O K L A H O M A S T A T E U N I V E R S I T Y

S C H O O L O F E L E C T R I C A L A N D C O M P U T E R E N G I N E E R I N G

ECEN 5713 Linear System
Spring 1999
Midterm Exam #1

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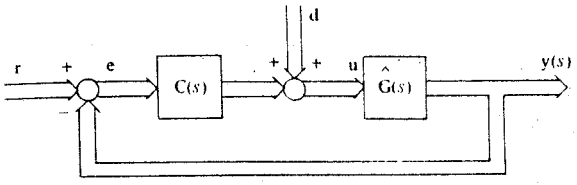
Problem 1:
Show that if $f(u_1 + u_2) = f(u_1) + f(u_2)$ for any u_1, u_2, then $f(\alpha u) = \alpha f(u)$ for any rational number α and for any u.

Problem 2:

Consider the multivariable feedback system shown below. Determine the composite transfer function matrix, *A*, such that

$$\begin{bmatrix} e(s) \\ u(s) \end{bmatrix} = A \begin{bmatrix} r(s) \\ d(s) \end{bmatrix}.$$



Problem 3:

Realize the following SIMO continuous-time, time-varying system and show the state space representation, i.e., $\{A(t), B(t), C(t), D(t)\}$,

$$\begin{aligned} e^{-t}\dot{y}_2(t) + y_1(t) + \ddot{y}_2(t) + y_2(t) &= tu(t) \\ \dot{y}_1(t) + \dot{y}_2(t) + ty_2(t) &= \dot{u}(t) + t^2 u(t) \end{aligned} .$$

Problem 4:

Let

$$H(z) = \begin{bmatrix} \dfrac{z+2}{z+1} & \dfrac{1}{z+3} \\ \dfrac{z}{z+1} & \dfrac{z+1}{z+2} \end{bmatrix}$$

be a transfer function matrix. Find a minimal realization (i.e., simulation diagram and state space representation) for discrete-time system, $H(z)$.