

Western University
Faculty of Engineering
Department of Mechanical & Materials Engineering

BME 9531 – Biomechanics of Human Joint Motion

COURSE OUTLINE 2019-2020

DESCRIPTION: Apply engineering analysis methods to human joint motion; especially the walking and running gait cycles. Investigate several common motion measurement methods, examine their practical applications and associated limitations and errors. Calculate external joint loads from measured kinematics of the body and understand the influence of segment inertia on linked rigid body motion. Study the architecture and function of skeletal muscle; concepts of energy, work and power applied to joint motion

PREREQUISITES: Graduate student standing or permission from the instructor

ANTIREQUISITES: None

TOPICS:

1. Kinematics of human body position, displacement and posture
2. Kinematic data capture and processing
3. Quantification and management of measurement errors
4. Mechanical modeling of the human joint - general kinetics and constraints
5. Measurement of external loads on joint systems
6. Inverse dynamics to determine joint reaction forces
7. Inertial properties of the human body
8. Muscle mechanics and modeling
9. Mechanical work and energy in human movement
10. Analysis of the human gait cycle

CONTACT HOURS: One 3-hour lecture per week, half course
Wed. 8:30-11:30 (UCC 54A)

TEXTBOOK(S): Course notes may be downloaded from OWL (at MME 9615 001 GF19) or requested from the instructor

The following are non-mandatory resources, but may be helpful:

D.A. Winter, Biomechanics and Motor Control of Human Movement, 4th edition, John Wiley & Sons, 2009
C. Ethier and C Simmons, Introductory Biomechanics: From Cells to Organisms, Cambridge University Press, 2007.
M. Nordin, and V.H.Frankel, Basic Biomechanics of the Musculoskeletal System, 3rd Edition, Lippincott Williams & Wilkins, 2000.
International Society of Biomechanics (<http://isbweb.org>)

REFERENCES: None

EVALUATION: The final course grade will be determined as listed below:
Deadline dates for assignments, project, presentations, and examination are determined according to the **tentative** schedule as follows:

Five assignments (Due)	30%
1. Wed. Sept. 25 th	
2. Wed. Oct. 23 rd	
3. Wed. Nov. 13 th	
4. Wed. Nov. 20 th	
5. Wed. Dec. 4 th	
Class project (Due)	
Report (Wed. Dec. 4 th)	25%
Class presentation (Wed. Dec. 4 th)	15%

Final examination 30%
During December exam period, closed book, no restrictions on calculators

If a minimum mark of 60% is not obtained **on the final examination**, the student cannot receive a final mark greater than 58%

TIMETABLE: The course will follow the *tentative schedule*:

Week #	Lecture #	Date	Lecture Topic(s)/Deliverables
1	1 & 2	Sept. 11, 2019	Lecture 1: Introduction, Anatomic Terminology Lecture 2: Kinematics 1 Sections 1-4 Assignment #1 Assigned
2	2 & 3	Sept. 18, 2019	Lecture 2: Kinematics 1 Sections 5-9 Lecture 3: Kinematics 2
3	4	Sept. 25, 2019	Lecture 4: Instrumentation and Error 1 Assignment #1 Due
4	5 & 6	Oct. 2, 2019	Lecture 5: Instrumentation and Error 2 Lecture 6: Kinematics 3 Section 1 – 2.0
5	6 & 7	Oct. 9, 2019	Lecture 6: Kinematics 3 Section 2.1-3.3 Lecture 7: Kinematics 4 Assignment #2 Assigned
6	8	Oct.16, 2019	Lecture 8: Kinetics 1 Project Assigned
7	9	Oct. 23, 2019	Lecture 9: Kinetics 2 Assignment #2 Due
8	10	Oct.30, 2019	Lecture 10: Kinetics 3 Assignment #3 Assigned
9	N/A	Nov. 6, 2019	FALL READING WEEK – NO CLASS
10	11	Nov. 13, 2019	Lecture 11: Gait 1 Assignment #3 Due; Assignment #4 Assigned
11	12	Nov. 20, 2019	Lecture 12: Gait 2 & Muscle Assignment #4 Due; Assignment #5 Assigned
12	13	Nov. 27, 2019	Lecture 13: Internal Kinetics
13	Presentations	Dec. 4, 2019	Student Presentations; Project Due; Assignment #5 Due

INSTRUCTOR:

Dr. N. Knowles
Office: TBD
Email: nknowle@uwo.ca
Office Hours: Wed. 11:30 – 12:30 or by appointment

ATTENDANCE:

Any student who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Associate Dean (Graduate), after due warning has been given. On the recommendation of the Department concerned, and with the permission of the Associate Dean (Graduate), the student will be debarred from taking the regular examination in the course

HEALTH/WELLNESS:

As part of a successful graduate student experience at Western, we encourage students to make their health and wellness a priority. Western provides several on campus health-related services to help you achieve optimum health and engage in healthy living while pursuing your graduate degree. For example, to support physical activity, all students, as part of their registration, receive membership in Western's Campus Recreation Centre. Numerous cultural events are offered throughout the year. Please check out the Faculty of Music web page <http://www.music.uwo.ca/>, and our own McIntosh Gallery <http://www.mcintoshgallery.ca/>. Information regarding health- and wellness-related services available to students may be found at <http://www.health.uwo.ca/>

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other

relevant administrators in their unit. Campus mental health resources may be found at http://www.health.uwo.ca/mental_health/resources.html

To help you learn more about mental health, Western has developed an interactive mental health learning module, found here: http://www.health.uwo.ca/mental_health/module.html. This module is 30 minutes in length and provides participants with a basic understanding of mental health issues and of available campus and community resources. Topics include stress, anxiety, depression, suicide and eating disorders. After successful completion of the module, participants receive a certificate confirming their participation.

CONDUCT: Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others.

SICKNESS: Students should immediately consult with the instructor or Associate Chair (Graduate) if they have problems that could affect their performance in the course. The student should seek advice from the Instructor or Associate Chair (Graduate) regarding how best to deal with the problem. Failure to notify the Instructor or the Associate Chair (Graduate) immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

ACCESSIBILITY: Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation

PLAGIARISM/

ACADEMIC OFFENCES: Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence. Scholastic offences are taken seriously and attended by academic penalties which may include expulsion from the program. Students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence (see Western's scholastic discipline regulations for graduate students)

NOTICES: Students are responsible for regularly checking their Western email and OWL.

NOTE: The above topics and outline are subject to adjustments and changes as needed.

Learning Outcomes (MME 9615)

Degree Level Expectation	Weight	Assessment Tools	Outcomes
Depth and breadth of knowledge	15%	<ul style="list-style-type: none"> • Assignments 2, 3, 5 • Final Exam 	<ul style="list-style-type: none"> • Understands advanced concepts and theories • Aware of important current problems in the field of study • Understands computational and/or empirical methodologies to solve related problems
Research & scholarship	25%	<ul style="list-style-type: none"> • Assignments 1 – 5 • Final Exam • Project Report • Project Presentation 	<ul style="list-style-type: none"> • Able to conduct critical evaluation of current advancements in the field of specialization • Able to conduct coherent and thorough analyses of complex problems using established techniques/principles and judgment
Application of knowledge	10%	<ul style="list-style-type: none"> • Assignments 2, 3, 5 	<ul style="list-style-type: none"> • Able to apply knowledge in a rational way to analyze a particular problem • Able to use coherent approach to design a particular engineering system using existing design tools
Professional capacity / autonomy	10%	<ul style="list-style-type: none"> • Project Report • Project Presentation 	<ul style="list-style-type: none"> • Aware of academic integrity • Implements established procedures and practices in the coursework • Defends own ideas and conclusions • Integrates reflection into his/her learning process
Communication skills	20%	<ul style="list-style-type: none"> • Assignment 1 & 4 • Project Report • Project Presentation 	<ul style="list-style-type: none"> • Communicates (oral and/or written) ideas, issues, results and conclusions clearly and effectively
Awareness of limits of knowledge	20%	<ul style="list-style-type: none"> • Assignments 2, 3, 5 • Final Exam 	<ul style="list-style-type: none"> • Aware of the need of assumptions in complex scientific analyses and their consequences • Understands the difference between theoretical and empirical approaches • Acknowledges analytical limitation due to complexity of practical problems