OKLAHOMA STATE UNIVERSITY

SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING
SCHOOL OF MECHANICAL AND AEROSPACE ENGINEERING

ECEN 4413/MAE 4053
Automatic Control Systems
Spring 2012
Final Exam

Choose any four out of five problems.
Please specify which four listed below to be graded:
_____; _____; _____; _____.

Name : ______________________________

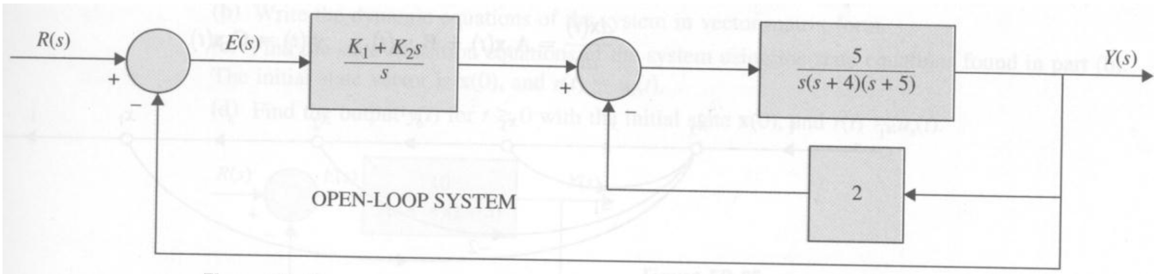
E-Mail Address:____

Problem 1:

The block diagram of a feedback control system is shown below.

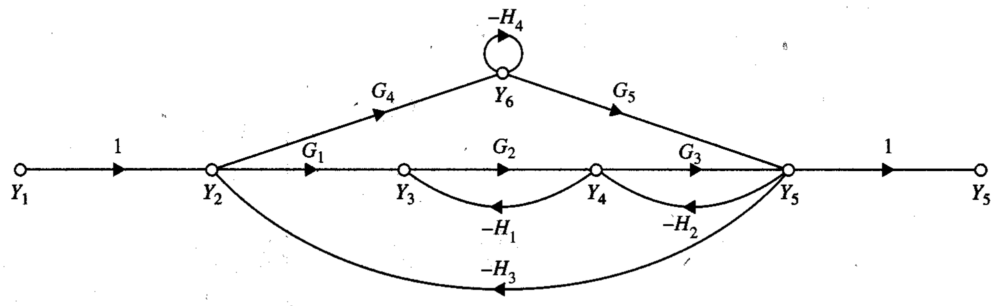
a) Find the forward path transfer function $Y(s)/E(s)$ and the closed-loop transfer function $Y(s)/R(s)$.

b) Express the dynamic system in the form of state space representation, $\dot{x}(t) = Ax(t) + Br(t), \quad y(t) = Cx(t) + Dr(t)$.



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:

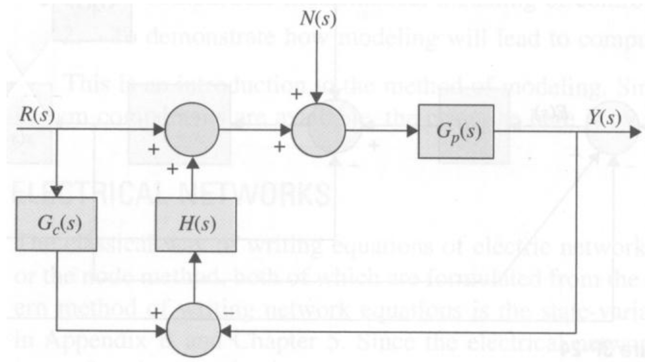
Figure below shows the block diagram of a control system with conditional feedback. The transfer function $G_p(s)$ denotes the controlled process, and $G_c(s)$ and $H(s)$ are the controller transfer functions.

a) Derive the transfer function $Y(s)/N(s)\big|_{R=0}$. Find $Y(s)/R(s)\big|_{N=0}$ when $G_p(s)=G_c(s)$.

b) Let

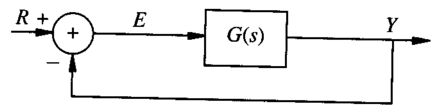
$$G_p(s)=G_c(s)=\frac{100}{(s+1)(s+5)},$$

find the output response $y(t)$ when $N(s)=0$ and $r(t)=u_s(t)$ (i.e., unit step function).



Problem 4:

Find the range of K in $G(s) = \dfrac{K}{s^4 + 6s^3 + 13s^2 + 12s + 4}$ for which the G-configuration equivalent system shown below is stable.



Problem 5:

A linear time-invariant system is described by the following state equation

$$\frac{dx(t)}{dt} = Ax(t) + Bu(t)$$

where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -4 & -3 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$.

Determine if the system is stable?