, or space. If they still fail to follow the policy, they may be referred to the Office of the Dean of Students. [Information on the Institute's policy on face coverings](#).
- Students are expected to sit in assigned seats and to come to class only on days that are assigned to them.
- Papers, projects, tests, homework, and other assignments will only be accepted in electronic form unless the assignment is a physical artifact.

Additional information is available in the [Student Guidebook](#).

### Student Illness or Exposure to Covid-19

During the semester, you may be required to quarantine or self-isolate to avoid the risk of infection to others. Quarantine is the separation of those who have been exposed to someone with Covid-19 but who are not ill; isolation is the separation of those who have tested positive for Covid-19 or been diagnosed with Covid-19 by symptoms.

If you have not tested positive but are ill or have been exposed to someone who is ill, please follow the [Covid-19 Exposure Decision Tree](#) for reporting your illness.

During the quarantine or isolation period you may feel completely well, ill but able to work as usual, or too ill to work until you recover.

Unless you are too ill to work, you should be able to complete your remote work while in quarantine or isolation.

If you are ill and unable to do course work this will be treated similarly to any student illness. The Dean of Students will have been contacted when you report your positive test or are told that it is necessary to quarantine and will notify your instructor that you may be unable to attend class events or finish your work as the result of a health issue. Your instructor will not be told the reason. We have asked all faculty to be lenient and understanding when setting work deadlines or expecting students to finish work, and so you should be able to catch up with any work that you miss while in quarantine or isolation. Your instructor may make available any

video recordings of classes or slides that have been used while you are absent, and may prepare some complementary asynchronous assignments that compensate for your inability to participate in class sessions. Ask your instructor for the details.

### **Accommodations for Students at Higher Risk for Severe Illness with Covid-19**

Students may request an accommodation through the Office of Disability Services (ODS) due to 1) presence of a condition as defined by the Americans with Disabilities Act (ADA), or 2) identification as an individual of higher risk for Covid-19, as defined by the Centers for Disease Control (CDC). Registering with ODS is a 3-step process that includes completing an application, uploading documentation related to the accommodation request, and scheduling an appointment for an “intake meeting” (either in person or via phone or video conference) with a disability coordinator.

If you have been approved by ODS for an accommodation, I will work closely with you to understand your needs and make a good faith effort to investigate whether or not requested accommodations are possible for this course. If the accommodation request results in a fundamental alteration of the stated learning outcome of this course, ODS, academic advisors, and the school offering the course will work with you to find a suitable alternative that as far as possible preserves your progress toward graduation.