University Of California, Berkeley
Department of Mechanical Engineering

ME 125 – Industry-Associated Capstones in Mechanical Engineering (iACME) (4 units)

Undergraduate Elective

Syllabus

CATALOG DESCRIPTION

iACME provide opportunities for Mechanical Engineering undergraduates to tackle real-world engineering problems. Student teams, consisting of no more than four students, will apply to work on specific industry-initiated projects. Teams will be selected based on prior experience in research/internships, scholastic achievements in ME courses, and most importantly, proposed initial approaches toward tackling the specific project. ME faculty, alumni of the Mechanical Engineering Department, and industry participants will mentor selected teams. Projects fall within a wide range of mechanical engineering disciplines, e.g. biomedical, automotive/transportation, energy, design, etc.

Each team will meet with industry clients throughout the semester to discuss the scope of the project and expectations and for design reviews. Topics covered in weekly lectures include how to approach a problem, project design and implementation, design or computational analysis, and oral/written communication. Guest lectures from industry will provide additional expertise in solving real-world engineering problems. All teams will be expected to present a working prototype or computational model, give an oral presentation, and a written report to the industry client. The final grade will be based on evaluations from the instructors and the industry clients on design check-points, final oral presentation, and written report.

All teams are formed through instructor invitation based on team-interviews during the first two weeks of the semester.

COURSE PREREQUISITES

Senior standing and a minimum GPA of 3.0.

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

No required textbook.

COURSE OBJECTIVES

The purpose of this course is to:

- learn the fundamental concepts of approaching practical engineering problems;
- enhance skills in communication with clients and other engineers;
- enhance skills in design, prototyping, testing, and analysis.

DESIRED COURSE OUTCOMES

Working knowledge of understanding/determining the scope of, and how to approach and solve, an industry-sponsored problem, subsequent design considerations for solving the problem, patent research, rapid

prototyping, high-resolution prototyping (physical or computational), and project management (e.g. proposing and justifying a budget, delegating work among team individuals to capitalize on individual strengths, and developing concrete milestones). Understanding in the ability to apply the appropriate engineering concepts to solve realistic engineering-based problems, knowing clearly the assumptions involved. Critical analysis of current literature and technology.

TOPICS COVERED

Professional development, intellectual property, and application and consolidation of skills learned in the ME curriculum (user surveys, customer needs, product/project spec development and planning, brainstorming, 3D prototyping, machining). Where applicable, FDA regulations and testing with human subjects will be covered.

CLASS/LABORATORY SCHEDULE

Three-hour weekly lecture with design sessions.

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

Emphasis on interpretation of customers' request and user needs to computational or physical solution. Students are required to write professional report summarizing their literature search, design process, experimental testing, data analysis, and design process. Students are required to provide an in-depth oral presentation to the class and to the industry mentors.

RELATIONSHIP OF THE COURSE TO ABET PROGRAM OUTCOMES

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

The students' progress is assessed via weekly workshop assignments with write-ups and design check-ins with ME faculty and industry mentors and a Final project (written and oral). All projects are group-based projects.

25% Write-Ups
25% Design Check-INs
50% Final Project

SAMPLE OF WEEKLY AGENDA

(See attached)

PERSON(S) WHO PREPARED THIS DESCRIPTION

Professors Grace O'Connell and Lydia Sohn
9/26/17

ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): IACME IND CAPSTONES
TIE CODE: LECS
GRADING: Letter
SEMESTER OFFERED: Fall and/or Spring
COURSES THAT WILL RESTRICT CREDIT: None
INSTRUCTORS: O'Connell and Sohn
DURATION OF COURSE: 15 Weeks
EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 12 Hours
IS COURSE REPEATABLE FOR CREDIT? No
CROSSLIST: None

ME111: iACME Weekly Schedule

Week	Topic	Homework
1	Course Introduction; Interest Surveys and Interviews	
2	Team interviews and selection; Project Management and Planning	Teaming Exercise with Collaborative Plan
3	Identifying Customer Needs & Customer Surveys	***1st Interviews with Industry Mentor*** (Due week 4) and interview with potential users (2 weeks - Due Week 5)
4	Survey of existing literature/technology; Specification Development & Planning	Define and prioritize product specs. Develop a plan for prototyping etc
5	Brainstorming/Concept Generation; ***Guest Speaker:*** Experiences of Cal Alum (early product design/startup)	Brainstorm 20+ ideas in with defined specs; prioritize based on weighting criteria
6	Planning through sketching & Prototyping	***2nd interview with Industry Mentor*** *re: brainstorm/concepts;* develop low-fidelity prototype (looks like prototype)
7	Robust Design	Define project-specific test factor and output measures; Develop 'works like' prototypes for testing
8	***Guest Lecture:*** Rep from large company about full design process	testing and reflection
9	Patents and Intellectual property; ***Guest speaker*** from IP office	Redesign CAD prototype based on Experiments; **3rd interview with Industry Mentor**
10	Ecosystems: Designing for others (e.g., children and other cultures)	Develop and create higher-resolution complete prototype (works and looks like product) - 4 weeks
11	**Guest Lecture:** Managing Projects (ideally one of the industry mentors)	
12	Open Design	GSI check-in on progress
13	Open Design	
14	Demo Projects/Final presentations	**4th feedback from industry mentor**
15	RRR Week	Final Written report due; Peer and industry evaluations due

ME111 – Example Guideline sent to industry sponsor
Guidelines for Project Proposals

The goal for the students in the class is to get a deep enough understanding of the beneficiary problem to come up with a minimal viable product that the program sponsor says, "Wow, let's figure out how to get this deployed/used/acquired."

Realistic problem selection is incredibly important. Program managers/mentors should consider problems where the entire use case (including the manufacturing) can be discussed with the teams.

Dr. O'Connell created a proposal write-up based on previous discussions; however, you may feel free to include additional information where appropriate

Students will need to meet and discuss with the industry/project mentor at least 4 times throughout the semester. Based on the course syllabus, we would like to ask you to be available for up to ***one hour (per session)*** to chat on the phone or by Skype/GChat during the following weeks:

- Sept. 27th – October 6th: One hour for problem interview
- Oct. 11th – Oct. 20th: Feedback from brainstorming
- Oct. 30th – Nov. 10th: Feedback from low-resolution prototype
- Nov 27th – Dec. 6th: Feedback on final prototype

For industry/sponsors located near the Bay Area, you are more than welcome to attend the Jacobs Hall Demo Day, where students will present their projects to the public. The Demo Day will be held during the week of Dec. 4th (exact day and time TBD).

ME111: iACME – Problem Proposal

Problem Title: Design a generalized customizable socket for hand prosthetics

Industry/Project Sponsor Contact: Michael Campos, clawsfromcarter@gmail.com at Claws for Carter ***or*** Maria Esquela, esquela.maria@gmail.com at E-NABLE

Challenge: Design, prototype, and test a functional 3D printed hand with a secure easy-to-use attachment design that will allow users to modify the function of their hand.

Background: Claws from Carter and E-NABEL are a non-profit organizations that provides low-cost 3D hand prosthetics (and designs) for children and adults. A particular problem that both organizations have with their 3D printed hand designs is being able to perform various tasks. That is, often a different design is needed for gripping a bar versus a box. ***The goal of this project is to develop a sturdy universal attachment for a 3D printed hand that will allow users to connect and detach various attachments for gripping round objects, riding a bike, etc.***

Boundaries: Consider the following areas in your device design:

- Weight of device
- Stresses at the attachment joint and fatigue concerns
- Shifts in loads distribution to the body
- Consider use flow (how it will be operated and the process of attaching and detaching the device, etc.)
- Other technologies that might be relevant

Project Deliverables

- *Biomechanical analysis of joints/limbs involved (i.e., compressive or shear forces added to the spine/body)*
- *User Interview and summary*
- *20+ Brainstormed Ideas*
- *Sketch of top 3 ideas with selection criteria*
    - *Feedback from industry/project sponsor of top idea(s)*
- *Low-resolution prototype*
- *Higher-resolution prototype*
    - *Prototype testing*
- *Demo-day presentation at Jacobs Hall*