BIOE 201
Fall, 2025

Credit Hours: 3 credit hours

Class meets Mon/Wed 2:00-3:20pm in 3031 Classroom Instructional Facility

Faculty

Dr. Jennifer Amos

jamos@illinois.edu

Office Hours

Mondays 11-12pm 1103 Everitt (Amos, Avni, Stephen, Caleb)

Mondays 3:30-4:30pm in 1306 Everitt (Amos, Allison, Stephanie)

Thursdays 3:30-4:30pm in 2223 Everitt (Amos, Ananya, Avni, Stephen, Caleb, Stephanie)

Course Description

Material, energy, charge, and momentum balances in biological problems. Steady-state and transient conservation equations for mass, energy, charge, and momentum will be derived and applied to mathematically analyze physiological systems using basic mathematical principles, physical laws, stoichiometry, and thermodynamic properties.

Student Learning Outcomes

Module 1:

By the end of this module, students will be able to

1. Describe engineering problem solving methodology
2. Define conservation principles
3. Classify conservation systems
4. Develop a sense for types of problems that bioengineers address

Module 2:

By the end of this module, students will be able to

1. List and explain the different types of mass flow
2. Write the algebraic, differential, and integral forms of the mass accounting and conservation equations.
3. Apply mass accounting and conservation equations correctly
4. Explain the meaning of a basis and how to apply one to specify a problem
5. Solve mass accounting and conservations systems of equations for

    1. Steady-state systems
    2. Multicomponent systems
    3. Reactive systems

Module 3:

By the end of this module, students will be able to

1. List and explain types of energy
2. Explain differences between heat, enthalpy, and heat capacity
3. Write the algebraic, differential, and integral forms of the energy accounting and conservation equations.
4. Apply energy accounting and conservation equations correctly
5. Calculate changes in enthalpy from perturbations in a system (phase change, temperature, etc.)
6. Solve energy accounting and conservations systems of equations for
    1. Open systems
    2. Closed systems
    3. Reactive systems
    4. Dynamic systems

Module 4:

By the end of this module, students will be able to

1. Explain concepts of linear and angular momentum conservation
2. Explain how momentum is transferred by material transfer or forces applied on a system
3. Write the differential, and integral forms of the momentum accounting and conservation equations.
4. Apply concepts of rigid-body and static mechanics
5. Solve momentum accounting and conservations systems of equations for systems with
    1. Collisions
    2. Flow systems
    3. Dynamic systems

Module 5:

By the end of this module, students will be able to

1. Explain applications of accounting and conservation in a complex problem
2. Simplify and justify basis, assumptions, and constraints to create an estimated solution

3. Model a system in MATLAB and present the problem in a executive summary report
4. Work collaboratively on a team to define, constrain, and solve a complex problem according to a project timeline

Related ABET Outcomes

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
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
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

Expectations for class:

The broad objective of this course is to enable students to learn to analyze processes, understand essential features and model the dynamic behavior in complex biological systems. Fundamental quantitative techniques and methods of biochemical analyses will be described. Examples will be provided to illustrate how the fundamentals of engineering analysis may be applied to explain and predict the function of human systems and life processes. Specifically, students will be able to

1. Conduct proficiently various engineering calculations
2. Identify important information in biological systems
3. Describe the biological phenomena visually, i.e. diagrams, in terms of “systems”
4. Set up idealized models under a set of justified assumptions
5. Apply conservation and accounting equations to models to describe them mathematically
6. Analyze the results to justify the accuracy or relevance of obtained expressions
7. Demonstrate proficiency by analyzing real-life biological/physiological processes

Required Text

None, course notes will be provided

Grading

Homework - there will be 5 homework assignments worth 40 points each for a total of 200 points (20% of your grade). Homework will be done individually.

Quiz - there will be 3 quizzes worth 50 points each for a total of 150 points (15% of your grade). Quizzes are a group effort. You will work with your breakout team.

Exam - there will be 3 midterm exams worth 150 points each for a total of 450 points (45% of your grade). Exams are timed and will be done individually.

Project - there will be 1 culminating project worth 200 points (20% of your grade). The project is a group project. You will work with your breakout team.

Grading Scale

A+ > 97% > A > 93% > A- 89%
B+ > 87% > B > 83% > B- 79%
C+ > 77% > C > 73% > C- 69%
D+ > 67% > D > 63% > D- 59%
F < 59%

Schedule

Date	Topic	Assignment
	Course structure, syllabus information, pre-course survey	Review syllabus and course overview
Monday, August 25, 2025	Introduction to Engineering Calculations	
Wednesday, August 27, 2025	Foundations of Conservation Principles	
Monday, September 1, 2025	**No school - Labor Day**	
Wednesday, September 3, 2025	Mass Accounting and Conservation Basics, Open systems	
Monday, September 8, 2025	Multicomponent Mass Systems	Homework 1, Due Monday, Sept 9 11:59pm
Wednesday, September 10, 2025	Multiple Connected Mass Systems and Dynamic Systems	
Monday, September 15, 2025	Mass Systems with Reactions	Homework 2, Due Monday, Sept 16 11:59pm
Wednesday, September 17, 2025	Review of Mass Systems	
Monday, September 22, 2025	Group Quiz on Mass	Quiz 1, in class
Wednesday, September 24, 2025	**Exam #1**	Exam 1, in class

Monday, September 29, 2025	Energy Accounting and Conservation Basics	
Wednesday, October 1, 2025	Energy Systems with Enthalpy	
Monday, October 6, 2025	Open, Steady State Energy Systems & Dynamic Flow Systems	Homework 3, Due Monday, Oct 7 11:59pm
Wednesday, October 8, 2025	Energy Systems with Reactions	
Monday, October 13, 2025	Metabolics as a Dynamic Energy System	
Wednesday, October 15, 2025	Review of Energy Systems	Homework 4, Due Monday, Oct 14 11:59pm
Monday, October 20, 2025	Group Quiz on Energy	Quiz 2, in class
Wednesday, October 22, 2025	**Exam #2**	Exam 2, in class
Monday, October 27, 2025	Intro to Momentum Conservation - Statics Review	
Wednesday, October 29, 2025	Linear Momentum Conservation and Torque	
Monday, November 3, 2025	Rigid Body and Fluid Static Systems	Homework 5, Due Monday Nov 4, 11:59pm
Wednesday, November 5, 2025	Steady State Momentum Collisions and Resultant Forces	
Monday, November 10, 2025	Mechanical Energy Systems and Bernoulli's Assumptions	Homework 6, Due Monday Nov 11, 11:59pm
Wednesday, November 12, 2025	Review of Momentum Systems	
Monday, November 17, 2025	Group Quiz on Momentum	Quiz 3, in class
Wednesday, November 19, 2025	**Exam #3**	Exam 3, in class
Monday, November 24, 2025	*Thanksgiving (NO LECTURE)*	
Wednesday, November 26, 2025	*Thanksgiving (NO LECTURE)*	
Monday, December 1, 2025	Project Overview and Select Teams	Must be present to join a group*
Wednesday, December 3, 2025	Project Time	Work in class
Monday, December 8, 2025	Project Time	Work in class

Wednesday, December 10, 2025	Project Time	Work in class
Sunday, December 14, 2025	**Project + Report Due**	Turn in report, code, and team evaluation

Assessments

We will be using Gradescope this term, which allows us to provide fast and accurate feedback on your work. Homework will be submitted through Gradescope, and homework and exam grades will be returned through Gradescope. NOTE: This makes a few extra steps at the time that you turn your homework in. Do not wait until the last minute to submit.

For other course policies, please see Week 0 content and accompanying policies.

Canvas

Our Canvas page is our course webpage. This is where you can find the syllabus, course schedule, all learning modules with videos, assignments, and discussion

Format

The class is in-person for sections AL1 and AL2. Section ALO will attend live via Zoom. Should you need to quarantine, you will need to request the online link to continue to attend via Zoom.

Groups

In class, we will solve problems in groups. The groups are made up of each table in 4029 CIF. Since many of you have not met in person, we will do group rotations so that you can meet your classmates and form study groups. See more about group work below.

Run > Hide > Fight

Emergencies can happen anywhere and at any time. It is important that we take a minute to prepare for a situation in which our safety or even our lives could depend on our ability to react quickly. When we're faced with almost any kind of emergency – like severe weather or if someone is trying to hurt you – we have three options: Run, hide

or fight.

Academic Integrity

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy. Students should pay particular attention to

Article 1, Part 4: Academic Integrity. Read the Code at the following URL: http://studentcode.illinois.edu/Links to an external site..
The Grainger College of Engineering uses the FAIR system to document and track academic integrity violations across courses. Multiple violations, even across multiple units, may be cause for dismissal. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Educate yourself on all policies here: https://provost.illinois.edu/policies/policies/academic-integrity/students-quick-reference-guide-to-academic-integrity/Links to an external site.

Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Attendance

Attendance is not required, but highly encouraged to create a collaborative problem solving atmosphere.

Students will be provided with opportunities throughout the semester to earn up to 5 points of credit for in-class participation in activities. I will conduct random attendance checks throughout the semester, each worth 1 points each. Students must be present and complete the required activities to earn the credit. No makeups will be given.

Disability Statement and Resources

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail disability@illinois.edu or go to the DRES websiteLinks to an external site.. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available on campus that can help diagnosis a previously undiagnosed disability by visiting the DRES website and selecting “Sign-Up for an Academic Screening” at the bottom of the page.

If you are interested in obtaining information to improve writing, study skills, time management or organization, the following campus resources are available to all students:

Writer’s Workshop, http://www.cws.illinois.edu/workshopLinks to an external site.
https://www.disability.illinois.edu/strategiesLinks to an external site.
http://www.counselingcenter.illinois.edu/self-help-brochures/Links to an external site.
Also, most college offices and academic deans provide academic skills support and assistance for academically related and personal problems. Links to the appropriate college contact can be found by going to this website and selecting your college or school: http://illinois.edu/colleges/colleges.htmlLinks to an external site.

If you are experiencing symptoms of anxiety or depression or are feeling overwhelmed, stressed, or in crisis, you can seek help through the following campus resources:

Counseling Center, 206 Fred H. Turner Student Services Building, 7:50 a.m.-5:00 p.m., Monday through Friday Phone: 333-3704

McKinley Mental Health, 313 McKinley Health Center, 8:00 a.m.-5:00 p.m., Monday through Friday Phone: 333-2705

McKinley Health Education offers individual consultations for students interested in learning relaxation and other stress/time management skills, call 333-2714.

Diversity, Equity, and Inclusion Statement

It is my intent that students from all diverse backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that the students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender identity, sexuality, disability, age, socioeconomic status, ethnicity, race, nationality, religion, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally, or for other students or student groups.

Important note: Given the sensitive and challenging nature of the material discussed in class, it is imperative that there be an atmosphere of trust and safety in the classroom. I will attempt to foster an environment in which each class member is able to hear and respect each other. It is critical that each class member show respect for all worldviews expressed in class. It is expected that some of the material in this course may evoke strong emotions, please be respectful of others' emotions and be mindful of your own. Please let me know if something said or done in the classroom, by either myself or other students, is particularly troubling or causes discomfort or offense. While our intention may not be to cause discomfort or offense, the impact of what happens throughout the course is not to be ignored and is something that I consider to be very important and deserving of attention. If and when this occurs, there are several ways to alleviate some of the discomfort or hurt you may experience:

1. Discuss the situation privately with me. I am always open to listening to students' experiences, and want to work with students to find acceptable ways to process and address the issue.
2. Discuss the situation with the class. Chances are there is at least one other student in the class who had a similar response to the material. Discussion enhances the ability for all class participants to have a fuller understanding of context and impact of course material and class discussions.
3. Notify me of the issue through another source such as your academic advisor, a trusted faculty member, or a peer. If for any reason you do not feel comfortable discussing the issue directly with me, I encourage you to seek out another, more comfortable avenue to address the issue.

Anti-Racism and Inclusivity Statement

The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (https://bart.illinois.edu/Links to an external site.**).** Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

Disability-Related Accommodations

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail disability@illinois.edu or go to https://www.disability.illinois.eduLinks to an external site.. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting “Request an Academic Screening” at the bottom of the page.

Family Educational Rights and Privacy Act (FERPA)

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course.
See https://registrar.illinois.edu/academic-records/ferpa/Links to an external site. for more information on FERPA.

Religious Observances
Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at https://odos.illinois.edu/community-of-care/resources/students/religious-observances/Links to an external site. to request appropriate accommodations. This should be done in the first two weeks of classes.

Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: wecare.illinois.edu/resources/students/#confidentialLinks to an external site.. Other information about resources and reporting is available here: wecare.illinois.eduLinks to an external site..

Gradescope

We will be using Gradescope this term, which allows us to provide fast and accurate feedback on your work. Homework will be submitted through Gradescope, and homework and exam grades will be returned through Gradescope. *NOTE: This makes a few extra steps at the time that you turn your homework in. Do not wait until the last minute to submit.*

If you are new to Gradescope, please set up an account using your Illinois email. Once I add the roster to the class, it should populate for you in your courses.

If you have used Gradescope previously, your Gradescope login is your university email, and your password can be changed at https://gradescope.com/reset_password (Links to an external site.).
Link to https://gradescope.com (Links to an external site.) (Links to an external site.)
How to submit homework video: https://gradescope.com/get_started#student-submission (Links to an external site.) (Links to an external site.)

Homework

Turning in homework requires that you scan in your work, or produce a pdf. There are many scanning apps for your phone that will produce an excellent scanned image. gradescope.com recommends: Scannable from Evernote OR Genius Scan.

FOR BEST RESULTS PLEASE USE: SCANNABLE from evernote (FREE). Available in app store for iOS or android. https://evernote.com/products/scannable (Links to an external site.) (Links to an external site.)
or https://combinepdf.com/ (Links to an external site.) which allows you to combine files into a single PDF using your browser.

As soon as grades are posted, you will be notified immediately so that you can log in and see your feedback. You may also submit regrade requests if you feel we have made a mistake.

Quiz

Quizzes will use the online web-based format in Gradescope. Everyone in class can access the quiz to see questions once it is released, but only one person will submit and add teammates to the submission.

When you open the quiz, you will see how long you have to complete it and can then confirm that you would like to begin. You will then see a countdown timer on your screen as you complete the assignment. (You can hide the timer, if you don't want to see it, and reveal again, if you change your mind.) During the submission period, you can update your answers any number of times. The most recently submitted answer for each question at the end of the time limit will be saved for the instructor to view and grade.

You will see a series of multiple choice questions and you should select the one best response to the question. The multiple choice questions will be followed by a word problem. You should collaborate to solve the problem and then upload files of any type to file upload questions (i.e. image of solution written on a tablet, photo of neatly written work, typed solution, etc.). As you complete each question, you will see a progress indicator telling you how many questions you have answered and how many questions you have left.

Once submitted, you will click on the submitted work and add group members. Simply start to type their name and Gradescope will auto-complete the names for you.

Regrade requests

To submit a Regrade Request, first click on the question that you wish to submit a request for. This will display the rubric for that question and highlight the rubric items that were applied. Once a question has been selected, click the Request Regrade button in the bottom action bar. A textbox will appear allowing you to type an explanation of the request for the specific question that was chosen. NOTE: Regrade requests are per question, so if you have multiple requests, make sure to submit one for each question that should be reviewed.

Before requesting a regrade, please prepare a clear and concise argument for your stance by reading carefully the comments we provide on your work and consider their meaning and what you feel was wrong in the graded work.

We reserve the right to regrade the entirety of any homework for which any regrade is requested. If the grader made a mistake or the solution for the problem was wrong, we are happy to regrade your problem and award points back. You will receive a notification in Gradescope when your request has been responded to.

Examples of good regrade requests include

- The TA said I left Problem 4 blank, but I have Problem 4 right here, and they just didn't see it.
- The TA said this solution was wrong, and I realize it is not the same as the one in the solution set, but here is a clear and informal explanation of why my alternate solution is correct. I have also attached a statement addressing any concerns the TA may have raised in a comment.

Examples of bad regrade requests include

- I think this rubric is unfair.
- I deserved to get "minor error (-1 points)" instead of "major error (-4 points)."
- I know I said X, but what I really meant was Y. (We can only grade what's on the page!)
- I gave several distinct answers to the problem, and one of them was correct! (Even if another was wrong).
- I gave a correct answer to a different problem from the one on the problem set.

Any request that asserts your solution is correct without giving new information that helps the TA interpret your solution. If your regrade request just says "My solution is correct, please take another look at it," the answer will probably be "I looked at it the first time, and I disagree with you, so you are getting no points back." Regrade requests result from communication failures (either the TA has failed to properly explain to you why your answer is wrong, or you have failed to clearly communicate your solution and why it is correct). So if there is no new information, the TA is unlikely to change their mind.

MATLAB

You can get a copy of MATLAB on a student license from MATLAB for $100 or there is a free version via remote access through EWS on Citrix. Remote access will require Virtual Private Network (VPN) access to authenticate the license.

You can also try MATLAB Online https://www.mathworks.com/products/matlab-online.html (Links to an external site.) - you will need to create an account using your Illinois login and it should recognize our UIUC license
- VPN: https://techservices.illinois.edu/services/virtual-private-networking-vpn/detailsLinks to an external site.
- Citrix access: https://it.engineering.illinois.edu/ews/lab-information/remote-connections/connecting-citrixLinks to an external site.
- MATLAB virtual
via Citrix computer/laptop: https://webstore.illinois.edu/shop/product.aspx?zpid=3819 Links to an external site.
- MATLAB for your personal computer/laptop
($100): https://www.mathworks.com/store/link/products/student/SV?s_tid=ac_buysuite_sv_bod (Links to an external site.)
- MATLAB OnRamp Training: https://www.mathworks.com/learn/tutorials/matlab-onramp.html (Links to an external site.)
- MATLAB Commands and Functions
(downloadable PDF) http://www.hkn.umn.edu/resources/files/matlab/MatlabCommands.pdf (Links to an external site.)
- MATLAB functions from
Mathworks https://www.mathworks.com/help/matlab/referencelist.html;jsessionid=595892246a16b37514d4a57e2717?type=function&listtype=alpha (Links to an external site.)

Last updated August 22, 2025 by Jenny Amos