

ECE504 Homework Assignment Number 4
Due by 8:45pm on 06-Oct-2009

Tips: Make sure your reasoning and work are clear to receive full credit for each problem.

1. 5 points total. Given the following discrete time, LTI, state-space system description,

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

- (a) 3 points. For $k \geq 0$, explicitly compute the zero-input response of the system for the following cases:

$$\mathbf{x}(0) = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, \quad \mathbf{x}(0) = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}, \quad \mathbf{x}(0) = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix},$$

- (b) 2 points. Use your result from part (a) to derive a general expression for the zero-input response of the system when the initial state $\mathbf{x}(0) = [\gamma_1, \gamma_2, \gamma_3]^T$.

2. 3 points. Chen 4.1.

3. 4 points. Find the state transition matrix $\Phi(t, s)$ when

$$\mathbf{A}(t) = \begin{bmatrix} 0 & e^{-t} \\ 0 & 1 \end{bmatrix}$$

4. 3 points. Chen 4.20.