

Last Name (PRINT): _____
First Name (PRINT): _____

**Autumn 2018 – Linear Analysis
First Examination**

Instructions

1. The use of all electronic devices is prohibited with the exception of a non graphing non programmable calculator. Any electronic device needs to be turn off and placed in your bag. Any textbooks or notes also need to be placed in your bag with the exception of one double sided handwritten cheat sheet.
2. Show all your work neatly and concisely. Clearly indicate your final answer. You will be graded not merely on the final answer, but also on the quality and correctness of the work leading up to it.

Scholastic dishonesty will not be tolerated and may result in terminating the midterm early. The work on this test is my own.

Signature: _____

Grade:

Exercise 1. (4 points) Transform the given differential equation or system into an equivalent system of first order differential equations. Give your answer in matrix notation.

$$\begin{cases} x'' - 2x' + 5y' + x = 0 \\ y'' + 7y' - 3y - 2x = 0 \end{cases}$$

Do not solve the system.

Exercise 2. (5 points) Find the general solution to

$$X' = \begin{pmatrix} -3 & 5 \\ -2 & -1 \end{pmatrix} X.$$

Exercise 3. (5 points) Find the solution to the initial value problem

$$X' = \begin{pmatrix} 5 & 1 \\ -4 & 1 \end{pmatrix} X, \quad X(0) = \begin{pmatrix} 0 \\ -2 \end{pmatrix}$$

Exercise 4. (6 points) Find the general solution to the system

$$X' = \begin{pmatrix} -1 & 0 \\ 3 & -2 \end{pmatrix} X + \begin{pmatrix} t \\ -3t \end{pmatrix}$$

Exercise 5. (5 points) Find the general solution to

$$X' = AX \quad \text{with } A = \begin{pmatrix} 0 & -1 & 0 \\ -1 & 0 & 0 \\ 2 & -2 & -1 \end{pmatrix}$$

Hint: $\det(A - rI) = (r + 1)^2(r - 1)$.