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

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<th>Laboratory workshop topic</th>
<th>Assignments/ Mini Projects (due)</th>
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<td>Week 1 Introduction; basic anatomy</td>
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<td>Week 2 Analysis of forces placed on the body (external and external)</td>
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<td>Week 3 Measure muscle output - emg laboratory assigment</td>
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<td>Week 4 Sensors for measuring tissue function (internal and external)</td>
<td>Project 1</td>
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<td>Week 5 Internal changes on external function (disease and drug treatment effects)</td>
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<td>Week 6 Design objectives of external devices</td>
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<td>Week 7 Midterm</td>
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<td>Week 8 Passive external device design and performance</td>
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<td>Week 9 Active external device design and performance</td>
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<td>Week 10</td>
<td>Contact, wear and failure</td>
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<td>Week 11</td>
<td>Fda process and approval</td>
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<td>Week 12</td>
<td>Current advancements technology and wearables based on covered topics</td>
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<td>Week 13</td>
<td>Final project presentations</td>
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<td>Week 14</td>
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**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

**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