

AN ABSTRACT OF THE THESIS OF

Ding Luo for the degree of Master of Science in Electrical and Computer Engineering presented on June 8, 2010.

Title: Development of Leadership and Design Skills Among ECE Juniors and Graduate Students.

Abstract approved:

Donald L. Heer

Engineering students spend a significant amount of their undergraduate careers focused on technical theory and practice. This intensive student prepares them for their technical challenges in the future. This training is so intense that often the more ‘soft skills’ such as communication, leadership, design, and troubleshooting are left out or are presented in only a few selected courses. This thesis presents two examples of these soft skills being approached and taught to engineers. The two skills addressed in this thesis are design and leadership.

To teach design, the approach taken in Electrical Engineering and Computer Science (EECS) at Oregon State University (OSU) is a scaffolding approach with a Platform for Learning (PFL). Specifically this thesis presents the redesign, implementation, and evaluation of a PFL into the Electronics II course.

To prepare engineers for leadership roles this thesis covers a graduate level course focusing on leadership applied to teaching. With the focus of “leadership is the foundation for teaching”, this training course gives students the tools and knowledge for becoming effective leaders.

©Copyright by Ding Luo
June 8, 2010
All Rights Reserved

Development of Leadership and Design Skills Among ECE Juniors and Graduate
Students

by
Ding Luo

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Presented June 8, 2010
Commencement June 2011

Master of Science thesis of Ding Luo presented on June 8, 2010.

APPROVED:

Major Professor, representing Electrical and Computer Engineering

Director of the School of Electrical Engineering and Computer Science

Dean of the Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Ding Luo, Author

ACKNOWLEDGEMENTS

I sincerely appreciate everyone who provided encouragement and help toward my success for the past two years. I thank my wife, Keyi, for her continuous understanding and support throughout my graduate school career. I thank Donald Heer for all of the mentoring he has given me since 2006. I thank all my role models: Roger Traylor, Pallavi Dhagat, Pavan Hanumolu, Donald Heer, Stephen Meliza, and Matthew Shuman for their continuous inspiration. I thank Nathanael Edwards, Tawalin Opastrakoon, Todd Waggoner, Tony Chen, Richard Przybyla, and Mohsen Nasroullahi for their strong friendship. I thank all of the teaching assistants I have worked with in the past. Lastly, I want to express my sincere appreciation to the OSU TekBots group.

CONTRIBUTION OF AUTHORS

Tawalin Opastrakoon, Jace Akerlund, and Marshall Adrian spent many hours assisting the development of the Electronics II laboratory project and its prototype. Donald Heer and Roger Traylor contributed ideas on the refinement of the project prototype. Un-Ku Moon, Pavan Hanumolu, Bangda Yang, Brian Drost, Todd Waggoner, and Tushar Uttarwar make a great team on delivering the project to students. Donald Heer and Matthew Shuman contributed greatly in the development of the Graduate Leadership Training course. Donald Heer, Matthew Shuman, Brandilyn Coker, and Tony Chen provided valuable advices and editing recommendation to this thesis. Shan Zhou provided valuable insights on confidence and correlation calculations.

TABLE OF CONTENTS

| | <u>Page</u> |
|--|-------------|
| PREFACE | 1 |
| CHAPTER 1 - INTRODUCTION | 2 |
| CHAPTER 2 – JUNIOR-LEVEL DESIGN EXPERIMENT IN A 10 WEEK ANALOG DESIGN COURSE | 4 |
| I. INTRODUCTION | 5 |
| A. Motivation for Change | 6 |
| B. Platforms for Learning | 7 |
| C. Open-ended Design | 7 |
| D. Preparation for Later Courses | 8 |
| II. ELECTRONICS II COURSE OVERVIEW | 9 |
| A. The Engineering Process | 10 |
| III. ASSESSMENT | 15 |
| A. Data Collection | 15 |
| B. Results | 15 |
| IV. CONCLUSION | 16 |
| V. FUTURE WORK | 16 |
| CHAPTER 3 – WORK IN PROGRESS: LEADERSHIP TRAINING FOR NEW EECS GRAUDATE TEACHING ASSISTANTS | 17 |
| I. INTRODUCTION | 18 |
| II. BACKGROUND | 19 |

TABLE OF CONTENTS (Continued)

| | <u>Page</u> |
|---|-------------|
| A. Participants..... | 19 |
| B. Self-efficacy | 19 |
| III. NEW COURSE..... | 19 |
| A. Learning Objectives | 20 |
| B. Motivating Learning Environment..... | 20 |
| C. Course Structure..... | 21 |
| D. Assignments | 22 |
| IV. THEORETICAL COURSE EVALUATION | 23 |
| CHAPTER 4 – FUTURE WORK..... | 24 |
| BIBLIOGRAPHY | 26 |

LIST OF FIGURES

| <u>Figure</u> | <u>Page</u> |
|--|-------------|
| Figure 1: Electronics II Laboratory Project Engineering Process..... | 11 |
| Figure 2: A completed Project with a Student Designed Case | 14 |
| Figure 3: A Student Designed Printed Circuit Board | 14 |

LIST OF APPENDICES

| | <u>Page</u> |
|---|-------------|
| APPENDICES | 28 |
| APPENDIX A – ECE 323 LABORATORY MANUAL | 29 |
| APPENDIX C – SURVEY AND RESULTS FOR NEW ECE 323, SPRING 2010 | 87 |
| APPENDIX D – ECE/CS 507 GTA LEADERSHIP TRAINING COURSE MATERIAL..... | 90 |
| GTA Leadership Training Course: Syllabus..... | 91 |
| GTA Leadership Training Course: Assignment 1 | 92 |
| GTA Leadership Training Course: Assignment 2 | 93 |
| GTA Leadership Training Course: Blackboard Discussion Topics..... | 94 |
| GTA Leadership Training Course: Instructor Notes Week 1 – 10 | 96 |
| GTA Leadership Training Course: Student Notes Week 1 – 10..... | 111 |
| APPENDIX E – BUILD A WAREHOUSE: A TEAM BUILDING ACTIVITY | 125 |

Dedication

This thesis is dedicated to my grandfather, Zongfu Luo (1918 – 2002), as a fulfillment of his wish to attend my university graduation.

Development of Leadership and Design Skills Among ECE Juniors and Graduate Students

PREFACE

The first section, “Junior-Level Design Experiment in a 10 Week Analog Design Course”, has been accepted by the Frontiers in Education conference (FIE 2010). This paper summarizes my work in designing a complete laboratory project for OSU junior level ECE students. The following paper, “Leadership Training for New EECS Graduate Teaching Assistants”, has been accepted as a Work in Progress (WIP) by the FIE. Its intention is to summarize the design and implementation of my work on the Graduate Leadership Training course. Both papers will be presented at the FIE conference in October 2010. This thesis also includes supporting materials in the appendices to provide for a more thorough and complete document, as well as supporting future educators with the necessary materials when offering course/methods described in this document.

CHAPTER 1 - INTRODUCTION

Engineering students spend a significant amount of their undergraduate careers focused on technical theory and practice. This intensive study prepares them for their future technical challenges. This training is so intense that often the more “soft skills” such as communication, leadership, design, and troubleshooting are left out or are presented in only a few selected courses. The work summarized in this thesis presents two examples of these soft skills can be taught to engineers. The two skills addressed are design and leadership.

Chapter 2 presents a junior level laboratory project that provides students an exposure to the engineering process: design, construction, testing, and final documentation. This 10 week project requires students to design, prototype, and refine their project. Oregon State University started the Platform for Learning (PFL) program to provide quality education to its engineering students for both technical and soft skills. The PFL suggests that laboratory projects should have the aspects of personal ownership, curriculum continuity, context, fun, and troubleshooting.

Chapter 3 covers the key elements of the Graduate Leadership course developed in the School of Electrical Engineering and Computer Science. Graduate student teaching assistants (GTAs) have been a valuable resource for Oregon State University in various areas, including teaching laboratories and leading undergraduate course recitations. In addition, many graduate students assist faculty members on research topics, and assist with undergraduate lecturing. Studies have shown that effective mentors/leaders are able to assist in the retention of students in engineering. This chapter summarizes a newly designed Graduate Leadership Training course with the focus of “leadership is the foundation for teaching”. This training course gives graduate students the tools and knowledge for becoming effective leaders, so that they are able to lead or to be led in the future.

Chapter 4 is a summary of future work and ideas to improve the methodology described in this thesis.

The appendices include supporting documentations: the ECE 323 laboratory manual; Fall 2009 survey results for the new ECE 323 laboratory project; spring 2010 preliminary survey results for the new ECE323 laboratory project; the Graduate Leadership Training course material; and the Build a Warehouse activity on teambuilding.

CHAPTER 2 – JUNIOR-LEVEL DESIGN EXPERIMENT IN A 10 WEEK ANALOG DESIGN COURSE

Ding Luo and Donald L. Heer

School of Electrical Engineering and Computer Science

Oregon State University

Corvallis, OR 97330

Abstract - This paper presents a newly designed laboratory project for the Oregon State University (OSU) Electronics II course for junior-level electrical and computer engineering (ECE) students. The previous course was taught using common-place single session laboratory experiments and was not well received by students. An open-ended multi-solution laboratory project designed to boost students' abilities on problem solving and innovation was chosen. The new laboratory project was developed to integrate design, communication, and system thinking into a single course. Integration of these soft-skills into the laboratory gives opportunities to use the skills in a technical context. This initial single term course better prepares students for later coursework. To assess the changes to this new laboratory, student pre and post surveys were used along side of laboratory observations. Topics of interest were student self-efficacy, student expectations of the laboratory, and student reflections on the course-laboratory connection. Results from the initial student self-efficacy survey results show an increase in student teamwork while the students' expectations of the course showed provable trends. Student reflections show the most variability and give insights into what aspects of the course worked the best.

Index Terms – Electronics, junior, design, platforms for learning

I. INTRODUCTION

It can be argued that engineering is not only a technical field; engineers must be able to interact with their peers, document their work and apply novel ideas to new situations. Often times it is difficult to teach these skills in parallel with the more traditional engineering coursework focusing on technical understanding. One approach is to teach distinctly separate courses presenting these ‘soft skills’. Another option is to bring these skills together in a capstone design sequence during the last years of a student’s undergraduate degree. In the School of Electrical Engineering and Computer Science at Oregon State University a coordinated effort has been put into place to include these non-technical skills in all technical courses students take at every level rather than the senior year alone. The program called Platforms for Learning©[1] has been adopted by 10 separate higher learning institutions across the world and has influenced the education of over 3000 individual students. This chapter specifically covers recent revisions to the second junior-level electronics course to integrate these skills.

The junior-level electronic sequence is a two term program focusing on transistors and their use in circuits. The first course (Electronics I) focuses primarily on DC small signal analysis, while the second (Electronics II) focuses on frequency response and more advanced topics. The previous version of the Electronics II course lab project was designed in 2006, and remained the same until June, 2009. The instructor of the course had changed twice since the 2006 version, and the current lecture and lab material became mismatched. Additional student feedback also indicated that the lab was not effective at supporting the lecture.

The revised Electronics II course lab project is redesigned based on the Platform for Learning key elements of personal ownership, curriculum continuity, contextual learning, hands-on/active learning, and fun factor. The goal of the project is to design, prototype and refine a USB powered audio amplifier by applying concepts acquired from the Electronics II lecture.

A. Motivation for Change

Motivations for course redesign can vary broadly but the primary reasons for redesign of the electronics course were changes in lecture material not being addressed by lab, and student dissatisfaction due to unable to apply course materials into laboratory practice. The earlier course material asked students to build an audio remote control. Students were required to design and construct a system that using audio tones would drive a robotic base around a room. This design had to be transistor based and was broken into separate labs. This lab suffered from several problems as the course evolved.

1. Earlier course versions covered material such as ring oscillators and peak detectors. These concepts were vital to the previous project. When they were removed from the newer lecture material, students were unable to properly apply this concept into the older version of project.
2. The courses surrounding the Electronics II course were revised to include more advanced design and communication skills. For example, in two previous courses prior to Electronics II, open-ended design labs had been adopted. Students were accustomed to the more difficult, but rewarding task, of design. The earlier Electronics II course however treated each lab as a separate item making the design complexity low and restrictive.
3. Technical documentation had been increased in surrounding courses to encourage students to better meet writing standards and to express their designs in a written form. The summary documentation from the Electronics II course was simple question and answer not requiring students to usage on the analysis of their design.

To address these problems, the lab was redesigned with a few philosophies including: Open ended design, integration to the Platforms for Learning, and preparation for later courses.

B. Platforms for Learning

A Platform for Learning is defined as a common unifying object or experience that unites various classes into a curriculum sequence [1]. In the freshmen curriculum, ECE students construct and improve a robot called a Tekbot. Using the TekBot and applying concepts learned from lecture simultaneously, students gain the advantages of any platform for learning: Personal Ownership, Curriculum Continuity, Context, Fun, and Troubleshooting [2]. The platform students utilize in Electronics II uses the knowledge scaffolding acquired from previous courses, giving students a foundation to make more sophisticated designs than if they were doing everything for the first time.

As an example for the platform of Electronics II: in the Electronics I course, students build a two channel DC power supply. This system is constructed from a project specification document describing the project. The specification document combines testing procedures, a summary of work, schematic designs, and design research into a single document. The more industry standard way of designing a project is novel to the students at this point since preceding laboratories have been more guided with step-by-step instructions. Students naturally struggle with this format in the first term, but once understood, they are expected to more effectively to perform design work in later courses, e.g. Electronics II.

In prior courses, design dissection and abstraction are introduced. Appropriately partitioning a large design into smaller pieces, based on function, with defined interconnections that can be characterized completely gives the designer the ability to focus on manageable pieces. This is critical for larger project organization.

C. Open-ended Design

Often, courses with a laboratory component treat the lab as a sequence of separate one week experiments used to illuminate the course material. This method is effective in teaching concepts but does not help to build other important skills.

Engineering as a field involves various activities including design, project management, simulation & verification, production, and technological evolution.

Laboratory projects in early academic years often times guide students to a single solution, and innovative solutions are always hinted and encouraged after the completion of the project. The laboratory project for Electronics II is specifically designed to be open-ended and have multiple solutions. Instead of guiding students to a single solution, hints and reference literatures are given to students, in order to build student skills in innovative design, project management, and technological evolution through this open-ended laboratory project.

Single week experiments often do not address these while larger more open-ended projects naturally do. In the Electronics II course, students are given the final specification for the project and little other direction. Students are expected to design the project over the 10 weeks of the course without intermediate coaching. However, information and tools are provided in the form of circuit topologies, help sessions on various tools, and leading study questions. This open-ended structure is expected to promote innovative solutions to an engineering problem, as well as build student skills in design and project management. The open-ended engineering experience from Electronics II also better prepares students for the 30 week Senior Design course.

D. Preparation for Later Courses

To best integrate the Electronics II course into the junior curriculum, the design needed to expose the connections between courses and make them obvious to students. Revealing these connections adds relevance and builds upon what the student already understands. Upon completion of Electronics II, concepts learned in lecture and experience gained through the lab project become the “platform” for future courses. Examples of these connections include:

- Electronics II uses the same style of project specifications as Electronics I.

- Circuit simulation is not re-taught but added on to from previous Electronics I course.
- Frequency response is reused from sophomore coursework and only added on to.
- During the ‘innovation’ section of the course, many students reuse embedded programming from previous courses by adding microcontroller control.
- Electronics II materials are used as prerequisites for some senior level integrated circuit courses where students design amplifiers.

II. ELECTRONICS II COURSE OVERVIEW

The primary focus of the course redesign was the laboratory. The new course project is to design, prototype, and refine a USB powered audio amplifier. The necessary required technical knowledge includes amplifiers and output stages, addressed early in the lecture material. In addition to gaining experience in the technical areas, the laboratory project was designed to improve: design, system thinking, innovation, critical thought, communication, and at same time allowing students to properly apply lecture knowledge into a design project.

The project structure is synchronized to the lecture schedule and to a model version of the engineering process, Figure 1. The laboratory project is divided into five sections with a span of 10 weeks, Table 1. The first section provides the students with a review of the tools (especially circuit simulation) required to successfully accomplish their project. The second section requires students to design the circuit for their project by using information from the lecture and previous courses. Section Three requires students to construct their physical prototype prior to the final “product”. Section Four requires each student to improve their design beyond the basic requirements.

Table 1: Electronics II Laboratory Project Outline

| Section Number | Tasks | Learning Outcomes |
|----------------|---|--|
| Section One | <ul style="list-style-type: none"> • Learn/review circuit simulator | <ul style="list-style-type: none"> • Design • Communication |
| Section Two | <ul style="list-style-type: none"> • Design project circuit • Circuit simulation • Troubleshoot | <ul style="list-style-type: none"> • Design • Innovation • Apply Lecture Topics • Communication • Critical thought • System thinking |
| Section Three | <ul style="list-style-type: none"> • Construct physical prototype • Verify functionality • Physical VS. simulation results • Troubleshoot | <ul style="list-style-type: none"> • Design • Apply Lecture Topics • Communication • System thinking • Critical thought |
| Section Four | <ul style="list-style-type: none"> • Project improvement • Construction • Finalize project • Troubleshoot | <ul style="list-style-type: none"> • Design • Innovation • Communication • System thinking |
| Section Five | <ul style="list-style-type: none"> • Presentation | <ul style="list-style-type: none"> • Communication • System Thinking |

The laboratory project leads students through a design, prototype, test, and improvement engineering cycle [3]. During this cycle, students are expected to learn and strengthen their technical and soft skills by applying them to the project.

A. The Engineering Process

The engineering process describes the different elements of any engineering design. Common elements of the engineering process include: establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation [3].

The new laboratory project models this process, requiring students to execute two cycles of the engineering process, Figure 1. During this process, students practice the learning outcomes shown in Table 1.

To better encapsulate the engineering process, it can be categorized into the design, construct, test, and final documentation steps.

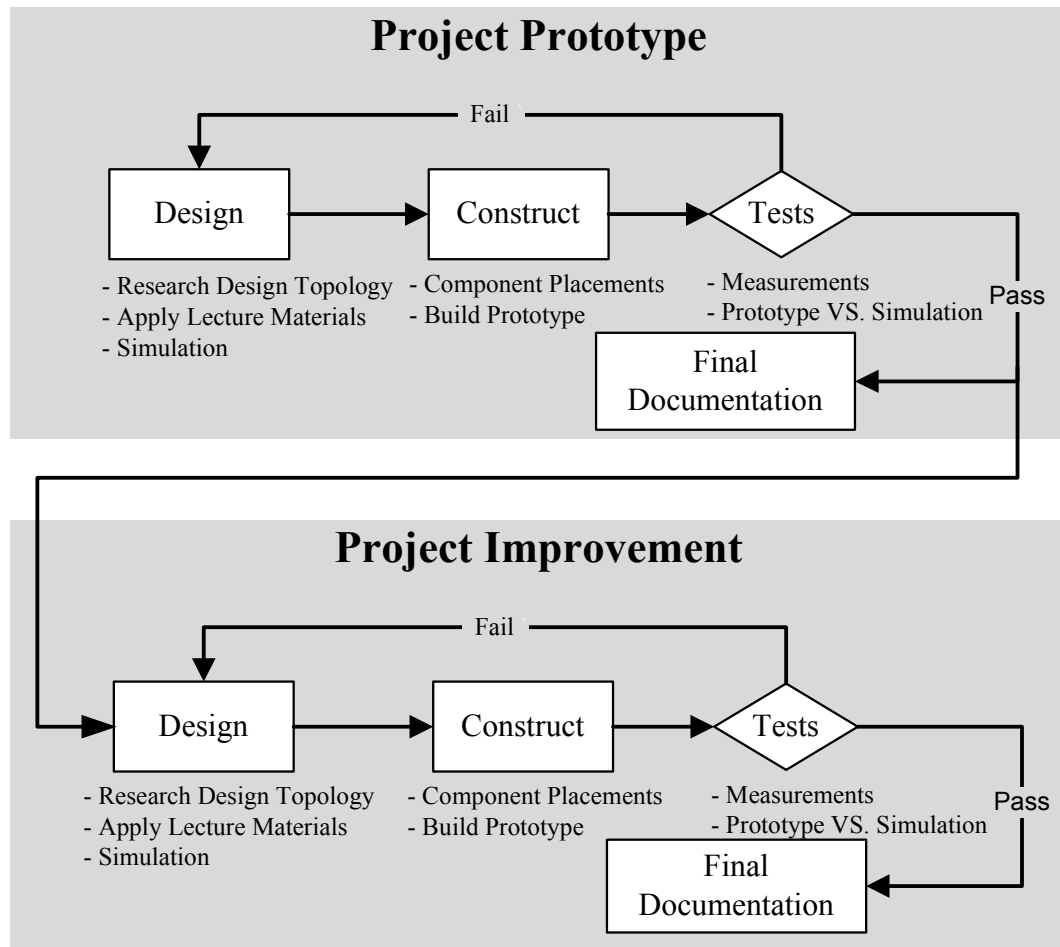


Figure 1: Electronics II Laboratory Project Engineering Process

1. Design: This phase involves requirements specification, research, and concept generation [4]. To emulate a common industry product line scenario, the concept of simulation-before-prototype is emphasized to the students. A list of

requirements is given in the lab manual. Students are expected to find and understand the pros and cons of several circuit topologies. They are required to design and analyze their project on paper in detail, utilizing the concepts received from the Electronics II lecture (application to lecture topic). During this design phase, detailed reasoning, calculations, and drawings are required. The lab manual instructs students to simulate their design to verify its functionality and that it meets the design specifications. Problems in the students' design are corrected (critical thought) prior to the construction of their prototype.

Text book references and internet sources are provided to the students, allowing them to find functional circuit topologies for their design. Pre-lab assignments are given and require students to find a list of topologies. To meet the project specifications, students need to combine several topologies together, add/remove components, and calculate the component values (design).

2. Construct: The prototyping phase involves physical construction of the design. It is possible that some prototypes are discarded or modified as the system evolves – the idea is to experiment, demonstrate a working physical prototype, and improve understanding [4]. Students are required to think of their project as a whole system (system thinking). Any modification to the students' design is back annotated to their documentation.

A lab kit containing some of the necessary components is provided to the students. Once the design is finalized, students create a list of components needed to construct the prototype. This list contains vendor information, part number, cost, reference number on the schematic, and estimated total cost (communication). For components outside of the lab kit, students must acquire their own components (design).

Construction of a prototype offers an excellent mechanism to practice troubleshooting and critical thinking skills. Hardware construction skills such as soldering and de-soldering are reviewed and practiced with the students.

3. Testing: Here, the overall system is tested to demonstrate that it meets the requirements. The test phase provides a method to evaluate how well a project meets requirements. Test procedures are provided as part of the project specification allowing for students to know how their design will be tested.

Matching simulation with reality is emphasized with the students. They are required to compare prototype measurements and simulation. For various reasons, sometimes it is extremely difficult to match both results, in which case students are required to identify the source of the mismatch, and document possible solutions in detail (critical thought).

4. Final Documentation: A project specification document is required to be updated during, and finalized at the completion of each engineering process. The project specification document acts as a tool to keep all of the information about the project organized and complete. The initial specification provided includes minimum requirements for the project and the testing procedure that will be used to evaluate the project success (communication).

Students are also required to present their final project to their peers at the end of the term (communication). Questions are asked by the audience, and students are expected to provide accurate answers. The laboratory teaching assistants will provide feedback on students' clarity of concept and presentation skill. Points on how to improve their communication and presentation skills are provided in the lab manual.

5. Project Improvement & Innovation: The laboratory project also requires students to revise their design once it passes basic testing (innovation and critical thinking). After verifying the functionality of the prototype, students are instructed to improve their project. The lab manual provides several possible improvement ideas, such as design of an enclosure, Figure 2, or printed circuit board, Figure 3, and/or adding wireless transmission capability to the project. Innovative ideas are strongly encouraged.

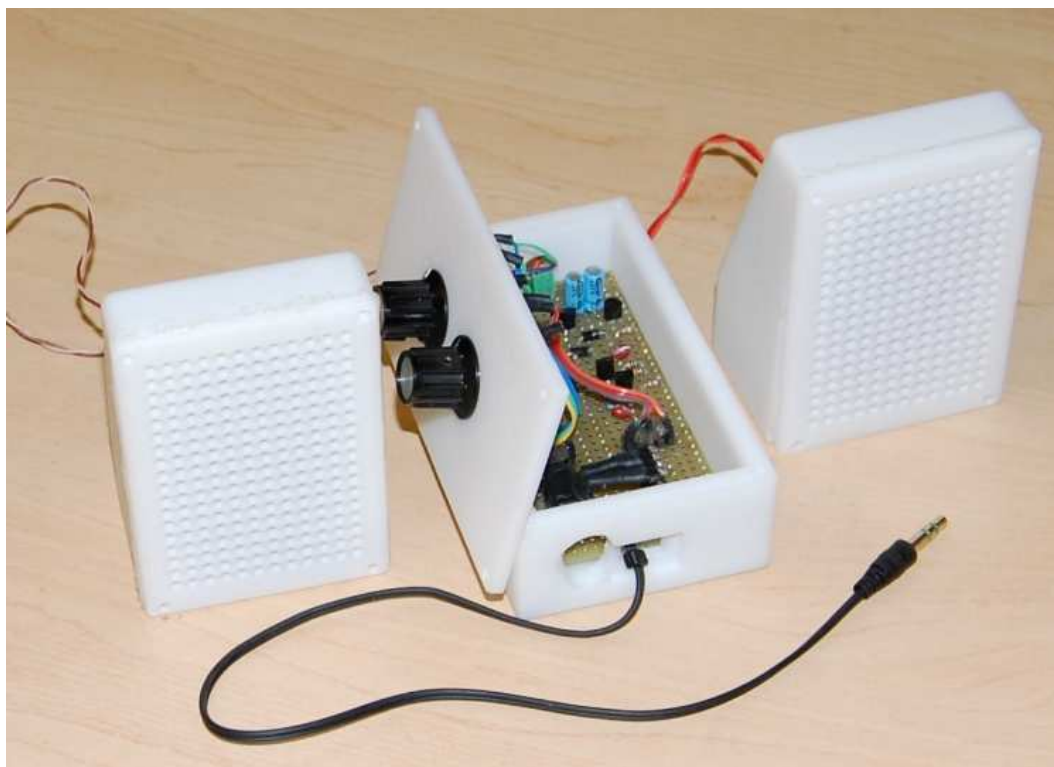


Figure 2: A completed Project with a Student Designed Case

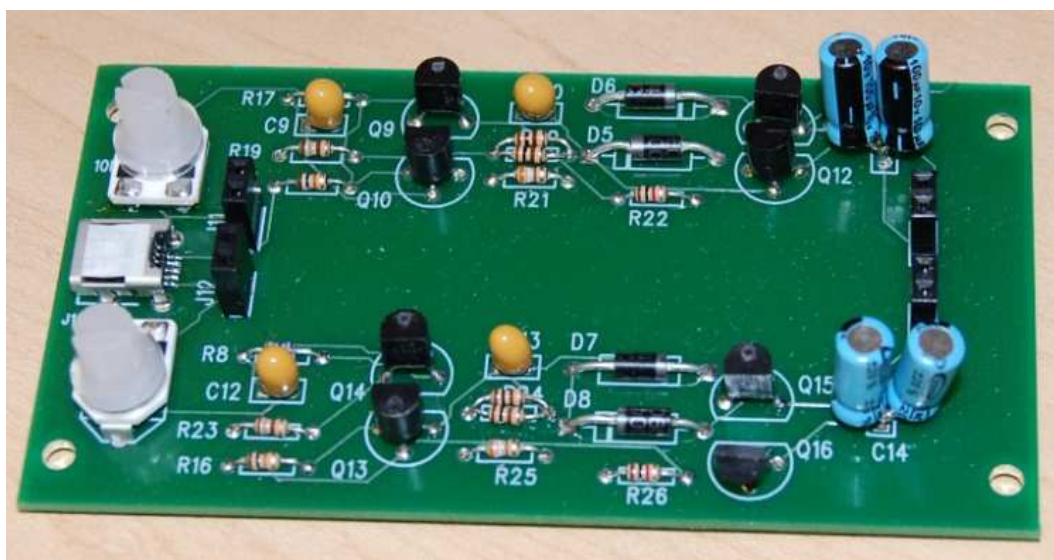


Figure 3: A Student Designed Printed Circuit Board

III. ASSESSMENT

A. Data Collection

To gather student expectations/feedback on the laboratory project, voluntary surveys were given to students at the beginning (expectations) and the end (feedback) of the term. The survey consists three sections: student background information, their thoughts on each section of the laboratory project, and questions relating to self-efficacy. Each survey question has five possible responses. Students had the option of choosing a 5 digit number to tag each survey. The “tag” allows analysis on tracking changes in the students’ expectation/feedback from the same students.

B. Results

The analysis of the surveys uses both independent and dependent T-Tests to find statistical differences in the two surveys that were given at the beginning and the end of the term. The T-Test is a common analysis technique that compares the mean, standard deviation, and sample size of surveys [5]. The T-Test removes guesswork from the analysis and provides a quantitative score to determine statistical certainty in the differences between survey results. Only T-Test results of 95% and higher are considered statistically significant, indicating that the changes made between the beginning and the end of the term are valid [6].

1. Dependent T-Test: Results from the tagged population are analyzed with the dependent T-Test. This T-Test compares changes in survey results throughout the term for students that were voluntarily tagged both in the beginning and the end of the term. The dependent T-Test result shows a significant increase on students’ agreement that “Lab 4 – Project Improvement” will help in their future careers.

2. Independent T-Test: The independent T-Test was used to analyze all surveys, regardless of “tag”, from 25 expectations and 21 feedbacks. The independent T-Test result also shows a significant increase on students’ agreement that the Project Improvement section will help in their future careers.

3. Survey Response Correlation: A correlation test was also performed with the survey results. A correlation is a single number that describes the degree of relationship between two variables [7]. The level of correlation is presented by a number that is always between -1.0 and +1.0, where negative presents negative correlation and vice versa. Generally, 0.7 or above is considered strongly correlated.

Due to the small number of participants in the survey, no correlation was able to be determined. However, there appears to be a possible positive correlation between student interest and their expectations about whether a topic will help them in the future. When students think a section will help them in the future they are more likely to be interested in that laboratory section.

IV. CONCLUSION

The new Electronics II laboratory project is designed to fix problems with the previous version of the course and better align with the philosophy of the OSU Platform for Learning. The key learning outcomes of design, application to lecture topics, system thinking, innovation, troubleshooting, and communication are built into the course. This scaffolding prepares students for higher level engineering courses, as well as their entry into the job market. The T-tests show that students believe the Project Improvement section will help their future. A positive trend was observed between student interest and expectation on if a topic will help them in the future.

V. FUTURE WORK

Future work includes updating the laboratory manual, training effective teaching assistants, as well as adjusting the laboratory schedule to match the lecture schedule due to possible change of instructors in the future. Later offerings of the course will be surveyed with the same survey questions to increase the sample size and validate statistical findings. Based on student feedback to lab evaluator, similar and/or more provable results with a larger sample size are expected.

CHAPTER 3 –LEADERSHIP TRAINING FOR NEW EECS GRAUDATE TEACHING ASSISTANTS

Ding Luo, Matthew W. Shuman, and Donald Heer

School of Electrical Engineering and Computer Science

Oregon State University

Corvallis, OR 97330

Abstract - The School of Electrical Engineering and Computer Science at Oregon State University has newly designed a graduate leadership course for all new graduate teaching assistants (GTAs). The subject of leadership is approached by looking at the specific application of teaching as a form of leadership. This interactive training course is collaboratively designed and taught by a graduate student who has sufficient leadership experience working as a teaching assistant for undergraduate courses. Having a graduate student with experience in leadership, as a role model, to train incoming GTAs, creates natural learning communities within the classroom. During the duration of the course, GTAs are constantly interacting with the graduate instructor and their peers both inside and outside of the classroom. GTAs are also encouraged to practice their learning within their study group, research group, and working environment. Self-efficacy surveys are given to students in the new GTA Leadership course, and the results are used on evaluating the successfulness of this course. Lessons learned and future work are also discussed.

Index Terms - Self-efficacy, leadership, graduate teaching assistants, GTA

I. INTRODUCTION

Graduate student teaching assistants (GTAs) have been a valuable resource for Oregon State University in various areas, including teaching laboratories and leading undergraduate course recitations. In addition, many graduate students assist faculty members on research topics, and assist with undergraduate lecturing. Efforts have been made to produce quality graduate student assistants through student selection and training.

The GTA Leadership course was first implemented in Fall 2006, and remained unchanged until June 2009. The course was created to help graduate students adapt to the leadership role they would be taking in classrooms and research. This course was conducted via lectures, with minor discussions in the class, and has a total of 10 lectures. The course is graded primarily on attendance with several required 'self-reflection' assignments.

Feedback from the course prior to 2009 suggested that not enough effort has been made to connect the course material to the graduate students' needs. Specifically, the previous version of GTA training course (GTA Leadership) was ineffective due to its lack of clear objectives, motivation, and engagement.

To address these concerns, this paper describes a redesigned GTA Leadership course that meets the needs of the graduate students in the program more effectively. The course contains lectures, discussions, and anecdotes focused around leadership as it applies to a graduate student. The participants, in this case the GTAs, receive various tools on leadership, while considering a variety of personalities. During the lecture, they discuss or address leadership topics such as roles, responsibilities, conflict styles, handling disputes, and self-improvement. This course is taught to all new and/or inexperienced GTAs, and may also be taught to undergraduate teaching assistants.

II. BACKGROUND

A. Participants

The target participants for the GTA Leadership course are first year Electrical and Computer Engineering (ECE) and Computer Science (CS) graduate students at OSU. OSU has an estimated 50-60 incoming graduate students annually in the department of EECS, with 80% of these being international students. Most (if not all) of the new graduate students are offered a 9 month teaching assistantship from the department in order to receive funding. Each GTA has at least one lab/recitation each week. Each lab/recitation at OSU contains 20-40 students depending on class size. This can be intimidating for a new graduate student, so they may perceive that their self-efficacy is not sufficient.

B. Self-efficacy

Perceived self-efficacy is defined as “people’s beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives [8].” The sources of self-efficacy are experience, vicarious experience, social persuasions, and physiological factors. Essentially, for graduate students who have not been GTAs, have not seen a good GTA, and have not been told they can be a good GTA, will never be effective GTAs. Self-efficacy surveys are used to evaluate the improvement of GTA abilities throughout this course.

III. NEW COURSE

The new structure designed in Summer 2009 presents leadership through its application to teaching in a motivated learning environment. This gives the teaching assistants incentive to learn about leadership. The course learning objectives focus around specific leadership skills applied to teaching.

A. Learning Objectives

1. Enhance students' ability to influence their professional environment in a positive manner: It is essential for GTAs to master the skill of setting the culture/environment of their lab/recitation at the beginning of the term, as well as maintaining it. The effectiveness of a role model is emphasized in lecture. GTAs are also expected to be able to recognize cultural differences.

2. Enhance students' ability to identify types of disputes and approach a solution with a professional manner: Sources and different styles of conflict are presented to GTAs. Real-life conflict scenarios are available for class discussion, so that GTAs have hands-on experience on handling disputes.

3. Educate students to self-evaluate and improve: Self-improvement skills are presented to GTAs. The skill of reviewing before and after teaching/leading is emphasized in lecture.

4. Guide students to become a self-directed learner who is able to develop professional networks and collaborate with colleagues to enhance excellence in job performance: Multi-solution real life scenarios are presented to GTAs for discussion both in class and online. GTAs are expected to utilize their learning throughout the term to respond to these scenarios.

5. Enable students to gain self-confidence in public speaking: Students are divided into groups of 3-4 during class discussion, and later share their thoughts to the entire class.

B. Motivating Learning Environment

The course is designed to form a cooperative learning environment for both inside and outside of the classroom. Inside of the classroom, participants acquire the knowledge from discussion within the classroom. The instructor of the course functions as a guide, and provides essential leadership concepts and discussion topics, to demonstrate one type of leadership style. Outside of the classroom, participants are

required to respond to the provided discussion questions, which are multi-solution questions, and emulate a real life situation within a lab/recitation. The course timeline is set up to provide hints and guides on leading the GTAs designated lab/recitation. GTAs have the chance to practice their learning while they are leading and are encouraged to bring their leadership experience into the lecture as a discussion topic.

True leadership stories/scenarios are gathered from experienced teaching assistants and instructors on campus. Each scenario has multiple ways of approaching to a solution depending on various factors such as the root of cause, personality, communication style, etc. Each style of solution will be presented in class by applying participants' learning from lecture. These stories/scenarios are made available to students both inside and outside of the class to boost participant engagement, and further provide a cooperative learning environment.

C. Course Structure

1. What is Leadership: Course overview is given in this lecture. GTAs introduction and icebreaker are also conducted in the purpose of emulating “first day of lab/recitation”. GTAs will have a hands-on experience on how to conduct their first day of teaching/leading in their designated lab/recitation. This lecture also includes a class-wide discussion comparing teaching and leading.

2. Influencing the Culture as a Leader: The focus on lecture 2 is how a leader effects the mood of the working environment. It is essential for GTAs to master the skill of setting the culture of their lab/recitation at the beginning of the term. Leadership styles and solution to suppress/overcome negative mood are also covered in this lecture.

3. Balancing Responsibilities: The sense of responsibility is emphasized in this lecture. The lecture includes student vs. GTA responsibilities, and responsibilities between GTAs. Scenarios on taking responsibility in the setting of student vs. GTA and GTA vs. GTA are presented in the lecture for discussion.

4. The Power of Reflection and Authentic Listening: Self-improvement skills are presented to GTAs. The skill of reviewing before and after teaching/leading is emphasized in this lecture.

5. Handling Disputes: Near the middle of the term, conflicts are likely to arise. Source and styles of conflict are presented to GTAs. Real life conflict scenarios are available for class discussion, so that GTAs have a hands-on experience on handling disputes.

6. Gender, Race & Ethnicity: This lecture mainly focuses on diversity of a class or a team. GTAs are expected to be able to realize culture differences and treat everyone equally. Guest speaker from different cultural background will be presenting to the GTAs.

7. Learning Through Leading: This lecture functions as a small recap of the learning throughout the term in order to prepare for GTAs' observation report assignment.

8. Leadership Scenarios: As a review for the entire course, multi-solution real life scenarios are presented to GTAs for class discussion. GTAs are expected to utilize their learning throughout the term to respond to these scenarios. GTAs are observing a lab/recitation conducted by their peer(s) this week, and finalize the observation report.

9. Observation Report: To conclude the learning from the course, GTAs will present their findings in the observation report.

D. Assignments

1. Online Discussion: A weekly discussion topic related to the course material is available on the Discussion Board of Blackboard (a web-based educational forum). Students are required to demonstrate respect, collegiality, and self-reflection in their weekly postings.

2. Observation Report: Near the end of the course, students are required to observe a short session led by their peers. The observation report shall contain comments relating to course material, and suggestions to the peer being observed.

IV. THEORETICAL COURSE EVALUATION

Self-efficacy voluntary surveys are given to participants in the GTA Leadership course at both the beginning and the end of the term. Survey questions are rated between A and E, where A indicates the least agreement and E indicates the strongest agreement to the question asked. The survey results are used to evaluate the improvement of GTA leadership ability throughout this course. As mentioned before, self-efficacy indicates key aspects of an effective leader. This survey was also given to participants in the previous version of GTA Leadership, allowing possible comparison between the previous and current version. More positive increment in self-efficacy is expected from survey results in the new version.

CHAPTER 4 – FUTURE WORK

The ECE 323 laboratory project was redesigned during the summer of 2009, and was integrated into the PFL at OSU in fall 2009. Most of this project's participants in fall 2009 are students who were returning from an internship program. Therefore connection between this new laboratory project and its prerequisite course might not be as clear as to someone who just took the prerequisite course. The number of students is significantly less compared to spring 2010, and therefore the “noise” inside the survey data could be large. The same survey questions will be given to future students to accurately interpret the effectiveness of this new laboratory project. It is also essential to continue evaluating, and update the laboratory manual for there are possible typos and unclear explanations that cause confusion.

Similarly to the Electronics II survey results, the Graduate Leadership Training course is offered once per year and therefore yields small survey results. Student feedback provided ideas to this course, such as more examples relating to various laboratory/recitation, so that students can receive information regarding a specific laboratory/recitation he or she is assigned to. Guest speaker from experienced leader and/or teaching assistants were also suggested from student feedback. The future instructor could add more real life scenarios to engage and relate to the students in the Graduate Leadership Training course.

CHAPTER 5 – OVERALL CONCLUSION

This thesis presented the work accomplished to teach leadership and design skills to ECE junior and graduate level students at OSU. These soft skills are vital to today's engineer graduates for their further schooling or employment.

The electronics II laboratory project is redesigned into an open-ended multi-solution style. Integrating soft skills such as design, testing, documentation, and project improvement and innovation, this laboratory project is expected to be an effective addition to the OSU Platform for Learning program. Survey results have shown that students believe the Project Improvement section will help their future career. Student interest and their expectation on whether a topic will help them in the future appear to have a possible positive correlation with each other. With more survey data samples, more positive outcomes/results of this laboratory project is expected.

With the focus “leadership is the foundation for teaching”, the newly designed Graduate Leadership Training course gives incoming graduate the tools for becoming effective leaders. These knowledge/tools allow students either to lead or to be led in the future. The course offers its students an interactive, open ended, and relaxed learning environment. The course received positive student feedback after its first offering. Self-efficacy is proposed as the tool to evaluate the effectiveness of this course.

BIBLIOGRAPHY

- [1] Traylor, R. L.; Heer, D.; Fiez, T.S., "Using an integrated platform for learning/spl trade/ to reinvent engineering education," Education, IEEE Transactions on, vol.46, no.4, pp. 409-419, Nov. 2003
- [2] Heer, D.; Traylor, R. L.; Thompson, T.; Fiez, T.S., "Enhancing the Freshman and Sophomore ECE Student Experience Using a Platform for Learning™," Education, IEEE Transactions on, vol. 46, no 4, pp. 434-443, 2003
- [3] "Criteria for Accrediting Engineering Programs," ABET Engineering Accreditation Commission, 2003.
- [4] R, Ford, R.; Coulston, C.; "Design for Electrical and Computer Engineers: Theory, Concepts, and Practice." McGraw-Hill Higher Education, pp. 7-8.
- [5] Shuman, M.; Traylor, R.; Luo, D.; Heer, D.; Fiez, T.; "A Comprehensive Integration of First Year Engineering Education," Scholars Archive at OSU, Sept 2009.
- [6] Anderson, D. R.; Sweeney, D. J.; Williams, T.A., Introduction to Statistical Inference, BA 276 at Oregon State University. U.S.A.: Thomson/Southwestern, 2008, pp. 195-214.
- [7] (2010, March), Correlation, Research Methods Knowledge Base [Online]. Available: "<http://www.socialresearchmethods.net/kb/statcorr.php>"
- [8] Bandura, A., Self-Efficacy: The Exercise of Control, W.H. Freeman and Company, New York, 1997.
- [9] Velez, I.; Sevillano, J.F., "A Course to Train Digital Hardware Designers for Industry," Education, IEEE Transactions on , vol.50, no.3, pp.236-243, Aug. 2007
- [10] A. Bandura, Social Foundations of Thought and Action: A Social Cognitive Theory, New Jersey: Prentice-Hall, Inc., 1986.
- [11] J. Conger, "The Brave New World of Leadership Training," Organizational Dynamics, vol. 21, no. 3, pp.46-58.

- [12] C.G. Masi, "Re-engineering engineering education," IEEE Spectrum, vol. 32, no. 9, pp.44-47.
- [13] R. Hess, "Follow the Teacher: Making a Difference for School Improvement" Rowman & Littlefield Education, 2007

APPENDICES

APPENDIX A – ECE 323 LABORATORY MANUAL

This appendix contains the entire manual for the Electronics II laboratory project. The lab manual is designed to match the style of other Platform for Learning laboratory manuals. It is printed in landscape format. The extra spacing on one side of manual gives binding option to the user.

The manual chapters are as follows:

1. LTspice
2. Design the Prototype
3. Prototype & Construction
4. Project Improvement

The manual also contains an appendix:

- A. LTspice
- B. Total Harmonic Distortion
- C. Presentation Pointers
- D. Suppliers

Copyright Information

Copyright © 2010
Oregon State University
School of Electrical Engineering & Computer Science (EECS)

This document is the property of Oregon State University and the School of EECS. Limited use of this document is allowed, according to the following criteria:

Materials are free to use, except for the cost of reproduction, and must always bear this statement in any reproduction.

Materials created using this information may not be labeled as TekBots' materials, without the prior written consent of both Oregon State University and the School of EECS.

Disclaimer of Liability

Oregon State University, Platforms for Learning, TekBots and other partner schools are not responsible for special, consequential, or incidental damages resulting from any breach of warranty, or under any legal theory, including lost profits, downtime, goodwill, damage to, or replacement of equipment or property, or any costs of recovering, reprogramming, or reproducing any data stored in or used with our products.

The aforementioned parties are also not responsible for any personal damage, including that to life and health, resulting from use of any of our products. You take full responsibility for your product application, no matter how life-threatening it may be.

Internet Access

We maintain Internet systems for your use. They can be used to obtain free TekBots' software and documentation and also to purchase TekBots' products. These systems may also be used to communicate with members of TekBots and other customers. Access information is shown below:

E-mail: tekbots@eeecs.oregonstate.edu

Web: <http://eeecs.oregonstate.edu/education/tekbots.html>

TABLE OF CONTENTS

| | |
|---|-----------|
| PREFACE | VII |
| SYSTEM OVERVIEW | VIII |
| HOW TO USE THIS MANUAL..... | VIII |
| IMPORTANT SYMBOLS..... | VIII |
| LAB STRUCTURE..... | IX |
| LAB SAFETY | X |
| Personal Safety | x |
| Component Safety | x |
| SECTION ONE..... | 11 |
| SECTION OVERVIEW | 12 |
| PROCEDURE..... | 12 |
| Task One: Design..... | 12 |
| Task Two: Simulation | 12 |
| TURN-IN..... | 13 |
| SECTION TWO | 15 |
| SECTION OVERVIEW | 16 |
| PRE-LAB (PART 1)..... | 16 |
| PROCEDURE (PART 1) | 16 |
| Design specification..... | 16 |
| <i>Absolute Minimum Requirements:</i> | 17 |
| <i>Desired Features</i> | 17 |
| Design Considerations..... | 17 |
| Design Process..... | 17 |
| PRE-LAB (PART 2)..... | 18 |
| PROCEDURE (PART 2) | 18 |
| Design Process..... | 18 |

| | |
|--|-----------|
| STUDY QUESTIONS | 19 |
| TURN-IN.....ERROR! BOOKMARK NOT DEFINED. | |
| SECTION THREE..... | 21 |
| SECTION OVERVIEW | 22 |
| PRE-LAB | 22 |
| PROCEDURE | 22 |
| Construct | 22 |
| Matching Simulation Results | 23 |
| STUDY QUESTIONS..... | 23 |
| TURN-IN.....ERROR! BOOKMARK NOT DEFINED. | |
| PROTOTYPE CHECK-OFF SHEET | 24 |
| SECTION FOUR..... | 25 |
| SECTION OVERVIEW | 26 |
| PRE-LAB | 26 |
| PROCEDURE | 26 |
| TURN-IN..... | 26 |
| Printed circuit board | 26 |
| Case | 26 |
| More power | 27 |
| Other innovative ideas | 27 |
| FINAL CHECK-OFF SHEET..... | 28 |
| APPENDIX A | 29 |
| I. DOWNLOADING LTSPICE..... | 30 |
| II. TYPES OF SOURCES | 30 |
| III. ADDING NEW MODELS TO LTSPICE | 32 |
| IV. SIMULATION..... | 34 |
| V. SIMULATION COMMANDS..... | 34 |
| VI. GENERAL TIPS AND HINTS..... | 35 |

| Contents | |
|--|----|
| APPENDIX B..... | 37 |
| SIMULATE TOTAL HARMONIC DISTORTION USING LTSPICE..... | 38 |
| MEASURE TOTAL HARMONIC DISTORTION WITH DPO4034 OSCILLOSCOPE..... | 38 |
| APPENDIX C..... | 41 |
| SECTION OVERVIEW | 42 |
| OBJECTIVES..... | 42 |
| Writing the document to be submitted for the presentation..... | 42 |
| Outline of the document content..... | 42 |
| Content of the document..... | 42 |
| Language of the written document..... | 43 |
| Outline of the presentation content/ slides..... | 43 |
| Communicating effectively through presentation media..... | 44 |
| Dressing right and using the right body language for the presentation..... | 45 |
| Visual..... | 45 |
| Vocal..... | 45 |
| Verbal..... | 46 |
| CONCLUSION | 46 |
| REFERENCES..... | 47 |

PREFACE

SYSTEM OVERVIEW

During the course of this lab, you will be designing and constructing an USB powered audio amplifier. During this project, you will explore the principles of amplification and system design. The USB audio amplifier project is composed of two pieces: a functional prototype, and a complete “product”. This lab structure is designed to emulate the 30-week Senior Design course in 10 weeks. Six weeks are given to complete the designing, constructing, and testing of the prototype. Three weeks are given to improve the prototype into a “product”. In order to emulate senior design more accurately, the prototype will be graded via given specification, and the improvement portion will be graded by student-determined design specifications.

HOW TO USE THIS MANUAL

During this course, various tasks will be performed from the design of electronic devices, to prototype design, as well as improvement on the prototype. These tasks are divided into individual lab documents that correspond to what is being taught in the Electronics II lecture, and emulate a real design and build engineering process.

Everything learned in lecture is relevant and useful in later (related) courses and in your future career. As various tasks are performed in these labs, try to pay attention to how the lecture material relates to these tasks. Understanding how the lecture material is used and applied will greatly improve your understanding of the topics as well.

IMPORTANT SYMBOLS

During this lab and other TekBots labs, you will encounter the following symbols. So, review or acquaint yourself with these symbols, as they are widely used in this lab manual.



This symbol indicates an **important note** that should be remembered/memorized. Paying attention to notes like these will make tasks easier and more efficient.



This symbol designates **caution**, and the information in this caution-table should be read thoroughly, and adhered to, before moving ahead. If the caution warning is ignored, the task may appear impossible and/ or can lead to damaged TekBots and systems.



This symbol represents something that helps you make your task easier by reminding you to perform a particular task before the next step. These **reminder** symbols are not normally critical things to complete, but can make things easier.



The **innovation** symbol will give information to enrich your experience. These sections will give more insight into the what, why, and how of the task being done. Use these to learn more, or to get ideas for cool innovations.

LAB STRUCTURE

Section Overview

The section overview briefly describes what will be learned in the section, and what will be done.

Procedure

The procedure portion of each section contains all of the tasks to be completed and relates to the corresponding lecture. Keeping this in mind will help to better understand the lecture as well as the lab material.

Study Questions

The study questions are intended to give more practice and insight into what has been learned in lab and lecture. Some of the study questions will be due in lab.

Challenges

The challenge sections of labs are for extra credit. Performing the tasks in the challenge sections will improve understanding of what is being learned and will result in some outstanding TekBots and innovations.

LAB SAFETY

Safety is always important when working with electricity and electronics. This includes the safety for you, your peers, as well as safety for the circuit components you are working with. Concerns such as high voltage or currents can affect the human body, while static safety and proper component use can affect the life of your circuits.

Personal Safety

When working with high voltage and currents, it is important you remember you can be hurt if your body becomes the 'circuit', since the human body is a conductor of electricity. This issue has long been combated by using the 'one hand rule.' Whenever you are working with a potentially dangerous circuit, turn it off, but if it cannot be turned off, use only one hand when working on it. This will prevent a circuit from being made through your heart, which could be potentially fatal.

Component Safety

Many electrical components are likely to be damaged by static electricity. Static charge can build up to many thousands of volts, but with little energy. This cannot harm humans, but it can easily damage electronic components. To ensure static-safe handling, the best practice is to wear an anti-static strap and connect it to an earth ground such as a computer case or a water pipe. If you do not have an anti-static wristband, you can instead touch a ground every few minutes to discharge your static build up.

SECTION ONE

LTspice

(Week 1)

SECTION OVERVIEW

This section functions as a training/review of LTspice. Learning outcomes are:

- Able to perform design-then-simulate engineering process
- Able to perform LTspice simulation.
- Able to add models to LTspice.



Bring a printed copy of *Appendix A: A simple guide on LTspice* with you to the lab. This will enable you to work lab quickly.

PROCEDURE

A key success factor for cost effective and timely development is prototyping based on simulation and optimization. It is important to design the prototype by the given specification, followed by verification of the design via simulation before constructing the actual prototype.

Task One: Design

Design an amplifier with the following specification **on paper**:

- 5V supply voltage
- Gain = $5 \pm 5\%$
- Small signal input of 200mV_{pp} , 500 Hz
- Using only resistor(s), capacitor(s), and one 2N4401 OR 2N4403
- Use a reasonable value for β (refer to datasheet)

Task Two: Simulation

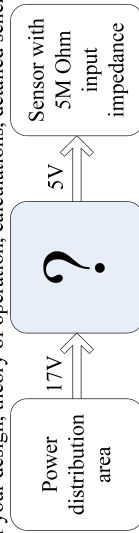
Simulate your design in LTspice using the correct parts that match your design. Print the following simulation results:

- A plot that contains both input and output waveform. (.TRAN)
- A plot that contains both magnitude (bode) plot and phase plot. (.AC)
- Simulation results on input and output impedance.
 - Hint: Research the transfer function simulation (.tf)

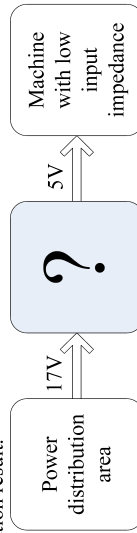
STUDY QUESTIONS

1. Were there any inconsistencies between your calculated and simulated results? What might be some of the causes? You had the option to choose either a 2N4401 or 2N4403 transistor. Which one did you choose and why did you choose it? Provide pros and cons for both transistors. Please give detailed answers for all of the above questions.

2. A sensor with 5M Ohm input impedance needs 5V to operate correctly. Assume that you get exactly 17V from the power distribution area. Design a functional block, (represented by the gray block), which will be able to change 17V to 5V. Use **ONLY** discrete parts (resistor, capacitor, diode, and transistor). Please provide detailed solution including reasoning of your design, theory of operation, calculations, detailed schematic, and simulation result.



3. A machine with low input impedance needs 5V and current ranges from 0.5 – 1 Amp to operate correctly. Assume that you get exactly 17V from the power distribution area. Design a functional block, (represented by the gray block), which will be able to change 17V to 5V. Use **ONLY** discrete parts (resistor, capacitor, diode, and BJT). Please provide detailed solution including reasoning of your design, theory of operation, calculations, detailed schematic, and simulation result.



4. Construct a parts list for the circuits designed in #2 and #3. Minimal requirement: location of purchase, vendor parts number, unit cost, total cost.

TURN-IN

- ☐ A copy of your design process, include equation used and calculation results with units.
 - a. Equations used to initially calculate all resistors in your design.
 - b. Calculations showing that the circuit still functions for maximum and minimum values of Beta from the datasheet.
- ☐ A copy of your simulation result including:

Section One: LTspice

- a. Input and Output Waveforms (on one graph)
 - b. Magnitude and Phase Plots (on one graph)
 - c. Input and Output Impedance
- ☐ Answers to study questions (typed, with SPICE schematic, equation editor for equations).

SECTION TWO

Design the prototype (Week 2 – 3)

SECTION OVERVIEW

In this section, you will design the schematic for your prototype USB powered audio amplifier. You will simulate and breadboard your design to check for functionality and consistency.

PRE-LAB (PART 1)

1. Review the three types of BJT amplifier configurations and complete the following table.
2. Comment on the advantage and disadvantages of each type of amplifier.
3. Design a single transistor amplifier with adjustable gain of 1 – 10 on paper.
4. Print out your simulation result showing outputs with gain of 1 – 10, with gain increment of 1.

| Type | Gain equation | Input impedance | Output impedance | Advantage | Disadvantage |
|------|---------------|-----------------|------------------|-----------|--------------|
| | $A_v =$ | $R_{in} =$ | $R_{out} =$ | | |
| | $A_v =$ | $R_{in} =$ | $R_{out} =$ | | |
| | $A_v =$ | $R_{in} =$ | $R_{out} =$ | | |

PROCEDURE (PART 1)

Design specification

The project requirements are listed below. Your prototype must meet ALL of the “Absolute Minimum Requirements” now, and at least one requirement in the “Desired Features” after the ‘Project Improvement’ section.

Absolute Minimum Requirements:

- ☐ USB powered
- ☐ Outputs at least 92dB
- ☐ Use only discrete components (resistor, capacitor, diode, transistor)
- ☐ Stereo output
- ☐ Adjustable gain
- ☐ System draws at least 90mA
- ☐ Total harmonic distortion less than 30%
- ☐ Receives audio signal from a computer
- ☐ Soldered

Desired Features

- Printed circuit board finish
- Louder output (more than 0.75 W)
- FM transmission
- Audio transmitted via USB
- Other student authored innovative improvements

Design Considerations

1. Are the components used in simulation reasonable?
 - a. Can they be purchased?
 - b. Will they handle the power dissipation needed?
2. How much current does your amplifier need? Can your amplifier supply enough current?
 - a. Is your Beta affected?
3. What is the desired R_{in} and R_{out} for your amplifier(s)?
 - a. Is a range allowable?

Design Process

1. First determine the audio signal you will need to amplify by measuring the signal output from your computer using the audio cable (provided in the lab kit) and oscilloscope.



A signal generator computer application will be helpful on determining the output signal amplitude. You may find an online audio frequency generator.

2. Determine the gain you will need to amplify the audio signal to the maximum
3. Design your gain amplifier
4. Simulate your design to verify functionality

PRE-LAB (PART 2)

1. Research the following basic output stage designs. The internet and Chapter 14 in Sedra/Smith should be helpful.
 - a. Class A amplifier. What are the advantages and disadvantages to a Class A design?
 - b. Class B amplifier. What are the advantages and disadvantages to a Class B design?
 - c. Class AB amplifier. What are the advantages and disadvantages to a Class AB design?
 - d. Class C amplifier. What are the advantages and disadvantages to a Class C design?(Hint: Two transistors, 2N4401 and 2N4403, as well as the audio transformer were included with your selection of parts for this section. A common design for this type of application is a Class-AB push-pull amplifier.)

2. Choose a topology from the list above or from your research (there are many more designs than those above and many of them could provide better characteristics than the simpler designs). Calculate the component values for your chosen topology based on the requirements of your system. You may want to check your textbook, look on-line, or ask professors for topology ideas. Also, there are a large number of schematic “cookbooks” with example circuits.

PROCEDURE (PART 2)

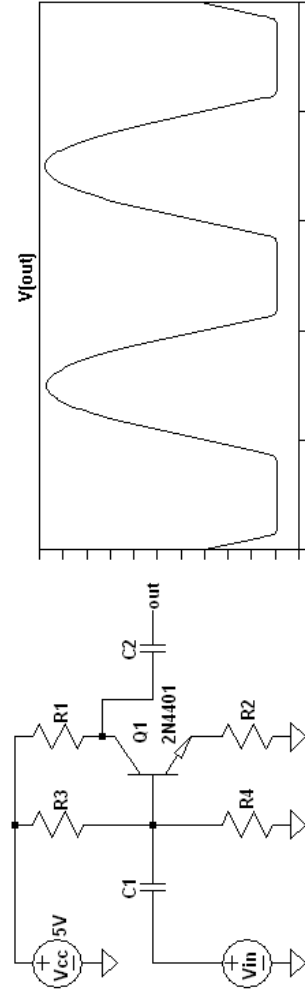
Design Process

Now you have your gain stage amplifier(s) simulated, does it supply enough current so that the audio output is audible? If not, find a solution to this problem using your knowledge from Pre-lab (part 2). Simulate your design result and fill out the table below.

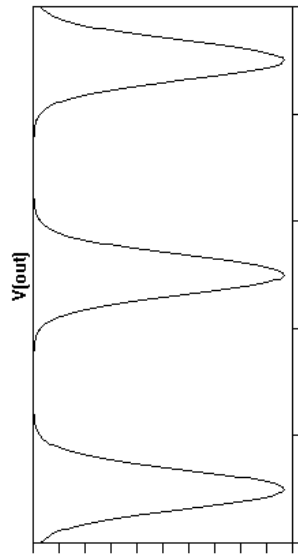
| Frequency | Vin (Peak-to-Peak) | Vout (Peak-to-Peak) | Phase Shift (Degrees) | THD |
|-----------|--------------------|---------------------|-----------------------|-----|
| 100Hz | | | | |
| 1kHz | | | | |
| 10kHz | | | | |
| 20KHz | | | | |

STUDY QUESTIONS

1. The following circuit has an input signal of 0.1Vp-p at 500 Hz. The output waveform is shown below. What could be the cause of the signal clipping? What can you do to make the circuit output a full waveform with a gain of at least 10? You may not adjust the supply and signal voltage. Please give calculation, equation, and reasoning.



2. Referring to the circuit in question #1, your output waveform is shown below. What could be the cause of this waveform? What can you do to make the circuit output a full waveform with a gain of at least 10? You may not adjust the supply and signal voltage. Please give calculation, equation, and reasoning.



TURN-IN

- ☐ A copy of your design process, include equation used and calculation on results with units.
 - a. Equations used to initially calculate all resistors in your design.
 - b. Calculations showing that the circuit still functions for maximum and minimum values of Beta from the datasheet.
- ☐ A copy of your simulation result including:
 - a. Input and Output Waveforms (on one graph)
 - b. Magnitude and Phase Plots (on one graph)
 - c. Input and Output Impedance
 - d. The table of values based on frequency
- ☐ Answers to study questions (typed, with SPICE schematic, equation editor for equations).

SECTION THREE

Prototype & Construction

(Week 4 – 5)

SECTION OVERVIEW

In this section, you will first breadboard your USB powered audio amplifier. After verifying the functionality, you will construct the prototype.

PRE-LAB

1. Find a way to measure/calculate **total harmonic distortion** (THD). Give detailed procedure.
2. Construct a parts list for the circuits designed in Section 2. Minimal requirement: location of purchase, vendor parts number, unit cost, total cost.
3. Acquire all parts needed to construct your prototype.

PROCEDURE

Construct

1. Breadboard your designed and simulated circuit by blocks (assume each amplifying stage is a block).
 - Once your circuit is breadboarded, fill in the following table with measurements. Once filled in, have your TA sign off they have seen the measurements.

| Frequency | V _{in} (Peak-to-Peak) | V _{out} (Peak-to-Peak) | Phase Shift (Degrees) | THD |
|-----------|--------------------------------|---------------------------------|-----------------------|-----|
| 100Hz | | | | |
| 1kHz | | | | |
| 10kHz | | | | |
| 20KHz | | | | |

2. After verifying the functionality of your breadboard circuit, construct the prototype.
 - Once your circuit is constructed, fill in the following table with measurements. Once filled in, have your TA sign off they have seen the measurements.

| Frequency | V _{in} (Peak-to-Peak) | V _{out} (Peak-to-Peak) | Phase Shift (Degrees) | THD |
|-----------|--------------------------------|---------------------------------|-----------------------|-----|
| 100Hz | | | | |
| 1kHz | | | | |
| 10kHz | | | | |
| 20KHz | | | | |

A few recommendations on your prototype:

- Construct the system by sections/blocks, and verify that each block functions correctly before proceeding to the next block.
- Avoid having long and/or exposed wires on the prototype.
- Double check places for components before you permanently solder them.

Matching Simulation Results

You need to ensure your prototype matches your simulation as close as possible. For this project, you will be required to match your simulation results within $\pm 10\%$. For example, if your peak to peak voltage is 4 volts, the inconsistency can be ± 0.4 volts.

STUDY QUESTIONS

1. Comparing the output of your breadboard circuit and your simulation, describe the inconsistencies. Please note there WILL be inconsistencies. What might be some of the causes for the inconsistencies? What modifications did you do to match the two outputs? Please give details such as reasoning, calculations, etc.
2. Comparing the output of your breadboard circuit and your prototyped (soldered) circuit, describe the inconsistencies. Please note there WILL be inconsistencies. What might be some of the causes for the inconsistencies? What modifications did you do to match the two outputs? Please give details such as reasoning, calculations, etc.

TURN-IN

- ☐ A copy of your design process, include equation used and calculation results with units.
 - a. Equations used to initially calculate all resistors in your design.
 - b. Calculations showing that the circuit still functions for maximum and minimum values of Beta from the datasheet.
- ☐ A copy of your simulation result including:
 - a. Input and Output Waveforms (on one graph)
 - b. Magnitude and Phase Plots (on one graph)
 - c. Input and Output Impedance
 - d. The two tables of values based on frequency
- ☐ Answers to study questions (typed, with SPICE schematic, equation editor for equations).
- ☐ This check off sheet.

PROTOTYPE CHECK-OFF SHEET

| Test (from Project Specification) | Measurements | TA signature |
|-----------------------------------|--------------|--------------|
| 7.1.1 – USB Powered | | |
| 7.1.2 – Components Used | | |
| 7.1.3 – Signal Source | | |
| 7.1.4 – Volume Control | | |
| 7.1.5 – Stereo Output | | |
| 7.1.6 – Current Consumption | | |
| 7.1.7 – System THD | | |
| 7.1.8 – Solid Construction | | |

SECTION FOUR

Project Improvement (Week 6 – 9)

SECTION OVERVIEW

In this section, you will make your designed USB powered audio amplifier prototype into a “product”.

PRE-LAB

Complete your project improvement proposal document (located on lab page). The proposal shall contain at minimum the following parts:

- A short paragraph describing how and why your improvement choice is important.
- A check-off list for your improvement. Be as specific as possible, including testing procedure.

PROCEDURE

Several options are listed below on improving your prototype USB powered audio amplifier.

- Printed circuit board
- Case
- More power
- Other innovative ideas (must be approved by course instructor or TA)

TURN-IN

Printed circuit board

- ☐ A printed copy of your schematic drawn with your PCB design tool
- ☐ A printed copy of your layout drawn with your PCB design tool
- ☐ A printed copy of your FreeDFM
- ☐ A written summary of your designed PCB
- ☐ A copy of your project improvement proposal with TA's approval signature
- ☐ Check-off sheet

Case

- ☐ A printed copy of your case drawn with a 3D CAD tool
- ☐ A written summary of your designed case, include dimensions/sizes.
- ☐ A copy of your project improvement proposal with TA's approval signature
- ☐ Check-off sheet

More power

- ☐ A printed copy of your schematic drawn with a CAD tool
- ☐ A written summary of your design. Include any reasoning, equations, calculations, references, etc.
- ☐ A copy of your project improvement proposal with TA's approval signature
- ☐ Check-off sheet

Other innovative ideas

- ☐ A written summary of your design
- ☐ A copy of your project improvement proposal with TA's approval signature
- ☐ Check-off sheet
- ☐ Other material that is required to receive credit. These requirements should be approved BEFORE the beginning of week 7.

FINAL CHECK-OFF SHEET

Please be sure to include your improvement check-off criteria

| Test (from Project Specification) | Measurements | TA signature |
|-----------------------------------|--------------|--------------|
| 7.1.1 – USB Powered | | |
| 7.1.2 – Components Used | | |
| 7.1.3 – Signal Source | | |
| 7.1.4 – Volume Control | | |
| 7.1.5 – Stereo Output | | |
| 7.1.6 – Current Consumption | | |
| 7.1.7 – System THD | | |
| 7.1.8 – Solid Construction | | |

APPENDIX A LTSPICE

Appendix A: LTspice

Useful Links & References

- <http://www.ece101.com/2010/01/an-introduction-to-LTspice/>
 - Has video tutorial for LTspice dealing with an inverting amplifier
- <http://denethor.wli.ca/LTspice/>
 - Very thorough tutorial of basic operations in LTspice (with screenshots)
- http://highered.mcgraw-hill.com/sites/0073106941/student_view0/lt_spice_instructions_and_support_files.html
 - Download contains a long powerpoint that is useful at first; gets more complicated at end
- <http://claymore.engineer.gvsu.edu/~steriana/Videos/>
 - Contains 2 video tutorials for LTspice; one basic, one dealing with models
- <http://ece.sdsmt.edu/ee221/Intro%20to%20LTspice.pdf>
 - Shorter tutorial, has lots of screenshots though (very simple, easy to follow)
- <http://home.zcu.cz/~panek50/TE1/Introduction%20to%20SwitcherCAD.pdf>
 - Quick PDF with basic operations
- <http://www.linear.com/designtools/software/LTspiceGettingStartedGuide.pdf>
 - Guide distributed by company which has good information

I. DOWNLOADING LTSPICE

1. Go to this website: <http://www.linear.com/designtools/software/>
2. Click the link titled "Download LTspice IV "
3. It isn't necessary to register for an account with the site.
4. Save the file to your computer and finish the download.

II. TYPES OF SOURCES

1. Voltage sources can be configured in many different ways in LTspice. In order to change one, right clicking on the source will bring up a window titled "Independent Voltage Source". (You might need to click "Advanced" to see these options)
 - a. (none) – This is the basic DC voltage source, simulating a simple battery. On the side of the window you can adjust the DC value to whatever voltage necessary.

- b. **PULSE** – This source defines a voltage with pulse characteristics. This is generally used for a transient circuit simulation in order to make a voltage source act like a square wave source. (*Note: Never use it for a frequency response study, because the probe plot will give inaccurate results.) The adjustable values are as follows:
- Vinitial is the value when the pulse is not “on.” So for a square wave, the value when the wave is “low” and this can be zero or negative depending on what is needed.
 - Von is the value when the pulse is turned “on,” and can also be zero or negative.
 - Tdelay is the time delay (default units are seconds), and may be zero but not a negative value.
 - Trise is the rise time of the pulse (default units are seconds). It may be zero, but using zero can cause convergence issues in some transient analysis.
 - Tfall is the fall time of the pulse (in seconds).
 - Ton is the pulse width (the time in seconds that the pulse is fully on).
 - Tperiod is the period (the total time in seconds of the pulse).
 - Ncycles is the number of cycles of the pulse that should happen (use zero if you want ongoing pulses).
- c. **SINE** – This is the AC voltage source, and defines a sinusoidal voltage. There are two possible ways to analyze the source (AC analysis and transient analysis), which two sets of parameters that can be changed.
- AC Amplitude is the RMS value of the voltage.
 - AC Phase is the phase angle of the voltage.
 - DC offset is the DC offset voltage (should be zero if you need a pure sinusoid).
 - Amplitude is the undamped amplitude of the sinusoid.
 - Freq is the sinusoid frequency in Hz.
 - Tdelay is the time delay (in seconds, set to zero for normal sinusoid).
 - Theta is the damping factor, should be set to zero for a normal sinusoid (this is not the phase angle).
- Used to apply an exponential decay to the sinusoid.
- Phi is the phase advance in degrees (set to 90 if you need a cosine wave form).
 - Ncycles is the number of cycles of the pulse that should happen (again, use zero if you want ongoing pulses).
- d. **EXP** – This is an exponential independent source that defines a voltage with exponential rise time and exponential fall time.
- Vinitial is the initial voltage
 - Vpulsed is the pulsed value.
 - Rise Delay is the time delay before the rise of the exponential function.
 - Rise Tau is the rise time constant.
 - Fall Delay is the time delay before the fall of the exponential function.
 - Fall Tau is the fall time constant.

- e. SFFM – This stands for “Single Frequency FM.” It represents a single-frequency voltage source whose frequency modulated output voltage value is independent of the current through the source.
 - DC offset is the magnitude of the time-independent part of the output voltage.
 - Amplitude is the magnitude of the sinusoidal part of the output voltage.
 - Carrier Freq is the frequency of the carrier wave. It may be zero, but cannot be negative.
 - Modulation Index is the amount by which the modulated signal varies around its unmodulated level. It may be zero, but cannot be negative.
 - Signal Freq is the frequency of the modulated signal. Value must be greater than or equal to zero.
- f. PWL – This is a piece wise linear function that can be used to create a waveform consisting of straight line segments drawn by linear interpolation between points that you define (as many points as you want can be used). The structure for this source is flexible and has a variety of parameters to choose from. However, there are some requirements:
 - Two-dimensional points consisting of a time value and a voltage.
 - Time values must be in ascending order (however, intervals between the values don’t need to be regular).

2. Current Sources

There exist current sources for all of the aforementioned voltage sources. The difference is that they produce current instead of voltage, and that you have to be aware and careful of the direction of the current arrow and the resulting polarities.

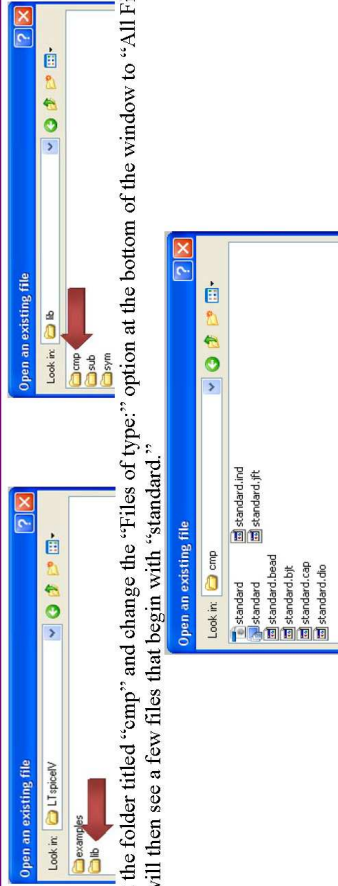
III. ADDING NEW MODELS TO LTSPICE

1. Here is an example to add a diode. Other components are added the same way.
2. First start by clicking the “File” menu, and “Open.”

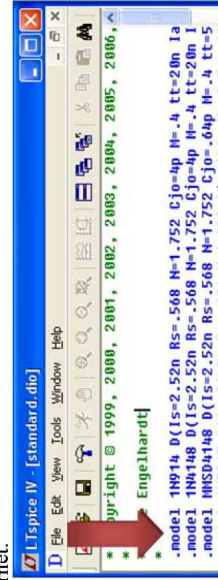


3. Look in the LTspice folder, and click the folder called “lib.” It contains the symbol libraries.

4. Select the folder titled “cmp” and change the “Files of type:” option at the bottom of the window to “All Files (**.*)”. You will then see a few files that begin with “standard.”



5. Choose and open what kind you need from these standard devices:
 - Standard.bjt – contains the bipolar junction transistors (BJTs)
 - Standard.dio – contains the diodes
 - Standard.cap – contains the capacitors
 - Standard.ind – contains the inductors
 - Standard.jft – contains the junction gate field-effect transistors (JFETs)
 - Standard.bead – contains the ferrite beads
6. Add a line with the “model” line for the device you are adding to the end of the file. Now it should show up in the LTspice lists, and you should be able to pick it as though it was one of the pre-existing models. You can find the model spice netlist on the internet.



-

IV. SIMULATION

1. Go to Simulate Menu in the tool bar and click on the "Edit Simulation CMD".
2. Select the type of simulation desired and make sure to place the spice directives on the schematic (See below for description of types of simulation)
3. Then click on "Run". (If errors appear then correct and rerun.)

V. SIMULATION COMMANDS

1. DC Operating Point
 - a. This is the most basic and commonly used analysis.
 - b. It does not give any plots but it is still very powerful.
2. Transient
 - a. It is used to observe various values of your circuit over time.
 - b. The ratio of Stop Time: Maximum Timestep determines how many calculations LTspice must make to plot a wave form. LTspice always defaults the start time to zero seconds and goes until it reaches the user defined

final time. Determine what timestep you should use before running the simulation. If you make the timestep too small the probe screen will be cluttered with unnecessary points making it hard to read, and all calculation performed by LTspice will take much longer to complete if you set the timestep too high, you might miss important phenomenon that are occurring over very short periods of time in the circuit. Therefore, play with step time to see what works best for your circuit.

3. AC Analysis
 - a. Allows plotting magnitude and/or phase versus frequency for different inputs of signals.
4. DC Sweep
 - a. Allows different types of sweeps of voltage, current and temperature to see how the circuit reacts.
 - b. For all sweeps make sure to specify a start, stop and the number of points you wish to plot.
5. Noise
 - a. This simulation allows for the creation of noise either as an input or output
6. DC Transfer
 - a. Finds small DC signal transfer function of a node voltage or branch currents due to small variations of independent sources.

VI. GENERAL TIPS AND HINTS

- A. Changing Part Values: "M" and "m" are interpreted the same by SPICE, because it is case insensitive. Putting 10m and 10M for a resistor value will have the same effect, giving it a value of 10 milliohms. Also, don't enter "1F" for a capacitor, because this will read as a femto-farad. To avoid this, reference the following information:

| | | |
|-------------------------|-------------------------|--------------------------|
| - T = terra = 10^{12} | - K = kilo = 10^3 | - N = nano = 10^{-9} |
| - G = giga = 10^9 | - M = milli = 10^{-3} | - P = pico = 10^{-12} |
| - MEG = mega = 10^6 | - U = micro = 10^{-6} | - F = femto = 10^{-15} |

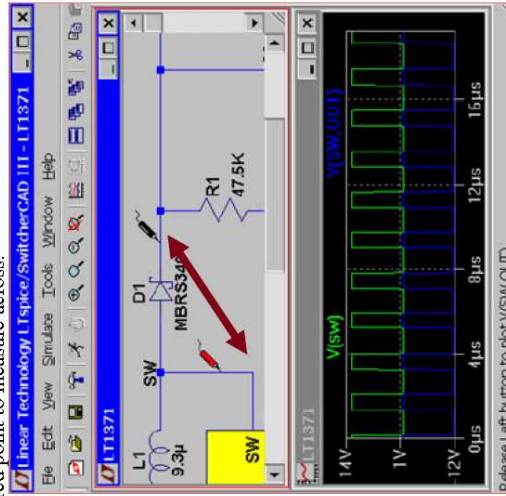
- B. LTspice Leading characters

| | |
|--|--|
| "A" - Special functions device | "F" - Current dependent current source |
| "B" - Arbitrary behavioral source | "G" - Voltage dependent current source |
| "C" - Capacitor | "H" - Current dependent voltage source |
| "D" - Diode | "I" - Independent current source |
| "E" - Voltage dependent voltage source | "J" - JFET transistor |

Appendix A: LTspice

| | |
|----------------------------------|----------------------------------|
| "K" - Mutual inductance | "U" - Uniform RC-line |
| "L" - Inductor | "V" - Independent voltage source |
| "M" - MOSFET transistor | "W" - Current controlled switch |
| "O" - Lossy transmission line | "X" - subcircuit invocation |
| "Q" - Bipolar transistor | "Z" - MESFET transistor |
| "R" - Resistor | "*" - Comment |
| "S" - Voltage controlled switch | "+" - Continuation of prior line |
| "T" - Lossless transmission line | "." - Simulation directive |

- C. The auto-generated SPICE netlist is located in the View menu.
- D. To set a component to a specific manufacturer right click on the component and then click "Select Component Type".
- E. Finding a voltage difference across two points can be achieved by simulating the design. Then using the red probe, left click, hold, and drag to desired point to measure across.



APPENDIX B

Total Harmonic Distortion

SIMULATE TOTAL HARMONIC DISTORTION USING LTSPICE

1. Setup a transient analysis with the analysis time a multiple of your signal generator's period
2. Add **.four** command using the "**SPICE directive**" button. **sp**

Syntax: `.four <frequency> [Nharmonics] [Nperiods] <datatrace1> [<data
trace2> ...]`

Note: The frequency in `.four` command is the same as the frequency of an input source. For example, if your signal generator is set to 1kHz and you want to watch the node named "out." The command would be:

Example: `.four 1kHz V(out)`

3. After running the simulation, you can see the results of THD using *View >> SPICE error log*

MEASURE TOTAL HARMONIC DISTORTION WITH DPO4034 OSCILLOSCOPE

After acquiring the output signal from your circuit, follow the procedure below in order to calculate the Total Harmonic Distortion;

1. Push **Math**



2. Push **FFT**



2

3. Push the side-bezel menu **FFT Source** repeatedly for the channel with reference waveform to be analyzed (your output waveform).
4. Push the side-bezel **Vertical Units** button repeatedly to select **dBV RMS**.
5. Push the side-bezel **Window** button repeatedly to select **Hanning** window choice.
6. Push the side-bezel **Horizontal** button. Use knob **a** and **b** to pan or zoom the FFT display on screen. Below is the example screen after step 1-5.

| |
|------------------------------------|
| FFT |
| FFT Source 1 |
| Vertical Units Linear-RMS |
| Window Hanning |
| Horizontal 625kHz 125kHz/div |

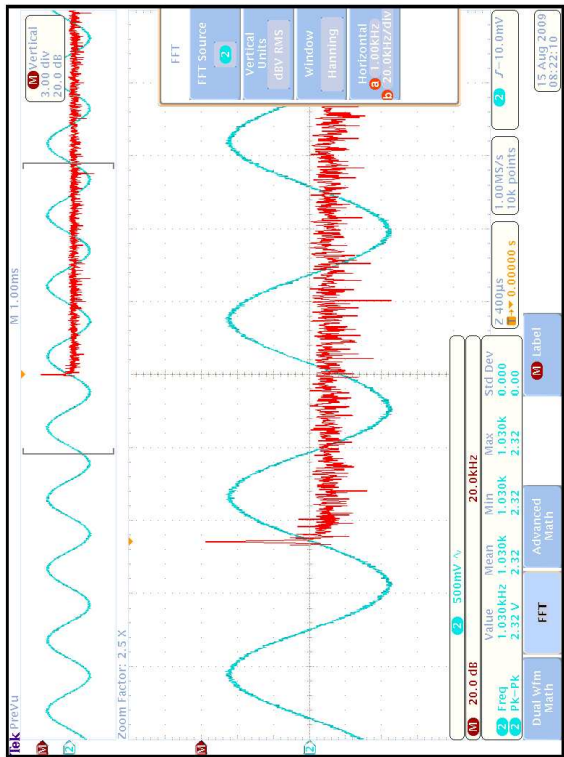


Figure Display Output Waveform and the Result of Math/FFT Function

Appendix B: Total Harmonic Distortion

- 7. Save your waveform in .csv format.
- 8. Import the data to your computer.
- 9. Choose the harmonic frequency and convert the data in dB to power using the equation below,

$$Power = 10^{(\frac{dB}{10})}$$

Example: $P_1 = 10^{(\frac{-17.9156}{10})} = 0.01616$

| | |
|----------|----------|
| 4.20E+02 | -45.0688 |
| 4.50E+02 | -24.15 |
| 4.80E+02 | -21.0344 |
| 5.00E+02 | -17.9156 |
| 5.20E+02 | -20.8281 |

- 10. Use equation below to determine THD;

$$\% THD = \left(\sqrt{\frac{(P_2 + P_3 + P_4 + \dots + P_n)}{P_1}} \right)$$

Note: P_n = the n^{th} power harmonic, where the fundamental harmonic is at $n=1$.

APPENDIX C

Presentation Pointers

SECTION OVERVIEW

The purpose of any form of technical communication is to inform, not impress. Classes that need students to give a technical presentation, actually require one that falls in the genre of formal presentation. This document falls in the same genre too. In addition, there is sometimes the requirement for the student to submit the written matter of that presentation in hard or soft copy. This document is therefore intended to help you with some basic tips to refine the outlook of a technical presentation, both for the presenter as well as for the presenter's document. Use them as guidelines and the result will be a well-prepared, well-presented, professional presentation.

OBJECTIVES

Any formal presentation has the following key features presenters need to focus on:

- Writing the document to be submitted for the presentation.
- Outline of the presentation content/ slides.
- Communicating effectively through presentation media.
- Dressing appropriate and using the correct body language for the presentation.

Writing the document to be submitted for the presentation

The tips for the written material (that you would submit at the end of the lab) include:

- Outline of the document content.
- Content of the document.
- Language of the written document.

Outline of the document content

The outline of the document (i.e. introduction/ body of the document/ conclusion), are explained later in this document under the section: *Outline of the presentation content*.

Content of the document

The content of the document would be similar to what you present in class. The following are some quick tips to start you on the content of the document, as well as on the slides:

1. Make a rough draft: Write down a synopsis of your goals, which would essentially be the purpose of the document.
2. Research the goals: Use reliable Internet resources/ the Library/ conduct surveys or interviews and get valid information to support your goals.

3. List five important facts: Depending on the length of the document, select any five goals/ concepts on which to focus the basis of your document, and arrange them in order of chronology/ priority.
4. Add appropriate visuals: A picture is worth a thousand words. Any part of the document text that can be replaced/ enriched with a visual will create more impact than just plain-text.
5. Cite all your resources: Check all author-date citations and all entries in the reference list for both accuracy and conformance to the format being imposed for your document.
6. Proofread: Use the spell-checker and/ or have a friend peer-edit the document before submission.

Language of the written document

Each document has a voice. Here are a few tips to observe, in order to ensure the language is not offensive or ambiguous:

1. Use a clear and informal style, avoiding unnecessary jargon and acronyms. Acronyms can be used when it is understood by both the audience and the reader.
2. Preferably, use first person and active voice.
3. Avoid language which might be construed as sexist/ racist/ politically incorrect.
4. Analyze the audience (international/ multi-cultural/ academic diversity). For an in-class, technical presentation/ submission, the presenter typically does not need to worry about the nature of the audience, but this is a handy tip that most presenters tend to overlook.

Outline of the presentation content/ slides

These tips are of great importance to forming a powerful outline for any technical document and/ or presentation slides:

1. **Start with a welcome-slide** – The first slide welcomes the audience, (and it is worthwhile to make a mention of notable attendees), and then introduce yourself. (This would conform to the cover-page of your written document).
2. **Spell out your conclusion or summary first** – Most people attending a presentation will "remember" no more than five concepts. Ideally, the presenter should have a list of the five most important points/ concepts/ facts that should be remembered. This introduction with the concepts should spell out the agenda for your presentation. Giving your audience a framework of understanding at the beginning allows them to easily integrate information into their knowledge, because they already have a "place to put that information."
3. **Highlight the main concepts, using visuals and minimum text.**
 - a) Use an 18-point (or higher) font size for your slides. Also, use an appealing but light-and-bright solid background color for the slides.
 - b) From the above-mentioned five primary concepts, allocate an average of two slides of text to each main concept.
 - c) Have about four to five key points for each concept.
 - d) Write these key points briefly in short one-liners, and elaborate on the points in the speech instead.

- e) About three visuals for the entire presentation should be sufficient, as long as they give appropriate and complete backing to the associated content.
 - f) Too much information, small-size text, and unclear visuals renders the presentation less effective in terms of message-delivery.
4. **Citation** – Cite any sources for visuals/ text, by mentioning it verbally or including it on the slide,, in a smaller footer area..
5. **Strong conclusion** – Make the closing short and sweet. Re-iterate the three dimensions of your message (what, why and how) in a powerful one-slide finale to the presentation. A good rule of thumb is to use 10-15% of your time for the opening and 5-10% for the closing.
6. **Question time** – Make the discussion open to questions from the audience after your closing. Answer the questions as briefly and concisely as you can. It is best to paraphrase the question before answering it, to clarify it in your mind and to make sure you understand the question. If you don't know the answer, say so. Do not try to make up an answer.

Communicating effectively through presentation media

To make your presentation more than just a stand-up speech with the whiteboard and markers as your tools, add pizzazz to your presentation by taking advantage of the multimedia tools. **Confirm with your professor/ TA as to what multimedia will be available for that day/ classroom.** Any of the following will make your presentation more effective:

If a computer will be available for your presentation, digital slides maybe a good choice for your presentation. However, make an intelligent decision because if slides are not needed or are an 'overkill' for your presentation, do not endanger your presentation by using them.

If you do decide to make digital slides, bear these guidelines in mind:

- **Use Microsoft PowerPoint or even Adobe PageMaker:** These are ideal for adding color, background theme, convenience and dynamic appeal to your presentation.
- Read and use the tips mentioned in the previous section, "Outline of the presentation content/ slides", to create your PowerPoint slides.
- **Confirm with your professor/ TA regarding what storage media (i.e. USB mass storage removable disk, CD, etc) you can use, and/ or if you can bring your own PC-notebook, or if there is wireless network access, with which to launch your PowerPoint presentation.**
- Allow the audience at least half to one minute to read a slide with important, concise, bulleted points and stress or elaborate on them verbally.
- Do not read your slides for your audience, because they can usually do that themselves. Instead, use your time to maximize impact by elaboration or descriptions and examples.

Dressing right and using the right body language for the presentation

The document and slides are not the only aspects for the presentation. In order to be effective in delivering the message, the presenter needs to bear in mind a few key-points as well. This has to do with dressing appropriately and using the right body language.

The ideal way to present yourself successfully is to use the three main components of person-presentation, commonly called **the three Vs: Visual, Vocal, and Verbal**.

Visual

The first thing your audience members see is your appearance. Your body language will also send the audience a message. Before you get a chance to say a word, some of them will already have judged you based solely on how you look. Your visual outlook therefore comprises of your *attire* and *body language*.

Tips for presentable *attire*:

- You can never be faulted for looking "too professional," even if the audience is dressed down.
- Formal clothing makes the audience accord you respect.
- Comfortable clothing helps the presenter to move around easily.
- Be certain that your outfit and accessories do not detract the audience from your presentation.
- Avoid anything that makes noise or looks flashy, like jangling bracelets or earrings.
- Avoid having money and keys in the pockets, especially if you have a tendency to put your hands in the pockets.

Tips for using the right *body language*:

- Do not cross your arms or fidget.
- Use gestures to emphasize points, but be careful not to flail your arms around.
- The most effective stance is a forward lean, not swaying back and forth or bouncing on your feet.
- Make regular eye contact with audience members, holding the connection to complete an idea. Look around with a panoramic view while you speak. Effective eye-contact helps draw listeners into your speech.
- Nodding to emphasize a point also helps make a connection with the audience. If you nod occasionally, audience members will too -- creating a bond.

Vocal

Appendix C: Presentation Pointers

If you have ever listened to people speaking in a monotone, or too softly, you know how difficult it is to pay attention. There are six *vocal cues* to remember: pitch, volume, rate, punch, pause, and diction.

- Pitch and volume: It is very important to speak loud, clearly and enunciate. When you look down, your voice drops.
- Rate: If you rush your delivery, the audience will have to work too hard to pay attention. Vary your tone and speed and tailor your delivery rate to accommodate any regional differences. Keep your chin up while speaking, and do not bury it in note-cards.
- Punch and pause: Emphasize or "punch" certain words for effect, but do not forget to incorporate pauses to give the audience time to let important points be understood.
- Diction: Proper diction is also essential; if you are not sure how to pronounce a word, look it up or do not use it.

Verbal

There are three verbal *communication rules* to remember:

- Use descriptive and simple language.
- Use short sentences.
- Avoid buzz-words and jargon.

Video-tape your presentation or practice in front of a friend. Watch your expressions, body language, vocal and verbal delivery, and your confidence level. See if you have smiled enough and in appropriate places.

CONCLUSION

As with most documents, this document re-caps the main points to remember for the final presentation:

- **Know the purpose, audience, and logistics** (such as time-limit for presentation, whether each member talks or just a team representative talks, and the visual equipment available for the presentation)
- **Prepare and research adequately** (with an opening that creates impact, and a closing that ends with strength).
- **Create a user-friendly draft** (that makes use of the available multimedia, such as PowerPoint presentation).
- **Most important of all: PRACTICE WELL, prior to giving your presentation.** (Video-tape yourself or envision a set-up similar to the presentation while practicing the speech delivery).
- **Arrive early** (to meet up your team, check that the visual equipment works, go over the slides).
- **Apply the delivery techniques** as a presenter (visually, verbally and vocally).
- **Handle questions and answers with tact.** (Stick to the time-limit, so that there is time for the Q&A session).
- **Be confident** (especially after you have read and applied the above techniques for an excellent presentation)!

REFERENCES

Following is a list of sources that were referred to extensively, in the making of this document. You are encouraged to refer to these sites, for more presentation pointers, apart from those outlined in this document.

1. Society for Technical Communication
<http://www.stc.org/>
2. The Art of Communicating Effectively
<http://www.presentation-pointers.com/>
3. National AV supply
<http://www.nationalavsupply.com/>
4. Chicago Manual of Style
<http://www.litbs.uga.edu/ref/chicago.html>

APPENDIX D

Suppliers

This section has a list of our suppliers:

| | |
|---------------------------|--|
| DigiKey | 701 Brooks Ave. South Thief River Falls, MN 56701-0677 (800) 344-4539 http://www.digikey.com |
| Mouser Electronics | 1000 N. Main Street, Mansfield, TX 76063 (800) 346-6873 http://www.mouser.com |
| Allied Electronics | 6700 SW 105th St, Suite 106 Beaverton, OR 97008 (800) 433-5700 http://www.alliedelec.com |
| TekBots | 220 Owen Hall Oregon State University Corvallis, OR 97331 tekbots_support@eecs.oregonstate.edu http://eecs.oregonstate.edu/tekbots |
| Solarbotics | 179 Harvest Glen Way N.E. Calgary, Alberta, Canada T3K 4J4 (866) B-ROBOTS http://www.solarbotics.com |
| McMaster-Carr | P.O. Box 7690, Chicago, IL 60680-7684 (562) 692-5911 http://www.mcmaster.com |
| Jameco Electronics | 1355 Shoreway Rd, Belmont, CA 94002 (800) 831-4242 http://www.jameco.com |

APPENDIX B – SURVEY AND RESULTS FOR NEW ECE 323, FALL 2009

This section contains the survey questions and results for the new ECE 323 Electronics II laboratory project in the Fall 2009 academic term. The results are listed in raw data form. The student tag numbers are blocked for confidential purposes.

Your last 5 digit of your student ID# _____

Section 1 – Circle the best response for each of the following items.

1. Gender
 - a. Female
 - b. Male
2. Class standing
 - a. Freshman
 - b. Sophomore
 - c. Junior
 - d. Senior
 - e. Graduate
3. When did you take the ECE322 course?
 - a. Winter 2007
 - b. Winter 2008
 - c. Winter 2009
 - d. Winter 2010
4. What grade did you receive in the ECE322 course?
 - a. A
 - b. B
 - c. C
 - d. D
 - e. Other
5. Have you taken ECE323 before?
 - a. Yes
 - b. No
6. Are you currently enrolled in ECE44X (Senior Design)?
 - a. Yes
 - b. No
7. What track are you most interested in?
 - a. Computer and Network
 - b. Energy Systems
 - c. Integrated Circuits
 - d. Systems, Signals, and Communications
 - e. Materials and Devices
 - f. Self-Designed Track
 - g. Robotics and Controls
 - h. Other
8. I entered OSU as a freshman.
 - a. Yes
 - b. No

Section 2 – There are/were 4 different labs in this course. Please circle the one best response to each of the statements as they relate to the lab.

Lab 1 – LTspice (Simulation tool)

A. *I think the difficulty of this lab was/will be:*

Too Difficult Difficult Medium Easy Too Easy

B. *My interest in this lab was/will be:*

Very High High Medium Low Very Low

C. *This lab was/will be helpful for my future career:*

Strongly Agree Agree Neutral Disagree Strongly Disagree

Lab 2 – Design the Prototype (Schematic creation & simulation)

D. *I think the difficulty of this lab was/will be:*

Too Difficult Difficult Medium Easy Too Easy

E. *My interest in this lab was/will be:*

Very High High Medium Low Very Low

F. *This lab was/will be helpful for my future career:*

Strongly Agree Agree Neutral Disagree Strongly Disagree

Lab 3 – Prototype & Construction (Construction and prototype testing)

G. *I think the difficulty of this lab was/will be:*

Too Difficult Difficult Medium Easy Too Easy

H. *My interest in this lab was/will be:*

Very High High Medium Low Very Low

I. *This lab was/will be helpful for my future career:*

Strongly Agree Agree Neutral Disagree Strongly Disagree

Lab 4 – Product Improvement (Improving prototype & project finalization)

J. I think the difficulty of this lab was/will be:

Too Difficult Difficult Medium Easy Too Easy

K. My interest in this lab was/will be:

Very High High Medium Low Very Low

L. This lab was/will be helpful for my future career:

Strongly Agree Agree Neutral Disagree Strongly Disagree

Over All

A. I think/expect the lab is/will be matching with the lecture material and schedule.

Strongly Agree Agree Neutral Disagree Strongly Disagree

B. I think/expect the lab is/will be helpful with ECE44X (Senior Design).

Strongly Agree Agree Neutral Disagree Strongly Disagree

Continue on the next page

Section 3 – Please answer the following questions by evaluation your **CURRENT** status.

A. *I can understand the topics in my engineering classes so that I am prepared for the next courses.*

Strongly Agree Agree Neutral Disagree Strongly Disagree

B. *I am able to build relationships with role models in the engineering field who will help me succeed in my degree.*

Strongly Agree Agree Neutral Disagree Strongly Disagree

C. *I can earn the grades and GPA I need to stay in engineering.*

Strongly Agree Agree Neutral Disagree Strongly Disagree

D. *I can motivate myself to overcome the obstacles to completing my engineering degree.*

Strongly Agree Agree Neutral Disagree Strongly Disagree

E. *I can do hands-on tasks such as making measurements, soldering, and using equipment to succeed in engineering lab courses.*

Strongly Agree Agree Neutral Disagree Strongly Disagree

F. *I can bounce back even if I get a bad grade on a homework or exam.*

Strongly Agree Agree Neutral Disagree Strongly Disagree

G. *I am able to solve problems that I don't initially know the answer to.*

Strongly Agree Agree Neutral Disagree Strongly Disagree

H. *I am able to interact with other students in my classes and form study groups with them.*

Strongly Agree Agree Neutral Disagree Strongly Disagree

I. *I can manage my time and tasks so that I get my class work done.*

Strongly Agree Agree Neutral Disagree Strongly Disagree

J. *I am able to find a place that's good for me to study.*

Strongly Agree Agree Neutral Disagree Strongly Disagree

Pre-term Survey Results

| Tag | Section 1 | | | | | | | | Section 2 | | | | | | | | | | | | Section 3 | | | | | | | | | | | | |
|-------|-----------|---|---|---|---|---|---|---|-----------|---|---|-------|---|---|-------|---|---|-------|---|---|-----------|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Lab 1 | | | Lab 2 | | | Lab 3 | | | Lab 4 | | | Over all | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | A | B | C | A | B | C | A | B | C | A | B | C | A | B | A | B | A | B | C | D | E | F | G | H | I |
| ##### | 1 | 4 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 4 | 5 | 2 | 3 | 5 | 2 | 3 | 4 | 3 | 3 | 5 | 3 | 4 | 2 | 3 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 5 |
| ##### | 2 | 4 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 4 | 1 | 4 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 1 | 1 | 2 | 3 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| ##### | 2 | 4 | 3 | 2 | 2 | 1 | 2 | 1 | 4 | 4 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 3 |
| ##### | 2 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 3 | 4 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| ##### | 2 | 4 | 2 | 1 | 2 | 1 | 1 | 1 | 4 | 3 | 1 | 3 | 2 | 1 | 3 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| ##### | 2 | 4 | 3 | 2 | 1 | 2 | 4 | 1 | 4 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 4 | 2 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 2 |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 3 | 1 | 4 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| ##### | 2 | 4 | 2 | 1 | 2 | 1 | 1 | 2 | 3 | 4 | 3 | 3 | 4 | 3 | 3 | 4 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 7 | 1 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 1 | 1 | 4 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 1 |
| ##### | 2 | 4 | 3 | 2 | 2 | 1 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 |
| ##### | 2 | 4 | 3 | 2 | 2 | 1 | 7 | 1 | 3 | 4 | 3 | 4 | 2 | 3 | 2 | 3 | 3 | 4 | 2 | 3 | 2 | 4 | | | | | | | | | | | |
| ##### | 2 | 4 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 3 | 3 | 2 | 4 | 3 | 2 | 3 | | | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | |
| ##### | 2 | 4 | 2 | 2 | 2 | 1 | 4 | 1 | 4 | 3 | 2 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | |
| ##### | 2 | 4 | 3 | 2 | | 2 | 7 | 1 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 1 | 1 | 4 | 3 | 4 | 2 | 3 | 4 | 2 | 3 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| ##### | 1 | 4 | 3 | 1 | 2 | 1 | 3 | 1 | 4 | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | |
| ##### | | 4 | 3 | 1 | 2 | 1 | 7 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 4 | 1 | 2 | 3 | 2 | 2 | 2 | 2 | | | | | | | | | | | |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 6 | 1 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 1 | 2 | 4 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 2 | 1 | 2 | 2 | |
| ##### | 2 | 4 | 3 | 2 | 2 | 1 | 2 | 2 | 4 | 5 | 5 | 3 | 5 | 5 | 3 | 5 | 5 | 3 | 5 | 5 | 4 | 5 | 4 | 5 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 2 | 2 | 4 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 2 | 2 | 4 | 2 | 2 | 3 | 1 | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| ##### | 2 | 4 | 2 | 2 | 2 | 1 | 2 | 1 | 4 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | |
| ##### | 2 | 4 | 2 | 1 | 2 | 1 | 2 | 1 | 4 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | |

Post-term Survey Results

| Tag | Section 1 | | | | | | | | Section 2 | | | | | | | | Section 3 | | | | | | | | | | | | | | | |
|-------|-----------|---|---|---|---|---|---|---|-----------|---|-------|---|-------|---|-------|---|-----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Lab 1 | | Lab 2 | | Lab 3 | | Lab 4 | | Over all | | | | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | A | B | C | A | B | C | A | B | C | A | B | A | B | C | D | E | F | G | H | I | J | | | |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 2 | 1 | 4 | 4 | 3 | 2 | 3 | 2 | 3 | 4 | 3 | 3 | 3 | 1 | 4 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 1 | 1 |
| ##### | 1 | 4 | 3 | 1 | 2 | 1 | 7 | 2 | 3 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 4 | 1 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 4 | 2 | |
| ##### | 2 | 4 | 2 | 2 | 2 | 1 | 2 | 1 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 2 | 2 | 4 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | |
| ##### | 2 | 4 | 1 | 2 | 1 | 8 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 4 | 3 | 3 | 2 | 4 | 4 | 3 | 3 | 1 | 3 | 2 | 1 | 3 | 2 |
| ##### | 2 | 4 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 1 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 |
| ##### | 1 | 4 | 2 | 2 | 2 | 1 | 2 | 2 | 3 | 3 | 2 | 2 | 4 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 4 | 3 | 4 | 2 | 2 | 2 | 2 | 3 | 1 | 2 | 5 |
| ##### | 1 | 4 | 2 | 1 | 2 | 1 | 2 | 2 | 4 | 3 | 2 | 3 | 3 | 2 | 4 | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 3 | 4 |
| ##### | 2 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 4 | 3 | 1 | 2 | 2 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 1 | | | | | | | | | | |
| ##### | 2 | 4 | 3 | 2 | 2 | 1 | 2 | 2 | 4 | 4 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 |
| ##### | 2 | 4 | 3 | 2 | 2 | 1 | 4 | 1 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 4 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 7 | 1 | 4 | 4 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 4 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 2 |
| ##### | 1 | 4 | 3 | 2 | 2 | 1 | 6 | 1 | 4 | 3 | 3 | 2 | 4 | 3 | 3 | 2 | 2 | 3 | 4 | 1 | 3 | 4 | 2 | 3 | 1 | 3 | 2 | 2 | 3 | 2 | 1 | 2 |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 1 | 1 | 4 | 4 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 1 | 1 |
| ##### | 2 | 4 | 3 | 2 | 1 | 2 | 7 | 1 | 4 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 4 | 3 | 2 | 1 | 3 | 2 | 4 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 |
| ##### | 2 | 4 | 2 | 2 | 2 | 1 | 1 | 1 | 4 | 2 | 2 | 3 | 2 | 2 | 3 | 4 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| ##### | 1 | 4 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 3 | 2 | 1 | 3 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 4 | 4 | 1 | 4 | 2 | | | | | | | | | | |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 1 | 1 | 4 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| ##### | 2 | 4 | 3 | 1 | 2 | 1 | 4 | 1 | 4 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 2 |

APPENDIX C – SURVEY AND RESULTS FOR NEW ECE 323, SPRING 2010

This section contains the pre-term results for the new ECE 323 Electronics II laboratory project in the Spring 2010 academic term. The results are listed in raw data form. The student tag numbers are blocked for confidential purposes. Survey questions used in Fall 2009 was reused in Spring 2010.

Pre-term Survey Results

| Tag | Section 1 | | | | | | | | Section 2 | | | | | | | | | | | | Section 3 | | | | | | | | | | | | | | |
|-------|-----------|---|---|---|---|---|---|---|-----------|---|---|-------|---|---|-------|---|---|-------|---|---|-----------|----|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Lab 1 | | | Lab 2 | | | Lab 3 | | | Lab 4 | | | Over all | | | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | A | B | C | A | B | C | A | B | C | A | B | C | A | B | A | B | A | B | C | D | E | F | G | H | I | J | |
| ##### | 2 | 3 | 4 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| ##### | 2 | 4 | 4 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 2 | 2 | 4 | 3 | 2 | 1 | 2 | 3 | 2 | 2 | 4 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| ##### | 2 | 4 | 4 | 2 | 2 | 2 | 6 | 1 | 3 | 3 | 4 | 2 | 3 | 4 | 3 | 3 | 4 | 3 | 4 | 4 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 |
| ##### | 2 | 4 | 4 | 1 | 2 | 2 | 5 | 1 | 4 | 3 | 4 | 3 | 4 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 3 |
| ##### | 1 | 3 | 4 | 2 | 2 | 2 | 5 | 1 | 3 | 3 | 4 | 4 | 3 | 4 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| ##### | 1 | 3 | 4 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| ##### | 2 | 3 | 4 | 1 | 2 | 2 | 1 | 1 | 3 | 2 | 2 | 3 | 1 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| ##### | 2 | 3 | 4 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| ##### | 2 | 3 | 4 | 2 | 2 | 2 | 7 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 4 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| ##### | 2 | 3 | 4 | 2 | 2 | 2 | 7 | 1 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| ##### | 1 | 3 | 4 | 2 | 2 | 2 | 5 | 1 | 4 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 3 | 2 |
| ##### | 2 | 3 | 4 | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 2 | 3 | 3 | 2 | 4 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| ##### | 2 | 3 | 4 | 3 | 2 | 2 | 4 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 4 | 2 | 1 | 2 | 1 | 1 | 1 | 3 | 2 | 2 |
| ##### | 2 | 3 | 4 | 3 | 2 | 2 | 7 | 1 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 4 | 3 | 2 | 3 | 2 | 3 | 2 | 2 |
| ##### | 2 | 3 | 4 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 |
| ##### | 2 | 3 | 4 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 4 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| ##### | 2 | 3 | 4 | 1 | 2 | 2 | 2 | 1 | 3 | 3 | 1 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| ##### | 2 | 4 | 3 | 2 | 2 | 1 | 5 | 1 | 3 | 3 | 4 | 1 | 4 | 3 | 3 | 3 | 4 | 3 | 3 | 4 | 2 | 5 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 4 | 4 | 4 | 4 |
| ##### | 2 | 3 | 4 | 1 | 2 | 2 | 7 | 1 | 4 | 2 | 2 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 3 | 1 | 2 | 2 | 2 | 2 | 2 |
| ##### | 2 | 3 | 4 | 5 | 2 | 2 | 2 | 1 | 3 | 4 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 4 | 4 | 3 | 2 | 3 | 2 | 4 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| ##### | 2 | 3 | 4 | 2 | 2 | 2 | 2 | 1 | 4 | 4 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| ##### | 2 | 4 | 4 | 1 | 2 | 2 | 2 | 1 | 3 | 3 | 4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| ##### | 2 | 3 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 |
| ##### | 2 | 3 | 4 | 2 | 2 | 2 | 2 | 1 | 2 | 4 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 4 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 4 | 2 | 2 | 3 | 3 | 3 | 3 |
| ##### | 2 | 3 | 4 | 1 | 2 | 2 | 2 | 1 | 3 | 4 | 2 | 2 | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 |
| ##### | 2 | 3 | 4 | 2 | 2 | 2 | 3 | 1 | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 2 | 4 | 2 | 1 | 3 | 3 | 5 | 2 | 3 | 1 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 |
| ##### | 2 | 3 | 4 | 2 | 2 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 2 |
| ##### | 2 | 4 | 4 | 2 | 2 | 2 | 1 | 1 | 4 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| ##### | 2 | 3 | 4 | 2 | 2 | 2 | 7 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| ##### | 1 | 4 | 4 | 3 | 2 | 2 | 5 | 1 | 3 | 4 | 2 | 2 | 4 | 3 | 2 | 4 | 3 | 2 | 4 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| ##### | 2 | 4 | 1 | 4 | 2 | 2 | 4 | 2 | 4 | 3 | 3 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 5 | 2 | 2 | 2 |
| ##### | 2 | 5 | | | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 3 | NA | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 3 | 2 | 1 | 2 | 2 | 2 |

Post-term Survey Results Continued

| | | | | | | | | |
|-------|---------|---------|-------|-------|-------|-------|-----|-----------------------|
| ##### | 2 5 4 2 | 2 2 2 2 | 3 3 4 | 2 2 4 | 2 2 4 | 2 2 4 | 2 3 | 2 2 2 2 2 2 2 2 2 2 |
| ##### | 2 3 4 3 | 2 2 1 1 | 4 4 3 | 2 3 2 | 2 3 3 | 2 3 2 | 3 2 | 3 2 2 2 2 2 2 2 2 3 2 |
| ##### | 2 3 4 2 | 2 2 1 1 | 4 3 3 | 2 3 3 | 3 2 2 | 3 2 2 | 2 3 | 2 2 2 2 1 2 2 1 2 2 |
| ##### | 2 4 4 3 | 2 2 3 1 | 4 4 4 | 3 3 3 | 2 3 2 | 3 3 3 | 3 2 | 3 4 3 2 1 4 2 3 2 2 |
| ##### | 2 3 4 1 | 2 2 3 1 | 4 3 2 | 2 2 2 | 4 3 2 | 3 2 2 | 2 2 | 2 2 2 2 2 2 2 2 1 1 1 |
| ##### | 2 3 4 2 | 2 2 2 1 | 3 2 3 | 2 3 3 | 3 3 3 | 3 3 3 | 3 2 | 2 3 1 2 2 2 3 2 2 1 |
| ##### | 2 3 4 3 | 2 2 8 2 | 3 2 2 | 3 3 3 | 3 2 4 | 2 2 1 | 4 2 | |
| ##### | 2 3 4 2 | 2 2 7 1 | 4 3 3 | 3 3 3 | 3 2 2 | 3 2 2 | 2 3 | 2 2 2 1 1 2 1 2 3 3 |
| ##### | 2 3 4 1 | 2 2 3 2 | 2 2 1 | 2 2 | 2 1 2 | 3 3 2 | 3 3 | |
| ##### | 2 3 4 2 | 2 2 4 2 | 3 3 3 | 3 2 2 | 2 2 2 | 2 1 1 | 2 1 | 1 1 1 1 1 1 1 1 2 1 |
| ##### | 2 4 4 2 | 2 2 2 2 | 3 2 2 | 3 2 2 | 2 2 3 | 2 2 3 | 2 1 | 2 3 3 3 1 2 2 3 3 3 |
| ##### | 2 3 3 2 | 2 2 8 2 | 4 3 2 | 4 3 2 | 3 3 2 | 3 3 2 | 3 3 | 2 2 2 1 1 1 1 2 1 1 |
| ##### | 2 3 3 3 | 2 2 2 1 | 3 3 2 | 3 3 2 | 2 3 2 | 2 2 2 | 4 1 | 3 5 5 2 2 4 3 1 1 1 |
| ##### | 2 3 3 2 | 2 2 3 1 | | | | | | 2 3 1 2 1 2 2 3 2 2 |
| ##### | 2 3 3 2 | 2 2 2 1 | 3 3 2 | 3 3 2 | 3 3 2 | 3 3 2 | 2 2 | 2 2 2 2 2 1 2 2 2 2 |
| ##### | 2 3 3 2 | 2 2 2 1 | 3 3 2 | 3 3 2 | 2 3 2 | 3 3 2 | 2 3 | 2 4 2 3 1 3 2 3 2 2 |
| ##### | 2 4 3 2 | 2 2 7 2 | 2 3 3 | 2 3 3 | 2 3 3 | 2 3 3 | 3 3 | 4 3 5 1 2 3 2 2 2 2 |
| ##### | 2 3 3 2 | 2 2 4 1 | 4 3 3 | 2 2 1 | 3 2 2 | 2 2 1 | 3 2 | 2 3 2 2 2 2 2 2 2 2 |
| ##### | 2 4 3 3 | 2 2 8 1 | 2 3 2 | 2 3 2 | 2 3 3 | 2 3 2 | 3 2 | 2 3 2 2 2 2 2 2 2 2 |
| ##### | 2 3 3 3 | 2 2 1 1 | | | | | | 2 3 2 2 2 2 2 2 2 2 |
| ##### | 2 2 3 1 | 2 2 5 1 | 4 4 2 | 3 3 2 | 2 4 2 | 3 3 2 | 3 2 | 4 4 3 2 2 4 2 3 3 2 |
| ##### | 2 3 3 2 | 2 2 3 1 | 4 3 3 | 3 2 3 | 3 2 2 | 2 2 2 | 2 2 | 2 2 2 2 1 2 2 2 2 2 |
| ##### | 2 3 3 3 | 2 2 4 1 | 3 3 3 | 2 4 3 | 3 3 3 | 2 3 3 | 5 3 | 4 5 3 2 2 2 2 2 2 2 |
| ##### | 2 3 3 1 | 2 2 1 1 | 4 3 2 | 3 3 2 | 2 2 1 | 2 2 1 | 2 1 | 2 3 1 2 1 2 2 1 1 1 |
| ##### | 2 3 4 3 | 2 2 1 2 | 3 2 2 | | | | | |
| ##### | 1 3 4 3 | 2 2 8 2 | 3 3 2 | 3 3 2 | 2 4 2 | 2 3 2 | 2 2 | 3 2 2 2 2 2 2 2 2 2 |
| ##### | 2 3 4 2 | 2 2 2 2 | 3 4 2 | 2 3 2 | 4 2 2 | 3 2 2 | 3 2 | 2 2 1 1 1 2 2 2 1 1 |
| ##### | 2 4 4 3 | 2 2 1 1 | 4 3 4 | 3 3 4 | 2 3 4 | 3 4 4 | 3 2 | 2 2 2 2 2 2 2 3 3 2 |
| ##### | 1 4 3 2 | 2 2 1 1 | 3 3 4 | 2 3 4 | 3 3 4 | 3 3 4 | 2 1 | 3 1 1 2 2 3 2 1 3 2 |

APPENDIX D – ECE/CS 507 GTA LEADERSHIP TRAINING COURSE MATERIAL

This section contains all information of the newly designed GTA Leadership Training Course. This course is offered every Fall term at Oregon State University as ECE 507 and CS 507. This 1 credit hour course is required for all incoming EECS graduate students who is assigned or have the desire to work as a graduate teaching assistant.

This appendix contains the follow:

- Sample course syllabus
- Course assignments
- Instructor notes
- Student notes

GTA Leadership Training Course: Syllabus

ECE/CS507: EECS GTA Leadership

Wednesday 4:00pm – 4:50pm

Instructor: Ding Luo (luod@onid.orst.edu)
Office Hours: By appointment
Course Website: <http://classes.engr.oregonstate.edu/eecs/fall2009/ece507/>

Schedule:

| Week | Date | Topic |
|------|----------------------------|---|
| 1 | September 30 th | What is Leadership |
| 2 | October 7 th | Influencing the Culture as a Leader |
| 3 | October 14 th | Balancing Responsibilities |
| 4 | October 21 st | The Power of Reflection and Authentic Listening |
| 5 | October 28 th | Handling Disputes |
| 6 | November 4 th | Gender, Race & Ethnicity |
| 7 | November 11 th | Learning Through Leading |
| 8 | November 18 th | Leadership Scenarios |
| 9 | November 25 th | Thanksgiving: No Class |
| 10 | December 2 nd | Observation Report |

Grading:

- **This course is PASS / FAIL with 70% as passing.**
- **Assignments:**

| | | |
|--------------------------|----------|------------------|
| Blackboard Discussion | – | 30 points |
| Final Observation Report | – | 20 points |
| Total | – | 50 points |

- **Attendance**

During required meeting times for the ECE507 course, attendance will be taken. Every missed session will result in reduction of your final grade in the course by about 10%. If you miss 4 sessions it will be impossible to pass the course. Please see equation below.

$$\text{Final Percentage} = \frac{\text{Total points earned}}{\text{Total points possible}} \times \left[1 - \frac{1}{9} \times (\# \text{ of class missed}) \right]$$

- **No late assignment accepted.**

GTA Leadership Training Course: Assignment 1

Blackboard Discussion

(Assignment idea borrowed from Dr. Robert Hess)

Total Points Possible: 30

Due: Every Monday at 23:59 (11:59 p.m.)

| 3 points | 2 points | 1 point | 0 point |
|---|---|---|--|
| 1) Demonstrated proof of thorough comprehension of the lecture material 2) Met or exceeded the required number of responses for each topic, including nominating someone for “poster of the week.” 3) Demonstrated respect, collegiality, and self-reflection | Meets two (2) out of the three (3) required criteria under the “3 points” column. | Fulfilled one (1) out of the three (3) required criteria under the “3 points” column. | Did not participate by Saturday 23:59 (11:59 p.m.) |
| <p>To promote class participation and genuine postings, every week I would like you to nominate someone other than yourself as “poster of the week” explaining something that considerably contributed to your learning. Send your nomination to me by Sunday night, and I will post the winner on Monday of each week. The “poster of the week” will receive one (1) bonus point.</p> <p>If you have an unexcused absent, you will receive no more than 1 point for that week.</p> | | | |

GTA Leadership Training Course: Assignment 2

Observation Report

Total points possible: 20 points

Due: Nov 29th, 2009 at the end of the day (11:59 pm)

| 18 – 20 points | 14 – 17 points | 10 – 13 point | 0 point |
|--|--|---|--|
| 1) Observed at least one lab/recitation session. 2) At least 0.75 page double spaced. 3) Given improvement suggestions for the TA observed 4) Use of materials from lecture is effective and appropriate. | Meets three (3) out of the four (4) required criteria under the “18 – 20 points” column. | Fulfilled two (2) or one (1) out of the four (4) required criteria under the “18 – 20 points” column. | Did not turn in a report by the deadline. =OR= Did not observe any lab/recitation session =OR= Fulfilled zero (0) out of the four (4) required criteria under the “18 – 20 points” column. |
| Completing the assignment is worth 10 points. Distribution of points is shown above with requirements. 2 bonus points will be given if a self evaluation is completed and attached to your assignment. In the self evaluation guide please highlight standards you obtained. | | | |

GTA Leadership Training Course: Blackboard Discussion Topics

Week 1: Expectations

What are your expectations for this course? In other words, what are something that you would like to see/learn in this course? Why are you interested in some of the topics you listed?

Week 2: Does work environment matter?

Compare the culture (or atmosphere) within classroom, research group, and job environment. What are the similarities and differences? What kind of influence do leaders have in moving the atmosphere of different environment in a positive direction?

Week 3: Who's responsible?

1. You are leading a team of engineers to design a new type of computer processor. Your team is not performing as well as you expect them to be. Who should take responsibility? What would you do as the leader?
2. Then assuming you are the leader of a soccer team. Your team is not performing well, who should take the responsibility?

Week 4: The Power of Reflection and Authentic Listening

In what ways do you reflect (notes, diary, talk to others, etc.)? How does reflection improve leading skills?

Week 5: "I felt threatened"

You are the instructor (yes, instructor) of a 9:00am class. Homework are due at the beginning of class, and you made it very clear to the students that you will NOT accept ANY homework after 9:15am. During your office hour (a private office all by yourself), a student came in with a late homework and demanded you to accept it. You told the student the homework is no longer acceptable. The student became angry and threatening (literally). What do you do?

Week 6: Gender, Race & Ethnicity

You are one of the three TAs in a lab with 20 students. 3 students in your lab begin to make inappropriate comments about a certain group of people. The head TA told the students to stop. They later begin to make inappropriate comments and jokes about one of the TAs in the lab, who happens to be a girl.

1. As a TA of the lab, what do you do?

2. Would you handle the situation differently if their inappropriate comments are pointing at a certain ethnic/race of people?

Week 7: Learning Through Leading

70% of the students claim the instructor did not give a thorough review for the final exam. Many students ask you (and ONLY you) to hold a review session. It's dead week, and you have your own final exam to study for.

1. The course has 1 TA who grades homework and exams, and 5 LAB TAs. You are one of the LAB TAs. What do you do?

2. How are you going to handle the situation if you are the only TA who grades homework and exams?

Week 8: Define a Perfect Leader

Relate to the course material we have covered/discussed this term. Please LIST, in your opinion, what makes a "perfect leader" (skills, attributes, anything you can think of).

Week 9: No Class

Week 10: Observation Report

What are some topics that you would like to see in ECE/CS507 but was not covered throughout this term? Please provide explanations on why you want to see some of the topics you listed.

GTA Leadership Training Course: Instructor Notes Week 1 – 10

Week 1: What is Leadership

Total: 45 min

- **Intro**
 - **People**
 - **Instructor Introduction** (2 min)
- “Welcome to ECE507, etc. ...”
 - **Participants Introduction & Icebreaker** (15 min)
- “Everyone introduces themselves, such as name, where you’re from, favorite food, etc. ...”
 - **Course Overview** (3 min)
- “Leading is the foundation of teaching. Most of you are TAing at least one lab this term. I understand that not everyone wants to work as a teacher or instructor. This course is focused mainly on leadership, with an emphasis on teaching or TAing. Kind of like having an electrical engineering major but with a focus on analog systems...”
- **Main**
 - **Discussion**
 - **Definition of Teacher Leadership** (5 min)
- “What are your definitions of the term ‘teacher leadership’?”
 - **Leader VS Teacher** (10 min)
- “In your opinion, what are the differences between a teacher and a leader?”
- “In your opinion, what are the similarities between a teacher and a leader?”
 - **Interview Results**
 - **Leader VS Teacher** (5 min)
- “Notice how the first question took longer or had less response. I have interviewed 5 outstanding instructors here at OSU, and they had the same response. ‘What are some differences between a leader and a teacher’ appeared to be the hardest question for the interviewees, regardless the number of years they have been teaching. All interviewees took a long silent for this question. Teacher and leader are so similar, and there is no clear line between the two. One instructor, who has taught at OSU for 12 continuous years, answered ‘[I] can’t find a difference.’”
- **Looking Forward** (5 min)
 - **Week 1 TA’ing**
 - **Introduction**

- **Icebreaker**
 - **Handout kits**
 - **Materials Due Next Week (if any)**
- **Week 2 TA'ing**

Week 2: Influencing the Culture as a Leader**Total : 45 min**

- **Review From Last Week** (5 min)
 - **Leader VS Teacher**
 - **Observations From Lab**
 - **Comments/questions About Last Week's Material**
- **Intro**
 - **Example of Showing Different Instructor Moods**
 - **Mood #1: Angry Instructor** (5 min)
 - *"That was an exaggerate example. What was your first reaction when you saw the instructor walks in?"*
 - **Mood #2: Nervous Instructor** (5 min)
 - *"What was your first reaction when you saw this instructor walks in?"*
 - **Mood #3: Enthusiastic** (5 min)
 - *"What was your first reaction when this instructor walked in?"*
- **Main**
 - *"Culture is intentional. Effective teachers monitor and influence the culture of their classrooms, so positive interaction and healthy relationships are constantly occurring. [p19]"*
 - **Leading Styles**
 - **Informal VS Formal** (5 min)
 - *"Formal roles are established over time, whereas informal leadership is all about relational power. Informal leadership happens naturally, but it doesn't happen predictably. [p 33] Let's take some time to describe the pros and cons of the two"*
 - **Seven Principles** (5 min)
 - *"SevenPrinciples.pdf"*
 - **Solution to Suppress/overcome Negative Mood** (10 min)
 - *"When conducting informal leadership, it is important to make it clear you are still the leader. I have had one instance when I was having too much informal leadership my students began to become disrespectful." The best way to avoid this is to keep some level of authority while conducting informal leadership."*
 - *"What are some solutions if the students are becoming disrespectful to you, or to other peers?"*
 - *"The mood of the classroom affects the learning attitude. What are some solutions if you walk into a classroom with a negative culture?"*
- **Looking Forward** (5 min)
 - **Week 3 TA'ing**
 - **Collect Assignments**
 - **Pre-lab (if any)**

- **Grading Reports**
- **Posting Grades**

Week 3: Balancing Responsibilities**Total: 47 min**

- **Review From Last Week** (5 min)
 - **Culture Influencing and Teaching Styles**
 - **Comments/questions About Last Week's Material**
- **Intro** (2 min)
 - *"It is important to clarify responsibilities with the people you are leading, in our case, our students."*
- **Main**
 - **TA Responsibilities** (10 min)
 - *"Let's list as many big picture responsibilities as we can."*
 - **Clarify Instructions**
 - **Positive Encouragement**
 - **Grading Confidentiality**
 - **Student Responsibilities** (10 min)
 - *"What are some responsibilities the students must take?"*
 - **Participate**
 - **Follow Instructions**
 - **Perform**
 - *"Quote from an instructor: It is not our problem if the students aren't doing what they're supposed to do." What do you think about this quote?"*
 - **Scenarios** (15 min)
 - *"You graded all student exams. For ABET purposes, you've made copies of randomly selected exams. The exams are then handed back to the students. A day later, one student returned the test to you, claiming you graded his exam wrong. Coincidentally this exam was one of the randomly selected ones. Comparing to the copy, the answers on the exam were altered. What do you do?"*
 - *"Lab report #1 is due today. 60% of the students in your lab did not finish the report. You did not mention the due date last week, but the due date was clearly written in the lab manual. Students claim that you did not mention this due date during last week's lab, and demand an extension period. What do you do?"*
 - *"The grading rubric for a temperature controlled fan said that 'the project is a pass if the fan slows down at low temperature.' You misunderstood the rubric and thought the fan must stop for the project to pass. You graded your 24 students the same way, and gave F's to the ones with a fan that*

only slows down but doesn't stop. You realized your mistake 2 weeks later. What do you do?"

- **Looking Forward** (5 min)
 - **Week 4 TA'ing**
 - **Student Stress Due to Midterms**
 - **Midterm Exam Proctoring, Grading, etc.**
 - **Handing Back Graded Material**

Week 4: The Power of Reflection and Authentic Listening Total: 43 min

- **Review From Last Week** (5 min)
 - **Balancing Responsibilities**
- **Intro** (3 min)
 - “Instructions are delivered by following the structure of preparation → experiment → reflection. Although you may begin the delivery of instruction by any of the three components, the real learning process always occurs in the reflection part.”
 - “Authentic listening involves actually putting yourself in the other person’s shoes—to experience work and life as they are experiencing it to the greatest degree possible.”
- **Main**
 - **Reflect Before Teaching** (5 min)
 - “Doing the particular lab before I lead labs helps me remember potential problems people may run into with the lab.”
 - “In reality, reflection is another method to better ‘serve’ the students.”
 - **Reflect After Teaching** (10 min)
 - “From the interview response of the 5 outstanding instructors, they’ve replied not only having a positive attitude helps develop a better learning environment, reflection is a big portion on self improvement.”
 - “At the beginning of every lecture, we have the “review from last week” section. Although the best time to reflect is right after lecture, reflect on last week’s material at the beginning of lecture may boost the “stickiness” of the information given a week ago.”
 - “What are types of reflection a TA should do?”
 - **Listen Authentically** (10 min)
 - “Blaming others is a hindrance to authentic listening. When a leader’s ego gets in the way, it is not possible for them to find out what is really going on. Their ego will filter them from understanding the facts, and they will constantly be missing the cues that they are in trouble. Authentic listening begins by removing all filters to the data, and that can only be done through careful observation and soliciting the input of a variety of individuals. Authentic listening is more like sonar than a sounding board. It is listening with the intent to create movement. Sonar sends out a signal and waits for a response, so the system can act upon the response. Authentic listening—

like effective use of sonar—causes movement. It is a generator of change, which is exactly what teacher leaders do.”

- **Telephone** (5 min)
- **Looking Forward** (5 min)
 - **Week 5 TA'ing**
 - **Student Stress Due to Midterms**

Week 5: Handling Disputes**Total: 45 min**

- **Review From Last Week** (5 min)
 - **Reflection**
 - **Authentic Listening**
- **Intro** (2 min)
 - *“Conflict is defined as ‘a situation in which two or more human beings desire goals which they perceive as being attainable by one or the other, but not by both. Conflict management is the process of influencing the activities and attitudes of an individual or group in the midst of disagreements.”*
- **Main**
 - **Source of Conflict** (5 min)
 - *“What are the sources of conflict?”*
 - *“Attitude – differences of opinion about facts, goals, ends or means”*
 - *“Substance – differences of opinion about facts, goals ends or means”*
 - *“Emotional – when personal value is attached either to attitudinal or substantive conflict”*
 - *“Communicative – the byproduct of a breakdown in healthy, open conversation about the sources of conflict”*
 - **Root of Conflict** (5 min)
 - *“What is the root cause of conflict?”*
 - *“Stress”*
 - **Conflict Style** (5 min)
 - *“Avoiding (turtle) – to stay out of the conflict, to avoid being identified with either side.”*
 - *“Accommodating (bear) – to preserve the relationship at all costs.”*
 - *“Collaborating (owl) – to get all the parties fully involved in defining the conflict and carrying out mutually agreeable steps for managing the conflict.”*
 - *“Compromising (fox) – to provide each side with a little bit of winning in order to persuade each to accept a little bit of losing.*
 - *“Competing (shark) – to win. Usually for people who are more interested in winning the argument than preserving relationships.”*
 - **Engaging Conflict as a Facilitator** (5 min)
 - *“Prepare – get the facts.”*
 - *“Affirm relationships – affirm the value of each person and the value of the relationship.”*

-“Understand interests – clarify the goal of each person involved.”

-“Search for creative solutions – help brainstorm to find a mutually agreeable solution.”

-“Evaluate options objectively and reasonably.”

○ **Conflict Scenarios** (10 min)

-“There are a total of 5 TAs for the course you are assigned to. You are the head TA for the course. During the TA training session, the course instructor specified you, as the head TA, designs a grading rubric, and other TAs must follow the designed grading rubric for consistency. One week later, you notice NONE of the other TAs followed your grading rubric. What do you do?”

-“The instructor is hospitalized. You, as the head TA, have told the other TAs to follow your grading rubric. It’s been 3 weeks and you notice nothing changed. What do you do?”

● **Looking Forward** (5 min)

○ **Week 6 TA’ing**

- **Main Tasks**
- **Close to the End of Projects**
- **Late Tasks**

Week 6: Gender, Race & Ethnicity **Total: 35~45 min**

- **Review From Last Week** (5 min)
 - **Dealing with Conflicts**
- **Intro**
- **Main**
 - **Racial** (5~10 min)
 - “US culture on dealing with categorization of people.”
 - **Class Discussion**
 - **Realizing Cultural Difference** (10 min)
 - “Family, religion, health and hygiene, food, dress and personal appearance, history and traditions, holidays and celebrations, pets and other animals, arts and music.”
 - “Most of all, remember the race, ethnicity, gender, or sexual orientation of your students is their own business. If they choose to bring their backgrounds to bear on a discussion or a project in your class, make them feel comfortable doing so. If they choose to draw no attention to their backgrounds you should not do so either.”
 - **Guest Speakers** (15~20 min)
 - **Student with Different Ethnicity Backgrounds**
- **Looking Forward**
 - **Week 7 TA’ing**

Week 7: Learning Through Leading**Total: 50 min**

- **Review From Last Week**

(5 min)

- **Intro**

-“One question I asked when I interviewed faculty of OSU was ‘what motivates you to become and be a leader/instructor?’ One response was ‘what I like about teaching is how much I learn because I teach.’”

-“Leadership is a constant state of learning. The best leaders are learners, and they are constantly learning in order to build their leadership skills.” [p71]

- **Main**

- **Intro**

(5 min)

-“Think about the best and worst teachers you ever had. What did the good instructors do to become the best?”

- **Learn From Leading**

(5 min)

-“What would happen if everyone in the department has some sort of leadership role? Describe the good and the bad.”

- **A Method to Self-improve**

(5 min)

-“Think about a lecture that did not go well. What did the instructor do?”

- **Guest Speaker(TBD)**

(30 min)

- **Lab Observation Assigned**

- **Looking Forward**

- **Week 8 TA'ing**

- **Student Stress Due to End of Term**

Week 8: Leadership Scenarios**Total: Uncertain**

- **Review From Last Week** (5 min)
 - **Leading to Learn**
- **Intro** (2 min)
 - *“It’s almost the end of the term. I have prepared some TA scenarios for us to have a class discussion. Please also feel free to add your own scenarios.”*
- **Main** (Uncertain)
 - **Scenarios**
 - *“Some of your students felt you are having ‘favorites’ and have talked to the instructor. You believe you treat all students equally. What do you do?”*
 - *“You are grading lab reports and noticed two identical reports. What do you do?”*
 - *“During your lab section, one student from another section came in seeking for help. This student has many questions and is taking a major chunk of your time. What do you do?”*
 - *“50% of your students claim you grade very differently compare to TAs from other sections. What do you do?”*
 - *“There is a student in your class that doesn’t seem to understand what is going on, but you don’t know how to explain the concept any better. What do you do?”*
 - *“70% of the students claim the instructor did not cover enough material for them to perform the lab. The instructor seemed to be apathetic about the lab. What do you do?”*
 - *“70% of the students claim the instructor did not lecture a thorough review for the final exam. Many students ask you, the lab TA of the class, to hold a review session. What do you do?”*
 - *“Some of your students aren’t finishing the task on time, but they seem to be working really hard. What do you do?”*
- **Looking Forward**
 - **Week 9 TA’ing**
 - **Student Stress Due to “Everything’s Due”**
 - **Week 10 TA’ing**
 - **Student Stress on Final Exams**
 - **Final Exam Proctoring, Grading, etc.**

Week 9: Thanksgiving Week**Total: 0**

-
- No Class

| Week 10: Observation report | Total: Uncertain |
|------------------------------------|-------------------------|
| • Review for the Entire Course | (5 min) |
| • Observation From Peer's Labs | (10~20 min) |
| • Final Discussion | (5 min) |
| • Looking Forward | (5~10 min) |
| ○ Next term | |
| • Evaluation | (The end) |

- Intro
 - People
 - Instructor Introduction
Welcome to ECE507
 - Participants Introduction & Icebreaker
 - Course Overview
Leading is the foundation of teaching. Kind of like having an electrical engineering major but with a focus on analog systems
- Main
 - Discussion
 - Definition of Teacher Leadership
What is your definition of the term “teacher leadership”?
 - Leader VS Teacher
In your opinion, what are the differences between a teacher and a leader?
 - In your opinion, what are the similarities between a teacher and a leader?*
 - Interview Results
 - Leader VS Teacher

- Looking Forward
 - Week 1 TA'ing
 - Introduction
 - Icebreaker
 - Handout kits
 - Materials Due Next Week (if any)
 - Week 2 TA'ing

Week 2: Influencing the Culture as a Leader

- Review From Last Week
- Intro
 - Example of Showing Different Instructor Moods
 - Mood #1: Angry Instructor
 - Mood #2: Nervous Instructor
 - Mood #3: Enthusiastic
- Main *Culture is intentional*
 - Leading Styles
 - Informal VS Formal
 - Seven Principles
See handout
 - Solution to Suppress/overcome Negative Mood
What are some solutions if the students are becoming disrespectful to you, or to other peers?

The mood of the classroom affects the learning attitude. What are some solutions if you walk into a classroom with a negative culture?

- Looking Forward
 - Week 3 TA'ing
 - Collect Assignments
 - Pre-lab (if any)
 - Grading Reports
 - Posting Grades

Week 3: Balancing Responsibilities

- Review From Last Week
- Intro
- Main
 - TA Responsibilities
 - Clarify Instructions
 - Positive Encouragement
 - Grading Confidentiality
 - Student Responsibilities
 - Participate
 - Follow Instructions
 - Perform

“It is not our problem if the students aren’t doing what they’re supposed to do.”
 - Scenarios

You graded all student exams. For ABET purposes, you’ve made copies of randomly selected exams. The exams are then handed back to the students. A day later, one student returned the test to you, claiming you graded his exam wrong. Coincidentally this exam was one of the randomly selected ones. Comparing to the copy, the answers on the exam were altered. What do you do?”

Lab report #1 is due today. 60% of the students in your lab did not finish the report. You did not mention the due date last week, but the due date was clearly written in the lab manual. Students claim that you did not mention this due date during last week's lab, and demand an extension period. What do you do?"

The grading rubric said the project is a pass if the fan slows down at low temperature. You misunderstood the rubric and thought the fan must stop for the project to pass. You graded your 24 students the same way, and gave F's to the ones with a fan that only slows down but doesn't stop. You realized your mistake 2 weeks after. What do you do?

- Looking Forward
 - Week 4 TA'ing
 - Student Stress Due to Midterms
 - Midterm Exam Proctoring, Grading, etc.
 - Handing Back Graded Material

Week 4: The Power of Reflection and Authentic Listening

- Review From Last Week
- Intro
 - Preparation → Experiment → Reflection*
- Main
 - When to reflect?
 - Listen Authentically
 - “Listen” VS “Hear”*
 - Telephone
- Looking Forward
 - Week 5 TA'ing
 - Student Stress Due to Midterms

Week 5: Handling Disputes

- Review From Last Week
- Intro
 - “*Conflict is defined as ‘a situation in which two or more human beings desire goals which they perceive as being attainable by one or the other, but not by both.’*”
- Main
 - Source of Conflict
 - Attitude*
 - Substance*
 - Emotional*
 - Communicative*
 - Root of Conflict
 - Conflict Style
 - “*Avoiding (turtle) – to stay out of the conflict, to avoid being identified with either side.*”
 - “*Accommodating (teddy bear) – to preserve the relationship at all costs.*”
 - “*Collaborating (owl) – to get all the parties fully involved in defining the conflict and carrying out mutually agreeable steps for managing the conflict.*”
 - “*Compromising (fox) – to provide each side with a little bit of winning in order to persuade each to accept a little bit of losing.*”
 - “*Competing (shark) – to win. Usually for people who are more interested in winning the argument than preserving relationships.*”
 - Engaging Conflict as a Facilitator
 - Prepare*
 - Affirm relationships*
 - Understand interests*

Search for creative solutions

Evaluate options objectively and reasonably

- Conflict Scenarios

There are a total of 5 TAs for the course you are assigned to. You are the head TA for the course. During the TA training session, the course instructor specified you, as the head TA, designs a grading rubric, and other TAs must follow the designed grading rubric. One week later, you notice NONE of the other TAs followed your grading rubric. What do you do?

The instructor is hospitalized. You, as the head TA, have told the other TAs to follow your grading rubric. It's been 3 weeks and you notice nothing changed. What do you do?

- Consensual Relationships

Consensual relationships to which the OSU policy applies are those romantic, intimate or sexual relationships where one of the parties has institutional responsibility for or authority over the other or is involved in evaluation of the other party, whether the other party is an employee or a student.

An employee shall not exercise academic responsibility (instructional, evaluative or supervisory) for any student with whom the employee has a consensual relationship.

Detailed information available here:

<http://oregonstate.edu/dept/affact/consensual-relationships-policy>

- Looking Forward

- Week 6 TA'ing

- Main Tasks
- Close to the End of Projects
- Late Tasks

Week 6: Gender, Race & Ethnicity

- Review From Last Week

- Intro
- Main
 - Gender

 - Race

 - Realizing Cultural Difference

 - Guest Speakers
 - Student with Different Ethnicity Backgrounds
- Looking Forward
 - Week 7 TA'ing

Week 7: Learning Through Leading

- Review From Last Week
- Intro
 - “What I like about teaching is how much I learn because I teach.”*
- Main
 - Intro
 - “Think about the best and worst teachers you ever had. What did the good instructors do to become the best?”*
 - Learn From Leading
 - “What would happen if everyone in the department has some sort of leadership role? Describe the good and the bad.”*
 - A Method to Self-improve
 - “Think about a lecture that did not go well. What did the instructor do?”*
 - Guest Speaker(TBD)
 - Lab Observation Assigned
- Looking Forward
 - Week 8 TA'ing
 - Student Stress Due to End of Term

Week 8: Leadership Scenarios

- Review From Last Week

- Intro

- Main

- Scenarios

Some of your students felt you are having 'favorites' and have talked to the instructor. You believe you treat all students equally. What do you do?

You are grading lab reports and noticed two identical reports. What do you do?

During your lab section, one student from another section came in seeking for help. This student has many questions and is taking a major chunk of your time. What do you do?

50% of your students claim you grade very differently compare to TAs from other sections. What do you do?

There is a student in your class that doesn't seem to understand what is going on, but you don't know how to explain the concept any better. What do you do?

70% of the students claim the instructor did not lecture a thorough review for the final exam. Many students ask you, the lab TA of the class, to hold a review session. What do you do?

Some of your students aren't finishing the task on time, but they seem to be working really hard. What do you do?

- Looking Forward
 - Week 9 TA'ing
 - Student Stress Due to “Everything's Due”
 - Week 10 TA'ing
 - Student Stress on Final Exams
 - Final Exam Proctoring, Grading, etc.

Week 10: Observation report

- Review for the Entire Course
- Observation From Peer's Labs
- Final Discussion
- Looking Forward
 - Next term
- Evaluation

APPENDIX E – BUILD A WAREHOUSE: A TEAM BUILDING ACTIVITY

This section contains material of an activity designed for students in the Platform for Learning program. Build A Warehouse is an activity that is intended to improve students abilities on teamwork.

Build a Warehouse

Designed and submitted by Ding Luo

Background

Teamwork is essential to success for engineers. Currently, teamwork is not specifically being taught/trained in the EECS undergraduate curriculum at OSU. Build a Warehouse is designed as an one-hour workshop (activity and discussion) for undergraduate EECS students to teach students 1) the roles and responsibilities of a team, 2) identify possible problems that may occur in a team, and 3) discuss possible ways to avoid or solve some of the difficulties. This activity is designed to be engaging and fun, with large number of possible solutions, and could be competitive. Through out the activity, the participants will 1) follow the direction from the team leader, 2) take responsibilities of each role within the team, and 3) discuss possible solutions to the given task.

Environmental Analysis

The intended audience for this workshop is undergraduate engineering students. The activity requires a common classroom (tables and chairs), with 2 tables per team. Written recording device for team communication purpose is required (such as paper, pen or pencil, wireless computer, etc.). A computer with project is optional, depending on whether the facilitator needs to give introduction via media. Build a Warehouse is recommended for participants who have basic geometry knowledge, and are experienced with algebra. This activity is not limited by age (however is recommended for participants with a high school diploma or higher), language, cultural, religion, and gender.

Rationale

Build a Warehouse takes an engaging, creative, fun, and hands-on route to teach/train teamwork skills to its participants. Participants will first be divided into teams of 3 or 4, then assign roles of leader, motivator, and doer(s). The leader will first receive design constraints from the “client” (the facilitator), and then will communicate to the motivator using written materials only. The motivator will then share the design constraints to the doer(s). The purpose for written material communication is to emulate the possibilities of information loss due to limited communication within a team. The doer(s) and motivator will then discuss possible solutions, and motivator must receive approval from the leader before making material purchases from the bank (the facilitator). Build a Warehouse teaches/trains participants by a team tasks/team building instructional strategy to complete the warehouse. It also promotes cooperative learning instructional strategy through the discussion on possible ideas to make the optimal warehouse.

Lesson/Training Plan

| Objective: Participants will work in teams to build a warehouse, and identify at least two common teamwork problems/conflicts and possible solutions for resolving each difficulty | | |
|---|---|--|
| Process | Materials | Time |
| BEGINNING: Setup Prepare handouts (refer to Build a Warehouse Activity Sheets) Prepare communication devices if using wireless laptops Introducing workshop Explain objective (see above) Explain activity rules (refer to Build a Warehouse Activity Sheet 1 of 5) | Handouts Laptop computers (optional) | 5 min 5 min. |
| MIDDLE: Divide participants into teams Determine roles within each team (facilitator assign, or team decide) Give design constraints to team leaders Answer possible questions from leaders Team working time Facilitator observe participants and formulate appropriate additional discussion questions Present designs Class discussion on possible problems/conflicts and solutions for teamwork (refer to the questions below) | Recording device for leaders Paper and pencil Activity handouts, laptops (optional) | 1 min 1 min 3 min 5 min 25 min 10 min |
| END: Participant feedback on this workshop. Comment/suggestions to improve this workshop. | Scoring sheet | 5 min |
| Warehouse trial | Random # generator | if time allows |
| Total time | | 60 min |

Debrief Questions:

- How well did this activity emulate a real teamwork situation?
- What are some of the teamwork problems shown through this activity?
- What are some of the solutions to resolve the problems?
- If the entire class were assigned into one big team, what will be some differences?

Results Report

Introduction

The objective of the Build a Warehouse activity is for participants to take roles of a team and design a warehouse using given materials. Participants are expected to understand different roles and take responsibilities within a team. The purpose of the Build a Warehouse activity is to have participants experience accomplishing a task with a team, identify at least two possible problems on teamwork, as well as formulate possible solutions to resolve each difficulty. This activity is specially designed to utilize cooperative learning and team tasks/team building experiential learning strategies by completing a task through an engaging, fun, and somewhat competitive experience.

Actual setup

The totals of seven participants were divided into one group of three (Team 1) and one group of four (Team 1), and then decided each person's role within their teams: 1 leader, 1 motivator, and 1 or 2 doers depending on team size. The leaders were then given design specifications from the facilitator outside of the classroom, and were only allowed to communicate to their team's motivator via a wireless laptop with chatting capability. The leaders are seated 2-3 rows away from their team. This particular set up is to emulate a team working environment where the leaders can only be reached by the motivators via written material, such as email, chat, etc.

Observations

All participants took the roles as intended by the activity. Doers communicate only to their motivator, and leaders were constantly typing information for their teams. Some notable messages from the leaders were "ok I want one person to calculate the cost of floor and one person to determine the length of wall;" "what is the total cost? Please report." As allowed time is running low, the stress level from each team noticeably increased. All participants seemed to be on task, and performed only assigned duties/roles.

Discussion with participants

Participants agreed that this is an engaging and fun activity, and promoted cooperative learning and team task/team building experimental learning strategies. Team 2 leader described herself trying to solve the problem on her own first, but soon realized that there's an entire team she can utilize to solve the problem. For the role of leader, participants pointed out that this activity only shows formal leadership style, and lacks the informal leadership style. The motivators described the activity "successfully emulated the role of a motivator," by interpreting information from the leader and share to the rest of the team, as well as being a inter-connection between the leader and doers. Doers pointed out that lacking the background knowledge of geometry makes the specific calculations (such as warehouse area and cost) a little

difficult to perform. Although for engineering students (the intended audience of this activity), geometry and algebra should not be a difficulty. Participants pointed out that one problem working in a team is that everyone has a different background, and must understand, and accept each other's differences to be a good team. Another problem in teamwork is miscommunication. Information sometime leaks away through transportation, and must be clarified when instructions aren't clear. This problem can easily be solved by letting the motivator know what the problem is, and the motivator can seek the accurate information from the leader. This activity promotes many good discussion topics with the class, but unfortunately only 10 minute discussion period was conducted due to time constraints. Overall, participants felt this is a successful activity for engineering students, and will successfully promote team work by utilizing cooperative learning and team task/team building experimental learning strategies.

Activity Conclusion

Build a Warehouse activity is suitable for undergraduate engineering students. It clearly reveals different roles and responsibilities within a team, and allows participants to design a warehouse by utilizing cooperative learning and team task/team building experimental learning strategies. Upon completion of this activity, participants will have better understanding and knowledge on teamwork in general, and how to perform well when working in a team. This activity also raises up many discussions topics that can promote a class-wide cooperative learning environment.

Personal Conclusion

Build a Warehouse proves my belief of delivering knowledge/concepts through cooperative learning and team task/team building experimental learning strategies. As a workshop that is designed specifically for engineering students, Build a Warehouse emulates a real engineering teamwork situation, distinctly shows each role and their responsibilities, and indicates problems when working in a team, through a hands-on, engaging, and somewhat competitive experience. Dr. Willard once mentioned in lecture, information do NOT have to be delivered through talking, Build a Warehouse requires very little talking from the facilitator. The majority amount of time is given to the participants on completing the activity. During that time, the facilitator shall make precise observations on the participants, and formulate suitable/appropriate discussion questions. Personally, I was amazed by the amount of *new* discussion questions that came to my mind after observing the participants. I've learned that the most important portion of this "talk less, do more" type of instruction is during the debrief part. Also, Facilitators must know the learning objective thoroughly in order to come up with additional discussion questions through observing the participants. I was a great experience for me to lead the "direction" of discussions by asking questions to participants, and having the entire class respond. I believe that debrief is a class-wide cooperative learning strategy.

When I was conducting this activity to my participants, I took consideration on their geometry backgrounds. I provided a sheet with simple geometry shapes with equations, hoping it will help for some of the calculations. Unfortunately the equation sheet did not help. Since this activity was specifically designed for undergraduate engineering students, geometry will not be a problem when given to its targeted audience.

When conducting this workshop to participants with less geometry background, a “special tool kit” shall be provided from the beginning. The special tool kit is a user-friendly Microsoft Excel worksheet with pre-programmed equations, sorted by shapes, warehouse components and materials. By entering a number, the worksheet is able to calculate the area, length, and cost of the warehouse based on the shape, component and material of the designed warehouse.

Build a Warehouse also provided me the confidence for my belief that “everyone can learn (a concept I have learned from TCE542 Teacher Leadership).” With appropriate supportive material (calculator, special Excel tool, etc.), all participants are capable of benefiting from Build a Warehouse. The participants I worked with had a variety social and educational background, and were feeling benefited from this activity. I have also recently conducted this workshop to 4 undergraduate engineering students, and received many positive feedbacks. These outcomes strongly supported my belief of “everyone can learn.”

Activity scores from seven participants

| Criteria | Average score (out of 5) |
|---|-----------------------------|
| Methods and Activities | |
| Were the learning objectives accomplished? | 4.6 |
| Were instructions clear and easy to follow? | 3.9 |
| Did the facilitator explain the activity well? | 4.6 |
| Will this workshop produce better “team-players”? | 4.1 |
| Did the activity promote team work/team task? | 4.6 |
| Did the activity promote cooperative learning? | 4.7 |
| Was the right amount of time given? | 4.6 |
| Was the activity fun? | 4.4 |

Participant comments:

- “Wanted more background info + math knowledge. Don’t know if geometric handout was applicable. Very interesting + engaging.”
- “When creating teamwork & collaborative work groups, I think that we need to take into account the dynamics, personalities, and leadership characteristics as well as the culture of the organization. Great job!”
- “This was terrific and I would like to suggest that Oregon Building Congress use this with their construction academy.”
- “I really enjoyed this activity. Lots of fun working as a team using technology in a way that brought us all together.”
- “Loved it!”
- “Nice job!!”

Build a Warehouse Activity Sheet 1 of 5

** This page shall be handed out for leader, motivator, and doer(s)*

Roles

Leader:

1. Planning responsibilities for motivator, and each doer
2. Receiving timely feedbacks and give approval for proposals
3. Presentation in the end.

Motivator:

1. Interpret instruction to doers
2. Provide accurate communication between leader and doers
3. Answer questions and provide feedback to leader

Doers:

1. Follow and perform instructions
2. Provide questions/feedbacks to motivator
3. Purchase material after receiving approval from leader

General activity outline:

- Receiving task - Leader from each team will meeting instructor outside of classroom
 - Facilitator will give the objective to the leaders **VERBALLY**
 - This is the only time for the leaders to ask facilitator any questions regarding the objective
 - Leaders go to their offices
- Experiencing task – leader, motivator, doers work together to finish the objective.
 - Leader must take time to plan ahead on approaching the solution for objective, and communicate to motivator using only written material
 - Motivators must take time to understand the objective and communicate with leader using only written material.
 - Motivators must make sure doers understand the objective and may communicate with doers in anyway shape or form.
 - Doers must take time performing the objective, and may only communicate to the motivator.
 - Doers must perform only motivator's instructions. If doers have recommendations for better solving the objective, the new instruction

must be communicated to the motivator and ultimately approved by the leader before doers can perform the recommended task.

- Warehouse trial (if times allows)
 - Find a random number generator that can generate numbers from 1-100.
 - Set number 1-25 = earth quake
 - Set number 26-30 = acid rain
 - Set number 31-40 = flood
 - Run the random number generator 5 times, indicating 5 years. If natural hazard occurs, the warehouse's IP will be reduced accordingly.

Build a Warehouse Activity Sheet 2 of 5

** This page shall **NOT** be available to participants.*

** Information on this page shall **ONLY** be shared to team leaders **VERBALLY***

Design specification:

- Must be able to store at least 5,000 square ft worth of goods in floor area
- Must spend no more than \$100,000 on raw materials
- Must be able to be intact for at least 5 years. In other words, maintain positive “intact points” (IP) at the end of the 5th year.
- Must only use the available materials

Other considerations:

- The warehouse’s location has annual 25% probability of earthquake, encountering of earth quake will reduce the warehouse’s IP by 15000 pt.
- The warehouse’s location has annual 10% probability of flood, encountering of earth quake will reduce the warehouse’s IP by 12000 pt.
- The warehouse’s location has annual 5% probability of acid rain, encountering of earth quake will reduce the warehouse’s IP by 20000 pt.
- Encountering of any natural hazard will reduce the warehouse’s “intact point”

For facilitators:

Please explain the concept of intact point as clearly as possible.

Intact point is the amount of “health” a warehouse has. Different materials add intact points. Natural hazards will reduce the intact points. When intact points reach to zero, the warehouse collapses.

Facilitators may decide to explain intact points to only leaders, or to all participants.

Common Q & A:

** Facilitator may answer these questions **ONLY WHEN A LEADER ASKS***

Q: Can different materials be mixed together?

A: Yes.

Q: Does the warehouse must have floor?

A: No, but floor is the main source of intact points.

Q: Does the warehouse must have walls?

A: No, but without walls, roofs are not allowed to be built.

Q: Does the warehouse must have roof?

A: No.

Q: Do I need to worry about the height of the wall?

A: No, only the parameter (notice how the price of wall is per foot, not per square foot).

Build a Warehouse Activity Sheet 3 of 5

** This page shall be handed out for leader, motivator, and doer(s)*

Available materials:

| Material | Effect | Cost |
|-------------------|---|----------------|
| Wooden floor | IP +5 per sq ft | \$10 per sq ft |
| Concrete floor | IP +10 per sq ft | \$15 per sq ft |
| Sheet metal floor | IP +15 per sq ft | \$25 per sq ft |
| Wooden wall | Reduces 5000 pt damage from earthquake Additional 5000 damage from flood | \$10 per ft |
| Concrete wall | Reduces 5000 pt damage from flood Additional 5000 pt damage from earth quake | \$15 per ft |
| Sheet metal wall | Reduces 2000 pt damage from earthquake Additional 2000 pt damage from flood | \$25 per ft |
| Wooden roof | Additional 10000 pt damage from acid rain IP +1 per sq ft | \$25 per sq ft |
| Concrete roof | Reduces 5000 pt damage from acid rain IP -2 per sq ft | \$15 per sq ft |
| Sheet metal roof | Reduces 10000 pt damage from acid rain IP -3 per sq ft | \$10 per sq ft |

Build a Warehouse Activity Sheet 4 of 5

** This page shall be handed out for leader, motivator, and doer(s)*

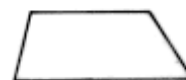
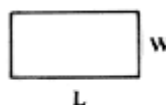
Appendix

10.1.0 Perimeters:

Square: $p = 4L$

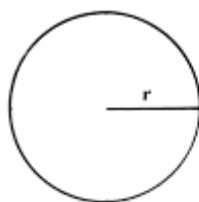


Rectangle: $p = 2(L + W)$



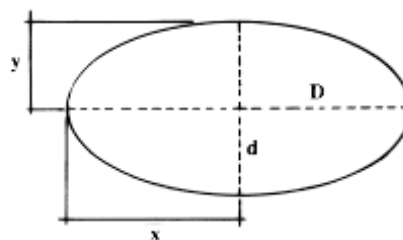
Parallelogram, Trapezoid: sum of the lengths of the sides

Circle: $C = 2\pi r$



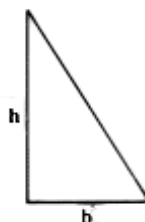
Ellipse (approximate):

$$p = \pi \sqrt{2(x^2 + y^2)}$$

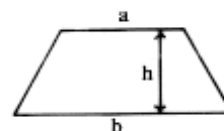


10.2.0 Areas:

Square: $A = L^2$



Rectangle: $A = LW$

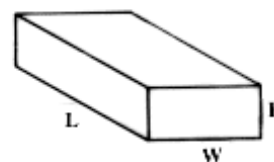
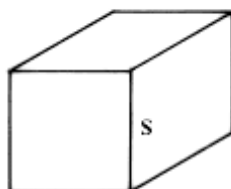


Right triangle: $A = bh/2$

Trapezoid: $A = \frac{h(a+b)}{2}$

Circle: $A = \pi r^2$

Ellipse: $(.7854)Dd$



10.3.0 Volumes:

Cube: S^3

Parallelepiped: $(L)(W)(H)$

Sphere: $4/3\pi r^3$

Cylinder: $(\text{area of the base})(h) = (\pi r^2)(h)$



Build a Warehouse Activity Sheet 5 of 5
** This page shall be available to all participants.*

Participant Scoring Guide

| Criteria | low | high | | | |
|---|-----|------|---|---|---|
| Methods and Activities | | | | | |
| Were the learning objectives accomplished? | 1 | 2 | 3 | 4 | 5 |
| Were instructions clear and easy to follow? | 1 | 2 | 3 | 4 | 5 |
| Did the facilitator explain the activity well? | 1 | 2 | 3 | 4 | 5 |
| Will this workshop produce better “team-players”? | 1 | 2 | 3 | 4 | 5 |
| Did the activity promote team work/team task? | 1 | 2 | 3 | 4 | 5 |
| Did the activity promote cooperative learning? | 1 | 2 | 3 | 4 | 5 |
| Was the right amount of time given? | 1 | 2 | 3 | 4 | 5 |
| Was the activity fun? | 1 | 2 | 3 | 4 | 5 |