CS/EE/CpE/Biom 480 Senior Design/Capstone Course – Fall 2014

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The capstone course in the Lane Department of Computer Science and Electrical Engineering is organized as a two semester sequence. During the first semester students form themselves into groups of size ranging from two to five, and select a project from a list of projects sponsored by individual faculty members or a research lab in the Department. In some cases a project may be sponsored by an external entity. It is also possible for student groups to come-up with their own project ideas provided they can persuade a faculty member to sponsor the project. In some cases, more than one group may work on the same project and thus create internal competition.

During the two semesters, the students will be exposed all phases of a project: a) concept development, b) background research, c) business plan development, d) project management plan development, e) requirements specification, f) system design, implementation and testing, g) project documentation and hand-off to the "customer."

Classroom lectures by the instructor and guest speakers are designed to emphasize the best practices including legal and ethical issues in all the phases of a project as well as prepare the students to become world-class engineering professionals.

CS/EE/CpE/Biom 480: 2 Hours Credit (GEC "W" Course)

Prerequisite: English 102 and Consent. You should take this course in your **penultimate semester**. You must submit a copy of your Graduation Eligibility Worksheet to the instructor as proof that you are qualified to take the class. *If we discover at any time that you are taking this course without having met these requirements, your name may be deleted from the class.*

Goals and Objectives

In this course, students will be exposed to a real-world like environment where they will be expected to work as part of a self-organized team to produce an appropriate solution for a real-world problem. The course process emphasizes realization of students' intrinsic motivation and peer input where appropriate. This will provide an opportunity to develop a number of essential skills:

1. Integrative thinking – how to apply knowledge gained in different courses to the problem at hand
2. Lateral thinking - how to apply knowledge gained in solving one problem to a similar problem in a different domain
3. Working as part of a team
4. Becoming aware of the global nature of business and develop cultural sensitivity
5. Managing time
6. Systematically analyzing the problem from different perspectives
7. Developing appropriate technical documents
8. Developing communication skills
9. Learning business development skills
10. Learning how to act ethically in all situations

Student Learning Outcomes

Upon successful completion of this course, all students are expected to demonstrate the ability to:

1. Develop a quality system design for a product or process that meets the complex needs of a prospective client or customer using a formally recognized and accepted engineering or software design process **(ABET 3.c).** In order to do this the design team will:
    - Determine and describe in specific terms the attributes of an acceptable technical solution to the recognized need, as well as the constraints that may be imposed on the solution.
    - Design a component, process, or system incorporating hardware and/or software to meet the desired needs.
    - Use one or more accepted technique for inventing multiple candidate concepts for products or processes to meet the recognized need.
    - Apply at least one of several techniques for synthesizing a preferred solution from a range of possible solutions.
    - Construct informative and accurate diagrams of hardware and/or software system behavioral modeling diagrams that conform to standard conventions for such diagrams and illustrate a system that meets the needs of the client within the constraints imposed.
    - Develop useful models and use them to effectively analyze candidate designs in order to predict performance.
    - Show proficiency in the use of modern engineering design software tools such as PSpice, ANSYS, Matlab, ORCAD, or Rational Rose.

- Include multiple criteria in product design and, where appropriate, use formal techniques such as reliability estimation and failure mode and effects analysis for hardware and software.
- Carefully evaluate the positive and negative attributes of candidate concept design and rationally choose the best alternative for the situation.
- Plan a design project by developing a work schedule and budget for the proposed design

2. Communicate the design by submitting via electronic means a written proposal and making a formal oral presentation of a design proposal at the end of the semester **(ABET 3.g).** This design proposal and presentation will illustrate the design team's ability to:
   - Write technical reports conforming to accepted standards.
   - Become proficient in combining the use of illustrations with technical prose to communicate effectively.
   - Articulate their ideas orally.
   - Present technical material to a general audience via a web page.
3. Design appropriate laboratory or field tests to verify performance and validate the finished design **(ABET 3.b1).**
4. Work effectively on a team with other technical people on a large project **(ABET 3.d).** The team will:
   - Allocate tasks to take advantage of team member's skills and move the project forward as quickly as possible.
   - Keep team members informed of progress that affects the work constraints of others.
   - Arrive at class and team meetings on time and with assigned work finished.

Textbook (Optional)

Clive L. Dym and Patrick Little, Engineering Design- a Project Based Introduction, 3rd edition, John Wiley, ISBN: 978- 0-470-22596

Course Process

All activities and deliverables are designed to ensure realization of the outcomes specified above.

1. Project Selection
2. Group Formation
3. Mentor Selection / Committee Formation
4. Spiral Method of Project Development
5. Project Presentation in Class (Preliminary, Intermediate and Final)
6. Project WIKI to document team work
7. "Idea Showcase" at the end of the semester

Deliverables

1. Elevator Pitch
2. Project Technical Merit
3. Extended Problem Statement and Requirements Specification
4. Design Proposal
5. Individual Research Paper
6. Project WIKI
7. Bi-Weekly Progress Reports
8. Group Self-Assessment
9. Peer Assessment (Each member evaluates the performance of the other members)
10. Peer Review of a Project of Another Group
11. Presentations – Elevator Pitch, Preliminary, Intermediate and Final
12. Outcomes Survey

Activities

1. Lectures / Discussions / Presentations
2. Group Meetings
3. Scheduled Meetings with the Instructor
4. Scheduled Meetings with the Mentor
5. Peer Review
6. Project Review with the Instructor/mentor

Assessment

1. Elevator Pitch (5%)
2. Extended Problem Statement and Requirements Specification (15%)
3. Design Proposal (50%)
4. Individual Research Paper (15%)
5. Project WIKI (5%)
6. Final Presentation (5%)
7. Idea Showcase (5%)

In addition to the above, each group is expected to submit bi-weekly reports as indicated on the Ecampus site. Missing more than two bi-weekly reports or if the reports are found to be perfunctory a 10% penalty will be applied to the overall course grade.

Lecture Topics

1. Introduction, course rules, forming teams and discussion of potential projects
2. what it takes to be a world-class engineer

3. Requirements Specification
4. Project Management and Concept Generation
5. Functional Decomposition
6. Behavioral Models
7. Failure Modes
8. Discussion of final design document – Examples, principles etc.
9. Testing
10. User Interface Design

Assignments

For each assignment, detailed description, evaluation rubric, and submission deadline will be posted on the Ecampus site. There is a built-in grace period of two days. All submissions must be done only through Ecampus. No hardcopies or Email attachments will be accepted. Deadlines are strictly enforced except in rare circumstances.

All the submissions must also be archived on the Project WIKI.

Attendance Policy

1. Missing six classes or group meetings will result in reduction of one letter grade.
2. Missing seven classes or group meetings will result in reduction of two letter grades
3. Missing more than seven classes or group meetings will result in a grade of F.

This policy will be strictly enforced with no exceptions save physician certified health situations.

Special Requirements for GEC-W Course

This course (CS/EE/CpE/Biom 480) satisfies the special requirements for GEC "W" courses. In addition to the individual research paper, each student is expected to contribute at least 20 pages to the various documents developed by the group. Each individual member should clearly identify his/her contribution in each document. In

addition to the feedback given by the instructor and the TA, you should seek comments from your project mentor. You are also encouraged to get feedback from the WVU Writing Laboratory. The feedback received should be incorporated into successive revisions of your documents. *Each document will be graded based on content, style and grammatical correctness using the rubric specified in the corresponding assignment.*

Social Justice

"The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion.
If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Disability Services (293-6700). For more information on West Virginia University's Diversity, Equity, and Inclusion initiatives, please see http://diversity.wvu.edu."

Academic Integrity Statement

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code at http://www.arc.wvu.edu/admissions/integrity.html. Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me *before* the assignment is due to discuss the matter.

I may use online tools such as Turnitin to detect plagiarism. If any assignment is deemed plagiarized from any source including from your team mates, as a minimum you will receive a zero for that assignment. If the plagiarism is found to be sufficiently egregious there may be other penalties that may result in a course grade of F.

Assessment Template for 480

Lane Department of Computer Science and Electrical Engineering
Undergraduate In-Course Program Outcomes Assessment Form

Course:BIOM/CS/CpE/EE/480 **Semester:**
Instructor: Reddy

Assessment of student preparedness for this course at the start of this term:

At the **beginning** of this term:	**Nearly 100%**	**About 75%**	**About 50%**	**About 25%**	**N/A**
1. Students had the prerequisite **math** skills.					
2. Students had the prerequisite **laboratory** skills.					
3. Students had the prerequisite **problem solving** skills.					
4. Students had the prerequisite **design** skills					
5. Students were capable of using the necessary **tools** (e.g. hardware/software, etc.)					
6. Students had the necessary **programming** skills.					
7. Students had the necessary **communication** skills.					

Course Learning Outcomes * (assessed within course)	**How/Where Assessed****	**Student Scores**			
		Min Pass %	**High Score %**	**Class Avg %**	**Grade *****
1. Develop a quality system design for a product or process that meets the complex needs of a prospective client or customer using a formally recognized and accepted engineering design process. (EE.c, CpE.c, CS.e)	System Design Document[1]				
2. Communicate the design by submitting via electronic means a written proposal and making a formal oral presentation of a design proposal at the end of the semester. (EE.g1, EE.g2, CpE.g1, CpE.g2, CS.g)	System Design Document				
3. Design appropriate laboratory or field tests to verify performance and validate the finished design (EE.b1, CpE.b1, CS.e)	System Design Document				
4. Work effectively on a team with other technical people on a large project. (EE.d, CpE.d, CS.g)	Presentation Project WIKI				

[1] The system design document contains different sections dealing with concepts, test plans etc. Only the overall score for the document is shown which is used to support outcomes 1, 2, 3 and 5.

5. Apply mathematics and physics to analyze candidate designs in order to predict performance. (EE.a, CpE.a, CS.j, CS.l).	System Design Document				

* Indicate which program outcome each course outcome maps into.
** For example "exam 1, problem 1"
*** For **Grade** give the class average on an "A=4.0, B=3.0" basis.

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** For example "exam 1, problem 1"
*** For **Grade** give the class average on an "A=4.0, B=3.0" basis.

Recommendations: Include which outcomes require more attention within the course to improve student performance, and how the course should be altered in the future to improve results

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Sample Project Ideas

1. Sustainability Applications
2. Knowledge Advantage Machine - Reddy
3. Mobile Apps (Android Operating System) – Reddy, VanScoy
4. Social Networking Apps
5. Robotics - Klink
6. Sensor Based Systems – Kulathumani
7. Power Systems - Famouri, Choudhry and Jerabek
8. Packet Radio / Wireless Systems - Valenti, Woerner and Reynolds
9. Virtual Reality / Augmented Reality - VanScoy
10. Sustainability Projects
11. Cyber Security - Nutter
12. Electric Car – Nutter
13. Internet of Things (Valenti, Reddy, Kulathumani)
14. Radio Astronomy – Schmidt, Reynolds

To see information about past projects follow this link:

https://seniordesign.lcsee.wvu.edu/capstoneCourse/Past_Projects/