



HK*2270 Principles of Human Biomechanics -

DRAFT

Fall 2018
Section(s): C01

Department of Human Health and Nutritional Sciences

Credit Weight: 0.50

Version 1.00 - June 05, 2018

1 Course Details

1.1 Calendar Description

This course will address the application of mechanical principles to the study of human movement. Topics will include: motion analysis techniques, anthropometrics, biological tissue tolerance, muscle force generation, static and dynamic equilibrium, work/energy and impulse/momentum as they apply to the description of motion, injury of musculoskeletal tissues and optimization of human performance.

Pre-Requisite(s): 4.00 credits including BIOL*1090, (PHYS*1000 or PHYS*1080)

1.2 Timetable

LECTURE HOURS: Tuesday & Thursday 10:00 am – 11:20 am **MACN 105**

TUTORIALS:

Wednesday Section 101 (9:30-10:20 am) in *MACN 118*

Wednesday Section 102 (12:30-1:20 pm) in *ANNU 204*

Wednesday Section 103 (2:30-3:20) in *MACN 233*

Wednesday Section 104 (3:30-4:20) in *MACN 118*

Thursday Section 105 (1:30-2:20) in *MACN 118*

Thursday Section 106 (2:30-3:20) in *ALEX 028*

1.3 Final Exam

Exam time and location is subject to change. Please see WebAdvisor for the latest information.

2 Instructional Support

2.1 Instructor(s)

Lori Ann Vallis

Email: lvallis@uoguelph.ca
Telephone: +1-519-824-4120 x54589
Office: ANNU 343
Office Hours: Tuesday, 11:30 – 2:00 p.m. or by appointment

3 Learning Resources

3.1 Required Resource(s)

Courselink (Website)

<https://courselink.uoguelph.ca>

Lecture notes are the required reading for the course. *Partially completed* lecture slides will be posted on [Courselink website](#) prior to the next week's lectures. It is your responsibility to print these slides and bring them to class with you as they will assist in lecture note taking and problem solving examples carried out in lecture.

Please familiarize yourself with the [Rights and Responsibilities](#) of all users prior to using Courselink.

3.2 Recommended Resource(s)

Introduction to Biomechanics for Human Motion Analysis (Textbook)

Gordon E. Robertson, *Introduction to Biomechanics for Human Motion Analysis* (3rd edition).
Publisher: Waterloo Biomechanics, Waterloo ON. ISBN : 0-9699420-2-8

This text is *recommended* for this course and is available for purchase in the University of Guelph Bookstore.

3.3 Additional Resource(s)

Basic Biomechanics (Textbook)

S. Hall, *Basic Biomechanics*.

Publisher: St. Louis, Toronto; Mosby (2014), 7th edition.

This text may be helpful as a reference on occasion and can be found in the library (note, it is not on reserve).

Basic Biomechanics of the Musculoskeletal System (Textbook)

Nordin and V.H. Frankel, *Basic Biomechanics of the Musculoskeletal System*.

Publisher: Lippincott Williams & Wilkins. (2012) 4th edition.

This text may be helpful as a reference on occasion and can be found in the library (note, it is not on reserve).

Biomechanical Basis of Human Movement (Textbook)

J. Hamill and K. Knutzen, *Biomechanical Basis of Human Movement*.

Publisher: Lippincott Williams & Wilkins. (2009), 3rd edition.

This text may be helpful as a reference on occasion and can be found in the library (note, it is *not* on reserve).

4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Describe the fundamental mechanical static and dynamic principles underlying human movement.
 2. Interpret human movement characteristics using basic descriptive qualitative techniques and quantitative assessment methods to compute forces and moments which generate human movement.
 3. Demonstrate knowledge of anthropometrics and biological tissue tolerance as it pertains to injury of musculoskeletal tissues.
 4. Apply the concepts of work/energy and impulse/momentum and compute these variables to describe motion and the optimization of human performance.
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5 Teaching and Learning Activities

5.1 Course Content

Introduction

- Definitions, relevance and applications of biomechanics

Review of Physics

- Force and moments, work, energy, momentum, power
- Vector vs. scalar, sine/cosine functions, essential math functions

The Human Biological System

- Strength of human tissues
- Skeletal muscle mechanics
- Anthropometry and body segment data: methods of estimation, use in kinematic and kinetic calculations,

Statics

- static equilibrium
- free body diagrams
- bone-on-bone forces (compression, shear, etc.)

Kinematics (motion that results from forces)

- vector representations
- linear vs. angular motion: displacement-velocity-acceleration equations
- quantifying segment motion
- absolute vs. relative motion

Kinetics (forces that cause motion)

- muscle mechanics revisited
- impulse/momentum approach
- linear vs. rotation momentum
- conservation of momentum
- work/energy approach
- efficiency, power calculations
- $F = ma$ approach
 - dynamic equilibrium
 - inverse vs. forward solutions
 - free body diagrams and bone-on-bone forces revisited

5.2 Course Structure

Presentation timing of lecture and tutorial material may vary slightly from that depicted here.

Week	Date	Lecture Topic	This week
1	Th Sept 6	1 <i>Welcome to Principles of Biomechanics</i> What is Biomechanics?	Practice Problems: PB Set #1

Week	Date	Lecture Topic	This week
		Basics of Human Anatomy	Practice Problems: PB Set #2
2	Tu Sept 11	2 Forces/Moments in the human body Newtonian Mechanics; Right Hand Rule	Practice Problems: PB Set #3
2	Th Sept 13	3 Free body diagrams: Overview & Sample Problems; Vector addition	Practice Problems: PB Set #3
3	<u>Tu Sept 18</u>	4 Net Joint Forces & Moments Rule	<i>Tutorial Quiz #1</i> - Free Body Diagrams (FBDs)
3	<u>Th Sept 20</u>	5 Calculating $F = ma$ when moment arm is unknown; Lever Arms	<i>Tutorial Quiz #1</i> - Free Body Diagrams (FBDs)
4	Tu Sept 25	6 Complex FBD; Net joint moment and relationship to muscle force Forces Bone on Bone Forces	Practice Problems: PB Set #4
4	Th Sept 27	7 Link Segment Modelling	Practice Problems: PB Set #4
5	Tu Oct 2	8 Linear Kinematics; Projectile Motion	Practice Problems: PB Set #5
5	Th Oct 4	8 Angular Kinematics; Joint Angles	Practice Problems: PB Set #5
	Tu Oct 9	Study BREAK –no lecture	
6	Th Oct 11	9 Review (if needed); Anthropometrics	Practice Problems: PB Set #6

Week	Date	Lecture Topic	This week
			<i>Mid-Term content:</i>
7	<u>Tu Oct 16</u>	10 <i>MID-TERM in class</i>	<i>Lec. 1-8; PB Sets 1 to 5</i>
7	Th Oct 18	11 Muscle Mechanics	Practice Problems: PB Set #6
8	Tu Oct 23	12 Electromyography	Practice Problems: PB Set #7
8	Th Oct 25	13 Force-Length & Force Velocity Relationships	Practice Problems: PB Set #7
9	<u>Tu Oct 30</u>	14 <i>Tissue Properties</i>	<i>Tutorial Quiz #2:</i> <i>Problem Sets 6, 7</i>
9	<u>Th Nov 1</u>	15 <i>Injury Mechanics</i> <i>Case study: Plyometrics</i>	<i>Tutorial Quiz #2:</i> <i>Problem Sets 6, 7</i>
10	Tu Nov 6	16 Kinetics: Moment of Inertia	Practice Problems: PB Set #8
10	Th Nov 8	17 Kinetics: Moment of Inertia	Practice Problems: PB Set #8
11	Tu Nov 13	18 Linear Impulse & Momentum	Practice Problems: PB Set #9
11	Th Nov 15	19 Rotational Impulse & Momentum Conservation of Momentum	Practice Problems: PB Set #9
12	<u>Tu Nov 20</u>	20 Work/Energy and Power	<i>Tutorial Quiz #3:</i> <i>Problem Sets 8, 9</i>

Week	Date	Lecture Topic	This week
12	Th Nov 22	21 Dynamic Equilibrium	Tutorial Quiz #3: Problem Sets 8, 9
13	Tu Nov 27	22 Segmental Energy/Efficiency	Review of all Course Material
13	Th Nov 29	23 Wrapping it up and Review	Review of all Course Material

Final Exam: Date and Time To Be Announced [Location to be Announced]

6 Assessments

6.1 Assessment Details

Tutorial Quizzes - 3 in total (12.00%)

Date: 1 – Sept 19 or 20 2 – Oct 31 or Nov 1 3 – Nov 21 or 22 In regular tutorial section
Each activity is worth 4%

Midterm Exam (33.00%)

Date: Tuesday October 16th, 10-11:20am MACN 105 (in lecture)

Final Exam - Cumulative (55.00%)

Date: To be Announced TBA

6.2 Description of Assessments

ALL tutorial activities, mid-term and final examinations are *mandatory*. Please inform the instructor of potential time conflicts with scheduled evaluations by *Thursday September 13, 2018*. All evaluation methods will count toward the calculation of your final grade in the course. If any scheduled evaluations are missed due to documented illness or compassionate circumstances, you must inform an instructor within 5 days of the missed evaluation. Negligence to do so may result in failure of the missed component. Accommodations following these circumstances will be made at the discretion of the course instructor. If a student has any objections or concerns regarding the way a course component has been graded, they may resubmit this component for re-marking; the risk, however, is that this re-evaluation will remain the final one, whether higher or lower in score than the original.

Practice Problems are assigned on a weekly basis; it is expected that students will attempt all problems prior to attending weekly tutorial sessions.

Tutorial Quizzes will test concepts taught in lecture and in assigned problem sets and *must be*

completed in the tutorial session; a zero mark will be recorded for any Tutorial Quiz not handed in for grading. **Please note** that all announcements, problem sets and course updates will be posted on the Courselink site.

Tutorial sessions will be used throughout the semester to take up questions from assigned problem sets, tackle new problems in break-out groups (Small Group Activities) and periodically for *marked Tutorial Quizzes* that will test concepts taught in lecture and in assigned problem sets. These Tutorial Quizzes *must be completed in the tutorial session*. It is expected that students will have attempted questions from the assigned problem sets prior to each weekly tutorial session.

7 Department of Human Health and Nutritional Sciences Statements

7.1 Academic Advisors

If you are concerned about any aspect of your academic program:

- Make an appointment with a program counsellor in your degree program. [B.Sc. Academic Advising](#) or [Program Counsellors](#)

7.2 Academic Support

If you are struggling to succeed academically:

- Learning Commons: There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist.
<http://www.learningcommons.uoguelph.ca/>
- Science Commons: Located in the library, the Science Commons provides support for physics, mathematic/statistics, and chemistry. Details on their hours of operations can be found at: <http://www.lib.uoguelph.ca/get-assistance/studying/chemistry-physics-help> and <http://www.lib.uoguelph.ca/get-assistance/studying/math-stats-help>

7.3 Wellness

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance.
<https://www.uoguelph.ca/counselling/>
- Student Health Services is located on campus and is available to provide medical attention. <https://www.uoguelph.ca/studenthealthservices/clinic>
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations. <http://www.uoguelph.ca/~ksomers/>

8 University Statements

8.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

8.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The regulations and procedures for [Academic Consideration](#) are detailed in the Undergraduate Calendar.

8.3 Drop Date

Courses that are one semester long must be dropped by the end of the fortieth class day; two-semester courses must be dropped by the last day of the add period in the second semester. The regulations and procedures for [Dropping Courses](#) are available in the Undergraduate Calendar.

8.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

8.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance, and not later than the 40th Class Day.

More information: www.uoguelph.ca/sas

8.6 Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The [Academic Misconduct Policy](#) is detailed in the Undergraduate Calendar.

8.7 Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

8.8 Resources

The [Academic Calendars](#) are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

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