

## Final Exam: Math 211, Section 6

The exam will cover material from lectures and homework over the following sections in the textbook: 1.1–1.9, 2.1, 2.2, 2.4, 3.1– 3.6, 4.1, 4.2, 6.1–6.3. Approximately one-third of the exam will cover the new material since the last exam.

### Chapter 1

- You should know the analytic techniques of separation of variables, method of undetermined coefficients (using linearity principle), and integrating factors and be able to recognize when to use a particular method to find general solutions and solve IVPs.
- You should be able to determine and classify equilibrium points and draw and interpret phase lines, including what they say about the long term behavior of solutions.
- Know the implications of the uniqueness theorem.
- Be able to make and understand a slope field and use Euler’s method to approximate solutions.
- Understand what a bifurcation value is and the ways in which we determine them.
- Be able to set up and solve mixing problems as in the text and homework.

### Chapter 2

- You should be familiar with the predator-prey systems.
- Be able to find equilibrium points for systems.
- Draw and understand slope fields for systems and use them to draw phase portraits. Be able to draw  $x(t)$  and  $y(t)$  graphs from a solution curve in the phase plane. Know the implications of the uniqueness theorem.
- Be able to do Euler’s method for systems.

### Chapter 3

- Be able to solve systems of linear equations using eigenvalues and eigenvectors.
- You should be able to classify equilibrium points and draw phase portraits for the cases of two, non-zero, real eigenvalues and complex eigenvalues. In the other cases, you should be able to recognize what the phase portrait should look like. And be able to use solution curves to determine the long term behavior of solutions.
- Know the different types of harmonic oscillators and how to solve the homogenous second order equation that corresponds to them.

### Chapter 4

- Be able to use the methods of the section to solve non-homogeneous second order equations.
- Be able to determine the long term behavior of solutions and interpret what it means for forced harmonic oscillators.

### Chapter 6

- Know the definition of the Laplace transform and be able to use the definition to compute the Laplace transform for some basic functions.
- Be able to use the Laplace transform to solve first and second order linear differential equations. (You will be given a list like Table 6.1 and Table 6.2 on p. 620 with common Laplace transforms and properties.)
- Find the inverse Laplace transform of a function using the known formulas for the Laplace transform.