



Cleveland State University

Department of Chemical and Biomedical Engineering, Spring 2015

Course Biomechanics, BME 651, BME 751, CHE 594 (3 credits)

Class Schedule FH 202; Tue, Thurs: 4.30 – 5.45 PM

Instructor Chandra Kothapalli, Ph.D.
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Chemical and Biomedical Engineering, FH 460
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Office Hours Tue, Thurs 2 – 4 PM
Email to setup an appointment outside office hours

Catalog Description:

BME 651/751 Biomechanics (3 credits)

Prerequisites: BME 553, ESC 201, BIO 266 or equivalent.

Graduate standing in engineering, sciences, or permission of the instructor.

Application of mechanics to the functioning of the human body at all levels, from the cell to the tissue, organ, and whole body. Topics include structure, function, and mechanical properties of musculoskeletal system (bone, articular cartilage, ligaments and tendons, skeletal muscle, peripheral nerve and spinal nerve roots), and joints (knee, hip, foot and ankle, spine, shoulder, elbow). Recent progress in cell mechanics is also introduced.

Goals and Overview:

Biomechanics uses physics and engineering concepts to describe the motion undergone by various segments of the body, and the forces acting on these body parts during normal activities. This course will detail the application of mechanics to the functioning of the human body at all levels from the cell to the tissue, organ, and whole body. Topics include structure, function, and mechanical properties of musculoskeletal system (bone, articular cartilage, ligaments and tendons, skeletal muscle, peripheral nerve and spinal nerve roots), and joints (knee, hip, foot and ankle, spine, shoulder, elbow). Recent progress in cell mechanics will also be introduced. Furthermore, biomechanical application in the treatment of fracture, arthroplasty and gait will be discussed.

Prerequisites/ Co-Requisites:

Graduate standing in engineering & sciences, or permission of the instructor. Students registered for this course are expected to have basic knowledge of blood, molecular and cell biology, human physiology, and solid/ fluid mechanics. Please let instructor know of your deficiencies, so that remedial material can be provided.

Reference Textbooks:

- Biomechanics: Mechanical Properties of Living Tissues, by Y. C. Fung. Springer New York, 2nd Edition.
- Introductory Biomechanics, by C. Ross Ethier and Craig Simmons. Cambridge University Press, 2007.
- Basic Biomechanics of the Musculoskeletal System, by Margareta Nordin and Victor Frankel. Wolters Kluwer Health, any edition.
- Fundamentals of Biomechanics, Equilibrium, Motion and Deformation, by N. Ozkaya and M. Nordin. Springer, 2nd Edition, 1998.
- Fundamentals of Anatomy and Physiology, by Frederic Martini. Prentice Hall, any edition.
- Journal papers from databases such as: PubMed, Scopus, Web of Knowledge, etc.

Class Policy:

- Students are expected to attend the classes regularly and complete all the course requirements, unless there is a well-documented emergency. Failure to attend classes without prior permission will affect your final grade.
- Lecture notes and relevant handout materials will be provided during each class, or uploaded to the course website prior to the beginning of each class. Students are expected to make additional class notes by themselves.
- Homework and final reports are due on assigned date, unless there is a well-documented emergency, or prior permission has been obtained.
- Since students from various undergraduate backgrounds register for this course, student participation and discussion during the lecture is expected and highly encouraged.
- Extra credit will be given for well-written, complete solutions to the problems given in homework and exams.
- Do not hesitate to ask me in person, by email or on the phone, if you need additional help with concepts, course material or homework.

Grading Policy:

BME 651	BME 751
<ul style="list-style-type: none"> • Homework (4 total)-----45% • Attendance/ Class participation-----5% • Final exam (take-home)-----25% • Term paper and Presentation—25% 	<ul style="list-style-type: none"> • Homework (4 total)-----45% • Final exam (take-home)-----30% • Term paper and Presentation—25%

Note: Since this is a split level course between 600x level and 700x level, the grading will be slightly different: Students enrolled in 700x level section will have to put in extra effort for the term paper and presentation, beyond that at the Master's level. Term papers and presentations are not group projects, and graded for individual efforts. More details will be shared soon on the term projects.

Letter grades for this course are defined as follows:

- A above 92%
- A- 86-91%
- B+ 80-85%
- B 74-79%
- B- 68-73%
- C 60-67%
- F below 60%

Academic Integrity:

Homework and exams should be completed individually and are considered intellectual property of the student. Consultations with other students are not encouraged without prior approval of the instructor. Grades for review paper submission and in-class presentation/ discussion are based on individual effort. Consultation with the course instructor is always encouraged.

Plagiarism in any form is considered academic misconduct, and automatically eligible for F grade. Please refer to the CSU student handbook for more information on what constitutes an act of plagiarism.

<http://www.csuohio.edu/academic/writingcenter/WAC/Plagiarism.html>).

Students interested in improving their writing and presentation skills can solicit further assistance (free) from CSU writing center.

<http://www.csuohio.edu/writingcenter/>).

Disability act:

CSU is committed to providing equal educational opportunities to all the students regardless of their disability. For accommodations based on disability, please refer to the CSU handbook on disability services. The office of Disability Services can be reached at 216-687-2015, and the office is located at MC 147. Please inform the instructor prior to the beginning of the course, so that necessary arrangements can be made.

<http://www.csuohio.edu/offices/disability/students/handbook/enableleg.html>)

Class Calendar:

Date	Topic	Notes
1/13/2015	Introduction & Overview of biomechanics	Kinematics, Kinetics, Planes of motion, Elasticity, Anatomy, Anthropometry, Statics & Dynamics
1/15/2015	Basic terminology & concepts	
1/20/2015	Basic terminology & concepts	
1/22/2015	Basic terminology & concepts	
1/27/2015	Introduction to rheology	HW-1 assigned
1/29/2015	Biomechanics of bone	
2/3/2015	Biomechanics of bone	HW-1 due
2/5/2015	Biomechanics of articular cartilage	
2/10/2015	Biomechanics of articular cartilage	
2/12/2015	Biomechanics of tendons & ligaments	
2/17/2015	Biomechanics of tendons & ligaments	HW-2 assigned
2/19/2015	Biomechanics of skeletal muscle	
2/24/2015	Biomechanics of blood & vessels	HW-2 due
2/26/2015	Biomechanics of blood & vessels	
3/3/2015	Biomechanics of cervical & lumbar spine	Term paper assigned
3/5/2015	Biomechanics of peripheral nerves	HW-3 assigned
3/17/2015	Biomechanics of knee & hip	
3/19/2015	Biomechanics of knee & hip	HW-3 due
3/24/2015	Misc. joints	
3/26/2015	Cell mechanics	
3/31/2015	Cell mechanics	
4/2/2015	Cell mechanics	
4/7/2015	Tissue mechanics	HW-4 assigned
4/9/2015	Tissue mechanics	
4/14/2015	Tissue mechanics	Term papers due
4/16/2015	Student presentations (3)	HW-4 due
4/21/2015	Student presentations (3)	
4/23/2015	Student presentations (3)	
4/28/2015	Review Class	
4/30/2015	Review Class	Final exam assigned
5/7/2015	Final Exam Due	