EE 175ABC: Senior Design Project
Fall-Spring 2014-2015

Instructors

Dr. Ping Liang, Dept. of Electrical & Computer Engineering;
WCH 323, 827-2261 liang@ee.ucr.edu

Dr. Roman Chomko, Dept. of Electrical Engineering;
WCH 411 827-7109 chomko@ee.ucr.edu

Dr. Gang Chen, Dept. of Electrical & Computer Engineering;
WCH 234, gachen@ee.ucr.edu

Dr. Nissim Amos, Dept. of Electrical & Computer Engineering;
WCH 411 827-7109 nissim.amos@ucr.edu

Pavle Kirilov, ECE Development Engineer
ENGR2 137 pavle@ee.ucr.edu

Textbook and Related Materials

No textbook required. All course materials are posted on iLearn.

Specific Course Information

A. Course Description (Catalog description)

EE 175A Senior Design Project (3) Lecture, 1 hour; laboratory, 3 hours; practicum, 3 hours. Prerequisite(s): EE 120B/CS 120B; senior standing in Electrical Engineering or consent of instructor. Proposal and design of electrical engineering devices or systems under the direction of the instructor. Develops technical specification; considers design constraints and industry standards; emphasizes ethical responsibilities; and promotes staying current on technology and its socioeconomic and environmental impact. Graded In Progress (IP) until EE 175A, EE 175B and EE 175C are completed, at which time, a final letter grade is assigned.

EE 175B Senior Design Project (4) Lecture, 1 hour; laboratory, 3 hours; practicum, 6 hours. Prerequisite(s): EE 175A; concurrent enrollment in ENGR 180W; senior standing in Electrical Engineering. Builds, tests, and redesigns electrical engineering devices or systems. Develops and carries out test plan according to design specification. Presents a demo of the design. Graded In Progress (IP) until EE 175A, EE 175B and EE 175C are completed, at which time, a final letter grade is assigned.

EE 175C Senior Design Project (1) Consultation, 1 hour. Prerequisite(s): EE 175B, senior standing in Electrical Engineering. Completes project testing and supporting documentation including design considerations and constraints, design process, implementation and testing, data analysis, and project management. Revises documentation based on instructor feedback. Satisfactory (S) or No Credit (NC) grading is not available.

B. Prerequisite(s)

EE175A: EE120B and senior standing in Electrical Engineering.
EE175B: EE175A, ENGR 180W and senior standing in Electrical Engineering.
EE175C: EE175B and senior standing in Electrical Engineering.

Specific Objectives

A. Course Objectives

1. Ability to understand the engineering design process.
2. Ability to formulate design specifications and evaluation criteria; determining methodologies and performing solution analyses
3. Develop skills in project management including organization, teamwork, planning, scheduling, and budgeting, gain teamwork experience.
4. Develop skills in background research and library techniques such as literature and information searching
5. Develop technical writing and oral communication skills through proposal and report writing, as well as mid-course and final presentations
6. Ability to design and conduct experiments and analyze data
7. Understanding of professional and ethical responsibility
8. Obtain a general understanding of engineering economics, marketing, career strategies, and resume preparation.
9. Understand the impact of engineering solutions in a global and societal context
10. Knowledge of contemporary engineering issues

B. Student Outcomes Addressed

Item	OUTCOME-RELATED LEARNING OBJECTIVES	OUTCOMES										
		A	B	C	D	E	F	G	H	I	J	K
1	Ability to understand the engineering design process.			1	1	1					1	1
2	Ability to formulate design specifications and evaluation criteria; determining methodologies and performing solution analyses	1	1	1		1						1
3	Develop skills in project management including organization, teamwork, planning, scheduling, and budgeting, gain teamwork experience.			1	1	1					1	1
4	4. Develop skills in background research and library techniques such as literature and information searching							1		1	1	1
5	Develop technical writing and oral communication skills through proposal and report writing, as well as mid-course and final presentations					1		1				1
6	Ability to design and conduct experiments and analyze data	1	1	1								1
7	Understanding of professional and ethical responsibility						1					1
8	Obtain a general understanding of engineering economics, marketing, career strategies, and resume preparation.						1		1	1		1
9	Understand the impact of engineering solutions in a global and societal context								1			1
10	Knowledge of contemporary engineering issues									1	1	1

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

List of Topics

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

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 Lectures and Meetings

The entire class of EE 175A and EE 175B will meet once each week for one hour. These lectures are intended to provide instruction in topics common to all design projects (design process, technical documentation, engineering economics, ethics, etc.). **If you miss a lecture, you will be required to submit a 500 words essay on the topic of the lecture and turn it in at the next lecture. If you miss more than 3 lectures, your final grade will be deducted one grade level regardless whether you submitted the essays.**

In addition, it is expected that each project team meet with their session instructor on a weekly basis to report and discuss the progress of the project. The weekly meetings may include progress reports, discussions of difficulties, problem solving, brief presentations by each team aimed at improving technical presentation skills. Attendance of the lectures and weekly meetings are mandatory.

Project Participants

Projects will be completed in small teams with shared responsibility. Each team should have 2 to 3 students. Single student team and team with more than 3 students are not generally not allowed. Exceptions require approval by the ECE department. Team projects will be sufficiently more complex to allow for an appropriate workload for all team members. Each student will be held responsible for a distinct component of the total team effort.

Project Elements

The senior design projects will include proposal and report writing, experiment design, hardware and software design, test plan and test, analysis of 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.

Each design project must include the following components:

1. **A Clear Technical Design Objective**: Each group must decide upon a design project and get the approval by their section professor by the time of the second lecture. If a team wishes to propose its own project, they must obtain the endorsement of the section professor. Each team should assess the following:
   - Is the design project doable within two quarters?

- Does the group have the expertise to complete the design, prototype, and testing?
- Does the group have sufficient funding for the project?
- 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** (Required section in Final Report, 5% of final grade) Design and carry out experiments to evaluate the feasibility of project ideas, alternatives, trade-offs and realistic engineering constraints. Analyze the experimental results to prove the feasibility of your project idea and select the best solution to be further developed in the design project.

3. **A Detailed Design Specification**: 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. **Global, Economic, Environmental and Societal Impact** (Required section in Final Report, 2% of final grade): Each team must write an essay (500 or more words) providing an analysis of the potential global, economic, societal, and environmental impact of the project. Everyone on the team must contribute to this essay. 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?

5. **Contemporary Engineering Issues** (Required section in Final Report, 2% of final grade, Required section in Final Report) Write an essay (500 or more words) on the contemporary engineering issues related to the project. Everyone on the team must contribute to this essay. Potential contemporary engineering issues related to your project are new technologies, new industry standards, new design methods, new materials, new trends in manufacturing, etc.

6. **Test Plan** (Required section in Final Report, 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.

7. **Understanding of Professional and Ethical Responsibility** (Required section in Final Report, will be a part of the 7.5% of the grades assigned to Professional and Ethical Responsibility. See 2 in the Grading section) Write an essay (500 or more words) on (a) what are the ethical considerations or implications of your project, (b) how you addressed them, and (c) what you learned through this design project about professional and ethical responsibility. Everyone on the team must contribute to this essay.

8. **Recognition of the need for and an ability to engage in lifelong learning** (Required section in Final Report, 2% of final grade) Write an essay (200 or more words) on how doing this design project helped you (a) recognize the need and (b) developed the ability in lifelong learning. Everyone on the team must contribute to this essay.

9. **Design Review Presentation** (Week 10 of the fall quarter, 5% of final grade): Each group must make a Power Point presentation of their design specification and progress to faculty and other students. Requirements of design review presentation will be provided.

10. **Detailed Quantitative Design and Prototype** (To be completed by week 10 of the winter quarter. See the Grading section) 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).

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

12. **Final Presentation** (Week 1 or 2 of the spring quarter, 5% of final grade): Each group must make a Power Point presentation of the final design and show a working demo to faculty and other students. Requirements of final presentation will be provided.

13. **Working Demo and Final Report** (Working demo at the end of the winter quarter, one updated demo allowed in the spring quarter. First draft of final report due in week 3 of the spring quarter. See the Grading section): The final report must include all the required sections and appendices in a template file, final presentation ppt file and video or data of a working demo must be uploaded on the iLearn website for the course. A working demo of the completed design is critical and required. The demo should show whether and how design specifications are met. Your section professor will review and marked up draft of your final reports and send it back for improvement and re-write. Each group may be given two iterations of review and revision.

Grading

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

1. **Design Notes or Project Wiki, Weekly Progress and Lecture Attendance:** Each student team need to maintain a design notebook and/or project wiki for the duration of their projects and report progress to the section instructor at least weekly. Each week, you must show evidence of amount of work done and progress in the design, implementation and/or testing. Attendance of the lectures is mandatory. Everyone must sign in at each lecture. (This portion accounts for 7.5% of grade, but each absence from lecture must be made up with an essay and excessive absence will result in punitive grade deductions. See notes on last page.)

2. **Professional Ethics and Responsibility** (7.5% of the final grade but unethical behavior will result in punitive grade deductions): You will be evaluated by your team member(s) and by your section instructor. See the attached evaluation forms on how this is graded.

3. The remaining 54% of the grade are based on the technical and design capability and problem solving skills you demonstrated in the design, prototype building, testing, and final report writing. **NOTE:** EE 175ABC do not have exams.

Grading will be determined by all of the section professors conferring on each project and student. Please note that grades are assigned to each individual student, not to a project team. That is, for a successful project, a student who contributed most to the success may get an A while another student on the same team who barely did any complex technical work may get a D or F.

Project Topics

Projects covering the main electrical engineering areas of the ECE department will be carried out in four different sections. You can pick a project suggested by the instructors or you can propose your own topic but it must be approved. In addition, joint projects with other departments may be arranged. Topics that each section professor will supervise are presented to the students in an information meeting held in the spring quarter and are available online.

Weekly Lecture Class Schedule

Date	Week	Lecturer	Lecture Content
10/3	Week 01	PL, RC, GC, NA, PK	Introduction, course outline, preliminary issues, requirements and expectations
10/10	Week 02	RC	Introduction to product specification process, engineering design process, understanding prior art, laboratory notebooks, library techniques, literature and information search
10/17	Week 03	GC	Design methodologies, functional block diagram and hardware block diagrams, evaluation of feasibility, problem solving and debug approaches
10/24	Week 04	PK	Lab skills, exam for equipment use and lab safety for gaining lab access
10/31	Week 05	NA	Project management: organization, teamwork, scheduling, budgeting, etc.
11/7	Week 06	GC	Experiment design, developing a test plan, collecting data, and evaluation. Realistic design constraints and considerations.
11/14	Week 07	RC	Implementation and debugging of microcontroller interfaces: RS232, I2C and SPI
11/21	Week 08	PK	Printed circuit board design, layout, and fabrication
12/5	Week 09	RC	System engineering
12/12	Week 10	ALL	No lecture. Design Review, Time TBA
			Lecture dates for winter quarter is tentative and subject to change
1/9	Week 01	Career Center	Career choices and strategies, job searches, how to write resumes
1/16	Week 02	GC	Debugging workshop: Debug case study, including cases for hardware and software
1/23	Week 03	GC	Data analysis techniques (statistical and time series analysis, curve fitting, regression, etc.)
1/30	Week 04	GC	Introduction to and use of industry standards. What is and is not an industry standard. Industry standards vs. de facto standards. Review the important sections of at least two actual industry standards, e.g., 802.11 (standard), SPI or I2C (de facto standard)
2/6	Week 05	NA	Understanding professional and ethical responsibility. IEEE Code of Ethics. A required ethics exam will be given at the lecture.
2/13	Week 06	NA	Contemporary engineering issues; understanding global, economic, environmental and societal impact; recognition of the need for and an ability to engage in lifelong learning. Engineering product testing requirements, test report requirements.
2/20	Week 07	NA	Patents and intellectual properties: how to apply for a patent, protection of IP.
2/27	Week 08	NA	Marketing engineering products, entrepreneurship, venture capital and startups
3/6	Week 09	RC	Writing Technical reports. Go over the Final Report Template section by section, with instruction on what to write in each section.
3/13	Week 10	RC	Writing Technical reports. Use two well-written EE 175 Reports as examples. Preparation for the final presentation
		ALL	Final Presentations and Demo in first or second week of Spring Quarter. Time TBA

PL – Ping Liang, **RC –** Roman Chomko, **GC -** Gang Chen, **NA** – Nissim Amos, **PK** – Pavle Kirilov

Design Review

At the end of the fall quarter, each project group is required to make a Design Review presentation. There is no computer in the presentation room. So bring your laptop for the presentation. Unless you have other classes, you are required to be there to listen to other groups' presentation.

Each group has 10 minutes for presentation. You will be cut off if you go over 10 min. So rehearse to make sure you can finish in 10min. Every member of a team must do a part of the presentation. Below is the template for the powerpoint slides. You MUST address all these issues in your presentation:

Slide 1: Title, group members, date, contact info
Slide 2: Concept and application of the design: What are you designing, technical principles, why this is a meaningful project, what are the intended applications, how is it related to subjects in electrical engineering.
Slide 3: Technical design objectives, be specific and should be numerical and measurable, e.g., response time, speed, frequency or transmission range, SNR, accuracy, false alarm rate, power consumption, capacity, etc.
Slide 4: High level design, show block diagram of the system.
Slide 5: Technical challenges, what are the difficult electrical engineering related technical problems that you need to solve, what are your approaches to solve them
Slide 6: Major tasks and who is responsible for what
Slide 7: Design considerations: realistic constraints, industry standards, costs, time, skills etc.
Slide 8: Summary and an optional short video showing what you have done so far
Slide 9: Acknowledgment of people helped you or provided you with the design concept or ideas

Final Presentation and Demo

At the beginning of the spring quarter, each project group is required to make a final presentation and public demo. There is no computer in the presentation room. So bring your laptop for the presentation. Unless you have other classes, you are required to be there to listen to other groups' presentation.

Each group has 10 minutes for presentation. You will be cut off if you go over 10 min. So rehearse to make sure you can finish in 10min. Every member of a team must do a part of the presentation. Below is the template for the powerpoint slides. Your final presentation MUST contain the info listed below and it MUST include a real time demo or a video demo.

Slide 1: Title, group members, date, contact info
Slide 2: Concept and application of the design: What did you design, technical principles, why this is a meaningful project, what are the intended applications, how is it related to subjects in electrical engineering. List any changes from your design review presentation in 175A
Slide 3: Technical design objectives, be specific and should be measurable (numerical), e.g., response time, frequency or transmission range, SNR, accuracy, false alarm rate, power consumption, capacity, etc. List any changes from your design review presentation in 175A
Slide 4: Final high level design, show block diagram of the system. Highlight any changes from your design review presentation in 175A
Slide 5: Technical challenges, what are the difficult electrical engineering related technical problems you encountered and solved, was there any difficulty that you were unable to solve, and how have you changed your design to get around it?
Slide 6: Major components of the design and implementation, and who contributed to what
Slide 7: Design considerations:
* Realistic constraints (time, skill, power consumption, weight, size, microcontroller speed, memory size, sampling rate, data rate, costs (this is for weighing the costs of different design decisions. Do NOT simply show a list of parts and their costs), etc.
* What industry standards did your project involve? e.g., 802.11, Bluetooth, I2C, USB, RS232, Zigbee, etc. How using the industry standards affected/constrained your design? (e.g., data rate, voltages, connectors, compatibility with other devices, etc.)
List any changes from your design review presentation in 175A
Slide 8: Test report: how did you test the system, what are the test results (in quantitative measures), how close did you come to your design specification?
Slide 9: A real demo or a demo video is required. If your design cannot be demoed at the presentation, you should schedule a demo after the presentation and invite the class to visit
Slide 10: Summary
Slide 11: Acknowledgment of people helped you or provided you with the design concept or ideas

Notes of first lecture

1. Attendance of lectures and weekly lab sessions are required. If you miss a lecture, you will be required to submit a >500 words essay on the topic of the lecture and submit it before the next lecture. If you miss more than 3 lectures, your final grade will be deducted one grade level and one more grade level for two more lectures you miss, and you are still required to submit the essays. EE 175ABC do not have textbooks nor exams.
2. You can pick a project suggested by the instructors or you can propose your own topic but it must be approved. All students must have decided upon a project by the time of the second lecture.
3. Each project team must be 2 or 3 students. Exceptions are approved only on rare cases with strong justifications. No single member team as teamwork experience is a requirement.
4. We will move you to the right lab section based on your project topic and all members on the same team will be moved to the same section.
5. Everyone on the team needs to do approximately equal amount of technical work. The design review, final presentation and final report must clearly indicate who did what. Cannot have one person do all administrative work, e.g., ordering parts, keeping notes.
6. Be a good team player. Teamwork is part of your grade. Everyone must be a reliable and helpful team member. Each member will be evaluated by all other team members.
7. Design specifications and test plans must be numerical and measurable.
8. Must do prior art study. Find out what has been done, how other people have done it and what are their advantages and shortcomings. How your design compare with theirs.
9. Focus is on design using electrical engineering knowledge. Don't spend more than 10% of your effort on mechanical designs.
10. You will be given access to ECE teaching lab to work on your project after you pass a lab skills and lab safety exam. You must follow lab rules or your lab access may be revoked.
11. Mr. Kirilov is in charge of ECE labs and can provide some parts. He is an experienced engineer and is available to help you.
12. Instructors will guide you and point you to the right direction, but you must do your own work. Systematic problem solving is a major part of this course. You will be evaluated on how you identify problems, approach them and find solutions.
13. Design review at the end of the fall quarter, final presentation and demo at the first or second week of the spring quarter.
14. Syllabus with course requirements and final report template in iLearn. Use it to check if you covered everything.
15. Document your design process, the alternatives you experimented with, the problems you encountered, how they were solved, and who did what. These all should go into your final report. Do not wait until the end to start writing the final report. Use the Final Report Template as a guide and to document your progress right from the beginning.
16. You must have a working demo to pass the course.

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Professional Ethics and Responsibility Outcomes

Instructor's Name: _____

Section: _____

TEAM MEMBER EVALUATION FORM

Project Team (name of project) _____

Name of Student Being Evaluated _____

Name of Team Member Evaluating the Student _____

For each attribute, circle the number that best corresponds to how much you feel the attribute was met (1 = very poorly, 5 = very well)

	Attribute	Very Poorly				Very Well
1	Responsibility for performing project duties in a timely manner	1	2	3	4	5
2	Timely response to e-mails, and /or answering phone calls, and/or team meetings regarding the project status and /or project design decisions	1	2	3	4	5
3	Use of proper language	1	2	3	4	5
4	Respect of other team members	1	2	3	4	5
5	Honesty in stating claims or estimates based on the conducted project research information and/or available data	1	2	3	4	5
6	Honesty in claiming ability and/or willingness to perform parts of a project	1	2	3	4	5
7	Honesty in promptly bringing up to attention of other team members factors that may affect individual safety, and/or overall safety of the project, and/or safety, health and welfare of the public, and other factors that might endanger the public or the environment	1	2	3	4	5
8	Ability to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others	1	2	3	4	5
9	Helpfulness to team members, and willingness to assist colleagues in their professional development	1	2	3	4	5

Written Comments:

Department of Electrical Engineering, UCR, Fall/Winter/Spring 2013/2014

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Professional Ethics and Responsibility Outcome

Instructor's Name: _____

Section: _____

INSTRUCTOR'S EVALUATION FORM

Project Team (name of project) _____

Student's Name (to be evaluated) _____

For each attribute, circle the number that best corresponds to how much you feel the course helped students develop that attribute (1 = very poorly, 5 = very well)

INSTRUCTOR'S USE ONLY (please ***do not*** evaluate the attributes in this table)

	Attribute	Very Poorly				Very Well
1	Responsibility for performing project duties in a timely manner	1	2	3	4	5
2	Prompt response to comments, remarks and/or requests for information	1	2	3	4	5
3	Results of the Ethics Test given after a lecture on Engineering Ethics	1	2	3	4	5
4	Ethics essay in the Final Report	1	2	3	4	5
5	Responsibility and faithfulness in project status reporting	1	2	3	4	5
6	Being a good team player, responsive to teammate requests, being helpful to teammate	1	2	3	4	5