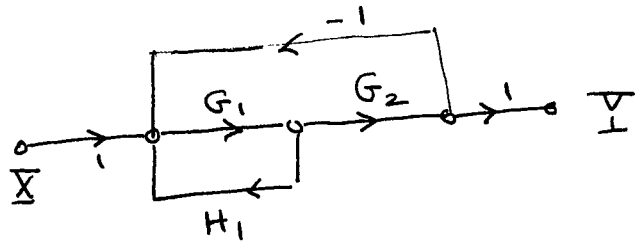
1 (a)



(b) $P_1 = 1(G_1)(G_2)(1)$

$L_1 = (-1)(G_1)(G_2)$

$L_2 = (H_1)(G_1)$

$\Delta = 1 - (L_1 + L_2) + 0$

$\Delta_1 = 1$

$$\frac{\frac{V}{I}}{\frac{V}{I}} = \frac{P_1 \Delta_1}{\Delta}$$

(2)

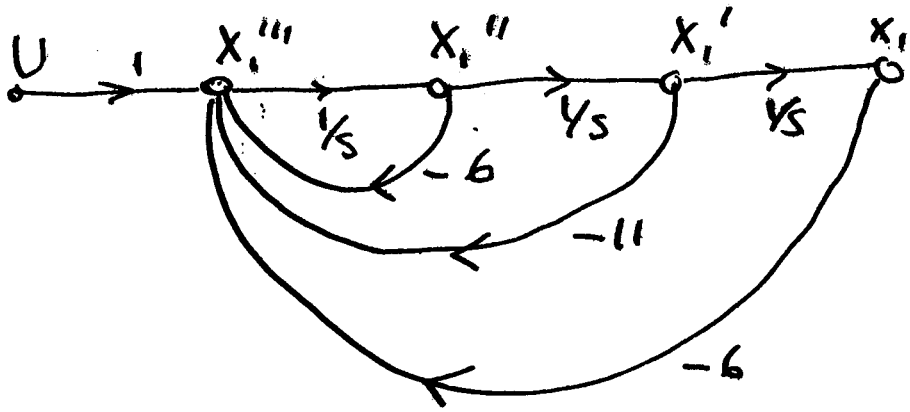
given

$$\dot{x}_1 = x_2$$
$$\dot{x}_2 = x_3$$
$$\dot{x}_3 = -6x_1 - 11x_2 - x_3 + u$$

rewrite in term of x_1

$$x_2 = x_1'$$
$$x_3 = x_2' = x_1''$$
$$\dot{x}_3 = x_1'''$$

$$\boxed{x_1''' = -6x_1 - 11x_1' - 6x_1'' + u}$$



MG formula

$$P_1 = 1/s^3$$
$$L_1 = -6/s$$
$$L_2 = -11/s^2$$
$$L_3 = -6/s^3$$
$$\Delta = 1 - (L_1 + L_2 + L_3)$$
$$\Delta_1 = 1$$

$$\boxed{\frac{x_1}{U} = \frac{P_1 \Delta_1}{\Delta}}$$

3

(a) $\frac{Y}{X} = \frac{GH}{1+GH}$

(b) $E = X - Y \Rightarrow \frac{E}{X} = 1 - \frac{Y}{X} \Rightarrow$

$$\boxed{\left(\frac{E}{X}\right) = \frac{1}{1+GH}}$$

(c) $X(s) = \frac{1}{s^2} \Rightarrow E = \frac{1}{s^2}\left[\frac{1}{1 + \frac{s+1}{(s+4)(s+5)}H}\right]$

$$e(\infty) = \overset{s}{\uparrow}{}^{0} \frac{1}{\frac{s}{4(5)}H} = 0 \qquad \boxed{\therefore H = \frac{k}{s^2}}$$

(d)

$$1 + \frac{(s+1)k}{(s+4)(s+5)s^2} = 0$$

$$s^4 + 9s^3 + 20s^2 + ks + k = 0$$

		20	k
s^4	1	k	stable if
s^3	9		$180-k > 0$
s^2	$\frac{180-k}{9}$	k	
s^1	$\left(\frac{180-k}{9}\right)k - 9k$ / $\frac{180-k}{9}$		$\left(\left(\frac{180-k}{9}\right) - 9\right)k > 0$
s^0	k		$k > 0$

(4) (a) $\frac{Y}{X} = \frac{G}{1+GH}$

(b) $E = X - HY \Rightarrow E = 1 - H\frac{Y}{X} = \frac{1}{1+GH}$

(c) $x(t) = u(t)$, $X(s) = \frac{1}{s}$ $\quad E = \left(\frac{1}{s}\right)\left[\frac{1}{1+\left(\frac{1}{s-4}\right)H}\right]$

$$e(\infty) = \lim_{s \to 0} s \frac{1}{1+\left(\frac{1}{s-4}\right)H} = 0 \qquad \boxed{H = \frac{k}{s}}$$

(d) Char eqn

$$1 + \frac{k}{s}\frac{1}{(s-4)} = 0 \Rightarrow \boxed{s^2 - 4s + k = 0}$$

s^2	1	k
s	-4	
s^0	k	

2 sign changes

unstable