Western University
Department of Mechanical & Materials Engineering

MME 4469B – Biomechanics of the Musculoskeletal System

COURSE OUTLINE – 2025-2026

CALENDAR DESCRIPTION: Application of fundamental principles of engineering to the analysis of the human musculoskeletal system. Bone and soft tissue biomechanics, joint mechanics and kinematics, joint replacement with implants, with special interest in design of these systems; biomaterials and wear. Joints studied will include the elbow, hip, shoulder and knee.

COURSE INFORMATION:

Instructor: James Johnson, Ph.D., P.Eng., FCAE
Room: CMLP 1307
Tel: 519-661-2111 ext. 88255

Email: jajohnso@uwo.ca

Lectures/tutorials/labs: See Draft My Schedule

CONSULTATION HOURS: Office hours: W:11:30-12:30

PREREQUISITES: ES 1022a/b/y, MME 2202a/b, MME 3380a/b

ANTIREQUISITES: None (or from academic calendar).

ACCREDITATION UNITS: Engineering Science = 100%

TOPICS:

- Basic anatomy of joints and other musculoskeletal structures
- Force analyses of joints
- Structure and function of bone
- Structure and function of ligaments and tendons
- Structure and function of muscle
- Lubrication and wear of joints
- Joint kinematics & navigation
- Biomechanics of the implant reconstructed joint

LEARNING OUTCOMES:

The Mechanical and Materials Engineering Program has been accredited by Canadian Engineering Accreditation Board (CEAB) of Engineers Canada. Accredited programs provide the academic requirements for licensure as a professional engineer in Canada. Western Engineering has defined indicators of the 12 Graduate Attributes (GAs) that the CEAB expects graduating engineering students to demonstrate. The connections between course learning outcomes and Western Engineering's GA Indicators are identified below.

Upon successful completion of this course, students will be able to:

1. determine joint and muscle loading for various activities. (KB3,KB4, PA1, PA2)
2. develop experiments to evaluate bone and tissue mechanical properties, implant fixation, computer-assisted surgery, and joint wear and motion. (IN1,KB4, PA1, PA2)
3. assess an implant system which meets current standards. (IN2,KB4)
4. develop significant insight into the field of biomedical and biomechanical engineering, particularly in the area of orthopaedic surgery. (IESE1)

CONTACT HOURS: 3 lecture hours, 2 tutorial hours per week, half course

TEXTBOOK: Custom Course Material. Textbook purchase is not required.

UNITS: SI units.

EVALUATION: The final grade is computed as follows:

Assignments (20%)

Four (4) throughout the term. The top 3 assignment grades will be used in the final overall assignment grade.

Midterm or Project (30%)

There is an option to do either a midterm or project. The midterm will be held in class in week 7 or 8 and cannot be used as an undocumented absence. The project will be due the last day of class. (Designated Assessment- cannot use as an undocumented absence for the Midterm.)

Final Examination (50%)

Held during the normal exam period. 3 hours, Part 1 (50%)- closed book, Part 2- (50%)- open books and notes with calculator.

If a student is excused from writing a midterm or quiz for legitimate reasons, and with the approval of the Department Chair, the weighting of the final examination can be adjusted accordingly.
If a minimum mark of 50% is not obtained on the final examination, the student cannot receive a final mark greater than 48%.

NB: **The final course grade will be computed as above or 45% Midterm + 55% Final, whichever is higher of the two options.**

COURSE POLICIES: The following course-specific policies will be strictly enforced throughout the course:

Midterm

- The midterm will take place as indicated under Evaluation above.
- The midterm will be 1.5 h long.
- Missing the midterm **without** academic consideration will translate into a mark of zero.
- Should a student miss the midterm **with** academic consideration, there will be no make-up midterm, however the value of the midterm will be shifted to the final exam.
- If cheating during the examination is suspected, the Associate Chair Undergrad will investigate and will determine an appropriate resolution. This may range from completing a one-on-one oral examination with the instructor, to receiving a grade of zero on the exam, to further academic penalties for scholastic offences applied by the Associate Dean Undergrad.
- Students are required to contact the instructor of the course for any other circumstances that appear to not be covered by the non-exhaustive list above.

Project

- Project teams will be formed in the fourth week of classes via online sign-up.
- The maximum team size will be four students, while the minimum team size will be three students.
- It is expected that the team will self-delegate for the various aspects of the project. Hence, wide-ranging expertise including CAD, component analyses, assembly and report-generation is expected.
- Students who do not choose a team will be assigned to one.
- SolidWorks will be used for the design drawings and layouts.
- The default assumption is that everyone contributes equally to the team effort (*i.e.*, project and labs) and hence everyone should receive the same mark for the common team submission.
- Please note that whenever individual contributions to the team effort are not equitably shared by the team members, individual adjustments of the marks might occur at the discretion of the instructional team of the course (*i.e.*, course instructor and teaching assistants).

Term work

- If a minimum of 50% is not obtained on term work, the student will fail the course irrespective of the mark obtained in the final examination.

Final examination

- The exam will take place during the Spring examination period. The timing will be announced in advance.
- The length of the final exam will be three hours.
- If a minimum of 50% is not obtained on the final examination, the student cannot receive a final mark greater than 48%.
- If cheating during the examination is suspected, the Associate Chair Undergrad will investigate and will determine an appropriate resolution. This may range from completing a one-on-one oral examination with the instructor, to receiving a grade of zero on the exam, to further academic penalties for scholastic offences applied by the Associate Dean Undergrad.
- Students are required to contact the instructor of the course for any other circumstances that appear to not be covered by the non-exhaustive list above.

Submissions

- Late submissions of the project will be penalized with 20% per day.

Students are required to contact the instructor of the course for any other circumstances that appear to not be covered by the non-exhaustive list above.

General Faculty / University Policies

The Faculty of Engineering and Western University have overarching policies that prescribe how undergraduate courses should run. The course-specific policies described above should be considered *in addition to* those overarching policies, or as course-specific interpretations of them. In the event of contradictions or confusion between course-specific policies above and general Faculty / University policies, please contact your course instructor for clarification.

Western Engineering's undergraduate polices can be found by navigating to:
https://www.eng.uwo.ca/undergraduate/academic-support-and-accommodations/policies.html

and then clicking the "*Engineering Undergraduate Policies framework*" link.