ECE 4010/4020
SENIOR PROJECT WORKBOOK

by
Dr. Fon Brown
Dr. Jonathan West
Dr. A. Tye Gardner

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Weber State University
Electrical and Computer Engineering
Ogden, Utah 84408-1703

Preface

The Department of Engineering has instituted the Senior Projects Program to help facilitate the student's transition into industry and to provide a

TABLE OF CONTENTS

1.0

2.0 COURSE DESCRIPTIONS

ECE 3090

Program Management (ECE 3090) is the first course in the series of three required for graduation. ECE 3090 is a two credit hour class. The course requires the completion of the following significant milestones:

1. Form a Team
2. Proposal Approved

After the teams have been formed, each team will meet with the senior projects coordinator 30 minutes each week. Students are expected to contribute about 10 hours per week for a total 150 hours during the semester. A letter grade will be given at the end of the semester.

ECE 4010

Senior Projects I (ECE 4010) is the second course in the series of three required for graduation. ECE 4010 is a two credit hour class. The course requires the completion of the following significant milestones:

1. Project Plan Complete
2. Hardware Components in Hand
3. Critical Circuits Proven
4. Preliminary Design Review

After the teams have been formed, each team will meet with the senior projects coordinator 30 minutes each week. Students are expected to contribute about 10 hours per week for a total 150 hours during the semester. A letter grade will be given at the end of the semester.

ECE 4020

Senior Projects II (ECE 4020) is the third course in the series required for graduation. ECE 4020 is a two credit hour class. The course requires the completion of the following significant milestones:

1. Proposal Obligations Fulfilled
2. Project Demonstration
3. Documentation and Poster Complete
4. Final Design Review
5. Log Book Complete

Each team must meet with the senior projects coordinator at least 30 minutes each week. Students are expected to contribute enough hours per week to meet schedule. A letter grade will be given at the end of the semester.

3.0 SENIOR PROJECTS EVALUATION

Each student or team is assigned a grade by the coordinator for the following c

ECE 4020 Team Evaluation

Project Demonstrated
If project was not demonstrated, enter a final grade of E or I. YES NO

Teamwork		**Points**		**Total**
Team meetings – students worked as a cohesive team	ABCDE	_____	× 2 =	_____
Coordinator Meetings – productive, team was prepared	ABCDE	_____	× 2 =	_____
Project Management				
Project milestones – team met documented milestones	ABCDE	_____	× 2 =	_____
Research and Development				
Problem Solving – team found solutions to problems	ABCDE	_____	× 2 =	_____
Quality Engineering – constructed to quality standards	ABCDE	_____	× 3 =	_____
Packaging – Final product has professional appearance	ABCDE	_____	× 2 =	_____
Impact/Complexity – project reflects a senior-level design	ABCDE	_____	× 3 =	_____
Communication				
Design documentation – clear, complete and concise	ABCDE	_____	× 3 =	_____
Standards and Constraints were enumerated.	ABCDE	_____	× 1 =	_____
Supplementary documentation – BOM, user's guide, etc.	ABCDE	_____	× 2 =	_____
Late Demonstration Penalty (up to 15 points)			**–**	_____
Late Documentation Penalty (up to 10 points)			**–**	_____
Total Team Score (out of 88)				_____

ECE 4020 Individual Evaluation

Teamwork		**Points**		**Total**
Participation – student carried his/her share of the load	ABCDE	_____	× 2 =	_____
Project Management				
Goals – student met his/her weekly goals	ABCDE	_____	× 3 =	_____
Communication				
Log Book – student's logbook was clear and well-kept	ABCDE	_____	× 2 =	_____
Final design review – see evaluation form	ABCDE	_____	× 4 =	_____
FE Practice Exam				
Number of questions answered correctly (max points = 26)	(	)12)	)	2

4.0 ADVISORS

Each team needs advisors (mentors) to ensure that the educational goals of senior projects are accomplir 6Box 6B0

5.0 LOG BOOKS

Each member must keep an accurate log of his or her activities during the senior projects classes. Class meetings, team meetings, phone calls, conversations, commitments, trips, ideas, schematics, calculations and sketches should be recorded in your logbook along with the date and the amount of time spent on the activity. These entries are to be made in a bound notebook in chronological order.

Your log book is a contemporaneous record of your activities and as such it is a legal document. If you keep your log book using good documentation practices, it can be used in a court of law as evidence of your work. A log book may save or cost an employer millions of dollars, depending on how it is kept.

Log books for Log ( )]TJa5 (i)6r in c [illegible]

6.0 PROPOSAL

The senior project must address a contemporary, unresolved issue or problem using the principals of engineering design at a senior level, including knowledge and skills from more than one Junior Core and Senior Elective course. Each team must write a proposal that clearly states the problem to be addressed, the approach the team is taking to solve the problem and what the team will deliver when the project concludes. The proposal must convince the faculty that the project is worthy of being a senior project, and all faculty members in the department must approve and sign it. The proposal should clearly state what is to be accomplished by the team to prevent any misunderstandings between the faculty and students. The proposal, signed by all ECE faculty, is due for ECE 4010 students on the second Tuesday of the semester.

Students or teams who have taken ECE 3090, project management, may use the proposal that they wrote during that course. Other students, or those who elect to pursue a different project may use a simplified proposal format that conforms to the following guidelines:

1. The proposal must be a short document that clearly describes the student commitment to the project. Team goals,

<PROJECT TITLE> PROPOSAL

TEAM MEMBER'S NAME	EMAIL ADDRESS	PHONE NUMBER

TEAM ADVISOR	COMPANY	PHONE NUMBER

PROJECT DESCRIPTION:

Section 1: Define the problem to be solved. This section must include:

- Why the problem is important and who it is important to
- A background on existing/similar solutions
- What sets your solution apart

Section 2: Explain how the problem is going to be solved. This section must include:

- A short description of relevant engineering theory
- How you will approach the solution and any tools required
- A list of milestones with detailed descriptions. This section should also include a Gantt chart, but clear milestones and deliverables will be sufficient.
- An estimated budget

Section 3: Describe the hardware and software that will be presented at the conclusion of the project. It is your responsibility to define good deliverables. Unclear deliverables are subject to faculty judgement on whether the project is complete and satisfactory, which may result in a lower or incomplete grade. When defining deliverables, consider the following:

- Good deliverables are specific including specifications of what *isn't* in the scope of the project
- You must specify which components will be designed by you and which are re-used from other sources (e.g., if using an algorithm, are you writing the code or using a library)
- Include specific programming languages and environments. Do not use the Arduino environment, board, or shields

FACULTY	APPROVAL	Complexity	Impact	DATE
Dr. Fon Brown				
Dr. Justin Jackson				
Dr. Christian Hearn				

7.0 PROJECT PLAN

Once your team is assembled and the proposal is signed, you will need to work on your project plan. Your project plan is due by the end of the fourth week of ECE 4010, but it is strongly recommended that you complete it sooner. Once your project plan is complete, you should try very hard to stick to the schedule it dictates. You will be graded on your ability to make a schedule then keep to it.

A project plan is a document that explains the scope of the project, a breakdown of the tasks necessary to accomplish it and the resources required for each task. The project plan also provides a schedule for the tasks (subject to the inevitable resource constraints) and gives a project timeline with a set of project milestones.

Research (See Section 13) must be done concurrently while developing a project plan. The task breakdown in the plan guides your research, and your research helps you estimate the time and resources required for each task (which is necessary if you want an accurate schedule).

The project plan may be stored as an MS Project file or even an Excel document, but whichever format you use, the document must contain the following four sections:

1. Scope of Project
   This section describes the planned project, why it is being built and who the stakeholders are. (Stakeholders are the people or organizations for whom the project is being built as well as those who will operate, maintain or develop it. The list of stakeholders includes, at a minimum, your team and your advisor(s).) This section explains the relationship of the project to the system in which it will operate or to other systems with which it will interface. It also describes the role each stakeholder will play in the development and maintenance of the project.
2. Project Tasks
   This section is the heart of the project plan. It defines each task necessary to complete the project in terms of its tangible inputs and outputs. An estimate of the resources, budget and time required for each task must be included. Complicated tasks may be broken down into a task hierarchy if it is helpful. Don't forget to include time for things like debugging and system integration.
3. Task Schedule
   Based on the inputs and outputs of Section 2 and the resource constraints that always exist, this section schedules the tasks (gives them start and end dates). As a consequence of this schedule, certain milestones will emerge, such as *preliminary design review complete* or *prototype fabrication complete*. These milestones should be listed on a timeline included in this section. This section must include a Gantt Chart.
4. Budget
   This section lists all the required resources and expenditures required for the project. (This normally includes engineering labor and overhead, but for senior projects, these two items would be omitted.)

The project plan must be approved and signed by all the stakeholders then submitted to the senior projects coordinator.

Keep in mind that the project plan is a "living document." In other words, if a task takes more or less time than estimated, the project plan should be updated to reflect a new schedule, and if the change to the schedule is substantial, it should be reapproved by the stakeholders (an informal or verbal approval is sufficient) and resubmitted to the senior projects coordinator.

8.0 DESIGN REQUIREMENTS AND CONSTRAINTS

All design efforts begin by enumerating the requirements and constraints. Requirements generally specify what the design must do, whereas the constraints are specific limits that the design must not exceed.

Requirements may be categorized as functional, performance, usability, aesthetic, interface, etc. To illustrate, consider the design of a smart-phone. An example of a functional requirement might be that the phone must use a G4 network if one is available but fall back to a G3 network if not. A performance requirement might specify how many applets may run simultaneously or the amount of time the phone operates before the battery dies. A usability requirement may insist that buttons be a ce( )1.8 (i)6.2 (ght)(he)-10[(t)7.2 (

9.0 DOCUMENTATION

paper. Second, it includes a literature review that lists the seminal contributions of others scientists and engineers to the problem outlined earlier. Third, it describes your specific contribution (i.e. design) along with an overview of the rest of the paper.

3. Methods
   This section describes the methods used solve the stated problem and the means of evaluating the efficacy of the solution. Since the design is part of the solution, it is appropriate it describe it here. Again, there is no set format, but another engineer or scientist should be able to duplicate your results (Section 4) using the description of the design you provide in this section.
4. Results
   This section describes the stimulus (test conditions) and the raw results obtained from the approach (design) described in Section 3. Commentary about the meaning or efficacy of these results should be reserved for the Discussion Section, below.
5. Discussion
   This section interprets the results and discusses the efficacy of the approach in solving the original problem. Topics of discussion might include: how do these results compare with other approaches, how do the results compare with modeled or expected behavior, what is new and significant about this approach, etc. The goal of this section is to interpret the results that lead to the main conclusion of the paper.
6. Conclusion.
   This section does not introduce any new information or insights about the problem, methods and results in this paper. Its main purpose is to succinctly highlight the important conclusions described earlier.
7. Further Research (optional)
   If your research or design has opened the doors to new problems or a different approach, you should include a section that briefly describes the problem(s) to be solved or the (potentially superior) approach to be taken.
8. Acknowledgements
   This section should acknowledge those who funded the project as well as contributors who do not rise to the level of author.
9. References
   The paper should contain a list of references formatted according the requirements of the journal to which it is submitted. You may not include a reference unless it is cited in the paper.

Again, you should endeavor to be as clear, concise and complete in your paper as possible.

Poster

Teams are required to summarize their design and results on a poster suitable for submission to an undergraduate conference (e.g. NCUR or the OUR Research Symposium). The poster will be printed and mounted at department expense and afterwards be displayed in the hallway near the engineering department office. The poster should be completed on or before the project is demonstrated to the faculty on demonstration day. Students should make sure to account for the time needed to print and mount the poster.

Code Listing

For projects that require software or programmable logic, the design documentation should include a code listing. The listing is a plain text file that includes the source code for the software or logic chip. The file should include a file header (a set of comments at the top of the file), . Tand sofe foruld inc ts oftsshoba6.2 (gn doc)-1

SAMPLE PARTS LIST

Project Title:_____

The recommended one-hour format for the presentation is as follows:

0:00 to 0:05 Hand out the presentation outlines to the faculty, advisors and guests (if available). A team member introduces the team, advisors, and guests to the faculty.

0:05 to 0:10 One or more team members clearly describe the problem to be solved including any social, economic or political ramifications it may have.

12.0 TEAMWORK

The ability of engineers to work in teams is crucial to most employers. The senior project provides an o

13.0 PROJECT MANAGEMENT

Project management involves forming a project development plan, then allocating time and resources to execute the plan. Careful planning and execution is essential to the success of any engineering project.

Project Plan

The following are examples of suitable goals and accomplishment criteria:

A. Goal: Research three types of microprocessors and obtain the data sheets. Select one to use for the project. (3 hrs)
   Accomplishment Criteria: Copies of data sheets in hand. Rationale for choice documented in logbook.
B. Draw a rough schematic of the microprocessor, RAM, and ROM sections. (4 hrs)
   Accomplishment Criteria: Schematic documented in logbook
C. Write the circuit descriptions for the microprocessor, RAM, and ROM sections on a word processor. (5 hrs)
   Accomplishment Criteria: Document written and reviewed by all team members.
D. Wire-wrap the microprocessor, RAM, and ROM sections of the project. Check continuity of connections. (7 hrs)
   Accomplishment Criteria: Hardware wire-wrap completed. Individual connections checked off schematic as part of continuity check.

A template for the weekly goal record can be found on page 23 of this workbook.

14.0 RESEARCH AND DEVELOPMENT

Research and Development skills are evaluated an attempt to measure the student's abilities to solve design problems.

Topical Research

Each team member will conduct basic research. Library or Internet search results should be recorded in your log book and presented during weekly meetings with the senior projects coordinator. Research is crucial and should dominate your time during the project planning phase. Once the plan is complete, research is still necessary, but it will occupy a relatively small amount of your time.

Circuit Design

Each member of a team must display good design techniques. Teams are not expected to design circuits that have never been designed before. Original circuit designs are unlikely and may not be the best for the job. Most designs are usually a combination of existing circuits. Good research techniques should unveil other circuit designs that could be used in your design. The use of other designs must be brought to the attention of the senior project coordinator and your design document should credit the original designer. Whether a design is original or not will not be the issue. The issue is whether or not the students understand the circuit well enough to modify or troubleshoot it themselves. The senior projects coordinator will assign a letter grade for the design and research effort by the students.

Circuit Construction

16.0 FE PRACTICE EXAM

Students in both ECE 4010 and ECE 4020 are required to take a 45-question FE Practice Exam. Questions for this exam are culled from previous FE (Fundamentals of Engineering) Exams. (The FE Exam is a standardized test administered nationally by NCEES – The National Council of Examiners for Engineering and Surveying).

The exam can be taken in any WSU testing center anytime between the first and last day of class. It is a closed book exam, except that you may bring a copy of the NCEES FE Reference Handbook. The handbook should not be necessary, however, because any tabular data you need will be provided in the exam questions. Still, the handbook does include equations and formula that may prove useful. The exam should take two hours or less, however you will be (t)7.2 [-41.747 5 (e t)7.2 (w)1Tc -0.062 Tw [t. -41.747(t)7.2 (i[e

DESIGN REVIEW PRESENTATION EVALUATION

Name of Evaluator: _____ ECE 4010___ ECE 4020___ Date _____

Individual Grades

Student #1:_____

Professional Attire	A	B	C	D	E
Speaking ability.	A	B	C	D	E
Knowledge of the project.	A	B	C	D	E
Share of the load	A	B	C	D	E

Student #2:_____

Professional Attire	A	B	C	D	E
Speaking ability	A	B	C	D	E
Knowledge of the project	A	B	C	D	E
Share of the load	A	B	C	D	E

Student #3:_____

Professional Attire	A	B	C	D	E
Speaking ability	A	B	C	D	E
Knowledge of the project	A	B	C	D	E
Share of the load	A	B	C	D	E

Team Grades

1.	Introduction / Overview	A	B	C	D	E	
2.	Explanation of the Problem	A	B	C	D	E	
3.	Slides and/or other Visual Aids	A	B	C	D	E	
4.	Presentation Organization	A	B	C	D	E	
5.	Results (ECE 4020 only)	A	B	C	D	E	N/A
6.	Conclusion	A	B	C	D	E	
7.	Impact/Complexity	A	B	C	D	E	

Comments:

Coordinator Use Only	Student 1	Student 2	Student 3
Total Grade Points			
Grade Point Average			

DEMO EVALUATION

Name of Evaluator: _____ Date _____

Individual Grades

Student #1:_____

Professional Attire	A	B	C	D	E
Speaking ability.	A	B	C	D	E
Knowledge of the project.	A	B	C	D	E
Share of the load	A	B	C	D	E

Student #2:_____

Professional Attire	A	B	C	D	E
Speaking ability	A	B	C	D	E
Knowledge of the project	A	B	C	D	E
Share of the load	A	B	C	D	E

Student #3:_____

Professional Attire	A	B	C	D	E
Speaking ability	A	B	C	D	E
Knowledge of the project	A	B	C	D	E
Share of the load	A	B	C	D	E

Team Grades

1.

WEEKLY GOAL RECORD

Project Title: _____ Y 8.1___ek_____ 1 Tc Tc 4