This exam will cover Chapter 2, except 2.5 and 2.8, section 5.2 (Nullclines) and section 3.1. It will have a 50 minute in-class, closed book portion on Tuesday 4/2 (though you can have all 75 minutes to take it) and an open book/Matlab take home portion 6 days later on Monday 4/8.

You do not have to do any or all of these suggested review problems. I picked mostly odd problems since the answers to most odd exercises are in the back of the textbook.

Chapter 2 Review: Any odd problem. All even problems except 12 (Euler’s method)

Section 5.2 problems: 5.2: 2, 3, 5, 21
Section 3.1 problems: 3.1:7, 11, 25, 27.

2 Chapter 2

2.1 Systems of DEs/Population models

- Be able to find equilibrium solutions for systems of DEs
- Interpret solution curves in the phase plane
- Sketch the versus t graphs given solution curves in the phase plane
- Be able to tell if a coupled population model is cooperative, competitive, or predator-prey

2.2 and 5.2 Direction Fields and Nullclines

- Be able to make a direction field using the scripts in Matlab
- Given a direction field, be able to sketch solution curves in the phase plane or interpret the long term behavior of solutions in a sentence.
- Be able to find nullclines and determine the direction of the vector field along the nullclines.
- Be able to interpret the long-term behavior of solutions in each region of the phase plane as determined by the nullclines of the system.

2.3 Harmonic Oscillator

- Know the models for an undamped and damped harmonic oscillator
- Be able to rewrite a generic 2nd order differential equation as a 1st order system of DEs.
- Be able to “guess” solutions of the form $e^{\lambda t}$ to a 2nd order DE and then get solutions to the corresponding 1st order system.
2.4 Decoupled and Partially Decoupled systems

- Be able to find general solutions to decoupled and partially decoupled systems
- Be able to solve IVPs of decoupled and partially decoupled systems

2.5 skipped

2.6 Existence and Uniqueness for Systems

- Use E&U to interpret long term behavior of solutions in the phase plane.
  - For autonomous systems (solutions can’t cross, asymptotic to eq pts or periodic solutions as \( t \to \pm \infty \), if solutions do “cross” they are the same curve parameterized at a different time.)
  - For nonautonomous systems (solutions can cross in the phase plane, but they go through the same point at different times)

2.7 SIR Model

- What are the assumptions that go into the SIR model?
- Definitions of variables and parameters
- Given parameters and ICs, predict the existence and behavior of an epidemic (book, not CDC definition of epidemic)
- Adapt the SIR model given new assumptions

2.8 skipped

3 Linear Systems

3.1 Linearity Principle

- Definition of a linear system
- Be able to find equilibrium points of system (either one at the origin or a line containing infinitely many)
- What is the linearity principle and what does it mean for solving systems?
- Given two linearly independent solutions to a linear system, solve an IVP.