MATH 4541 Syllabus

Dynamics and Bifurcations, Section AG,AU, 3 credit hours

Fall 2026

Instructor Information

Instructor: Dr. Federico Bonetto

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General Course Information

Description

A broad introduction to the local and global behavior of nonlinear dynamical systems arising from maps and ordinary differential equations

Course topics include:

1. Scalar Autonomous Equations
2. Elementary Bifurcations
3. Scalar Maps
4. Scalar Nonautonomous Equations
5. Bifurcations of Periodic Equations
6. Planar Autonomous Systems
7. Linear Systems
8. Hopf Bifurcation

Course Learning Outcomes

Students in this course are expected to master the following concepts:

1D Systems : Analyzing flows on the line and flows on the circle.

Bifurcation Theory : Understanding elementary bifurcations in 1D systems and Hopf bifurcations in 2D systems.

Linear & Nonlinear Systems : Studying planar autonomous systems and nonlinear systems in the phase plane.

Limit Cycles & Closed Orbits : Determining the existence and behavior of closed orbits and limit sets.

Prerequisites

(MATH 2403 or MATH 2413 or MATH 24X3 or MATH 2552 or MATH 2562 or MATH 2X52) and (MATH 1522 or MATH 1553 or MATH 1554 or MATH 1564 or MATH 1502 or MATH 1512)

Required Course Materials

Steven H. Strogatz, *Nonlinear Dynamics and Chaos with applications to physics, biology, chemistry and engineering*, 2nd edition.

You can get a free electronic copy of the text book from Nonlinear Dynamics and Chaos | With Applications to Physics, Biology, (taylorfrancis.com). You can access it either via GT Library (using a GT computer system) or via GT log in (Click on "Get Access > With Shibboleth or OpenAthens", search for "Georgia Institute of Technology", then sign into your GT account.)

Grading Policy

Grading for the course will be broken down as follows:

4 HW sets	5% each
2 Midterms	25% each
1 Final exam	30%

Grade Scale

A	100%-90%
B	89%-80%
C	79%-70%
D	69%-60%
F	<60%

Assignments

- Midterms, 50%
- HW sets, 20
- Final 30%

Description of Graded Components

- Midterms and Final: they will take place at 1/3, 2/3 and at the end of the semester. They will consist in 4 or 5 questions (possibly divided in more that one point). The midterm will be given in class during a full class period. They will be graded and returned the week after together with a solution set.
- HW sets: They will be due every ≈3 weeks. They will be posted on Canvas and consist on few selected exercises, mostly from the texbook, that I consider important to check that you are following along.

Course Policies

Attendance and Participation

This class is designed to encourage students to become active participants, so it's very important that all students attend each class session. Please attend every scheduled meeting on time. That said, if you are exhibiting any symptoms of illness (fever over 100.4 F, coughing, nausea, etc.), please stay home to rest, seek medical attention if appropriate, and contact me as soon as possible. Excessive lateness and absences can negatively impact your final grade outcome. If you have extenuating circumstances, I will try and work with you to address those challenges. Please communicate early and often if you are struggling with issues that may call for accommodations.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the student Code of Conduct.

Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.