BME 498/GME 595 – Computer Simulation of Human Movement

Spring 2015

**Time:** 1:30 – 2:50p T, Th, Zurn 141

**Credits:** 3

**Instructor:** Anne Schmitz, PhD

**Office:** Zurn 120

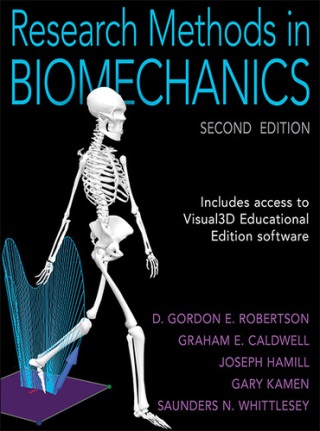
**Phone:** (814) 871-5799

**E-Mail:** schmitz005@gannon.edu

**Course Page:** Blackboard

**Office Hours:** 9am – 11am, M, W, Th, Zurn 120

**Required Text:** G. Robertson, G. Caldwell, J. Hamill, G. Kamen, S. Whittlesey, Research Methods in Biomechanics, 2nd edition, Human Kinetics 2014



**Required Software:** OpenSim, <http://www.stanford.edu/group/opensim/support/index.html>

**Prerequisites:** ME 201 Statics, ME 204 Dynamics, ME 205/206 Digital Computer Usage and Lab

**Course Description:** Special courses developed for students interested in all areas of biomedical engineering. A brief description of current content will be announced in the schedule of classes. Topics can include but are not limited to: biomedical robotics, biomimetic, rehabilitation engineering, continuum mechanics of biological tissue, tissue engineering, biomedical imaging, hemodynamics, motor control. May be taken more than once.

**Course Objectives:**

### Interpret results obtained from inverse kinematics, inverse dynamics, and forward dynamics analyses done

### Understand calculations done by a commercial/open-source software with user-generated code

### Simulate human movement to obtain estimates of immeasurable quantities (e.g. muscle forces)

**How this course meets the Biomedical Engineering program objectives:**

* The lectures and readings provide students the opportunity to *read information* while the labs then require the students to *assimilate and apply this information*.
* Students will learn the *value of scholarly activity* as the lectures and labs provide examples of how simulation of human movement is useful to answer scientific research questions in the health care field.
* Students will gain an *appreciation for the value of the profession with the local and global community* by simulating human conditions (e.g. the need for an ankle orthosis) that are present both local and globally.

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Course Grading

Grades will be based on your performance on homework, projects, and quizzes. All scores will be maintained on Blackboard. This will allow you to monitor your own performance and see the distribution of points for all students in your lecture section. This information should give you a continuous idea of your performance. Specific score-related questions must be raised prior to the next class period after receiving the score. Percentage participation to the final grade shall be distributed in the following manner:

|  |  |  |
| --- | --- | --- |
| **Labs/Homework (7 assignments)** | **=** | **25%** |
| **In Class Quizzes (7 quizzes)** | **=** | **25%** |
| **Team Project** | **=** | **25%** |
| **Final Project** | **=** | **25%** |
|  |  | **100%** |

**Labs/Homework:** Computer simulations will be performed using Matlab and the open-source software OpenSim. Each lab consists of questions that are due as homework on the dates specified in the schedule. All assigned homework must be submitted online using Blackboard by the beginning of class on the date due. No late or paper copies will be accepted and will be considered a zero. Homework solutions should be neat and well organized. All necessary diagrams and calculations must be clearly shown to receive full credit. For an assignment, each problem has a number of points attached to it. The total point count for the assignment is the sum of the points of the problems in that assignment. Your score for that assignment will be based on how many points the solutions you provide accumulate. For example, if you get 30 points out of a max of 40 points, your score will be 30/40 for that assignment.

**Quizzes:** In-class quizzes (closed book, closed notes, ~10 minutes per quiz) will be given to assess each individual student. Since no makeups are allowed for the quizzes, the two lowest quiz grades will be dropped.

**Project:** A team project (poster) and an individual final project (technical report) will be done during the semester. Refer to the handouts for details.

**Letter Grades**: Final letter grades will be based on the total score accumulated on labs, quizzes, and projects. This will be calculated using the above percentages and based on the total points accumulated for each part. For example, a student who gets a total of 80/90 (sum of all lab grades), 60/70 on the quizzes, 50/60 on the team project, and a 90/100 on the final project will have their final grade calculated as 0.25(80/90) + 0.25(60/70) + 0.25(50/60) + 0.25(90/100) = 0.869841 = 86.98% B. The following scale will be used for letter grades:

|  |  |
| --- | --- |
| **Score** | **Grade** |
| >96 | A+ |
| 94-96 | A |
| 90-93 | A- |
| 87-90 | B+ |
| 84-86 | B |
| 80-83 | B- |
| 77-79 | C+ |
| 74-76 | C |
| 70-73 | C- |
| 60-69 | D |
| <60 | F |

**BME 498: Computer Simulation of Human Movement**

Spring 2015 Schedule, Text: Robertson, *Research Methods in Biomechanics*

|  |  |  |  |
| --- | --- | --- | --- |
| Class Dates (document Due) | Topic | Reading | Lab |
| Jan 13  Jan 15 (Quiz1) | Introduction to simulation  Forward dynamics | Ch. 10 | Lab 1: Introduction to Dynamic Simulations |
| Jan 20 (Lab 1) (Groups for Group Projects)  Jan 22 (Quiz2) | Introduction to motion capture technology, anatomy, and OpenSim models | Ch. 11 | Lab 2: Introduction to Musculoskeletal Modeling |
| Jan 27 (Lab 2)  Jan 29 (Quiz3) | Scaling and Inverse kinematics | Ch. 2 | Lab 3: Scaling and Inverse Kinematics |
| Feb 3 (Lab 3)  Feb 5 (Quiz4) | Inverse dynamics | Ch. 7 | Lab 4: Inverse Dynamics |
| Feb 10 (Lab 4)  Feb 12 (Quiz5) | Residual Reduction Analysis |  | Lab 5: Introduction to RRA |
| Feb 17 (Lab 5)  Feb 19 (no class) | Muscle models | Ch. 9 | Lab 6: Tutorial 2 Simulation and Analysis of a Tendon Transfer |
| Feb 24 (Quiz6) (Lab 6)  Feb 26 (Quiz 7)  (Feb 27 - Group Project Abstract) | Computed Muscle Control |  | Lab 7: Estimating Leg Muscle Forces in Stance and Swing |
| Spring Break (no class) | | | |
| Mar 10  Mar 12 (Quiz8) | Final project assigned |  | Project: Simulation-Based Orthotic Design |
| Mar 17 (Lab 7)  Mar 19 (Quiz9) | Work on projects |  |  |
| Mar 24  Mar 26 (Project Report Intro) | Work on projects |  |  |
| Mar 31  (Apr 2 – Group Project Poster) | Work on projects |  |  |
| Easter Break (no class) | | | |
| Apr 9 (Project Report Methods) | Work on final project |  |  |
| Apr 14 (Celebrate Gannon)  Apr 16 (no class) (Project Report Results) | Work on final project |  |  |
| Apr 21 (no class)  Apr 23 (no class) | Work on final project |  |  |
| Apr 28 (no class)  Apr 30 (no class) (Final Project Report) | Work on final project |  |  |

Academic integrity will be rigidly enforced. Therefore, all assignments and projects must be turned in on Blackboard using the .docx Microsoft Word format so that plagiarism can be assessed. Late or paper copies will be considered a zero.

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Course Policies

**Expectations:** Students are to conduct themselves in a professional manner. As such, students are expected to:

* Read the appropriate book chapters before coming to lecture. Students are responsible for material in the text even if not presented in class as book material will be considered as source material for homework and quizzes.
* Be prepared for class. Students are expected to bring the textbook to all class sessions.
* Complete and submit assignments on time. All late assignments will receive a zero. Those with an excused absence (e.g. representing Gannon at an event, student athletes) are still expected to turn in the homework on time unless arranged ahead of time with the instructor.
* Arrive on time. The classroom door will be shut when class starts. Late entry will not be permitted and will be considered an unexcused absence.
* Attend all lectures. Attendance will be taken at every lecture. *Four or more unexcused absences will result in an F for the course.* Unexcused missed exams/quizzes will get a zero. Those with an excused absence are expected to arrange a makeup exam before missing the class. Quizzes will not be made up since the two lowest scores are dropped. “Freshmen who absent themselves, whether it be excused or unexcused, from a particular course in excess of twice the number of credit hours assigned to that course may be withdrawn from the course, upon recommendation by the faculty member to the Dean of the student's college.” Undergraduate Catalogue
* Be actively engaged.
* Work only on the class material at hand. Working on other homework during class is only permissible if the student has already turned in the most recent homework for the class material being presented.
* Use electronics appropriately. The use of electronics such as laptops, cell phones, iPads, etc. is only permitted during class if used for learning purposes (e.g. note taking, recording the lecture, etc.). Ringers must be turned off. Students who have a device ring will first be given a warning, second time a 5% reduction in the final grade, and a 5% reduction for each additional warning.
* Maintain academic integrity.Cheating is defined to include falsely claiming work that was performed by someone else as one’s own or facilitating the cheating of others. This includes direct copying of work (from current classmates, former class students, or other outside agent), allowing copy of one’s own work, plagiarism, improper communication during an exam or quiz (including verbal, visual, electronic, or any other communication means, known or unknown), signing in lieu of another student (e.g. signing another student’s name for attendance), and utilizing any material (physical or electronic) during an exam or quiz other than those materials specifically authorized by the instructor. Other forms of cheating may exist and may be identified by the course instructor. A zero score will be issued for any assignment (homework, quiz, examination, laboratory report, or project) for which cheating is suspected. A zero score will be issued to all students thought to be involved with the cheating, regardless of information indicating which student had originated the work that was subsequently copied. *Two or more instances of cheating by any student will result in an F in the class.* All students accused of cheating have the right to protest the accusation by consulting with the instructor. In the event that consultation does not end in agreement between the professor and the student, the student has the right to pursue redress as specified in the Academic Integrity Policy of Gannon University.
* Write well. Effective communication is important in any field. For writing assistance, please visit the Writing Center at 1025 Palumbo, phone 871-7127, for one-on-one service.

**Disability requests**: Dr. Harvey L. Kanter is the 504/ADA coordinator for students with disabilities who require accommodation of facilities, programs, or services of the University. Students seeking information or assistance in any matter regarding accessibility or accommodations should contact Christy Samuelson at 814-871-5326 promptly upon admission to the University.

**Complaints**: If a student has a complaint regarding the course and if the student is unsatisfied with the response of the instructor, then he/she should contact the Chair of the Department of Mechanical Engineering. An appointment to see the Chair can be made by contacting the Department Office at 814-263-5372.

**Blackboard**: All technical and troubleshooting issues with Blackboard should be directed to 3000 AJ Palumbo Academic Center, my.gannon.edu/ITS, 814-871-7501. Blackboard orientation is available at gannon.blackboard.com. The Student Technology Supply Center in Nash library also offers walk-in service and training for Blackboard.