College of the Redwoods
Mathematics Department

Math 55 — Differential Equations
Quiz #2

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Quiz Questions

Read Carefully! *You have until Monday of next week (3/10/08) to complete the quiz. The quiz is due, in my hands, at the beginning of class.*

All submitted work must be clearly original. You may not share source code, either LaTeX or Matlab source code, with your fellow students. If you experience difficulty, you must contact me directly for help, and refrain from asking your fellow students for help.

When working in the lab, please do not work at a terminal next to any other student who is also working on the quiz. For the sake of propriety, please separate yourselves when working on the quiz in the lab.

If you so desire, you may drop by my office this week and ask for a preliminary scan of your work. During your visit, you may ask questions regarding your LaTeX work.

This quiz asks only one question. Please follow the directions explicitly.

EXERCISE 1. Consider the following model of a damped, driven, harmonic oscillator.

$$y'' + 0.2y' + 3y = 4\cos 2t \tag{1}$$

The position of the oscillator is given by y, measured in meters, and the derivatives are with respect to time t, measured in seconds. Suppose that the spring is displaced -2 meters from its equilibrium position and released from rest. Your task is analyze the motion of the oscillator and write up your analysis in LaTeX.

(a) Make the appropriate choice of new variables needed to write the second order initial value problem (1) as a system of two first order differential equations with initial conditions.

(b) Write a function M-file to model your system of differential equations.

(c) Write a script file that initializes the time span, initial conditions, and calls the Matlab solver. The call to Matlab's `ode45` solver should save the output to variables of your choice. Your script must then use the output from the solver and the `plot` command to produce a plot of the position of the oscillator versus time. Your script file should annotate your plot, size the graphic, and save the result to a file, ready for inclusion in your LaTeX source code.

(d) Write up your solution in LaTeX. Your writeup should cover the following points.

- Your article should have a title, author, abstract, body, and bibliography.
- Your article should explain how you converted the second order equation into two first order equations, including your conversion of the initial conditions.
- Your article should use the `verbatim` environment to contain code from your script file and function M-file. These should be broken into small chunks, in order, and there should be intermittent prose explaining their use and effect.
- Your article should include the graph of the position of the mass versus time. The graph should be contained in a `figure` environment, contain a caption and label, and should be referenced in the narrative.
- Any equation referenced in the narrative should include a label and be referenced using the `amsmath` reference command `\eqref`.

You must submit a printed copy of the compiled LaTeX report, a printed copy of your LaTeX source code, and printed copies of your script and function M-files.