

BME 2202 Engineering Statics and Dynamics in Biological Systems

Class Periods: Tues Periods 5-6 (11:45 AM - 1:40 PM), Thurs Period 6 (12:50 PM – 1:40 PM)

Location: NEB 102

Academic Term: Spring 2025

Instructor:

Daniel P. Ferris, Ph.D.

dferris@bme.ufl.edu

(352) 294-1281

Office Hours: TBD

Student Learning Assistant:

Jenna Bello

jenna.bello@ufl.edu

Course Description

Principles of engineering statics and dynamics as they relate to biological systems. Topics include vector mathematics, summation of forces and moments in static equilibrium, equations of motion, dynamics of particles and rigid bodies, concepts of work, energy, and momentum, & introduction to deformable bodies. All topics are discussed in the context of biological systems.

Course Pre-Requisites

PHY2049, MAC2313.

Course Objectives

At completion of this course, students will be able to:

1. To apply vector mathematics to analysis of biological systems.
2. To calculate forces and moments at equilibrium within biological systems.
3. To calculate a summation of forces and moments of biological systems at non-equilibrium.
4. To calculate changes in energy and momentum of biological systems approximated as rigid body systems.
5. To calculate dynamics of deformable bodies, including stress and strain.
5. To identify the basic mechanical properties of biological tissues.

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3. An ability to communicate effectively with a range of audiences	
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	Medium

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Required Textbooks

Title: Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation
Authors: Nihat Özkaya, Dawn Leger, David Goldsheyder, Margareta Nordin
Publication Date: 2017 (4th edition)
Hardcover, softcover, or eBook are all okay to use:
Hardcover ISBN: 978-3-319-44737-7
Softcover ISBN: 978-3-319-83125-1
eBook ISBN: 978-3-319-44738-4

Course Schedule

Week 1: Introduction to Biomechanics
Week 2: Force Vectors
Week 3: Moment and Torque Vectors
Week 4: Systems in Equilibrium
Week 5: Applications of Statics in Biological Systems
Week 6: Introduction to Dynamics
Week 7: Linear Kinematics
Week 8: Linear Kinetics
Week 9: Angular Kinematics
Week 10: Angular Kinetics
Week 11: Impulse and Momentum
Week 12: Deformable Bodies
Week 13: Stress and Strain
Week 14: Dynamics at Different Size Scales in Biological Systems
Week 15: Review
FINAL EXAM Thursday, May 1, 10 am – 12 noon

Attendance Policy, Class Expectations, and Make-Up Policy

Regular lectures will be held in person in the designated classroom. Attendance at lectures is REQUIRED as the only way to learn the material will be practicing problems. We will work on problem solving in class with help from peers and the instructor. This cannot be replaced with at home study. For every class you miss without pre-approved permission, 1% will be taken off your final grade.

Weekly quizzes will be completed outside of class through the Canvas course website. They will have a two-hour time limit. The midterm and final exam will be completed in class and will require students to be present during the exam. There will be homework assignments for student practice but they will not be graded. Answers will be provided for homework assignments to help students work through the problems.

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

Evaluation of Grades

Assignment	Percentage of Final Grade
Quizzes	30%
Midterm Exam	30%
Final Exam	40%

Grading Policy

The grading scale for the course will be as follows:

Grade	Percentage
A	92.50-100%
A-	90.00-92.49%
B+	87.50-89.99%
B	82.50-87.49%
B-	80.00-82.49%
C+	77.50-79.99%
C	72.50-77.49%
C-	70.00-72.49%
D+	67.50-69.99%
D	62.50-67.49%
D-	60.00-62.49%
F	below 60.00%

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.ua.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.ua.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by

a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University’s core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Undergraduate Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://elearning.ufl.edu/>.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

On-Line Students Complaints: <https://distance.ufl.edu/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.