

MECH 435/535
Orthopaedic Biomechanics

3 credits, September-December 2019
T & Th 9:30-11am – SCARFE 1003
First class: September 5, 2019

Contact Information

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Class Format

Two 1.5 hour classes each week / Tutorials on an as-needed basis / Three optional lab field trips

Learning Objectives

By the end of the course, we expect that students will be able to:

- Describe the structure and function of the major components of the musculoskeletal system;
- Integrate engineering concepts in statics, dynamics, materials, and structural analysis to examine the mechanical behaviour of the skeletal system;
- Identify and analyse problems of the musculoskeletal system where mechanical engineers can make a significant contribution;

Prerequisites

Registration in the fourth or higher year of the mechanical engineering program. Otherwise, approval of the instructor is required. We will draw from material covered in courses such as MECH 260 and MECH 265.

Textbook

There is no required text for the course. A series of readings that supplement the class material are included online through the UBC Library (LOCR). The following reference books can also be accessed through Woodward Library:

Carter DR, Beaupre GS. Skeletal Function and Form. 2001
Fung YC. Biomechanics - Mechanical Properties of Living Tissues. 1981
Mow VC, Huiskes R. Basic Orthopaedic Biomechanics. Third Edition. 2005
Nordin M, Frankel V. Basic Biomechanics of the Musculoskeletal System. 2001

Classes

Our perspective is that the best learning is achieved through active participation and thus, it is recommended that all students attend class with an openness and willingness to discuss the subject material and take part in class activities. In general, the classes will be structured for active student participation in the learning process. We will have some guest speakers coming to the class, including orthopaedic surgeons from the UBC Dept. of Orthopaedics to provide a clinical perspective on the material.

Problem Sets

Four problem sets will be distributed to allow application of the subject matter. It is recommended that they be completed in a timely fashion. Problem sets will not be graded but they will form the core of the material examined at mid-term and at the end of term.

Labs

Two to three informal labs / field trips will be arranged during the term. These include a visit to the UBC Anatomy lab, the Gait Lab at Sunnyhill Children's Hospital, and the Orthopaedic and Injury Biomechanics Lab at Vancouver General Hospital. In the past, students have attended at least one surgery at UBC Hospital and we hope for this to continue. None of these events are mandatory, but they do represent a unique opportunity to see application of the subject matter and are therefore, highly recommended.

Project Requirements

MECH 435 Projects

Groups of three MECH 435 students will conduct an analysis of the human body (Part A) and a simple experiment (Part B) that will test one of the concepts learned in class. Part A will be presented as a report (mid-Oct) and Part B as an in-class presentation (end Nov).

MECH 535 Projects

Groups of two MECH 535 students will conduct an analysis of the human body (Part A) and a simple experiment (Part B) that will test one of the concepts learned in class. Part A will be presented as a report (mid Oct) and Part B as an in-class presentation (end Nov). The combined project should be prepared as an abstract for a relevant scientific conference.

Part C will be a literature review on an orthopaedic biomechanical topic that is related to the area of the body that you are studying in Parts A & B. It will be due on November 28.

Research Articles

Original research articles will be distributed at different points throughout the term for in-class discussion. MECH 435 students are expected to read the articles and complete an online quiz prior to the class discussion. MECH 535 students will help select one of the articles and lead that in-class discussion.

Course Grading

<i>Activity</i>	<i>MECH 435</i>	<i>MECH 535</i>
Mid-term exam	25%	25%
Final exam	40%	40%
Project	30%	30%
Research Article Quiz/Discussion	5%	5%

Week	Lecture Topic	Instructor	Lab	Deadlines
Sept 3	Introduction/terminology/anatomy (first class Sept. 5th)	TRO		
Sept 10	Muscle and joint loads – static Indeterminate problem & OrthoLoad	TRO TRO		
Sept 17	MSK loads - dynamic & bone-bone MSK Modelling (research paper: muscle redundancy)	TRO MM TRO/grad	UBC Anatomy Lab (Sept 16th; 9-11am)	Prob. Set 1 due
Sept 24	Bone - anatomy & mechanics ** problem set 1&2 review ** Gait analysis/Instrumentation	TRO CJ TB/CJ		Prob. Set 2 due Project Proposals due Sept. 26
Oct 1	Viscoelasticity T&L - anatomy & mechanics (research paper: viscoelasticity)	TRO TRO TRO/grad	Sunnyhill Gait Lab (Oct 3rd; 2-3pm)	Prob. Set 3 due
Oct 8	Bone - adaptive nature; review ** problem set 3&4 review ** AC - anatomy & mechanics	TRO CJ DRW		Prob. Set 4 due
Oct 15	Joint replacement - challenges Mid-Term Exam (Oct 17)	BAM		
Oct 22	Implant R&D Joint replacement - mechanics (research paper: biomaterials)	Guest/TRO TRO		Project Part A due Oct. 25th
Oct 29	Mechanobiology (research paper - mechanobiology?) Muscle mechanics	TRO TRO	OIBG Biomech. Lab (date tbd)	
Nov 5	Spine Biomechanics (research paper - spine) Spine surgery - challenges	TRO/grad JS		
Nov 12	Fracture healing - mechanics (research paper - Claes theory?) Trauma/ Fracture fixation	TRO PG		
Nov 19	Project Presentations Project Presentations	TRO/CJ TRO/CJ		Part B Presentations begin Nov. 19
Nov 26	Project Presentations Review (one-two classes)	TRO/CJ TRO/CJ		Part C reports due Nov. 28