



Biomathematics Seminar 2

MAP 6488

Spring 2024

Instructor



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Office: 460 Little Hall



Office Hours:

- TBD
- By appointment

Lecture



Mondays/Wednesdays/Fridays



Period 6 (12:50–1:40pm)



5 Matherly Hall

Web Site



Canvas:
<https://elearning.ufl.edu/>

Course Objectives/Goals

Partial Differential Equations in Biomathematics

Modeling biological phenomena using partial differential equations (PDEs) dates back to the early 1900s. As biological systems generally have underlying spatial variation, whether it's through the surrounding environment or among individuals within the population, a goal of this course is to understand how spatial effects influence motion, distribution, and behavior by introducing fundamental properties of PDEs in the context of interesting biological phenomena.

Mathematical topics covered include derivation of relevant PDEs including reaction-diffusion equations from first principles; traveling wave analysis in cases of single-species and multi-species waves; pattern formation and concepts of spatial stability and instability; and moving boundary problems.

These concepts will be introduced within the setting of classical and current problems in biology, though the approaches can be used to study a wide range of physical systems. There will be a special focus on biomedical topics such as embryonic development, wound healing, and tumor growth, and students will have the opportunity to explore other biological systems via a course project.

Prerequisites: No graduate prerequisites. Familiarity with differential equations and linear algebra and knowledge of a programming language (e.g. MATLAB, Mathematica, Maple, R, Python, C/C++, etc.) will be useful.

Textbook

While not mandatory to purchase a textbook, students might find the following books useful for the course.

- *Mathematical Biology: I: An Introduction* (3rd edition) by J.D. Murray
<https://doi.org/10.1007/b98868>
- *Mathematical Biology: II: Spatial Models and Biomedical Applications* (3rd edition) by J.D. Murray
<https://doi.org/10.1007/b98869>
- *Mathematical Models in Biology* by Leah Edelstein-Keshet
<https://doi.org/10.1137/1.9780898719147>

The 2nd edition of the textbooks by Murray are accessible for free as an eBook (with both volumes contained in one book) through the UF Libraries (<https://uflib.ufl.edu>).

Additional readings will be posted on the course web site.

Software

Homework assignments and projects may require computer skills using software such as MATLAB, Mathematica, Maple, R, Excel, Python, C/C++, etc.

Some of this software is available to download to personal computers for no cost, while others are available through **UFApps** (<https://info.apps.ufl.edu>), **GatorCloud** (<https://cloud.it.ufl.edu>), and in computer labs (<https://labs.at.ufl.edu/computer-labs/>).

Communication

Course Announcements: Posted on **Canvas**. It is the student's responsibility to make sure they receive notifications for this course.

Discussion Board: Homework/content questions should be posted on our class discussion board on **Canvas Discussions**.

Personal Matters: Students may e-mail the instructor via **Canvas Inbox** or e-mail using their official UF e-mail address.

Grading Scheme

60% Homework

40% Project

Your final course grade will be no lower than the following:

A-=[90,93) A=[93,100]

B-=[80,83) B=[83,87) B+=[87,90)

C=[70,76) C+=[76,80)

D=[60,70)

E=[0,60)

Grades are based only on academic work and are calculated using the same criteria for all students. It is unethical to bring to your instructor's attention the possible impact of your mathematics grade on your future plans, including graduation, scholarships, jobs, etc.

More information on UF grading policies (including requests for withdrawal (W) or incomplete (I*/I) grades) may be found at:

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

Academic Calendar Dates



Mon., Jan. 8

First day of class



Fri., Jan. 12

Last day to drop/add courses with no fee liability



Mon., Jan. 15

No Classes (Martin Luther King Jr. Day)



Mon., Mar. 11–Fri., Mar. 15

No Classes (Spring Break)



Fri., Apr. 12

Last day to withdraw from courses with W



Wed., Apr. 24

Last day to petition to your college for late withdrawal



Wed., Apr. 24

Last day of class

Tentative Lecture Schedule

Weeks 1–3 (Jan. 8–26) Reaction–Diffusion Equations

Weeks 4–6 (Jan. 29–Feb. 16) Traveling Waves

Weeks 7–8 (Feb. 19–Mar. 1) Pattern Formation

Week 9 (Mar. 4–8) Project Presentations I

Weeks 10–13 (Mar. 18–12) Moving Boundary Problems

Weeks 14–15 (Apr. 15–24) Project Presentations II

Homework

Written homework assignments showing all work with proper notation will be due bi-weekly via electronic submission through Canvas.

Project

You will have the opportunity to work on a project using mathematical techniques from the course to explore biological systems that were not discussed or to dive deeper into the systems introduced in lecture. The instructor will suggest topics, but you are welcome to propose others that interest you. In any case, the final topic and scope of work will be negotiated with the instructor well in advance.

You will give two oral presentations and write a grant proposal-style paper.

Attendance

Attending lectures are vital to the learning process. Furthermore, a huge part of the transition into your professional careers is being where you are supposed to be when you are supposed to be there. As such, your attendance is expected at every lecture. Furthermore, our focus is on the tasks at hand and not on extraneous activities such as chatting, texting, surfing the web/social media, etc.

Classroom/Online Behavior

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed.

The use of personal electronics such as laptops, tablets, and cell phones is distracting to the other students and the instructor. Their use can degrade the learning environment. Therefore, students are not permitted to use these devices during the class period (unless they are being used solely for note taking purposes).

Accessibility and 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/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**.

Health and Wellness Resources

- U Matter, We Care
<https://umatter.ufl.edu>
- Counseling and Wellness Center
<https://counseling.ufl.edu>
- Student Health Care Center
<https://shcc.ufl.edu>
- University Police Department
<https://police.ufl.edu>
- UF Health Shands Emergency Room/Trauma Center
<https://ufhealth.org/emergency-room-trauma-center>
- GatorWell Health Promotion Services
<https://gatorwell.ufsa.ufl.edu>
- Whole Gator App
<https://studentlife.ufl.edu/wholegator/>

Academic Resources

- CLAS Academic Resources (tutoring, study groups)
<https://academicresources.clas.ufl.edu/>
- UF Student Success (tutoring, coaching)
<https://studentsuccess.ufl.edu>
- Computing Help Desk
<https://helpdesk.ufl.edu>
- Career Connections Center
<https://career.ufl.edu>
- Library Support
<https://uflib.ufl.edu/find/ask/>
- Writing Studio
<https://writing.ufl.edu/writing-studio/>

Important Note: Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

Course image by Ricky Reusser from <https://rreusser.github.io/multiscale-turing-pattern-gallery/>

Honesty Policy Regarding Cheating, Plagiarism, etc.

UF students are bound by *The Honor Pledge* (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) 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 Student Conduct Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of the honor 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 or consult with the instructor in this class.

Online Course Evaluations

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.aa.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.aa.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.