Review guide for the final exam

This is a list of the sections from the text that will be covered on the final exam. For a more detailed list of the main topics for the sections through §3.7, take a look at the review sheets for exams 1 and 2.

Chapter 1. §1,2,5,6,7,8,9
Chapter 2. §1, 2, 3
Chapter 3 §1, 2, 3,4,5,6,7
Chapter 4 §1, 2 3, 4
Chapter 5 §1,2,3 (we won't have §4 on the final)

Review of Chapters 4, 5.

§4.1. Forced harmonic oscillators (and other 2nd order equations). You should know:

• The linearity principle for inhomogeneous 2nd order linear equations: the general solution is of the form $y = y_p + y_h$, with y_p one solution to the inhomogeneous equation, and y_h the general solution to the associated homogeneous equation.
• How use the method of undetermined coefficients to find y_p for a forcing function of the form: e^{at}, $\sin at$, $\cos at$, a polynomial in t, or a sum or product of these.

§4.2. Sinusoidal forcing. You should know how to use complex exponentials to solve the forced harmonic oscillator with a forcing function of the form $\sin bt$ or $\cos bt$.

§4.3. Undamped forcing and resonance. You should understand how to write down solutions to the undamped harmonic oscillator, with forcing $\cos \omega t$, as a function of ω, and analyze the behavior as ω gets close to the natural frequency of the homogeneous equation.

§4.4 Damped forcing. You should be able to write down the general solution of the damped harmonic oscillator with forcing function $\cos \omega t$, and how to write down the steady state solution in the form $\cos(\omega t + \phi)$.

§5.1 Introduction to non-linear systems: equilibrium point analysis. You should know

• How to find the equilibrium points of a non-linear system
• How to linearize a system at an equilibrium point, to give a local description of the phase picture.

§5.2 Qualitative analysis. You should know how to fit together the linear phase pictures near each equilibrium point to give a rough idea of the phase plane for the whole system (in simple cases).

§5.3. Hamiltonian systems. You should know:

• what a Hamiltonian system is, how to tell if a given system is Hamiltonian or not, and if it is, how to find a Hamiltonian function for the system.
• Using the fact that the Hamiltonian "energy" is conserved in a Hamiltonian system, you can use the level curves of the Hamiltonian function to sketch the phase plane picture.