



Alexandria University

Faculty of Engineering

Division of Communications & Electronics

EE391: Control Systems and Components

Sheet 3: Stability, Controllability, and Observability

1. Consider

$$\dot{\mathbf{x}} = \begin{bmatrix} -1 & 10 \\ 0 & 1 \end{bmatrix} \mathbf{x} + \begin{bmatrix} -2 \\ 0 \end{bmatrix} u$$
$$y = [-2 \ 3] \mathbf{x} - 2u$$

is it BIBO stable?

2. In the previous problem, is the state equation is marginally stable?
asymptotically stable?

3. Is the homogeneous state equation

$$\dot{\mathbf{x}} = \begin{bmatrix} -1 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \mathbf{x}$$

marginally stable? Asymptotically stable?

4. Is the homogeneous state equation

$$\dot{\mathbf{x}} = \begin{bmatrix} -1 & 0 & 1 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix} \mathbf{x}$$

marginally stable? Asymptotically stable?

5. Is the state equation

$$\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -3 & -3 \end{bmatrix} \mathbf{x} + \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} u$$
$$y = [1 \ 2 \ 1]\mathbf{x}$$

Controllable? Observable?

6. Is the state equation

$$\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 2 & -1 \end{bmatrix} \mathbf{x} + \begin{bmatrix} 0 & 1 \\ 1 & 0 \\ 0 & 0 \end{bmatrix} \mathbf{u}$$
$$y = [1 \ 0 \ 1]\mathbf{x}$$

Controllable? Observable?