Math 256
Applied Honors Calculus IV: Differential Equations, Fall 2007

Phantom Homework Set 14
Never Due

Road map for §9.4, 9.5, 9.6. Section 9.4 shows how location of equilibria and determination of the local behavior by linearization can be used to discover the qualitative behavior of nonlinear systems. In addition, another and complementary technique using nullclines is introduced.

§9.5 continues these themes and includes an example of oscillatory populations with a surprising integral of motion.

§9.6 develops the elements of Lyapunov's method which uses functions whose derivatives with respect to time are nonnegative on orbits to determine stability. Integrals of motion are sometimes the starting points of the analysis.

Problems from §9.4,9.5.

- Finding the phase plane trajectory without finding $(x_1(t)\,,\,x_2(t))$. §9.2/15-22.
- Competing species, linearization and nullclines. §9.4/1-6. Here is what you should do with these six problems.

  i. Sketch the nullclines. Classify the systems according to the scheme on page 523. Choose four problems from among the six which are representative of as many of the types as you can.

  Then perform the steps (a)-(f).

  ii. One a new set of axes sketch the nullclines and the compass rose direction appropriate for each subdomain. This gives an alternate, simpler, and more crude derivation of the qualitative behavior found in the preceding steps.
- Linearization and phase portraits. 527/12.
- Predator prey. §9.5/1-5. In addition.

  (g.) Find the nullclines. For the subregions of the positive quadrant mapped out by the nullclines, indicate with a compass rose the quadrant into which the direction field points.
- Predator prey in more detail. §9.5/6,7,8,9. **Discussion.** Using `pplane` you can also investigate the period of larger periodic orbits. You can click to find the period of such orbits.