OKLAHOMA STATE UNIVERSITY

SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING

ECEN 4413 Controls II
Spring 2004
Final Exam

Choose any four out of five problems,
Please specify
1)_____; 2)_____; 3)_____; 4)_____;

Name : _____

Student ID: _____

E-Mail Address:_____

Problem 1:

Consider the *truncation* and *shift* operators defined by,

$$T_\tau(u(t)) = \begin{cases} u(t) & t \le \tau \\ 0, & t > \tau \end{cases},$$

and

$$Q_\tau(u(t)) = u(t-\tau),$$

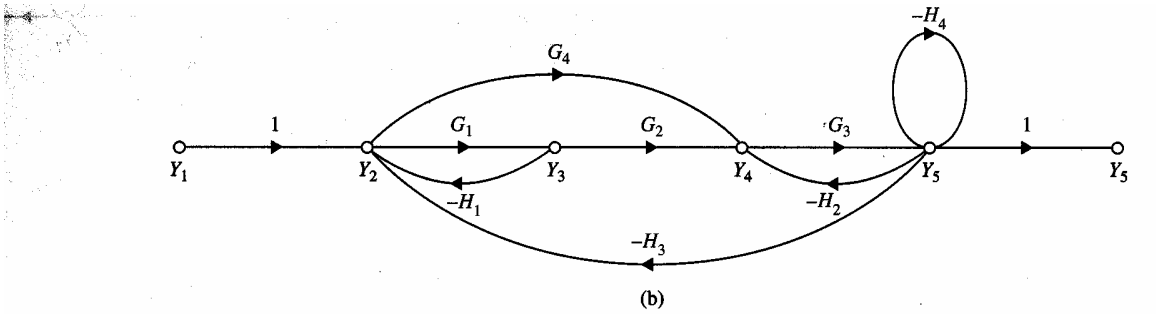
respectively. For a given system described by

$$y(t) = T_\tau\big(Q_\tau(u(t))\big),$$

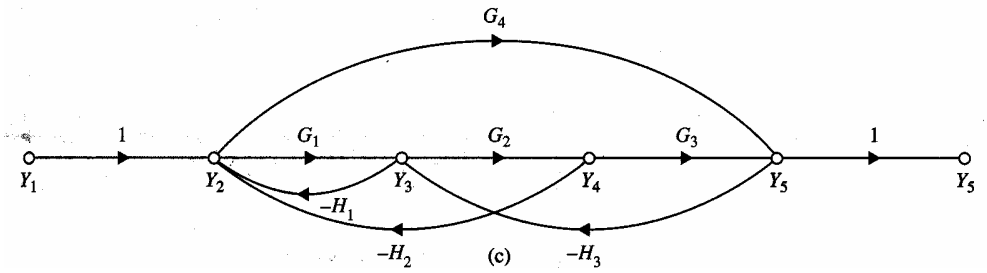
is it causal ? is it linear ? is it time-invariant (fixed) ? Justify your answers.

Problem 2:

Apply the gain formula to the SFGs shown below to find the transfer functions $\frac{Y_2}{Y_1}$.



(b)



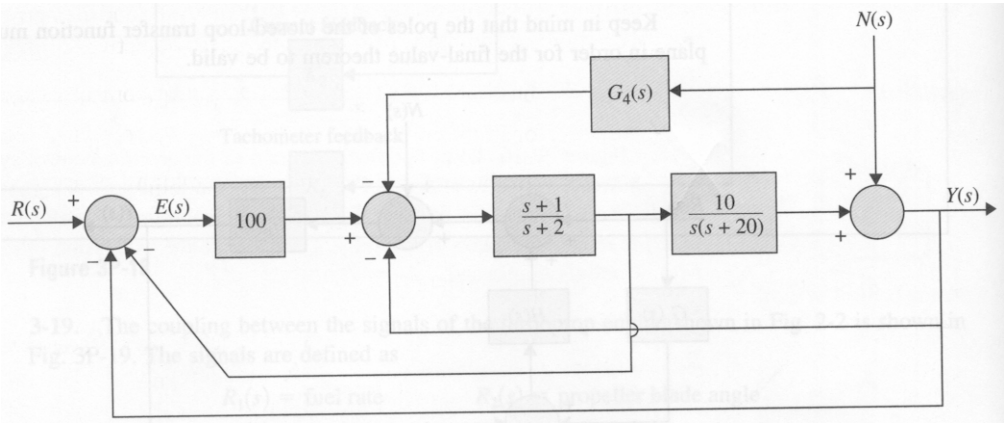
(c)

Problem 3:

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

a) Derive the transfer functions of $\left.\frac{Y(s)}{R(s)}\right|_{N=0}$, $\left.\frac{Y(s)}{N(s)}\right|_{R=0}$.

b) The controller with the transfer function $G_4(s)$ is for the reduction of the effect of the noise $N(s)$. Find $G_4(s)$ so that the output $Y(s)$ is totally independent of $N(s)$.



Problem 4:

Draw the state diagram for the state space system given

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

Problem 5:

Find an minimal controllable canonical form realization in state space for the following system described by transfer function matrix,

$$H(s) = \begin{bmatrix} \dfrac{2s}{s^3 + 6s^2 + 11s + 6} \\ \dfrac{s^2 + 2s + 2}{s^4 + 6s^3 + 9s^2 + 4s} \end{bmatrix}.$$

Note A is a 6×6 matrix.