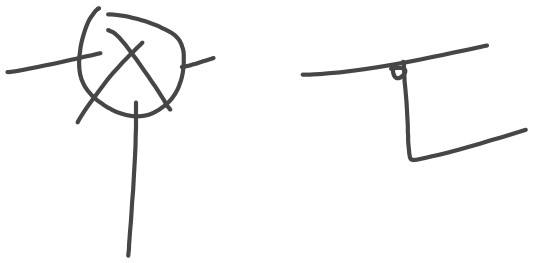
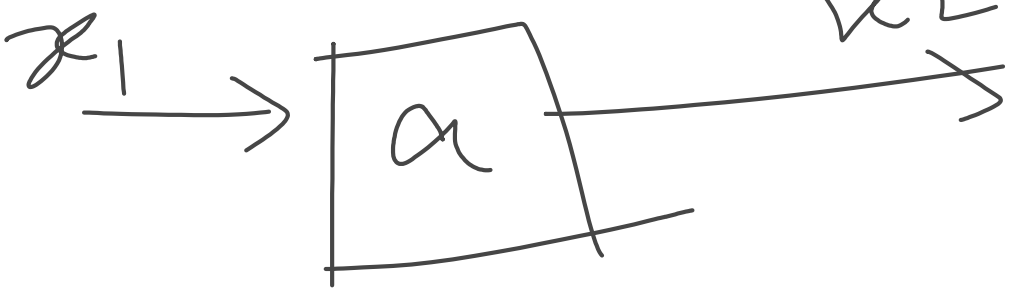
Block Diagram

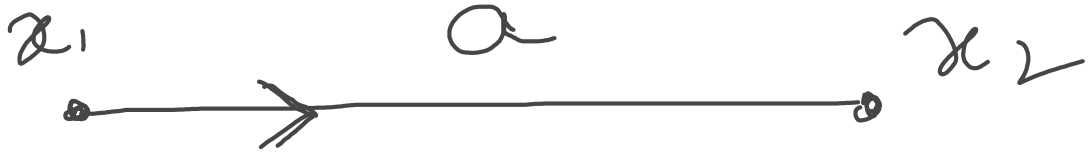
↓

Signal Flow

(node) (branch) gain (T) - transmittance

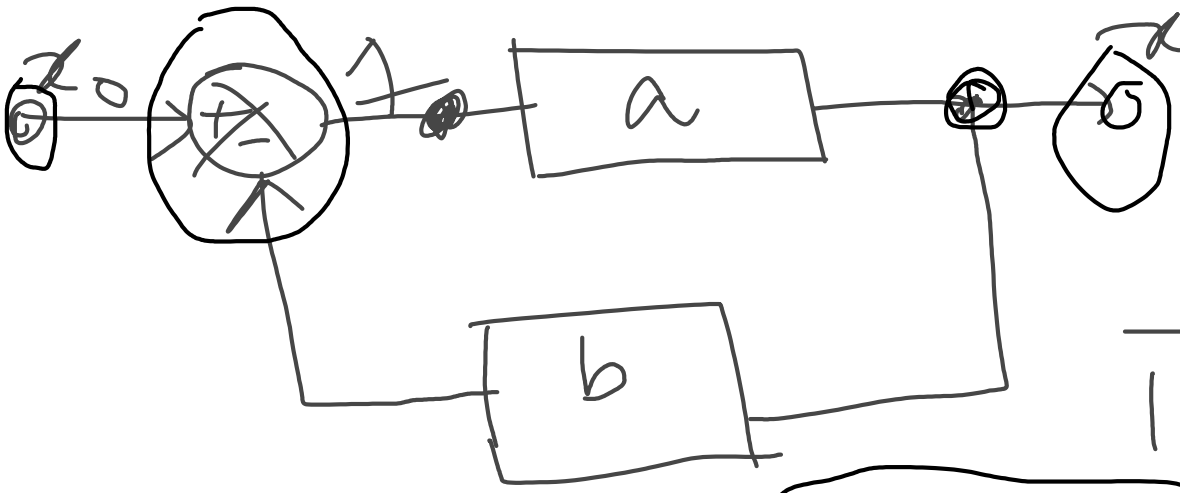






$$\frac{x_2}{x_1} = a$$

$$x_2 = a\,x_1$$



$$G_2 = \frac{G}{1 + GH}$$

$x_3 = x_0 - b x_1$

$$x_2 = x_0 - b x_1$$

$$x_1 = a x_2$$

$$= a(x_0 - b x_1)$$

$$\Rightarrow x_1 = a x_0 - ab x_1$$

$$\Rightarrow x_1 + ab x_1 = a x_0$$

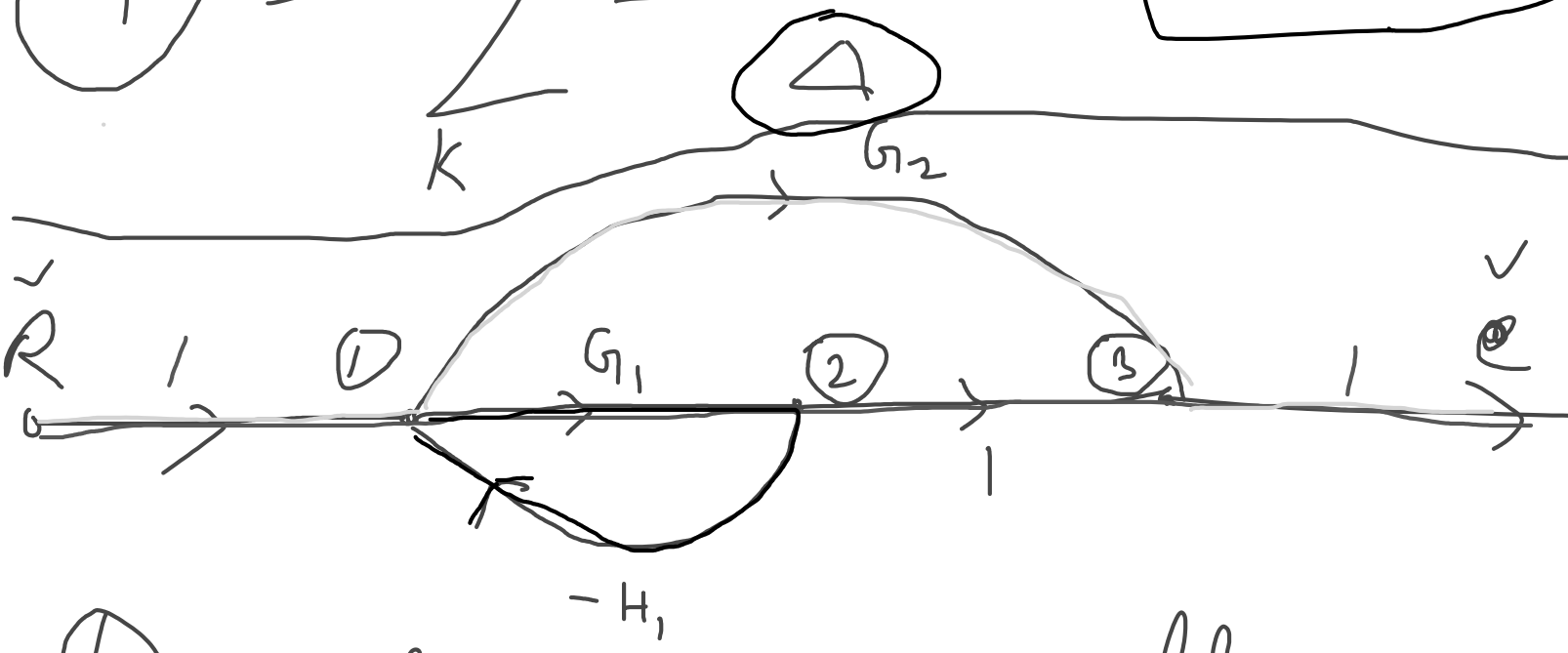
$$\Rightarrow x_1 (1 + ab) = a x_0$$

$$\Rightarrow \frac{x_1}{x_0} = \frac{a}{1 + ab}$$

T from S.F graph

Mason's Gain Formula

$$T = \sum_k \frac{P_k \Delta_k}{\Delta}$$



P_k = forward path

$P_1 = G_1$	$\Delta_1 = 1$	$\Delta = 1 - (-G_1 H_1)$
$P_2 = G_2$	$\Delta_2 = 1$	$= 1 + G_1 H_1$

$\Delta_k = 1 - (\sum$ loop not touching the f. path$) + (\sum$ products of pair of non touching loops not touching

the f. path) - ( )

$\Delta = 1 - (\sum \text{loop gain}) + (\sum \text{product of 2 non touching loops}) - (\sum \text{product of 3 non touching loops}) +$

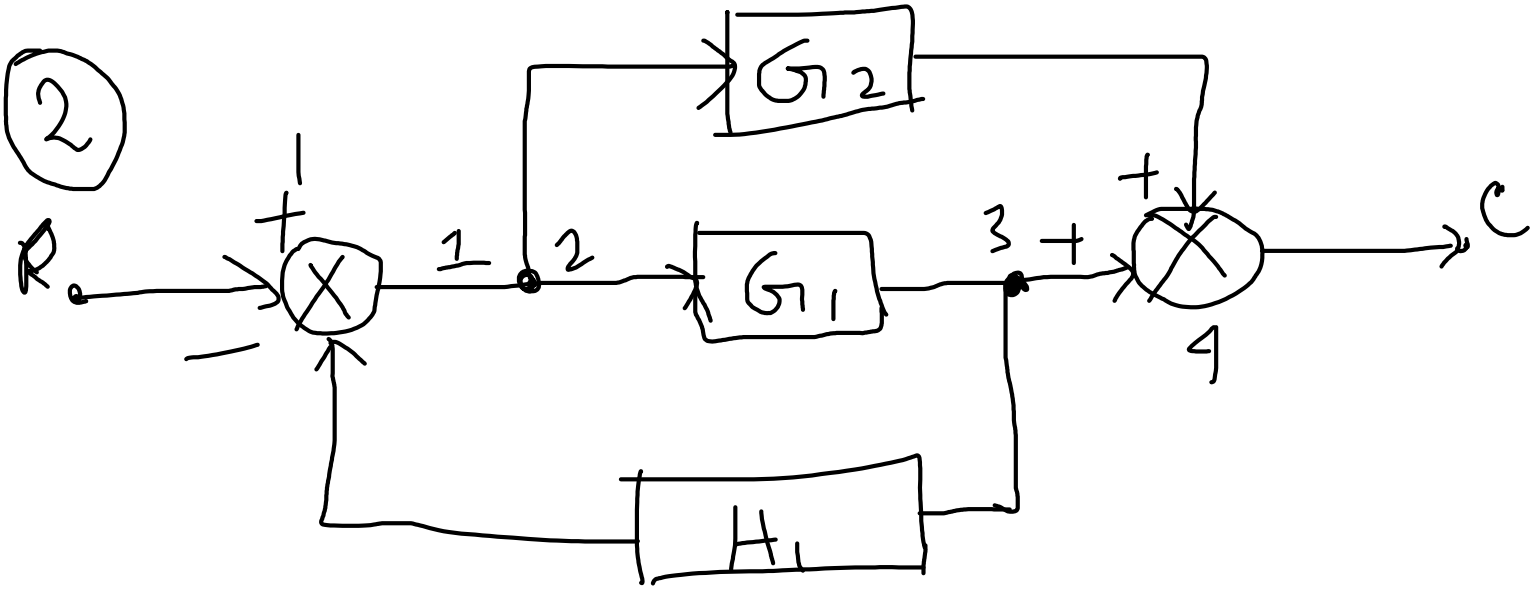
$$T = \sum_{k} \frac{P_k \Delta_k}{\Delta}$$

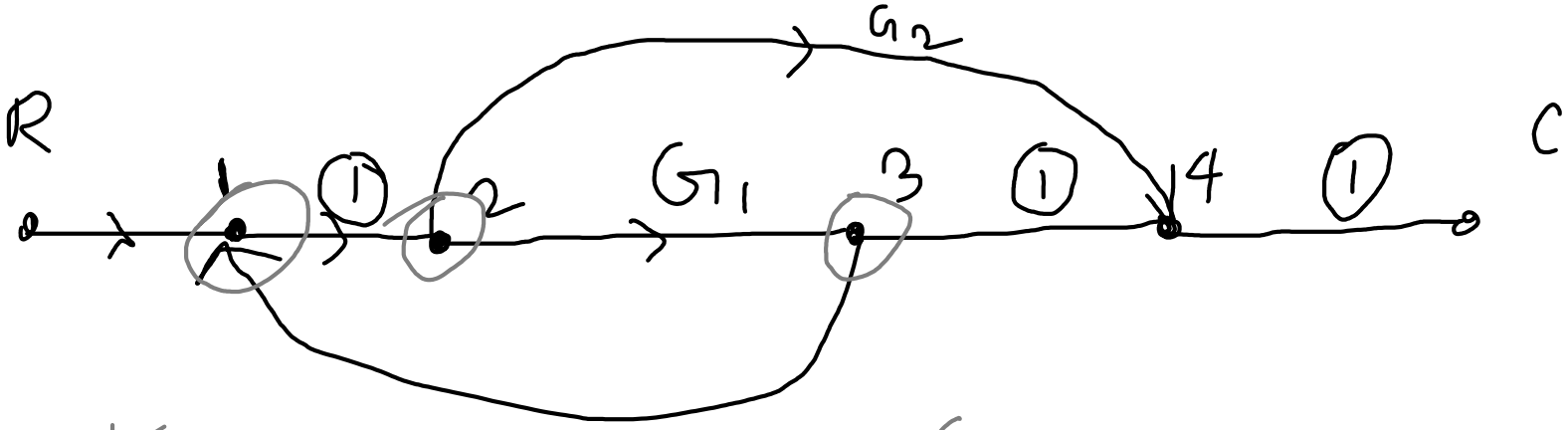
$k = 1, 2$

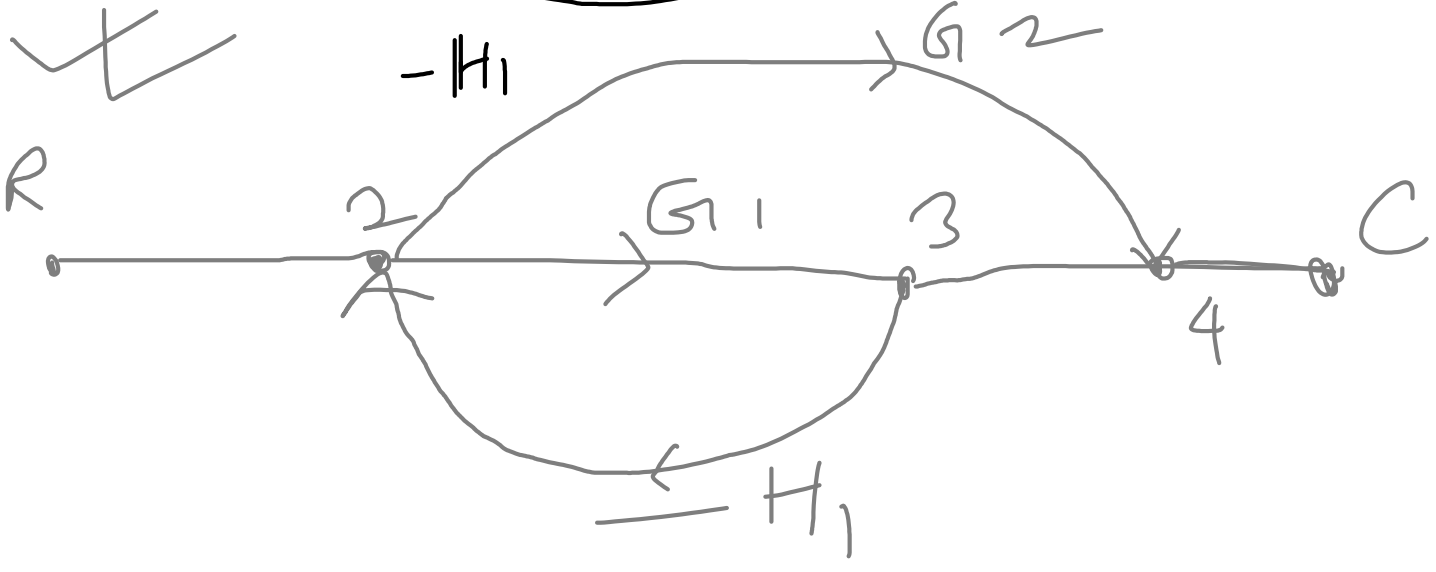
$$= \frac{P_1 \Delta_1}{\Delta} + \frac{P_2 \Delta_2}{\Delta}$$

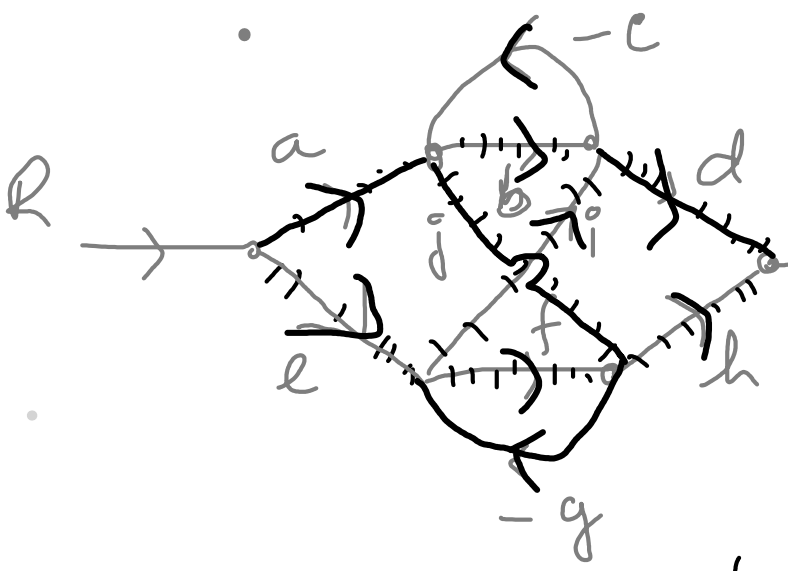
$$T = \frac{G_1 + G_2}{1 + G_1 H}$$

(2)









$$\frac{\sum P_k \Delta_k}{\Delta}$$

$P_1 = abd$

$P_2 = ajh$

$P_3 = efh$

$P_4 = eid$

$P_5 = -eicjh$

$P_6 = -ajgid$

$L_1 = -bc$

$L_2 = -gf$

$L_3 = i(-c)j(-g)$

$= icjg$

$\Delta_1 = 1 - (-fg) + (0) + 0$

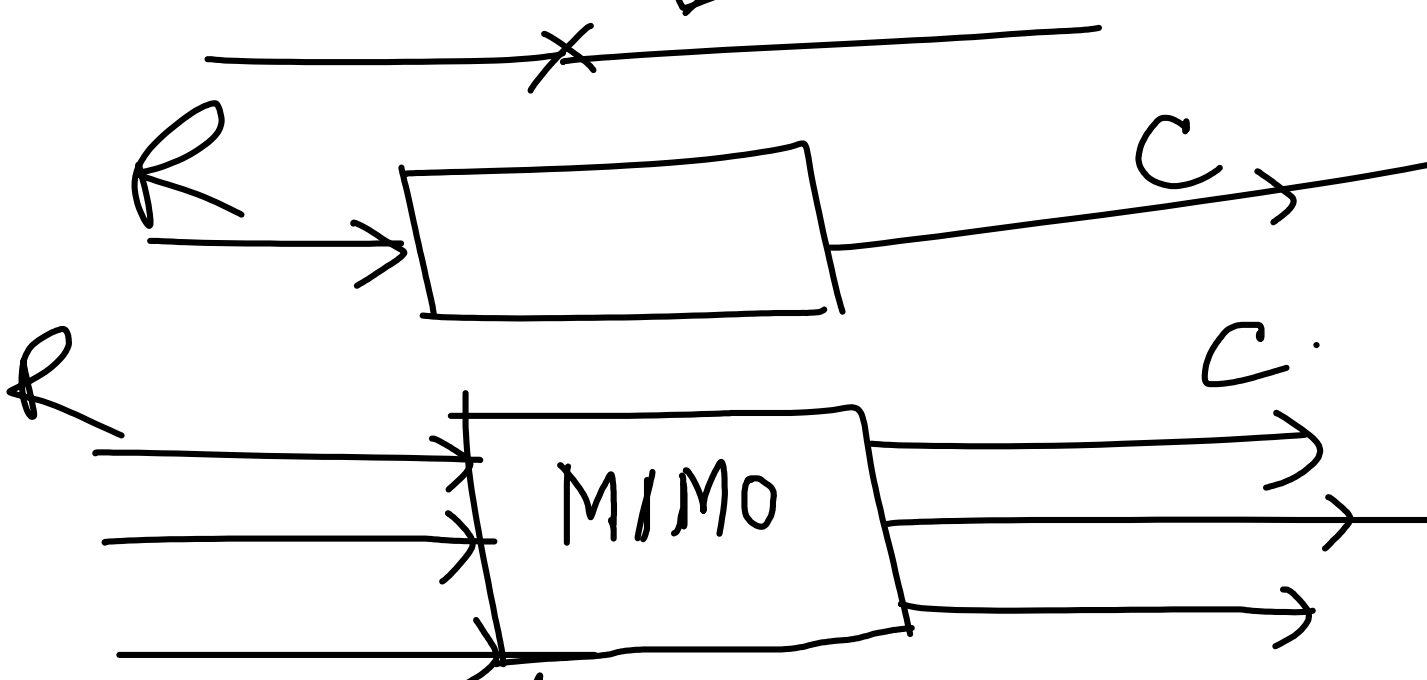
$= 1 + fg.$

$$\Delta_2 = 1 + \quad \Delta_3 = 1 + bc$$

$$\Delta_4 = \Delta_5 = \Delta_6 = 1$$

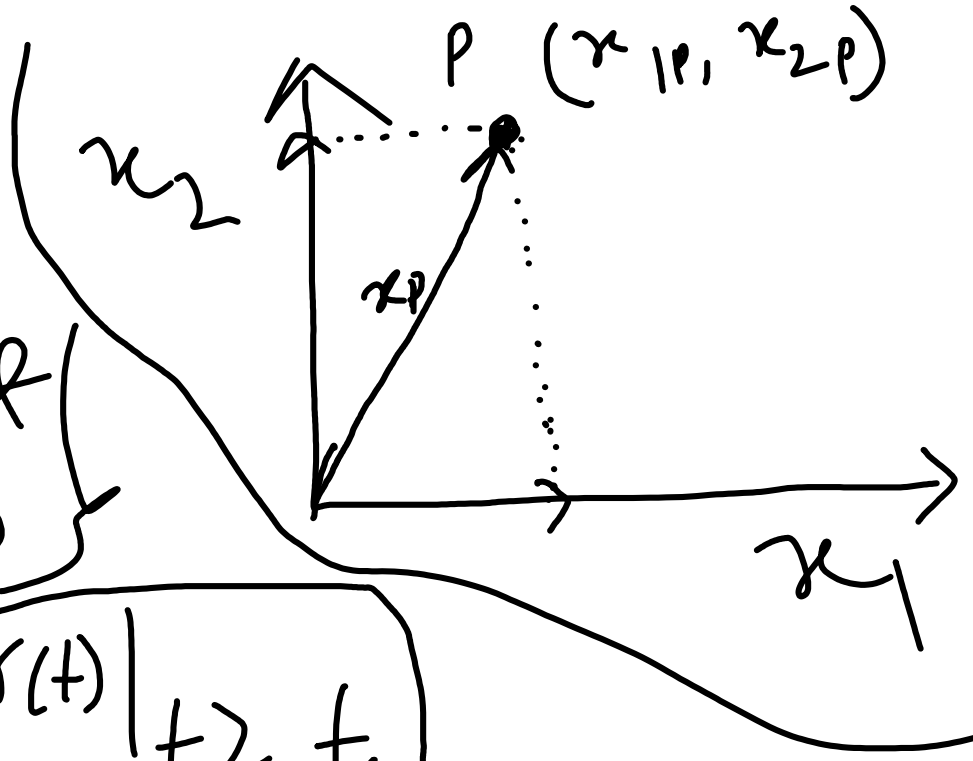
$$\Delta = 1 - (L_1 + L_2 + L_3)$$

$$+ (L_1 L_2) + \cdots$$



state space

state



smallest set of variables

$t = t_0$, $x(t)|_{t \geq t_0}$

$t \geq t_0$

state variables:- need not to be physical or measurable

state vector:-

State space