

ECE 386  
Homework 3

**Due date: 26-05-2014**

Q-1- The state-space representation of a system is given by the following set of equations:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 1 & 0 \\ 0 & 0 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u \quad y = \begin{bmatrix} 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

- a) Find the transfer function of this system.
- b) Find the eigenvalues of this system.
- c) Is this system bounded input-bounded output stable?
- d) Is this system stable in the sense of Lypunov?
- e) What is the degree of the transfer function?
- f) Is this system completely controllable?
- g) Is this system completely observable?
- h) Show that it is not possible to use state-feedback for this system in order to bring the system poles to new locations as  $p_1=p_2=p_3=-5$ .
- i) Show that it is possible to design a Luenberger observer for this system with the observer poles located at  $p_1=p_2=p_3=-5$ .