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 proud 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.

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 proposals, 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 Allen Hansen (technician supervisor). 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 and Reports

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.

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. 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).

ME 481 (see course syllabus for specific dates):

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. It should be one page maximum and not include attachments (other than sketches). Include the following:

- Identify all team members and identify the lead for the first semester
- Clear and complete description of the problem.
- Criteria tables (with 5-10 criteria that define the finished product)
- Bibliographic information of at least two useful professional references.
- List or brief description of 5-10 major milestones for the project
- Description of the probable finished product; what is it, what will it do, how will it be fabricated (if it that is the plan), etc. Sketches must be included (as an attachment if needed).

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. The following are to be included within the body or as an attachment.
The use of headings within the body is mandatory (introduction, background, etc.).

- Clear explanation for the impetus for the work (why are you doing the project)
- Background (including literature search with proper bibliography and citations). This section should also identify at least one engineering standard that will be used for the project. This may be a material standard, hardware standard, test standard, HVAC standard, etc.
- Discuss the expected finished product and the plan to produce it. Include figures and/or sketch of the proposed finished project (even if it isn't going to be fabricated).
- Criteria table for the finished product
- MS Project schedule for the entire project (ME481 and ME482) with approximately 10-15 milestones and approximately 3-4 tasks per milestone.
- Required resources (shop, financial, etc.)
- Completed *Shop Request Work Order* (for projects needing shop support)

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). Attachments:

- Properly captioned photographs of the prototype
- Completed Design Decision Document based off of a decision made from the prototype work.
- Other attachments may be included such as preliminary test data or other relevant information.

First Semester Progress Memo
Near the end of ME 481, teams are to submit a one-page memo (plus attachments) documenting their design work. Minimum attachments:

- Project Plan (previously submitted)
- The prototype demonstration memo (previously submitted)
- At least one significant Design Decision Document (not the DDD from the prototype)
- At least one engineering drawing (detail or assembly) that meets drawing standards (see ME481 web page for "drawing standards")
- Photographs (properly captioned)
- Action Item log (to be maintained throughout the project)
- Industrial Advisor feedback form (given to the advisor by the team)

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.

Questions from the faculty and Industrial Advisors will follow the end of the presentation and if time permits, questions from the general audience will follow the faculty questions. The course instructor will limit the number of questions where appropriate. 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.

Hardcopies of the presentation must be provided to the instructor, faculty advisor and the Industrial Advisor at the beginning of the presentation session. Print six slides per sheet.

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**. Appendices must include: Project Plan (from ME 481), Prototype

Demonstration Memo (from ME 481), First Semester Progress Memo (from ME 481), at least one additional Design Decision Document and the Action Item Log.

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 Founder's Day, others will give their presentation to the class near the end of the semester.

Meetings with Advisors

Faculty Advisor Meeting: 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" in "Basecamp." 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.

Progress updates: Using their Basecamp account, teams will send weekly updates to all stakeholders (due each Wednesday). 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. Updates should **briefly** (two or three sentences) explain the purpose of the update and discuss accomplishments for the past week. If appropriate, discuss milestones that were recently met or should have been met but were not. If milestones were missed, briefly explain why and explain how the impact will be mitigated. The advisors will then review these updates and send a response to the team via email if necessary. The team will then have 24 hours to respond to any comments. Remember, time is very valuable – updates MUST be written **very concisely** but be specific – a few sentences and outline form. If advisors request more extensive and detailed information, the teams should comply.

Lesson's Learned – DON'T GET BEHIND!

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

- *It is not "due" this week.* Other classes with more eminent due dates often take priority over capstone work. A solution: schedule specific times each week to work on the project – hopefully, all team members can be available for this time when team work is required.
- *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 team mates 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 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 <u>have to</u> 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 <u>using</u> a schedule with 10-15 major 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).