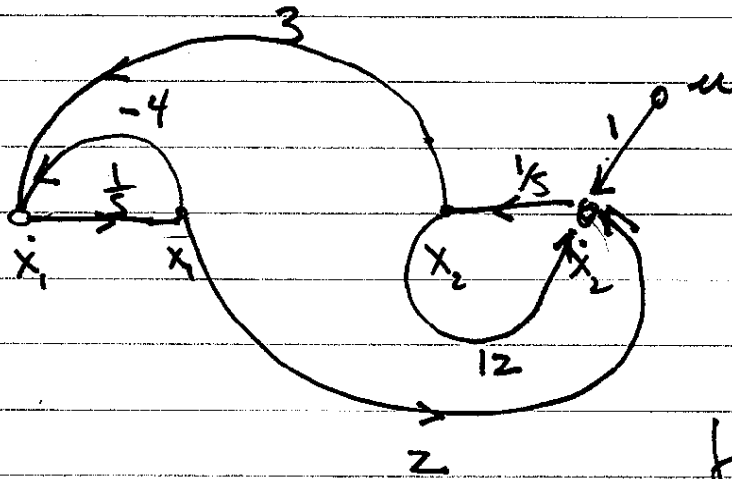


Test 1

1. (a)

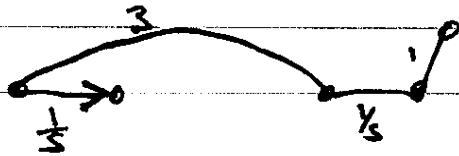
10'



(b) Forward path

Hoi
ched

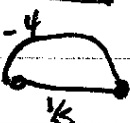
14'



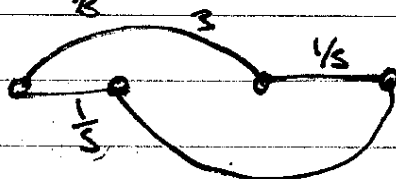
$$P_1 = \frac{1}{s^2}$$

2'

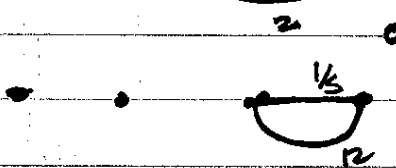
Loop



$$L_1 = -\frac{4}{s} \quad 2'$$



$$L_2 = \left(\frac{1}{s}\right)(+3)\left(2\right)\left(\frac{1}{s}\right) = \frac{6}{s^2} \quad 2'$$



$$L_3 = \frac{12}{s} \quad 2'$$

$$\Delta = 1 - (L_1 + L_2 + L_3) + L_1 L_3 \quad 2'$$

$$\Delta_1 = 1 \quad 2'$$

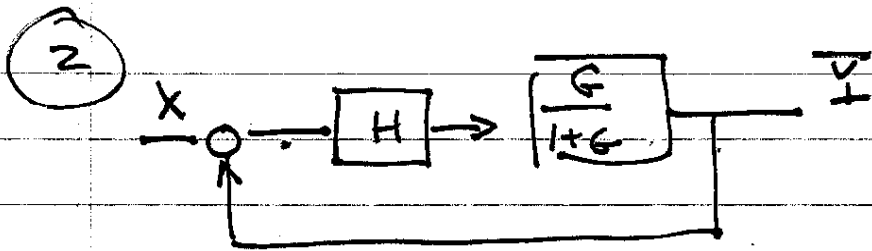
$$X_1 = \frac{P_1 \Delta_1}{\Delta} = \frac{3}{s^2 - 8s - 6 - 48} \quad 2'$$

Direct 6'

$$\begin{bmatrix} -4-s & 3 \\ 2 & 12-s \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$x_1 = u \quad \left| \begin{array}{cc|c} 0 & 3 & 0 \\ 1 & 12-s & 1 \end{array} \right| = \frac{3u}{s^2 - 8s - 54} \quad ?$$

(54) ✓



10 (a) $\frac{Y}{X} = \frac{\frac{HG}{1+G}}{1 + \frac{HG}{1+G}}$

10 (b) $E = X - Y \Rightarrow \frac{E}{X} = 1 - \frac{Y}{X} = \frac{1}{1 + \frac{HG}{1+G}}$

10 (c) $x(t) \rightarrow X(s) = \frac{1}{s}$

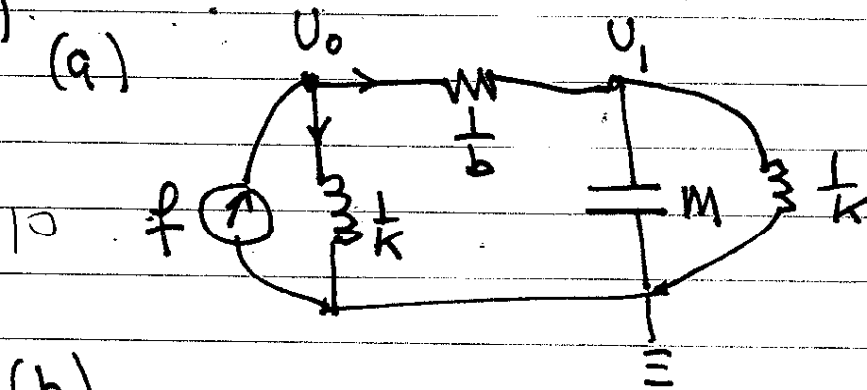
$$e(s) = \frac{0}{s} = \frac{1}{s} \frac{1}{1 + H \left(\frac{G}{1+G} \right)}$$

$$= \frac{1}{s} \frac{1}{1 + H \frac{(s+10)}{s(s+12) + s+10}} = \frac{1}{s} \frac{1}{1+H} = \frac{1}{10}$$

$$\left. \begin{array}{l} H = k \\ HH = 10 \end{array} \right\} H = 9$$

(3)

(a)



(b)

node U_0 :

$$F = \frac{U_0}{\frac{s}{k}} + \frac{U_0 - U_1}{\frac{1}{b}} \Rightarrow \dot{F} = m\ddot{u}_0 + b(\dot{u}_0 - \dot{u}_1)$$

node U_1 :

$$\frac{U_0 - U_1}{\frac{1}{b}} = \frac{U_1}{\frac{1}{ms}} + \frac{U_1}{\frac{s}{k}} \Rightarrow (\dot{u}_0 - \dot{u}_1)b = m\ddot{u}_1 + k u_1$$

(c)

$$\frac{U_1}{U_0} = \frac{\frac{1}{ms} \parallel \frac{s}{k}}{\frac{1}{b} + \frac{1}{ms} \parallel \frac{s}{k}}$$