Course Outline for CDS 104

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Spring, 2005

Textbook:

• Steven Strogatz: *Nonlinear Dynamics and Chaos, with Applications to Physics, Biology, Chemistry, and Engineering.*

Course Outline

1. Week 1: Read Chapter 1 and Chapter 2.

2. Week 2: Read Chapter 5.
   Two-Dimensional Flows: Linear Systems, Definition and Examples; Classification of Linear Systems.

   Phase Plane: Phase Portraits; Existence, Uniqueness, and Topological Consequences; Fixed Points and Linearization; Rabbits versus Sheep.

4. Week 4: Read 6.5-6.8 of Chapter 6.
   Phase Plane: Conservative Systems; Reversible Systems; Pendulum; Index Theory.

5. Week 5: Read 7.0-7.3 of Chapter 7.
   Limit Cycles: Examples; Ruling Out Closed Orbits; Poicaré-Bendixson Theorem.

6. Week 6: Read 7.4-7.6 of Chapter 7.
   Limit Cycles: Liénard Systems; Relaxation Oscillators; Weekly Nonlinear Oscillators.

7. Week 7: Read Chapter 3.
   Bifurcations: Saddle-Node Bifurcation; Transcritical Bifurcation; Pitchfork Bifurcation. Laser Threshold.

8. Week 8: Read 8.0-8.3, and 8.7 of Chapter 8.
   Hopf Bifurcation; Oscillating Chemical Reactions; Poincaré Map.
   Chaos: Simple Properties of the Lorentz Equations; Chaos on a Strange Attractor.

10. Week 10: Read 9.4-9.5 of Chapter 9.
    Lorenz Map; Exploring Parameter Space.