Instructor: Zaher Hani, (Office: 5834 East Hall (EH)), Email: zhani@umich.edu, Website: https://sites.lsa.umich.edu/zhani/ Office hours: T-Th 1:00-2:00pm and by appointment.

Prerequisites: Basic Linear Algebra, Ordinary Differential Equations (Math 216 or 316 or equivalent), Multivariable Calculus (Math 215 or equivalent). Some exposure to more advanced mathematics, e.g. Advanced Calculus (Math 451) or Advanced Mathematical Methods (Math 454).

Course Coordinates: TTh 2:30–4:00 pm in 1449 Mason Hall (MH)


Further Reference and resources: I will often supplement the textbook with material from other sources, like:


Homework: There will be (roughly) weekly homework sets.

Grading: Homework 45%, Midterm 25%, and Final 30%. The final may be a take-home project with informal presentations.

Course Description: This is a course on Ordinary Differential Equations (ODE) and dynamics with an eye towards applications and concrete examples. It emphasizes techniques and results that are useful in applied mathematics, physics, and engineering. Proofs will be supplied, sketched, or at least provided in references. The course will be roughly split into three parts: A) Linear analysis, where we study the dynamics of linear systems, as it is the starting point to understanding the more complicated nonlinear systems; B) Nonlinear Analysis, which will constitute the bulk of the course, and C) Introduction to Chaotic dynamics.
Outline:

A) Linear Dynamics:
   - Dynamics in 1D and 1.5D.
   - Dynamics in 2D: Phase portraits, dynamical classification.
   - Higher dimensional linear systems

B) Nonlinear Dynamics:
   - Existence, Uniqueness, and Continuous Dependence on the initial data.
   - Analysis of Equilibria and their stability.
   - Bifurcation Theory.
   - Limit sets and Poincare Map.

C) Introduction to Chaos
   - The Lorentz system.
   - Discrete dynamical system.

Important Dates

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>September 4</td>
<td>First day of classes</td>
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<tr>
<td>October 16</td>
<td>Fall recess - No Class</td>
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<tr>
<td>November ?</td>
<td>Midterm (tentatively in one of the first two weeks of November)</td>
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<tr>
<td>November 22,23</td>
<td>Thanksgiving break- No Class</td>
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<tr>
<td>Dec 11</td>
<td>Last day of classes.</td>
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