EEE482 Exam 1
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Problem 1.3.11 (State Space Representations)

(a) Suppose $H(s) = \frac{4s^2+8}{s^2+5s+6}$*. Determine a state space representation for* H*.*

(b) Determine a block diagram and state space representation for the following dynamical system:

$$\dot{x}_1 = x_1 + u + d \qquad \dot{x}_2 = e \qquad u = x_2 + 2e \qquad e = r - y \qquad y = x_1 \tag{1.82}$$

What are the closed loop poles?

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Problem 1.3.12 (Transfer Function Matrix, Matrix Exponential, Modal Analysis)

Consider the dynamical system $\dot{x} = Ax + Bu$, $y = Cx$, *where*

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -8 & 6 \end{bmatrix} \qquad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \qquad C = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \tag{1.83}$$

(a) Determine the system transfer function from u *to* y*. What are the system poles?*

(b) Use eigenvalue-eigenvector techniques to determine e^{At}*.*

(c) Show how each mode can be excited by appropriate selection of the initial condition x_o*.* ■

Problem 1.3.13 (Laplace, Step Response)

Consider the dynamical system $\dot{x} = Ax + Bu$, *where*

$$A = \begin{bmatrix} 0 & 1 \\ 0 & -2 \end{bmatrix} \qquad B = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \tag{1.84}$$

Determine x *when* u *is a unit step function.*

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Problem 1.3.14 (Transmission Zeros)

Consider the dynamical system $\dot{x} = Ax + Bu$, $y = Cx + Du$ *where*

$$A = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \qquad C = \begin{bmatrix} -1 & 1 \\ 1 & 1 \end{bmatrix} \qquad D = \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix} \tag{1.85}$$

(a) Determine the system transfer function matrix. What are the system poles?

(b) Determine the system's transmission zeros. Hint: Only has one.

(c) Determine an associated input direction u_o*.*

(d) Determine an associated state direction x_o*.* ■

Problem 1.3.15 (Model Based Compensators)

Consider a SISO plant $P = \frac{1}{s-2}$*. Determine a model based compensator* K *such that the closed loop system (1) has poles at* $s = -1 \pm j1$, $s = -100, -100$*, (2) follows step reference commands.* ■