# Homework No.1, 550.391, Due Septemember 9, 2011.

1. Show that the equation $\dot{x} = \frac{1+\sin^2 x}{\cos x}$ has no fixed points on the real line by investigating the zeros of $f(x) = \frac{1+\sin^2 x}{\cos x}$.

2. It can be shown that the exact solutions of the equation in Problem 1 are given by $\arctan(\sin x) = t + C$, for an arbitrary constant $C$. (Can you show it?) Verify your answer in Problem 1 using this formula.

3. Strogatz, Problem 2.2.4.

4. Parts (a-b): Strogatz, Problem 2.3.3.

Part (c): Verify that the exact solution of the Gompertz equation is given by $N = \frac{1}{b}\exp\left(Ae^{-at}\right)$ and use this formula to study the long-time behavior of $N(t)$ as $t \to \infty$.

5. Classify the stability of the fixed points of the system $\dot{x} = \tanh(x^2)$, using either linear stability analysis or, if that fails, a graphical argument.

6. Same as problem 5 above, but for the system $\dot{x} = \frac{1}{2} - e^{-x^2}$.

7. Strogatz, Problem 2.5.2.

8. Strogatz, Problem 2.5.6.