

OKLAHOMA STATE UNIVERSITY
SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING



ECEN 4413
Automatic Control Systems
Spring 2004



Midterm Exam #2

Choose any four out of five.
Please specify below which four you choose to be graded.

Name : _____

Student ID: _____

E-Mail Address: _____

Problem 1:

Given a nonlinear system described by

$$\ddot{y} - \dot{y} - e^{a+1}y = \ddot{u} + \dot{u} + 2u,$$

linearize the system about the equilibrium point and show the state space representation in $\dot{x} = Ax + Bu, y = Cx + Du$.

Problem 2:

Find a state space representation for the continuous-time MIMO system described by

$$\dot{y}_1 + 3(y_1 + y_2) = u_1$$

$$\ddot{y}_2 + 4\dot{y}_2 + 3y_1 = u_2$$

Problem 3:

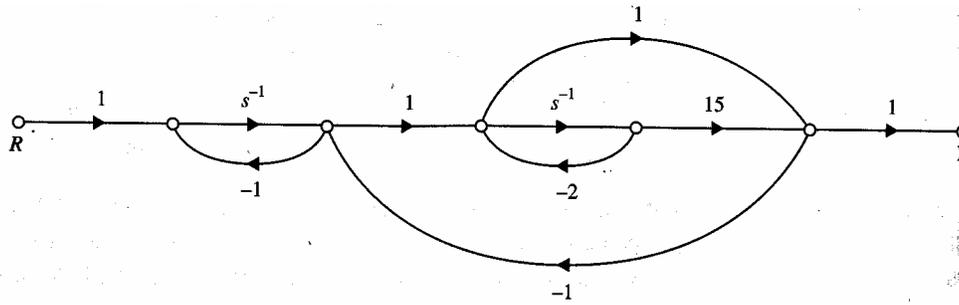
Find the solution (i.e., $x(t)$) of

$$\dot{x} = \begin{bmatrix} 1 & 2 \\ -2 & 1 \end{bmatrix} x \quad \text{with} \quad x(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix} \quad \text{for } t \geq 0.$$

Problem 4:

Derive the state space representation of the system in the state diagram shown below

$$\dot{x}(t) = Ax(t) + Br(t), \quad y(t) = Cx(t),$$



Problem 5:

Let

$$H(s) = \begin{bmatrix} \frac{2s^2 + s - 1}{s^2 - 1} \\ \frac{s + 2}{s^2 - 1} \end{bmatrix}$$

be a transfer function matrix. Find a controllable realization (i.e., state diagram and state space representation) for the continuous-time system using only two integrators.