



**BME 499: Rehabilitation Engineering and
Assistive Technologies**

Units: 2

**Fall 2020, DAY, TIME (one 110-minute lecture per
week)**

Location: TBD

Instructor: Brittany P. Kay, Ph.D.

Office: Denney Research Center (DRB), room 163

Office Hours: TBD

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Teaching Assistant: TBD

Office: DRB 156 (BME TA room)

Office Hours: TBD

Contact Info: TBD

IT Help: N/A

Hours of Service: N/A

Contact Info: N/A

Catalog Course Description

Introduction to technologies used for rehabilitation and improved function, including limb and spinal orthoses and prostheses, gait analysis, and sensory aids and augmentation.

Expanded Course Description

This course is meant to act as an introduction to various rehabilitation and assistive technologies with a wide range of applications, focusing on current/cutting-edge procedures and devices as well as practical issues that need to be considered. The goal of this course is to allow students to see real-world applications of the theoretical material they learn in their other biomedical engineering classes. An expanded list of topics discussed includes: devices used to regain function after limb amputation or paralysis, software used to motivate patients during rehabilitation, retinal implants for restoring sight in the blind, and wheelchair designs for optimal performance and/or ergonomics.

Learning Objectives

After successfully completing this course, students will be able to:

Objective 1: Apply measurement concepts and biomechanical principles to measure and analyze human movement in order to calculate forces, accelerations, etc., acting on or associated with specific joints or limbs.

Objective 2: Analyze stress/strain experienced by body parts and prosthetic elements, and evaluate related safety factors.

Objective 3: Work as part of a team to complete a multi-week research project and share the results of their research through an oral presentation.

Objective 4: Identify and discuss key elements and issues of rehabilitative/assistive technologies.

Prerequisite(s): N/A

Co-Requisite(s): N/A

Concurrent Enrollment: N/A

Recommended Preparation: Basic background in statics and dynamics (e.g., at the level taught in AME 201 and AME 301)

Course Notes

This course is graded using a letter grade scale (i.e., A through F). Blackboard will be used for the posting of assignment and exam scores, as well as for providing course materials, including all lecture slides and homework assignments.

Technological Proficiency and Hardware/Software Required

N/A

Required Readings and Supplementary Materials

There is no textbook for this course. Lecture slides will be provided via Blackboard.

Description and Assessment of Assignments

Exams:

Exams will consist primarily of by-hand calculations and short- and medium-length written responses, with the possibility of a few True/False and/or multiple-choice questions.

Students will be allowed to bring a calculator and two double-sided, 8.5" by 11" note pages for each exam. These note pages may either be typed or hand-written.

Homeworks:

Homeworks will reflect the general question types seen on exams: by-hand calculations, short- and medium-length written responses, True/False, and multiple choice.

While students may consult with classmates regarding the homework assignments and solution ideas, students are required to write their own homework solutions: homework solutions may not be shared. It is also not acceptable to copy and paste answers from the internet, from the lecture notes, or from any other source. See the Academic Conduct section near the end of the syllabus for more information and resources. All suspected cases of plagiarism will be referred to Student Judicial Affairs and Community Standards (SJACS).

Group Presentation:

Groups made up of roughly 4 students will each prepare a 15-minute PowerPoint presentation on the (rehabilitation/assistive-engineering-related) topic of their choice. Following each presentation, there will be a 5-minute question-and-answer period during which the group will field questions from the instructor and/or their classmates. There is no write-up component of this group work.

In addition to their oral presentation, each group will be responsible for writing one exam-type question regarding their topic. Presenting groups will provide both their question and the answer/solution on the last slide(s) of their PowerPoint presentation. These questions may be used as-is or as inspiration for one or more question on the Final Exam.

Students may choose their own groups and must declare their group choices by Week 4 of the semester. Groups must then choose their topics by Week 6 of the semester.

Presentations will be made in the last week of the semester (i.e., Week 15). Students will be distributed such that there will be no more than 5 groups, so that all presentations can fit into the last lecture period of the semester.

A grading rubric has been provided at the end of the syllabus, as Appendix A.

Grading Breakdown

Assessment Tool	Percentage of Grade
Midterm Exam	30%
Final Exam	35%
Homeworks (4 total)	25%
Group Presentation	10%
TOTAL	100%

Homework Submission Policy

All homework assignments will be turned in as hard copies at the front desk of the BME suite (DRB 140); there will be a submission box set up for this purpose. See the Weekly Course Schedule for all assignment due dates.

Grading Timeline

Homeworks and exams will be graded and returned within two weeks of submission.

Additional Policies

Late policy: For every day (or portion of a day) that an assignment is late, 25% will be subtracted from its maximum point total. Assignments that are more than four days late will not be eligible for credit (exceptions will be made for documented emergencies).

Weekly Course Schedule

	Topics/Daily Activities	Deliverables
Week 1	Introduction Basics of Biomechanics Anthropometrics	Homework 1 Assigned
Week 2	Modeling Dynamic Behavior	
Week 3	Motion Measurement & Analysis	
Week 4	In-Class Biomechanics Problems	Homework 1 Due: Friday, Noon Oral Presentation Group Choice Due: Friday, Noon Homework 2 Assigned
Week 5	Analysis of Stress & Strain	
Week 6	In-Class Stress & Strain Problems	Oral Presentation Topic Due: Friday, Noon
Week 7	Clinical Motion/Gait Analysis	
Week 8	Artificial Haptic Sensing	Homework 2 Due: Friday, Noon
Week 9	MIDTERM EXAM (in class)	Homework 3 Assigned
Week 10	Functional Electrical Stimulation	
Week 11	Locomotor Control & Rehabilitation	Homework 3 Due: Friday, Noon Homework 4 Assigned
Week 12	Wheelchair Concerns, Analysis, & Enhancements	
Week 13	Blind Navigation & Vision Augmentation	
Week 14	Neurally-Inspired Approaches to Vision Problems	
Week 15	Oral Presentations	Oral Presentation PowerPoint Due: Monday, 10 AM Homework 4 Due: Friday, Noon
FINALS WEEK	FINAL EXAM (as per the University's Final Exam Schedule)	

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call
suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call
studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298
equity.usc.edu, titleix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
usc-advocate.symplcity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776
dsp.usc.edu

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention - (213) 821-4710
campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101
diversity.usc.edu

Information on events, programs and training, the Provost’s Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

ombuds.usc.edu

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

STUDENT OUTCOMES of BIOMEDICAL ENGINEERING PROGRAM

Students completing the program have

- 1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- 2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factor
- 3) an ability to communicate effectively with a range of audiences
- 4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- 5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- 6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- 7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Appendix A: Group Presentation Grading Rubric

Group Members:			
Category	Scoring Criteria	Total Points	Score
Organization (15 points)	Information is presented in a logical sequence (logical structure; main ideas presented in orderly and clear manner)	10	
	Sign-posting: show clearly how presentation is going to develop, and where in that process key presentation points are	5	
Content (60 points)	Introduction is attention-getting, lays out the problem/topic well, and establishes framework for rest of presentation	5	
	Proper background information on topic is given	5	
	Addresses audience at an appropriate level (rigorous, but generally understandable to a scientifically-minded group)	5	
	Technical terms are well-defined in language appropriate for target audience (i.e., undergraduate BME students with a decent amount of background knowledge)	5	
	Presentation contains accurate information	10	
	Material included is relevant to the overall message/purpose, excludes irrelevant/filler information	10	
	Appropriate quantity of material is prepared; points that are made suitably reflect their relative importance to the overall topic; information provided allows audience to effectively evaluate topic	10	
	There is an obvious conclusion summarizing the main points of presentation, potential weaknesses of the technology/approach, etc.; provides a “take-home” message	5	
	Good mechanics: few or no misspellings or grammatical errors	5	
Presentation (65 points)	Visual aids are well prepared, informative, effective, and not distracting; graphs/figures are clear and understandable, text is readable and clean	15	
	Length of presentation is appropriate (15 minutes)	5	
	PowerPoint slides and spoken words complement each other	15	
	Presenters are familiar with material, capable of competently and clearly discussing all aspects of topic	10	
	Presentation is not read	10	
	Overall impression: interesting, pleasant to listen to, good/clear/accurate communication	10	
Exam-Type Question (10 points)	Question was submitted	5	
	Question is well-thought out/reasonable	5	
Score	Total Points	150	