Department of Mechanical Engineering

ME 4444
Senior Design (Capstone) Project

Student Handbook
Fall 2012

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www.tntech.edu/me
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Introduction

ABET definition of Engineering Design

Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing and evaluation.

Accreditation Board for Engineering and Technology (ABET)

In order to meet the new ABET requirement all engineering programs across the country have started offering a senior capstone design course for graduating seniors in their programs. ME4444, Senior Design Project is the Mechanical Engineering capstone course included in the curriculum to satisfy the ABET requirements. In this course, in the lecture, the students are exposed to concepts of product design starting from concept development to managing a product design project so that a product design project may be completed on a timely basis within budget. In the lab, students are assigned design projects. The projects may either be sponsored by companies or the Department. The laboratory portion of the course provides the students with experience of applying mechanical engineering design principles for solving open ended engineering design problems.

ME4444 Senior Capstone Design Project is required of all mechanical engineering seniors. Typically seniors take this course in the graduating semester. Students work in teams of four to six on a project either by a company/ department. The faculty coordinator/advisor provides the help needed in steering the students in the right direction so that the students get the desired capstone project experience before graduating. The students are expected to conceptualize, design, analyze, make production drawings, and fabricate (build), test, and control, collect data and make inference from the collected data. As part of this course, students are expected to learn to work on teams, learn to make oral presentations, communicate with vendors and write formal reports. Also the students are required to apply technical skills in solving design problems and to learn personal and leadership skills. A typical project requires students to apply technical skills in several of the following areas of mechanical engineering:

1. Machine design
2. Controls
3. Manufacturing
4. Materials
5. Thermal systems
6. Fluid system
7. Kinematics
8. Dynamics
9. Modeling of dynamic systems
10. Man machine interfacing
11. Data acquisition and data analysis
12. Measurements
13. Project management
14. Mechatronics
15. Engineering Costing
Upon completion of this course, the student will be able to:

1. Engage in the various elements of the engineering design process
2. Complete a group-based, hands-on, capstone design project
3. Able to use basic computer-based data acquisition systems
4. Understand applications of programmable logic controllers and ladder_logic programming.
5. Work in a team professionally in the design and realization of a mechanical or thermal system.
6. Determine the potential impact of ethical and societal concerns on the engineer and engineering design process
7. Prepare technical report and make oral presentations
8. Communicate with a variety of "nonacademic" contacts (e.g. technicians, vendors, and other professionals for the purpose of gaining factual information and making component purchases."

Project Overview:

Each group/team will conduct a semester-long design project on a mechanical engineering topic that must include significant design in both the mechanical systems and thermal/fluid science areas. In addition, a suitable topic must also involve the use of computer-based data acquisition for real-time control of one or more significant variables. Safety, design analysis, cost, manufacturability, scheduling and managing budgets are other important aspects of the project. Note that the quality, not the quantity of the project is very important. Documentation of project efforts will be made through a formal project proposal (written and oral presentation); an engineering design analysis report; construction drawings; and final written & oral project reports.

Project groups/teams will normally consist of four to six students, depending on enrollment. All group members are expected to contribute equally to the project effort. A careful accounting of the time and efforts expended by each team member will be required through the submitting of weekly time sheets. Each team will be assigned a cubicle area in the ME 4444 project lab in which to work on and store items acquired for the project. Proper maintenance of a clean and safe work environment is required.
Summary of Basic Project Requirements:

- Acceptable projects must require significant engineering design component.
- Projects related to the thermal/fluid sciences, mechanical systems, design and manufacturing areas are highly desirable.
- It is expected projects will facilitate measurement/control of one or more variables in real time using an appropriate automated data acquisition/control system. Projects requiring higher degrees of automation are encouraged.

- In choosing a project, consideration must be given to the availability of the equipment and supplies needed for successful completion of the project. The Department and or sponsoring company will defray the cost for most of the supplies. But, the student team/group may have to bear some of the costs if the cost of supplies exceeds a certain pre-determined limit. The scope, objectives and deliverables of a project may be determined in consultation with the instructor, prior to submission of a formal written proposal. Project scope will be chosen such that fabrication and testing of the projects can be accomplished during the normal working hours of the Student Machine Shop and ME 4444 Senior Design Project Lab (NOTE: These facilities are NOT be available during nights or weekends!).
- Sponsored projects are highly encouraged; however, to be acceptable, the projects must satisfy all of the course requirements.

Attendance and Participation

Students registered for ME4444 must be available during scheduled class times for lecture and lab meetings throughout the whole semester. Active participation in all team activities is required. **Missing more than three classes will affect the course grade.** It is important for each team member to take care of the assigned responsibilities. Students should not accept any part time job during scheduled class times. Weekend work related to project should be kept to a minimum.
**Engineering Design Process**

The team/group should structure project reports, and presentations to reflect an implementation of the Engineering Design Process (EDP) detailed in Table 1.

### Table 1. Engineering Design Process

<table>
<thead>
<tr>
<th>No</th>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Define the problem.</td>
<td>Develop a problem statement and project objective(s). Identify the project evaluation criteria. Prepare a project proposal.</td>
</tr>
<tr>
<td>2</td>
<td>Identify, collect, and analyze data.</td>
<td>Document the processes. Identify the data needed to analyze the problem. Collect historical and current process data. Analyze the data using statistical and modeling techniques.</td>
</tr>
<tr>
<td>3</td>
<td>Develop design alternatives.</td>
<td>Based on the analysis, develop alternative designs for addressing the problem.</td>
</tr>
<tr>
<td>4</td>
<td>Evaluate design alternatives.</td>
<td>Document and evaluate each alternative, including the “do-nothing” alternative using the evaluation criteria.</td>
</tr>
<tr>
<td>5</td>
<td>Develop recommendations.</td>
<td>Select the preferred alternative(s)</td>
</tr>
<tr>
<td>6</td>
<td>Present recommendations.</td>
<td>Prepare the final report and presentation that summarizes the recommendations and the problem solving methodology. Submit required documentation.</td>
</tr>
</tbody>
</table>

**Interaction with the Faculty Coordinator/Advisor**

The faculty advisor is the resident mentor for the project. Therefore, the advisor should be filled in with project status periodically. In addition, all project activities should have prior approval by the advisor. Any purchase of parts/components and supplies must be approved by the faculty coordinator. For industrial/sponsored projects, the faculty advisor should be apprised of communications (written or oral) with the sponsor. This is to ensure that the team does not over commit and not deviate from sponsor’s protocol.

**Interaction with the Company for Sponsored Projects**

Each team member represents Tennessee Tech and the mechanical engineering department. Act, speak and dress in a professional manner. Be polite, positive, enthusiastic and friendly with employees in the company as you may end up working there upon graduation. For company visits, wear something comfortable and observe all safety requirements of sponsors. Obtain all necessary data and information with a minimum of inconvenience to the mentor/sponsor of the company. Whenever possible, use existing data, drawings, etc., at the plant location.
If you can get digital copies of drawings, it will help. Make sure that you do have the permission to make copies if you need copies to use elsewhere. Do not remove any documents from the sponsor’s premises without approval. If you need to make photographs and or video recordings, etc., obtain permission. Any authorized materials from the company such as pictures or videos may be included in reports and presentations.

Respect the non-disclosure form signed at the sponsoring organization. If any doubt arises concerning confidentiality, obtain permission either to use the data or information as they exist or to disguise it as necessary in the written portions of the project.

**Compensation**

Arrangements may be made by the faculty advisor to cover significant project-related expenses such as travel, software and hardware. Under no circumstances should anyone accept payment for work performed as part of this course. Should there be any question about compensation or conflict of interest, please check with the faculty advisor.

**Team Management**

Most engineers in professional practice are expected to work on teams. An important learning aspect of this project course is developing your ability to be an effective team member. Therefore, each team member will be assessed not only on technical skills and but also on interpersonal skills during the course of the project. No matter whether you like or dislike a person based on his/her religion, race, gender and national origin, please learn to work with that person in a professional manner.

**Leadership**

Each team is supposed to have a team leader. The leadership may rotate during the project, but the leader is the key contact for the faculty advisor and the sponsor. The leader is charged with ensuring that the team conducts business in a professional manner as efficiently as possible. Team members are expected to function as both a leader and a follower at various times during the course of the project.

**Communications**

The team leader must know the status of the project at any given time. Each team member is responsible for communicating the status of his or her effort on the project. Any problem that may arise within the team must be brought to the attention of the faculty advisor as soon as possible before it becomes a major problem.

**Stress and Conflict Resolution**

During the course of the design project, stress levels often may increase with work requirements due to deadlines and social activities. Team members may find personal differences that contribute to stress or conflict. The team is expected to address these
issues among themselves and, if necessary, meet with the faculty advisor for assistance in resolving conflict. Under no circumstances should your sponsoring company be aware of stress or conflict.

**Information Sources**

Establish credibility with the sponsor by searching for state-of-the-art technology, techniques, and tools for the project. Teams are encouraged to conduct the following activities:

**Problem Definition and Data Collection**
Several visits with the client may be necessary to define the problem. Additional visits may be necessary for data collection. However, some data may be obtained over the phone or via e-mail. In both activities, minimize inconvenience to the client.

**Identify Technical Mentors**
In addition to the faculty advisor, identify other technical experts either in the Department or in the College. Occasionally, you may find practicing engineers acquainted with you willing to help you. Avail the opportunity if one presents and make sure the faculty advisor/coordinator knows this arrangement. This is learning phase of your student life.

**Conduct Literature Search**
Proven methods may be found in a library and/or web search utilizing online catalogs, indexes, and abstracts. Search tools may have slightly different approaches to subject indexing, so identify as many key words and concepts as possible that relate to the problem. Engineering dictionaries and thesauruses are helpful in identifying synonyms for technical terms. Make hard copies of useful documents and include them in the final report.

**Contact Vendors and Specialists**
Use the Thomas Register website and websites of vendors such as McMaster Carr and professional societies such as ASME, SME, ASM, and IEEE to obtain equipment specifications related to recommendations. Books, journals, telephone interviews, on-site personal interviews, e-mail and other reference material should be cited in the final report and included the list of references.

**Project Proposal:**

The design proposal is a planning document that describes the objectives, background, methodology, expected results, costs, and safety issues related to the proposed project. Design proposals are typically required of engineers in industrial practice to justify the significant cost, time, and effort required for successful completion of projects. In addition, a carefully prepared design proposal serves as an important aid to the engineer both for formulating the problem correctly and in foreseeing problems before they arise. Both a written report and an oral presentation are required for the design proposal.
**Format**

The following format for writing project proposals is highly recommended.

- **Title Page** - Contains the project title, group number, group members, etc.

- **Introduction** - The following: items should be included:
  1. A brief description of the problem and the motivation for seeking a solution to the problem (need)
  2. A list of additional project Goals
  3. A list of the specific project Objectives
  4. A list of resources needed to work on the project
  5. A list of project Constraints
  6. A list of project Deliverables

**Need and Goal Statement**

This topic will be covered in detail in the class lecture.

- **Background** – This section provides the necessary contextual background for the project for those who will be reading the proposal. Prior work and existing solutions to this or similar problems should be reviewed.

- **Methodology** – This section is of primary importance, and should describe in detail the proposed approach that will be used in the project design.
  - Some items to be included in this section are:
    1. One or more sketches of the design and testing setups.
    2. A list of the primary/secondary personnel responsible for each design task (use form in Appendix).
    3. A project schedule preferably a “Gantt Chart” showing all project tasks with precedence relationship.
    4. The results of any back-of-the-envelope calculations necessary for proof-of-concept.
    5. To the extent possible at this stage, estimates of the anticipated ranges of important design variables (input and output parameters of the system).

- **Safety** – Since safety is of utmost importance throughout all phases of the design process, any significant safety issues must be identified and addressed in this section.

- General notes:
  a) Number pages
  b) Include references, as appropriate
  c) Proofread the report to check spelling, grammar, and meaning; (do not solely rely on a spell / grammar checker)
  d) It is preferable to place figures within the body of the report for convenience to the reader.
  e) A copy of each report will be made by the instructor for reference and grading purposes. Therefore, do not spiral bind reports, staple, or otherwise fasten reports in a manner that will make producing a copy more difficult. A folder or paper clip is fine.
**Design Analysis Report**

The design analysis report outlines all the engineering analysis such as stress, flow, thermal, design for X analyses required to perform on the project. Detailed analyses of all the critical aspects/components of the project prior to finalizing design and preparing production drawings for fabrication and assembly is essential to minimize the amount of time/money involved in re-works later in the project cycle. Suitable analysis methods may take many forms, for example: classical closed-form solutions, finite-difference and finite element modeling, bounds estimation, and simple experimental tests. Show all the computations and analyses in detail so that any possible erroneous assumptions or miscalculations may be identified at this stage.

For the purposes of this course, the following items are to be included in the design analysis report:

- **Title Page** - Contains the project title, group number, group members, etc.
- **Introduction** - This section briefly re-introduces the project to the reader and includes any changes in the proposed project objectives/methods that may have occurred since the project proposal. Please do not cut and paste from the project proposal. Specific additional items to be included are:
  1. One or more drawings of the project as a whole and any important sub-sections of the project; updated as needed from the design proposal.
  2. An itemized list of those portions or components of the project for which a design analysis is going to be presented in this report.
- **Product Decomposition Diagram** - A product decomposition diagram will help identify how the various components are going to be assembled. Also it will help improve the design by reducing the number of parts.
- **Engineering Analysis** – This section forms the bulk of the report and contains summaries of the analyses made for each item listed in the previous section. Drawings, equations, sample calculations, discussions, etc. should be included for each item as needed to make the analysis method and results clearly understandable to the reader. Extensive calculations, computer programs, etc. should be placed at the end of the report in the Appendix.
- **Safety and Hazards Analysis** – Identification of potential safety hazards and how they will be addressed. FMEA approach is desired. This topic will be discussed in the lecture class.
- **Summary and Conclusions** – A brief listing of the major results and conclusions of each analysis should be made here. In addition, an overall summary of the implications of the analyses on the project as a whole should conclude this section, i.e., is it going to work as planned?
- **Appendices** – Include supplementary information in the form of one or more appendices. If several appendices are included, precede this section with a “Table of Contents” listing each appendix and its contents in turn. For example:
  - Appendix A – Finite Element Modeling of Force Transducer Beam
  - Appendix B – Flow Calculations for Venturi Flowmeter
  - Appendix C – LVDT Sizing
• General notes:
  a) Number pages
  b) Include references as appropriate
  c) Proofread the report to check spelling, grammar, and meaning
  d) Figures should be placed within the body of the report for convenience to the reader.
  
  • A copy of each report will be made by the instructor for reference and grading purposes. Therefore, do not spiral bind reports, staple, or otherwise fasten reports in a manner that will make producing a copy more difficult. A folder or paper clip is fine.

Project Drawings

Complete, professional engineering drawings are required for any device/hardware to be constructed as part of the project, whether by the M.E. shop or by the group itself. These drawings may be either hand-drawn or generated by a CAD program. Close attention to tolerance and surface finish must be paid in developing production drawings.

• An “overview/assembly” drawing is to be included as the first page to show the relationships of individual parts to each other.
• Detailed drawings of pre-assembled units (such as motors or standard nuts and bolts) are not required; however, some relevant features, such as motor mounting holes, may need to be included on the drawings.
• Use of stock sizes can greatly reduce the amount of machining work needed and thus reduce costs.
• Proper dimensioning and tolerancing specifying resonance are important so that machining and assembly can be completed in a cost-effective and efficient manner. Be especially careful not to over-tolerance a part, as this can add greatly to the time and cost to produce the part. Stock items can be specified by their nominal dimensions (for example, a 2” x 4” board), unless their actual dimensions are critical (1.5” x 3.5”).
• Indicate on the drawings any special assistance (machining, welding, etc.) that will be required from the M.E. shop technician.
• Standard size paper (8½” x 11”) is preferred for ease-of-handling. Do not spiral-bind drawings, as they may be copied for future reference.

Oral Presentations

In engineering practice, the oral presentation is extremely important. This is often the primary vehicle of communicating any items of significance related a project starting from proposals to final results to all stakeholders. The effectiveness of any presentation may make or break a product/project idea. Hence, the time spent preparing a good oral presentation is usually effort well spent; a poor oral presentation can detract from what is otherwise a good project.

For all presentations in this course, it is highly recommended the teams/groups follow guidelines below.
• Begin the presentation by introducing the project and the group members.
• The length of the oral presentation may not exceed 30 minutes.
• Include project objectives, activities and deliverables at the conclusion of the project.
• A brief summary of the findings and/or recommendations for further work must be included.
• Any major hurdles and problems encountered may be mentioned.
• Each group member must present some portion of the project.
• After the presentation, each project team will be required to answer questions or elaborate a technique/tool from the audience including the instructor of the class.
• Presentations will be judged based primarily on the clarity/quality of the presentation, and on the ability to answer questions related to the project work.
• Dress appropriately for a professional presentation.
• Visual aids: When carefully used, visual aids are a very effective and efficient method of transmitting information in a concise, understandable way. When improperly used, they can be distracting and time-wasters. Common forms of visual aids include:
  1. PowerPoint presentations (see Betsy Grannis about computer/projector arrangements)
     - Review and adhere to guidelines for PowerPoint presentations.
     - Use fonts large enough to read without difficulty.
     - Use appropriate software packages for drawings and sketches.
     - Use charts and models along with text to illustrate points.
     - Use an electronic pointer as needed when making presentation.
  2. Videotape- Embed videos with PowerPoint Presentation
  3. Demo of project hardware/ software.
     If the project is small enough to be able to bring to the presentation, feel free to do so.
Do not go through the trouble of providing a demo for the audience if it is cumbersome and inconvenient.

**Poster Presentation**
Using oral presentation materials, a poster presentation is required.

The poster presentation may include the following information related to the project.

• Brief problem statement
• Design Analysis
• Project Schedule
• Cost
• Data Collection and Analysis
• Test Results
• Pictures/ drawings of the designed project
• Graphs

Use your discretion or check with the instructor about including proprietary/ confidential information.
Final Project Report

It is recommended that each team follows the format below for writing the final report. The completed report could be bound with a cover.

1. Writing style:
   a) Focus on the project, not the team (no first person or references to the team).
   b) Use MS Word or compatible word processor.
   c) Include a narrative with suitably detailed documentation (in an appendix or appendices).
   d) Include illustrations with printed labels and captions. Use appropriate software for a professional appearance. Illustrations and tables should be numbered and referenced by number in the text.

2. Title Page: The title of the capstone design project is to be at the top of the page. The rest of the items to be included in the title page are as below.
   a) Date:
   b) Course/Section:
   c) Instructor(s)
   d) Team Members:

3. Executive Summary:
   a) The purpose of the executive summary is to provide important information up-front, such that while reading the report, a reader has expectations that are fulfilled on a continuous basis. Key to a good Summary is the first sentence, which must contain the most essential information that you wish to convey.
   b) The summary is to be written as if the reader is totally uninformed about your project and is not necessarily going to read the complete report.
   c) It must include a short description of the project, the design process and the results.
   d) The Executive Summary is to be one page or less without any figures, it all possible.

4. Table of Contents: Include section titles and page numbers.

5. Design problem and objectives: Give a clear, complete and concise description of the problem and the intended objectives. State the design constraints and cost implications as applicable.
   a) Include appropriate background information based on your literature /web search on the design problem for the reader to be able to put the information provided in context.
   b) The final project objectives must also be presented in the form of a set of technical specifications.

6. Detailed design documentation: Describe all phases of the design project including an explanation of:
   a) Assumptions made, making sure to justify your design decisions.
   b) Function of the System
   c) Ability of meet Engineering Specifications
   d) Prototypes developed, their testing and results relative to Engineering Specifications
e) Control/measurement systems used
f) Cost analysis
g) Manufacturing processes used
h) DFX analysis as applicable
i) Tolerance Analysis
j) Human factors issues/problems considered
k) FMEA as appropriate
l) All diagrams, figures and tables should be accurately and clearly labeled with meaningful names and/or titles. When there are numerous pages of computer-generated data, it is preferable to put this information in an appendix with an explanation in the report narrative.

7. **Laboratory test plans and results** for all portions of the system that you built and tested. Write a narrative description of test plan(s). Use tables, graphs, and wherever possible to show your results. Also, include a description of how you plan to test the final system, and any features you will include in the design to facilitate this testing. This section forms the written record of the performance of your design against specifications.

8. **Bill of materials**: Parts costs include only those items included in the final design. A detailed bill of materials includes (if possible) manufacturer, part number, part description, supplier, quantity, and cost.

9. **Project Schedule/Gantt chart**: Show a complete listing of the major tasks to be performed, a time schedule for completing them, and which team member has the primary responsibility (and who will be held accountable) for each task.

10. **Ethical Consideration**: Provide information on any ethical considerations that govern the product specifications you have developed or that need to be taken into account in potentially marketing the product.

11. **Safety**: Provide a statement of the safety consideration in your proposed design to the extent that is relevant.

12. **Conclusions**: Provide a reasoned listing of only the most significant results.

13. **Acknowledgments**: List individuals and/or companies that provided support in the way of equipment, advice, money, samples, etc.

14. **References**: Including books, technical journals, and patents.

15. **Appendices**: As needed for the following types of information:
   a) Detailed computations and computer generated data.
   b) Manufacturers’ specifications.
   c) Experimental Data
   d) Drawings/Sketches
   e) Analysis
Appendix

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Mechanical Engineering Department
Machine Shop Safety Rules

- Make sure you get permission from Jeff Randolph or Chris Mills before you start operating equipment in the shop.
- Safety glasses with side shields or goggles are required to be worn at all times while working in the shop. You may bring your own safety glasses if you have them.
- Loose fitting clothing is not allowed anytime in the shop, especially when working on machines.
- Open toe shoes or sandals are absolutely not allowed in the shop.
- Two persons must be in shop to operate a mill or a lathe unless authorized.
- Please keep door to shop open while working in the shop.
- Please make sure that you have reasonably good drawings.sketches of parts with dimensions, hole locations, thread sizes, and other machining information prior to starting your machining work.
- Users must clean up area used every time work is completed. Even if you have not completed your work and must leave the shop, please clean area prior to leaving. Others may need to use the area during your absence.
- Students must clean and return all tools to proper location when finished.
- No tools are to be removed from shop without authorization.
- No horseplay allowed in shop. Do not distract anyone using equipment.
- Report all injuries to Jeff Randolph or Chris Mills immediately.
- Floor area where work was done must be swept after every use.
- Safety is top priority for every one when using the shop. If you are not sure what you are doing, “ASK”.
- Never attempt to use equipment that you are not familiar with.
- Report any problems related to equipment to either Jeff Randolph or Chris Mills immediately.
ME 4444 PREFERRED VENDOR LIST

Notes:
(1) The funds that the M.E. Department has available for student design projects are relatively limited; making project cost an important consideration when selecting and executing your project.

(2) In order to take advantage of the tax-exempt status of the University, as well as too best distribute the available funds between the project groups, most purchases will be made by the course instructor and/or M.E. Department staff using a University credit card.

(3) Consequently, to minimize the time and effort spent by the instructor in the ordering process, as well as to reduce excess shipping costs associated with placing many different orders from many different vendors, group members are asked to order, whenever possible, from the vendors listed below (in rough order of preference). Only if the desired item is not available from one of the listed vendors should a request be made for a purchase from a different vendor.

(4) When making an order request, you will need to submit a purchasing request form in electronic form to the course instructor. (This form will be emailed to all groups at the appropriate time; please see attached for an example order). Important: Check price, availability, and delivery times on orders before submitting your requests; also make sure that you include all relevant order information

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Web Site</th>
<th>Comments</th>
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<tbody>
<tr>
<td>McMaster-Carr</td>
<td><a href="http://www.mcmaster.com">www.mcmaster.com</a></td>
<td>Extensive source of project supplies with quick delivery</td>
</tr>
<tr>
<td>Lowes</td>
<td><a href="http://www.lowes.com">www.lowes.com</a></td>
<td>Local source of wood and general hardware items</td>
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<tr>
<td>Bennetts</td>
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<td>Local source of metal products</td>
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<tr>
<td>Newark</td>
<td><a href="http://www.newark.com">www.newark.com</a></td>
<td>Electronics</td>
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<tr>
<td>Electronics</td>
<td><a href="http://www.jameco.com">www.jameco.com</a></td>
<td>Electronics; stepper motors</td>
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<tr>
<td>Omega</td>
<td><a href="http://www.omega.com">www.omega.com</a></td>
<td>Sensors and controllers: temperature, pressure, etc.</td>
</tr>
</tbody>
</table>
GROUP ACTIVITY TIME REPORT  

(1) Submit one report weekly from each group  
(2) Document ALL time spent on project-related activities (lab, library, shop, discussions, purchasing, fabrication, testing, reports, presentations, etc.)

Total Hours for Each Group Member, in ALPHABETICAL order, from Itemized Listing Below:

<table>
<thead>
<tr>
<th>Name(Print):</th>
<th>Signature:</th>
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Itemized Task List

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<th>Date</th>
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<th>Hours (to nearest 0.25 hr)</th>
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### Senior Design Project Group Sign-Up

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ME4444 Senior Design Project
Project Evaluation - Faculty

Sponsor/Project: ____________________________________________
Evaluator: ____________________________________________
Semester: ____________________

<table>
<thead>
<tr>
<th>None</th>
<th>Poor</th>
<th>Fair</th>
<th>Average</th>
<th>Good</th>
<th>Outstanding</th>
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<td></td>
<td>Inadequate</td>
<td>Some</td>
<td>Useful</td>
<td>Many Good Features</td>
<td>Complete, Top Quality</td>
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</table>

Not Applicable

Using the above scale, how well has the team demonstrated competence in the following areas. As appropriate, please provide comments that support your assessment. The back of this form may be used for additional comments.

The team has demonstrated the ability to:

1. Apply mechanical engineering knowledge, design tools, and controls to solve real world problems. N/A 1 2 3 4 5
2. Identify and formulate engineering problems embedded in the project. N/A 1 2 3 4 5
3. Design system, components, and processes to meet project requirements. N/A 1 2 3 4 5
4. Demonstrate knowledge and understanding of programmable logic controllers. N/A 1 2 3 4 5
5. Acquire data online using an acceptable DAQ system. N/A 1 2 3 4 5
6. Use automation and computer control. N/A 1 2 3 4 5
7. Understand the importance of design for “x”. N/A 1 2 3 4 5
8. Assess embedded contemporary, societal, and ethical issues. N/A 1 2 3 4 5
9. Organize and make formal presentations. N/A 1 2 3 4 5

Comments:

ME4444 Senior Design Project
Project Evaluation - Sponsor

Client Company/Project:_____________________
Evaluator____________________ Semester:____________________

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<tbody>
<tr>
<td></td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Neither Agree or Disagree</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
</tbody>
</table>

Using the above scale, please rate the following. (as appropriate, provide comments that support your assessment. The back of the form may be used for additional comments.)

**Project Effort:**
1. Project design and fabrication met sponsor expectations. 1 2 3 4 5
2. Project design is adoptable and implementable. 1 2 3 4 5
3. Team has applied sound engineering principles. 1 2 3 4 5
4. Final report met sponsor expectations. 1 2 3 4 5
5. Team demonstrated technical abilities of an engineer. 1 2 3 4 5
6. Team exhibited enthusiasm for the project. 1 2 3 4 5
7. Team communicated well with the client. 1 2 3 4 5

**Presentation:**
8. Organization of presentation 1 2 3 4 5
9. Visual aids (slides, models) 1 2 3 4 5
10. Professional image 1 2 3 4 5

**Other:**
11. Our organization plans to implement the design. 1 2 3 4 5
12. Our organization plans to sponsor other student projects. 1 2 3 4 5
13. Participation was a valuable experience for our organization. 1 2 3 4 5

Comments:
ME4444 Senior Design Project
Project Evaluation - Team Members

Sponsor/Project: ________________________________________________________________
Evaluator ____________________________ Semester: ______________________________

Using the above scale, evaluate the effectiveness for each team member (include yourself) in the following areas.

**Quantity of effort:**
- TM1: 1 2 3 4 5
- TM2: 1 2 3 4 5
- TM3: 1 2 3 4 5
- TM4: 1 2 3 4 5
- TM5: 1 2 3 4 5
- TM6: 1 2 3 4 5

**Attention to detail:**
- TM1: 1 2 3 4 5
- TM2: 1 2 3 4 5
- TM3: 1 2 3 4 5
- TM4: 1 2 3 4 5
- TM5: 1 2 3 4 5
- TM6: 1 2 3 4 5

**Credibility of effort:**
(Well researched, documented)
- TM1: 1 2 3 4 5
- TM2: 1 2 3 4 5
- TM3: 1 2 3 4 5
- TM4: 1 2 3 4 5
- TM5: 1 2 3 4 5
- TM6: 1 2 3 4 5

**Timeliness of effort:**
- TM1: 1 2 3 4 5
- TM2: 1 2 3 4 5
- TM3: 1 2 3 4 5
- TM4: 1 2 3 4 5
- TM5: 1 2 3 4 5
- TM6: 1 2 3 4 5

**Contribution to project management:**
- TM1: 1 2 3 4 5
- TM2: 1 2 3 4 5
- TM3: 1 2 3 4 5
- TM4: 1 2 3 4 5
- TM5: 1 2 3 4 5
- TM6: 1 2 3 4 5

**Attitude toward a team effort:**
- TM1: 1 2 3 4 5
- TM2: 1 2 3 4 5
- TM3: 1 2 3 4 5
- TM4: 1 2 3 4 5
- TM5: 1 2 3 4 5
- TM6: 1 2 3 4 5

**Project Knowledge**
- TM1: 1 2 3 4 5
- TM2: 1 2 3 4 5
- TM3: 1 2 3 4 5
- TM4: 1 2 3 4 5
- TM5: 1 2 3 4 5
- TM6: 1 2 3 4 5

**Contribution to the overall project**
- TM1: 1 2 3 4 5
- TM2: 1 2 3 4 5
- TM3: 1 2 3 4 5
- TM4: 1 2 3 4 5
- TM5: 1 2 3 4 5
- TM6: 1 2 3 4 5

Your most valuable project experience:

Additional comments that you consider important to the evaluation of this project: