Syllabus for ME 633: Basic Biomechanics

Course Information
Basic Biomechanics is a first course in undergraduate biomechanics that provides background in muskuloskeletal anatomy and principles of biomechanics. The course applies and builds on the concepts of Statics and, Dynamics for human activities, and Mechanics of Materials and tissues.

Class Meeting Times
Tuesdays and Thursday: 9:30 - 10:50 AM, Learned Hall 3111

Office Hours
Mondays 11:30 AM –12:30 PM, Tuesdays 11 AM - Noon, and Thursday: 11 AM - Noon, Learned Hall 3132
Or by appointment.

Course Description
The course provides an overview of musculoskeletal anatomy, the mechanical properties and structural behavior of biological tissues, and biodynamics. Specific course topics will include structure and function relationships in tissues and organs; application of stress and strain analysis to biological tissues; analysis of forces in human function and movement; energy and power in human activity; introduction to modeling viscoelasticity of tissues (including an ADAMS modeling laboratory). Finally, the course will include the beginning stages of a biomechanical design project. Course format will include readings, lectures, active learning exercises, discussion, group activities, in-class quizzes, two mid-term exams, and a final exam.

Course Rationale
Basic Biomechanics is a junior/senior elective in Mechanical Engineering. The course is meant to provide basic background in biomechanics for engineering students considering medical school, industrial positions in the biomedical and biotechnology fields, and for those planning to attend graduate school in biomedical engineering. For those interested in industrial positions, this course provides a foundation for careers as design engineers in medical device companies and exercise equipment companies, as laboratory/testing technician in research facilities, and as a clinical engineer in the hospital environment. While these positions are available with a Bachelor's degree, most companies (or positions) will require continued training to improve skills in specific areas. This course is appropriate for people on any of these career paths, provided the prerequisites have been taken (ME 311 and ME 520 or equivalent).

Course Learning Objectives
After active participation in this course and an effort to learn the material, students will be able to:

1. Identify a given bone, ligament or muscle by name, anatomic location, or function.

2. Recall the general characteristics, material properties, appropriate constitutive model, and adaptation potential for tissue and organs studied.

3. Identify relationships between structure and function in tissues and the implications/importance of these relationships.

4. Analyze the forces at a skeletal joint for various static and dynamic human activities.

5. Calculate the energy expenditure and power required to perform an activity.

6. Analyze the stresses and strains in biological tissues, given the loading conditions and material properties.

7. Identify the appropriate viscoelasticity model for the mechanical behavior of a given biological tissue.

8. Predict the overall creep and stress relaxation behavior for a basic viscoelastic material model.

Course Outline
Week 1-3: Musculoskeletal Anatomy, Basic Statics and Joint Mechanics (elbow, shoulder, spine, hip, knee, ankle)

Week 4-7: Basic Dynamics to Human Motion:
Review of linear and angular kinematics; Kinetic equations of motion; Work & energy methods; Momentum methods; Examples in biomechanics; Modern kinematic measurement techniques; Applications of human motion analysis

Week 7-10: Structure, Function, and Adaptation of Major Tissues and Organs:
Bones, Cartilage, Ligaments, Tendons, Muscles, Skin, Heart, Artery, Vein, Lung, Liver, Kidney, Intestine

Week 10-13: Fundamental Strength of Materials in Biological Tissues:

Week 14-16: Introduction to Viscoelasticity and Comprehensive Review

Course Materials

Primary texts

1) Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation, by Ozkaya and Nordin
2) The New American Medical Dictionary and Health Manual, by Rothenberg
3) Musculoskeletal Anatomy Supplement

Supplemental texts and resources

1) Basic Orthopaedic Biomechanics, by Mow and Hayes
2) Fundamentals of Orthopaedic Biomechanics, by Burstein and Wright
3) Orthopaedic Basic Science, Ed. by Simon
4) Basic Biomechanics of the Musculoskeletal System, by Nordin & Frankel
5) Cardiovascular Biomechanics, by Chandran
6) Biomechanics: Mechanical Properties of Living Tissues, by Fung
7) Melloni's Illustrated Medical Dictionary, by Dox, Melloni, and Eisner

Course Requirements and Grading

Homework is due at the beginning of class time on the due date. Homework will be accepted up to 1 week late, with a **10% reduction in score *for each day (24 hours) late***. For instance, a homework turned in 4 hours late would have the final score be reduced by 10 percent. Similarly, a homework turned in less than 3 days (72 hours) late would have the final score be reduced by 30 percent. Problems for which the solution has been presented in class (after the due date) will receive a zero score, but other problems will be scored normally and the final score reduced per the late homework policy.

Class quizzes will be random and unannounced. The primary purpose of quizzes is to allow the student to test their knowledge and to allow the instructor to get feedback about comprehension of the material. Some quizzes will be graded, and others may receive credit for participation. In addition some quizzes will be conducted through the Blackboard internet testing function.

Exam dates are provided in the detailed schedule handed out in class and available from the course webpage. *Anyone missing the exam without informing the instructor of a conflict at least one week prior to the exam will receive a zero score for the exam.* By contacting the instructor in advance, arrangements can be made for an alternate exam day and/or time.

Homework/Labs	18%	Design Proposal (Verbal)	6%	Design Proposal (Written)	6%
Mid-Term Exam 1	10%	Mid-Term Exam 2	15%	Mid-Term Exam 3	15%
Final Exam	25%	Class quizzes, Class Participation & Professionalism			5%

A percentage-based system will be used for final grade assignment. A for score $\geq$ 90, B for score $\geq$ 80, C for score $\geq$ 70, D for score $\geq$ 60%, and F for score < 60%. The instructor reserves the right to systematically alter the grading algorithm.

Course Policies

Class attendance is expected and strongly encouraged. Note that because of the broad multidisciplinary nature of the course, material presented in class may not be covered in the readings. The student is responsible to know all the material presented, whether from the readings or from class. The student is expected to expend sufficient effort to learn the material, to respect the instructors authority, and to be attentive and participatory in the classroom.

Course Policies (Academic Integrity)

Students in this course will be expected to comply with the University of Kansas Policy on Academic Integrity. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include, but is not limited to, the confiscation of the examination of any individual suspected of violating University Policy. Furthermore, no student may bring any unauthorized materials to an examination, including dictionaries and programmable calculators.

Course Policies (Disabilities)

Any student at the University of Kansas who has a disability that may prevent him/her from fully demonstrating his/her abilities should contact the instructor and the office of Services for Students with Disabilities (SSD) as soon as possible, so we can discuss accomodations necessary to ensure full participation in this course and your college experience.

Note that students must self-identify to SSD and the faculty, the SSD staff will collect documentation and evaluate eligibility. SSD will provide a letter too notify faculty of appropriate accomodations. Faculty have no obligation to provide accomodations without a letter from SSD, and there is no requirement for retroactive consideration. It is the student's responsibility to follow up with faculty on implementation of the accomodations in the SSD letter.