University Of California, Berkeley
Department of Mechanical Engineering

ME C278/BioE C237: Adv Designing for the Human Body (3 units)

Graduate Course

Syllabus

CATALOG DESCRIPTION

The course provides project-based learning experience in understanding product design, with a focus on the human body as a mechanical machine. Students will learn the design of external devices used to aid or protect the body. Topics will include forces acting on internal materials (e.g., muscles and total replacement devices), forces acting on external materials (e.g., prothetics and crash pads), design/analysis of devices aimed to improve or fix the human body, muscle adaptation, and soft tissue injury. Weekly laboratory projects will incorporate EMG sensing, force plate analysis, and interpretation of data collection (e.g., MATLAB analysis) to integrate course material to better understand contemporary design/analysis/problems. The final group project will challenge students to design a human body-interfacing product based on the course material covered throughout the semester.

COURSE PREREQUISITES

Proficiency in MatLab or equivalent. Prior knowledge of biology or anatomy is not assumed.

NO TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

A list of recommended texts will be available on reserve at the library.

COURSE OBJECTIVES

The purpose of this course is twofold:

- to learn the fundamental concepts of designing devices that interact with the human body;
- to enhance skills in mechanical engineering and bioengineering by analyzing the behavior of various complex biomedical problems;
- To explore the transition of a device or discovery as it goes from “benchtop to bedside”.
- Three separate written projects evaluating devices that interact with the body. Projects will focus on 1) biomechanical analysis, 2) FDA regulations and procedures, and 3) design lifecycle.

DESIRED COURSE OUTCOMES

Working knowledge of design considerations for creating a device to protect or aid the human body, force transfer and distribution, data analysis, and FDA approval process for new devices. Understanding of basic concepts in orthopaedic biomechanics and the ability to apply the appropriate engineering concepts to solve realistic biomechanical problems, knowing clearly the assumptions involved. Critical analysis of current literature and technology.

TOPICS COVERED

Basic anatomy, Muscle Mechanics, Sensors for measuring tissue function (internal and external) (EMG/Force plate experiments), Disease and Drug Treatment effects, Design objectives of external devices, passive external device design (e.g. braces, prosthetics), active prosthetic devices (e.g., connection to brain impulses), Contact stresses and wear, implantation and failure.

CLASS/LABORATORY SCHEDULE

Three-hour weekly lecture with lab.

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

Emphasis on interpretation of results from analytical and computational models, in light of economic, ethical and safety issues provides students with substantial professional component. Students are required to write professional-type short reports summarizing their computational analyses. Students are required to provide a brief oral presentation to discuss the etiology and epidemiology associated with part of the anatomy. Students will also be required to write a professional review-type summary of the literature that has improved our basic understanding of biomechanics.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

The students' progress is assessed via weekly workshop assignments with writeups, three mini-projects, which involves computer programming, one literature review paper, one Mid-term exam and a Final project (written and oral). All projects are group-based projects.

Homeworks	10%
Mini-Projects (3)	30%
Mid-term exam	20%
Final group project	40%

TOPICS COVERED/WEEKLY AGENDA

	Laboratory workshop topic	**Assignments/ Mini Projects (due)**
Week 1	Introduction; basic anatomy	
Week 2	Analysis of forces placed on the body (external and external)	
Week 3	Measure muscle output - emg laboratory assigment	
Week 4	Sensors for measuring tissue function (internal and external)	Project 1
Week 5	Internal changes on external function (disease and drug treatment effects)	
Week 6	Design objectives of external devices	
Week 7	Midterm	Project 2
Week 8	Passive external device design and performance	
Week 9	Active external device design and performance	

Week 10	Contact, wear and failure	Project 3
Week 11	Fda process and approval	
Week 12	Current advancements technology and wearables based on covered topics	
Week 13	Final project presentations	
Week 14	No discussion	Final project
Week 15		

ROOMSHARE NOTES:

This course is intended to be a roomshare with ME C178/BIOE C137. This biggest difference is the addition of three papers for the graduate students:

- Three separate written projects evaluating devices that interact with the body. Projects will focus on 1) biomechanical analysis, 2) FDA regulations and procedures, and 3) design lifecycle
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PERSON(S) WHO PREPARED THIS DESCRIPTION

Dr. Grace O'Connell

ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): ADV DES HUMAN BODY
TIE CODE: LECS
GRADING: Letter
SEMESTER OFFERED: Spring
COURSES THAT WILL RESTRICT CREDIT: None
INSTRUCTORS: Prof. O'Connell
DURATION OF COURSE: 15 Weeks
EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 9
IS COURSE REPEATABLE FOR CREDIT? No
CROSSLIST: BioE