MAP 4484/5489: Modeling in Mathematical Biology

Instructor:	Youngmin Park
E-mail:	park.y@ufl.edu
Class:	LIT 225, MWF 12:50pm – 1:40pm, period 6.
Office Hours:	LIT 454, Wed 1:55pm – 2:45pm (per. 7), Fri 11:45am – 12:35pm (per. 5), or appointment

Course Description: Mathematical biology is a highly interdisciplinary and diverse field that requires knowledge of both math and biology to make meaningful progress. In terms of biology, we will study sub-cellular mechanisms involving motor proteins, transport, and intracellular filaments, cellular interactions such as biological neural networks, wound healing, and pattern formation, and social/ecological networks such as disease dynamics and other network dynamics. In terms of mathematics, we will learn applied dynamical systems, including but not limited to the analysis and simulation of partial and ordinary differential equations (including some mean-field theory) and some information theory and network theory.
Students who successfully complete the course will be able to demonstrate strong competency in the above course material and utilize these concepts to identify and apply potentially relevant mathematical methods to biological systems.

Resources: All homework assignments will be based on lecture notes and in-class programming tasks. If needed, additional notes will be provided on Canvas.

Attendance: Attendance is required. We will adhere to the university attendance policies that can be found here: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/. In particular, **I will not provide in-class notes, nor will the course be recorded**. I will only share notes and record the class for people with specific DRC accommodations. I reserve the right to implement the Socratic method in this course, where I call names at random to answer specific questions in class. See the grading section below for details.

Programming Prerequisite: We will use Python for all assignments and in-class demos, exercises, and discussions. If you don't know how to program in Python, you will need enough proficiency to keep pace, or be comfortable in another language with comparable libraries.

Weekly Schedule (subject to change):

- Part 1: Epidemiology/pathology/ecology
  - Week 1 (Jan 8–12): Single species population dynamics
  - Week 2 (Jan 15–19): Interacting populations
  - Week 3 (Jan 22–26): Susceptible, Infected, Recovered (SIR) models
  - Week 4 (Jan 29–Feb 2): Social networks and network theory
- Part 2: Cell physiology
  - Week 5 (Feb 5– 9): Elementary stochastic calculus and differential equations
  - Week 6 (Feb 12– 16): Molecular motor dynamics and transport 1
  - Week 7 (Feb 19–23): Molecular motor dynamics and transport 2
  - Week 8 (Feb 26–Mar 1): Cell motility, partial differential equations
- Part 3: Electrophysiology
  - Week 9 (Mar 4–8): Single-cell neural dynamics 1
  - Week 10 (Mar 18–22): Single-cell neural dynamics 2
  - Week 11 (Mar 25–29): Biological neural networks
  - Week 12 (Apr 1–5): Pattern formation
  - Week 13 (Apr 8–12): Elementary information theory
- Part 4: Data science methods in biology
  - Week 14: (Apr 15–19) Parameter estimation, model selection
  - Week 15: (Apr 22–26) Artificial neural networks + presentations if any

Homework: Assignments will be assigned every other week on Fridays and due in two weeks. They will be posted on Canvas and will involve a combination of paper-and-pencil calculations alongside programming assignments. The lowest homework score will be dropped. **I will not accept late assignments without a valid medical reason** https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/. Assignments will typically be due just before class.

Grading: Homework problems will be assigned and due every other week. There will be no exams or quizzes. All homework grades will be posted to canvas. Please notify me as soon as possible if you anticipate being unable to submit

a homework assignment. Any issues or questions about the grading of homework assignments must be brought to my attention within one week after assignments are returned to the class. If I implement the Socratic method, 5% of your semester grade will go towards class participation.

Semester letter grade assignments will be no stricter than the following: 93-100 A, 90-92 A-, 87-89 B+, 83-86 B, 80-82 B-, 77-79 C+, 73-76 C, 70-72 C-, 67-69 D+, 63-66 D, 60-62 D-, 0-59 E. We will adhere to the university grading policies that can be found here: `https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/`

Honor Code and Collaboration: In this course, authorized aid on projects and homework consists of talking to me, other students, reading documentation for your computational platform, and looking at the notes for this course. You may use online resources and students with permission but **cite all sources**. I encourage collaboration and discussion, but you must write and submit your own work.

Announcements: You are responsible for all announcements made in Canvas and via email which could include changes in due dates and material covered.

Diversity Statement: I am committed to diversity and inclusion of all students in this course. I acknowledge, respect, and value the diverse nature, background and perspective of students and believe that it furthers academic achievements. It is my intent to present materials and activities that are respectful of diversity: race, color, creed, gender, gender identity, sexual orientation, age, religious status, national origin, ethnicity, disability, socioeconomic status, and any other distinguishing qualities.

Student 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/`.

Disabilities statement: 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/`. 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.

Academic Integrity: 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 Conduct Code specifies a number of behaviors that are in violation of this code and the possible sanctions. See `https://sccr.dso.ufl.edu/process/student-conduct-code/` to read the Conduct Code. If you have any questions or concerns, please consult with the instructor of this class.