SCHOOL OF KINESIOLOGY
THE UNIVERSITY OF BRITISH COLUMBIA

Kinesiology 316: Mechanical Properties of Tissues

2022W Term 2; Formerly KIN 351

Summary

The objective of this course is to provide the opportunity to explore the mechanics of muscular contraction and to examine how the mechanical properties of the muscle work synergistically with tendons, bones and ligaments. Practical applications (training & clinical) of key concepts will be discussed in class.

Where: West Mall Swing Space, room 121
Tuesdays: 14h – 15h30 Lectures
Tuesdays: 15h30 – 17h Programming activities & Tutorials

Additional tutorials: Wednesday 10h30-12h and Thursday 14h-15h30 in Osborne Gym G1 (study room)

Instructor: Jean-Sébastien Blouin
Teaching Assistants: Paul Belzner and Amin Mohammadinasrabadi

Prerequisites:

School of Kinesiology Core and third-year standing.

Required Reading

Review of biomechanical definitions provided on the web site (Canvas)
Readings: Lecture notes provided on the web site (Canvas).
On-line reading material provided on the web site (Canvas). The on-line reading material includes excerpt from:

1- Whiting WC, Zernicke RF (1998) Biomechanics of musculoskeletal injury. Chapter 3 pp. 41-85.
2- Lieber RL (2002) Skeletal Muscle Structure, Function & Plasticity. Chapter 2 pp 45-112 & Chapter 3 pp 113-172.
3- McGill SM (2008) Low Back Disorders - Evidence-Based Prevention and Rehabilitation. Chapters 4 & 5 pp 35-112

Optional Readings available at the Library

Title: Skeletal Muscle Structure, Function & Plasticity
Author: Richard Lieber

Title: Neuromechanical Basis of Kinesiology
Author: Roger Enoka
Title: Low Back Disorders - Evidence-Based Prevention and Rehabilitation
Author: Stuart M McGill
Title: Basic Biomechanics of the Skeletal System
Authors: Margareta Nordin and Victor Frankel

Not available at the Library
Title: Biomechanics of movement: the science of sports, robotics, and rehabilitation
Authors: Thomas K Uchida and Scott L Delp.

Course Learning Objectives

1. Demonstrate a conceptual understanding of the elements of the human musculoskeletal system and how their properties interact during human movement.
2. Be able to use the concepts of force-length, force-velocity, hysteresis, compression, tension, shear, stress, strain, Young's Modulus to explain musculoskeletal adaptation.
3. Apply knowledge of anatomy to describe human movement in both anatomical and mechanical terms.
4. Become familiar with the interaction of the mechanical properties of the musculoskeletal system as they affect human movement and relate these properties to real-world applications.
5. Become familiar with the conceptual framework for analysis of human movement and understand the physiological and biomechanical basis for recording electrical potentials from skeletal muscles using surface electrodes.
6. Demonstrate an understanding of basic computer programming concepts.
7. Apply knowledge of computer programming to collect and describe human movements in multiple axes.
8. Have demonstrated personal and social responsibility towards class and tutorial participation.
9. Be able to facilitate active learning, critical thinking, and problem solving skills in the analysis of human musculoskeletal system.

Course Content (and tentative schedule)

Course outline and Introduction to Computational Kinesiology (Jan 10): Introduction to Biomechanical concepts, Matlab and onramp activities
Ref: Whiting WC, Zernicke RF (1998) Biomechanics of musculoskeletal injury. Chapter 3 pp. 41-85.

Module 1 (Jan 17): Biomechanical concepts
Ref: Whiting WC, Zernicke RF (1998) Biomechanics of musculoskeletal injury. Chapter 3 pp. 41-85.

Module 2 (Jan 24): Locomotion and Wearable motion tracking
Ref: Uchida TK, Delp SL (2021) Biomechanics of movement: the science of sports, robotics, and rehabilitation

Module 3 (Jan 31): Introduction to muscle structure and function
Ref: Lieber RL (2002) Skeletal Muscle Structure, Function & Plasticity. Chapter 2 pp 45-112.

Module 4 (Feb 6): Electromyography

Modules 5 & 6 (Feb 13): Force-length relationship & Force-velocity relationship

Ref: Lieber RL (2002) Skeletal Muscle Structure, Function & Plasticity. Chapter 2 pp 45-112.

Reading Week (Feb 20-24)

Module 7 (Feb 27): Current topics on muscle mechanics

Midterm (Mar 7)

Module 8 (Mar 14): Muscle length- joint geometry

Ref: Lieber RL (2002) Skeletal Muscle Structure, Function & Plasticity. Chapter 3 pp 113-172.

Module 9 (Mar 21): Muscle moment arm & joint geometry

Ref: Lieber RL (2002) Skeletal Muscle Structure, Function & Plasticity. Chapter 3 pp 113-172.

Module 10 (Mar 28): Lumbar spine: muscle anatomy and physiology

Ref: McGill SM (2008) Low Back Disorders - Evidence-Based Prevention and Rehabilitation. Chapters 4 & 5 pp 35-112.

Module 11 (Apr 4): Introducing the tendon: Structure and function & Electromechanical delay

Ref: Lieber RL (2002) Skeletal Muscle Structure, Function & Plasticity. Chapter 3 pp 113-172

Module 12 (Apr 11): Biomechanics of biarticular muscles and muscle force measurement

Ref: Lieber RL (2002) Skeletal Muscle Structure, Function & Plasticity. Chapter 3 pp 113-172

Review/Tutorial (April 11)

Course Structure

Tuesday. The *lecture component* will be a single 90-minute seminar per week on Tuesdays. The weekly seminars will include lecturing, quizzes and discussions around pre-assigned topics. Students will be requested to prepare for these discussions with readings posted on Canvas before the beginning of the course.

Tuesday. There will be five computer programming activities throughout the term. Programming activities will be interleaved with tutorials. The objective of these activities is to introduce students to computer programming and data collection/analysis using wearable sensors. The data analysis concepts will be applicable to any type of data and emphasize certain theoretical concepts discussed in the lectures. To obtain full marks for the programming activities (25), students are required to submit the programming activities on Canvas by the provided deadline. Any late submission will result in a 10% penalty per day.

Schedule for the programming activities:

Activity 1: Standing balance (Jan 17). Tutorial on Jan 24. Due date: Jan 30.
Activity 2: Load-deformation (Jan 31). Tutorial on Feb 7. Due date: Feb 13.
Activity 3: Force-length-velocity relationship (Feb 14). Tutorials on Feb 28 & Mar 7. Due date: Mar 13.
Activity 4: Locomotion (Mar 14). Tutorial on Mar 21. Due date: Mar 27.
Activity 5: Electromyography (Mar 28). Tutorial on Apr 4. Due date: Apr 10.

All programming activities are due on Mondays at 23h59 PST.

We will also offer guided *tutorials* every week on Wednesday 10h30-12h and Thursday 14h-15h30 in Osborne Gym G1 (study room). This will provide an opportunity to address questions, perform targeted activities related to lecture material and provide support for the programming activities. Students are encouraged to attend all tutorials and ask questions about any material.

WITHDRAWAL DATES

Last day to withdraw without a W standing : January 20, 2023

Last day to withdraw with a W standing
(course cannot be dropped after this date) : March 3, 2023

Course Participation: personal and social responsibility

As there are tutorials and group discussions in this course, students are expected to participate actively in these activities and demonstrate leadership, critical contribution, interpersonal skills, support activities, punctual attendance, on-time completion of class activities, positive attitude and effort according to the following schedule.

Evaluation Profile

Learning objective	*Methods* **(all required)**	*Value*
1, 2, 3, 4, 5, 6	Written examinations (2)	
	Mid-term (Mar 7)	30
	Final	40
5, 6, 7, 8, 9	Tutorials and programming	
	Programming activities (5)	25
6, 8	Participation marks	
	Online quiz	5
	Total	100 marks

Important Notes: If you miss the Mid-term for a valid reason, the marks will be transferred to the Final exam.

Attendance: Regular attendance is expected of students in all their classes (including lectures, tutorials, seminars, etc.). Students who neglect their academic work and assignments may be excluded from the final examinations. Students who are unavoidably absent because of illness or disability should report to their instructors on return to classes.

UNIVERSITY POLICIES

Academic Honesty and Standards

Academic honesty is essential to the continued functioning of the University of British Columbia as an institution of higher learning and research. All UBC students are expected to behave as honest and responsible members of an academic community. Breach of those expectations or failure to follow the appropriate policies, principles, rules, and guidelines of the University with respect to academic honesty may result in disciplinary action.

It is the student's obligation to inform themself of the applicable standards for academic honesty (see https://academicintegrity.ubc.ca/regulation-process/academic-misconduct/). Students must be aware that standards at the University of British Columbia may be different from those in secondary schools or at other institutions. If a student is in any doubt as to the standard of academic honesty in a particular course or assignment, then the student must consult with the instructor as soon as possible, and in no case should a student submit an assignment if the student is not clear on the relevant standard of academic honesty.

If an allegation is made against a student, the Registrar may place the student on academic hold until the President has made his or her final decision. When a student is placed on academic hold, the student is blocked from all activity in the Student Service Centre.

Resources to Support Student Success

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available on the UBC Senate website.

Academic Accommodation for Students with Disabilities

The University of British Columbia recognizes its moral and legal duty to provide academic accommodation. The University must remove barriers and provide opportunities to students with a disability, enabling them to access university services, programs, and facilities and to be welcomed as participating members of the University community. The University's goal is to ensure fair and consistent treatment of all students, including students with a disability, in accordance with their distinct needs and in a manner consistent with academic principles.

Students with a disability who wish to have an academic accommodation should contact Centre for Accessibility without delay.

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