STUDY GUIDE FOR TEST 2

Chapter summary

3.1. **Second-order linear equations.** Understand linear independence, including how to calculate the Wronskian of two functions. Understand Theorem 1, the Principle of Superposition. Know how to solve second order linear equations with constant coefficients, both when the roots are distinct and when the roots are the same. *Example problems: 3.1 1-16,20,24-29,33-42.*

3.2. **General solutions of linear equations.** Know how to calculate the Wronskian for three functions (I will not ask you to take the determinant of a 4×4 matrix). Understand Theorem 1, the Principle of Superposition. Understand the difference between particular solutions and complementary solutions, and know how to write down the general solution for both homogeneous and nonhomogeneous linear differential equations. Know how to solve an initial value problem if you have the general solution and initial values. *Example problems: 3.2 1-24.*

3.3. **Homogeneous equations with constant coefficients.** Know how to calculate solutions for homogeneous equations with constant coefficients, regardless of whether the roots are real or complex (or even repeated and complex). Understand how to perform polynomial long division. Example problems: *Example problems: 3.3 1-32.*

3.4. **Mechanical vibrations.** Make sure you understand how to write down a differential equation corresponding to a mass-spring problem, including initial conditions if appopriate (e.g. you should know that "at rest at position p" means $x(0) = p$, $x'(0) = 0$). Know how to distinguish between overdamped and underdamped spring systems, and recognize what the solutions for overdamped and underdamped problems look like in a graph. Know how to calculate period, frequency, amplitude (but you do not have to know how to calculate the phase angle). You also do not have to know how to write your solutions in the form $\cos(\omega t - \alpha)$ like the book always asks for. *Example problems: 3.4 1-4, 15-23.*

3.5. **Nonhomogeneous equations and undetermined coefficients.** Know how to use the technique of undetermined coefficients for polynomials, exponential functions, trig and hyperbolic trig functions. Know how to use the Variation of Parameters formula (you do not have to memorize the formula) *Example problems: 3.5 1-20,31-43,58-63*

3.6. **Forced oscillations and resonance.** Understand resonance, and the concept of a natural frequency of forced mass-spring system with no friction (damping). For the case where there is friction (damping), you do not have to memorize $C(\omega)$, the amplitude function, but you should know how to use it to calculate the practical resonance of a system (if there is one). Know how to distinguish between steady periodic and transient solutions of a system. Again, you never have to write solutions in the form $\cos(\omega t - \alpha)$. *Example problems 3.6 1-20.*

4.1. **First-order systems and applications.** Understand how to convert a nth order linear differential equation into a system of first order equations. Know how to solve simple systems of first order equations involving two dependent variables and one independent variable (with, possibly an initial condition) *Example problems 4.1 1-20.*