ME498R/599: Biomechanics of Movement

Winter 2015: Tuesday/Thursday, Time 2:30 – 3:50pm, Location MEB234

Instructor: Dr. Kat Steele **Office:** MEB323 **Office Hours:** T 12:30am-2:00pm, Th 4-5pm
kmsteele@uw.edu
TA: Hwan Choi **Office Hours:** M & W 12:30-2:00pm in MEB236
hwanc@uw.edu
Website: Materials available on Canvas

Course Objectives

The objective of this course is to provide you with an overview of the major challenges in movement biomechanics and experience with the engineering tools we use to address these challenges. We will achieve this objective through lectures, a field trip to a motion capture laboratory, homework problems, simulation exercises, and student research papers and presentations.

After completing this course, you will be able to:
1) Describe the biological, mechanical, and neurological mechanisms by which muscles produce movement
2) Identify and use engineering tools that are used to study movement
3) Write and solve equations of motion for simple models of human movement
4) Apply biomechanics principles to "real-world" clinical and biomechanical research.

Course Prerequisites

This course is for advanced undergrads and graduate students and will demonstrate how to apply engineering principles to the human body. We assume that you have the following background:
▪ Statics (draw a free body diagram; solve for joint reaction forces and moments)
▪ Dynamics (write and solve equations of motion for spring-mass-damper and multi-body systems)
▪ Linear Algebra (perform matrix addition and multiplication; dot and cross product)
▪ Differential Equations (know how to solve 1st and 2nd order ODEs)

Grading & Structure

30% Homework & OpenSim Assignments
30% Final Exam
40% Biomechanics Project
      5% Project Ideation
      5% Project Outline
      5% Project Quick Pitch
      15% Project Presentation
      10% Project Report

Re-grade Policy

If you feel that an exam or assignment was graded incorrectly, please return your work to the TA along with a written description of what you believe to be the grading error **within 2 business days** of when it was returned. The teaching team will look over the problem(s) that you believe are in error and adjust your score accordingly. While we are happy to correct simple errors, we do our best to grade the exams uniformly and fairly on the first pass, so your written argument will have to be convincing to result in a change.

Schedule

Day	Date	Topic	Reading	Assignments	Project
Tues	1/6	Introduction & Course Overview			
Thur	1/8	Modeling Human Movement: Tuned Track	McMahon		
Tues	1/13	Muscle Structure and Force Generation	Lieber (2)		
Thur	1/15	Muscle-Tendon Interaction and Mechanics	Lieber (3)	**HW1 Due**	
Tues	1/20	Musculoskeletal Geometry	An & Zajac		Ideation
Thur	1/22	Neuromuscular Overview	McMahon	**OpenSim 1 Due**	
Tues	1/27	Electromyography & Ultrasound Lab			
Thur	1/29	Muscle Adaptation		**HW2 Due**	
Tues	2/3	Project Quick Pitches			Outline
Thur	2/5	Motion Tracking Techniques	Optometric	**OpenSim 2 Due**	
Tues	2/10	Inverse Kinematics	Winter		
Thur	2/12	Inverse Dynamics	Zajac	**OpenSim 3 Due**	
Tues	2/17	Clinical Motion Analysis			
Thur	2/19	Tour of Motion Analysis Lab		**HW3 Due**	
Tues	2/24	Exam Review			
Thur	2/26	**Exam**			
Tues	3/3	Comparative Biomechanics	TBA		
Thur	3/5	Industry Applications: Orthocare Innovations	Kobayashi	**HW4 Due**	
Tues	3/10	Student Presentations			
Thur	3/12	Student Presentations			Paper Due Tues, 3/17

Homework & Simulations

All assignments **are due at the beginning of the class period** indicated on the schedule above. Assignments turned in late will not be graded except under extreme circumstances at the discretion of the instructor. Students are encouraged to work together on assignments; however, every student must individually submit assignments consisting of his/her own work. Submitting assignments that are copied in any portion from another source, including another student's work constitutes academic misconduct. All assigned problems will be graded as 0, 1, or 2 depending on completeness and correctness of the solution. Your lowest assignment grade will be dropped **if you turn in all assignments by the end of the quarter.**

Additional Guidelines:
- The first page of each assignment should include your name, due date, and assignment number
- Equations and solutions must be supplemented with enough text to explain the solution. Never include a numerical calculation without the algebraic form of the equation listed first.
- **Identify the final answer(s) with a surrounding box**.
- For any graph or drawing, identify the scales and units used.
- It is the student's responsibility to turn in assignments that are clear legible. Difficulty in following and/or reading the work will result in a reduced grade. Make good use of "white space" in the assignment.

Exam

The exam will be closed book. You will be allowed one 8.5 x 11 inch piece of paper containing equations written in your own hand writing on both sides of the page. The page of equations must be submitted with your exam. Students who miss an exam due to illness or emergency will take a make-up for full credit as soon as possible after original exam date.