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2024

### BIOM 3710: Physiological Systems and Modeling (Syllabus)

Stephen Strain

*University of Memphis*

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**Hello! I am Dr. Strain.** Welcome to BIOM 3710. We will meet in ES 326. Please feel free to email me at [sfstrain@memphis.edu](mailto:sfstrain@memphis.edu) with any questions, concerns, etc. that you might have.

**I look forward to hearing from you!**

For class business, use University email only—I cannot record verbal discussions after class, so if, for instance, you have an issue with attendance or assignment due dates, send an email. **Do not send messages through other students, but communicate directly with me by email.** My address is [sfstrain@memphis.edu](mailto:sfstrain@memphis.edu). Please include “BIOM 3710” in the subject line when you write.

**Instructor**

Dr. Stephen Strain

[sfstrain@memphis.edu](mailto:sfstrain@memphis.edu)

Office: ET308

Virtual Office: <https://memphis.zoom.us/j/3271381594?pwd=VW9FYThrS293d0FwYUZ2TVFyeVJLdz09>

Office hours: Monday and Wednesday 10-11 AM, or email for appointment

**Teaching Assistant:** Utsav Shrestha ([shrstha3@memphis.edu](mailto:shrstha3@memphis.edu))

**Course Description:** This course will provide an introduction to fundamentals of mathematical modeling and analysis as applied to physiological systems. The course provides a framework for students to understand, investigate, and further develop complex models for physiological systems.

**PREREQUISITES:**

- BIOM 1720 (Intro to Biomedical Engineering Tools)
- CIVL 2131 (Statics)
- EECE 2201 (Circuit Analysis I) or EECE 2283 (Electrical Engineering/Instrumentation)
- MATH 2120 (Differential Equations) or MATH 3402 (Honors Mathematics IV)
- PHYS 2120 (Physics for Scientists and Engineers II)

**PREREQUISITES or COREQUISITES:**

- BIOL 3730 (Vertebrate Physiology) or BIOM 3110 (Medical Physiology)
- MATH 2110 (Calculus III)

This course is required for the Biomedical Engineering Degree Program.

**Course Goals**

At the end of the course, students will be able to

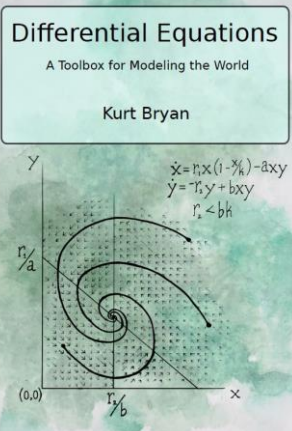
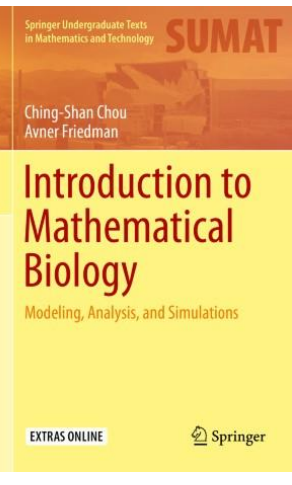
- Identify qualitative and quantitative features of complex physiological models
- Formulate mathematical models of physiological systems with terms of feedback and control
- Solve complex physiological problems using basic concepts and applying differential equations

**Course Topics**

- Introduction to physiological complexity and modeling process
- Review 1st order, 2nd order and systems of differential equations
- MATLAB symbolic and numeric solutions and Live Script
- Static modeling and examples of physiological models
- Linear Modeling and examples of physiological models
- Non-linear modeling and examples of physiological models
- Data fitting and estimation of model parameters
- MATLAB Simulink modeling

### Specific Course Requirements

Review of differential equations and linear algebra is necessary for writing and solving model equations so that course time is spent effectively on modeling aspects of physiological systems.

	<p>© 2021 <i>Differential Equations: A Toolbox for Modeling the World</i> Author: Kurt Bryan ISBN: 978-1-63877-937-7</p> <p>Purchase through <a href="https://shop.simiode.org/collections/textbooks">Tigers SmartStart</a> or <a href="https://shop.simiode.org/collections/textbooks">https://shop.simiode.org/collections/textbooks</a></p>
	<p>© 2016 <i>Introduction to Mathematical Biology, Modeling, Analysis, and Simulation</i> Authors: C.S. Chou &amp; A. Friedman ISBN: 978-3-319-80614-3</p> <p>Free access/download through UM library: <a href="https://link-springer-com.ezproxy.memphis.edu/book/10.1007/978-3-319-29638-8">https://link-springer-com.ezproxy.memphis.edu/book/10.1007/978-3-319-29638-8</a></p>

### Required Materials

- Internet Access
- Desktop Computer, Laptop, or Tablet
- Canvas ([memphis.instructure.com](https://memphis.instructure.com))
- MATLAB & Simulink (see link below)
- MATLAB and Simulink Training: <https://matlabacademy.mathworks.com/>

A personal computer is required. A laptop with MS Windows 10 or higher is highly recommended; see Herff College requirements at <https://www.memphis.edu/herff/departments/computer-requirements.php>

A free MATLAB download is available for UM students through the university's site license at <https://www.mathworks.com/academia/tah-portal/university-of-memphis-40714972.html>

MS Word & Excel is available for UM students through the university's technology access program at <https://www.memphis.edu/umtech/solutions/software/software.php>

University resources to support online learning:

<https://www.memphis.edu/uofmglobal/students/online-intro.php>

### **Exams**

- Exams will be open book and open note. Access to MATLAB and Simulink is required. Submissions must be uploaded to Canvas.
- Quizzes will be open book and notes and will involve solving differential equations by hand and/or using MATLAB.
- Communication between students during quizzes and exams is not allowed.

### **Grading**

Homework, quizzes, exams and projects will be scored and published on the Grades tab.

10%	Attendance
15%	Quizzes
15%	Homework
20%	Midterm Exams
20%	Final
20%	Projects

Letter grades will be determined as below, with plus/minus modifiers for A, B, or C grades and plus modifier for D grade. Modifiers (eg A+ or C-) are applied if numerical grade is above X7.5% or below X2.5%. I reserve the right to round up or down or otherwise adjust the final grade based on other factors such as attendance, effort, and engagement inside and out of class.

**A: (90-100); B (80-89); C (70-79); D (60-69); F (<59)**

### **Attendance**

In order to be successful in this class, attendance is MANDATORY. You are allowed at most three unexcused absences.

If you have a health condition that prevents you from regular class attendance, you **MUST** register with Disability Resource Services (see **Student Accommodations** below) and contact me to discuss an alternative plan ASAP.

- Attendance at all class meetings is required.
- You are allowed three unexcused absences.
- **A fourth unexcused absence will result in an "F" for the course.**
- Absences will be excused **at my discretion** for circumstances such as illness, personal/family emergency, academic/professional commitments, etc. must be documented via an email to Dr. Strain. Student athletes may provide scheduled absences for athletic events per usual methods. Email me at [sfstrain@memphis.edu](mailto:sfstrain@memphis.edu) if you wish an absence to be considered for excusal.

### **Honors Section**

If you are enrolled in BIOM 3710-350, you are in the Honors section. If you are enrolled in BIOM 3710-001, you are enrolled in the regular (non-Honors) section. Honors students must complete the course requirements listed above as well as an additional activity that will be assigned towards the end of the term. The assignment will be graded on a pass-fail basis. If the honors assignment is not completed or if it receives a failing grade, the maximum final grade in the course will be B-.

**Policies** (Note: Policies may be revised during the term at the instructor's discretion)

1. Attendance is **REQUIRED**. See above for attendance policy.
2. You are responsible for all material, whether covered in class or as part of an assignment.
3. If you miss a class, you are responsible for obtaining any material covered in class.
4. You are expected to come to class prepared and to participate actively in class. This participation may include, but not be limited to, explanation or demonstration of concepts, in-class problem solving, or discussion of assignments. Volunteers for participation may be solicited, or you may be called upon.
5. I will often use Zoom to record a class lecture, but this is **NOT** for remote attendance. Unless university policy changes, you must attend class face to face. For questions, contact me at [sfstrain@memphis.edu](mailto:sfstrain@memphis.edu).
6. There will be regular assignments, and many of them will be collected and graded. You are expected to complete and understand all assignments, whether they are graded or not.
7. Except when collaboration and teamwork is specifically encouraged or required, any work submitted for a grade **must be your own original work**. Do **NOT** share files or copy/paste from the work of others. Working together on homework is certainly acceptable, but each person must work through the problem individually. Do not simply copy someone else's solution.
8. Assignments must be turned in by the due date in Canvas. All assignments must be submitted via Canvas unless otherwise stated—I cannot accept assignments by email. You may contact me at [sfstrain@memphis.edu](mailto:sfstrain@memphis.edu) regarding late assignments. Based on our communication, and at my discretion, I may decide to accept a late assignment. However, if I am not contacted, if the lateness is part of an ongoing pattern, or for other reasons as I may deem applicable, I will not accept it. In cases where late acceptance is not granted, the late/missing assignment will receive a grade of zero.
9. No make-up exams will be given. If your absence from an exam is officially excused (documentation required), an alternate exam grade (eg final exam grade) will be substituted for the missing exam. A grade of zero will be assigned for a missed exam in all other cases.
10. Academic dishonesty of any form will not be tolerated. See the "Code of Student Rights & Responsibilities" in the Student Handbook (<http://www.memphis.edu/saos/pdfs/csrr.pdf>) for further details.
11. You are responsible for determining the availability of the computing resources used in this class and for scheduling your work accordingly.
12. You must fully comply with all university guidelines and applicable laws regarding the use of computing facilities and software that may be provided for this course.
13. Please show up on time for class. Attendance is taken at the beginning of class and if you are not present, you will be marked as absent.
14. These policies may be revised or augmented as required during the term.

### **Academic Integrity**

The University of Memphis expects all students to behave honestly. The Code of Student Rights & Responsibilities explains what constitutes a violation of our Academic Integrity policy. Please see the website for more information: <https://www.memphis.edu/osa/>. Plagiarism, cheating, and other forms of academic dishonesty are prohibited. Students who violate the academic misconduct policy, either directly or indirectly, through participation or assistance, are immediately responsible to the instructor of the class in addition to other possible disciplinary sanctions which may be imposed through the regular institutional disciplinary procedures.

### **Student Health**

Students who are experiencing symptoms such as sneezing, coughing or a higher than normal temperature should inform me by email so they can be excused from class and should stay home. Students should contact their health care provider or the Student Health Center at <https://www.memphis.edu/health>.

### **Student Accommodations**

Students with accessibility issues or learning accommodation issues due to a disability should contact Disability Resources for Students (DRS) to submit an official request for course accommodations. Contact DRS at 901.678.2880 or at [drs@memphis.edu](mailto:drs@memphis.edu). (<https://www.memphis.edu/drs/index.php>).

### **Student Resources**

Students who need additional resources can contact the Dean of Students Office at <https://www.memphis.edu/deanofstudents/crisis/index.php>.

## Course Policy on Ethical Use of Generative AI

**NOTE: This policy is ONLY applicable in this class (BIOM 3710, Spring 2024, Dr. Strain).**

Generative AI (GAI), such as ChatGPT, Google Bard, and many others, is beginning to transform various aspects of society, including academic and technical fields. In this class, AI literacy will be encouraged. **However, you MUST notify the instructor if you use GAI for help with an assignment.** See below for acceptable vs unacceptable use.

### Scope of Use

Inappropriate and/or unethical use of GAI can negatively impact your education and professional development. Therefore, the following guidelines apply:

1. **No Academic Dishonesty:** Do not use GAI to generate answers for graded assignments or tests. Violations will be referred to the University's Office of Student Accountability.
2. **Permissible Use:** You may use GAI to
  - a. understand concepts or questions related to lectures or assignments;
  - b. generate ideas for code, reports, or team project topics;
  - c. get suggestions for code improvement, reports, or presentations; or
  - d. assist in debugging code.

### Additional Guidelines

1. **Cite AI Use:** Treat AI like any other source. If AI helps draft or edit a MATLAB script or report, cite it appropriately.
2. **Document Interaction:** When using ChatGPT or similar tools, provide a transcript of your interaction in MATLAB comments (for code) or in an appendix (for reports).
3. **Bibliography Summary:** Include a summary in your bibliography or works cited page detailing how you used the AI.
4. **In-text Citation for AI:** For each paragraph aided by AI, include an in-text citation.
5. **Original Thought Requirement:** The majority of the insights and arguments in your work should be your own. Using AI for phrasing or structure is acceptable, but the core ideas must be original.
6. **Be Responsible:** Use AI responsibly to enhance your work, not to bypass critical thinking and creativity. Consult the instructor or TA if in doubt.

### Additional Points to Consider

1. **Ethical AI Usage:** When using AI for topics related to healthcare and biomedical engineering, ensure the data and methods you employ adhere to privacy laws and ethical considerations.
2. **Data Integrity:** When using AI for data generation or simulation, clearly state the limitations and potential biases of the model in your report.
3. **Transparency in Team Projects:** In the case of team projects, disclose the extent of AI use to your team members.
4. **Quality Control:** Ensure that information generated by AI is factually accurate and scientifically valid. Verify generated content with peer-reviewed sources.
5. **Consultation and Approval:** For substantial use of AI in a project or paper, obtain approval from the instructor to ensure it aligns with course objectives and ethics.
6. **Regular Updates:** This policy may be subject to changes or updates as we uncover more about the capabilities and limitations of AI technology.

**NOTE: In case of new developments in AI ethics or technology during the semester, the instructor reserves the right to amend this policy to protect academic integrity and ethical standards.**

By adhering to this policy, you commit to responsible and ethical use of generative AI in this course.