San José State University

College of Engineering

Biomedical Engineering Department

BME/ME 167, Introduction to Engineering Biomechanics Spring 2019

Course and Contact Information

Instructor:	Matthew Leineweber
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Office Hours:	T 10:00-11:00 W 16:00-17:00
Class Days/Time:	TR 16:30-17:45
Classroom:	CL 226
Prerequisites:	CE 095, CE 099, or equivalent MatE 25, or equivalent

Course Format

Technology Intensive, Hybrid, and Online Courses

The course will emphasize application of engineering mechanics to studying biomedical systems. The course consists of two 75 minute lectures per week. Homework and a take-home labs will focus on modeling and quantifying biomedical systems using both analytical and numerical (MATLAB) approaches. Take-home labs will be completed in groups using lab kits provided by the instructor. iClickers will be used to assess student learning throughout the semester.

Faculty Web Page and MYSJSU Messaging (Optional)

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on the Canvas learning management system course website. All communications relevant to the course will be sent out using the Canvas messaging system (Canvas email and announcement board). You are responsible for regularly checking with the messaging system through Canvas to learn of any updates by logging into https://sjsu.instructure.com/.

Course Piazza Site

A link to the course Piazza site is provided on Canvas, or the site can be accessed directly at the URL piazza.com/sjsu/spring2019/bme167/home. Piazza is the fastest way for you to ask technical questions to the professor while allowing them to share their response to all students at once. You may post questions anonymous to other students (instructor will see who you are). Students may also answer your questions, endorse responses made by other students, and mark duplicate questions.

To ensure fair treatment of all students and to provide students with the most rapid and consistent instructional information, **the instructor will not answer technical and policy questions by email.** Technical and policy questions include those regarding homework content, exam content, assignment deadlines, etc. Students should instead post to the class discussion board on Piazza.

Email Policy
Please send **emails regarding personal issues** (academic integrity issues, personal grades, medical issues, etc.) to the instructor. To receive the most rapid response to your email message, please start the subject line with the characters "**BME167**". Out of fairness to all students, email communications related to technical questions or course policy will *not* be returned (please post these types of questions to the course Piazza site).

Course Description (Required)

Introduction to the mechanical behavior of biological systems: mechanics of cells, mechanics of biological fluids (blood circulation), mechanics of blood vessels, biomechanics of the muscular-skeletal system. Kinematics and dynamics of motion. Application of engineering fundamentals to the human body structure and functional relationships. Prerequisites: MatE 25 and either CE 095 or CE 099.

Course Goals (Optional)

1. To gain broad knowledge about the mechanics of moving systems, human anatomy, and the basic biomechanics of the human musculoskeletal system

2. To learn how to apply engineering fundamentals to the human musculoskeletal system.

3. To understand the mechanical and physiological properties of bones, muscles, arteries, heart, cartilage, tendons, ligaments, and their relationships to one another.

4. To understand the biomechanical aspects of the coupling of bones and orthopedic implants.

5. To understand the mechanics of human gait.

Course Learning Outcomes (CLO) (Required)

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

1. **Describe** and understand the functional anatomy of the human body.
2. **Understand** kinetic concepts including inertia, force, torque, and impulse.
3. **Discuss** and compare different formulations of conservation principles.
4. **Apply** the principles of biomechanics to different components of the human musculoskeletal systems.
5. **Formulate** the physical models and simplified linear mathematical models describing equilibrium and dynamic problems related to the human body.
6. **Solve** biomechanics problems quantitatively.

Required Texts/Readings (Required)

Textbook

Özkaya et al., Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation. 4th Ed., Springer, 2017.

Other Readings

Özkaya et al., Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation. 3rd Ed., Springer, 2012.
Oomens et al., Biomechanics Concepts and Computation. 2nd Ed., Cambridge Publishing 2018

Other technology requirements / equipment / material

iClicker Reef App or iClicker remote
MATLAB
Take-Home Lab Kits (provided by instructor)

Library Liaison (Optional)

Anamika Megwalu

Phone: (408) 808-2089

Email: anamika.megwalu@sjsu.edu

Course Requirements and Assignments (Required)

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours during the semester for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in the University Policy S16-9,

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus."

Attainment of the learning objectives (as listed above) will be assessed via homework, quizzes, lab reports, midterm examinations, and the final examination.

Homework

Homework assignments will include questions and problems related to the materials covered in the lectures, and may require the use of MATLAB/Simulink. Students are expected and encouraged to work together on assignments. However, submitted homework should be individual work. Homework must be turned in to the Canvas submission link before the beginning of class (4:30 PM) on the due date.

- Late assignments will not be accepted. The lowest homework score at the end of the semester will be dropped.
- **Students are responsible for ensuring that all submitted files are readable and not corrupted. Files that cannot be opened by the instructor will receive a zero score.** Do not wait until the last minute to turn in your work!

Reading Quizzes

Will be given online through Canvas, and will cover assigned reading and previous lecture materials. Quizzes should be completed before the beginning of class on ***Tuesdays (4:30 PM)***. Missed quizzes cannot be re-taken or made-up and will be scored as zero, unless prior approval has been given. Prior approval will only be given under exceptional circumstances, or if the instructor is informed at the beginning of the semester. The lowest quiz score of the semester will be dropped.

REEF (iClicker) Questions

Lectures will routinely contain in-class concept questions and quizzes using the REEF Polling system. Students will typically be given two opportunities to answer the question: once before and once after discussion with peers. The second response will be recorded and graded for possible extra credit applied at the end of the semester.

Take-Home Labs

A series of take-home labs will be assigned in the second half of the semester. Labs will be completed in groups of 2-3 students, using lab-kits provided by the instructor. These kits are **rental kits only**, and must be returned to the instructor before the end of the semester. Final grades will not be assigned until kits are returned.

Each take-home lab will require students to submit a lab report documenting their findings. The format and requirements for these reports will be provided with the lab assignments. Students are responsible for coordinating with their groupmates to ensure all work is completed on time in its entirety.

Midterm examinations

There will be two mid-semester examinations. Each examination will cover the entire course material covered until the time of the examination. Examinations may include multiple-choice questions, open-ended questions, and problems, as well as a MATLAB programming portion. During the exam, students can have only a non-programmable scientific calculator. Internet-connected devices, books and notes are not allowed.
The dates of the mid-semester examinations are indicated in the Lecture Schedule.

Final Examination or Evaluation

The final examination will be held on the date and time stipulated by SJSU's Final Examination Schedule for the particular semester. The final examination will cover the entire course material covered during the semester. The final examination may include multiple-choice questions, open-ended questions, and problems. During the

exam, students can have only a non-programmable scientific calculator. Internet-connected devices, books and notes are not allowed unless otherwise specified by the instructor.

NOTE that University policy F69-24 at http://www.sjsu.edu/senate/docs/F69-24.pdf states that "Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to insure maximum benefit for all members of the class. Attendance per se shall not be used as a criterion for grading."

Grading Information (Required)

Letter Grades:

A+	> 97%
A	> 93% – 97%
A-	> 90% – 93%
B+	> 87% – 90%
B	> 83% – 87%
B-	> 80% – 83%
C+	> 77% – 80%
C	> 74% – 77%
C-	> 70% – 73%
D+	> 67% – 70%
D	> 64% – 67%
D-	> 60% – 63%
F	< 60%

Determination of Grades

Grades will be determined based on all the assignments and examinations, weighted as reported in the table below:

Homework	10%
Midterm 1	20%
Midterm 2	20%
Final Exam	25%
Take-Home Labs	15%
Reading Quizzes	10%
REEF & In-class Examples	+2% Extra-credit, maximum

Absence during examinations, without prior approval, will result in a zero. Prior approval will be given only under exceptional circumstances. Please contact the instructor as soon as possible if you have such a situation.

Late work is not accepted, and will be scored as zeros. Students are responsible for ensuring all work submitted to Canvas is uploaded correctly and can be read by the instructional staff.

Note that "All students have the right, within a reasonable time, to know their academic scores, to review their grade-dependent work, and to be provided with explanations for the determination of their course grades." See University Policy F13-1 at http://www.sjsu.edu/senate/docs/F13-1.pdf for more details.

Classroom Protocol

Attendance and arrival times

Students are expected to be set up for lecture by the time the class begins and remain in the classroom for the duration of the lecture. Attendance in class is not mandatory and shall not be used per se as a criterion for grading. However, class attendance and participation are highly recommended.

Behavior

Students should remain respectful of each other at all times. Students will respect a diversity of opinions, ethnicities, cultures, and religious backgrounds. Interruptive or disruptive attitudes are discouraged. While in the classroom, the use of electronic devices (laptops, tablets, smartphones) MUST be limited to activities closely related to the learning objectives. While in the classroom, electronic devices should not be used for personal communication, included messaging and use of social media. All cell phones must be silenced prior to entering the classroom.

Safety

Students should familiarize themselves with all emergency exits and evacuation plans. In particular, if the class meeting ends in the evening, students should be aware of their surroundings when exiting the building, and are encouraged to carry a cell phone for emergency communications.

University Policies (Required)

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/" Make sure to review these policies and resources.

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Course Schedule

	Session	Date	Day	Lecture topics, examinations, lab activities	Reading
Week 1	Lec1	January 24	*R*	Introduction and Basic Concepts of Biomechanics	
Week 2	Lec2	January 29	*T*	Basic Concepts of Biomechanics; Force, moment, and torque vectors	O1.1-1.5
	Lec3	January 31	*R*		O2.1-1.14
Week 3	Lec4	February 5	*T*	Finish Force, moment and torque vectors	
	Lec5	February 7	*R*	Equilibrium of rigid bodies: Free-body Diagrams	O3.1-3.10
Week 4	Lec6	February 12	*T*	Equilibrium of rigid bodies: Free-body Diagrams	
	Lec7	February 14	*R*	Application of Statics to Musculoskeletal Mechanics	O4.1-4.13
Week 5	Lec8	February 19	*T*	Application of Statics to Musculoskeletal Mechanics	
	Lec9	February 21	*R*		O5.1-5.11
Week 6	**Lec10**	**February 26**	***T***	**Review & Midterm 1**	
	Lec11	**February 28**	***R***		
Week 7	Lec12	March 5	*T*	Mechanics of Deformable Systems: Stress and strain	O12.1-12.7, 13.1-13.16
	Lec13	March 7	*R*		
Week 8	Lec14	March 12	*T*	Stress Transformations: principal stresses, constitutive behaviors	
	Lec15	March 14	*R*		O14.1-14.13
Week 9	Lec16	March 19	*T*	Mechanical properties of biological systems: Viscoelasticity	
	Lec17	March 21	*R*		O15.1-15.10
Week 10	**Lec18**	**March 26**	**T**	Mechanical properties of biological systems: musculoskeletal tissues, cardiovascular tissues	
	Lec19	**March 28**	**R**		O15.1-15.10
Week 11	**Lec20**	**April 2**	**T**	**SPRING RECESS – NO CLASSES**	
	Lec21	**April 4**	**R**		
Week 12	**Lec22**	**April 9**	***T***	**Review & Midterm 2**	
	Lec23	**April 11**	***R***		
Week 13	Lec24	April 16	*T*	Linear Kinematics: Uniaxial and biaxial motion	
	Lec 25	April 18	*R*		O7.1-7.11
Week 14	Lec 26	April 23	*T*	Linear Kinetics: conservation principles, work and energy	
	Lec 27	April 25	*R*		O8.1-8.13
Week 15	Lec 28	April 30	*T*	Angular Kinematics and Kinetics	
	Lec 29	May 2	*R*		O9.1-9.13
Week 16	Lec 30	May 7	*T*	Terrestrial Locomotion: jumping, walking, running, Final Review	
	Lec 31	May 9	*R*		Handout
FINALS WEEK	**FINAL**	**May 20**	***M***	**Final Exam – 14:45-17:00**	

O = Özkaya text