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

Prerequisites: 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.

Topical Outline:

Software Engineering Design Process
Human factors and usability
Engineering Design Process
Component Selection and Evaluation
Testing and Validation Plans
Ethical Considerations in Engineering Processes
Customer Discovery

Grading:

Projects:	75%
Worksheets:	20%
Teamwork Plans and Reflection:	5%

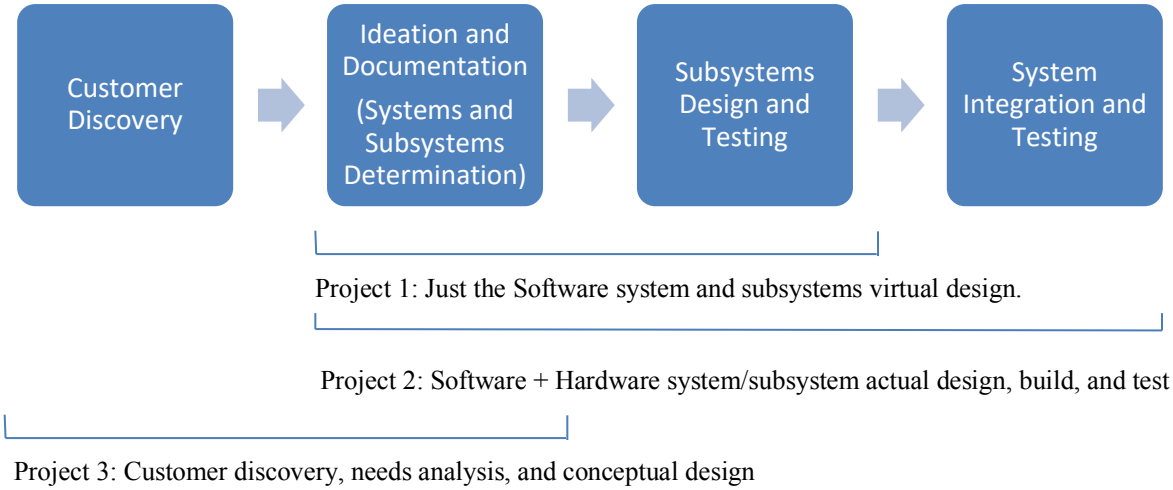
Sample Schedule

Topic	**In class and online activities**	**Project and due date**
Introduction and Overview		
Software engineering design process • Waterfall, V, agile • Task decomposition • State machines • Layered architecture • Behavioral descriptions and documentation • Test plans (2 weeks)	Lectures + online lectures used in the online MS CS program for resources In-class activity 1: given an application such as an autonomous mobile robot, design a layered architecture In-class activity 2: given an architecture, write a behavioral description and devise a test plan **Deliverables: worksheets**	Project: Virtual product-lifecycle management (select a specific commercial product and identify the requirements; do software task decomposition and design a layered software architecture and test plan), **Deliverables: Virtual Product Lifecycle Management** document – have another team critique it and then submit original and revised copies, and the critique
Human factors and usability (1 week)	Lecture Group activity: student groups perform human factors testing on students from another group on a commercial product (a software product and another product?) [Possibly include some aspects of ethics in design. One example: http://designmarketinglab.com/archives/2063] **Deliverable: worksheet and conclusions**	
Engineering design process • Waterfall, V • System-level thinking • Morphological charts • Engineering Requirements documents (ERDs) • Specifications and Standards (2 weeks)	Mini-lectures, online resources, case study In class activity: virtual design of sample product, including specifications and design requirements **Deliverables: in-class worksheets**	Mini-design project: A mini-design project involving microcontroller+sensors+motors (or similar, such as the use of LEGOs components with standard microcontrollers and sensors), include system-level block diagram, software design;

Part selection, procurement and evaluation • Datasheets • Power calculations (1 week)	Mini-lectures In-class activity: parts selection from vendor sites and battery sizing, how long battery will last (probability) A more specific suggestion: Solar charged LED lantern: Parts selection taking cost and lead-time into account. Evaluation in terms of charging reliability under different scenarios. **Deliverables: in-class worksheets**	testing and validation plan and results **Deliverables: project report and demo,** report first reviewed by another group, and draft and final copies submitted along with the critique
Testing, troubleshooting and validation plans • Subsystem testing • Failure modes and effects analysis • System integration testing (1 week)	Mini-lectures In-class activity: case study discussion of test and validation plans In-class activity: test chips and other components (probability); test a known broken circuit. Generate FMEA table and locate the problem **Deliverable: in-class worksheets**	
Engineering Ethics (1 week)	Mini-lecture In-class activity: case studies of engineering ethical dilemmas **Deliverable: selected groups give a summary of their topic and their conclusions**	
Entrepreneurial Basics • Customer discovery • Needs Analysis • Marketing Requirements Documents • Viability (marketing, IP, manufacturing) (4 weeks)	Mini-lectures. online resources In-class group assignments: discuss what group of people you want to help (*ideally, Service Learn Sustain application*), sample interviews	Open-Ended Design Project: do a virtual initial design - start from customer discovery, interview people, determine requirements, initial system-level design, examine business aspects such as market/cost/IP etc. **Deliverable: project report, poster**
Plus Training on teamwork, two half-hour sessions during term;		

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:



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

Students with medical or family emergencies should contact the Dean of Students. See http://catalog.gatech.edu/rules/4/ for an articulation of the Institute rules. Students with excused absences will be allowed to make up the work, normally within two days. Assignments turned in late without an excused absence will incur a penalty of 20% per day. Assignments will not be accepted beyond three days late.

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. At all times students are expected to follow the Academic Honor Code (http://www.catalog.gatech.edu/policies/honor-code/)