ECE 4810 ELECTRICAL/COMPUTER ENGINEERING DESIGN I
Fall 2009

Important Note:
The webpage http://homepages.wmich.edu/~miller/ECE4810.html provides critical resources for this course, including homework assignments, handouts, hyperlinked materials, etc.

Instructor:
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Course Coordinators:
Dr. John Gesink (john.gesink@wmich.edu) and
Dr. Damon A. Miller (damon.miller@wmich.edu)

Course Development:
Dr. Gesink developed and collected much of the material used in this course. Dr. Miller and Dr. Daniel M. Litynski (dan.litynski@wmich.edu) typically alternate teaching this course and are continually working to improve your senior design experience. Your comments are welcome.

Office Hours:
Office hours are posted on Dr. Miller's door and at http://homepages.wmich.edu/~miller/. Please respect course instructor office hours. Other times are available by appointment.

WMU Catalog Description:
ECE 4810 Electrical/Computer Engineering Design I (1--3), 2 hrs. First of a two-semester sequence on engineering design in which students work in teams on approved design projects. A preliminary design is expected at the conclusion of this course. This course and ECE 4820 are approved as writing-intensive courses which may fulfill the baccalaureate-level writing requirement of the student's curriculum. ***Prerequisites:*** IME 3160; consent of department chair.

Consent of the department chair is obtained by completion of an application to enroll in ECE 4810 and is based on:

1. completion of IME 3160/ECE 3550 or ECE 4510 (for CpE students);
2. completion of ECE 2510/IME 3160/ECE 3200 or ECE 3300 (for EE students); and an
3. ability to work independently and as part of a design team, accepting responsibility for specific portions of a design project.

Project Constraints:

1. Projects requiring knowledge of subject matter presented in courses not yet successfully completed by at least one project team member will not be approved.
2. In consideration of federal export control laws, senior design projects will only utilize information that is broadly available to the engineering and scientific community. No

restrictions on dissemination of any project information or results will be accepted. Project final reports (ECE 4820) will be available to the public and project topic applications and project proposals (ECE 4810) are subject to public release less personal information. Projects that require or involve non-disclosure agreements, trade secrets, etc. will not be accepted. Student are cautioned that the export of project material goods are subject to federal export control laws and should be carefully reviewed beforehand. Federal export laws apply now and after graduation. This policy was prepared using information provided in *Export Control Laws and Senior Design Projects* by Vicki Janson, Research Compliance Coordinator, Office of the Vice President for Research.

Course Tasks and Description:
Students will be responsible for selecting a design project, forming a three-person design team, and for writing a formal proposal, which describes the project as well as its implementation. The designed device or system will be constructed in ECE 4820 based on this proposal. Lectures and assignments will examine topics relating to engineering design such as needs and specifications, patents, feasibility, engineering design methodology, project scheduling, and human factors engineering. Students will explore topics critical to the practice of engineering, including engineering ethics, intellectual property, and professional registration. Witten communication skills are also emphasized throughout the course. Each student is urged to keep a permanently bound journal/log/lab notebook in which individual contributions to the design proposal are recorded. Students are required to attend all seminars as noted in the course schedule, all ECE 4810 class meetings, and are required to register with the WMU Career Services office (See Bronco Jobs at http://www.wmich.edu/career/). Religious observances will be accommodated with advanced notice.

Department and Course Level Learning Outcomes:

Department Level Learning Outcomes[1]:

Graduates must have:

a. an ability to apply knowledge of mathematics, science, and engineering;
b. an ability to design and conduct experiments, as well as to analyze and interpret data;
c. an ability to design a system, component, or process to meet desired needs[2];
d. an ability to function on multi-disciplinary teams;
e. an ability to identify, formulate, and solve engineering problems;
f. an ability to understand professional and ethical responsibility;
g. an ability to communicate effectively;
h. a broad education necessary to understand the impact of engineering solutions in a global and societal context;
i. a recognition of the need for, and an ability to engage in, life-long learning;
j. a knowledge of contemporary issues; and
k. an ability to use techniques, skills, and modern engineering tools necessary for engineering practice and/or further graduate study.

In addition to these learning outcomes ECE 4810/20 is designed to contribute to the professional component[3] (PC) of the student's education.

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[1]The following is adapted (with only slight modification) from the Accreditation Board for Engineering and Technology (ABET) Engineering Criteria 2000, Criteria for Accrediting Engineering:

> Criterion 3. Program Outcomes and Assessment Engineering programs must demonstrate that their graduates have: (a) an ability to apply knowledge of mathematics, science, and engineering (b) an ability to design and conduct experiments, as well as to analyze and interpret data (c) an ability to design a system, component, or process to meet desired needs (d) an ability to function on multi-disciplinary teams (e) an ability to identify, formulate, and solve engineering problems (f) an understanding of professional and ethical responsibility (g) an ability to communicate effectively (h) the broad education necessary to understand the impact of engineering solutions in a global and societal context (i) a recognition of the need for, and an ability to engage in life-long learning (j) a knowledge of contemporary issues (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

[2]Defintion directly from the Annual Report of the ABET circa 1992-93:

> (3) Engineering Design. (a) Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation. The engineering design component of a curriculum must include at least some of the following features: development of student creativity, use of open-ended problems, development and use of modern design theory and methodology, formulation of design problem statements and specifications, consideration of alternative solutions, feasibility considerations, production processes, concurrent engineering design, and detailed system descriptions. Further, it is essential to include a variety of realistic constraints such as economic factors, safety, reliability, aesthetics, ethics, and social impact.

[3]The following is taken from the ABET Engineering Criteria 2000, Criteria for Accrediting Engineering:

Criterion 4. Professional Component. The professional component requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The engineering faculty must assure that the program curriculum devotes adequate attention and time to each component, consistent with the objectives of the program and institution. Students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating engineering standards and realistic constraints that include most of the following considerations: economic;

environmental; sustainability; manufacturability; ethical; health and safety; social; and political. The professional component must include (a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline (b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study (c) a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.

ECE 4810 Course Learning Outcomes

The course level learning outcomes contribute to the departmental learning outcomes as indicated below. The relevance of specific course activities to the departmental learning objectives is indicated in the course schedule at the end of the syllabus. Graduates of ECE 4810 must have:

1. an appreciation of the importance of using notebooks to document engineering research and development work (ABET: g);
2. an ability to develop a needs analysis (ABET: a,c,e,h,j);
3. a working knowledge of the sources of engineering design specifications (e.g. consumers, companies, groups having authority) (ABET: c,e);
4. an ability to develop a comprehensive set of quantitative and qualitative engineering design specifications based on a needs analysis (ABET: a,c,e,h,j);
5. an ability to apply and understand the advantages and disadvantages of the three primary methods of engineering design: synthesis, repeated analysis, and device evolution (ABET: a,c,e,k);
6. an ability to conduct a physical and economic feasibility study for a proposed device or system (ABET: a,b,c,e,k);
7. an ability to conduct a literature and patent search to support an engineering design project (ABET: a,b,c,e,k);
8. an ability to design a device or system to meet a specified need using knowledge of mathematics, science, and engineering, while considering (as listed by ABET Engineering Criteria 2000) “economic; environmental; sustainability; manufacturability; ethical; health and safety; social; and political” issues (ABET: a,b,c,e,h,j,k);
9. an ability to effectively function as a member of a design team (ABET: c,d,g);
10. an ability to develop a strategy for designing a device or system based on a precedence matrix (ABET: a,b,c,e,k);
11. an ability to use physical and/or mathematical models to verify that a designed device or system satisfies the design specifications (ABET: a,b,c,e,k);
12. an ability to provide effective documentation for an engineering design project (ABET: g);
13. an ability to estimate time needed to complete an engineering project using the critical math method and the program evaluation and review technique (ABET: c,k);
14. a knowledge of the role that human factors engineering has in engineering design (ABET: a,c);

15. an ability to determine the tolerance on a device or system based on the tolerances of the individual components comprising that device or system (ABET: a,c,e,k);
16. a basic understanding of mechanisms to protect intellectual property, including patents, copyrights, trademarks, semiconductor masks, and trade secrets (ABET: c,e,k);
17. an understanding and appreciation of engineering ethics, including an ability to cite examples where engineering ethics were compromised with disastrous consequences (ABET: f);
18. a knowledge of the IEEE and the NSPE Code of Ethics (ABET: f);
19. an understanding of the importance of, and how to obtain, a professional engineering license (ABET: f);
20. an appreciation for the role engineers play in society (ABET: f,h,i,j);
21. an awareness of basic electronic system prototyping techniques (ABET: k);
22. and an ability to correctly and effectively communicate via the written word (ABET: d,g,k).

Textbook and Materials:

Required:

1. Access to the webpage http://homepages.wmich.edu/~miller/ECE4810.html
2. W. H. Middendorf, Design of Devices and Systems, Marcel Dekker, 3rd ed., 1998.
3. Pfeiffer, Technical Writing, 5th ed. or later, 2003, Prentice Hall.

References:

1. Student Reference Manual for Electronic Instrumentation Laboratories, S. Wolf and R. F. M. Smith, Prentice Hall, 1990 (1st ed.) or 2004 (2nd ed.).
2. See http://www.wmich.edu/engineer/events.htm for events in the WMU College of Engineering and Applied Sciences.
3. Other hyperlinks are provided on the course website for resources related to engineering design, vendors, engineering ethics, etc.

Recommended:

1. Student Reference Manual for Electronic Instrumentation Laboratories, S. Wolf and R. F. M. Smith, Prentice Hall, 1990 (1st ed.) or 2004 (2nd ed.).
2. Linear Technology**,** LTspice/SwitcherCAD III, available at no cost at http://www.linear.com/designtools/software/. This software can be used to simulate circuits of any complexity and is available in the CAE center.
3. A high level mathematics software suite is useful but not required for course assignments. Such packages are practically indispensable for your senior design project. These packages are typically offered to students at significantly reduced rates. Pick one and master it for use throughout your academic and professional career:
    a. The MathWorks, MATLAB® & SIMULINK®. MATLAB® is widely in engineering. The CAE center provides access to this software.

b. Wolfram Research, Mathematica® provides a remarkable, unified *symbolic* approach to computing. Visit http://www.mathematica.com/ to see some of the extraordinary capabilities of this package developed by Stephen Wolfram.
c. MapleSoft, Maple®, available on main campus.

COURSE POLICIES

Academic Honesty

General:

> *You are responsible for making yourself aware of and understanding the policies and procedures in the Undergraduate and Graduate Catalogs that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. [The policies can be found at http://catalog.wmich.edu under Academic Policies, Student Rights and Responsibilities.] If there is reason to believe you have been involved in academic dishonesty, you will be referred to the Office of Student Conduct. You will be given the opportunity to review the charge(s). If you believe you are not responsible, you will have the opportunity for a hearing. You should consult with your instructor if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test.* — provided by the Professional Concerns Committee of the WMU Faculty Senate

Plagiarism:

> *One of the most serious academic offenses is **plagiarism** (see definition for "plagiarize" in the Cambridge Advanced Learner's Dictionary). If your institution, colleagues, or professional organization believe that you have unfairly used the work (the intellectual property) of another person, you may lose your job, be asked to leave your university, and/or have your professional career ruined* [from www.ohiou.edu/Esl/help/plagiarism.html]. See that website for tutorials on how to insure that you never plagiarize another's work.

Grading Basis

Project Proposal (written)	40%
Proposal Preparation, Preparation Process, and Homework	15%
Examination and Quizzes (announced or unannounced)	45%
Penalty for avoidable non-3-person team	15%

OUTSTANDING WORK might earn extra credit. The first student to report an error in any material prepared by the course instructor will earn extra credit.

Scale: 0-60 E | 60-65 D | 65-70 DC | 70-75 C | 75-80 CB | 80-85 B | 85-90 BA | 90-100 A |

Class attendance is required and might be factored into the final class score.

Fundamentals of Engineering (FE) Examination

Students that take the FE exam **during this semester** will earn a 10% credit added to their final grade. Proof of examination attendance attached to a memo submitted to the course instructor by the Wednesday of final exam week is required to earn this credit. See http://www.ncees.org for the examination registration deadline and test date. Students that have already passed this examination are eligible for this credit. **Note that the FE exam is offered 24 October 2009 at the CEAS.**

EXAMINATIONS AND QUIZZES will be closed-notes closed-book unless otherwise noted. You must have a WMU issued ID with you at the exam.

Only under extremely unusual circumstances will make-up examinations and quizzes be considered. If an emergency prevents you from attending a scheduled examination or quiz, contact your instructor PRIOR to the test or as soon as you can reach a telephone, e-mail terminal, etc. If the instructor cannot be reached directly, leave a message with the department (276-3150). Failure to adhere to this policy will result in zero credit for the exercise.

Use of Calculators

When a calculator is allowed on a quiz/exam, **without exception** only models accepted by the Fundamentals of Engineering Examination may be used; see http://www.ncees.org/exams/calculators/index.php#approved for a list of approved calculators.

HOMEWORK will be assigned regularly. Some of it will be collected and evaluated. Collected homework should normally be done on 8 1/2" by 11" sheets. "Engineer's Pad" sheets are preferred. Solutions must be done in a neat, structured, logical, and orderly manner with frequent brief notations enabling the grader to readily verify the author's source of information, steps taken, sources of formula, equations, and methods used. (USE THE PARTIAL CHECK LIST FOR HOMEWORK SUBMITTED FOR EVALUATION below). Papers failing to meet these guidelines may not be graded and may be returned, with or without an opportunity for resubmission with a penalty. LATE HOMEWORK will not be accepted, except under extraordinary circumstances.

PARTIAL CHECK LIST FOR HOMEWORK SUBMITTED FOR EVALUATION:

1. The first page must include: (a) author's name, (b) course name/number, (c) due date, and (d) name/title/identification of the assignment (e.g. R&D problems 3, 7 & 9 chapter 4, Middendorf).

2. Use only one side of the paper and include a brief and concise statement of the problem prior to its solution. Begin each problem on a new page.
3. Number the pages and {DOUBLE SPACE} the text.
4. Place problems in ascending order and staple in the upper left corner.
5. In answers to subjective questions, **USE COMPLETE SENTENCES** and proper grammar, punctuation, style and terminology appropriate to technical writing. Consult Pfeiffer.
6. **GRAPHS:** Entitle graphs, label and include axes, include key symbols for multiple curve graphs, and give brief notes of explanation where appropriate.
7. Briefly but clearly annotate your document in a way which will provide the document reader with information such as:
    - Which part of the assignment is this?
    - What is being done and why?
    - How was it done and what are the results?
    - How was an equation (formula) obtained and how was it used?
    - If calculation results are included, always include a set or sets of sample calculations.
    - If a computer was used in a solution, provide appropriate hard-copy documentation validating originality of author's work. Include adequate explanatory comments, give spreadsheet cell formulas, and present sample calculations.
    - DEFINITIONS OF SYMBOLS AND PARAMETERS.
8. You may not use circuit design software tools alone to complete homework without prior permission. You may use such tools to check homework hand analyses.

The author's sense of professional pride should be discernible from the manner of information presentation.

TENTATIVE COURSE SCHEDULE

Schedule subject to change. Additional Friday class meetings might be scheduled.

class #	**date**	**topic**
WEEK 1		
1	9/9	course introduction discuss course learning objectives, syllabus, plagiarism discuss ideal 4810/20 project importance of engineering notebooks project search formation of senior design teams Note: course instructor to send test email and bring example proposals
WEEK 2		
2	9/14	engineering design: needs analysis and specifications plagiarism quiz?

		Note: course instructor to email project leads list.
3	9/16	engineering design: sources and types of specifications Note: course instructor to bring example devices: straight-line trainer, GFI
WEEK 3		
4	9/21	**ATTEND CEAS SEMINAR: Engineering Ethics – Dr. Tony Vizzini, Dean, CEAS, D-115, 4:30-5:20**
5	9/23	engineering design: specifications/taxonomy, device evolution
6	9/25	project topic application (PTA) Note: course instructor to bring example PTAs
WEEK 4		
7	9/28	evolution engineering design: repeated analysis
8	9/30	engineering design: synthesis
WEEK 5		
9	10/5	engineering design: design methods and feasibility studies
10	10/7	quiz: design methods
WEEK 6		
11	10/12	quiz: design methods
12	10/14	project scheduling: CPM
13	10/16	**FRIDAY FRIDAY FRIDAY** **PTA due** project scheduling: CPM and PERT system vs. component tolerances Note: Course instructor to provide examples of excellent/poor essays
WEEK 7		
14	10/19	**ATTEND CEAS SEMINAR: (tentative title) "WMU's Energy Sustainability/Conservation Efforts" – Peter Strazda, CEAS, D-115, 4:30-5:20**
15	10/21	engineering design: "The Light Stuff"' a PBS NOVA program on engineering design of human powered flight (guest lecturer: Dr. Litynksi)
	10/22	CEAS Career Day 10AM-3PM Main Entrance, CEAS
WEEK 8		
16	10/26	"Light Stuff" discussion; CPM method
17	10/28	review project topic applications
WEEK 9		
18	11/2	**ATTEND CEAS SEMINAR: Engineering Written Communication – Dr. Betsy Aller, D-109 CEAS, 5:30-6:20**
19	11/4	intellectual property **FIRST DRAFT OF PROPOSAL DUE** to 4810 instructor Be sure to attach a proposal evaluation form ("Evaluation Criteria for ECE 4810 Project Proposals") as the cover of your proposal; **FILL OUT THE PROJECT TITLE AND TEAM MEMBERS** on that form. Also **TURN IN YOUR GRADED PTA** with your proposal.

WEEK 10		
20	11/9	review assignments
21	11/11	engineering ethics: introduction
22	11/13	**FRIDAY FRIDAY FRIDAY** **EXAM #1** (bring "blue book")
WEEK 11		
23	11/16	intellectual property engineering ethics
24	11/18	engineering ethics: view NSPE "Gilbane Gold" video on realistic but fictitious ethics case
WEEK 12		
25	11/23	engineering registration **SECOND DRAFT OF PROPOSAL DUE** to 4810 instructor (be sure to include a copy of the **proposal evaluation form** as the proposal cover sheet)
WEEK 13		
26	11/30	electronic fabrication techniques
27	12/2	discuss assignments DM-1 and DM-2
WEEK 14		
28	12/8	**TUESDAY:** attend at least two ECE presentations at the senior design conference. **Sign attendance sheet**.
29	12/9	product liability instructor evaluation course wrap-up **FINAL DRAFT OF PROPOSAL DUE** to 4810 advisor (be sure to include a copy of the **proposal evaluation form** as the proposal cover sheet); **Submit** *Sponsor Evaluation and Acknowledgement of Receipt of Final Project Proposal* form. See form for instructions **before submitting final proposal draft.**
WEEK 15		
30	TBD	**FINAL: Bring "blue book"**

Credits

Adapted in part from syllabi by J. Gesink and J. Kelemen.