MCMASTER UNIVERSITY
Department of Kinesiology

Kinesiology 2A03: Biomechanics

Fall 2017

Prof. Krista Madsen (madsenk@mcmaster.ca)

IWC 215 – office hours will be posted on Avenue. If my door is open you are welcome to drop in and say hi. Appointments are usually best.

Lab Coordinator: Christiane De Savigny (desavig@mcmaster.ca), IWC A102/B

A. DESCRIPTION

This is an introductory course designed to provide Kinesiology students with a broad foundation in human biomechanics. In biomechanics we study external forces (such as gravity) and how they interact with internal forces (such as those generated by muscle) to control human motion. The study of biomechanics is essential to improving human performance (example: through analyzing and correcting technique), preventing injury (example: by designing protective equipment or an occupational task), and in rehabilitation (example: by modifying forces to facilitate healing of damaged tissues).

B. OBJECTIVES

By the end of this course successful students will be able to:

- Classify different types of forces and describe how they influence motion
- Determine the resultant force from two more forces, and resolve a given force into component forces
- Use forces to determine if an object is in static equilibrium, and determine the forces acting on an object when it is in a state of static equilibrium
- Draw free-body diagrams to illustrate forces acting on the human body, or upon an object or tool a human is using

- Describe linear and angular motion of an object using kinematic terms including displacement, velocity and acceleration
- Calculate displacement, velocity and acceleration of linear and angular motion using examples relevant to human motion
- Explain the relationship between impulse and momentum, in the contexts of both linear and angular motion
- Calculate impulse and momentum for linear and angular motion in the context of human motion
- Describe the relationship between the net force acting on the body and acceleration of that body
- Describe the differences between kinetic and potential energy
- Calculate kinetic energy, gravitational potential energy, strain energy
- Explain the relationship between mechanical work, energy and power
- Calculate mechanical work and power in the context of human motion
- Distinguish between positive and negative work
- Describe torque/moment of force and determine if an object is in static equilibrium
- Describe compression, tension and shear forces in the context of biologic tissues such as bone or tendon
- Describe elastic and plastic behaviour of biologic tissues
- Describe the stress-strain relationship as it applies to biologic tissues, and interpret stress-strain data plots
- Calculate stress and strain for deformable tissues such as bone and tendon
- Use relative and absolute terms to describe angular position of parts of the body
- Explain the relationship between linear velocity and angular velocity
- Explain the relationship between tangential and angular acceleration
- Explain how centripetal acceleration relates to angular velocity and tangential velocity
- Describe the concepts of inertia and moment of inertia, and explain how the body's moment of inertia can be manipulated
- Collect and interpret data using common biomechanical tools and techniques - force platform, 2D motion capture systems (MaxTraq), and electromyography (EMG)

By the end of this course successful students will develop the following skills and attitudes

- Learn cooperatively with their peers and instructors
- Take personal responsibility for their learning
- Increase their capacity to be resourceful
- Communicate effectively and respectfully with peers and instructors
- Develop a mindset of growth and practice personal reflection
- Act with discipline when faced with challenging problems
- Act with personal and academic integrity

C. REQUIRED TEXT AND OTHER MATERIALS

- McGinnis, P.M. (2013). *Biomechanics of Sport and Exercise, 3rd Edition*. Windsor, ON: Human Kinetics.
- Casio FX-991 Calculator (available at the Campus Store and other retailers)
- i>Clicker: Register your device online at https://www1.iclicker.com/register-clicker/
- Spiral bound notebook for classroom and lab activities: 8 ½ x 11 inches

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D. THIS IS HOW WE DO THINGS

1. Introduce (and re-introduce) yourself when you talk to me in class – I would like to get to know you. Do the same with your TAs.

2. We work on a first name basis. Please start emails with something like "Hi Krista" and finish with your name and a friendly/professional sign-off.

3. Be mentally where you are physically.

Continue to the next page.

E. CONTENT OUTLINE

This year we are working within a new course framework and will be working flexibly with respect to the dates listed below. This information is provided to give you a sense of our direction and what content we will cover. All schedules, readings and notes will be posted on Avenue.

Unit 1: Weeks 1 to 3 (September)

In this unit our goal is to develop fundamental skills that we will use all term. As such, we will have an early test (see schedule) to help everyone get on track.

- Forces
- Our good friend Pythagoras
- Free Body Diagrams and Static Equilibrium
- Chapter 1 in your text

Unit 2: Weeks 4 to 9 (September to November)

In this unit we will be working on linear motion – movement along a linear path, as opposed to rotation. We will begin our work in the lab (see schedule on Avenue) where we can experiment with equipment (such as the force plate) and techniques (such as 2D motion capture) and begin to interpret biomechanical data. We will start to ask ourselves mechanical questions and determine how they can be answered using these biomechanical tools. Our last goal is to learn about biological tissue mechanics, such as stress and strain, and connect these ideas to injury (and it's prevention) as well as human performance.

- Linear Kinematics – acceleration, velocity and displacement
- Projectile motion
- Linear Kinetics – inertia, impulse, momentum
- Work, Energy and Power
- Mechanics of Biologic Tissues
- Chapters 2, 3, 4 and 9

Unit 3: Weeks 10 – 13 (November to December)

In this unit we will be working on angular motion – motion of an object as it rotates. We will continue in the lab (see schedule on Avenue) with some of the same equipment as in the previous unit, to build upon our competencies, and introduce electromyography (the collection of electrical signals from muscle). We will build upon many of the concepts introduced in Units 1 and 2 to finish with a strong overall foundation in biomechanics.

- Torques, Moment of Force and Centre of Gravity
- Angular Kinematics – acceleration, velocity and displacement
- Angular Kinetics – moment of inertia, impulse, momentum
- Electromyography
- Chapters 5, 6 and 7

F. EVALUATION

Test locations will be posted on Avenue.

Test 1	10%	Friday September 22nd – during class time
Test 2	35%	Saturday November 11th – 9am to 10:30am
Lab Portfolio	20%	Monday November 20th – due before 4pm
Final exam	35%	Scheduled by the Registrar

G. POLICY REGARDING DEFERRED TESTS AND EXAMS

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work". **Please note these regulations have changed and are effective Fall 2015.**

If you use the MSAF you must report your absence to me by email **within 2 working days** in order to request accommodation (madsenk@mcmaster.ca). If you fail to do so you may forfeit your opportunity for accommodation and receive a score of zero on your evaluation.

Students who miss a Registrar-scheduled final exam can apply to the Associate Dean's office for permission to write in the deferred final exam schedule. In all cases, appropriate documentation must be submitted to the Office of the Associate Dean, Faculty of Science, for consideration of deferred examination permission. Under no circumstances will the instructor re-schedule a final exam for individual students.

H. USE OF COURSE MATERIALS

Course materials provided by the instructor are for use by students registered in this class only. Under no circumstances are these materials to be shared, posted or sold to a third party without permission from the instructor. This includes, but is not limited to, online posting of instructor provided lecture/lab notes, online lectures, recordings of lectures, or any lab materials on a website other than the Avenue site designed for the course.

I. ACADEMIC INTEGRITY

Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences (e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript reading "Grade of F assigned for academic dishonesty", and/or suspension or expulsion from the university). It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at:
http://www.mcmaster.ca/univsec/policy/AcademicIntegrity.pdf
The following illustrates only three forms of academic dishonesty: plagiarism (e.g. the submission of work that is not one's own or for which other credit has been obtained), inappropriate collaboration on group work, copying or using unauthorized aids in tests and examinations.

J. ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140, ext. 2865 or e-mail sas@mcmaster.ca. For further information, consult McMaster University's Policy for Academic Accommodation of Students with Disabilities.

K. ON-LINE LEARNING RESOURCES

Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

L. MODIFICATIONS TO COURSE

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

M. FEEDBACK

It really helps us improve our services when we hear from our students, faculty and staff about what we can do better. A feedback process brings to our attention situations in which we may not have adequately considered accessibility and allows us to better plan for accessibility in the future.