The Erik Jonsson School of Engineering and Computer Science
Culminating Design Experience Proposal Guidelines and Format

~~January 9, 2006~~
September 12, 2006

Culminating Design Experience Proposal Guidelines and Format

The objective of the culminating design experience is to provide a forum for senior engineering students to: (i) practice the engineering design, and (ii) demonstrate their mastery of undergraduate-level engineering and computer science technical knowledge through the solution of a significant design problem, including some original design or research work within a simulated or real-life professional engineering environment. At the conclusion of the design sequence the student will have completed an engineering project from conceptual design (problem selection and definition), through preliminary design of the complete system and performance design (optimization) of system components, to final detail design and demonstration of the system.

Course Content

A engineering and computer science students culminating design experiences must include the following essential elements:

1. Conceptual design

- Problem definition and specification development
- Defines the final product and its expected/planned performance, not the solution
- Idea/concept level
- Answers what the system will do and how well it will do it
- Documented in the proposal

2. Preliminary Design

- Choosing the solution from several feasible alternatives, using defined criteria
- Must involve some formal decision-making process
- Block diagram level
- Tells how the system will do it
- Documented in the PDR (oral ppt presentation)

3. Final design, Implementation and Validation

- Actually completing the project
- Involves detail circuit/software design, component selection, packaging, etc.
- Schematic/solder iron level
- Demonstrates the system in operation
- Documented in the Final Design Report, Oral Presentation, Poster Presentation

Course Requirements

The following deliverables will be required from all students.

Project Proposal		Formal, written
Preliminary Design Review	(30 minutes)	Informal oral w/graphics (ppt)
Status Reports (2)		Email to instructor
Final Design Review	(30 minutes)	Informal oral w/graphics (ppt)

Project Poster/Demo *		Poster presentation
Final Design Report		Formal, written
Design Documentation	(logbook, data)	

* Presented as part of Engineering and Computer Science Poster Day the last week of the semester

Notes:

1. The formal written and presentation materials (proposal, PDR ppt, FDR ppt, final report, and poster) must all be submitted to the Arts and Humanities technical editors for review before being submitted to the instructor. The technical editors will make corrections and comments. Students will correct and rewrite their documents and then submit them to the instructor. **The instructor will not accept submissions that have not been through this process.** The attached schedule of dates lists when the items must be submitted to the **instructor**. Make sure to submit them for technical editing early enough to get the documents back and rewritten in time for submission.

2. All documents (except for the Final Poster) should be submitted to the instructor in electronic form.

3. Detailed information about each course requirement is given below and on the course webpage at TBD, where samples can also be found).

4. Details about **when the assignments are due** will be provided by the instructor.

5. For oral presentations to the instructor (Project Proposal, Preliminary Design Review, and Final Design Review), email the instructor for directions.

6. Page counts indicated above refer to individual projects. Team projects should have appropriately longer reports.

7. Students working as part of a team submit group reports and give group presentations. Typically students in a team will all receive the same grade. It is the responsibility of each student in a team to make sure the team receives a desirable grade.

8. The instructor will evaluate all presentations and reports.

9. In the case of students whose senior project is done on a summer job or through some other sponsor:
   - The sponsor will make the primary assessment of the work, using the forms included below
   - Students must review PDR and FDR presentations with the instructor
   - If a PDR or FDR was not done then student must complete and Individual Oral Presentation at the end of the semester in which they enroll.
   - Students must write a proposal and a final report
   - Sponsored students should also submit status reports via email to the senior design instructor approximately monthly while executing their project

10. Students taking the culminating design must complete a Preliminary Design Review before receiving for the first semester.

11. Email is the primary mode of communication that will be used in senior design. Following the initial orientation meeting formal in-class meetings of senior design may not be scheduled

Expected Level of Effort

The expectation is that each team member is expending at the appropriate amount of time on the project. Team projects should be of sufficient complexity to allow each team member to make a significant contribution.

Evaluation of Senior Design

There are some specific forms that have been developed for use in evaluating senior projects (attached at the end of the packet):

1. Preliminary Design Review
2. Final Report
3. Student's Performance on Sponsored Projects

Use these forms and the content guidelines to guide you in your documentation efforts.

Grading

Each instructor will determine the grade for each team.

Culminating Design Experience Proposal Guidelines and Format

The *Project Proposal* must discuss the need or value of the project and any relevant technical background material. It must contain a fairly detailed description of the project at the system/functional level and identify requirements, constraints, criteria for making decisions between alternatives, and at several feasible alternative project solutions that will be evaluated. It should also identify the work to be completed and the project deliverables. It must address project management issues such as personnel, resources, budget, tasks and schedule. In addition to the instructor, faculty or external supervisors responsible for the preliminary design review may be added to approve and sign the proposal.

Overview

Engineering design problems begin with an identified need. Identified needs can come from a variety of sources, including formal requests (Requests for Proposals, or RFPs), informal requests (suggestions from a client), unsolicited proposals, and assignments from superiors, ideas formulated during routine tasks, new legislation, and other sources. At the very root, all identified needs are based on a want or desire for something arising from a deficiency (real or perceived). Note that most identified needs begin as rather vague, abstract statements. The definition of an identified need is the first stage of what can be called *conceptual design.*

Unfortunately, vague, abstract statements of an identified need are not suitable as a definition of a design problem. Thus, early in the design process it is necessary to move from a vague, abstract problem statement to a fairly concrete design problem with appropriate specifications. The exact steps that students follow in this process depend on the design methodology used and may vary from one problem to the next. The RFP can be thought of as the output of the second stage of conceptual design, i.e., problem definition, where the vague statement of an identified need is quantified into a more concrete description of what the customer wants accomplished. The RFP tells *what* the customer wants, but not necessarily *how*. The purpose of the RFP is to provide prospective bidders with the information necessary to: decide whether or not to participate in the competition and prepare the best possible proposal to satisfy the customer's needs

(usually including price quotations). Key information in an RFP typically includes specifications for the final result of the project.

The *Project Proposal* is usually a bid for a job, for services, for a cash award, or for research money. Although sometimes proposals are unsolicited, it is more common to prepare a proposal in response to an RFP. In this case, a proposal is a report that presents a clear delineation of the initial ideas the proposer has developed for solving the problem given in the RFP, including preliminary cost, resource, and schedule information. It also indicates the qualifications of the contractor for performing the tasks identified in the RFP's statement of work. Note that in the best of all worlds the RFP should complete the initial stage of problem definition, where the vague statement of an identified need is quantified into a more concrete description of what the customer wants accomplished, with specifications. However, if the RFP is inadequate, the proposal may need to refine the problem statement. As noted, the RFP may tell what the customer wants, but the customer may not always know how or how much. Thus the proposal must sometimes re-define or define the system specifications. This is usually done in collaboration with the customer. The project proposal is typically the first stage of what is called *preliminary deign*, where initial solution ideas and approaches are identified and possibly developed.

Proposal Format

The next page gives a list of generic content and organization that could be found in many project proposals. The project will follow established industrial standards or if none exist the project will follow the generic standards included in this document.

Generic Proposal Content

The following is a list of topics included in a typical proposal (but, not all topics would appear in every proposal).

- Letter of Transmittal (one page)
  - State your point
  - Explain how you learned of the customer's need
  - Explain why your proposal will be superior to others
  - Comment on your organization's qualifications
  - Express appreciation for consideration; offer to discuss in person
- Title Page
- Abstract or Executive Summary
- Introduction
  - Subject and purpose
  - Definition of problem
  - Immediate background
  - Need for solution
  - Benefits that will come from solution
  - Brief Summary of proposed solution(s)
  - Overview of proposal
- Objectives and Deliverables
  - Objectives: " I propose to investigate …, to determine …, to design …, etc."
  - Scope of Work: what specific tasks or activities will be carried out to achieve the objectives.
  - Deliverables: Working model, prototype equipment, follow-up maintenance, design drawings, consulting services, etc.
- Engineering or Technical Approach
  - Plan of attack, method of operation
  - Systematic presentation of intended procedures
  - **Alternate approaches you plan to consider**
- Project Management
  - Tasks: what will be done (collect parts, assemble equipment, gather data, analyze data)
  - Time: Gantt chart showing activities and their duration and order
  - Budget: materials, man-hours, travel, materials and supplies
  - Facilities
  - Personnel: summarize personnel needs; refer to attached resumes.
- Conclusion
  - Restate needs and benefits
  - Restate objectives
  - Summarize approach
  - Give costs and timeline
  - State willingness to modify proposal
- Appendices
  - Pert chart
  - Supporting illustrations
  - Supplementary tables and figures
  - Cost breakdown information
  - Extended analyses
  - Lists of personnel
- Attachments
  - Resumes of key personnel
  - Testimonial letters from previous customers
  - Descriptions of earlier projects
  - Revised specifications and effectiveness criteria as needed

Project Proposal Format

The project proposal will combine elements of conceptual design (e.g., the RFP) and preliminary design (e.g., the proposal) in a single document. The **following suggested format** indicates the minimally acceptable content:

- Cover letter or memorandum from the student(s) to Instructor

- Proposal

Title Page with place for Instructor and Sponsor approval signatures

1.0 Introduction (problem description and background)
- Discussion of the need for and value of the project in the context of a customer's need, including any relevant background material. Clearly state the identified need.
- Knowledge and skills acquired in earlier course work and appropriate engineering standards and realistic constraints

2.0 Problem Definition (requirements and specifications)
- Definition and delineation of the problem similar to an RFP, including identifying requirements, specifications (may be placed in appendix and discussed in this section, or included directly in this section), and constraints. To the extent possible your proposal should
  - Discuss requirements quantitatively (with tolerances).
  - Give physical constraints and environmental constraints.
  - Define interface requirements when your project impacts other project
  - Tell the relative merit of each objective and/or performance specification.
  - Provide criteria for making trade-offs between objectives and specifications

3.0 Objectives and Deliverables (scope of work, etc.)
- Presentation of a proposed scope of work, including objectives (what you hope to achieve), work to be completed (exactly what tasks you will do to achieve the objectives) and deliverables (what you will give your customer, such as prototype, schematics, training, etc.).

4.0 Engineering Approach (including solution alternatives)
- Your proposed engineering approach (i.e., your basic design ideas), including **different solution alternatives**, and a fairly detailed description of the project at the system/functional level.

5.0 Project Management
- Project management issues, such as personnel (typically attach resume as an appendix, but refer to it in this section), resources, budget, tasks, and schedule.

6.0 Conclusion

Attachments
Appendix A Specifications
Appendix B Resume

Two additional points

1. If you are doing a sponsored project, make sure this fact is made clear in the cover letter and that the name and contact information of the supervisor at the sponsor's organization is given.

2. If you are doing a team project you may turn in a single proposal, but the project management section must clearly define the roles and contribution of each team member and the length should be appropriate to the number of people involved (and so should the project complexity).

Preliminary Design Review
Overview

Preliminary design is the design process that bridges the gap between the conceptual design phase and the detail design activity. The conceptual design phase results in complete system-level specifications of "what"' the system is supposed to do. Conceptual design specifications are performance oriented. On the other hand, the deliverable produced at the end of the final design process is typically a set of engineering drawings and/or instructions that provide all the information to produce the product or system that is being designed. Such drawings and instructions are produced to meet the specifications and requirements developed during preliminary design. Preliminary design activity translates system-level specifications and requirements into component-level specifications and performance requirements necessary to complete the detail design. During the preliminary design process, the requirements of "what the system or product will do," as defined in the conceptual design process, are developed into a specification of "how the system or product will do it." Such a specification is usually done by defining the individual subsystems or components of the system and developing specifications for these individual parts. These specifications are then used in the detail design phase to complete the design process. The preliminary design report documents the sub-system-level specifications and constraints derived from the overall project requirements. Typically, at the preliminary design stage architectures are defined and the design is primarily documented with block diagrams, tables, flowcharts, etc., but usually not with schematics and complete parts lists. The *Preliminary Design Report* documents the various decisions and trade-offs made in coming up with the proposed design. Project management issues are also detailed in the Preliminary Design Report. Think of the Preliminary Design Report as a "Draft Final Report", but it is really more than that, as it may include more detail on the alternatives you explored and the decision making leading to the final design than the Final Report.

Preliminary Design Activities

As noted, preliminary design begins with system-level specifications of "what" objectives the system will achieve and translates these into detailed qualitative and quantitative design requirements. This process involves a number of activities, including: (1) engineering design, (2) cost estimating, and (3) project management. *Engineering design* refers to completing mass, momentum, force, energy, species, particle, current, etc. balances to establish proof-of-concept for your ideas. During this activity the designer will develop drawings, schematics, and/or flow charts to show how the various components of the system are related to each other. At this stage the various parts of the system will also be sized. Most calculations at this stage are initially based on heuristics and proceed to final exact specifications for each component. Note however, that the components are not designed at this stage; rather, the specification for the individual components are determined. During preliminary design the designer also completes initial *cost estimates*. Although complete costs for product construction will not be determined until the end of the detail design phase, it is important to estimate the approximate costs during the preliminary design phase. At this phase the designer will also estimate the cost of completing the design. *Project management* is the third major area of activity that takes place during the preliminary design. Typically the designer will develop schedules using Gantt charts and critical path analysis. Also, work breakdown structures (WBS) will be used to define personnel workload and responsibilities. Note that project management involves two areas: the design activity, and the product building or construction activity. Preliminary design emphasizes the former.

A fourth activity is implicit in the preliminary design process: *decision-making*. The success of an engineering design project is often dependent on the ability of the designer to make trade-offs between design specifications in a logical and systematic manner. Typically, there is more than one feasible alternative for solving a design problem. The designer must choose from among several approaches to select the "best"' design. Such decisions are usually made using decision matrices, decision trees, or other formal methods of decision-making. This is usually done after completing the preliminary design of several feasible alternatives, including cost estimating, and then choosing the best design based on the relative importance of the system objectives as defined by the system effectiveness criteria.

Preliminary Design Review Content

The preliminary design review (PRD) is a forum where the results of the preliminary design process are presented to your sponsor for their approval. It is often the case that a Preliminary Design Report is submitted before the PDR. This is not required in culminating design experience. However, the content of a typical preliminary design report should be included in the PDR. The following evaluation form for the PDR can be used as a guide to the content of the PDR. The idea is that you must document the basic design concept you are putting forward, with enough justifications of your decision-making and trade-off of alternatives to convince a knowledgeable engineer working for your client. The PDR should also include a preliminary cost estimate and a description of the project management activity (schedules and WBS) through the completion of detail design.

Electrical and Computer Engineering
Assessment of Preliminary Design Review

Name of student (s)	Project Title
Name of Evaluator	Relationship to Project
Email	Telephone
Name of affiliated company, research, or academic unit.	Address

Preliminary Design Review Assessment Scale: 5-Excellent, 4-Very Good, 3-Good, 2-Fair, 1-Poor, N/A-Not Applicable

Content	**Score**	**Comments (use additional sheets as needed)**
1 Clear statement of the problem, including the background and the need for the project		
2 Well-defined specifications for the project, including assumptions and constraints, and description of anticipated end-product and performance criteria and objectives		
3 Design objectives, including functionality and design constraints for sub-systems, and component-level specs, driven by overall project specifications		
4 Technical approach and solution, including descriptions of solution alternatives for the problem and decision analysis to justify final design approach		
5 Summary of preliminary design solution, with appropriate definition of all system components and their relationships; schematics, block diagrams		
6 Preliminary cost estimates, including estimates of system cost and design cost (personnel)		
7 Project management for complete project (covering Design II and III), including a work breakdown structure, personnel resource leveling, and a Gantt chart		
Other		
1 Clear delineation of contributions of each team member		
2 Overall completeness of descriptions and understandability of report		
3 The proposed technical solution is reasonable and correct		
Communication	**Score**	**Comments (use additional sheets as needed)**
1 Presentation begins with an agenda and is well-organized with clearly defined intro, body, and conclusions; presenters stay on topic and on schedule		
2 Visual aids: appropriate and professional; legible, uncluttered; consistent among presenters		
3 Professional delivery: presenters do not read directly from notes; good eye contact; strong, audible voice; good grammar; no "uhs;" presenters are enthusiastic		
4 Professional appearance (clothes, grooming, posture, use of hands, body movements, etc.)		
5 Presenters are knowledgeable and confident; presenters are respectful and courteous to audience; presenters give good, helpful responses to questions		
6 Overall, the presentation is professional, persuasive, and convincing		

Final Design Report Guidelines and Format

The *Final Design Report* is the culmination of senior capstone design process. The report provides a complete documentation of the student's activity toward the solution of the original problem statement as described in the proposal. The report should completely specify the design solution and should also present the final detailed design, including design optimization documentation and appropriate engineering drawings and schematics. Any performance results should also be included, as well as cost information. The report should include a complete accounting of the project management issues and an assessment of the project. In short, the Final Design Report provides everything your client needs to know about what you did.

Final Design Report Format

Listed below is a set of topics that might be included in your report. There is some redundancy in the list. Also, there is some overlap between this report and the Preliminary Design Report. In some cases the Final Design Report might be a detailed revision and update of the Preliminary Design Report. However, the Final Design Report should typically include much more detail and "tie up all the loose ends." Each report may not necessarily include every item listed and many reports may include items not listed. However, many of the topics listed would certainly be found in any acceptable design report (such as a cover letter, for example) and the report must stand alone.

Letter of Transmittal (one-two pages maximum)
Preliminary Material

- Title or cover page
- Abstract or executive summary
- Table of contents
- List of tables
- List of figures
- Acknowledgements

1.0 Introduction or Background

- Subject and purpose
- Problem statement and design objectives
- Summary of design process you executed
- Summary of final results
- Organization and summary of report

2.0 Review of Conceptual and Preliminary Design

2.1 Problem Analysis

- Review of problem
- Summary of specifications (comment on any changes)
- Discussion of main features of the design problem
- Summary of basic engineering or technical approach
  - Basic design concept
  - Features common to all feasible solutions
  - Areas of problem that admit different solutions

2.2 Decision Analysis

- Description of solution alternatives for the problem
- Definition of effectiveness criteria
- Discussion of decision analysis and final decision

3.0 Basic Solution Description

- Schematics and flow sheets defining all system components and their relationships
- Mass, momentum, force, energy, species, particle, current, etc. balances
- Component sizing and component-level specifications
- Initial system performance estimates

4.0 Performance Optimization and Design of System Components

- Description of components and their component-level specifications
- Design criteria used
- Discussion of the technical approach used
- Discussion of design details
- Presentation and discussion of engineering drawings and schematics
- Fabrication, construction, or production instructions and specifications
- This section should provide any and all information necessary to ``build" the component of the design you have focused on, all the way down to the number of nuts, bolts, transistors, wiring harness pinouts, etc.
- Summary of the final design results
- Performance evaluation

5.0 Project Implementation/Operation and Assessment

- Details of implementation
- Operational test results
- Evaluation of results relative to design criteria (how well did it do?)
- What changes are suggested by design results

6.0 Final Scope of Work Statement

- Summarize what has been done
- Summarize what still needs to be done
- Lessons learned and suggestions for future activities
- Describe any special details of the design that only you would know
- Related project management issues
- Address complete system life-cycle issues (marketing, sales, service, retirement)

7.0 Other Issues (as needed)

- Material selection
- Component or material suppliers
- Safety
- Reliability
- Environmental issues
- Maintenance
- Contracts and other legal and ethical issues
- Customer support and training
- Product documentation
- Operating procedures
- Contractor selection and supervision
- Inspection
- Decommissioning
- Quality assurance
- Etc., depending on your specific project

8.0 Cost Estimation

- Estimate of system cost (materials and construction)
- Estimate of design cost (man-hours, materials and supplies, travel)
- Other (such as construction or production or operating costs)

9.0 Project Management Summary

- Tasks: what has been done
- Tasks: what still needs to be done
- Time: Gantt chart showing activities and their duration and order
- Facilities
- Personnel: summarize personnel needs to complete design; include a WBS

10.0 Conclusion

- Restate purpose of report
- Restate objectives

- Summarize final design selection
- Give costs and timeline
- State willingness to ``keep the customer satisfied''

Appendices (as needed)

- Bibliography
- Correspondence record
- Supporting documents for project management
  - Gantt and/or Pert chart
  - WBS
  - Engineering design task list
  - Construction task list
  - Engineering design schedule
  - Construction design schedule
- Equipment list
- Parts list
- Suppliers list
- Supporting illustrations, engineering drawings, and schematics
- Supplementary tables and figures
- Calculations
- Cost breakdown information
- Revised specifications and effectiveness criteria as needed
  - Tells quantitatively (with tolerances)
  - Gives physical constraints
  - Gives environmental constraints
  - Any other constraints specific to the problem
  - Tells the relative merit of each objective and/or performance specification
  - Provides criteria for making trade-offs between objectives and specifications
  - Design specifications as required to define interface requirements

Erik Jonsson School of Engineering and Computer Science
Assessment of Final Design

Name of student (s)	Project Title
Name of Evaluator	Relationship to Project
Email	Telephone
Name of affiliated company, research, or academic unit.	Address

Final Design Report Assessment Scale: 5-Excellent, 4-Very Good, 3-Good, 2-Fair, 1-Poor, N/A-Not Applicable

Communication	**Score**	**Comments (use additional sheets as needed)**
1 Report is well-organized, with appropriate front matter, introductions, body, conclusions, appendices, etc.		
2 Capitalization, spelling, grammar (use of third person rather than first person; use of active voice rather than passive)		
3 Appropriate labeling of figures and tables (figures labeled at the top, tables labeled at the bottom)		
4 Appropriate use of visuals, such tables and figures; adequate textual explanations of visuals, attachments, appendices, etc.		
5 Definition of terms and acronyms used, nonuse of jargon		
6 Writing is clear, concise, and easy to read, conveying relevant, appropriate info; good paragraph and sentence structures (with topic and transition sentences)		
Content		
1 Clear statement of the problem, including the background and the need for the project		
2 Review of conceptual and preliminary design		
a) Design objectives, specs, and performance criteria		
b) Overall and component-level specifications		
c) Technical approach and decision analysis to justify solution		
3 Performance optimization and design detail of system components, including design technique, schematics, drawings, etc.		
4 Project implementation details; test results, assessment and evaluation of results relative to design criteria		
5 Final scope of work, including lessons learned, suggestions for future, system life-cycle issues		
6 Final cost estimates		
7 Final project management for complete project		
Other		
1 Clear delineation of contributions of each team member		
2 Overall completeness of descriptions and understandability of report		
3 Overall assessment of project (strength, weaknesses, etc.; use additional sheets as needed)		

Final Design Review/Demo Assessment Scale: 5-Excellent, 4-Very Good, 3-Good, 2-Fair, 1-Poor, N/A-Not Applicable

	Score	**Comments (use additional sheets as needed)**
1 Presentation begins with an agenda and is well-organized with clearly defined intro, body, and conclusions; presenters stay on topic and on schedule		
2 Visual aids: appropriate and professional; legible, uncluttered; consistent among presenters		
3 Professional delivery: presenters do not read directly from notes; good eye contact; strong, audible voice; good grammar; no "uhs;" presenters are enthusiastic		
4 Professional appearance (clothes, grooming, posture, use of hands, body movements, etc.)		
5 Presenters are knowledgeable and confident; presenters are respectful and courteous to audience; presenters give good, helpful responses to questions		
6 Presentation content covers all key elements of the Final Design Report		
a) Review of problem and preliminary design results		
b) Detail design and optimization of components/sub-systems		
c) Project implementation details, results, and assessment		
d) Final scope of work and system life-cycle issues		
e) Cost estimates and project management, including path forward		
f) Final assessment of project and its successes/failures		
7 Overall, the presentation is professional, persuasive, and convincing		

Erik Jonsson Engineering and Computer Science School
Sponsor's Assessment of Student Senior Design Performance

Name of student (s)	Project Title
Name of Evaluator	Relationship to Project
Email	Telephone
Name of affiliated company, research, or academic unit.	Address

Please assess the following attributes of the student during completion of their senior project:

Attribute	Excellent	Good	Fair	Poor	Not Observed
Ability to apply mathematics, science and engineering knowledge.					
Ability to design a component, process or system.					
Ability to use modern engineering tools.					
Ability to identify, formulate and solve problems.					
Ability to design and conduct experiments and to debug problems.					
Ability to get along with colleagues.					
Ability to function effectively as a member of a team.					
Ability to verbally communicate with others.					
Ability to communicate with written documents.					
Ability to learn new knowledge and skills.					
Professional and ethical behavior.					
Performance of student in engineering design reviews.					
Overall evaluation of the student's skills as an engineer.					

Student's strengths:

Student's weaknesses:

Other comments

Summary of Requirements

PROJECT PROPOSAL– see below.

PRELIMINARY DESIGN REVIEW

The *Preliminary Design Review* is an informal presentation (with appropriate presentation graphics) by the team/student to the instructor that summarizes the project concept and requirements, discusses the alternatives that have been considered and the decision-making logic leading to a final design approach, and then outlines the proposed design solution. Project management details should also be included. Note that all the technical design details are not expected to have been completed at this point but the basic solution should be defined. The team/student will make a 20-minute presentation on the project and be prepared to respond to questions following the presentation. The review will discuss technical design details and project documentation must be available for inspection upon request (see below). Students working on a project with a company or under the direct supervision of a faculty member may have the Preliminary Design Review with company personnel or with the faculty member. Students in this situation will need to have their supervisor complete the evaluation form (copy included below), which should be returned to the course instructor along with a copy of the presentation graphics. Typically the instructor will discuss the presentation graphics and the evaluation with the student.

PROJECT STATUS REPORTS

Project Status Reports are required throughout the course of the senior design sequence. These should be emailed reports (attachments are acceptable) that should discuss the current status of the project. The status reports should clearly identify tasks completed on the project and tasks that are yet to be finished. Items that may impact the schedule, budget, or successful completion of the project, should be discussed. Changes to the original project as approved should be discussed and justified. Status Reports should include everything a client would expect to hear regarding the progress of the project. The point is to inform the instructor about your progress as you go. Thus, sending a bunch of emails or turning in all the reports at once near the end of the project will result in a lower grade. After mailing the status reports students should arrange a brief meeting with the instructor to discuss the report orally. A possible format for the emailed report and the oral discussion is: a) Progress; b) Problems; and c) Plans.

FINAL DESIGN REPORT – see below.

FINAL DESIGN REVIEW AND DEMONSTRATION

The *Final Design Review*, like the PDR, is an informal presentation (with appropriate presentation graphics) by the team/student to the instructor that summarizes the final design completed by the team following the PDR. The team/student will make a 30-minute presentation on the project presentation on the project and be prepared to respond to questions following the presentation. If the project is not complete, is not working, or does not meet design requirements or specifications, the student must be prepared to discuss problems and difficulties that prevented the work from being completed successfully. The project documentation must be available at the final review (see below). Students working on a project with a company or under the direct supervision of a faculty member may have the Final Design Review with company personnel or with the faculty member. Students in this situation will need to have their supervisor complete the evaluation form (copy included below), which should be returned to the course instructor along with a copy of the presentation graphics. Typically the instructor will discuss the presentation graphics and the evaluation with the student.

PROJECT POSTER/DEMONSTRATION

At the end of each semester the Engineering and Computer Science School, ECS, will sponsor an *ECS Senior Project Poster Day* where each team will demonstrate their project. Tables and poster space will be

made available. Sample poster templates are available on the course webpage. Students will be present with their projects and posters to answer questions from faculty, invited guests, and others who visit the poster presentation area.

SPONSOR'S ASSESSMENT OF STUDENT SENIOR DESIGN PERFORMANCE

In addition to assessment forms for the Preliminary Design Report and PDR and the Final Design Report and FDR, the student's sponsor or faculty advisor should complete an *assessment of the student's overall performance* in senior design. A form for this assessment is included below.

PROJECT DOCUMENTATION

The *Project Documentation* should include all of the documentation and design details on the project and should be available for inspection upon request by the instructor. The documentation might typically include a project logbook and a three-ring binder. The project logbook is a bound notebook containing dates and work activity for the project from the beginning to the end of the project. Notes on design ideas, design calculations, parts, vendor information, discussions with faculty, problems encountered, etc. should be included. Important entries should be signed and dated. Project specifications from laboratory tests and measurements should be recorded. Some people like to paste computer output or data sheets in the bound logbook, rather than placing them in the three-ring binder. This is fine, but typically students also need a three-ring binder to collect schematics, oversize materials, etc. Items in the three-ring binder should be signed and dated. The documentation package should contain everything another engineer would need to duplicate the project.

Some of the items that might be included in the project documentation are listed below. The list is not exhaustive and some of the items may not be appropriate for certain projects. Items contained in the documentation should be professional quality. Copies of data sheets, etc. should be readable. Design calculations should be organized and readable.

bill of material with cost data
schematics
block diagrams
simulation models
calibration data
simulation results
data sheets for components
software system design
design details and calculations
software listings
functional requirements
specifications
IC pin diagrams
test data
mechanical drawings
test equipment
operating instructions
test plans
pictorial drawings
test procedures
printed circuit board layouts
users manuals
circuit schematics
wiring diagrams
etc.