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
Automatic Control Systems
Spring 2009
Final Exam

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

Name : _____

E-Mail Address:_____

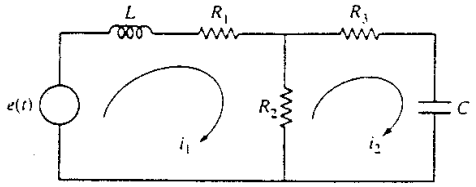
Problem 1:

For the RLC circuit shown below, consider voltage source $e(t)$ is the input (u) and voltage across capacitor C is the output (y) and then find the following system representations:

a) input-output representation (described by ordinary differential equations)

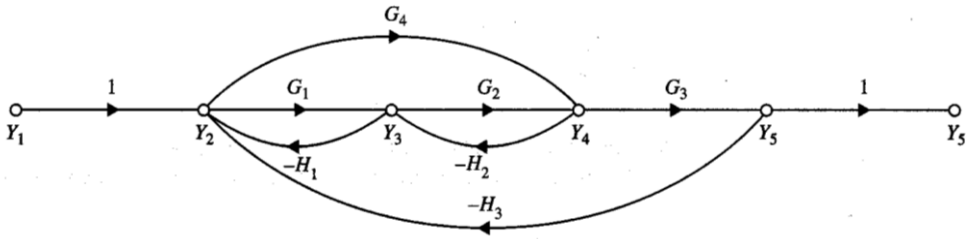
b) transfer function, $H(s) = Y(s)/U(s)$

c) state space representation, $\dot{x} = Ax + Bu, \quad y = Cx + Du$.



Problem 2:

Apply the gain formula to the SFG shown below to find the transfer functions of $\frac{Y_5}{Y_1}$ and $\frac{Y_5}{Y_2}$.



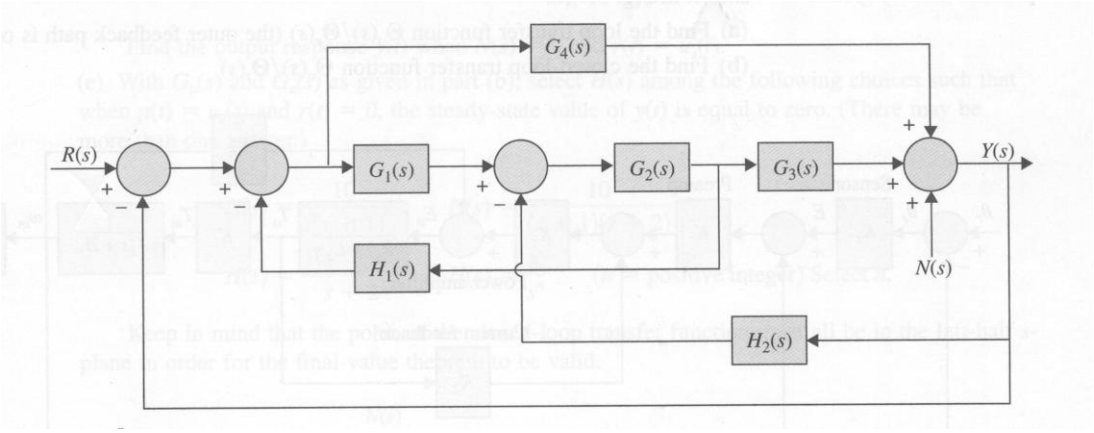
Problem 3:

The block diagram of a feedback control system is shown below

a) Apply the SFG gain formula directly to the block diagram to find the transfer functions $\left.\frac{Y(s)}{R(s)}\right|_{N=0}$ and $\left.\frac{Y(s)}{N(s)}\right|_{R=0}$.

Express $Y(s)$ in terms of $R(s)$ and $N(s)$ when both inputs are applied simultaneously.

b) Find the desired relation among the transfer functions $G_1(s)$, $G_2(s)$, $G_3(s)$, $G_4(s)$, $H_1(s)$ and $H_2(s)$ so that the output $Y(s)$ is not affected by the disturbance signal $N(s)$ at all.



Problem 4: Find the solution of

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -2 & -4 & -3 \end{bmatrix} x + \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ -1 & 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 0 & 1 & -1 \\ 1 & 2 & 1 \end{bmatrix} x$$

with

$$x(0) = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, \quad u(t) = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \text{ for } t \geq 0.$$

Problem 5:

Find the region of K in $G(s)$ (in which $G(s) = \dfrac{K}{s^4 + 6s^3 + 13s^2 + 12s + 4}$) for which the unity feedback control system given below is stable.