CENG/EE 464: Engineering Design I  
Fall 2014  
Rev. 1

CLASS SCHEDULE:
Lecture: Tuesday at 8:00AM in EP208

INSTRUCTOR INFORMATION:
Dr. Charles R. Tolle  
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Office: EP 323, Phone: 394-6133  
Office Hours: MWF 3:00pm-4:00pm, T 9:00am-11:00am, Th 8:00am-10:00am, or by appointment.

Catalog Description:
CENG 464 COMPUTER ENGINEERING DESIGN I  
(2-0) 2 credit. Prerequisites: CENG 342, EE 320. Prerequisite or corequisite: EE 311, EE 312, CSC 470, and ENGL 289. This course will focus on the design process and culminate with the faculty approval of design projects (including schematics and parts list) for CENG 465. Typical topics included are the development of a product mission statement, identification of the customer and customer needs, development of target specifications, consideration of alternate designs using a decision matrix, project management techniques, legal and ethical issues, FCC verification and certification, use of probability and statistics for reliable design, interpretation of data sheets, and component selection. (Design content - two (2) credits)
Expectation: completed prototype of central part of project.

EE 464 SENIOR DESIGN I  
(2-0) 2 credits. Prerequisites: Senior standing and prerequisite or corequisite EE 311, EE 312, EE 322 and ENGL 289. This course will focus on the design process and culminate with the EE faculty approval of design projects (including schematics and parts list) for EE 465. Typical topics included are the development of a product mission statement, identification of the customer and customer needs, development of target specifications, consideration of alternate designs using a decision matrix, project management techniques, legal and ethical issues, FCC verification and certification, use of probability and statistics for reliable design, interpretation of data sheets, and component selection. (Design content - two (2) credits)
Expectation: completed prototype for central portion of the project by end of Senior Design II, engineering documentation: aka user documentation, requirements document, specification document, testing plan document, engineering design (semantics, board layouts, software, SPICE simulations, Matlab Simulations, algorithms, data sheets, vendor lists, etc.), project management documentation (earn value analysis, effort reporting, and budget accounting information), logbook, PDR, CDR, Poster and any engineering turnover documentation needed by the nature of the project (i.e. if the project was not fully completed – provide the additional information needed by the next team to continue the project). This list is subject to changes.

Expectation: each student will commit least 300~350 hours on their project spread over two terms, aka ~10 hours a week.

There is a lot of documentation within this 2 semester course—more than 50% of your effort will be in documentation.
**PDR Grading:** Exceptions must be approved by instructors and advisors:
- PDRs that occur before Nov. 17th start grading at 100%
- PDRs that occur between Nov. 17th and Nov. 30th start grading at 90%
- PDRs that occur after Dec. 1st start grading at 80%

**Writing and Global Issues:**
This course emphasizes writing and an understanding of global issues in fulfillment of Policy 2:7 of the Board of Regents. The quality of your writing will be evaluated and will contribute to your grade for the progress- and final reports. Evaluation of your grasp of global issues will be done as part of the final written report and occasional quizzes.

**Supplemental Textbook:**

**Goals:**
The goal of this course is to provide students with the working knowledge of practical design issues, project management, issues of professionalism, and prototype development.

**Faculty Mentor:**
Each project must have a faculty mentor. You must meet with your faculty mentor weekly (or regularly as specified by your mentor).

**Class Schedule:**
Lecture: 1 hour per week. Laboratory: Open Lab to work on your project.

**Submitting Memos and Reports:** email to charles.tolle@sdsmt.edu and project mentor and turn in a printed copy as well.
If attachments are too large to email, submit on CDROM or place in the temporary directory on the fileserver emailing the location. Progress report means a brief memo with an updated Gantt chart realistically describing your progress, difficulties, and any relevant issues with a copy to your mentor and me. The final report is a formal oral and written report.

**Make-up Policy:**
Missed lectures will not be made up. Assignments will be considered late if not submitted by 5:00 PM on the day they are due. Please make arrangements with the instructor ahead of time for planned absences and late assignments.

**ADA Note:**
Students with special needs or requiring special accommodations should contact me and/or the campus ADA coordinator, Ms. Jolie McCoy, at 394-1924 at the earliest opportunity.

**Topics May Include:** (still under development)
1. Introduction
   - Discussion of course goals, class logistics, and use of logbook
   - Discussion of project possibilities and presentations by project sponsors
2. Design Background
3. Teaming
4. Data Sheets – Publications -- Standards and Certification
6. PCB Layout, using the circuit board prototyping machine
7. Professionalism and Ethics
8. Intellectual Property: patents
9. Product Liability
10. ES&H (Environmental, Safety and Health)
11. Quality
12. PE – career paths
13. Globalization

TENTATIVE GRADING (SUBJECT TO CHANGE BY THE INSTRUCTOR DURING THE COURSE):

- **25%** Assignments: mini-project, essays, earned value analysis (EVA), etc.
- **25%** Preliminary Design Review and Scheduling
- Critical Design Review (if undertaken within the first semester of the sequence)
- **15%** Professionalism/Progress Reports/Meeting Goals/Project Effort/Difficulty/Use of Project Management Tools (Assigned by instructor and mentor considering project difficulty, background, team size, choice of tool (e.g. Trello, svn, etc.))
- **10%** Log Book – each student must have their own logbook – and use it!
- **15%** Req./Spec./Test Plans
- **10%** Time Cards

PROJECTS:
- You must find a faculty mentor who is willing advise your project, i.e. to meet weekly (or other regular schedule specified by your mentor) with you and guide you through your design project.
- Team projects are encouraged, Interdisciplinary projects are encouraged (perhaps a joint project with an ME or CSC senior design team).
- Be careful of projects that depend on a particular/unique/expensive/hard-to-get... chip, sensor, or part.
- A project with a sponsor is closer to an actual industrial project - several are available. (Be sure to coordinate with your sponsor providing copies of class memos and reports.)
- Software only projects are possible. (A logbook is still required!)
- The educational value of the project is more important than being state-of-the-art; nevertheless, the $200 lamp dimmer projects should be avoided.
- ABET requires projects that incorporate engineering standards and realistic constraints that include most of the following considerations: economic; environmental; sustainability; manufacturability; ethical; health and safety; social; and political

ABET:
“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.”

“... a word about my view of what an engineer does, since this colors my ideas of how an engineer needs to be educated. Science is analytic - it strives to understand nature, what is. Engineering is synthetic - it strives to create what can be. My favorite operational definition of engineering is "design under constraint." Engineering is creating, designing what can be, but it is constrained by nature, by cost, by concerns of safety, reliability, environmental impact, manufacturability, maintainability, and many other such "ilities." Engineering is not "applied science." To be sure, our understanding of nature is one of the constraints we work under, but it is far from the only one, it is seldom the hardest one, and almost never the limiting one.” Source: William A. Wulf, The Bridge, National Academy of Engineering, Volume 28, Number 1 - Spring, 1998

FREEDOM IN LEARNING: Under Board of Regents and University policy student academic performance may be evaluated solely on an academic basis, not on opinions or conduct in matters unrelated to academic standards. Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled. Students who believe that an academic evaluation reflects prejudiced or capricious consideration of student opinions or conduct unrelated to academic standards should contact the dean of the college which offers the class to initiate a review of the evaluation.
**Project Management Tools:** Each project will have a Trello project page unless otherwise agreed upon by project sponsors. Trello helps organize and track week-to-week activities. Additionally, each project is required to have an accessible electronic warehouse for all project documents, e.g. a GitHub, Dropbox, or SVN. The students are required to use this warehouse to maintain them to the latest versions of their documentation, code, planning, etc. documents. The project members, advisors and instructors will each have access to these tools.

**Time Sheets:** Each student will track their project time on a weekly basis against charge account task numbers tied to their project plans. Time sheets will be logged, signed, and dated every week! The student’s mentor/advisor must sign and date these time sheets on a bi-weekly basis, i.e. every other week at a minimum!) Initially all students will begin logging time against a project planning account task, number 101. The student and mentors/advisors should assign task numbers such that the work being performed each week under the task structure decided upon gives sufficient detail so that your mentor/advisor clearly understands what portion of the design/project/classwork you have been spending your time on that week. We will use these results to discuss project planning, value added cost accounting and other modern project monitoring methods. Engineers are generally exempt employees, nevertheless many companies that interact with government agencies still require cost accounting to the nearest tenth of an hour. We will assume your pay is ~$30 per hour and our overhead multiplier is 2.5 for a charge out rate of $75 an hour. Time is money! So track it and don’t waste it!

**Logbook:** Each student must keep his or her own logbook for your project; i.e. when working on a team, each person must keep a separate logbook for their own work! All work on the project should be recorded in the logbook as the work is performed. **If you do not record your work in your logbook then it will be assume that no work has been completed on the project — and a commensurate grade will have been earned!** Even your rough calculations and thoughts about how to proceed on the project should be entered. The reader should be able not only to reproduce your work from the logbook, but also should be able to understand why you made certain choices from your comments in the logbook. Further more the logbook serves the following purposes:

**First,** the logbook serves as a record of design ideas, design calculations, experimental procedures and data, library research, diagrams, graphs, photographs, lists, phone numbers, addresses, etc. – the “nuts and bolts” of the project. The logbook is therefore a means of managing the project.

**Second,** the logbook is the primary source for progress reports and other technical documents, such as applications for patents, or papers submitted to a professional society, or proposals for new work.

**Third,** the logbook provides the technical chronology of the project, and thus provides a legal record of work done. This is particularly important when it comes to filing a patent claim, or defending one in court.

**Fourth,** the logbook becomes indispensable when the work you have done is to be continued by someone else. Frequently you will need to refer to work done on past projects, and a well-written logbook can often save you from repeating an experiment or a calculation.

You will quickly forget work and ideas, so write them down, in detail. Write your logbook as though:

i. You are anticipating that someone else will eventually continue the work.

ii. It may be needed to back patent priority claims in court.

iii. One day you will be famous, and your logbooks will be made public.

Logbook requirements:
1. The logbook must be bound (spiral notebook is not acceptable).
2. Each page must be numbered from front to back before any entries can be made in the book.
3. After the index -- No pages are to be left empty, i.e. no blank or extra pages can be left without a formal statement on that page that they have been left blank and signed and dated.
4. All entries must be in ink.
5. Project title, principal investigator (your name) and a brief statement of the project should appear at the front of the logbook.
6. All entries must be signed and dated.
7. The top of each page should be initialed and dated by the author, the bottom of the page should be signed and dated by the author when complete, and another individual – and advisor, other student, or project member
capable of understanding the entries must also sign and date each bottom of the page indicating that the information has been read and understood near to the entries dates (within a few weeks).

8. Blank areas must be crossed out and signed along the cross.
9. Mistakes should be lined out and initialed, still legible.
10. Data sheet copies, program listings, design ideas from trade journals, web page printouts, faxes, textbook page copies etc can be glued or taped in the logbook. Sign and date so that the writing is half on the logbook page and half on the entered page. (Supplementary items too large for the logbook can be kept in a binder and referenced in the logbook.)

11. Leave a few pages at the beginning for use as a table of contents.
12. Do your work in the logbook i.e. don’t work on scratch paper then copy into logbook. Record a narrative – what you are doing and why i.e. record what you are thinking.
13. Record phone numbers and summarize conversations with vendors about parts.
14. Can keep CD, DVD, or flash drive in a sleeve fixed to the back cover to keep successive versions of software.
15. Make timely entries i.e. make entries at least every week. If nothing accomplished, enter that in logbook
16. It is permissible to write only on the facing page leaving the opposite page as a scratch work area but if blank these must be lined out and signed as one progress to the next page.
17. It is permissible to write “continued on page xx” and “continued from page yy” if needed.

The completion of the course includes a final written report. The final written report from 465, Engineering Design II, may be placed on the web. Arrangements can be made in cases where this may not be appropriate such as sponsor confidential material. A project poster will be required as part of the participation in the Project Demonstration (fall) or Design Fair (spring).

At the discretion of the instructor, PDRs, CDRs, and Final Project presentations will be recorded on video for possible internet posting in the future.
OUTCOMES:
Upon completion of this course, students should demonstrate the ability to:
1. Begin a design project by writing a mission statement, developing an objectives tree, consider alternative solutions, and choose a solution using a matrix comparison technique.
2. Use data sheets to understanding the types (product review, advance information, preliminary information, and definitive), terms (e.g. typical, min, max, absolute max), and issues of specsmanship.
3. Use project management tools such as Gantt Charts created with MS Project.
4. Work effectively in teams.
5. Use appropriate prototyping techniques such as breadboards, wirewrap, protoboards, surface mount, programmable chips, and PCB layout and fabrication.
6. Be familiar concepts of professionalism and ethics.
7. Be familiar with issues of globalization and its effect on engineering.
8. Include issues of standards and certification in project design.
9. Include issues of intellectual property in project design.
10. Include issues of product liability and social responsibility in project design.
11. Use design resources such as professional journals, trade journals, catalogs, and the internet in project design.
12. Communicate the project design effectively.
13. Test, debug, and verify that the design meets the desired specifications.

RELATION OF COURSE TO PROGRAM OBJECTIVES:
These course outcomes fulfill the following program objectives:
(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.

The following table indicates the relative strengths of each course outcome in addressing the program objectives listed above (on a scale of 1 to 4 where 4 indicates a strong emphasis).

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PREPARED BY: Michael J. Batchelder, Date: August 30, 2002--Aug. 29, 2013 by Ralph Grahek