

MCMASTER UNIVERSITY
Department of Kinesiology

Kinesiology 4A03: Advanced Biomechanics

Term Fall 2017

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DESCRIPTION

This course is an In-depth study of the mechanics of human movement including the topics of multi-linked segment analysis, individual muscle force estimation, forward dynamics and optimization, fluid resistance, optimization, efficiency and power flow. The laboratory component covers the scientific method, data acquisition, instrumentation and numerical methods.

OBJECTIVES

To further the understanding of the biomechanics of human movement by:

- 1) Introducing the concept of multi-linked segment analysis of the musculoskeletal system for whole body motion analysis.
- 2) Examining the various methods of kinematic, kinetic and electromyographical data collection and data processing.
- 3) Estimating individual muscle forces and examining power flow and human movement efficiency.
- 4) Using forward dynamics and simulation of human movement.

TOPICS TO BE COVERED:

- Kinematic and kinetic data acquisition methods
- Scientific method, measurement chain, properties of transducers
- A/D conversion, spectral analysis, filtering, precision and accuracy
- Review of Free Body Diagrams and Static Equilibrium
- Review of Dynamic Equilibrium, Joint Reaction Forces and Net Joint Moments
- Linked Segment Mechanics and interpretation of moments during gait
- Joint Reaction Forces versus Bone-on-Bone Forces
- Optimization and individual muscle force estimation
- Review of Work, Energy, Power

- A Physiologist's view of Human Efficiency
- Energy Transfer and Power Flow (interpretation of muscle power during gait)
- A Biomechanist's view of Efficiency of Human Movement
- Review of Electromyography and Muscle Mechanics
- Prediction of Individual Muscle Forces using EMG
- EMG and Muscular Fatigue
- Inter-segmental Dynamics (Forward Solutions and Computer Simulation)
- Paradoxical muscle action
- Angular momentum of linked segment systems
- Finite element analysis in biomechanics and Virtual work
- Wobbling mass considerations in biomechanics

<u>EVALUATION</u>	Midterm Exam 1	30%
	Lab test.....	20%
	Final Examination.....	50%

POLICY REGARDING DEFERRED TESTS AND EXAMS

Students who miss the term test or final exam for legitimate reasons such as illness may be allowed to write a deferred final exam or receive an estimated mark for a midterm or lab test. In all instances, appropriate documentation must be submitted to the Office of the Associate Dean, Faculty of Science.

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.

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),
- Improper collaboration in group work.
- Copying or using unauthorized aids in tests and examinations.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

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.

ON-LINE LEARNING RESOURCES (if applicable)

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.

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.

MISSED STUDENT ABSENT FORM

If you are absent from the university for a minor medical reason, lasting fewer than *3 days* you may report your absence, without documentation, using the McMaster Student Absence Form. Absences for a longer duration or for other reasons (eg. Religious, personal) must be reported to your Faculty/Program office, with documentation, and relief from term work may not necessarily be granted. When using the MSAF, report your absence to dowlingj@mcmaster.ca. Then contact the instructor/lab TA immediately (normally within 2 working days) by email/telephone/in person to learn what relief may be granted for the work you have missed, and relevant details such as revised deadlines, or time and location of a make-up exam.

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.