

EE Culminating Design Project I and II: (EE 4910 and EE 4920)

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EE 4910 (2.0 credit hours)

Objectives: Through an individualized culminating design project, a group of students will have a complete design experience including project proposal, specification development, engineering design, implementation/simulation, testing, evaluation and revision of the final deliverables. Students will be able to achieve the objectives of engineering design by incorporating engineering standards and multiple realistic constraints with the knowledge learned in one or more of the major electrical engineering focus areas such as integrated electronics, control, communication, signal processing, MEMS/micro-fabrication and RF engineering. Students will also learn to communicate project proposal, designs, and reports effectively in writing and presentation.

In this course, each project group should produce the following measurable results: 1) project proposal, organization, schedule, budget, and planning; 2) the development of design specifications; 3) engineering design and design review; 4) development and implementation progress report. At the end of the first semester, each group should have their initial implementation/simulation completed or at least have all the parts acquired ready for assembly. All the project groups achieved those goals will be enrolled in the next class EE4920 consecutively.

Prerequisites: EGR 3350 and at least one of the following courses: EE4170, EE4100, EE4440, EE4360, EE4730, EE4540 or EE4420

Co-requisites: Complete at least one design sequence while reregistering for EE4910.

Class structure: This is a project oriented class. Normally, students will work as groups of three members. Each group of students will select a project based on their interests, their knowledge base, and client's needs. Based on the selected project, the student group must find a faculty advisor for the project. In addition, it may also invite an engineering mentor if the project is sponsored by a company. Each student group must have a project leader who can be appointed by the faculty advisor or elected by the group. The project leader will act as the project manager responsible for scheduling meetings, organizing documentation, watching for deadlines, executing project schedule, managing resources (budget and man power), etc. The class will have a few general meetings where all the groups meet to present their project oral visual briefing.

Class schedule:

1st Week: Introduce the course information, class structure, and scheduling issues. The students should start looking for potential topics for the projects and forming groups based on common interest, client's needs and the knowledge base needed for the project. Where to

look for project ideas: client's needs (some listed in the course website), personal interests, talking to faculty members and engineers at government laboratories or local companies, visit related Web sites.

In 3rd Week: All the students who registered the courses should already have

1. selected their project topics,
2. formed their project groups and
3. picked up their faculty advisors/engineering mentors.

Email following information to the course instructor: 1) project title; 2) group members; 3) faculty advisor name; 4) set up a 15 minute meeting with the course instructor to get a preliminary approval for your project before the end of 3rd week.

Project proposal is due on **the Friday of 3rd week** to your faculty advisor and course instructor. **You may request for late submission with prior approval.** Project proposal shall include following information.

1. Project Title (captures the essence of your project and provide positive marketing value for your project)
2. Project group leader, group members and faculty advisor (and engineering mentor if needed).
3. Introduction to your project (purpose, benefits, risks, and background on how did people do in the past)
4. Realistic constraints and industry standards apply to your project
5. Project scope, approach, goals and deliverables
6. Project plan (personnel, resource, budget, and schedule)
7. Conclusion summary
8. References (For all the reports in this course, you need include a reference section to document all the sources which are referred to.)

Project portfolio: At this point, each group should start their project portfolio which will include the project proposal as the first document. Project group meeting minutes should be kept in the project portfolio too. It serves as a common project folder for the communication among the group members, faculty advisor, and course instructor. At the end of the semester, the group will get a grade assigned to their portfolio. The portfolio could be in electronic form (such as a website, dropbox, or a file directory) assessable to all the constituents.

4th Week: Project kick off presentation is on this week. Each group has 15 minutes to present its project and answer questions and critiques. The evaluation points (on the scale of 0 – 10 and 10 is the best) of the presentation are:

- How much do you understand what the group tries to achieve?
- Do you think the proposal has addressed the realistic constrains and relevant industry standards which apply to their project?
- Are you clear about their project scope? Do you think they are reasonable set of goals?
- Are you clear about their project deliverables? Do you think their deliverables are sufficient to support their project goals?
- Do you agree the team has sufficient expert knowledge to carry out the project?

- Do you think the group has a good plan and budgeted resources to accomplish the project goals within the scheduled time period?
- Finally, based on their proposal and weighted the potential benefits and risks, you are in favor of approving the budget to support the project.

grade scale: 0 ~ 10	Faculty advisor	Course Instructor
Project Proposal Doc	80%	20%
Presentation	50% if present	50%

5th Week: Detailed design specifications are due to the faculty advisor this week.

Document the design process to convert the realistic constrains and industry standards to detailed technical specifications. The specifications should include all the performance measurements (numbers) that can be verified during project testing phase. You need to demonstrate the connections from the engineering problems and realistic constrains to design specifications. Of course, the specifications can be modified during the course of design. All versions of specifications should be kept in the project portfolio.

grade scale: 0 ~ 10	Faculty advisor	Course Instructor
Design specifications	100%	0%

6th to 9th Week: The group should carry out their design and review their design methods and discuss any revisions and project progress with their faculty advisor. **The group should document (in the design review document) the design methods, alternative designs, any design revisions, modifications of specifications, and key design components.** At this point, each group should start assembling the parts list, allocate potential vendors, and order essential parts for the project. All the project orders will go through the Laboratory Manager of EE department, Mr. Tony Tritschler, 322RC (775-5047) or simon.tritschler@wright.edu . To reduce the shipping and handling cost, each group should generate the complete list of parts at their best effort before submitting to Mr. Tritschler. All parts orders have to be approved by the faculty advisor.

Design review documentation (due 9th week to the faculty advisor) should include the following information.

1. Detailed description of your project and background information with demonstration of utilizing a variety of resources.
2. Detailed description of realistic constrains and documented process to formulate the design specifications of your project.
3. Show complete design process including research, calculation, alternative solutions, etc.
4. Describe specifically the impact of your design solutions in a broad sense (for example, global, environmental, and societal impact).
5. Document the design results including schematics, parts and materials list with purchase requirements and vendors.

grade scale: 0 ~ 10	Faculty advisor	Course Instructor
Design review Doc.	100%	0%

10th Week: Design review oral presentation. Each group has 15 minutes to show their design details and progress including couple minutes for questions. The evaluation points (on the scale of 0 – 10 and 10 is the best) of the presentation are:

- Do you agree that their design specifications are complete in addressing the realistic constrains and industry standards related to their project?
- Do you understand their design procedures and design results?
- Have you convinced that their design(s) have the potential to meet the specifications?
- How do you think the progress of the project? Do you want to continually support the project?

grade scale: 0 ~ 10	Faculty advisor	Course Instructor
Design review presentation	50% if present	50%

11th to 14th Week: Each group should have finalized their first design(s) and start to implement their design(s). A midpoint progress report needs to be submitted to their faculty advisor at the end of the 14th week. **The progress report shall include**

1. Final design specifications
2. Final design(s) to be implemented
3. Detailed implementation plan and progress with all the electronic documents such as schematics, parts lists, simulation results, etc.
4. Outline your prototype testing plan which includes testing experiments, data collection process and data analysis methods to verify that your prototype meets the specifications.
5. You may also include any success stories and problems in the progress of your project.
6. Please address the project budget/resource/schedule and report your progress status.

The **portfolio** shall be well organized with a detailed table of content and shall include all of the documents submitted throughout the semester and any other materials pertinent to the project such as program codes, design calculations, schematics, product photos, data sheets for selected parts, testing data, meeting minutes, etc. All the materials with electronic files shall be put on a CD (or in dropbox) with a “readme.txt” to explain the content. The faculty advisor will review the organization and content of the project portfolio and assign a grade to it. The portfolio will be returned to the project leader for continuous use in EE4920.

grade scale: 0 ~ 10	Faculty advisor	Course Instructor
Progress report	100%	0%
Portfolio grade	100%	0%

Final (15th) Week: Design Project Midpoint Progress Conference will be held in the last day of the final week. Each project group will have 15 minutes to present their design and implementation progress including achievements and problems, summarize the status and schedule of their project. The evaluation points (on the scale of 0 – 10 and 10 is the best) of the presentation are:

- Does the group clearly present their final design(s) and design specifications?

- Is the group well prepared to implement their design? (Parts list, parts substitution, parts ordering, implementation methods, equipment, materials, and other resources, etc.)
- Do they have a well-planned product testing process?
- Are you satisfied with the progress of the project? Do you want to continue the support of the project?

grade scale: 0 ~ 10	Faculty advisor	Course Instructor
Progress oral presentation	50% if present	50%

Students need to be present at all the general meeting entirely. Every student will have an opportunity to evaluate the oral/visual presentations by all the other project groups. **Participation grade** is based on you attendance and participation in the evaluation process.

Individual grades: A grade is assigned to every member of a project team. The grade of project leader is measured by his or her leadership performance and project outcome and is decided entirely by the faculty advisor. The grade for the individual member of the group is measured by their individual contributions to the project and is jointly decided by the faculty advisor and project leader. The individual performance is considered in the following aspects:

1. Prepared for assignment independently.
2. Assisted in planning team's approach.
3. Completed assigned tasks as planned.
4. Listened to feedback and ideas from the team.
5. Generated initiatives to help project development.

grade scale: 0 ~ 10	Faculty advisor	Project leader
Leadership grade	100%	
Membership grade	50%	50%
Bonus (only to one student in the team)	100%	

Grades Weighting:

Part I:	Project proposal documentation	10%
Part II:	Project kick-off Presentation	10%
Part III:	Design Specifications	10%
Part IV:	Design review Documentation	10%
Part V:	Design review presentation	10%
Part VI:	Midpoint progress report	10%
Part VII:	Progress oral presentation	10%
Part VIII:	Portfolio grade	10%
Part IX:	Participation grades	10%
Part X:	Individual grades	10%
Bonus*	Each group has only one bonus assigned by the faculty advisor	5%

* Each project team has only one bonus that will be assigned to one team member for his or her extraordinary effort. The faculty advisor will decide who, if any, should be awarded the bonus points.

EE 4920 (3.0 credit hours)

Objectives: Continue working on the individualized design project established in EE 4910, the group of students will have a complete experience in project implementation/simulation, testing, evaluation and revision of the final deliverables. At the end of this course, each group will demonstrate a working product described in their project proposal. Students will communicate project implementation, testing, and evaluation effectively in writing and presentation. In this semester, each project group should produce the following measurable results: 1) project testing report and demonstration; 2) product poster and poster presentation; 3) project final report and final product debut conference presentation.

Prerequisites: EE4910 (consecutively registered) and complete at least one of the design focus areas.

Class structure: Same as EE4910

Class schedule:

1st Week: An informational meeting to set motions to continue the on going projects. Each group should start design their product test experiments which can verify if the product meets the specifications or not.

2nd – 4th week: Implementation and testing of prototype product

5th Week: By now, each group should have finished their initial implementation and their prototype product should be undergoing testing. Initial test should indicate if the product meets the specifications or not. **Each group should submit a prototype testing and specification verification report which includes:**

1. Detailed design of prototype test experiments
2. Presentation of the collected testing measurement data including experimental setup conditions
3. Comprehensive data analysis results for specification verification
4. Detailed design/implementation revision and improvement

grade scale: 0 ~ 10	Faculty advisor	Course Instructor
Prototype Product Testing Report	100%	

7th Week: Midterm project demonstration conference where each group will demonstrate their initial prototype product implementation and present their comprehensive specification evaluation results. Each project team also needs to address the revision plans and proposals to improve their design or implementation if some specifications are not met. Each group has 15 minutes for oral presentation and demonstration including questions. The evaluation points (on the scale of 0 – 10 and 10 is the best) of the presentation are:

- Are you satisfied with the progress of prototype product development?
- Does the group explain clearly their testing process and data collection methods?
- Do you think their testing and data analysis methods are valid and complete?

- Based on the analysis of their testing results and the proposed remedy, are you convinced that their final product can meet the proposed objectives and specifications?

grade scale: 0 ~ 10	Faculty advisor	Course Instructor
Midterm project Demonstration	50% if present	50%

10-11th Week: Prepare a product poster to promote your product in various trade shows or technical conferences. You need to turn in the poster file approved by your advisor to the EE office by **Noon on Monday of the 12th week**. The poster includes following information (with visuals to illustrate the information).

1. The significance and purpose of the product
2. Description of the product
3. Key technical specifications and performances of the product
4. Key testing results to demonstrate/validate the product performance
5. Other information you may include such as benefits, risks, limitations, broad sense (global, economic, environmental and societal) impact of the product
6. Wow the audience! Make a poster that sales your product.

grade scale: 0 ~ 10	Faculty advisor	Course Instructor
Progress Report	100%	

A poster presentation conference is scheduled in 12th week. Each group will introduce their product in terms of its purpose, functions, specifications, performance, test results, and to market their product to potential buyers. (Demonstrations may be included if applicable.) The evaluation points (on the scale of 0 – 10 and 10 is the best) of the poster presentation are:

- Do you thing the information about the product on the poster is persuasive and complete?
- How do you rate the completeness and validity of their prototype testing data and evaluation methods?
- Are you convinced their product meets the performances or objectives claimed in the poster?
- How do you rate their poster presentation in terms of clarity, visual appealing, and information completeness (product objectives, description, testing, evaluation, and conclusions)?
- Did the presenter effectively answer your questions and clearly explain their product to you?
- The quality of their prototype product demonstration (if apply).
- Will you buy their product?

grade scale: 0 ~ 10	Faculty advisor	Course Instructor
Progress poster presentation	50% if present	50%

14th Week: Final report is due to faculty advisor. The final report contains complete information of the project such that a third party manufacture firm can produce the product with the final report. Much of the information needed for the final report has already existed in the past documents. Specifically,

1. Introduction of the project
2. Product description and complete specifications
3. Complete design information include detailed explanation, all the calculations, and parts/components/materials list with specifications and purchasing information
4. Product implementation and production information (schematics, manufacture process, and special instructions)
5. Product testing procedures and data collection/analysis methods including testing results and specification verifications
6. The report is ended with a conclusion which summarizes the project results and future improvements.
7. ABET assessment component may be included (assigned specifically for student outcome assessment)

grade scale: 0 ~ 10	Faculty advisor	Course Instructor
Final report	100%	0%

Final (15th) Week: Final Product Debut Conference will be held in the last day of the final week. Each project group will have 15 minutes to present and demonstrate their product including questions. The evaluation points (on the scale of 0 – 10 and 10 is the best) of the final presentation are:

- Does the group convince you that they have a purposeful and functional product?
- Do the testing results and analysis prove their product meets the specifications?
- How do you rate the production quality and performance of their prototype?
- Do you think their product demonstration is persuasive?
- How do you rate the investment to the project?
- Do you think their suggested future improvements valuable to the product development?

After presentation, each group should turn in their project portfolio to their faculty advisor for grading. **The portfolio shall be well organized with a detailed table of contents and shall include all of the documents submitted throughout the past two semesters and other materials listed in page 4. All the materials with electronic files shall be put on a CD (or in dropbox) with a “readme.txt” to explain the content.** The project portfolio will be kept by the faculty advisor. If students want to have a copy of portfolio, they need to duplicate for themselves. The project portfolio will be evaluated by the faculty advisor.

grade scale: 0 ~ 10	Faculty advisor	Course Instructor
Final Conference presentation	50% if present	50%
Project Portfolio	100%	0%

Individual grades: This grade is assigned to every member of a project team. The grade of project leader is measured by his or her leadership performance and project outcome and is decided entirely by the faculty advisor. The grade for the individual member of the group is measured by their individual contributions to the project and is jointly decided by the faculty advisor and project leader. The individual performance is considered in the following aspects:

1. Prepared for assignment independently.
2. Assisted in planning team's approach.
3. Completed assigned tasks as planned.
4. Listened to feedback and ideas from the team.
5. Generated initiatives to help project development.

grade scale: 0 ~ 10	Faculty advisor	Project leader
Leadership grade	100%	
Membership grade	50%	50%
Optional Bonus (only one student/group)	100%	

Students need to be present for the entire general meetings. Every student will have an opportunity to evaluate the oral/visual presentations by all the other project groups. **Participation grade** is based on your attendance and participation in the evaluation process.

grade scale: 0 ~ 10	Faculty advisor	Course Instructor
Participation		100%

Grades distribution:

Part I:	Prototype product testing report	10%
Part II:	Midterm project Demonstration	10%
Part III:	Product poster	10%
Part IV:	Poster presentation	10%
Part V:	Final report	10%
Part VI:	Final conference presentation	15%
Part VII:	Project portfolio	15%
Part VIII:	Individual grades	10%
Part IX:	Participation grades	10%
Bonus*	Each project group has one bonus assigned by the faculty advisor	5%

* Each project team has one bonus that will be assigned to one team member for his or her extraordinary effort. The faculty advisor will decide who, if any, should be awarded the bonus points.