Homework #8
ME EN 5210/6210 & CH EN 5203/6203 & ECE 5652/6652
Linear Systems & State-Space Control

Use this page as the cover page on your assignment, submitted as a single pdf.

Problem 1

Is the homogeneous state-space equation below asymptotically stable, marginally stable, or unstable? Us the definition of marginally stable that means neither asymptotically stable nor unstable.

$$\dot{\boldsymbol{x}}(t) = \begin{bmatrix} -1 & 0 & 2 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \boldsymbol{x}(t)$$

Problem 2

Is the homogeneous state-space equation below asymptotically stable, marginally stable, or unstable? Us the definition of marginally stable that means neither asymptotically stable nor unstable.

$$\dot{\boldsymbol{x}}(t) = \begin{bmatrix} -1 & 0 & 2 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix} \boldsymbol{x}(t)$$

Problem 3

Is the discrete-time homogeneous state-space equation below asymptotically stable, marginally stable, or unstable? Us the definition of marginally stable that means neither asymptotically stable nor unstable.

$$\boldsymbol{x}[k+1] = \begin{bmatrix} 0.9 & 0 & 2 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \boldsymbol{x}[k]$$

Problem 4

Is the discrete-time homogeneous state-space equation below asymptotically stable, marginally stable, or unstable? Us the definition of marginally stable that means neither asymptotically stable nor unstable.

$$\boldsymbol{x}[k+1] = \begin{bmatrix} 0.9 & 0 & 2 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix} \boldsymbol{x}[k]$$

Problem 5
Is the state-space equation

$$\dot{\boldsymbol{x}}(t) = \begin{bmatrix} -2 & 3 & 0 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \boldsymbol{x}(t) + \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} 0 & 1 & 3 \end{bmatrix} \boldsymbol{x}(t) + [0] u(t)$$

controllable? Observable? To solve for controllability, use Statement 3 and Statement 4 of Theorem 6.1, and verify that both give the same result. Repeat the equivalent process for observability using Theorem 6.O1.

Problem 6
Is the state-space equation

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

$$y(t) = \begin{bmatrix} 1 & 0 & -2 \end{bmatrix} \boldsymbol{x}(t) + [0] u(t)$$

controllable? Observable? To solve for controllability, use Statement 3 of Theorem 6.1, and then use Corollary 6.1; verify that both give the same result. Repeat the equivalent process for observability using Theorem 6.O1 and Corollary 6.O1.