

Syllabus Spring 2025
Biochemical/Cellular Sys Model - BINF 751
George Mason University, Bioinformatic and Computational
Biology, School of System Biology

INSTRUCTOR: Aman Ullah.

Locations/times: Lecture: Wednesday 4:30PM - 7:10PM, PW: Colgan 304B and DL (Zoom's link will be available on the Canvas).

Phone: (703) 993-7182; Email: aullah3@gmu.edu

Office Hour: Wednesday: 10:00 PM-1:00 PM or by an appointment through Zoom's Link.

Course Description:

This interdisciplinary course examines the dynamic behavior of cellular systems through computational modeling and systems biology. Students will explore biophysical mechanisms such as voltage-gated ionic currents, membrane transporters, and intracellular calcium signaling. Emphasis is placed on understanding fast and slow timescales of cellular responses and on constructing whole-cell models that integrate electrical, biochemical, and spatial dynamics.

The course also covers intercellular communication, calcium wave propagation, biochemical oscillations, and cell cycle regulation. Students will learn to translate biological processes into mathematical language and apply computational methods for simulation and analysis. Designed for students in biology, physics, bioengineering, or related disciplines, the course equips learners to critically evaluate models and develop their own simulations of cellular processes.

Application of Knowledge

Translate cellular and subcellular processes into mathematical equations.

Use computational methods to analyze biological models and gain insight into cellular function.

Course Introduction

Introduction to dynamical modeling in cell biology.

Focus on computational cell biology and computer-based simulations.

Course Objectives

Understand core concepts and techniques in computational cell biology.

Apply mathematical and computational approaches to model cellular functions.

Foster collaboration between mathematicians and experimental scientists.

Course Scope

Progress from modeling basic to complex cellular functions.

Emphasize interdisciplinary learning and hands-on computational techniques.

Course Goals

Equip students with tools to access, interpret, and build upon modeling literature.

Promote interdisciplinary collaboration in theoretical and experimental cell biology.

Textbooks

Computational Cell Biology: by Chris P. Fall, John Tyson, John Wagner, and Eric Marland. “*An Introductory Text on Computer Modeling in Molecular and Cellular Biology*”

Mathematical Physiology: by James Keener and James Sneyd.

Note: Lecture material will be based heavily on these textbooks.

Prerequisites

Calculus and knowledge of a programming language. Knowledge of differential equations is helpful.

Grading Policy

The course grade will be determined as follows:

Activities:	Percent of Final Grade:
Homework-	25%
Mid-Term (Take Home) -	25%
Final Exam (Take Home) -	30%
Final Project -	20%

Grades are assigned on the following basis.

98 to 100%:	A+
90 to 97%:	A
87 to 89%:	B+
80 to 86%:	B
77 to 79%:	C+
70 to 76%:	C
60 to 69%:	D
Less than 60%:	F

Attendance and Participation

Regular attendance and active participation are essential for success in this course. Students are expected to attend all scheduled lectures—whether in-person or via Zoom (for the distance learning section)—and to arrive prepared to engage with the material. This includes:

- Attending class on time and staying for the full duration.
- Contributing to discussions and group activities.
- Reading all assigned references and materials before class.

By maintaining consistent attendance and active engagement, students will be better equipped to ask informed questions, collaborate productively with peers, and deepen their understanding of the subject matter.

Academic Integrity Policy:

Academic dishonesty, including cheating, plagiarism, and falsification of academic records, will not be tolerated in this course. Any instances of academic dishonesty will be addressed accordingly.

However, collaboration and seeking help from peers is encouraged. You are allowed to:

- Discuss homework assignments with classmates
- Seek help and guidance from peers
- Work together to understand course concepts

But remember, copying someone else's work or submitting it as your own is not acceptable. All submitted work must be original and written in your own words.

Policy on the Use of AI Tools

Artificial Intelligence (AI) tools (e.g., ChatGPT, GitHub Copilot, Grammarly, QuillBot, and similar applications) can be valuable for learning when used appropriately. In this course, AI use is regulated to ensure it supports, rather than replaces, your own work and critical thinking.

Permitted Uses:

- Clarifying concepts or reviewing material covered in class.
- Improving grammar, spelling, or clarity in your own writing while maintaining your original meaning.
- Creating practice problems or questions for study purposes.

Prohibited Uses:

- Submitting AI-generated text, code, images, or other work as your own without attribution.
- Using AI to complete any graded assignment, quiz, or exam, unless explicitly permitted by the instructor.
- Uploading course materials (assignments, tests, lecture slides) to AI platforms.
- Using AI in ways that bypass the learning objectives of the course.

Academic Integrity:

Any unauthorized use of AI tools will be treated as an **academic integrity violation** and addressed according to university policy.

Tentative Course Schedule:

Tuesday, January 21nd --- Overview of the course and Dynamic Phenomenon in cells

Tuesday, January 28th --- Biochemical Reactions

Tuesday, February 4th --- Voltage Gated Ionic Currents, The Hodgkin-Huxley Model

Tuesday, February 11th --- Excitability and action potential and Spiking

Tuesday, February 18st --- Transporters and pumps, Reduction of Scale

Tuesday, February 25th --- Reduction of Scale, Fast and Slow Time Scale

Tuesday, March 4th --- **Midterm (Take home)**

Tuesday, March 11th --- **No class -- Spring Recess**

Tuesday, March 18th --- whole-cell models

Tuesday, March 25th --- Intracellular communication

Tuesday, April 1st --- Spatial Modeling

Tuesday, April 8th --- Calcium dynamics, Modeling intracellular Calcium waves and sparks
Tuesday, April 15th --- Modeling intracellular Calcium waves and sparks
Tuesday, April 22nd --- Final Project
Tuesday, April 29th --- Final Project
Tuesday, May 6th --- (**Final, Take-home exam due**)

Changes if needed will be announced in the class.

Advice

If you want to do well in course: 1) Do all the homework. 2) Ask questions in class and office hours. 3) If you are having difficulty doing the homework, be sure to see the instructor for additional help.

Student Services

Disabilities

If you have a documented learning disability or other condition that may affect academic performance you should: (1) make sure this documentation is on file with Office of Disability Services (SUB I, Rm. 4205; 703-993-2474; <http://ods.gmu.edu>) to determine the accommodations you need, and (2) talk with me to discuss your accommodation needs.

Mason Live/Email: Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account.

University libraries: University Libraries provide resources for distance learning students [See Library website: <http://library.gmu.edu/for/online>].

WEATHER

For closings due to inclement weather, register for Mason-ALERT to receive text messages by email or phone.