ECE 3882: ECE Design Fundamentals (1-3-2)

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. Students must have access to a myDAQ board for use during the classes.

Use of this class towards BS EE and BS CmpE degrees:
- ECE3882+GT4823 will satisfy the senior design degree requirements (it substitutes for ECE4011+ECE4012). In this process, the prerequisites for GT4823 are all of the prerequisites for ECE4011 and ECE4012.
- ECE3882+ECE4011 lite+ECE4012 will satisfy the senior design requirements. ECE4011 lite is an abbreviated version of ECE4011, where only the senior-design project-related materials are required.
- Further instructions: ECE3882 can only count as part of the senior design requirement, so it cannot be counted as an ECE elective or free elective.

Topical Outline:
> Software Engineering Design Process (3 weeks)
>> Requirements
>> System-level thinking and task decomposition
>> Design patterns
>> Design methods
>> Working in Teams
> Human-Centered Design (1.5 -2 weeks)
>> Design Thinking
>> Human Factors
> Hardware Design and Prototyping (4-5 weeks)
>> Design Considerations
>> Protection and Safety
>> Prototyping Skills (soldering, PCB layout)
>> Troubleshooting and Instrumentation
> Applications of Probability (0.5 week)
> Ethical Considerations in Engineering Design (1 week)
> Introduction to Entrepreneurship (3.5 weeks)

Grading:
> Projects: 65%
>> Software Virtual PLM (10%)
>> Software Design Project (13%)
>> Design and Prototyping Project(30%)
>> Entrepreneurial Project (12%)
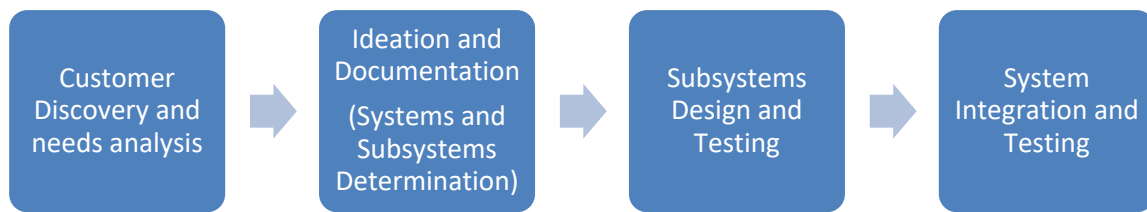> In-class activities: 30%
> Constructive Peer Critiques   2%
> Teamwork Plans and Reflection: 3%

Note, in place of a final, students will do a poster presentation of their Entrepreneurial Project. The draft of the poster will be due the last day of classes, and the constructive peer critiques will take place on that day.

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:

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│  Customer   │    │ Ideation and│    │ Subsystems  │    │   System    │
│ Discovery and│ ▶ │Documentation│ ▶  │ Design and  │ ▶  │Integration and│
│needs analysis│    │(Systems and │    │  Testing    │    │  Testing    │
│             │    │ Subsystems  │    │             │    │             │
│             │    │Determination)│   │             │    │             │
└─────────────┘    └─────────────┘    └─────────────┘    └─────────────┘
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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 Student Outcomes to which that objective is contributing. The following Student Outcomes were approved in 2017 for the BSEE and BSCmpE degree programs:

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

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. Depending on the circumstance, credit might be deducted from the work.

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/)