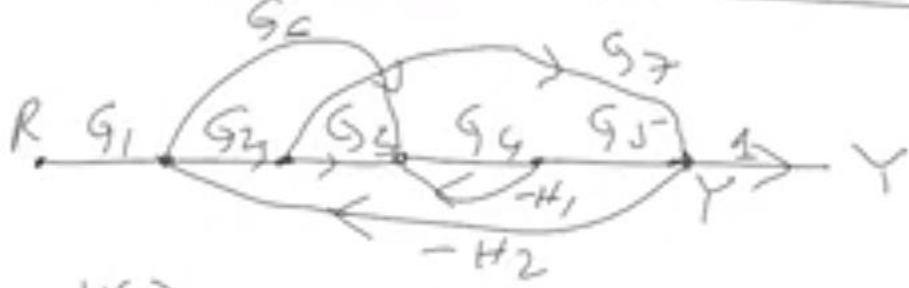
Signal Flow Graph

2.20



Find $\frac{Y(s)}{R(s)}$? Apply Mason Gain Formula

Forward path 1 $G_1 G_2 G_3 G_4 G_6$

Forward path 2 $G_1 G_6 G_4 G_5$

Forward path 3 $G_1 G_2 G_7$

Loop gain

1. $-G_2 G_3 G_4 G_5 H_2$
2. $-G_4 H_1$
3. $-G_6 G_4 G_5 H_2$
4. $-G_2 G_7 H_2$

loop 2 & 4 are non touching

Mason's gain Formula

$$\frac{Y(s)}{R(s)} = \sum_{k=1}^{N} \frac{M_k \Delta_k}{\Delta}$$

$\Delta = 1 - (\text{sum of individual loop gain}) + (\text{all possible combination of two non touching loops}) + - - \ldots$

$= 1 + G_4 H_1 + G_2 G_3 G_4 G_5 H_2 + G_6 G_3 G_5 H_2 + G_2 G_7 H_2 + G_4 H_1 G_2 G_7 H_2$

$\Delta_1 = 1$

$\Delta_2 = 1$

$\Delta_3 = 1 + G_4 H_1$

$$\frac{Y(s)}{R(s)} = \frac{G_1G_2G_3G_4G_5 + G_6G_4G_5 + G_1G_2G_7(1+G_4H_1)}{\Delta}$$