BMED 3520 Biomedical Systems and Modeling Fall 2026

Credit Hours: 3

Prerequisites: BMED 3100, BMED 2210, MATH 2403

Monday Lectures (all sections): 12:30pm – 1:20pm Molecular Sciences and Engineering G011

Tuesday–Thursday Problem Solving Studio (PSS) sections:
Section A01: Tu/Th 8:10 – 10:05 Whitaker 1232 (Prof. Tara Deans)
Section A02: Tu/Th 10:20 – 12:15 Whitaker 1232 (Prof. Denis Tsygankov)
Section A03: Tu/Th 12:30 – 2:25 Whitaker 1232 (Prof. Ahmet Coskun)

Instructors and Office Hours:
Tara Deans (Section A01)
tara.deans@bme.gatech.edu Office hours: Mondays 11am, Whitaker 4109

Denis Tsygankov (Section A02)
denis.tsygankov@bme.gatech.edu Office hours: TBD

Ahmet Coskun (Section A03)
ahmet.coskun@bme.gatech.edu Office hours: TBD

Teaching Assistants (Office Hours TBD):
TA #1: TBD (Section A01)
Email, Office hours: TBD

TA #2: TBD (Section A02)
Email, Office hours: TBD

TA #3: (Section A03)
Email, Office hours: TBD
Students are welcome to attend any instructor or TA's office hours.

Course Graders:
Grader #1: TBD, email
Grader #2: TBD, email
Grader #3: TBD, email
Grader #4: TBD, email
Grader #5: TBD, email
All Graders will be serving all three sections.

Course overview:
August 24: First day of classes
August 28: Phase II registration deadline
September 7: Labor Day, Official University Holiday
October 5-6: Fall Break
October 31: Withdrawal Deadline
November 25-27 Thanksgiving Break
December 7: Final Instruction Day

December 10-17: Final Exam (details determined by GT)
December 21: Grades Due
December 22: Grades Available

Note: This syllabus may be subject to change during the semester. Students are expected to be familiar with and abide by the Institute guidelines, information, and updates related to personal and campus health considerations. This can be found on the Georgia Tech Health site. Please consider the health of your classmates, teachers, and their respective households in the choices you make.

If campus is closed due to inclement weather, the instructor(s) will notify you of alternative plans for the day(s) that campus is closed by posting an announcement on Canvas.

Course Objective
This course introduces the student to the emerging field of systems biology. It will consist of a weekly overview lecture, interactive reviews, and problem-solving sessions. The overarching objective is to equip students with solid basic knowledge of different types of mathematical and computational modeling approaches and their applications to solving biomedical problems.

Catalog Description
The course introduces BME students to the field of computational systems biology. It covers all typical aspects of biomathematical modeling, including: the choice of a modeling framework from among alternative approaches; the design of interaction diagrams; the identification of variables and processes; the design of systems models; the concept of approximations; standard methods of parameter estimation; the analysis of steady states, stability, sensitivity and gains; numerical evaluations of transients; phase-plane analysis; and the simulation of representative biomedical scenarios. All theoretical concepts are exemplified with biomedical applications.

Expected Outcomes
By the end of the course the students should:

1. Understand the basic strengths and limitations of quantitative modeling;
2. Have acquired a basic skill set for designing and implementing quantitative models of biomedical systems;
3. Have mastered standard techniques of steady-state and dynamical analysis;
4. Understand how to apply different modeling tools to the analysis of dynamical systems in biomedicine.

Text
Voit, E.O., Kemp, M.L. A First Course in Systems Biology; 3rd edition. Taylor & Francis, New York, NY, 2025.
Or
Voit, E.O. A First Course in Systems Biology; 2nd edition. Taylor & Francis, New York, NY, 2018.

Hard copy available from the Georgia Tech Library on hold under course reserves, and available for purchase at the bookstore or Amazon.

Instructional Format
It is expected that all classes will be in person. Supplemental instructional videos may be used to assist in learning.

Approximately five hours are scheduled for the class each week. The weekly one-hour overview lecture on Monday presents a high-level introduction to the topics to be studied during the following week. The sessions on Tuesday and Thursday are dedicated to hands-on projects and problem-solving, as well as reviews and additional explanations of details regarding the topics addressed during the week. Homework assignments are to be done individually and are due at 11:59 p.m. of the day listed in the syllabus. No homework will be due during exam weeks.

Two midterm exams and one cumulative final exam will assess each student's mastery of the materials discussed in class.

Delivery Mode
First and foremost, it is the goal of the instructional team for the classroom community to thrive regardless of the classroom delivery method or individual approaches to learning the material. We will strive to minimize disruptions to your learning, treat all students equitably, and ensure that grading is clear, consistent, and fair for all. It is critical for you to maintain communication with the instructional team so that we can understand your circumstances. Should your situation change regarding your health, housing, or any other aspect affecting your ability to participate in the class, ***please contact the instructor of your PSS section as soon as feasible***. In general, your first contact in the course is the TA or instructor in the PSS section for which you are registered.

The course consists of lecture classes and "problem solving studios" (PSSs). The lectures will be delivered in person only, no recording will be provided. Any materials posted on Canvas are for the sole purpose of educating the students currently enrolled in the course. Students may not share the materials or recordings, including screen capturing, recordings made by students or automated bots/AI unless the instructor gives permission. Students who use Zoom, Canvas, MS Teams, or other course software with their camera engaged or utilize a profile image are agreeing to have their video or image recorded.

The PSSs will be used for hands-on, group problem solving. ***Past semesters have shown a strong correlation between grade performance and attendance, and we will keep a record of your participation in these sessions.*** All PSSs will be held in person in the assigned classroom. ***PSS will not be recorded, and you cannot participate remotely in PSS.*** Although all sections will cover the same material, you must attend the PSS section for which you are registered to maintain equitable interactions within the PSS and to ensure adequate classroom space. A record of attendance and engagement during PSS will be maintained. However, if you must miss PSS, no excuse is required for absence. Every student will have three built-in excused absences. That is, your grade will only decrease beginning with the 4th missed PSS. Each subsequent absence will result in loss of the corresponding proportion of your total PSS grade, which is 5% of your total grade. Attending and engaging with the course material during PSS will also facilitate completion of your homework assignments. The classrooms are not designed for remote teaching, and these interactive sessions are NOT designed for recording nor for posted solutions afterwards. You will gain the skills outlined in the course objectives through hands-on and peer-based modeling during these PSS sessions. **No solutions to PSS problems will be provided**, and students may not post solutions.

Because the class discusses topics that may be new to you, communication is important. As the primary tool for communication, we will use Canvas for critical announcements. We will also use Piazza as the primary forum for student questions. Piazza may be used at any time except during exams. The instructors and TAs will make every attempt to respond to emails in an expedient manner, with delays to be expected outside normal business hours and on weekends.

Evaluation

Homework assignments (7)	21% (total)
In-semester exams (2)	24% (each)
Final exam	26%
PSS participation*	5%

*Note that participation is not just physical presence, but mentally present in the class.

Institute-approved absences must be made in advance of the missed class through written communication with your instructor. Repeated requests for excuses before exams will be handled through the Office of the Dean of Students. Any absences from exams will be considered in consultation with the Office of the Dean of Students, and a request for a makeup exam may be denied. Makeup exams will be different from the original exam and may not align as well with the content covered this semester.

In most cases, exams are not curved. However, instructors may decide to curve individual exams upward, which will be announced when grades for these assignments are released.

Final grades (rounded to the whole)

A	90.0% and above
B	80.0% to 89.9%
C	70.0% to 79.9%
D	60.0% to 69.0%
F	Below 60.0%

Software

While you are welcome to use any pertinent software you like, such as Python or R, we will use Matlab for most PSS instruction. Installation of software or online use of Matlab will be necessary throughout the semester for specific computational exercises. There are 3 ways to use access. 1) For laptop downloads, please refer to the Georgia Tech Matlab Portal for installation. 2) You may use VLab, or 3) you can use your browser by logging onto your Mathworks account at https://matlab.mathworks.com/ for the online version.

Websites

Class notes, homework, homework solutions, etc. will be posted on the course website on Canvas, unified across all three sections by placing pertinent information under the 3520-A listing. This course site will be used to send critical and section-specific information to the class; therefore, you must verify that you are enlisted in the membership.

Piazza website

We will be using Piazza for class discussion collectively. The system is highly effective at getting you help fast and efficiently from classmates, the TA, and instructors. Rather than emailing questions to the teaching staff, we encourage you to post your questions on Piazza. While we have set up automatic enrollment for the Piazza site, you are ultimately responsible for making sure you have access to the course Piazza page. If you have any problems or feedback for the developers, email team@piazza.com. Find our class page on the tool tabs of the course Canvas site.

Math review:

There will be PSSs with special reviews held virtually by the TAs during the first week of classes. These will focus on concepts from calculus, linear algebra, and programming that you need to master to pass BMED 3520. Past experience shows that many students need this

refresher. Please don't miss this material and then be mathematically "under water" for the rest of the term.

Mid-term exams:
Mid-term exams will be held in person during your regular PSS session. The exams will be closed book, written exams without the use of other resources. While Matlab is used as a tool to develop programs in this class, you will be tested on the underlying mathematical, physical, and biological concepts rather than on Matlab programming. **You are required to complete the exam in person at the location provided by your instructor**. Instructors will be in the classroom during your test time to answer clarification questions. Students with disabilities need to register with the testing center in advance to take the exam there or, if needed, discuss their specific testing accommodations with their instructor in advance.

Final exam:
The date and location of the final exam will be determined by GT's administration. This class is considered "off-grid" and requires special scheduling by the registrar. Mid-term exam policies above apply. The final exam will be comprehensive covering all material from the entire semester, however, there will be a particular focus on material since exam 2 that has not yet been covered on an exam.

Homework and Regrade Policy:
Homework will be performed and submitted individually and must be uploaded to Gradescope in PDF format, **other file formats will not be accepted**. Please submit one PDF file rather than multiple files. Your last name must be listed as part of file name. For example: HW4_Deans.pdf. While it is generally acceptable to discuss homework problems with other students, each student must submit their own unique file. If two students submit the same file, both students are subject to honor code violations described below.

Requests for regrades on exams and homework are permitted up to one week after graded materials are returned to the student and can be submitted via Gradescope. Requests for any regrades must provide an explicit justification for why the student believes an error in the grading was made. When submitting a regrade request, please be respectful to those who are grading assignments. The following template must be followed for regrade requests:
"I am requesting a regrade on Problem _ because I believe the answer submitted to Gradescope follows the solution in the following way: ..."
If this is not followed, the re-grade request may be denied. No regrade requests will be accepted later than one week after the graded material is returned to the student.

AI Policy:
Generative AI tools are tempting to use, but require domain-specific knowledge to fully leverage. We understand that in the future you are likely to use AI tools to help you model, so we are focusing on instilling the fundamentals such that you can appropriately leverage this in your career. You may use AI programs e.g. ChatGPT to help generate ideas and brainstorm.

You may not submit any work generated by an AI program as your own. If you were aided by AI, you and include material generated by an AI program, you must include an appendix that provides the complete prompt and output from the exchange.

You may NOT use AI tools during in-class examinations or problem-solving exercises unless explicitly permitted and instructed.

Any plagiarism or other form of cheating will be dealt with severely under relevant Georgia Tech policies.

Honor Code:
Students are expected to abide by the GT Honor Code (https://osi.gatech.edu/) at all times. The objective of the honor code is "to prevent any students from gaining an unfair advantage over other students through academic misconduct". Starting with the first offense, any potential violations of the honor code will be reported to the Office of Student Integrity for review. To preserve the integrity of the classroom and the instructor-student relationship, the instructors cannot use personal discretion in instances of potential honor code violations – ***consider this the first and only warning***.

Examples of honor code violations include:

- Looking at another individual's solutions during an exam.
- Communicating with other students or giving or receiving aid during an exam.
- Claiming other students' work as your own.
- Making untrue claims/statements (of any sort) to the instructors regarding use of electronic resources (Canvas submission, PLAS/Matlab, your personal laptop crashing, etc.).
- Illegally copying, sharing, or downloading the textbook.
- Misrepresenting attendance in class through signing in when not present or facilitating another student signing in who is not present.

For any questions involving these or any other Academic Honor Code issues, please consult your instructor or visit https://osi.gatech.edu/.

Topical Outline

Week	Date	Class	Instructor	Topic	Reading & Assignments Key: 3rd edition/2nd edition
1	8/24	Lecture 1	Coskun	Introduction Why systems modeling?	Chapter 1/Chapter 1
	8/25	PSS	TAs	TA-led math review: calculus and linear algebra	
	8/27	PSS	TAs	TA-led Matlab review/Matlab for ODE modeling	Homework 1 released
2	8/31	Lecture 2	Coskun	Components of models	Chapter 2/Chapter 2
	9/1	PSS	Team	Introduction to modeling	
	9/3	PSS	Team	Components of models	
3	9/7	Labor Day no class			
	9/8	PSS	Team	Components of models	
	9/10	PSS	Team	Components of models	Homework 1 due; Homework 2 released

4	9/14	Lecture 3	Coskun	Static network models	Chapter 3/Chapter 3
	9/15	PSS	Team	Static network models	
	9/17	PSS	Team	Static network models	
5	9/21	Lecture 4	Coskun	Discrete models (linear, nonlinear) Continuous models	Chapter 4/Chapter 4 pp. 83-93
	9/22	PSS	Team	Discrete models	
	9/24	PSS	Team	Discrete models	Homework 2 due; Homework 3 released
6	9/28	Lecture 5	Coskun	Dynamic continuous models	Chapter 5/Chapter 4 pp. 93-128
	9/30	PSS	Team	Dynamic continuous models/Exam review	
	10/1			Exam 1 covering Ch. 1-Ch. 4 through discrete models; pp 1-93 (2nd edition) or ch. 1- Ch. 5 (3rd edition); HW 1-2	
7	10/5	FALL BREAK			
	10/6	FALL BREAK			
	10/8	PSS	Team	Dynamic continuous models	
8	10/12	Lecture 6	Deans	Standard methods of analysis	Chapter 5/Chapter 4 pp. 93-128
	10/13	PSS	Team	Standard methods of analysis	
	10/15	PSS	Team	Standard methods of analysis	Homework 3 due; Homework 4 released
9	10/19	Lecture 7	Deans	Optimal models (parameter estimation)	Chapter 6/Chapter 5
	10/20	PSS	Team	Optimal models (parameter estimation)	
	10/22	PSS	Team	Optimal models (parameter estimation)	
10	10/26	Lecture 8	Deans	Gene and protein networks	Chapter 6, 7 to page 239 / Chapter 7, 8
	10/27	PSS	Team	Gene and protein networks	
	10/29	PSS	Team	Gene and protein networks	
11	11/2	Lecture 9	Deans	Metabolic systems	Chapter 8/Chapter 9

	11/3	PSS	Team	Metabolic systems/Review	Homework 5 due; Homework 6 released
	11/5			Exam 2 covering Ch. 4-7 (2nd edition); HW 3-5	
12	11/9	Lecture 10	Tsygankov	Signaling systems	Chapter 10/Chapter 9
	11/10	PSS	Team	Signaling systems	
	11/12	PSS	Team	Signaling systems	
13	11/16	Lecture 11	Tsygankov	Personalized medicine and drug delivery	Chapter 13/Chapter 13
	11/17	PSS	Team	Personalized medicine and drug delivery	
	11/19	PSS	Team	Personalized medicine and drug delivery	Homework 6 due; Homework 7 released
14	11/23	Lecture 12	Tsygankov	Population systems	Chapter 14/Chapter 10
	11/24	PSS	Team	Population systems	
	11/26	Thanksgiving			
15	11/30	Lecture 13	Tsygankov	Design of biological systems/syn bio	Chapter 7 pp. 239-245/Chapter 14
	12/1	PSS	Team	Population systems	
	12/3	PSS	Team	Synthetic biology	Homework 7 due
	12/7	Lecture 14	Tsygankov	Frontiers of systems biology	Chapter 15 (pdf provided)
16	12/8	PSS	Team	Final exam review	
	12/10-12/17	Final		Exact date TBD; HW 6-7	