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

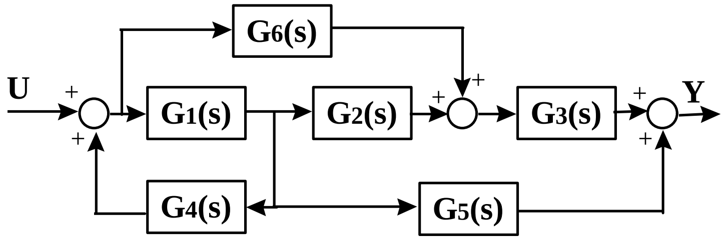
ECEN 4413 Controls II
Fall 1997
Final Exam

Name : ______________________________

Student ID: ________________________________

E-Mail Address:_______________________________________

Problem 1:
Using the block diagram reduction technique, find the plant transfer function $G_p(s)$.



Problem 2:

Plot the approximate Bode magnitude and Bode phase plots for the transfer functions:

$$G(s) = \frac{20(s^2 + 2s + 1)}{s(s + 0.1)(s + 10)}.$$

And determine the analytical expression for $y(t)$ at $\omega = 1$ if the input is $r(t) = 4\cos\omega t$ (**not** $\sin\omega t$). Justify your answer.

Problem 3:

Consider the closed-loop control system described by

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ -b_3 & 0 & 1 \\ 0 & -b_2 & -b_1 \end{bmatrix} x + \begin{bmatrix} 1 \\ b_1 \\ b_3 \end{bmatrix} r \,.$$

$$y = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix} x$$

Determine its stability criteria.

<u>Problem 4</u>:

Find the region of $K(\in R)$ in $G(s)$ for which the unity feedback control system is stable

$$G(s) = \frac{K(s^2 + 15s + 55)}{s(s^2 + s + 10)}.$$

Problem 5:

Consider the state feedback control system shown below, and determine the feedback coefficients (k_1 and k_2) so that the poles of the closed-loop control system are located at -5 and -7.