

Week 8 Tutorial

Question 1. Consider the discrete-time system $x[k+1] = Ax[k] + Bu[k]$ from last week. Let

$$A = \begin{bmatrix} 0 & 1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ -1 \\ 0 \end{bmatrix}.$$

(a) Using PHB test determine the unreachable modes.

(b) Show that the system is controllable.

Question 2. Consider the continuous-time system $\dot{x}[k+1] = Ax[k] + Bu[k]$ from last week. Let

$$A = \begin{bmatrix} 0 & \gamma \\ -1 & 0 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}.$$

(a) Show using PHB test that the system is reachable.

(b) Express the state-space representation of the electrical system in controllable canonical form.

Question 3. Consider the discrete-time system $x[k+1] = Ax[k] + Bu[k]$. Let

$$A = \begin{bmatrix} -3 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -2 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}.$$

(a) Using PHB test determine the unreachable modes.

(b) Comment on whether the system is controllable.