

George Mason University
College of Education and Human Development
Exercise, Fitness and Health Promotion

EFHP813.001 Musculoskeletal Biomechanics in Human Movement
3 Credits, Fall 2018
Friday: 9 – 11:40 AM, 252 Bull Run Hall – Science and Technology Campus

Faculty

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Prerequisites/Corequisites

Graduate Standing or Permission of Instructor

University Catalog Course Description

Advanced study of the biomechanical analysis of the musculoskeletal system, including collecting, interpreting, and modeling biomechanical data.

Course Overview

Not Applicable

Course Delivery Method

This course will be delivered using a face-to-face format.

Learner Outcomes or Objectives

This course is designed to enable students to do the following:

1. Critically understand the musculoskeletal biomechanical concepts.
2. Integrate motion capture, electromyography, wearable technologies, and modeling techniques for the assessment of musculoskeletal system.
3. Design an experiment utilizing musculoskeletal biomechanical concepts.
4. Simulate musculoskeletal motion utilizing data-driven biomechanical models.

Required Texts:

Winter DA. *Biomechanics and motor control of human movement*. 4th ed. Hoboken, N.J.: Wiley; 2009. ISBN-13: 978-0-470-39818-0

*Note this textbook will be used in EFHP 815 & EFHP 825

Additional article readings:

TBD – as assigned by instructor

Optional/Suggested Texts:

Foundational Knowledge – McGinnis, Peter. *Biomechanics of Sport and Exercise*, 3rd Edition, Human

Kinetics. Champaign, Illinois, 2013.

Advanced Concepts -

Robertson G, Caldwell G, Hamill J, Kamen G, Whittlesey S. *Research methods in biomechanics, 2E.* Human Kinetics; 2013.

Zatsiorsky V. *Kinematics of Human Motion*, Human Kinetics, Champaign, Illinois, 1997.

Zatsiorsky V. *Kinetics of Human Motion*, Human Kinetics, Champaign, Illinois, 2002.

Zatsiorsky V, Prilutsky B. *Biomechanics of Skeletal Muscles*, Human Kinetics, Champaign, Illinois, 2012.

Course Performance Evaluation

Students are expected to submit all assignments on time in the manner outlined by the instructor (e.g., Blackboard, Tk20, hard copy).

- **Assignments and Examinations**
- **Final Exam** – Each student will be required to complete a final exam. The final exam will be cumulative. The format will be multiple choice, true/false, short essays, and problem-solving questions. Demonstration of ability to critically understand the musculoskeletal biomechanical concepts and integration of the various equipment will be assessed.
- **Research Projects** – The research projects provide experience in developing an in-depth understanding of a movement with application of biomechanical concepts. It enhances communication (oral and written) skills, as it is important in the development of the professional student. It also stimulates critical thought process to develop the methodology of a study to assess that problem. These are intended to give students hands-on, practical experience with musculoskeletal concepts that are covered in class. It will also assess the integration of the various experiments, as well as the simulation of musculoskeletal motion utilizing data-driven biomechanical models. The data will be collected in class. It will assess the design of an experiment while utilizing musculoskeletal biomechanical concepts. American Medical Association Manual (AMA) of Style (10th edition) format must be used for all written work in this class (e.g., citations, references, creation of tables, and formatting headers for paper sections). These will be group projects. Detailed instructions will be provided to students.
- **OpenSim Module** – The modeling software OpenSim will be utilized to provide experience modeling musculoskeletal mechanics from kinematic, kinetic and EMG data. Students will work through a series of guided activities to gain an understanding of mechanical properties of muscles, tendons and ligaments. The activities will illustrate several clinical applications of modeling biomechanical data. Detailed instructions will be provided to students.

- **Online Activities** – Throughout the semester online assignments will be required to be completed prior to class on Blackboard. These will assist you in reviewing key concepts, preparing for class and studying for the final exam.

Course Performance Evaluation Weighting

The course will be graded on a total of 100 points

Assignment	Points
Research Project #1	30
Research Project #2	30
OpenSim Module	10
Online Activities	10
Final Exam	20
Total	100

Grading Policies

The student's final letter grade will be earned based on the following scale:

Grade	Percentage
A	94 – 100%
A-	90 – 93%
B+	88 – 89%
B	84 – 87%
B-	80 – 83%
C	70 – 79%
F	0 – 69%

Note: Although a B- is a satisfactory grade for a course, students must maintain a 3.00 average in their degree program.

Professional Dispositions

See <https://cehd.gmu.edu/students/policies-procedures/>

Class Schedule

Week	Date	Topic	Due
Week 1	Aug 27 – Sept 2	Complete the 3 Knowledge Assessment Check Quizzes on Blackboard: 1) Kinematics, 2) Kinetics and 3) Musculoskeletal Mechanics	Knowledge Assessment Check Quizzes - Due Midnight Sept 2
Module 1: Kinematics			
Week 2	Sept 3 – Sept 9	Fundamental Concepts in Kinematics	Kinematics Equation Sheet Due by 9 am to BB Sept 7; Review Kinematics Materials on BB Prior to Class; Winter Chapter 3 pp 45-47; 75-78, 176-187
Week 3	Sept 10 – Sept 16	Focused Topic: Kinematic Chain & Application to Human Movement Research Project #1: Conceptualize	Article(s) on Blackboard Prior to Class
Week 4	Sept 17 – Sept 23	Focused Topic: Video-Based Motion Analysis Research Project #1: Planning	Article(s) on Blackboard Prior to Class; Kinematic Problem Set Due Midnight Sept 23
Week 5	Sept 24 – Sept 30	Focused Topic: Mechanical Load Monitoring During Activity & Sport – Kinematic Approach Research Project #1: Data Collection	Article(s) on Blackboard Prior to Class; Work on Research Project #1
Week 6	Oct 1 – Oct 7	Research Project #1: Data Analysis	Work on Research Project #1
Week 7	Oct 8 – Oct 14	Research Project #1 Presentations & Discussion	Research Project #1 Due by Midnight Oct 14
Module 2: Kinetics			
Week 8	Oct 15 – Oct 21	Fundamental Concepts in Kinetics	Kinetics Equation Sheet Due by 9 am to BB Oct 19; Review Kinetics Materials on BB Prior to Class; Winter Chapter 5 & 6, Chapter 8 pp 216
Week 9	Oct 22 – Oct 28	Focused Topic: What can we learn from the GRF and COP? Research Project #2: Conceptualize & Planning	Article(s) on Blackboard Prior to Class; Winter Chapter 11
Week 10	Oct 29 – Nov 4	Focused Topic: TBD Research Project #2: Data Collection	Kinetic Problem Set Due Midnight Nov 4; Article(s) on Blackboard Prior to Class
Week 11	Nov 5 – Nov 11	Focused Topic: TBD Research Project #2: Data Analysis	Article(s) on Blackboard Prior to Class; Work on Research Project #2

Week 12	Nov 12 – Nov 18	Research Project #2 Presentations & Discussion	Research Project #2 Due by Midnight Nov 18
Module 3: Musculoskeletal Biomechanics & Modeling			
Week 13	Nov 19 – Nov 25	NO CLASS - THANKSGIVING	Review Mechanics of Tissues Material on BB; Winter Chapter 9
Week 14	Nov 26 – Dec 2	Muscle Mechanics & Modeling Overview; Introduction to OpenSim	Article(s) on Blackboard Prior to Class
Week 15	Dec 3 – Dec 9	Focused Topic: Stretch-Shorten Cycle; OpenSim Workday	Article(s) on Blackboard Prior to Class
Final	Dec 14	FINAL EXAM	OpenSim Module Due by Midnight Dec 14

Note: Faculty reserves the right to alter the schedule as necessary, with notification to students.

Core Values Commitment

The College of Education and Human Development is committed to collaboration, ethical leadership, innovation, research-based practice, and social justice. Students are expected to adhere to these principles: <http://cehd.gmu.edu/values/>.

GMU Policies and Resources for Students

Policies

- Students must adhere to the guidelines of the Mason Honor Code (see <http://oai.gmu.edu/the-mason-honor-code/>).
- Students must follow the university policy for Responsible Use of Computing (see <http://universitypolicy.gmu.edu/policies/responsible-use-of-computing/>).
- Students are responsible for the content of university communications sent to their Mason email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students **solely** through their Mason email account.
- Students with disabilities who seek accommodations in a course must be registered with George Mason University Disability Services. Approved accommodations will begin at the time the written letter from Disability Services is received by the instructor (see <http://ods.gmu.edu/>).
- Students must follow the university policy stating that all sound emitting devices shall be silenced during class unless otherwise authorized by the instructor.

Campus Resources

- Support for submission of assignments to Tk20 should be directed to tk20help@gmu.edu or <https://cehd.gmu.edu/aero/tk20>. Questions or concerns regarding use of Blackboard should be directed to <http://coursesupport.gmu.edu/>.
- For information on student support resources on campus, see <https://ctfe.gmu.edu/teaching/student-support-resources-on-campus>

For additional information on the College of Education and Human Development, please visit our website <https://cehd.gmu.edu/students/> .