SISTEMAS DE CONTROL

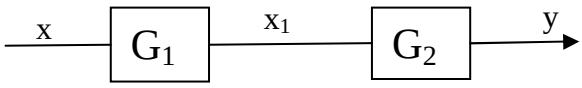
REDUCCIÓN DE DIAGRAMAS DE BLOQUES (Parte 1)

Métodos de reducción → Álgebra de bloques
Métodos de reducción → Masson

REDUCCIÓN DE DIAGRAMAS DE BLOQUES POR EL MÉTODO DEL ÁLGEBRA DE BLOQUES

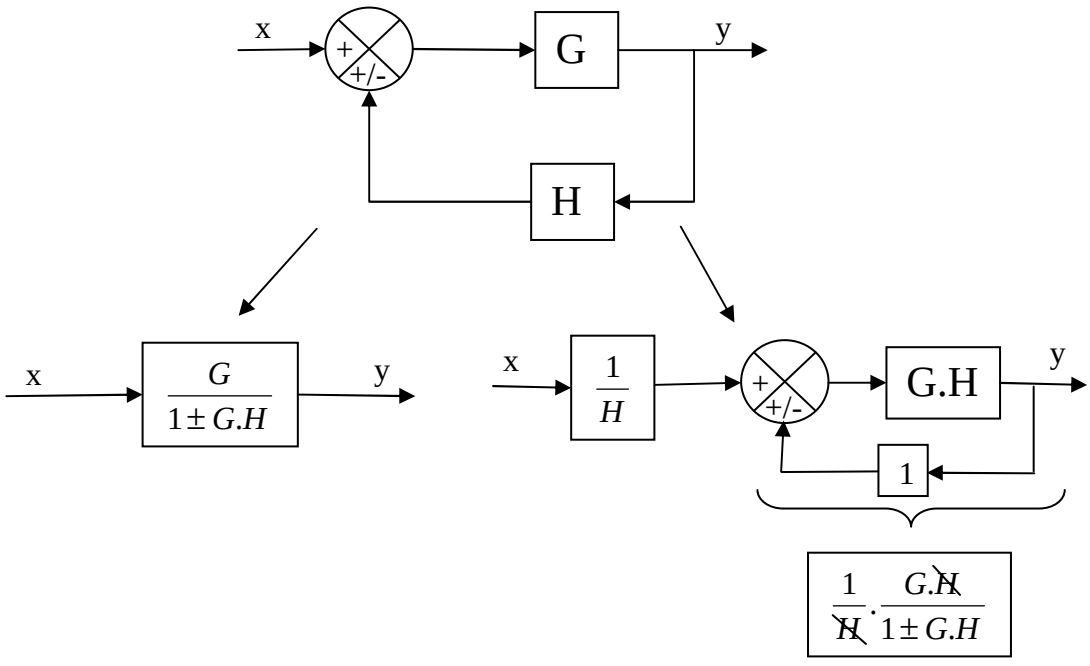
Criterios de reducción:

1) Combinación de bloques en cascada

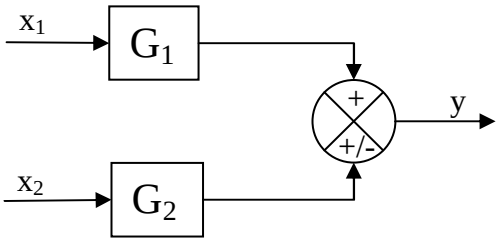


$$\left.\begin{aligned} G_1 &= \frac{x_1}{x} \\ G_2 &= \frac{y}{x_1} \end{aligned}\right\} \frac{y}{x} = G_1.G_2$$

2) Lazo de realimentación

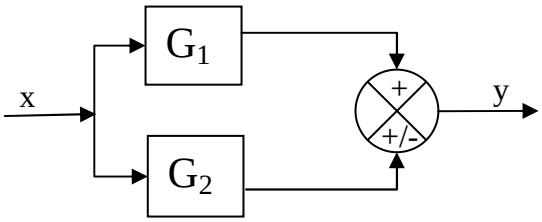


3) Combinación de bloques en paralelo



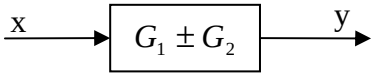
$$y = x_1.G_1 \pm x_2.G_2$$

Si $x_1 = x_2 = x$

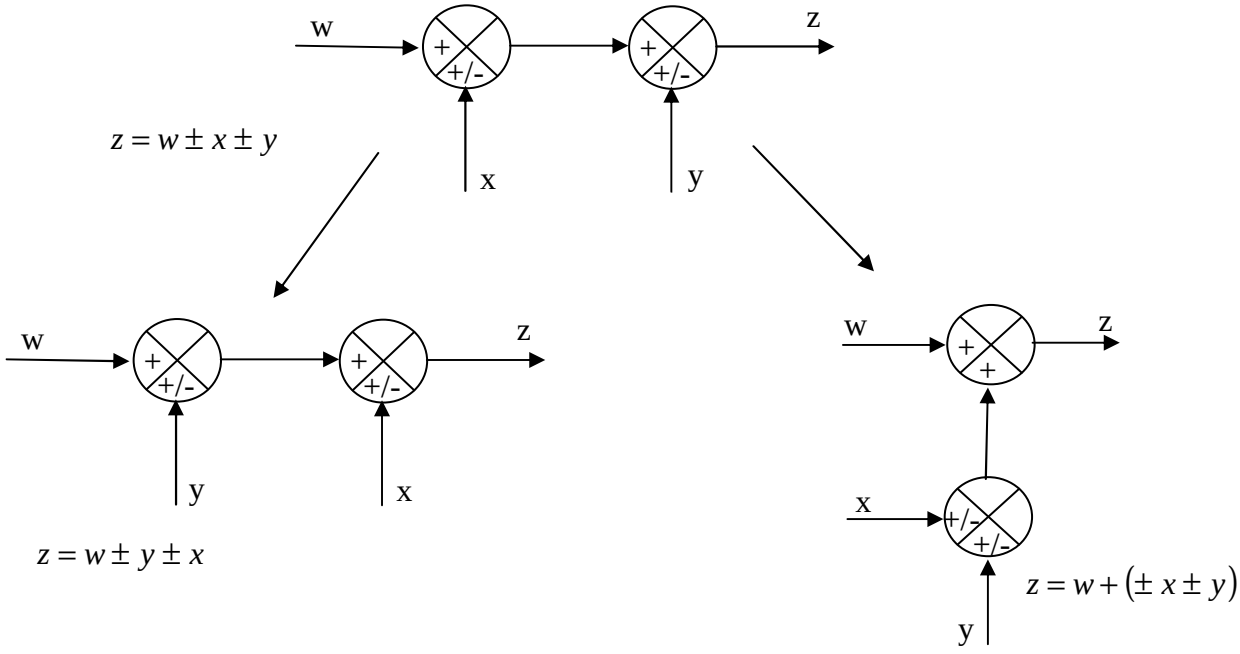


$$y = x(G_1 \pm G_2)$$

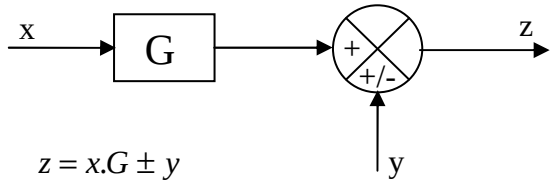
$$\frac{y}{x} = G_1 \pm G_2 \Longrightarrow$$



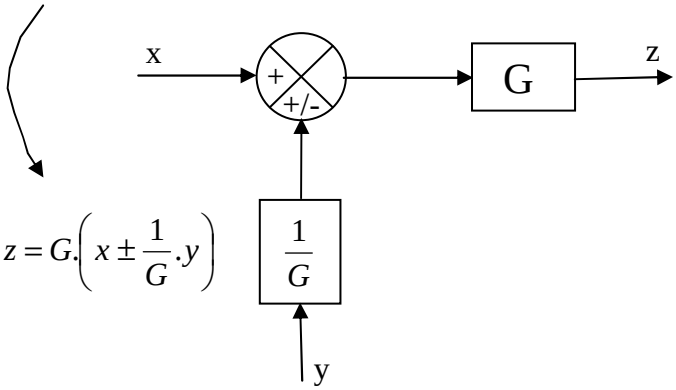
4) Reordenamiento de puntos de suma



5) Movimiento de un punto de suma hacia atrás de un bloque

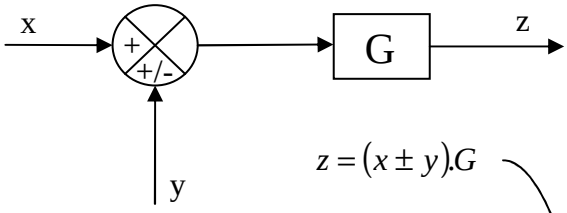


$$z = x.G \pm y$$

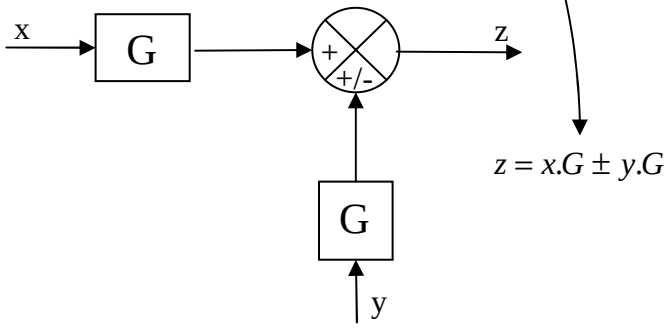


$$z = G.\left(x \pm \frac{1}{G}.y \right)$$

6) Movimiento de un punto de suma hacia adelante de un bloque

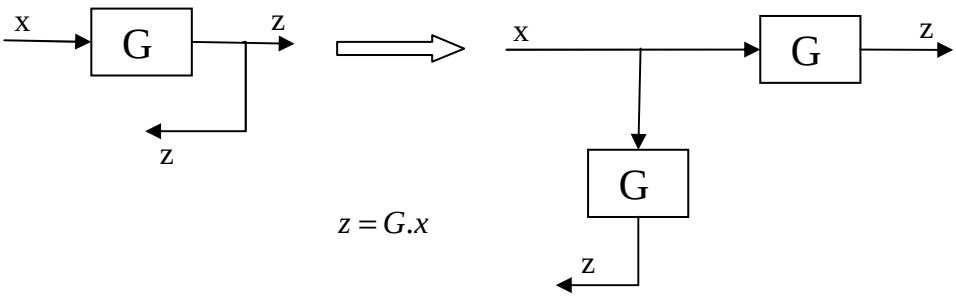


$$z = (x \pm y).G$$



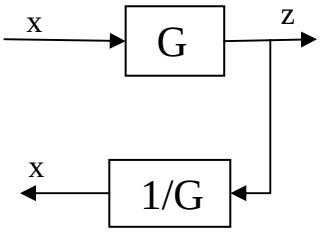
$$z = x.G \pm y.G$$

7) Movimiento de un punto de toma hacia atrás de un bloque



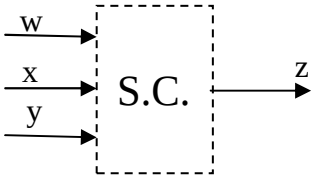
$$z = G.x$$

8) Movimiento de un punto de toma hacia adelante de un bloque



$$x = x.G.\frac{1}{G}$$

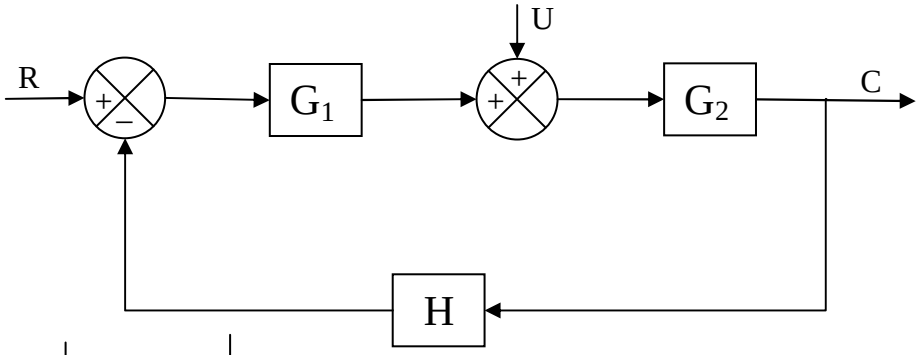
Sistemas de entradas múltiples



$$Z(s) = W.\frac{Z}{W}(s)\Big|_{\substack{x=0\\y=0}} + X.\frac{Z}{X}(s)\Big|_{\substack{w=0\\y=0}} + Y.\frac{Z}{Y}(s)\Big|_{\substack{w=0\\x=0}}$$

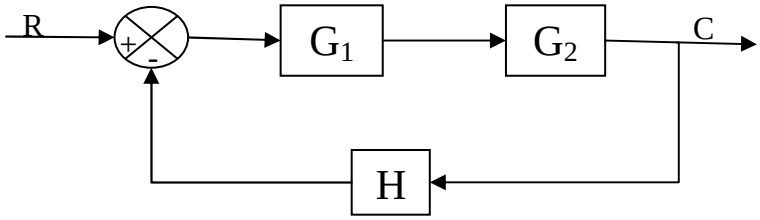
Ejemplos de aplicación:

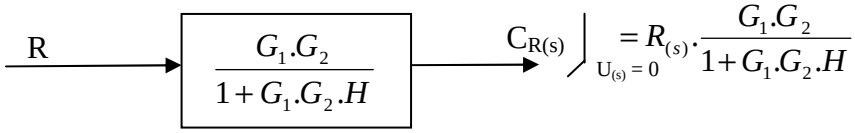
1) Hallar la salida C(s) para el siguiente diagrama de bloques.



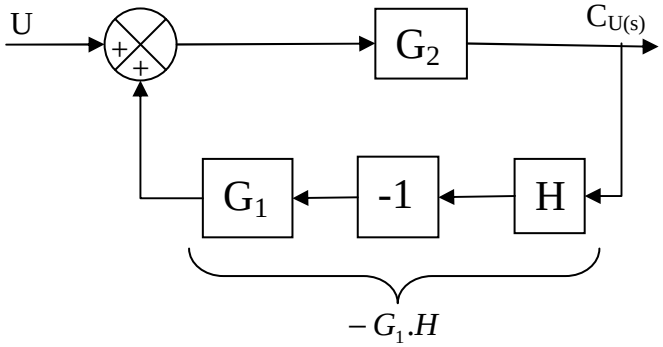
$$C_{(s)} = C_{R(s)}\Big|_{U_{(s)}=0} + C_{u(s)}\Big|_{R_{(s)}=0}$$

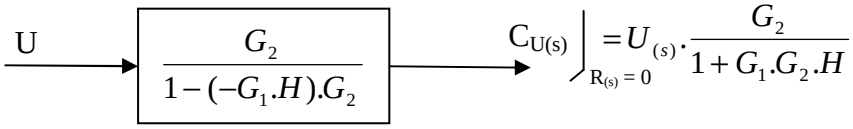
Para $U_{(s)} = 0$:





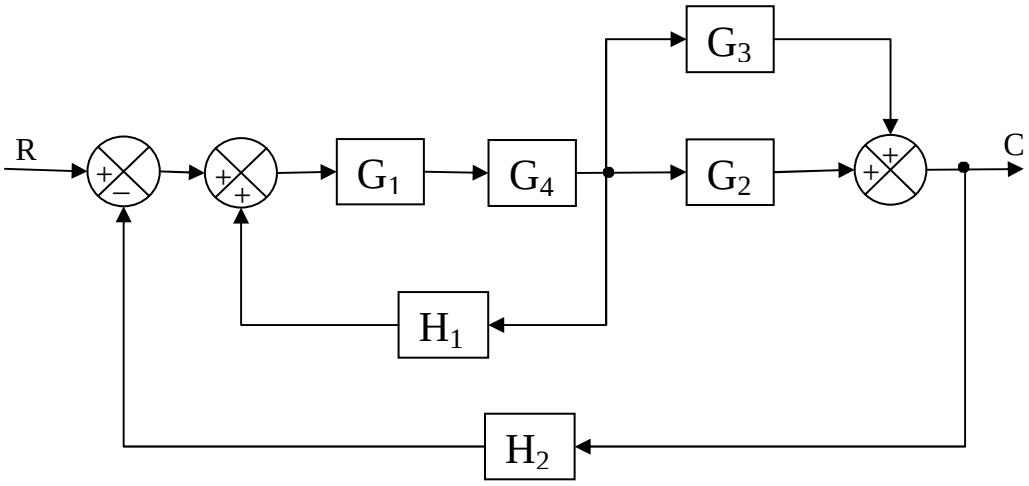
Para $R_{(s)} = 0$:

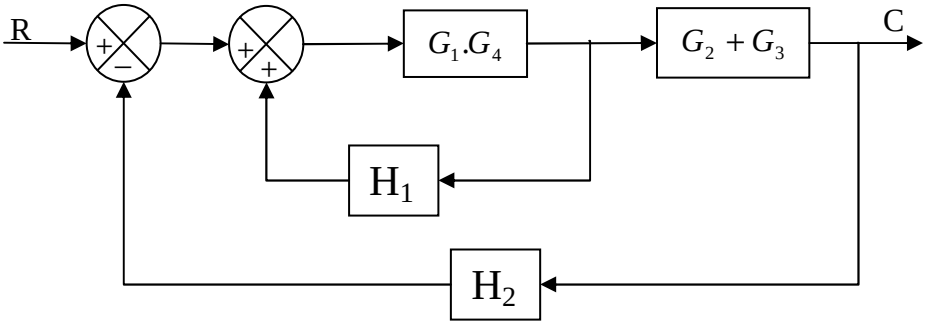


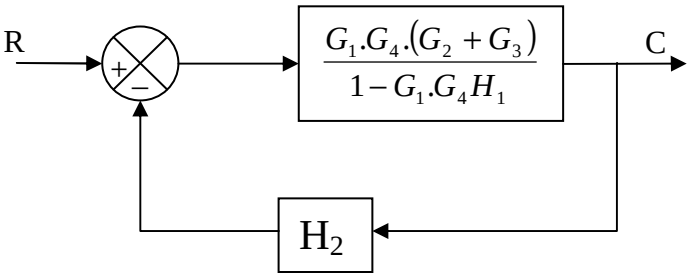


$$C_{(s)} = R_{(s)} \cdot \frac{G_1.G_2}{1+G_1.G_2H} + U_{(s)} \cdot \frac{G_2}{1+G_1.G_2.H} = \frac{G_2}{1+G_1.G_2.H}.\left[R_{(s)}.G_1 + U_{(s)}\right]$$

2) Hallar la transferencia $\frac{C}{R}(s)$

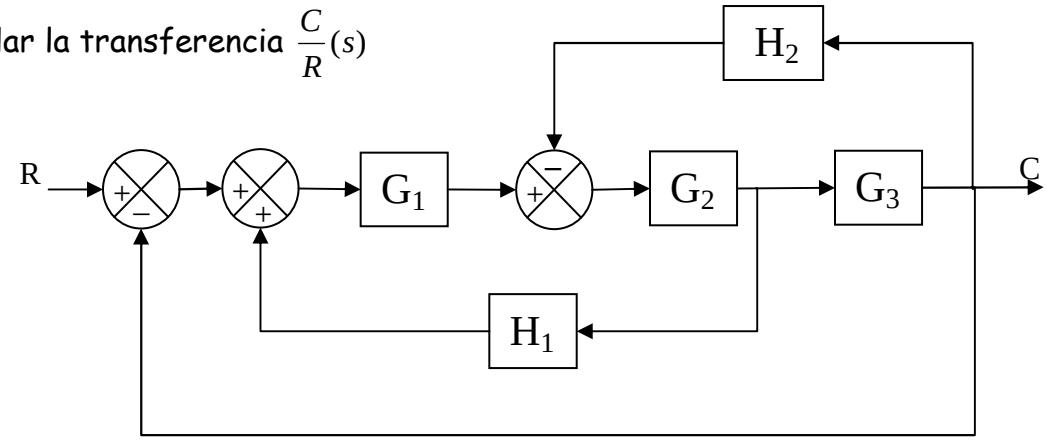


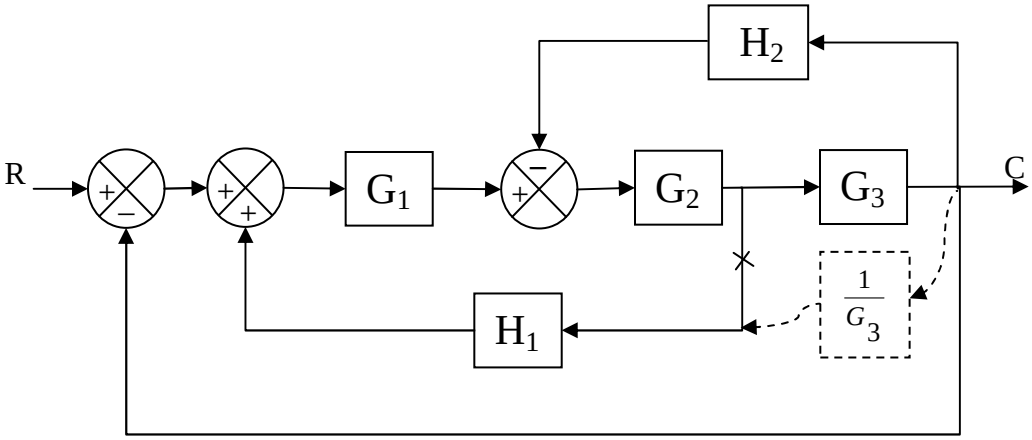


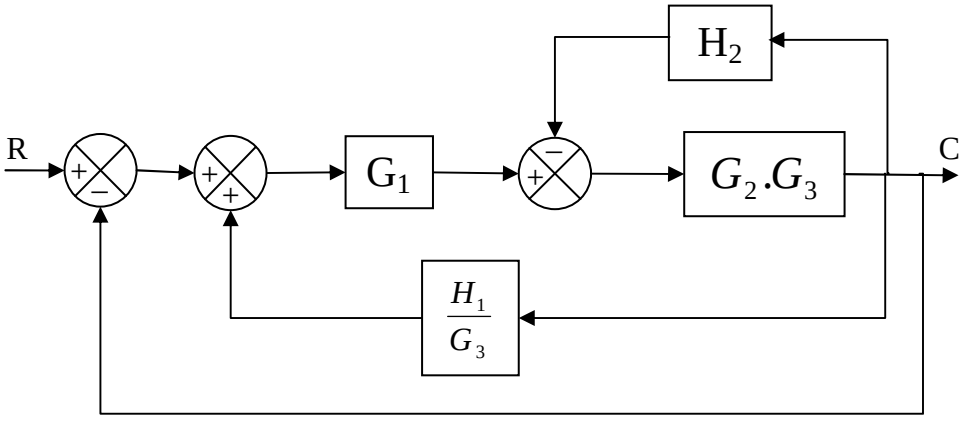


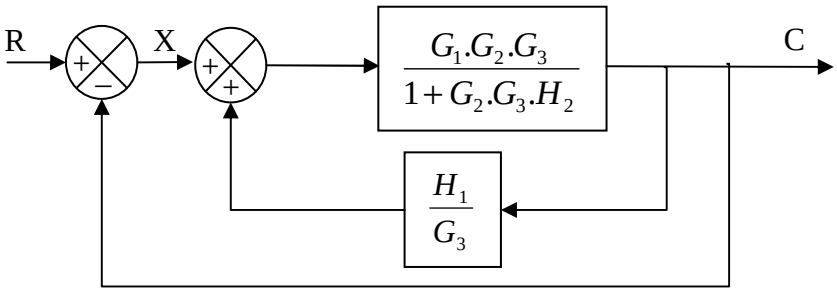
$$\frac{C}{R}(s)=\frac{G_1.G_4.(G_2+G_3)}{1-G_1.G_4.H_1+G_1.G_4.(G_2+G_3).H_2}$$

3) Hallar la transferencia $\frac{C}{R}(s)$

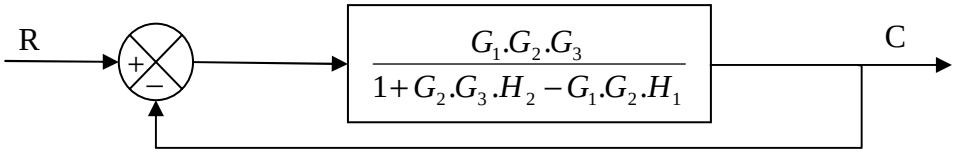






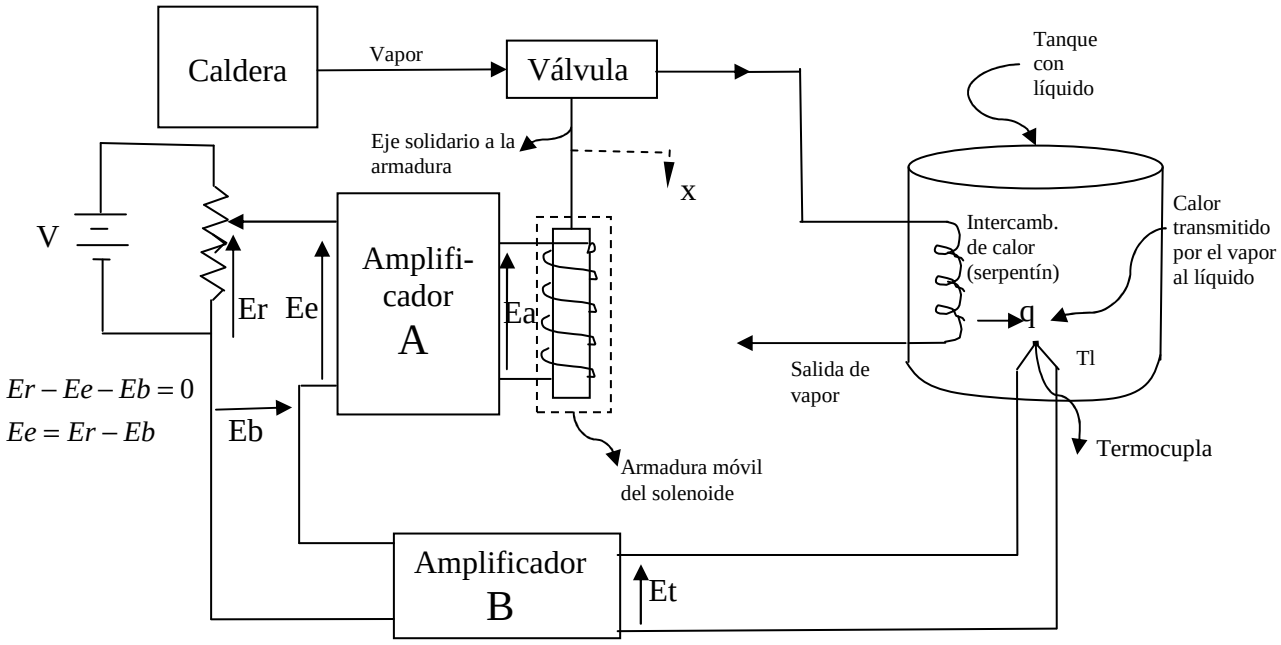


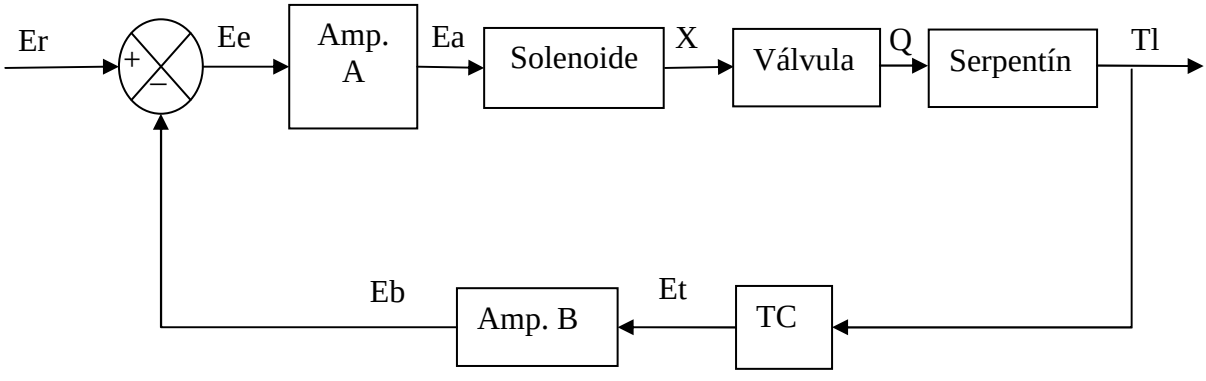
$$\frac{C}{X}(s)=\frac{G_1.G_2.G_3}{1+G_2.G_3.H_2-G_1.G_2.H_1}$$



$$\frac{C}{R}(s)=\frac{G_1.G_2.G_3}{1+G_2.G_3.H_2-G_1.G_2.H_1+G_1.G_2.G_3}$$

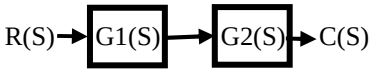
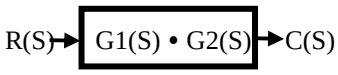
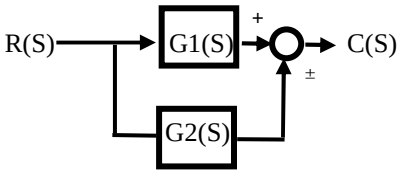
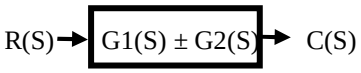
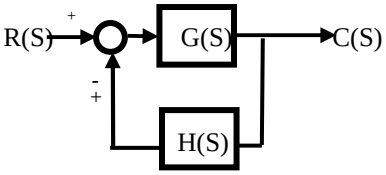
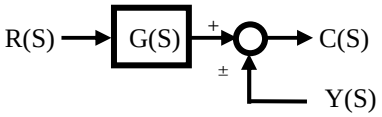
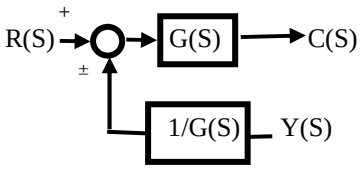
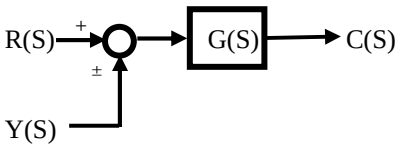
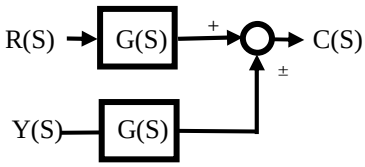
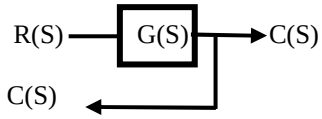
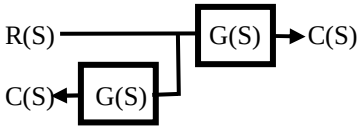
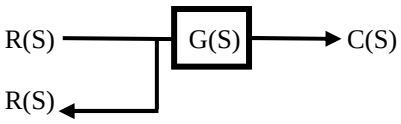
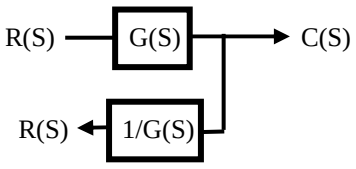
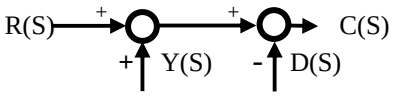
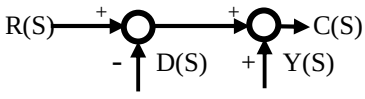
4) Hallar el diagrama de bloques del siguiente sistema:





ANEXO

REGLAS DEL ÁLGEBRA DE LOS DIAGRAMAS DE BLOQUES

	TRASNFOR-MACION	ECUACION	DIAGRAMA EN BLOQUES	DIAGRAMA EN BLOQUES EQUIVALENTE
1	Combinación de *Bloques en Cascada*	$C(S) = G1_{(S)} \cdot G2_{(S)}$		
2	Combinación de *Bloques en Paralelo*	$C(S) = G1_{(S)} \pm G2_{(S)}$		
3	*Lazo de Realimentación*	$C(S) = \frac{G_{(S)}}{1 \pm G_{(S)} H_{(S)}}$		
4	Desplazamiento de un *Punto de **Suma** de Señal* hacia la *Entrada* de un Bloque	**C(S) = G(S) . R(S) ± Y(S)**		
5	Desplazamiento de un *Punto de **Suma** de Señal* hacia la *Salida* de un Bloque	**C(S) = G(S) {R(S) ± Y(S)}**		
6	Desplazamiento de un *Punto de **Toma** de Señal* hacia la *Entrada* de un Bloque	**C(S) = G(S) . R(S)**		
7	Desplazamiento de un *Punto de **Toma** de Señal* hacia la *Salida* de un Bloque	**C(S) = G(S) . R(S)**		
8	Permuta de *Puntos de **Suma** de Señal* en serie	**C(S) = R(S) + Y(S) + D(S)**		
9	Permuta de *Puntos de **Suma** de Señal* en serie	**C(S) ≠ R(S) + Y(S) + D(S)**