

# Capstone Design Sequence

Department of Mechanical Engineering  
Lyles College of Engineering  
California State University, Fresno

Beginning Fall 2014

## Overview

Solutions Center is an industry-academic-government partnership within the Department of Mechanical Engineering of the Lyles College of Engineering at California State University, Fresno. Solutions Center is a proven concept in engineering education, fostering innovative, technical collaborations with business, industry, and government agencies. The Center brings real-world projects to undergraduate students in mechanical engineering at California State University, Fresno, where integrated teams of 4 to 5 undergraduate students, a faculty advisor, and a project-sponsor mentor/liaison develop workable solutions. Student teams work on selected projects for two consecutive semesters and deliver tested, functional hardware and documentation to the sponsor at the completion of the project.

## Coursework

Senior capstone design is a two-course culminating experience in the Mechanical Engineering program at California State University, Fresno. The purpose of this course is to simulate an entry-level engineering project in industry—allowing students to apply engineering knowledge acquired in fundamental ME courses to a real-world, open-ended design challenge.

Through this two-semester experience students have the unique opportunity to work with a group of 4 or 5 peer students, who will be personally mentored by a ME Faculty Instructor and a Project Mentor/Liaison from the sponsoring company, government agency, or organization. Students will learn the complete cycle of design and what it entails. At the end of the academic year, actual hardware/software will be produced and presented to the sponsors. Most importantly, by the end of each student's ME academic program, he/she will understand the difference between theory, paper, and prototype. This capstone experience is required for all undergraduate mechanical engineering students, ensuring that each student will interface with talented faculty, staff and sponsor.

## Fall Term

### ME135 Engineering Product Design (a.k.a., Intro to Design - Capstone Design I)

Introduction to engineering design with consideration given to economic, safety, quality, aesthetics, environmental, liability, and patent law issues. Open ended design project is selected as part of team-based process. Students develop problem statement with constraints, brain storm, create decision matrix and identify winning concept.

#### Course Objectives:

- o Develop an understanding of the necessary professional skills needed to succeed in industry (life!)
- o Understand how to work collaboratively in a team toward a common design goal
- o Become proficient at written and oral technical communication skills, as well as managing long-term projects
- o Learn to integrate technical engineering skills to successfully complete a project
- o Generate alternative design concepts and evaluate ideas using design requirements
- o Use results of engineering analysis to make design decisions (engineering and business) in a methodical manner
- o Apply previous knowledge to create CAE models and engineering drawings to build physical prototypes

## Spring Term

### ME155 Elements of System Design (a.k.a., Capstone Design II)

Continuation of ME135 including analysis of winning concept in the design of a commercially feasible engineering system. Students work in teams to design, build, and test prototype engineering systems using sponsored projects. Meeting realistic constraints, including client-based specifications; optimizing designs, working in a team environment, and developing project management skills form the basis for the course. Winning concept is fabricated, tested, refined and demonstrated to sponsor. Oral and written communication skills are employed.

#### Course Objectives:

- o Develop an understanding of the necessary professional skills needed to succeed in industry (life!)
- o Understand how to work collaboratively in a team toward a common design goal
- o Become proficient at written and oral technical communication skills, as well as managing long-term projects
- o Learn to integrate technical engineering skills to successfully complete a project
- o Generate alternative design concepts and evaluate ideas using design requirements
- o Use results of engineering analysis to make design decisions (engineering and business) in a methodical manner
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## How the Solution Center Works

Summer  
Semester

Fall  
Semester

Spring  
Semester

### What?

Prospective Projects

ME135 Capstone Design I

ME155 Capstone Design II

### Who?

ME135 and 155 Course Instructor

Project Sponsor

ME135 Instructor  
ME135 Students  
Project Liaison/Mentor

ME 155 Instructor  
ME155 Students  
Project Liaison/Mentor

### When?

Mid to Late Summer-Gather Project Requests

Early Fall for Students to form Teams to Bid on Projects  
Mid Fall for Projects to be Awarded Projects  
Mid to End Fall for Early Design Process  
(Problem Statement, Brain Storm, Decision Matrix)

Early Spring Analysis of Winning Concept  
Mid Spring Construction of Prototype  
End Spring Testing, Refining and Presentation  
(Final Report, Demonstration, Presentation)

Draft - 15 August 2014

## How the Solution Center Works

Design projects are funded by sponsors who provide funds commensurate with complexity of project and details of final prototype. Throughout each design project, the student team works closely with its faculty advisor and project mentor/liaison, who provide technical support and oversee the project to ensure it meets specifications and is delivered on time. Over the academic year, a dynamic relationship is developed, allowing the student team's solution to come to fruition as a real engineering innovation benefiting the project sponsor.

| <b>What Sponsors Do</b>   | <b>What Students Do</b>   | <b>What Faculty Do</b>   |
|---|---|--|
| <ul style="list-style-type: none"> <li>• Sponsors provide a detailed problem statement with potential funding, realistic constraints, the required deliverables, and name of project mentor/liaison</li> <li>• If project is selected, sponsor complete appropriate paperwork and arranges funding</li> <li>• Sponsors provide funding commensurate with complexity of project and details of final prototype.</li> <li>• Portions of the budget go to student project budgets, and to support the infrastructure of the dewhere students design and build hardware for their projects</li> <li>• Sponsors are asked to provide an project mentor/liaison who can commit minimum of 10 hours per semester to support the student team. These hours are typically dedicated to weekly meetings with the students.</li> <li>• Sponsors benefit from students' fresh ideas, obtain a working piece of hardware at the end of the project, and if an industry sponsor, may gain an edge in recruiting top students to their company. The investment of an industry sponsor may also can result in a competitive advantage, with the company retaining exclusive rights to the intellectual property developed.</li> </ul> | <ul style="list-style-type: none"> <li>• Each team "bids" on potential projects, providing strengths, weaknesses, expertise as part of "bid" process</li> <li>• Each student team may commit a minimum of 1000 hours to the project</li> <li>• Students gain valuable experience working with professional engineers</li> <li>• Students may work in the various department, college and university laboratories, workshops, and computer facilities. If desired, students may also work at the sponsor's work site</li> <li>• Students work within time and materials budgets, while gaining experience with industry procedures such as writing purchase orders and meeting deadlines under pressure</li> <li>• Student teams submit approximately four written reports and many oral presentations on product development and testing</li> </ul> | <ul style="list-style-type: none"> <li>• ME135 and ME155 Faculty Instructor(s) solicit projects and organize student teams to "bid" on projects. Faculty then work with sponsors to award project to student teams. Faculty also work with sponsors to submit paperwork and secure funding.</li> <li>• The ME135 and ME155 Faculty Instructor(s) may devote a minimum of 90 hours to supervising the sponsored student team throughout the academic year</li> <li>• The ME135 and ME155 Faculty Instructor assists student teams in understanding and executing the design process</li> <li>• The ME135 and ME155 Faculty Instructor serves as the primary point of contact for academic topics (schedule, deliverables, grading, etc.)</li> <li>• The ME135 and ME155 Faculty Instructor ensures that student teams meet the academic course learning objectives, program student outcomes and sponsor's project goals</li> </ul> |

# How to Sponsor a Project

## Benefits to You, the Sponsor

- **Branding/visibility** within the Solutions Center labs and publicity on department website and PR materials.
- **Year-long recruitment** – your design/engineering team will work closely with a team of 4 to 5 graduating seniors for an academic year (two semesters).
- **Low cost skunkworks R&D** – Student teams mentored by a faculty, work on open-ended design challenges offered by you, the sponsor. They also build and test prototypes to see their design ideas in action! Students send the final project report and the prototype to the sponsor at the end of the semester.

## Request to Sponsor

- **Complete the External or Internal “Sponsor Project Submission Form”** (including contact info)
- **Provide funding** suitable that to cover course expenses including costs associated with a prototype
- **Mentor and guide students** through a liaison dedicated to the project
- **Schedule a kickoff meeting** in the second or third week of classes in the Fall semester usually the first or second week of September.
- **Work within the typical process and workflow of the project:** Senior projects last for two semesters beginning at the end of August and ending in mid-May. A meeting in the second or third week between sponsors and students is requested. Depending on schedules and locations, the meeting may be at CSU Fresno campus, a sponsor site, or via video conference. Formal design reviews will be scheduled according to project needs. Typically there are two formal reviews. The location of these reviews depends on schedule and location. It is preferable if they can be at the sponsor’s site. Projects will continue in the spring semester in a similar format. Students will prepare formal reports that include needs analysis and problem clarification; functional decomposition; concept generation and related details; concept selection; design refinement and embodiment design; and solid models and engineering drawings as appropriate to the project. Depending on the nature of the project, proof of concepts or fully functional prototypes may be developed.

## Intellectual Property

In accordance with the California State University, Fresno Intellectual Property Policy, undergraduate students who are not employees of the University, are not performing research under a sponsored program, or are not using significant resources of the University do not have an obligation to assign their intellectual property rights to the University.

In those instances, students participating in a Solutions Center may commercialize, license or otherwise assign their intellectual property to a third party (Conveyance of Rights), including to the company mentoring the student group on a project based on that company’s information (Mentoring Company) without seeking a license or release from University. At the sole discretion of the Student(s), any Conveyance of Rights may or may not be for monetary consideration.

## Confidentiality

A Company may request students to enter into a confidentiality agreement in order for the Company to participate and provide a project to the students. In certain circumstances this may be a reasonable request by the Company.

In some circumstances, a Company’s proprietary information must be shared with California State University, Fresno, such as with the Faculty Instructor of ME135 and/or ME155. In such cases, a confidentiality agreement with the California State University, Fresno may also be required. The California State University, Fresno one-way NDA. Companies needing to execute a confidentiality agreement with California State University, Fresno should contact the Solutions Center at least two weeks prior to start of the semester to have the form routed through California State University, Fresno legal department.

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## Capstone Design External Sponsor Project Submission Form

**Company/Government Agency Name:**

**Semester for the start of project:**

| Contact Info      | Name, Designation | Email | Phone |
|-------------------|-------------------|-------|-------|
| Technical Contact |                   |       |       |
| Director Contact  |                   |       |       |

**Project Name:**

**Project Description:** (A descriptive, enticing 1/2-1 page introduction to the project using the following template)  
**MUST INCLUDE AT LEAST 1 PICTURE**

Background/Problem/Need:

Concept: The purpose of this project is to design, build, and test .....

Design considerations (if any): (A brief overview is sufficient, details may be sent later)

Desired student skills:

Acceptable solutions/deliverables:

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**Funding Commitment:**

We, \_\_\_\_\_ (Company Name) commit to provide \$\_\_\_\_\_ to Solutions Center at California State University, to cover the costs associated with providing a working prototype developed, designed and fabricated by students in Capstone Design Course

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## Capstone Design Internal Sponsor Project Submission Form

**Project/Competition/Organization/Club Name:**

**Semester for the start of project:**

| Contact Info      | Name, Designation | Email | Phone |
|-------------------|-------------------|-------|-------|
| Technical Contact |                   |       |       |
| Faculty Advisor   |                   |       |       |

**Project Name:**

**Project Description:** (A descriptive, enticing 1/2-1 page introduction to the project using the following template)  
**MUST INCLUDE AT LEAST 1 PICTURE**

Background/Problem/Need:

Concept: The purpose of this project is to design, build, and test .....

Design considerations (if any): (A brief overview is sufficient, details may be sent later)

Desired student skills:

Acceptable solutions/deliverables:

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**Funding Commitment:**

We, \_\_\_\_\_ (Project/Competition/Organization/Club) commit to provide \$ \_\_\_\_\_ to this project at California State University, to cover the costs associated with providing a working prototype developed, designed and fabricated by students in Capstone Design Course