

SYLLABUS Spring 2024
The University of Iowa
The College of Liberal Arts and Sciences
Department of Mathematics
Mathematical Biology II, MATH:5760:0AAA
Time and Location: MWF 12:30-1:20 PM, 218 MLH

Prerequisites: None.

Corequisites: MATH:5600 and MATH:5700, if not taken as prerequisites.

Catalog Description of Course: This course describes a number of topics in mathematical biology and covers canonical mathematical modeling and analysis of problems in the biological sciences. This is the second of a two-semester sequence.

Course ICON site: To access the course site, log into [Iowa Courses Online \(ICON\)](https://icon.uiowa.edu/index.shtml) <https://icon.uiowa.edu/index.shtml> using your Hawk ID and password.

Some of the policies relating to this course (such as the drop deadline) are governed by its administrative home, the College of Liberal Arts and Sciences, 120 Schaeffer Hall.

Supervisor: For this course, see the DEO.

DEO Contact Information: Professor Ryan Kinser, 14 MLH, ryan-kinser@uiowa.edu

Instructors: Colleen Mitchell and Isabel Darcy

This course is divided into 2 modules. Each module is lectured by a different instructor. The instructions related to each module (topics, assignments, exam(s), etc.) are described below in detail.

Course Grades: Course grades will be assessed based on your performance in the following activities:

Homework Module 1: 25%
Midterm (over Module 1): 25%
Homework and Quizzes for Module 2: 25%
Final exam (over Module 2): 25%

Grade cuts and Grade Distribution:

90% <= A- < 92% <= A
80% <= B- < 82% <= B < 88% <= B+ < 90%
70% <= C- < 72% <= C < 78% <= C+ < 80%
60% <= D- < 62% <= D < 68% <= D+ < 70%
F < 60%

Improvement may be taken into consideration.

The grade of A+ will be considered for truly exceptional performance.

Part 1: Cellular Physiology and Metabolism

Instructor: Colleen Mitchell

Office location and office hours: **225E MLH Wednesday 3:30-4:30 and Friday 1:30-3:30**

Phone and E-mail: **335--3813**, colleen-mitchell@uiowa.edu

TA: **Fatemeh Shanehsazan**, fatemeh-shanehsazan@uiowa.edu

Description: This module will introduce students to mathematical models of cellular physiology. Using techniques from dynamical systems, including separation of time scales, bifurcations and Markov processes, we will build from biochemical reactions to enzyme dynamics to detailed models of cellular metabolism.

Required text: Mathematical Physiology I. J Keener and J. Sneyd (This book can be downloaded for free from the UI library, a link to the book is on ICON under Module 1).

Material to Be Covered & Tentative Timetable:

Week 1: Chemical reaction networks. The law of mass action, and thermodynamics. (Sections 1.1-1.3)

Week 2: Biochemical kinetics. Enzymes and Michaelis-Mentor Kinetics. Separation of time scales and model reduction. (Sections 1.4.1-1.4.2 and 1.6.1)

Week 3: Enzyme regulation. Competitive and allosteric inhibition, cooperativity. (Sections 1.4.3-1.4.6, 1.6.2)

Week 4: Metabolic networks and control. Glycolysis and glycolytic oscillations. Stability and Hopf bifurcation. (Sections 1.5, 1.6.3)

Week 5: Transport. Cell membrane, carrier mediated transport. Discrete Markov chains. (Sections 2.1, 2.4, 1.9.1)

Week 6: Nuclear transport. Exchangers and membrane potential. Gillespie method. (Sections 2.5, 2.6, 2.9.3)

Week 7: Diffusion, buffered diffusion and facilitated diffusion. (Sections 2.2-2.3)

Week 8: Wrap up, review, and midterm exam.

Midterm exam will consist of 2 parts:

In class test will be Wednesday 3/6 (60% of exam, 15% of course total)

A take home test will be due Friday 3/8 (40% of exam, 10% of course total)

Part 2: Intro to Machine Learning

Instructor: Isabel Darcy

Office location and office hours: **M 2:30 – 3:20pm, WF 11:45pm – 12:15pm in 25J MLH, And 6:00pm-6:35pm Tuesdays/Thursday on zoom.**

Join URL: <https://uiowa.zoom.us/j/92642528819?pwd=SXMzbXdZcm9xNFBvNHB6Vkp1dWhVQT09>

And by appointment.

Phone and E-mail: **335-0770**, isabel-darcy@uiowa.edu

TA: **Joe Star**, joseph-starr@uiowa.edu

Description: Students will learn the basics of machine learning and be introduced to python in order to use python to analyze biological data. Benefits and pitfalls of machine learning will also be discussed.

Required text:

An Introduction to Statistical Learning with applications in Python, <http://www.statlearning.com>
Scikit-learn Machine Learning in Python, available at <https://scikit-learn.org>

Material to Be Covered & Tentative Timetable:

- Week 9: Introduction to python, data analysis and machine learning (supervised vs unsupervised learning).
- Week 10: The curse of dimensionality, sparsity, PCA, linear regression.
- Week 11: Linear regression.
- Week 12: Logistic regression.
- Week 13: Linear and logistic regression.
- Week 14: Introduction to ridge, lasso, and elastic net regression.
- Week 15: Discussion of results/issues that have arisen in students' analysis of data. Reproducible research, publication bias, data privacy.

Final Exam (held during Final Exam week) will consist of 3 parts and is worth 25% of your course grade:

- Icon Quiz (20%), Due Friday May 10.
- [Written Project \(40%\)](#), including correcting your lab notebooks if needed. Due Friday May 10.
- Presentation including giving feedback to others (40%) (held during Final exam period)

Date and Time of the Final Exam

The final examination date and time will be announced by the Registrar generally by the fifth week of classes and it will be announced on the course ICON site once it is known. Do not plan your end of the semester travel plans until the final exam schedule is made public. It is your responsibility to know the date, time, and place of the final exam. According to Registrar's final exam policy, students have a maximum of two weeks after the announced final exam schedule to request a change if an exam conflict exists or if a student has more than two exams in one day (see the [policy](#) here).

Course Policies for both modules:

- You should bring a computer to class on **Fridays**. If you do not have a laptop, you can borrow one from the library.
- **Student Collaboration:** Student collaboration is permitted on Homework only, however you must typeset and submit your solutions yourself. **Any significant collaboration should be acknowledged. You should also cite any sources that you use including online**

resources and AI. It is NOT permitted for any exam/quiz. Any attempt to collaborate during the exam/quiz will result in a 0 score on that test. The University policies on scholastic dishonesty will be strictly enforced including reporting any misconduct to the college.

ATTENDANCE AND CLASSROOM EXPECTATIONS

Students are expected to attend every class. Absences may affect your grade.

All students are expected to attend class and to contribute to its learning environment in part by complying with University policies and directives regarding appropriate classroom behavior or other matters.

Academic Honesty and Misconduct

All students in CLAS courses are expected to abide by the [CLAS Code of Academic Honesty](#). Undergraduate academic misconduct must be reported by instructors to CLAS according to [these procedures](#). Graduate academic misconduct must be reported to the Graduate College according to Section F of the [Graduate College Manual](#).

Rules on Student Collaboration:

In this class, students are encouraged to talk with others about homework. However, do not share your written work with others or ask others to see their completed assignments since both are considered academic misconduct. In other words, you can discuss a problem with other students, but you write your solution alone. If you worked/discussed a problem with others, you must state their names on your homework before the beginning of that problem, even if you wrote the solution yourself. HWs showing duplication will be considered as the result of academic dishonesty. If you need help, please stop by during my office hours. Students are responsible for understanding this policy; if you have questions, ask for clarification.

Student Complaints

Students with a complaint about a grade or a related matter should first discuss the situation with the instructor and/or the course supervisor (if applicable), and finally with the Director or Chair of the school, department, or program offering the course.

Undergraduate students should contact [CLAS Undergraduate Programs](#) for support when the matter is not resolved at the previous level. Graduate students should contact the CLAS [Associate Dean for Graduate Education and Outreach and Engagement](#) when additional support is needed.

Drop Deadline for this Course

You may drop an individual course before the deadline; after this deadline you will need collegiate approval. You can look up the [drop deadline for this course](#) here. When you drop a course, a “W” will appear on your transcript. The mark of “W” is a neutral mark that does not affect your GPA. Directions for adding or dropping a course and other registration changes can be found on the [Registrar’s website](#). Undergraduate students can find policies on dropping and withdrawing [here](#).

Graduate students should adhere to the [academic deadlines](#) and policies set by the Graduate College.

College of Liberal Arts and Sciences (CLAS) Course Policies

[Attendance and Absences](#)

University regulations require that students be allowed to make up examinations which have been missed due to illness or other unavoidable circumstances. Students with mandatory religious obligations or UI authorized activities must discuss their absences with me as soon as possible. Religious obligations must be communicated within the first three weeks of classes.

[Exam Policies](#)

Communication: UI Email

Students are responsible for all official correspondences sent to their UI email address (uiowa.edu) and must use this address for any communication with instructors or staff in the UI community.

University Policies

[Accommodations for Students with Disabilities](#)

[Basic Needs and Support for Students](#)

[Classroom Expectations](#)

[Exam Make-up Owing to Absence](#)

[Free Speech and Expression](#)

[Mental Health](#)

[Military Service Obligations](#)

[Non-discrimination](#)

[Religious Holy Days](#)

[Sexual Harassment/Misconduct and Supportive Measures](#)

[Sharing of Class Recordings](#)