MATH 341: DIFFERENTIAL EQUATIONS Reading Quiz **THREE** (Sections 2.1-2.4 of Blanchard)
September 29, 2008 *Prof. R. Buckmire*

Your Name: BUCKMIRE **SCORE:** /10

INSTRUCTIONS: Answer the following short-answer questions (in 10 minutes).
GOAL: This reading quiz is designed to illuminate your understanding of the concepts in Chapter 2 of the book: Modeling Using Systems of ODEs, Geometry of Systems of ODEs, Analytic Methods for Special Systems, Euler's Method for Systems.

1. (*2 points.*) What is an equilibrium solution for a system of differential equations $\frac{d\vec{x}}{dt} = \vec{F}(\vec{x})$ and how does it differ (geometrically) from an equilibrium solution for a differential equation, $y' = f(y)$?

Equilibrium is a point $\vec{x}=\vec{x}^*$ such that $\vec{F}(\vec{x}^*)=0$
while $y=y^*$ s.t. $f(y^*)=0$ is an equilibrium solution to $y'=f(y)$
$y=y^*$ is a constant solution (horizontal line) while $\vec{x}=\vec{x}^*$ is a single point in $\mathbb{R}^n$

2. (*2 points.*) What are two equilibrium solutions for the standard Lotka-Volterra predator-prey model discussed in your text? What is the physical interpretation of these equilibria?

$R' = aR - bRF$
$F' = -dF + eRF$

Equilibrium solutions are $R=0, F=0$ and $R=\frac{d}{e}, F=\frac{a}{b}$

$F=R=0$ is the trivial equilibrium while $R=\frac{d}{e}, F=\frac{a}{b}$ means there is a long term steady state value for R and F.

3. (*2 points.*) Explain in your own words what the difference between coupled and decoupled systems of equations are. Give an example of each type.

coupled equations mean that $x'=f(x,y), y'=g(x,y)$
while decoupled equations are autonomous in the dependent variable, i.e. $x'=f(x), y'=g(y)$.

Decoupled
$x'=2x$
$y'=3y$

Coupled
$x'=xy$
$y'=y^2+x^2$

4. (*2 points.*) Which are generally easier to solve, coupled systems of equations or decoupled systems of equations? EXPLAIN YOUR ANSWER.

decoupled systems are easier to solve because they are automatically separable.

5. (*2 points.*) **TRUE or FALSE:** "Euler's Method can never be used to approximate solutions to a second-order nonlinear ordinary differential equation." EXPLAIN YOUR ANSWER.

~~TRUE~~ FALSE! Euler's Method can be used to approximate sol'ns of $\vec{x}'=f(\vec{x})$.

$y'' = f(x,y,y')$ can be rewritten as a 1st order system: Let $y'=u$, $u'=y''=f(x,y,u)$ which looks like $\frac{d}{dt}\begin{pmatrix} y \\ u \end{pmatrix} = \begin{pmatrix} u \\ f(x,y,u) \end{pmatrix}$

BONUS (*2 points.*) Discuss your feeling about the textbook, *Blanchard, Devaney & Hall*. On a scale of 1 to 10, what would you rate the textbook in **clarity**, **usefulness** and **quality**?