University of Notre Dame
Aerospace and Mechanical Engineering

AME 30315: Differential Equations, Vibrations and Controls II
First Exam

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February 16, 2011

ID Number:_____

NAME:_____

- Do not start or turn the page until instructed to do so.
- You have 55 minutes to complete this exam.
- This is an open book exam. You may consult the course text and one 8.5 by 11 inch sheet of notes (both sides) that you prepare.
- You may **not** use a calculator or other electronic device.
- There are three problems. Problems 1 and 3 are worth 35 points each and Problem 2 is worth 30 points.
- Your grade on this exam will constitute 20% of your total grade for the course. *Show your work* if you want to receive partial credit for any problem.
- Answer each question in the space provided on each page. If you need more space, use the back of the pages or use additional sheets of paper as necessary.
- If you do not have a stapler, do not take the pages apart.

Gold medals aren't really made of gold. They're made of sweat, determination, and a hard-to-find alloy called guts. —Dan Gable

1. Consider

$$\ddot{x} + 6\dot{x} + 25x = 0$$
$$\dot{y} - \dot{x} = 0.$$

- Convert these two equations to a system of first order equations.
- Determine the solution.

2. Determine the general solution to

$$\frac{d}{dt}\begin{bmatrix}\xi_1\\ \xi_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}\begin{bmatrix}\xi_1\\ \xi_2\end{bmatrix} + \begin{bmatrix}0\\ e^{-2t}\end{bmatrix}.$$

3. Determine the general solution to $\dot{\xi} = A\xi$ where

$$A = \begin{bmatrix} -6 & 0 & 0 \\ 0 & -11 & 1 \\ 0 & -4 & -7 \end{bmatrix}.$$