MATH 4560 Study Guide for Exam II
Professor Chicone Fall 2006

Ch. 6 Be ready to draw the phase portrait of a two-dimensional system. The main idea from this chapter is linearization at rest points. Know the basic results concerning eigenvalues of linearizations at rest points and local phase portraits. Know how to recognize a conservative system and how to determine its energy. Also, know how to use this property to help draw the phase portrait of the system. Know how to recognize a reversible system and how to use this property to help draw its phase portrait.

Ch. 7 The main idea here is the existence of limit cycles. Know how to change to polar coordinates. Know how to prove a system has no limit cycle (gradient-like systems and Dulac's criterion). Know how to apply the Poincaré-Bendixson theorem (trapping regions). Know how to go to the Liénard plane as in Example 7.5.1 and how this is used to prove the van der Pol equation has a limit cycle in the relaxation oscillation regime ($\mu \gg 1$). Know the method of averaging for weakly nonlinear oscillators as presented in class.

Ch. 8 The main idea here is bifurcation of rest points and periodic orbits for planar systems. Know how to determine saddle-node and pitchfork bifurcations for planar systems. Know how to find Hopf bifurcations. Know the meaning of sub-critical, super-critical, and degenerate Hopf bifurcations. Know what is meant by an infinite-period bifurcation and a homoclinic loop bifurcation. Know what a Poincaré map is.

Ch. 9 Know how to treat linearization for three-dimensional systems. Know the meaning of the words trapping regions, sensitive dependence on initial conditions, chaos, attractor, strange attractor, and Lorenz map.