OKLAHOMA STATE UNIVERSITY

SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING

ECEN 5713 Linear Systems
Spring 2009
Midterm Exam #2

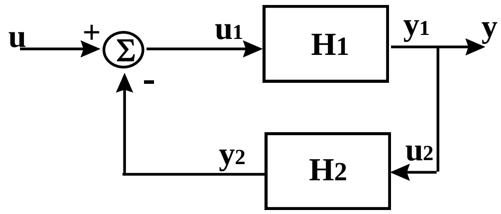
Choose any four out of five problems.
Please specify which four listed below to be graded:
1)_____; 2)_____; 3)_____; 4)_____;

Name : ______________________________

E-Mail Address:_______________________________________

Problem 1:

Find the matrices *A*, *B*, *C*, and *D* of state space representation for a composite configurations using two subsystems $\{A_i, B_i, C_i, D_i\}$, *i*=1, 2, connected in negative feedback, with $\{A_1, B_1, C_1, D_1\}$ in the forward loop and $\{A_2, B_2, C_2, D_2\}$ in the feedback loop. Assume subsystem 1 (denoted by H_1),$\{A_1, B_1, C_1, D_1\}$ has the transfer function $H_1(s) = \dfrac{s+5}{s^2+3s+6}$, and subsystem 2 (denoted by H_2),$\{A_2, B_2, C_2, D_2\}$ has the transfer function $H_2(s) = \dfrac{s+2}{s^2+4s+3}$.



Problem 2:

Let

$$V^{\perp} = Span\left(\begin{bmatrix} 1 & -2 & 1 \\ -1 & 3 & 0 \end{bmatrix}, \begin{bmatrix} 0 & 1 & -1 \\ 2 & 0 & 0 \end{bmatrix}, \begin{bmatrix} 1 & -1 & 0 \\ 1 & 3 & 0 \end{bmatrix}\right),$$

determine the original space, V. For $x = \begin{bmatrix} 1 & -1 & 0 \\ 1 & 3 & 0 \end{bmatrix}$, find its direct sum representation of $x = x_1 \oplus x_2$, such that $x_1 \in V$, and $x_2 \in V^{\perp}$ (i.e., the direct sum of spaces V and $V^{\perp}$ is the set of all 2×3 matrics with real coefficients).

Problem 3:

$$A = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 2 & 3 & 4 & 1 & 2 \\ 3 & 4 & 5 & 0 & 0 \end{bmatrix}$$

What are the rank and nullity of the above linear operator, A ? And find the bases of the range spaces and the null spaces of the operator, A ?

Problem 4:

Consider the subspace of $\Re^4$ consisting of all 4×1 column vector $x = [x_1 \quad x_2 \quad x_3 \quad x_4]^T$ with constraints $x_1 - 2x_2 + 3x_3 = 0$ and $-x_1 + 2x_2 - 3x_3 = 0$. Extend the following set to form a basis for THE subspace:

$$\begin{bmatrix} 1 \\ 2 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} -1 \\ -2 \\ -1 \\ 0 \end{bmatrix}.$$

Problem 5:

Show that

$$\begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 2 \\ -3 \end{bmatrix} \text{ and } \begin{bmatrix} 3 \\ 1 \\ -2 \end{bmatrix}, \begin{bmatrix} -1 \\ 3 \\ -4 \end{bmatrix}$$

span the same subspace V of $(\Re^3, \Re)$.