NJIT Department of Biomedical Engineering

BME 495 Senior Capstone Design I

Instructor: Dr. Lisa Simone (simone@njit.edu), 608 Fenster Hall, x2982
Class Hours: Wednesdays 8:30-10:30 am (Room Tiernan 104)
Office Hours: Thursday 10:30-12:00 or by appointment
Website: http://web.njit.edu/~simone/BME495.html
Syllabus Version: 3

Welcome to Capstone Design!

We refer to this as a CAPSTONE program because you will employ much of what you have studied since you started college. In this class, you will learn how an engineer designs a device, system, or product. You will develop and fabricate novel technology. This course is what separates engineers from scientists.

TEXT
None. Supplemental handouts will be provided as needed.

COURSE DESCRIPTION:
Prerequisites: Senior Standing or permission of the instructor.
To provide students with the guidance to choose a capstone design topic and advisor and to prepare the design proposal. The course introduces the student to the definition of design as well as introducing issues of intellectual property, bioethics and safety, and professional societies.

Capstone Design I and II are run like the real world. You are now engineers in a biomedical product development firm, reporting to a project manager. Your major deliverable this term is a Contract Book. It includes all the research, analysis, planning, and documentation needed to build and test your design in Capstone II and in particular, consists of the customer needs and requirements, design requirements, test plans, and test results. In Capstone I, you will develop several of these documents including the customer requirements and preliminary design requirements. In Capstone II, you will develop the remainder.

LEARNING OUTCOMES:
By the end of the course you will be able to do the following:

1. **Design Principles**: Understand the design process from assessing customer needs through testing product release.
2. **Project Design**: Design a biomedical engineering technology-based project by applying knowledge gained at NJIT and other institutions. Apply knowledge of math and science to identify, formulate, and solve problems in the chosen design area.
3. **Develop Documentation**: Develop engineering documentation for the selected project. The Contract Book includes a mission statement, customer needs/requirements, competitive analysis, high level specifications, design specifications, design concepts, and a project plan with schedule, tasks, budget and risk analysis.

4. **Project Planning**: Divide it into deliverables, monitor the progress of this project and make improvements. Ensure your proposed project for Capstone II is feasible, doable, and APPROVED by your customer.
5. **Critical Thinking and Ethics**: Learn to research effectively. Develop an understanding of ethical issues in research and design.
6. **Effective communication skills**: Learn how to give an effective presentation. Understand how to communicate progress orally and through the written word.
7. **Work in Multi-disciplinary teams:** Learn to work and communicate effectively with peers on multi-disciplinary teams to attain a common goal. **You must first form teams (2-4 students) and find a customer with a problem or need by the second week.** Teamwork is an essential component of modern professional life as an engineer. You each bring skills, insights, and effort that the team will expect you to contribute.

COURSE OUTLINE:

Class #	Date	Topics	Homework (due this class)
1	9/6	- Introduction: What is design? - Overview of Research in BME	Three design ideas (I)
2	9/13	- Product Design Process: Overview of the Phases - Concept Development: Identifying Customer Needs	Team, Skillsets, and Problem Identification, Advisor, acquired lab notebook. (T)
3	9/20	- Product Design Process: How to Do Research - Design Competitions	CB: Background research on problem (T)
4	9/27	- Research and Feasibility Studies - Concept Development: Establishing Target Specifications - Case Study	CB: Customer Needs/Customer Requirements (T)
5	10/4	- Concept Development: Concept Generation, Selection, and Testing - Animals and Human Subject Testing	CB: Competitive Analysis (T)
6	10/11	- How to Give Effective Presentations - How to Document Work	CB: Target Specifications (T)
7	10/18	- Project Management and Project Planning using Microsoft Project, and How to Get a Job. Guest Lecturer Ron Rockland, Assoc. Dean, Newark College of Engineering	Completed Human Subjects Testing Certificate (I)
8	10/25	- In class presentation of Product Concepts	CB: Project Plan (T) Interim Presentation
9	11/1	- Ethics in Biomedical Product Design - FDA Regulation of Devices - Case Study	CB: Final Specifications (T)
10	11/8	- System Level Design: Product Architecture	Ethics Homework (I)
11	11/15	- Intellectual Property - Guest Lecturer Nicole Woods, Esq., Manager of Patent Prosecution, NJIT	IRB Application (Proposal + Consent Form) (T)
12	11/19	- System Level Design - Budget and Risk Analysis	Resume (I)
13	12/6	- Final Presentations start	Final Presentation PPT (T)
14	12/13	- Final Presentations	
	TBD	Final Exam	Completed Contract Book (T)

***The Course Outline may be modified at the discretion of the instructor or in the event of extenuating circumstances. Students will be notified in class of any changes to the Course outline and schedule.**

GRADING:

- 25% - Contract Book Assignments and Status Reports (Team grade)
- 15% - Midterm Presentation (Team grade)
- 10% - Contract Book (Final Proposal WITH advisor signature) (Team grade)
- 15% - Final presentation (Team grade)
- 25% - Final exam (Individual grade)
- 10% - Quizzes, Individual assignments, Performance Review (Individual grade)

Assignments and guidelines for deliverables will be made available via email and the website throughout the term. You are responsible for monitoring your email for timely messages.

Quizzes are unannounced and may cover any information covered in class.
Final Contract Books are due as you enter the final exam room.
Final exam covers all material covered in class.

Honor Code Violations/Disruptive Behavior:

NJIT has a zero-tolerance policy regarding cheating of any kind and student behavior that is disruptive to a learning environment. Any incidents will be immediately reported to the Dean of Students. In the cases the Honor Code violations are detected, the punishments range from a minimum of failure in the course plus disciplinary probation up to expulsion from NJIT with notations on students' permanent record. Avoid situations where honorable behavior could be misinterpreted.

No eating or drinking is allowed at the lectures, recitations, workshops, and laboratories.
Cellular phones must be turned off during the class hours.

BME 495: Learning Outcome Summary

Outcome # 1. Students will understand the fundamental principles of the design process		
Strategies & Actions	**Program Outcomes**	**Assessment Methods**
All design phases are discussed in lectures, with case studies and in class exercises.	C,D,E,H,J,K	Homework, in-class exercises and tests are graded.
Outcome # 2. Students will have the ability to design an engineering technology-based product.		
Strategies & Actions	**Program Outcomes**	**Assessment Methods**
Using lecture examples, students propose and develop project ideas under the guidance of the instructor and an external "customer." In-class progress reports and design reviews provide regular feedback.	A,C,D,E,F,G,H,I,J,K	In-class presentations, homework, tests.
Outcome # 3. Students will develop an engineering documentation package for their senior design projects.		
Strategies & Actions	**Program Outcomes**	**Assessment Methods**
Lectures and class exercises provide the template for each design phase and document. Case studies are used as examples.	D,G,H,J,K,	Homework, Contract Book deliverable, final presentation, tests.
Outcome # 4. Students will develop and execute a project plan for their design project.		
Strategies & Actions	**Program Outcomes**	**Assessment Methods**
Lectures and examples of project planning will introduce the components of a project plan.	D,G,H,I,J,K	Homework, in-class progress reports, tests.
Outcome # 5. Students will learn skills for effective research, critical thinking, and ethical guidelines for research and development		
Strategies & Actions	**Program Outcomes**	**Assessment Methods**
Lectures focus on specific topics such as ethics, plagiarism, research using human and animal subjects, and how to perform research.	B,C,E,F,G,I,J,	Homework, in-class exercises, tests.
Outcome # 6. Students will learn to work and communicate effectively with peers on multi-disciplinary teams.		
Strategies & Actions	**Program Outcomes**	**Assessment Methods**
Student projects will be conducted by teams of approximately 3 students. Each team member is expected to participate in the development of problem-solving strategies and to assume a specific role in accomplishing the team's goals.	A,B,C,D,E,G,K	Homework, oral and written presentations, performance review are graded.

ABET Outcomes expected of graduates of BME BS program by the time that they graduate:

(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 within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(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, economic, environmental, 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.
(L) an understanding of biology and physiology
(M) the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve problems at the interface of engineering and biology
(N) an ability to make measurements on and interpret data from living systems
(O) an ability to address problems associated with the interaction between living and non-living materials and systems