Appendix A

Bourns College of Engineering, University of California, Riverside

EE-175: Senior Design Project

Winter and Spring 2007

Class

Lecture: Mondays 10:10 a.m. - 11:00 a.m. STAT B650
Lab: to be arranged with section professor

Instructors:

Professor Amit Roy Chowdhury	amitrc@ee.ucr.edu	EBU-II 322	827-7886
Professor Yingbo Hua	yhua@ee.ucr.edu	EBU-II 432	827-2853
Professor Sakhrat Khizroev	khizroev@ee.ucr.edu	EBU-II 424	827-5816
Professor Ping Liang	liang@ee.ucr.edu	EBU-II 323	827-2261
Professor Mihri Ozkan	mihri@ee.ucr.edu	EBU-II 436	827-2900
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Prerequisites

Senior standing in Electrical Engineering.

Objectives

The Senior Design Project is the culmination of course work in the bachelor's degree program in electrical engineering or computer engineering. In this comprehensive two-quarter course, students are expected to apply the concepts and theories of electrical engineering or computer engineering to an engineering project. Detailed written reports, working demonstration, poster and oral presentations are required.

Credits and Hours

Eight quarter units of engineering design credit will be granted for the completed project and other required components listed here. It is expected that approximately twelve hours of laboratory (or field) work will be required weekly for satisfactory completion of the project. The design value of these units has been accounted for in the total number of required science and design units necessary for graduation.

Weekly Class Meetings

The entire class of EE 175A and EE 175B will meet once each week for one hour. These meetings are intended to provide instruction in topics common to all design projects (engineering economics, ethics, etc.). They may include brief presentations by each team, aimed at improving technical presentation skills. Lectures will be provided by the instructors and some outside contacts. These meetings are mandatory and are for your benefit (10% of grade). In addition, it is

expected that each project team meet with their faculty supervisor on a weekly basis to report and discuss the progress of the project.

Project Participants

Projects will be completed in small teams with shared responsibility. If the team option is elected, each student will be held responsible for a distinct component of the total team effort. Team projects will be sufficiently more complex than individual projects so as to allow for an appropriate workload for all team members.

Project Elements

The senior design projects will include proposal and report writing, experiment design, hardware and software design, test plan and test, broad impact and ethical issues, among other things. Remember that this is a design course and students must define a ***design*** project, not a research, nor an evaluation or fabrication project. It is a balanced approach to encompass many of the elements stated above.

Each design project must include the following components:

1. **A Clear Technical Design Objective and the Project Contract** (Contract due 1/22/07): Each group must identify a design project in the first two weeks of the Winter quarter, and should have good estimated answers to the following questions and obtain the endorsement of the section professor:
   - Is the objective achievable within two quarters?
   - Does the group have the expertise to complete the design, prototype, and testing?
   - Does the group have access to the financing for the prototype?
   - Does the group have access to the required test equipment?
   - Is this a design problem (not research, nor fabrication)?
   - Is the project significant enough to be worthy of eight credits (12 hours/week/person)?

2. **Experiment Design and Feasibility Study** (Due in week 5 to 6 of the Winter quarter, 5% of final grade)**:** Each group must write an Experiment Design document, which describes its design of experiments to evaluate the feasibility of its project ideas, alternatives, trade-offs and realistic engineering constraints. These experiments must then be carried out and experimental results are to be analyzed to prove the feasibility of your project idea and select the best solution to be further developed in the design project. The experimental data, the quantitative analysis of the data, and the conclusion are to be presented in a Feasibility Study Report.

3. **A Detailed Design Specification** (Due in week 7 to 9 in the Fall quarter, 10% of final grade): Describes the functions and quantitatively measurable design objectives, design methods, hardware and software architecture and interfaces, user interface, realistic constraints in terms of time, cost, safety, reliability, social impact, ethics, etc. It must also list and consider the industry standards related to your project, including hardware, protocols, software and tools (e.g., 802.11, RS232, USB, PCI, 3G, API, device drivers, VHDL).

4. **Test Plan** (Due in week 8 to 9 of the Fall quarter, 5% of final grade)**:** A detailed description of your design of experiments to test and measure whether the final product and each of its components meet the design specifications, and, if not, to test and measure the errors and deviations from specifications.

5. **Global, economic, environmental and societal impact** (Due 2/12/07, 2.5% of final grade): Each student must write an essay (800 or more words) providing an analysis of the potential global, economic, societal, and environmental impact of the project. You do not need to address every aspect, just focus on a couple of aspects that are related to your project. For example, if your project is made into a product, how will it improve quality of life, affect the environment, enhance entertainment, education, globalization etc.? Are there any ethical or political debates, laws and regulations that are related to your project?

6. **Contempory Engineering issues** (Due 2/26/07, 2.5% of final grade) Provide in essay form a description of the contemporary engineering issues related to the project. Potential contemporary engineering issues related to your project are new technologies, new industry standards, new design methods, new materials, new trends in manufacturing, etc.

7. **Detailed Quantitative Design and Prototype** (To be completed before week 9 of the Spring Quarter) Each component of the selected solution and the overall system should be designed and implemented. In most cases, it is necessary to construct a system prototype (or component prototype).

8. **Test Report** (Due week 10 of the Spring quarter, 5% of final grade): Carry out the Test Plan you developed to how well your final design meet the specifications under the defined constraints, and present the results in this report.

9. **Poster and Final Presentation** (Due week 10 of the Spring quarter, 15% of final grade): Each group must prepare a poster and a Power Point presentation, and present the final design to faculty and other students.

10. **Working Demo and Final Report** (Due 6/8/2007 before 5pm, 40% of final grade): The final report must include all the required sections and appendices in a template file to be posted on the iLearn website for the course. A working demo of the completed design is critical, it is a convincing evidence that you design is completed and works. The demo should show whether and how design specifications are met.

Grading

In addition to the 9 deliverables listed above, each project will also be graded on the following:

1. **Laboratory Notebook, Weekly Reports and Lecture Attendance—**The student teams will need to maintain a laboratory notebook for the duration of their projects and submit written weekly reports. This notebook and reports will be inspected at weekly meetings and graded for content. Attendance of the lectures is mandatory. Everyone must sign in at each lecture. (This portion accounts for 10% of grade)
2. **Ethics Exam**: 5% of the final grade

Grading will be determined by all of the section professors conferring on each project and student. Please note that grades are assigned to an individual, not to a project.

Appendix A

Project Topics

Projects will be carried out in four different sections corresponding to the main electrical engineering areas taught at UCR. Each section will have a "section professor" (i.e., faculty supervisor) as designated below. Possible project topics are obtained from the section professor. In addition, joint projects with the mechanical engineering department are possible.

Electrical Engineering Area	Section Professor	Topics
Nano-Materials, Devices and Circuits (NMDC)	Mihri Ozkan and Sakhrat Khizroev	***Solarium Environment and Solar Cell Development—***Students will build an environmental test chamber (i.e., Solarium) that is capable of simulated sunlight at different intensities. The students will then fabricate organic solar cells and subsequently characterize these designs in the environmental test chamber.
Intelligent Systems (IS)	Ping Liang	***Embedded systems, video processing—***Projects may include video processing, wireless networking and embedded systems. Students may choose their own project subject to the approval of the instructor.
Controls and Robotics (CR) (& Sensing)	Amit Roy Chowdhury	***Image Processing—***Other projects include face recognition, video based digital map design, and the synthesis of human activities using learned dynamical models.
Communications and Signal Processing (CSP)	Yingbo Hua and Sheldon Tan	***Ad Hoc Communication Networks—***Projects include building and testing a network of three or more wireless nodes that can communicate with each other. Students will search and buy commercially available wireless transceivers, and then design, develop, and implement communication protocols into the network. Students will demonstrate that their network can indeed perform communications among its nodes without assistance from any established base station. ***Communication electronic design—***Projects include designing optical wavelength locking sub-system(s) for semiconductor DFB lasers; developing high-speed analog/digital electronics for a 10 Gb/s duobinary communications receiver; and designing an optical phase stabilization sub-system using fiber optics, analog electronics, and feedback principles. ***Signal Processing for VLSI—***projects include designing signal-processing algorithms for a variety of VLSI systems.

Steps in Selecting a Project

Appendix A

Upon reviewing the topic areas, students should invoke the following steps to select a project, and sign the corresponding senior design contract (next page), in order to "officially" register for the course.

Step - 0: Prepare a brief academic resume, which describes your specific technical strengths and general background in less than two pages. It is very important that you make a case for yourself as why you should be doing a specific project. This step is more or less like applying for a job, and therefore this resume is the first draft of your future resume that opens a door for you. Then follow one of the following Steps 1A to 1C, depending on your situation.

Step - 1A: Make an appointment to meet and talk to the section professors with whom you wish to work, and see whether they are willing to recommend you for their projects. At a minimum you should talk to two (preferably three) professors. Alternatively:

Step - 1B: If you have an industrial project in mind that meets the requirements stated above, then you still need to talk to an EE175 section professor. This professor must approve and supervise the project. Alternatively:

Step - 1C: If none of the above projects appeals to you, but you have your own ideas, then you must lobby for that idea with a section professor. This approach requires additional effort, but is doable if it is planned in advance.

Step - 2: Identify one or possibly two of your classmates who have similar interests and want to work with you on the same project and have gone through the same steps as you did. Discuss the project among team members and achieve a consistent project idea.

Step - 3: Make a brief written proposal to the section professor that includes your resume, your classmate(s) resume(s) if applicable, the title of the project, and a brief description. Also have at least two more project titles in this proposal as your second and third choices. Please note that every effort will be made to match you with your best choices, although in certain instances changes may be required. In that case you will be notified promptly.

Step – 4: Once the projects are verbally approved by the section professors, each student team is to fill out a project contract available on the class web site. Be sure to fill out every section, sign it, and turn it in to your section professor.

Appendix A

Approximate Class Schedule

Date	Event	Lecturer	Lecture Content
1/8	Lecture 01	All	Introduction, course outline, preliminary issues, requirements and expectations
1/15	Lecture 02		Holiday, no class
1/22	Lecture 03	MO	Technical writing
1/29	Lecture 04	YH	Design methodologies and approaches; block diagrams, analyses of solutions, evaluation of feasibility
2/5	Lecture 05	AC	Experiment design, developing a test plan, collecting data, and evaluation
2/12	Lecture 06	SK	Introduction to the design process, specification process, laboratory notebooks, library techniques, literature and information search
2/19	Lecture 07		Holiday, no class
2/26	Lecture 08	SK	Project management: organization, teamwork, scheduling, budgeting, etc.
3/5	Lecture 09	MO	How to give oral presentations, preparing for the design review
3/12	Lecture 10	AC	Design constraints, industry standards
TBD	Design Review	All	Two parallel sessions
4/2	Lecture 11	DG	Printed circuit board design, layout, and fabrication
4/9	Lecture 12	ST	Contemporary engineering issues
4/16	Lecture 13	SK	Engineering ethics (exam required)
4/23	Lecture 14	PL	Intellectual properties
4/30	Lecture 15	ST	Career strategies, resumes
5/7	Lecture 16	PL	Engineering economics, marketing engineering products
5/14	Lecture 17	ST	Final testing requirements, test report, preparation for the final presentation
5/21	Lecture 18	PL	Entrepreneurial, venture capital and start-ups
5/28	Lecture 19	MO	Societal, environmental and cultural impact, international engineering projects
6/4	Final Presentations.	All	Poster required. Two parallel sessions

Lecturer code: **AC -** Amit Chowdhury, **DG** – Dan Giles, **YH** – Yingbo Hua, **SK** - Sakhrat Khizroev
PL – Ping Liang **MO** – Mihri Ozkan, **ST** – Sheldon Tan

Appendix A

Learning Objectives

- Ability to apply knowledge of mathematics, science, and engineering
- Ability to design and conduct experiments, as well as analyze and interpret data
- Ability to design a system, component, or process to meet desired needs
- Ability to function as effective teams
- Ability to identify, formulate, and solve engineering problems
- Understanding of professional and ethical responsibility
- Ability to communicate effectively
- Broad education necessary to understand the impact of engineering solutions in a global and societal context
- Recognition of the need for and an ability to engage in lifelong learning
- Knowledge of contemporary issues
- Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Appendix B

EE175AB Final Report Template

EE175AB Final Report Template

Project Title

EE 175AB Final Report

Department of Electrical Engineering, UC Riverside

Project Team Member(s)	
Date Submitted	
Section Professor	
Revision	e.g., revision 2.1
URL of Project Wiki/Webpage	http://

Summary

This report presents …….

Note:

- **Sections marked with * are required**
- **In each section, you must clearly identify which team member is responsible for which objectives, modules or tasks.**

Revisions

Version	Description of Version	Author(s)	Date Completed	Approval
Version Number	Information about the revision. This table does not need to be filled in whenever a document is touched, only when the version is being upgraded.	Full Name	00/00/00	
0.5	First draft	X,y,z	01/01/2005	
0.8	List major changes from previous version, reference to the related Engineering Change Notices (ECN) or Engineering Design Notes (EDN).	X,y,z	02/01/2005	

This template serves as a basis for the EE175 Senior Design Project Final Report.

This document should be customized to the needs of each specific project. This template is only a starting point.

A formula approach to design will seldom yield the best results. This template does not imply that all components listed in this template should be included (except the sections marked with *) nor does it imply that this template includes all the necessary components needed for a specific project. Instead this template provides a basic starting point that will work well in many situations. The design team must modify and/or expand the contents in order to meet the specific requirements of their project.

Table of Contents

1 * Executive Summary

In one page, present the summary of your project. Outline the overall goals, design objectives, the chosen method, key features, testing results, and your important achievements. You may use several paragraphs, but no more sub-sections.

2 * Introduction

This space may be used to provide an introduction for the design and ties to other project materials.

2.1 * Design Objectives and System Overview

High-level description of overall goals, the intended , the application, system structure, functionality, interactions with external systems, system issues, operating environment, user environment, inputs, outputs, etc. You do not need to provide implementation details in this section.

You must provide a list of quantitative technical design objectives, e.g., accuracy of 95%, sensor range of 20 feet, 90% successful retrieval or recognition, mean square error < 0.1, response time < 1ms, dynamic range of 20Vp-p, bandwidth of 20MHz, transmission range>100m at 100mW, SNR>10dB, data transfer rate = 100Mbps, costing less than $500, etc.

Responsibilities: clearly state which team member is responsible for which goals/objectives

2.2 * Development Environment and Tools

Describe any design environment or tools used in this project.

2.3 Related Documents and Supporting Materials

References to any industry standards involved in your project should be listed here.

(Optional) – Note any other references or related materials. For instance, if this design required interfacing with X10 hardware devices, then you would want a reference the X10 specification. If you use the .NET development environment or need to interface with MS Internet Explorer, the related documents should be referenced here.

2.4 * Definitions and Acronyms

List any project definitions and acronyms introduced to the project by this design.

3 * Design Considerations

This section describes issues that need to be addressed or resolved prior to or while completing the design as well as issues that may influence the design process.

3.1 * Assumptions

Describe any assumption, background, or dependencies of the end product, its use, the operational environment, or significant project issues. These are things you are assuming to be true, that directly affect the design.

3.2 * Realistic Constraints

Describe any constraints on the system that have a significant impact on the design of the system. (e.g. technology constraints such as power constraints, processor speed/memory size constraints, frequency constraints, performance requirements, end user characteristics, weight/size constraints, validation requirements, project constraints, government regulations and legal constraints, societal and environmental constraints, requirements of industry standards, cost constraints, etc.)

3.3 * System Environment and External Interfaces

Describe the system, hardware and software that your product must operate in and interact with, any communication protocols and APIs the system must comply to, etc.

3.4 * Industry Standards

Describe the industry standards involved with the hardware and software in your design. This may include hardware, software and protocols, such as RS232, I2C, USB, IEEE802.11, Bluetooth, RFID, Windows API, device drivers, etc. Reference the standards documents and describe how you design will comply with the standards.

3.5 * Budget and Cost Analysis

Present your budget and/or cost analysis.
safety, ethics, and social
impacts, must be addressed explicitly herein. You may use a table to respond briefly about some of these matters that are tangentially related to your project.

3.6 * Safety

Discuss safety considerations and specify safety objectives

3.7 Performance, Security, Quality, Reliability, Aesthetics etc.

Describe the considerations and processes to ensure meeting performance, security, quality control, reliability, aesthetics etc. requirements.

3.8 * Documentation

Describe the processes for generating and maintaining technical and user documentation for the project, including design notes, engineering change notices, version update and version control procedures.

3.9 Design Methodology

(Optional) - Summarize the approach that will be used to create and evolve the designs for this system. Cover any processes, conventions, policies, techniques, development environments, tool or other issues which will guide design work. This is not a rehash of your project lifecycle or change management. This is for deciding whether you will use structured, object-oriented, formal specification or other specific methodologies..

3.10 Risks and Volatile Areas

(Optional) - Describe any notably volatile or risky areas of the system and any special strategies taken to mitigate risks or prepare for changes. These are risks specific for the design—not project management type stuff. For instance if there is an algorithm that is especially difficult that you must implement.

3.11 * Global, Economic, Environmental and Societal Impact

Include an essay (800 or more words) that discusses the potential global, economic, societal, and environmental impact of the project. You do not need to address every aspect, just focus on a couple of aspects that are related to your project. For example, if your project is made into a product, how will it improve quality of life, affect the environment, enhance entertainment, education, globalization etc.? Are there any ethical or political debates, laws and regulations that are related to your project?

Every team member must contribute to this essay and it must state that every team member contributed to this essay.

3.12 * Contemporary Engineering Issues

Include an essay (800 or more words) on the contemporary engineering issues related to the project. Potential contemporary engineering issues related to your project are new technologies, new industry standards, new design methods, new materials, new trends in manufacturing, etc.

Every team member must contribute to this essay and it must state that every team member contributed to this essay.

4 Experiment Design and Feasibility Study

Include this section if you need to conduct experiments to evaluate the feasibility of your project ideas, alternatives, trade-offs and realistic engineering constraints, and to answer key design questions, such as what parts to use, how to collect data, whether accuracy of sensor is sufficient for the design objective, whether battery provides enough power, what hardware or software interface methods to use to connect the different modules, etc.

4.1 Experiment Design

Describe the objective, setup, procedure and expected results of each experiment.

State clearly who is responsible for which task

4.2 Experiment Results and Feasibility

Carry out the experiments designed above and present experimental data, quantitative analysis of the data, and the conclusion to show the feasibility of your project idea, how the experiments help you decide whether your technical design objectives can be achieved, and how they help you select the best solution to be further developed in the design project.

State clearly who is responsible for which task

5 Architecture

The architecture provides the top level design view of a system and provides a basis for more detailed design work. These are the top level components of the system you are building and their relationships.

5.1 System Architecture

This section provides a high level overview of the structural and functional decomposition of the system. Focus on how and why the system is decomposed in a particular way rather than on details of the particular components. Include information on the major responsibilities and roles the system (or portions thereof) must play. A pictorial representation of the architecture should be presented, which should show the hierarchical structure of the modules; interaction and interface among modules and with databases, external software, system, and networks

State clearly who is responsible for which module/task

5.2 Rationale and Alternatives

This section discusses why you are using the architecture or approach you have decided upon. A discussion of other architectures or approaches considered should be presented here.

State clearly who is responsible for which module/task

6 * High Level Design

This section describes in further detail elements discussed in the Architecture. Normally this section may be split into separate documents for different areas of the design.

High-level designs are most effective if they attempt to model groups of system elements from a number of different views. Typical viewpoints are:

a. Conceptual or Logical: this is the view most often used in Section 3. This view shows the logical functional elements of the system. Each component represents a similar grouping of functionality. For UML, this would be a component diagram or a package diagram..

b. Hardware: this view is for hardware functional blocks and how they interface.

c. Software: this view is the software view of the system. The components are modules, threads, processes or distributed applications.

d. Security: this view typically focuses on the components that cooperate to provide security features of the system. It is often a subset of the Conceptual view.

For many smaller applications, the conceptual view is all that is necessary. Document those views that will help you design and implement the system. If you have only a single view, and that view is discussed adequately in section 3, then this entire section can be deleted.

State clearly who is responsible for which module/task

6.1 Conceptual View

Provide a description and diagrams of a system element or set of elements that describes a clearly defined view or model of the entire system or a subset of the system.

State clearly who is responsible for which module/task

6.2 Hardware

State clearly who is responsible for which module/task

6.3 Software

State clearly who is responsible for which module/task

7 Data Structures

A description of all data structures including internal, global, and temporary data structures. State clearly who is responsible for which module/task

7.1 Internal software data structure

Data structures that are passed among components the software are described.

7.2 Global data structure

Data structured that are available to major portions of the architecture are described.

7.3 Temporary data structure

Files created for interim use are described.

7.4 Database descriptions

Database(s) created as part of the application is(are) described.

8 * Low Level Design

This section provides low-level design descriptions that directly support construction of modules. Normally this section may be split into separate documents for different areas of the design. For each component we now need to break it down into its fundamental units or modules. Each module or block may be hardware or software or a subsystem implemented using hardware and software

8.1 Module i (for i = 1 to n)

Provide or reference a detailed description and diagrams of this module. Repeat this section for each module i.

State clearly who is responsible for which module/task

8.1.1 Processing narrative for module i

A processing narrative for module i is presented.

8.1.2 Module i interface description.

A detailed description of the input and output interfaces of the module with other modules in the system, with other software or systems or module is presented.

8.1.3 Module i processing details

A detailed description for each module is presented, including hardware, algorithm, local data structures, design constraints, limitations, performance issues, etc.

9 User Interface Design

This section provides user interface design descriptions that directly support construction of user interface screens.

State clearly who is responsible for which module/task

9.1 Application Control

Detail the common behavior that all screens will have. Common look and feel details such as menus, popup menus, toolbars, status bar, title bars, drag and drop mouse behavior should be described here. Conventions and standards used for designing/implementing the user interface are stated.

9.2 Screen 1..m

Illustrate all major user interface screens and describe the behavior and state changes that the user will experience. All screen objects and actions are identified.

A screen transition diagram or table can optionally be created to illustrate the flow of control through the various screens.

This does not have to be actual screenshots since they have not been programmed. They can be power-point drawings or mockups created in Visual Basic or some other rapid GUI-building tool.

9.3 Development system and components available

The user interface development system and GUI components available for implementation are described.

10 Administrative and Other Design Issues

10.1 * Project Management

One paragraph from each team member
How was the project managed, how was tasks distributed, how was scheduled made, what project management software/method did you use, your experience in working together, what have you learned in terms of team work, time management, project management etc., from this project.

10.2 Requirements traceability matrix

A matrix that traces stated modules and data structures to the Software Requirements Specification is developed.

10.3 Packaging and installation issues

Special considerations for software packaging and installation are presented.

10.4 Design metrics to be used

A description of all design metrics to be used during the design activity is noted here.

10.5 Restrictions, limitations, and constraints

Special design issues that impact the design or implementation of the design are noted here.

11 * Experiment Design and Test Plan

11.1 * Design of Experiments

Design experiments to verify whether your design meets the design objectives. Design experiments to test and prototype your modules. The set of experiments which constitute your test plan. are to specified, including as much detail as is possible at this stage.

Experiments and expected responses

Specify the experiment and the expected results.

Test Experiment Case i (repeat for i=1,…n):

1. What is the objective of the experiment? What function does it test? Which technical design objective does this measure?
2. Experiment setup
3. Experiment procedure and how to collect data
4. Expected results

State clearly who is responsible for which experiment

11.2 * Bug Tracking

A database will be used to track defects found while performing the test cases. All defects will be logged as they are discovered. Defects will be assigned to Person A to fix, or to Person B to investigate.

11.3 * Quality Control

The completed test cases will be reviewed to ensure that all cases were run; that all were completed successfully; and that any deviations from the test cases were noted accordingly. Each step should be marked as Passed or Failed. Failed cases should be marked with the date and time of the failure, and the associated test track number. When a failed case is fixed, the date and time of the retest should be noted

11.4 Performance bounds

Special performance requirements are specified.

11.5 * Identification of critical components

Those components that are critical and demand particular attention during testing are identified.

11.6 * Items Not Tested by the Experiments

List any functions or processes not being tested by the experiments and why.

12 * Experimental Results and Test Report

Carry out the experiments designed in the section above to test your modules and prototype and present the results. Present the results of the experiments and provide an analysis of the experimental test data.

State clearly who is responsible for which test case

12.1 * Test Iteration 1

Each experiment may need to be run multiple times. When you find deviation from the expected results, you must take action to debug your design, then test it again.

12.1.1 Experiment 1

Person(s) performing the experiment

1. Experiment results, person performing the test
2. Comparison with expected results
3. Analysis of experiment results
4. Corrective actions taken

12.1.2 Experiment i (repeat for i = 1, …., n)

Person(s) performing the experiment

1. Experiment results, person performing the test
2. Comparison with expected results
3. Analysis of experiment results
4. Corrective actions taken

12.2 * Test Iteration j (repeat for j=1,…m)

12.2.1 Experiment 1

Person(s) performing the experiment

1. Experiment results
2. Comparison with expected results
3. Analysis of experiment results
4. Corrective actions taken

12.2.2 Experiment i (repeat for i = 1, …., n)

Person(s) performing the experiment

1. Experiment results
2. Comparison with expected results
3. Analysis of experiment results

4. Corrective actions taken

13 * Conclusion and Future Work

13.1 * Conclusion

Present the conclusion of your project, state clearly whether the finished work meet the overall project goals and the quantitative technical design objectives. If not, just state what and how it failed and the TECHNICAL reasons why it failed and what you have learned.

State clearly who is responsible for achieving or missing which goals/objectives.

Do NOT complain and give personal, non-technical reasons why it failed. You should talk to your advisors about these, but do not include them in a design document.

13.2 Future Work

Expansion and Improvement; discuss the impact of this work and its possible expansion into perhaps a more promising design than what you had started. This is particularly important in order to address the marketability of your design. Or why this project merits another look by perhaps next year's students.

13.3 Acknowledgement

Be considerate and credit all those who have helped you in this project.

14 * References

List the references used in the design, including books, data sheets, technical documents, industry standard documents. References can be printed documents or online.

Use the IEEE Citation procedures and list in alphabetic order all your references based on their first, second, etc., authors, in a chronological order. You may include these references depending on each chapter or as a whole.

15 Appendices

Presents information that supplements the design specification, including:

Appendix A: Parts List
Appendix B: Equipment List
Appendix C: Software List
Appendix D: Special Resources
Appendix E: User's Manual - If your design requires instructions for future use, here is the place to put that information.
Appendix F to Z: Whatever Else You Wish To Add; for instance, here, you may include detailed solution methods or derivations, which you need for your future review of this report or whoever else is interested to pursue this study. Some side drawings and printouts that are of value to people who will continue this work should be given herein. Some information about the vendors and how to locate parts for similar projects must be included herein. In other words, information that is important about the overall construction of the project should be given herein.)

Appendix C

Revised Catalog text for EE 120A and EE 120B

EE 120A. Logic Design (5) Lecture, 3 hours; laboratory, 6 hours. Prerequisite(s): CS 061 with a grade of "C-" or better. Covers the design of digital systems. Topics include Boolean algebra; combinational and sequential logic design; design and use of arithmetic-logic units, carry-lookahead adders, multiplexors, decoders, comparators, multipliers, flip-flops, registers, and simple memories; state-machine design; and basic register-transfer level design. Interdisciplinary laboratories involve use of hardware description languages, synthesis tools, programmable logic, and significant hardware prototyping. Cross-listed with CS 120A.

EE 120B. Introduction to Embedded Systems (5) Lecture, 3 hours; laboratory, 6 hours. Prerequisite(s): CS 120A/EE 120A. Introduction to hardware and software design of digital computing systems embedded in electronic devices (such as digital cameras or portable video games). Topics include embedded processor programming, custom processor design, standard peripherals, memories, interfacing, and hardware/software tradeoffs. The interdisciplinary laboratory involves use of synthesis tools, programmable logic, and microcontrollers and development of working embedded systems. Cross-listed with CS 120B.

Appendix D

Department of Electrical Engineering
University of California – Riverside

EE 120A LOGIC DESIGN

(Prerequisite: CS 061)

Lecture:
Section 001: MWF 2:10 – 3:00 p.m., Boyce Hall 1471
Instructor: Dr. Vladimir Fonoberov

Web: http://www.faculty.ucr.edu/~vladimf/ & http://www.iLearn.ucr.edu/
Office Hours: MW 1:10 – 2:00 p.m., ENGR2 408

Labs:
Section 021: MT 6:10 – 9:00 p.m., ENGR2 125
TA: Lingfei Zhou (lzhou001@student.ucr.edu)

Section 022: RF 11:10 a.m. – 2:00 p.m., ENGR2 125
TAs: Ben Fellows (bfellows@ee.ucr.edu) & Zhuo Zhao (zhaozhuo@ee.ucr.edu)

Catalog Description:
Covers the design of digital systems. Topics include Boolean algebra; combinational and sequential logic design; design and use of arithmetic-logic units, carry-lookahead adders, multiplexors, decoders, comparators, multipliers, flip-flops, registers, and simple memories; state-machine design; and basic register-transfer level design. Laboratories involve use of hardware description languages, synthesis tools, programmable logic, and significant hardware prototyping.

Text:
"***Digital Design***" by Frank Vahid, John Wiley & Sons, 2006 (ISBN 0-471-46784-7)

Homework:
Four homework assignments will be given during the course. Solution of the homework problems will normally require reading the book, working on examples, and reviewing class material. Homework must be typed or very neatly written.

Quizzes:
Four 50-minute quizzes will be given during the course.

Labs:
Eight lab assignments and one lab exam will be given. Lab attendance is required for the full 3-hour lab. For the first part of the course, the Instructor and TAs will form interdisciplinary teams of two students, e.g. one EE student and one CS/CE student. New teams will be formed each week (for each lab assignment). Each lab report must show students' names and majors.

Midterm: February 9, 2007 (subject to change)
Final Exam: March 22, 2007; 8 – 11 a.m.

Grading:
- **Lecture component** (70 points)
  - 30 pts: Final
  - 20 pts: Midterm
  - 10 pts: Quizzes (4 @ 2.5 pts)

  - 10 pts: Homework (4 @ 2.5 pts)
- **Lab component** (30 points)
  - 24 pts: Lab assignments (8 @ 3 pts)
  - 6 pts: Lab practical exam

EE 114 Course proposal

Probability, Random Variables, and Random Processes in Electrical Engineering

Course Request and Maintenance System

EE 114, 01/25/2007, 04:28 PM
MARKB (Mark Bourbonnais)

Course Approval Form
(Saved)

Coll./Schl./Div.:	College of Engineering
Dept./Comm./Prog.:	Electrical Engineering
Action:	NEW
Course Level:	Undergraduate Course
Course Type:	Standard Course
Effective:	Fall 2007
Offered once only:	No
Offered summer sessions only:	No
Quarter(s) Offered:	Spring
Last Approved Form Effective:	(Submitted:)
Notes:	

	Proposed
Course Number:	EE 114
Renumbered From:	
Course Title:	Probability, Random Variables, and Random Processes in Electrical Engineering
E-Z Segment Title:	
Units:	4
Activity(ies):	Lecture, 3 hours per week (group activity) Discussion, 1 hour per week (group activity)
Prerequisite(s):	EE 110A
Description:	Covers fundamentals of probability theory, random variables, and random processes with applications to electrical and computer engineering. Includes probability theory, random variables, densities, functions of random variables, expectations and moments, and multivariate distributions. Also addresses random processes, autocorrelation function, spectral analysis of random signals, and linear systems with random inputs.
Grading	

Type:	Letter Grade or petition for Satisfactory/No Credit (S/NC)
In Progress:	No
Statement:	
Repeatable:	No
Maximum Units:	
Statement:	
Cross-listed With:	
Credit Statement:	

If repeatable, may be taken more than once per quarter: No

Breadth Statement:

Instructor(s): Assistant Professor Ertem Tuncel

Justification:
The ABET EE program criteria requires that each "program must demonstrate that graduates have knowledge of probability and statistics, including applications appropriate to EE and its program objectives." Previously, the EE program tried to addressed this requirement through STAT155. In a recent site visit, ABET officials stated the lack of probability and statistics appropriate to EE as a "program weakness" that needs to be addressed as soon as possible, and pointed out that the best way to address this "program weakness" was to introduce a new course highlighting EE applications taught by EE faculty. Similar courses or sequences of courses are currently being offered, with the same motivations, at other UC schools (e.g., ECE139A/B and ECE140 at UCSB, ECE 109 and 153 at UCSD, EE131A/B at UCLA).

Correspondence:

Overlaps/Duplicates Other Courses: STAT 155. Stat 155 covers the theory of probability, random variables and stochastic processes, among various other topics (e.g., statistical inference, testing) not relevant to EE114. EE114 will introduce the concepts of probability, random variables, and stochastic processes, but the primary focus will be on the application of these concepts in EE (e.g., image equalization, filtering, digital communications, signal processing, coding and error detection).

Affects Programs: This course is to replace STAT 155 in the Electrical Engineering undergraduate curriculum as a junior-year required course.

Affects Prerequisites/Descriptions: This course replaces STAT 155 as the prerequisite for EE 150.

Syllabus:

Example syllabus:

1) Basic Concepts of Probability Theory
- Specifying random experiments and axioms of probability
- Conditional probability and independence of events
- Sequential experiments
- Application: quality control
- Application: communication over unreliable channels

2) Random Variables
- The notion of a random variable
- The cumulative distribution and probability density functions
- Some important random variables
- Functions of a random variable
- The expected value of random variables
- Application: quantization of analog data
- Application: image histogram equalization

3) Multiple Random Variables
- Pairs of random variables
- Independence of two random variables
- Conditional probability and expectation
- Multiple random variables
- Correlation and covariance
- Applicaton: Image motion estimation

4) Random Processes
- Definition of a random process
- Specifying a random process
- Example processes
- Stationarity

5) Analysis and Processing of Random Signals
- Power spectral density
- Response of linear systems to random signals
- Application: Denoising

EXAMS:
One midterm and one final.

HOMEWORK:
There will be weekly homework assignments

GRADING:
HW: 15%
Midterm: 35%
Final: 50%

TEXTBOOK:
Albert Leon-Garcia, "Probability and Random Processes for Electrical Engineering", 2nd Edition, Prentice Hall, 1993.

Possible alternative text:
Roy D. Yates and David J. Goodman, "Probability and Stochastic Processes: A friendly

introduction for Electrical and Computer Engineers," John Wiley, 1999.

Approvals:

Department/Committee/Program Faculty:		10/25/2006
Submitted by Department/Committee/Program Chair:	Roger Lake	10/25/2006

Reviewed by Courses Office:

Reviewed by Dean of College/School/Division:

Executive Committee
College of Engineering:
College of Humanities, Arts, and Social Sciences:
College of Natural and Agricultural Sciences:
Division of Biomedical Sciences:
Graduate School of Education:
Graduate School of Management:
University Honors Program:

Dean of the Graduate Division:
Graduate Council:

Committee on Courses:

Appendix F

EE Focus Areas

1. Controls and Robotics (CR)
EE132 Automatic Control
EE128 Data Acquisition and Process Control
EE141 Digital Signal Processing
EE144 Introduction to Robotics
EE146 Computer Vision
EE151 Introduction to Digital Control
EE152 Image Processing

2. Communications and Signal Processing (CSP)
EE141 Digital Signal Processing
EE117 Electromagnetics-II
EE128 Data Acquisition and Process Control
EE143 Multimedia Technologies and Programming
EE146 Computer Vision
EE150 Digital Communications
EE152 Image Processing
EE160 Fiber Optic Communication Systems.

3. Intelligent Systems (IS)
EE141 Digital Signal Processing
EE128 Data Acquisition and Process Control
EE140 Computer Visualization
EE143 Multimedia Technologies and Programming
EE146 Computer Vision
EE144 Introduction to Robotics
EE152 Image Processing

4. Nano Materials, Devices and Circuits (NMDC)
EE133 Solid-State Electronics
EE117 Electromagnetics-II
EE130 Engineering Quantum Computing
EE134 Digital Integrated Circuit Layout and Design
EE135 Analog Integrated Circuit Layout and Design
EE136 Semiconductor Device Processing Lab
EE141 Digital Signal Processing
EE160 Fiber Optic Communication Systems