1. For system described by differential equation, we define state variable as $x_1 = y, x_2 = \dot{y}$. Find g_1 and g_2 so that state feedback with equation $u(t)=r(t)- g_1x_1(t)- g_2x_2(t)$ transfers poles of system to s=-2 and s=-3.

$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + y = u(t)$$

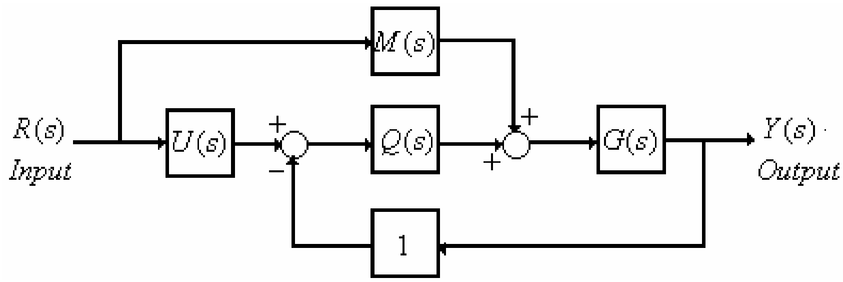
....

2. A control system has tow forward paths, as shown in Figure.

(a) Determine the overall transfer function T(s)=Y(s)/R(s).

(b) Calculate the sensitivity S_G^T.

(c) Does the sensitivity depend on U(s) or M(s)?



....

3. A system has the transfer function :

$$\frac{Y(s)}{R(s)} = T(s) = \frac{8}{s^3 + 7s^2 + 14s + 8}.$$

(a) Construct a state-space representation of the system.

(b) Determine the element $\phi_{11}(t)$ of the state transition matrix for this system.

....

4. Obtain the Transfer function for a system with state equations bellow.

$$\begin{vmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{vmatrix} = \begin{vmatrix} -1 & 1 & 0 \\ 0 & -1 & 1 \\ 0 & 0 & -2 \end{vmatrix} \begin{vmatrix} x_1 \\ x_2 \\ x_3 \end{vmatrix} + \begin{vmatrix} 0 \\ 0 \\ 1 \end{vmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

5. The dynamics of a rocket are represented by

$$\frac{Y(s)}{R(s)} = G(s) = \frac{1}{s^2}.$$

And state variable feedback is used where

$x_1 = y(t), x_2 = \dot{y}(t), and u = -x_2 - 0.5x_1$. *Determine the roots of the characteristic equation of this system and the response of the system when the initial conditions are* $x_1(0) = 0$ *and* $x_2(0) = 1$. *The input U(s) is the applied torques, and Y(s) is the rocket attitude.*

……………………………………………………………………………………………..

6. Consider the inverse pendulum, its state equation was developed in bellow

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 5 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 0 \\ -2 \end{bmatrix} u$$

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

Find its observability and controllability.

……………………………………………………………………………………………..

7. Obtain observable and controllable eigenvalues of system with state equation

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -2 \end{bmatrix} x + \begin{bmatrix} 10 \\ 0 \\ 0 \\ 1 \end{bmatrix} u$$

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

……………………………………………………………………………………………..

8. Consider the network shown in Fig. The net work has two state variables: the current x_1 *through the inductor and the voltage* x_2 *across the capacitor. The input u is a current source. If u=0 argue about observability.*