MATH 4780/6780 - Mathematical Biology

Instructor: Caner Kazanci **Office:** 444 Boyd GSRC **E-mail:** caner@uga.edu

Grader: Nicole Song

Course website: `http://alpha.math.uga.edu/~caner/math6780`
Homework assignments, general announcements, and any extra material I provide will be posted on this website. ELC will not be used for this course.

Office Hours: 1:30-2:30 pm on Wednesdays, 2:30-3:30 pm on Thursdays, and anytime by appointment.

Objective: The course will provide students with mathematical and computational tools necessary to model, analyze and manipulate a variety of biological and ecological systems.

Text: A Course in Mathematical Biology, *G. Vries, T. Hillen, M. Lewis, B. Schönfisch,* SIAM. We will cover additional material including some papers, lecture notes and material from the following books; however you do not need to have these books, I will provide any necessary additional material:
- Handbook of Stochastic Methods, *by C. W. Gardier*, Springer
- Computational Cell Biology, *by C. Fall, E Marland, J. Wagner, J. Tyson*, Springer
- Systems Biology in Practice, *by E. Klipp, R. Herwig, A. Kowald, C. Wierling*, Wiley
- Nonlinear Dynamics and Chaos, *by S. Strogatz*, Wiley
- Mathematical Biology I, *by J. D. Murray*, Springer
- Essential Mathematical Biology, *by Nicholas F. Britton*, Springer

Prerequisites: Basic differential equations and linear algebra knowledge is necessary. We will use Matlab and XPP for simulation and analysis, however no prior experience with these software is necessary.

Evaluation: The course grade will be based on homework assignments (30%), two in class exams (30% each, on February 28 and April 27. Your lowest test grade will count 20% towards your grade) and a group project (20% total, 10% for report and 10% for presentation). Cut-offs are as follows:

A	90	A-	87	B+	83	B	80	B-	77	C+	73	C	70	C-	67	D	60	F

Projects: One of the important objectives of this course is to successfully communicate a biological or ecological problem across disciplines, collaborate with others, and work as a team. Students will form (interdisciplinary) groups (2 or 3 members), and work on a project together as a team. The project will consist of a presentation and a report. Projects will be presented on the final exam date.

You should form groups and a project title must be determined by the end of February. You can search for a project title based on your interest, using online resources, or mathematical biology texts. I will go over some examples in class. It is important that you apply

what you have learned in class on a problem, where your work provides insights that increase our understanding of the modeled system. More information will be provided on the course website.

Topics:

Discrete-time models, population dynamics, stability, chaos, Liapunov coefficient, using Matlab.	January
Continuous time models, chemical reactions, phase plane analysis, stability analysis, infectious disease models, using XPP, bifurcations, numerical ODE solutions, Enzymatic reactions.	February - March
Stochastic models, Markov chains, Gillespie's stochastic algorithm, chemical master and Fokker-Planck equations, Langevin equation.	April
Agent based models, cellular automata, game of life.	April
Systems biology, parameter estimation.	

Use of electronic equipment: Studies have shown that using a laptop in class does not only have a negative impact in your learning, but also has negative implications for other students in class. Use of laptops, netbooks, tablet PC's, iphones, ipads, android devices, smart phones, and cellphones are not permitted, unless you have a documented disability that requires you to use one. If this is the case, you need to contact and inform me about your situation beforehand. **You should not have a device with a screen in front of you unless I am informed about your situation. First time violators will be asked to leave class. Second time violators will have their cumulative course average decreased by 10/100.**

Attendance: Attendance is required. If you miss any classes, it is your responsibility to get notes from your classmates and make up for the class you missed.

Collaboration policy: As a University of Georgia student, you have agreed to abide by the University's academic honesty policy, "A Culture of Honesty," and the Student Honor Code. All academic work must meet the standards described in "A Culture of Honesty" found at: `www.uga.edu/honesty`. Lack of knowledge of the academic honesty policy is not a reasonable explanation for a violation. Questions related to course assignments and the academic honesty policy should be directed to the instructor. Specifically, you should write your own solutions to assignments. In other words, you are not allowed to see the actual paper that somebody else is handing in. This rule applies to computer codes and figures as well. The only code you are allowed to see and modify is the one that is available through the course website. You should not send, receive, start as a template or look at somebody else's code.

The course syllabus is a general plan for the course; deviations announced to the class by the instructor may be necessary.