Biology 226L: Mathematical Methods for Quantitative Biology Lab Syllabus
Wednesday, 2:40 PM – 3:30 PM via Zoom

Credit Hours: 1. This course has a 1 hour computational lab each week.

Instructor:
Brian K. Taylor
Assistant Professor of Biology
Email: brian.taylor@unc.edu Website: http://taylorlab.web.unc.edu/
Course Website: https://sakai.unc.edu/portal/site/biol226_fall_2020
Office: Coker Building – Room 301
Office Hours: Wednesday – 3:30PM – 5:00PM, and by appointment, all through Zoom

Teaching Assistant:
Juan Shi
Graduate Student: Department of Mathematics
Email: juans@live.unc.edu
Wednesdays – 1:30PM – 2:30PM, and by appointment, all through Zoom

Target Audience: Biology majors who are interested in quantitative biology, mathematical modeling, and computer simulation. Mathematics, physics, chemistry, and computer science majors who are interested in biological applications of mathematics.

Course Prerequisites: One of MATH 231/283 and one of BIO 201/202, or equivalents

Course Goals and Key Learning Objectives:

- Write down mathematical models to describe molecular, cellular, and organismal processes.
- Solve the mathematical models numerically or analytically and evaluate them against experimental data.
- Become proficient in the use of MATLAB for biological applications, both in terms of writing programs and using software packages.

Course Requirements:
Students will be expected to review assigned readings from the course packet, lecture notes, and other materials posted on webassign and/or Sakai before each lab.

Grades: Graded work will consist of approximately ten lab exercises (80%), and a semester-long coding project (20%). Lab exercises include activities to demonstrate proficiency at mathematical modeling and the use of MATLAB.

Help/Camaraderie: While all submitted work must ultimately be your own, I want to encourage you to help each other, and ask each other questions on assignments. This course should be a community where we all help to increase each other's comprehension and understanding of the material, and just plain have fun! Therefore, if you agree with a classmate to help and/or receive help on a particular assignment via webassign, that exchange will be recorded. At the end of the semester, I will take the total number of times you received/gave help, compare that to the number of times possible (i.e., assignments given), and convert that to a maximum of 2 percentage points that will be added to your grade after the final grade has been computed. ***To get credit, you must both separately indicate the party that provided help, and the party that received it. If one party states that they gave/received help and the other does not, neither gets the extra credit for that assignment.***

Assignment Redos: If you don't like your grade on an assignment, if you ***come and talk to me about what you did wrong***, you may resubmit a corrected version of the assignment ***within one week of when***

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the grade is posted. If you do this, and the assignment is correct (i.e., flawless), you will be given back half of the points that you lost ***up to an 85%***. For example, if you get a 50/100 on an assignment, talk to me about it to understand what you did wrong, and resubmit something perfect, you will get back 25 points, so you now have a 75/100. ***THIS DOES NOT APPLY TO EXAMS***

Course Policies:

Late Lab Report and Lab Activity Policy: 10% will be deducted the first hour the assignment is late, and then 20% will be deducted each day unless the student can provide a written excuse with documentation for valid reasons (illness, family emergency, religious observance, university sponsored travel, etc.). A student should present his or her explanation for any absences in writing in advance if the reason for the absence could be foreseen, or within 5 days of the due date of the assignment if the reason could not be foreseen.

Honor Code Statement: "It is expected that each student will conduct him or herself within the guidelines of the Honor System. All academic work should be done with the highest level of honesty and integrity that this University demands." In particular, all tests and quizzes should be taken without texts without consultation with other student's work, except as indicated. Students are encouraged to work together on all homework assignments.

Attendance: Attendance will not be figured into your grade directly. However, attending class, either live as the lectures are done, or asynchronously on your own time, is highly recommended *as there may be things that are stated in class that are not posted* (e.g., concepts around the lecture material). For me to write every single thing out, I think I would have to write something 100x longer than War and Peace (~1,200 pages), and I'm sure that none of you want to read that. You will be responsible for any in-class activities that may be assigned during your absence. While attendance will not be taken, I DO monitor who comes to class on a regular basis. Unless you contact me and work something out prior, exams MUST BE TAKEN UNDER THE SPECIFIED RULES. If you can't make it to class, or have circumstances that are preventing you from attending synchronously or asynchronously, let me know and let's talk about it – I might be able to help!

Contact with Dr. Taylor: I STRONGLY encourage you to use my office hours, e-mail me, and talk to me about the class, career advice, or things in life that are affecting your ability to perform in the class. It will help you do better in the class, maybe help you figure out future plans, help smooth out life, and I just like to hear and learn (yes, learn) from all of you! I think that this IS ESPECIALLY TRUE DURING THE PANDEMIC. That being said, this class is not my only responsibility. Just as you all have other classes to balance on top of your personal lives, I have other personal and professional responsibilities to balance. While I want to be available and responsive to you, I cannot be available all the time. If you have a question about something, *I ENCOURAGE* you to ask. However, if you e-mail me after 7:00PM, you may not receive a response until the following day. Please keep this in mind, especially if you are sending an e-mail about an assignment the night before it is due.

Code: If asked to turn in or submit code, ASSUME THAT I WILL PUT IT IN MATLAB AND RUN IT! If your code does not run, but you acknowledge this along with what might be wrong in your writeup, partial credit will be given. If your code does not run, and you make no acknowledgement that your code does not run, the question under consideration WILL RECEIVE ZERO CREDIT. Bottom line: Make sure your code works, or acknowledge that it doesn't, and why you think it might be broken. Making mistakes is OK! But, we have to acknowledge them.

Course Resources:

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Suggested Text: F.C. Hoppensteadt and C.S. Peskin. Modeling and Simulation in Medicine and the Life Sciences. Second Edition, New York: Springer-Verlag, 2002.

Sakai Resources: Supplemental reading and labs will be posted to www.unc.edu/sakai throughout the semester. Digital assignments will be maintained on www.unc.edu/sakai.

Webassign: Homework will be assigned and submitted through webassign. Please create an account using your onyen as the username at http://www.webassign.net.

Instructor	Section	Class Key
Brian K. Taylor	**BIOL 226**	**unc 0293 4814**

Grading Scale: A letter grade will be based on the following APPROXIMATE scale: A= 95-100%, A- = 90-94%, B+ = 86-90%, B = 81-85%, B- = 80-81%, C+= 78-80%, C = 71-77%, D= 60-70%, F= less than 60%.

Calendar: Labs will be due approximately 1-1.5 weeks after the class period in which they are presented. The coding project is due BY THE END OF CLASS on Wednesday, November 11. Unless there are unforeseen extenuating circumstances, the coding project WILL NOT BE ACCEPTED LATE.

Tentative Time Table (Approximately 1 Lab/week):
NOTE: Lab order may be changed to better fit material being covered in class.

Lab 1: Introduction to Matlab
Lab 2 - 3: Random walks and programming in Matlab
(Mathematics: vectors, matrices, matrix addition and multiplication, linear maps, basic probability)

Lab 4: Developing a model of diffusion
(Mathematics: Tangent lines, partial derivatives, tangent planes, boundary conditions)

Lab 5: Robotics
(Mathematics: Vector Loops and Homogeneous Transformations)

Lab 6-10: Solving differential equations in Matlab, and looking at feedback loops
Lab 8: Simulating feedback loops using differential equations in Matlab
(Mathematics: numerical methods, Matlab tools, Numerical solution of nonlinear differential equations)

Lab 10-11: Simulating nerve dynamics in Matlab
(Mathematics: Numerical solving systems of nonlinear differential equations)

Lab 10-12: Simulating crossbridge attachments in Matlab and calculating force-velocity curves
(Mathematics: The probability density function, linear regression)

Other:: Vector representations of genomes and simple fitness functions
(Mathematics: Basic probability, expected value, normal distribution, independence, conditional probability, basic statistical tools).

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Coding Project:
The coding project **(20% of your total grade in the course)** is actually posted on Sakai right now, along with sample data sets so you can check to make sure your code works. By the deadline, you will submit a set of code to me that I will run for a given set of parameters. I will evaluate the outputs, and if they are correct, then you receive full credit for the problem. THERE WILL BE NO PARTIAL CREDIT FOR THIS PROBLEM.

That probably sounds really scary, but I promise it's not! As we move through the class, you will acquire the skills to write the code for the lab final, and you will be able to check your code against the sample data sets that are posted. So, you could actually verify that you have this correct ahead of time! I will let you know what parts of the project you should be able to do as we move through the course so that you can work on it during the semester. I can't make you do anything, but I STRONGLY ENCOURAGE YOU TO WORK ON THE FINAL AS WE MOVE THROUGH THE SEMESTER so that the end of the semester is low stress for you. I am more than happy to help you with your code, and even go over code in class, but **I WILL NOT GO OVER THE CODING PORTION OF THE LAB FINAL AFTER 5PM NOVEMBER 4**. Therefore, **prioritize your time, do not procrastinate**, and if you have questions about the lab final, **ask early**.

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