**ECE 3872: ECE Design Fundamentals**

**Prerequisites:** ECE2026 AND ECE2031 AND ECE2040 AND (ECE2035 OR ECE2036)

**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.

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**Topical Outline:**
    Design Processes (3 weeks)
        Requirements Decomposition
        System-level thinking and task decomposition
        Design patterns
        Design methods
        Working in Teams
    Software Design (1 week)
        Software Decomposition
        Simulation
    Hardware Design and Prototyping (3 weeks)
        Protection/ Safety
        Parts selection (motors)
        Prototyping Skills (soldering)
        Schematic / Printed Circuit Board design
    Human-Centered Design (1 weeks)
        Design Thinking
        Human Factors
    Effective Team Dynamics (1 week)
    Applications of Probability/Reliability (0.5 weeks)
    Thermal Considerations (0.5 weeks)
    Ethical Considerations in Engineering Design (2 week)
    Introduction to Entrepreneurship (2 weeks)

**Grading:**

| | |
|---|---|
| Projects: | 60% |
|     Software Simulation (15%) | |
|     Design Project (30%) | |
|     Entrepreneurial Project (15%) | |
| Assignments and In-class activities/attendance: | 20% |
| In-class activities/attendance: | 10% |
| Knowledge Checks | 5% |
| Teamwork Plans, Reflection, and Critiques | 5% |

The 2 lowest Knowledge Check grades will be dropped.

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 Bluejeans (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 projects address:
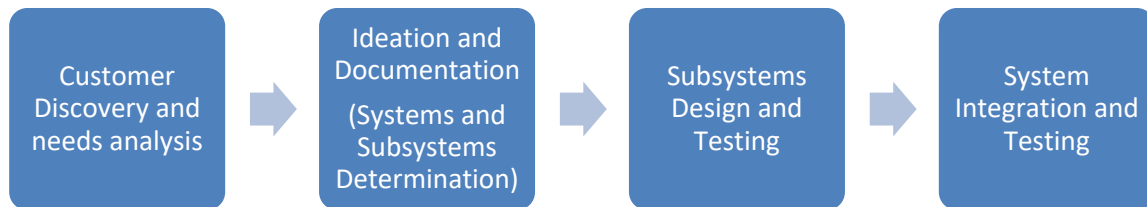


Project 1: Just the Software system and subsystems design.

Project 2: Software + Hardware system/subsystem actual design, build, and test

Project 3: Customer discovery, needs analysis, and conceptual design

**Course objectives:**

As part of this course, students

- apply their earlier coursework to develop an understanding of software engineering principles [1]
- demonstrate an ability to develop a validation procedure using laboratory equipment [3]
- engage in both formal and informal written and oral professional communication exercises. [4]
- utilize their earlier coursework and acquired expertise to complete a team-based design projects. [1, 2, 7]
- demonstrate an understanding of ethical considerations in engineering solutions [5]
- examine engineering solutions in a global, environmental, and societal context [2,5]
- use contemporary resources for learning basic skills and knowledge needed for their application [6]
- practice strategies for effective team dynamics [7]

The letters in brackets at the end of each statement, which are required in the form but not the syllabus, identify the ABET Student Outcomes, shown below, to which that objective is contributing.

1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2) An ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and global, cultural, social, environmental, economic, and other factors as appropriate to the discipline.
3) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
4) An ability to communicate effectively with a range of audiences.
5) 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.
6) An ability to recognize the ongoing need to acquire new knowledge, to choose appropriate learning strategies, and to apply this knowledge.
7) An ability to function effectively as a member or leader of a team that establishes goals, plans tasks, meets deadlines, and creates a collaborative and inclusive environment.

**Learning outcomes:**

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

- develop a Product Lifecycle Management Plan
- 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

**Considerations for Hybrid format**

ECE 3872 was designed with each week having a lecture on Tuesdays/Wednesdays followed by studio time on Thursdays/Fridays. The studio time is mostly dedicated to working on team projects throughout the semester. We will break the class of 36 students into 9 teams of 4. In an effort to minimize classroom exposure, ECE 3872 shall have a weekly rhythm as follows.

- Wednesday 1 week prior to class: a lecture video shall be posted to CANVAS
- Tuesday or Wednesday (depending on the section): we shall hold class virtually in Bluejeans to work any sample problems and answer questions. We may also start the class with a simple quiz (knowledge check) to ensure that each student has watched the lecture video prior to class.
- Thursday or Friday (depending on the section): Depending on the COVID risk we will meet in-personal or virtually with the design teams. Scheduling will vary over the semester given the current activity.
- Solder exercise: we will be having students perform a soldering exercise, any remote students shall need to procure a soldering iron and a small list of materials to perform the exercise remotely.

- Team Projects: This course requires a HW team project that entails design, fabrication, integration, and demonstration. Remote students need to be prepared to still contribute to their team and may have to do some assembly or soldering of printed circuit boards remotely.
- Attendance: we will be taking attendance for the virtual Bluejeans class time as well as the in person studio time. If you are unable to attend the in person studio time – you need to join your team virtually on Bluejeans.
- Final exam: shall be conducted on Blujeans with each team presenting their entrepreneurial project during the Final Exam period.

**Requirements and Guidelines Specific to Spring 2021**

The spring semester 2021 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.

# 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 the work.

### 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/)