Donald P. Shiley School of Engineering
ME 481 and 482
Mechanical Engineering Project Description

This document describes the Mechanical Engineering Project and associated requirements. The word "deliverable" is used throughout projects and refers to anything of value produced by the project. It includes such things as reports (oral and written), engineering sketches and drawings, test data, and physical mock-ups or prototyping. "Stake holders" are all people associated with the project. Typically, in ME 481/482 all team members, the course instructor and all project advisors (industrial and faculty) are stakeholders. ALL stakeholders are to be included (cc'd) in weekly email updates.

Quality and Quantity of Technical Content

The quality and quantity of the engineering content must be appropriate based on the number of students involved with the project and the course credit. This is the engineering capstone project and student work is expected to be of professional quality. ***This should be work that you are <u>proud</u> of discussing during a job interview.***

Evidence of high quality engineering work must be provided in the written work and oral presentations as well as in discussions with faculty and advisors. The mechanical engineering faculty advisors will provide recommendations to the course instructor regarding the grade for the course but the course instructor will have the final decision for assigning the grade.

Design Project Description

The Senior Design Project is the capstone experience for engineering students at the University of Portland. Technical and non-technical criteria should be included in the project. Every project should consider all of the following in determining design criteria: performance, serviceability, environmental sustainability, and manufacturability. Consideration should also be given to the ethical impact of the design, health and safety effects, social and economic feasibility, environmental effects or impact, and political factors. See web page for details and further description of these "design considerations."

Each project will have at least one Faculty Advisor (Mechanical Engineering faculty), the course instructor, and an Industrial Advisor. The Industrial Advisors are practicing engineers – the team may select their own (with instructor approval) or the Mechanical Engineering faculty will assign them. Mechanical Engineering faculty will assign the Faculty Advisor for all projects.

Students are not required to construct their final design; however, students may choose to do so. Even if it is not practical to construct the actual design, it may be feasible to construct a small scale mock-up or demonstration article. Construction can add significantly to the education process, as it is easy to make something work "on paper" but not easy to make it work in the real world. Learning this first-hand is of great value. Projects may consist of testing existing systems or components but must involve significant engineering decisions. When deciding whether or not to fabricate, keep in mind limitations of time, shop resources, and finances. Students are responsible for raising funds for their projects if needed. If no physical article is constructed or tested, then the "paper" study/design is to be more detailed and involved.

If fabrication is planned, keep in mind that capstone projects are at best a proof-of-concept or functioning prototype and do not represent a "marketable" design. Material selection, fabrication details, etc., should take this into consideration to minimize time and expenses.

Project Structure
Students must form their own teams and identify their project. All projects must contain significant mechanical engineering elements. Projects started in ME 481 will be continued into ME 482. Students wishing to have two smaller projects (different projects in ME 481 and ME 482) may choose to do so, but must receive instructor permission (in such cases, separate plans, memos and reports are required). The ME faculty encourage but do not require students to work on teams, especially teams with other departments. Teams of 3 or 4 students often are an "ideal" size. If you are working on a team that includes non-mechanical engineering students, please discuss this with the instructor to ensure proper cross-discipline issues are addressed.

In ME 481 students are to define and plan their projects, complete a thorough literature search, and complete the project through what may be considered "tentative final design." In ME 481, students are to produce a physical mock-up by mid-semester. By the end of the semester, they should produce some form of proof-of-concept and have made significant engineering decisions. Proof of concept will likely entail testing of mock-ups, demonstration of test capability, demonstration of manufacturing or fabrication, detailed assembly drawings, or in some other way show the concept is sound and the finished design will likely succeed. Detailed design, fabrication and testing should be completed in ME 482. It should be noted that it is **very** uncommon for projects to be successfully fabricated and tested in one semester, so if the project involves significant construction, fabrication must be **well underway** (not just beginning) before the end of the first semester.

Shop and Laboratory Use
Students wishing to use any laboratory are required to first obtain instructor permission. Before using any shop space, tools, or equipment, students are required to receiving training and permission from the technician supervisor (Allen Hansen). This applies to everyone – even those who have extensive shop experience. The shop technician can also help fabricate parts. Students are REQUIRED to plan ahead and to meet with the shop technician well in advance of need date. A *Shop Request Work Order* MUST BE completed well in advance of construction and **must be included** in the ME 481 Project Plan.

Financial
Students are responsible for raising any funds required, so plan accordingly. Funds are typically obtained from a number of sources. The School of Engineering typically can provide a few hundred dollars (maximum) and Oregon ASME, SAE, ASHRAE may provide support for some projects. Be sure to keep all receipts; they will be required for reimbursement. If you plan to fundraise, **do NOT contact companies or foundations without first discussing with the course instructor**. The Development Office can be helpful, but they NEED to be advised of any fundraising activity prior to it occurring. It is ESSENTIAL to discuss fundraising with the instructor before seeking funds!

The School's dean can provide additional financial support for exceptional projects and to support travel and registration fees for competitions. A proposal/request must be made to the

dean's office early in the first semester. Teams planning on using travel support **must be able to demonstrate to faculty their device is fully functional three weeks prior to the competition**.

Major Documents

Each team member is expected to contribute to the written work and oral presentations; however, the final documents should be well edited to read or present clearly with one blended voice. All documents must be of professional quality. Unless otherwise agreed upon, hardcopies are to be provided to faculty (instructor and advisors) and after being approved, softcopies are to be sent to the Industrial Advisor.

The following describes the formal written and oral documents and reports for both ME 481 and ME 482.

Design Notebook (ME 481 and ME 482)

Each student should consider maintaining a design notebook. Some faculty advisors may require them. All project related notes, meeting minutes, sketches, raw data, calculations, computer printouts (taped in, dated, initialed), etc. should be kept in the notebook. Each page must be dated (unambiguously April 6, 2011 not 4/6/11) and initialed. All work should be in ink not pencil.

These design notebook practices are standard and important for Intellectual Property documentation. The *School of Engineering, Writing for Engineers* has a detailed explanation for how to create, maintain, and use notebooks (aka *laboratory notebooks*).

All Memo's and Reports (ME 481 and ME 482):

All memo's and reports are to be addressed to the instructor and "cc" all advisors (faculty advisors and industrial advisors). Provide course instructor and faculty advisors with hardcopies and send the Industrial Advisors softcopies (after waiting one week for faculty feedback for the Project Plan).

Project Charter

The Project Charter must be completed by students in ME 481 (and ME 482 for new projects). The charter defines the team and the project objectives very concisely.

Pre-Plan memo

A pre-plan memo is due early in the first semester. Much or all of this will be incorporated in the Project Plan. It is required so that faculty can assist in making sure the project is off to a good start and proceeding along appropriate paths.

Project Plan

The Project Plan must be submitted in ME 481 (and ME 482 for new projects). The first several steps of the design process shall be completed and discussed in the Project Plan: problem definition, information gathering, and creating criteria for the overall project. Since developing a full understanding of the design problem is a critical and involved step, a substantial amount of work is required for the plan. For projects expecting any form of shop support, a *Shop Request Work Order* is required (and requires meeting with the technician well in advance).

The purpose of the Project Plan is to communicate what it is you expect to do and produce in ME481 and ME482. Details, such as schedule and budget help communicate your plan.

Faculty have one week to review the document. If teams do not hear back from faculty after one week's time, they are to send their Industrial Advisors a softcopy (and cc all other stakeholders).

Prototype Demonstration
By mid-semester, each team is to produce a prototype to demonstrate their design. The prototype may demonstrate fabrication methods, test methods, design characteristics, or other related engineering decision. The prototype does not need to be sophisticated; often "duct tape and cardboard" will suffice. Teams should identify the greatest obstacles for project success and use the prototyping process to address those concerns. A one page memo (plus photographs and other relevant attachments) documenting the prototype demonstration is required (properly captioned photographs are required).

Status Report Memo
Near the end of ME 481, teams are to submit a concise report in memo format documenting their completed design work with conclusions and recommendations.

Oral Report Presentation
Each team will present their respective projects to the class, faculty and Industrial Advisors (should they choose to attend). The presentation should give a clear and concise overview of all pertinent aspects of the project as well as the final conclusions and recommendations. When assembling the presentation, keep in mind that the audience has not been studying your particular subject for 15-30 weeks and appropriate background and introduction to your project is absolutely necessary. Your presentation should be well rehearsed, professional and within time limits (limits to be determined by instructor). Evidence of sound engineering decisions should be provided.

Part of the expectation for the presentation is that each team will be able to thoroughly present their project in a professional manner without going over or under the time limit. It is common in engineering practice to have only a few minutes to present literally thousands of hours of work – so being able to concisely present your project in limited time is a valuable skill. All faculty present will be evaluating/reviewing the presentation for clarity, professionalism, and content.

ME 482 (see course syllabus for specific dates):

Written Project Report
Near the end of ME 482, each team will submit a final written project report. A final report is also required in ME 481 for projects not continuing into ME 482. Bound hardcopies (BC Print Shop can help with this) is to be given to both the course instructor and faculty advisor. Students are encouraged to have a bound copy produced for themselves, as these are often good things to bring to job interviews. Industrial Advisors are to receive a softcopy (cc all other stakeholders). See course web page for requirement sheet.

The report is to include one paragraph (minimum) discussion of at least one engineering standard utilized. The heading of "Engineering Standards" must be used.

Oral Presentations
The same requirement for ME 481 oral presentations apply. The emphasis of the ME 482 presentation should be on the work completed in ME 482. However, the work completed in ME 481 should be included in the background discussion. Some teams will give their presentation during Founders Day, others will give their presentation to the class near the end of the semester.

Posters
If teams do not give their oral presentation on Founders Day, they are required to give a poster presentation on Founders Day.

Meetings with Advisors

Super-Group Meetings: There are several "super group" meetings scheduled throughout the year. These meetings provided students an opportunity to develop peer evaluation skills – from both sides. Each team will have an opportunity to discuss their projects and to seek feedback and assistance from their peers and from the faculty advisor. They also will have the opportunity to provide input to their peers on their projects. Students should also feel free to meet with their faculty advisor, or any other faculty member, at any time they desire additional help.

Industrial Advisor Meetings: For most projects, it is expected that students meet with their industrial advisors once or twice each semester. It is the student's responsibility to schedule and conduct all meetings; finding a time and location suitable for all attendees. Since Industrial Advisors are volunteering their time, it is advisable to hold meetings at their work site (this often gives students a chance to receive an interesting tour). However, some advisors welcome a chance to visit the UP campus. It should be their choice. Faculty Advisors may attend such meetings via teleconferencing or in person. If scheduling does not permit face-to-face meeting with the Industrial Advisor, teleconferencing is allowed (but not preferred). The most effective communication is face-to-face.

Project Management

To assist with project management and communication, accounts in "Basecamp" will be created for each project team. Details will be provided in class. Basecamp should facilitate communication between all stakeholders.

Action Item Log: As part of project management and communication, each team must keep an active "action item log." Action Item logs are basically "to do" lists maintained during a project. The Project Leader is to maintain the log and make sure all team members are aware of their assigned tasks. A copy of the log should be included in the ME 481 End of Semester Progress memo and ME 482 final report. Basecamp may be used for this, but not required.

Weekly updates: Using their Basecamp account, teams will send weekly updates to all stakeholders. It is important to use Basecamp for this as it maintains an email log for all stakeholders to view at a later date. As with all correspondence in the professional world, these must be written without spelling and grammatical errors.

Roles:

Team Lead=Project Lead=Lead Engineer – this is the student selected by the team to be the "lead" on the project. This person may (or may not) carry more day-to-day management responsibility than other team members (this is up to the team to determine) but project work and success is to be equally shared by all members. The Lead is responsible for weekly email updates and in general is the main point of communication between the team and faculty.

Instructor – this is the faculty member who oversees the project. Their role is similar to that of an engineering manager. They are ultimately concerned with the success of the project, but may or may not be involved with the technical aspects of the project.

Faculty Advisor – this is a faculty member (but is not the instructor) in the School. The faculty advisor's role will vary significantly from one project to another. At a minimum, they help the instructor evaluate the effectiveness of the team and the success of the project. For some projects, advisors may desire to meet with the team on a regular schedule. How frequent and to what extent the advisors provide guidance often depends upon team's initiative. If you need help, ask. If you feel the need to have regular meetings, ask for that too. In addition to the "official" faculty advisor, students should not hesitate to seek help from any other faculty member in the School of Engineering that have the appropriate background.

Industrial Advisor – this is a practicing engineering who has volunteered his/her time to assist you with your project. Do not be shy, they do want to be involved; but obviously, be respectful of their time. It is not their responsibility to initiate contact or to push the team towards success. They can offer real-world advice to help you with team issues, scheduling problems, and technical challenges. They provide a perspective different from faculty. But you must ask.

Lesson's Learned – DON'T GET BEHIND!

It is easy to get behind on senior design project for many reasons including:

- *It is not really due this week.* Other classes with more eminent due dates often take priority over capstone work. A solution: your weekly updates must identify tasks to be accomplished the next week. Treat this seriously – get done what you say you will.
- *I'm not sure what I'm supposed to be doing, so I'll work on something else*. A solution: ask your team mates for help, spend time figuring out what you should be doing for the project rather than working on some other class.
- *I'm getting tired of working on the project, I'm getting tired of my teammates attitude*, etc. This is a great opportunity for you to overcome a common obstacle. Overcoming such obstacles can be a valuable "point of discussion" in a job interview. A solution: the *Learning Resource Center* (part of the *Health Center)* offers assistance with function as a group or team.
- *I didn't get the part I ordered, I ordered the right part but it was out of stock*, etc. Solution: expect this, plan for it (leave time in the schedule/milestones for it).
- *I'm waiting for someone to provide me information* (team members or others). A solution: DO NOT WAIT, ALWAYS keep making progress. If you have to wait for one thing, work on something else for the project.
- REMEMBER project due dates are fixed! If you fall behind early in the project, you will HAVE TO MAKE UP the time later. Don't fall behind!

Besides the above bulleted items, the following can prevent falling behind. First, you have to know when you are behind. Creating and using a schedule with milestones can help. Meet the due dates for each milestone even at times when you are not prepared to do so. In other words, you may have a milestone for selecting the material for a critical component. The engineer responsible for that decision wants to slide the due date one week because he is waiting for a critical piece of information. Be careful, it is often better to make the decision when it is required even with limited information (that is almost always the situation in real practice) rather than to seek the "ideal" solution. Remember "*The perfect is the enemy of the good*" (Voltaire).