Assignment-1

Instructor: Dr. Shaurya Agarwal
EE-5600

February 2, 2018

Instructions:

- Total Marks: **60**. Total Questions: 6
- Please write CLEARLY.
- Complete all the questions, Scan and Upload on Moodle
- All the assignment submissions will be digital, and NO hard copy will be allowed.
- Students can either use a traditional scanner or even a smartphone based **scanner app** such as tiny scanner, cam scanner or any other application.
- Final submission should be a **single pdf** with all the assignment questions in order, and all sub-parts of a question solved together.
- Due Date: **15^{th} Feb, by 11:55pm**. Submissions will close on Moodle after this date.
- All submissions will be graded on moodle and comments provided on original submissions. Students should check back and read the comments for feedback.

Question 1: What are the 1-, 2-, and infinite norm of vectors

$$x_1 = \begin{bmatrix} 2 \\ -3 \\ -1 \end{bmatrix}, \quad x_2 = \begin{bmatrix} 1 \\ 1 \\ -1 \end{bmatrix}$$

Question 2: Find two orthonormal vectors that span the same space as two vectors in problem 1.

Question 3: Find the rank and nullities of the following matrices

$$A_1 = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{bmatrix}, \quad A_2 = \begin{bmatrix} 4 & 1 & 1 \\ 3 & 2 & 0 \\ 1 & 1 & 0 \end{bmatrix}, \quad A_3 = \begin{bmatrix} 1 & 2 & -3 & 4 \\ 0 & -1 & 2 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Question 4: If A matrix is given as follows

$$A_1 = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix}$$

Then compute A^{10}, A^{103}, e^{At}

Question 5: Find the unit step response of the following system using two different methods

$$\dot{X}(t) = \begin{bmatrix} 0 & 1 \\ -2 & -2 \end{bmatrix} X(t) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(t)$$

$$y(t) = [2 \quad 3] X(t)$$

Question 6: Are the two sets of state-space equations

$$\dot{X}(t) = \begin{bmatrix} 2 & 1 & 2 \\ 0 & 2 & 2 \\ 0 & 0 & 1 \end{bmatrix} X(t) + \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} u(t), \qquad y(t) = [1 \quad -1 \quad 0] X(t)$$

$$\dot{X}(t) = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 2 & 1 \\ 0 & 0 & -1 \end{bmatrix} X(t) + \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} u(t), \qquad y(t) = [1 \quad -1 \quad 0] X(t)$$

equivalent? Zero state equivalent?