

UNIVERSITY OF NOTRE DAME  
Aerospace and Mechanical Engineering

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

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ID Number: \_\_\_\_\_

NAME: \_\_\_\_\_

- Do not start or turn the page until instructed to do so.
- You have 50 minutes to complete this exam.
- This is an open book exam. You may consult the course text and your own course notes, but nothing else.
- 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 between 0 and 30% 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.

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A pessimist sees the difficulty in every opportunity; an optimist sees the opportunity in every difficulty.  
—Winston Churchill

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

$$A = \begin{bmatrix} -4 & 1 & 1 \\ 0 & -3 & -1 \\ 0 & 1 & -5 \end{bmatrix}.$$



2. Determine the general solution to

$$\frac{d}{dt} \begin{bmatrix} \xi_1 \\ \xi_2 \end{bmatrix} = \begin{bmatrix} -3 & -4 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} \xi_1 \\ \xi_2 \end{bmatrix} + \begin{bmatrix} \sin 2t \\ e^{-t} \end{bmatrix}.$$



3. Determine the solution to the initial value problem  $\dot{\xi} = A\xi$  where

$$A = \begin{bmatrix} -6 & 0 & 0 \\ 0 & -2 & -3 \\ 0 & -3 & -2 \end{bmatrix}, \quad \xi(0) = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}.$$

