

Capstone Senior Design Courses Mechanical Engineering Program

Definitions and Guidelines

Objectives

- To apply knowledge learned in other courses.
- To enhance the thought and planning process.
- To expose students to a team design and implementation similar to that encountered in industry
- To improve the written and oral communication skills of the students.

Courses Involved

- ME 48700 and ME 48800 are the mechanical engineering senior design sequence courses.
- ENGR 41000 and ENGR 41100 are multidisciplinary senior design activities open to students from all engineering programs.
- Enrollment in ENGR 41000 & 41100 is subject to the approval of the coordinator. These projects are advised by a committee consisting of two faculty members each from a different engineering program, e.g. one from electrical engineering and the other from mechanical engineering for a project that consists of electrical and mechanical systems.

Project Teams

- All senior design projects must be performed as teams. No individual projects will be permitted. Each project is advised by one ME faculty member.
- The minimum size of any team is two. The size and composition of the team should properly match the nature and complexity of the project. It is strongly discouraged to have a team with more than five students.
- Multidisciplinary projects may include students from at least two engineering programs, or can include students and advisors from other programs, e.g. computer science, physics, and engineering technology.

Proposing Projects

Project suggestions may come from a number of different sources such as:

- senior design students;
- faculty members; or
- industry

Project suggestions must meet the following criteria in order to be accepted as a design project:

Each project must be sufficiently complex, yet able to be accomplished within the allocated time, with the understanding that a worthwhile product or at least a functioning prototype will result from the project.

All project proposals must be directed and discussed with the prospective team advisor. The final decision, to accept a project proposal or not, will be made by the advisor.

Course Activity

- ME 48700 and ENGR 41000

- All students enrolled in these courses shall attend common lectures arranged by the coordinator. Failure to attend these lectures is subject to the penalty as outlined below under functions of the coordinator.

- The first activity is the formation of project teams. Shortly after that (two weeks into the semester), each team is required to develop a problem statement and a written project plan that covers the activities planned for the entire semester.

- Each team must accomplish certain tasks such as:

- brainstorming
- conceptual designs
- evaluations of conceptual designs
- detailed design of the selected concept

before the end of the first semester. Deadlines for these task completion dates and design reviews are set through discussion between the advisor and the project team.

- Complete a set of design reviews

- System Requirement Review (SRR) – Faculty members and the project advisor assess the completeness and suitability of the problem statement and resulting set of requirements which quantify the problem definition. This review will be carried out in the form of oral presentation by each design team of their problem statement. The oral presentations will be scheduled during the weekly common meeting by the coordinator. Advisors must attend the presentation of his/her design team. Faculty members are encouraged to attend and participate in the review.
- Preliminary Design Review (PDR) – Faculty members and the project advisor assess the selected conceptual design to confirm that the design approach satisfies the requirements, risks are under control and that the preliminary design is ready to be detailed. This review will be carried out in the form of oral presentation by each design team of their selected conceptual design. The oral presentations will be scheduled during the weekly common meeting by the coordinator. Advisors must attend the presentation of his/her design team. Faculty members are encouraged to attend and participate in the review.
- Critical Design Review (CDR) – A formal end-of-semester oral presentation of the detailed design to the faculty and sponsors.

- Near the end of the semester, each team is required to submit a final design report to its advisor(s) and to the coordinator, and hold a critical design review (CDR). The coordinator will request changes in the report if it does not comply with the format provided at the start of the semester. The due date for the final design report and CDR are set by the coordinator.

- ME 48800 and ENGR 41100
 - Teams should complete their projects by implementing what they have designed in the first semester, that is, building, testing and evaluation, and demonstration of the end products. Deadlines for these tasks are set through discussion between the advisor and the project team.
 - A schedule of the semester's tasks should be submitted by the advisor to the coordinator by the end of the second week of the semester.
 - By the date indicated on the semester schedule, each team is required to submit to the coordinator a "Measured Parameters Statement" to identify various parameters that need to be determined as well as the method of measurement.
 - Near the end of the semester, each team is required to submit each copy of a final design report and a poster to the team advisor(s) and senior design coordinator and hold a System Verification Review (SVR). The submission dates for the final design report and SVR are set by the coordinator.
 - Complete a formal System Verification Review (SVR) at the end of the semester where the students present the results of their semester work to faculty and sponsors that demonstrate that their prototype meets the needs of the problem statement and satisfies the requirements.

Senior Design Courses Coordinator

The functions of the coordinator are outlined below:

- Being in charge of the weekly common meeting hour.
- Request from the engineering faculty titles and brief descriptions of any project they would like to supervise. The faculty member should indicate if the prospective senior design project is being supported by outside funding. This request should be made four weeks before the end of each semester.
- Publicize all the prospective senior design projects received from the faculty. Students should be encouraged to go and discuss the prospective projects with the relevant faculty advisors.
- Collect student applications for projects.
- Assign students to projects during the first week of the semester in which the project begins.
- Post a list of the final team assignments on the web before the second meeting of the semester.
- Give lectures (ME 48700 and ENGR 41000) that cover the following topics:
 - Formulation of design problem and developing a set of requirements which quantify the problem statement;
 - Brainstorming of conceptual designs;
 - Evaluation of conceptual designs;
 - Initial design, modeling and simulation, iteration and development of an acceptable design.
- Arrange for at least four lectures to cover the following areas which will provide the students (ME 48800 and ENGR 41100) with:
 - Understanding professional and ethical responsibilities;
 - Recognition of the need for life-long learning;

- The broad education necessary to understand the impact of engineering solutions in global and societal contexts.
- Arrange the time and place for the team reviews at least a month in advanced (both semesters).
- Attend all reviews.
- Coordinate the evaluations of the presenters by the attending engineering faculty members (i.e., distributing the evaluation forms to the attending engineering faculty members before the presentations and collecting them afterwards) and then calculate the average.
- Assign a maximum of 25% (for ENGR 41000/ME 48700) and (for ENGR 41100/ME 48800) of the final course grade for each student, based on activities/assignments during the common meeting hour and oral presentations performance.
- Collect grades from faculty advisors and figure out the total grade for each student and submit the final course grade to the Registrar office.

Team Advisors

- ME Faculty members shall be assigned by the department chair to serve as senior design advisors.
- Co-Advisors from other disciplines, e.g. other engineering programs, physics, computer science, can also be included in multidisciplinary projects.
- Each of the remaining projects shall be advised by an individual engineering faculty.
- The team advisor shall follow the grading scheme outlined below. The advisor has control of 75% (for ENGR 41000/ME 48700) and (for ENGR 41100/ME 48800) of the final course grade for each student. This portion of the grade covers all the activities listed in the “Grading of the Projects” section except for the oral presentations which assigned by the coordinator.
- The team advisor shall forward, to the coordinator, her/his portion of the grade for each student in the team by the deadline set by the coordinator.

Grading of the Projects

The team advisors/coordinator shall follow the grading scheme outlined below.

- The grades of the students in ME 48700 and ENGR 41000 shall be based on the following distribution:

Problem Statement / Requirement Set	10%
System Requirement Review (SRR) Oral Presentation	5%
Conceptual Designs (CD)	10%
Preliminary Design Review (PDR) Oral Presentation	5%
Evaluation Summary of CD	10%
Detailed Design (including cost analysis)	35%
Compiling of Final Design Report [†]	5%
Semester Schedule, Progress Reports, and Teamwork	5%
Critical Design Review (CDR) Oral Presentation [†]	15%*

[†] Satisfactory completion of the final design report and the CDR is required to pass ME 48700 and ENGR 41000.

* The grade for the SSR, PDR, and CDR shall be assigned by the coordinator based on the average of the evaluations of the presentation by the attending engineering faculty minus any penalty (up to 5%) for failing to meet the requirements during the common lectures.

- The grades of the students in ME 48800 and ENGR 41100 shall be based on the following distribution:

Measured Parameters Statement	5%
Building Prototype	20%
Testing and Evaluation	40%
Compiling of Final Design Report [†]	5%
Semester Schedule, Progress Reports, and Teamwork	5%
System Verification Review (SVR) Oral Presentation [†]	15%*
Ethics, SIE, and LLL	10%

[†] Satisfactory completion of the final design report and the SVR is required to pass ME 48800 and ENGR 41100.

* The grade for the SVR shall be assigned by the coordinator based on the average of the evaluations of the presentation by the attending engineering faculty minus any penalty (up to 5%) for failing to meet the requirements during the common lectures.

A penalty (e.g., 10% per day) for failing to complete the specified tasks or submit written sections of the report by the dates agreed to on the semester schedule is recommended. This penalty should be decided by the advisor and communicated to the team.

It is not necessary for all students on a given team to receive the same grade.