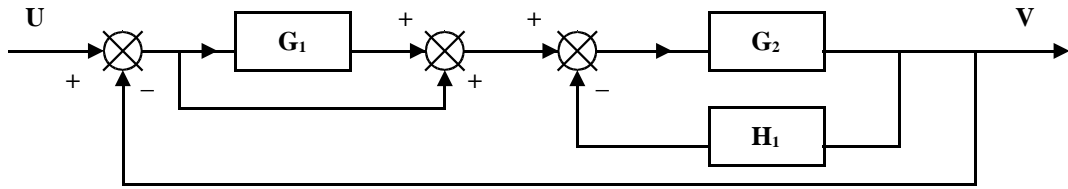
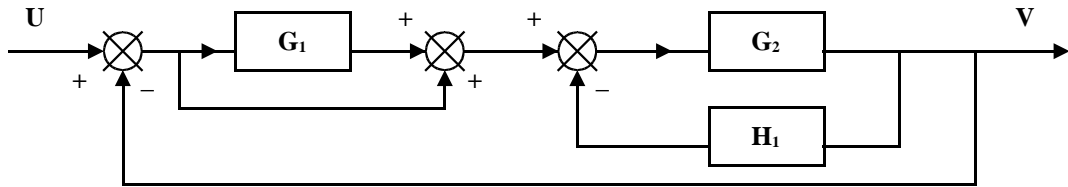


1.- **Halla** la función de transferencia del sistema representado mediante el siguiente diagrama de bloques.

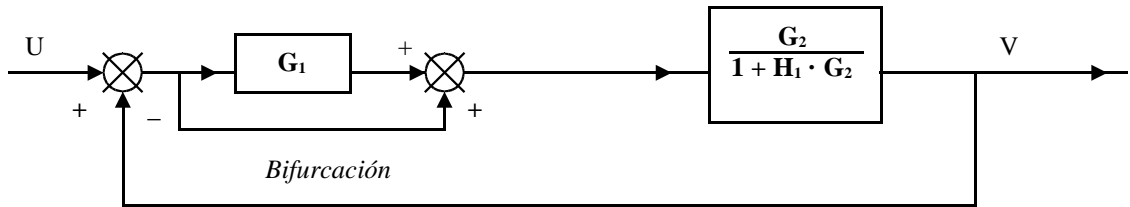


Bucle de realimentación negativa



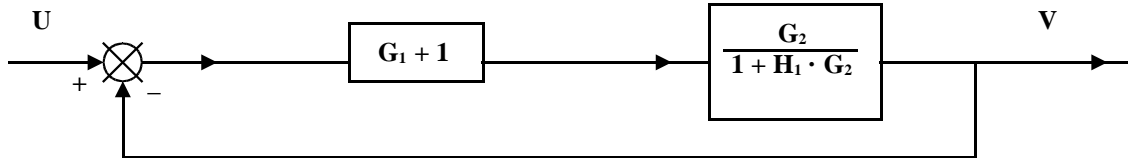
Paso 1.- Realimentación negativa:

$$FT = \frac{G_2}{1 + H_1 \cdot G_2}$$



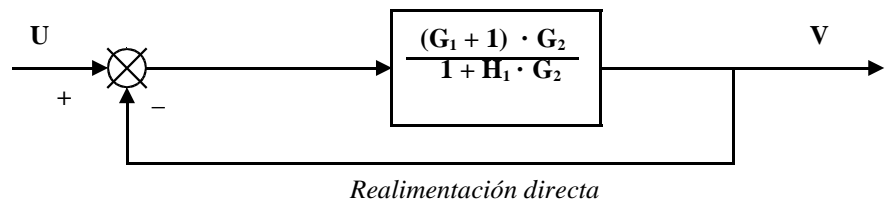
Paso 2.- Bifurcación: $FT = G_1 + 1$

Asociación en serie



Paso 3.- Asociación en serie:

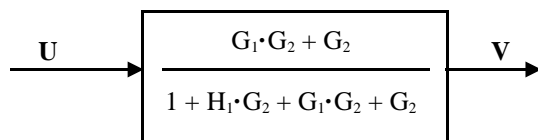
$$FT = FT_1 \cdot FT_2 = \frac{(G_1 + 1) \cdot G_2}{1 + H_1 \cdot G_2}$$



Paso 4.- Realimentación directa (negativa): :

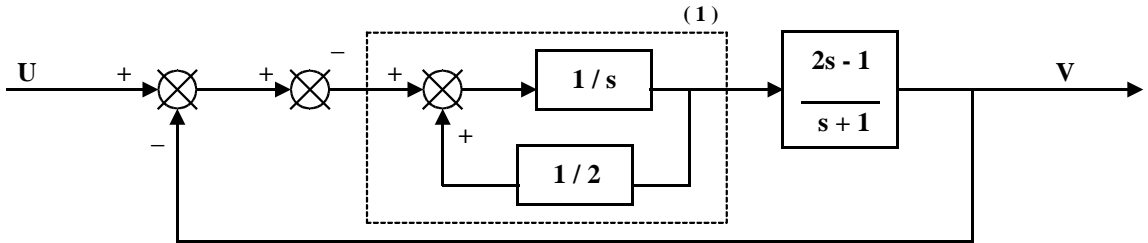
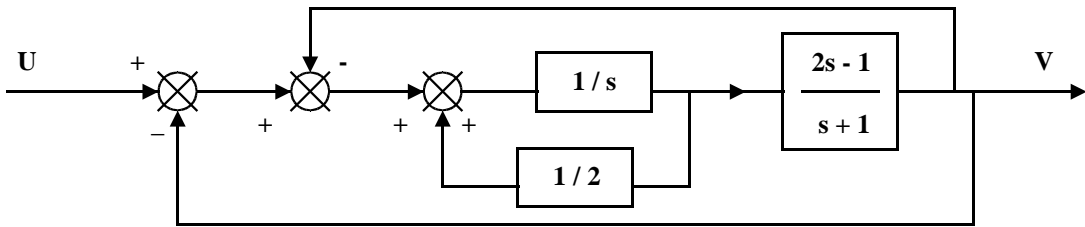
$$FT = \frac{G}{1 + G}$$

$$FT = \frac{\frac{(G_1 + 1) \cdot G_2}{1 + H_1 \cdot G_2}}{1 + \frac{(G_1 + 1) \cdot G_2}{1 + H_1 \cdot G_2}} = \frac{\frac{(G_1 + 1) \cdot G_2}{1 + H_1 \cdot G_2}}{\frac{1 + H_1 \cdot G_2 + (G_1 + 1) \cdot G_2}{1 + H_1 \cdot G_2}} = \frac{(G_1 + 1) \cdot G_2}{1 + H_1 \cdot G_2 + (G_1 + 1) \cdot G_2}$$



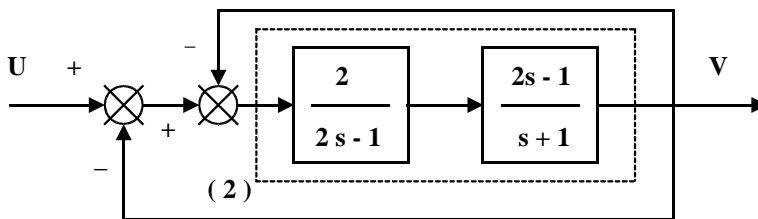
$$F.T. = \frac{V(s)}{U(s)} = \frac{G_1 \cdot G_2 + G_2}{1 + H_1 \cdot G_2 + G_1 \cdot G_2 + G_2}$$

2.- Simplificar el siguiente sistema de control hasta conseguir la función de transferencia.



(1) .- Realimentación positiva:

$$FT_1 = \frac{G}{1 + H \cdot G} = \frac{1/s}{1 - \left[\frac{1}{2} \cdot \frac{1}{s} \right]} = \frac{1/s}{\frac{2s-1}{2s}} = \frac{2s}{2s^2-s} = \frac{2}{2s-1}$$

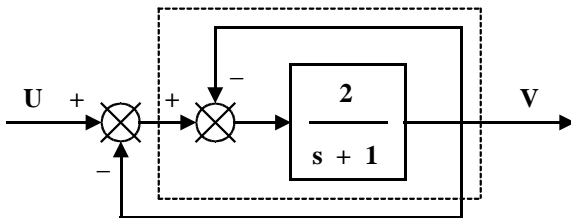


(2) .- Asociación en serie:

$$FT_2 = G_1 \cdot G_2$$

$$FT_2 = \frac{2}{2s-1} \cdot \frac{2s-1}{s+1} = \frac{2}{s+1}$$

(3)

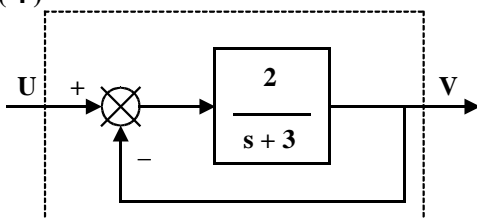


(3) .- Realimentación directa (negativa):

$$FT_3 = \frac{G}{1 + H \cdot G}$$

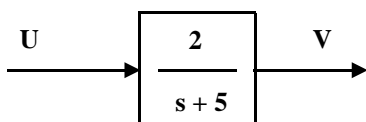
$$FT_3 = \frac{\frac{2}{s+1}}{1 + \left[1 \cdot \frac{2}{s+1} \right]} = \frac{\frac{2}{s+1}}{\frac{s+1+2}{s+1}} = \frac{2}{s+3}$$

(4)



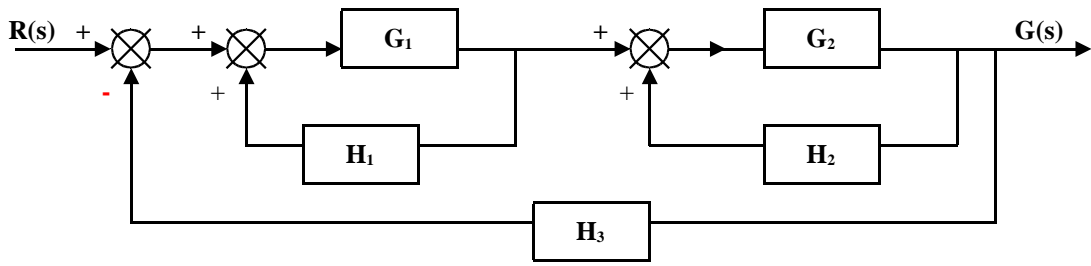
(4) .- Realimentación directa (negativa):

$$FT_4 = \frac{\frac{2}{s+3}}{1 + \left[1 \cdot \frac{2}{s+3} \right]} = \frac{\frac{2}{s+3}}{\frac{s+3+2}{s+3}} = \frac{2}{s+5}$$

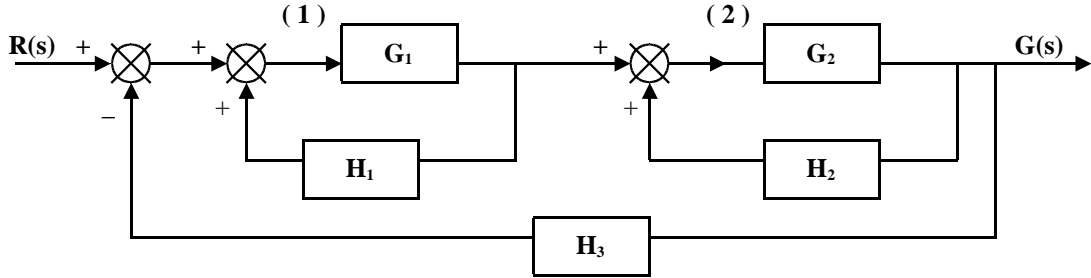


$$G(s) = \frac{V(s)}{U(s)} = \frac{2}{s+5}$$

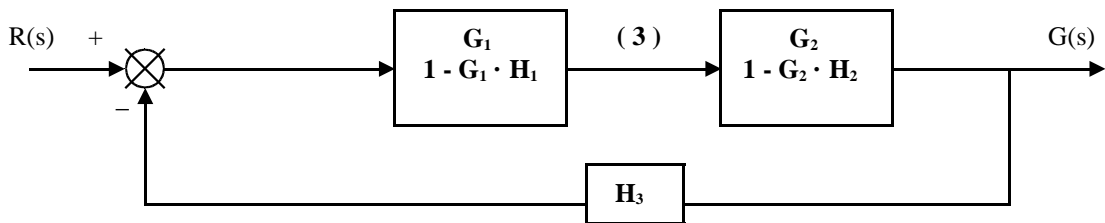
3.- **Halla** la función de transferencia del sistema representado mediante el siguiente diagrama de bloques.



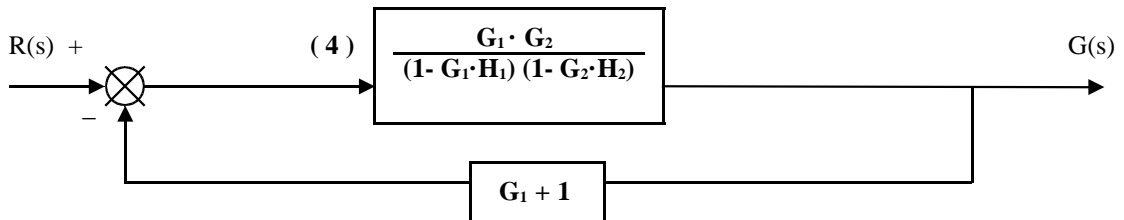
(1) y (2).- *Bucles de realimentación positiva:*



Pasos 1 y 2.- Realimentaciones positivas: $FT = \frac{G_1}{1 - G_1 \cdot H_1}$ y $FT = \frac{G_2}{1 - G_2 \cdot H_2}$

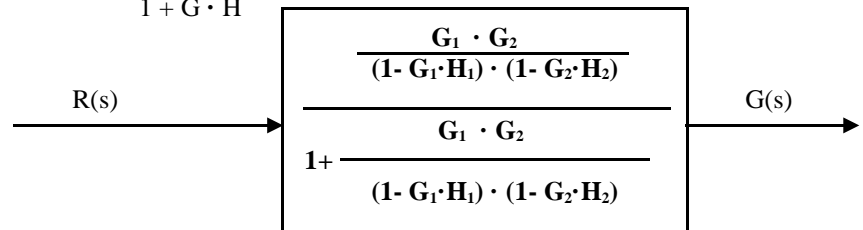


Paso 3.- Asociación SERIE o CASCADA: $FT = FT_1 \times FT_2$



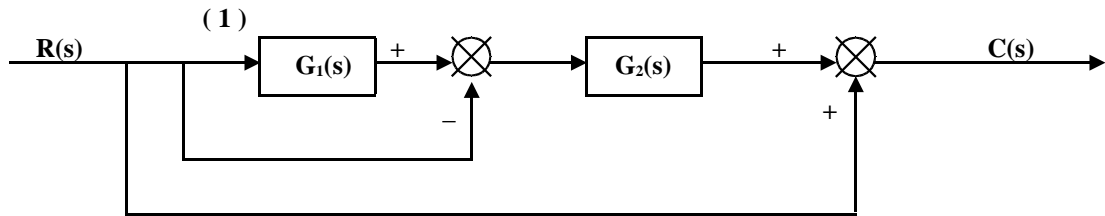
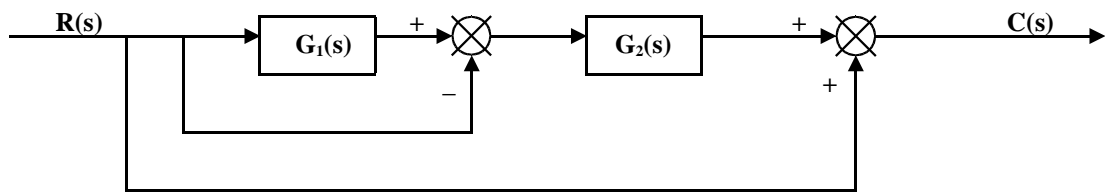
Paso 4.- Realimentación negativa:

$$FT = \frac{G}{1 + G \cdot H}$$

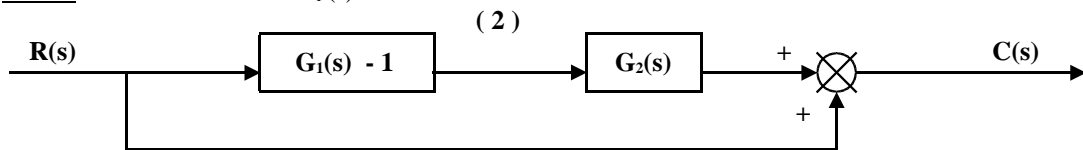


$$\frac{\frac{G_1 \cdot G_2}{(1 - G_1 \cdot H_1) \cdot (1 - G_2 \cdot H_2)}}{1 + \frac{G_1 \cdot G_2}{(1 - G_1 \cdot H_1) \cdot (1 - G_2 \cdot H_2)}} = \frac{G_1 \cdot G_2}{(1 - G_1 \cdot H_1) \cdot (1 - G_2 \cdot H_2) + G_1 \cdot G_2 \cdot H_3} = \frac{G(s)}{R(s)} = \text{F.T.}$$

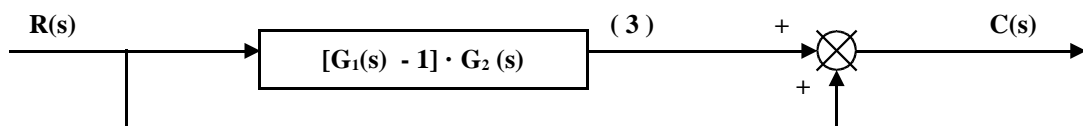
4.- Simplificar el siguiente sistema de control hasta conseguir la función de transferencia.



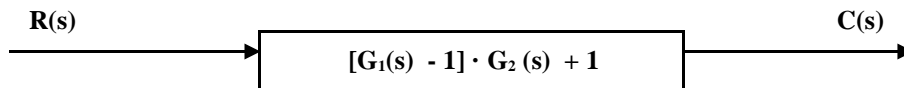
Paso 1: Punto de suma: $G_1(s) - 1$



Paso 2: Asociación SERIE o CASCADA: $(G_1(s) - 1) \cdot G_2(s)$

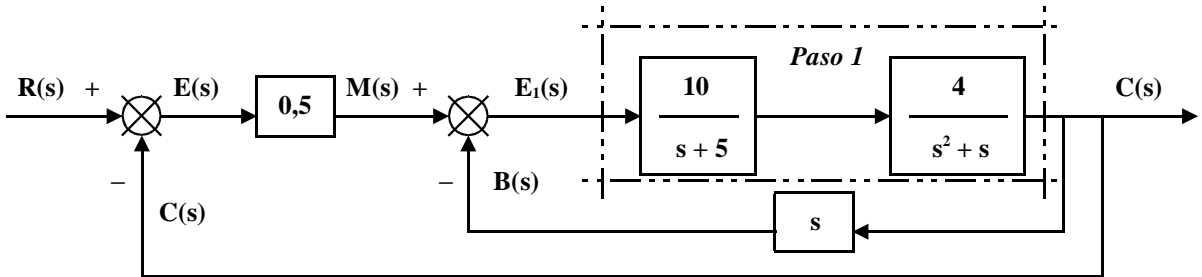
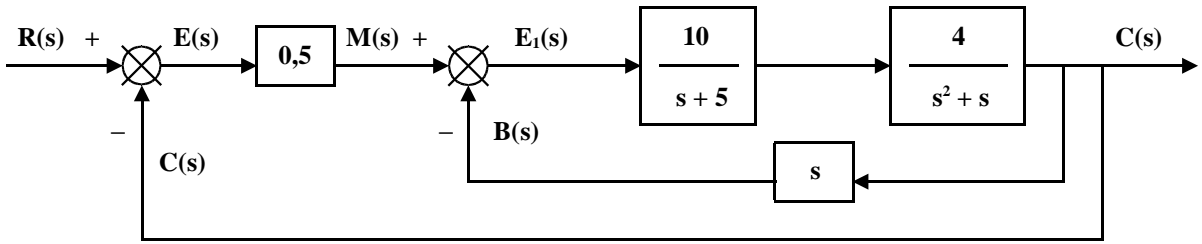


Paso 3: Punto de suma: $[G_1(s) - 1] \cdot G_2(s) + 1$

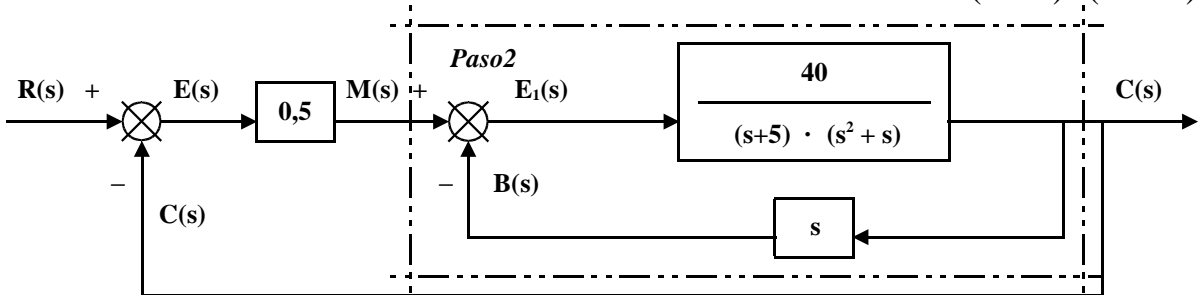


$$\text{F.T.} = \frac{C(s)}{R(s)} = [G_1(s) - 1] \cdot G_2(s) + 1$$

5. Reducir el diagrama de bloques de la figura y obtener la función de transferencia $C(s)/R(s)$.

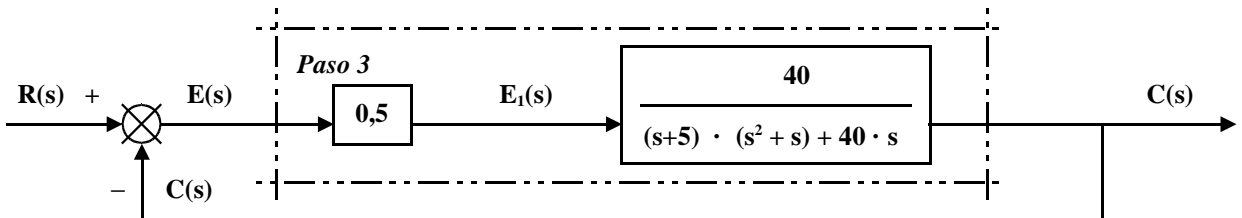


Paso 1: Asociación SERIE $\rightarrow F.T. = G_1 \cdot G_2 = \frac{10}{s+5} \cdot \frac{4}{s^2+s} = \frac{40}{(s+5) \cdot (s^2+s)}$



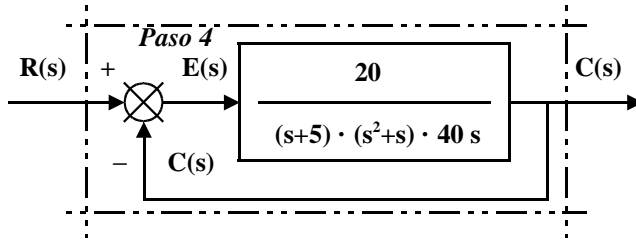
Paso 2: Realimentación Negativa $\rightarrow F.T. = \frac{G}{1+G \cdot H}$

$$F.T. = \frac{\frac{40}{(s+5) \cdot (s^2+s)}}{1 + \frac{40 \cdot s}{(s+5) \cdot (s^2+s)}} = \frac{\frac{40}{(s+5) \cdot (s^2+s)}}{\frac{(s+5) \cdot (s^2+s) + 40 \cdot s}{(s+5) \cdot (s^2+s)}} = \frac{40}{(s+5) \cdot (s^2+s) + 40 \cdot s}$$



Paso 3: Asociación SERIE $\rightarrow F.T. = G_1 \cdot G_2$

$$F.T. = 0,5 \cdot \frac{40}{(s+5) \cdot (s^2+s) + 40 \cdot s} = \frac{20}{(s+5) \cdot (s^2+s) + 40 \cdot s}$$

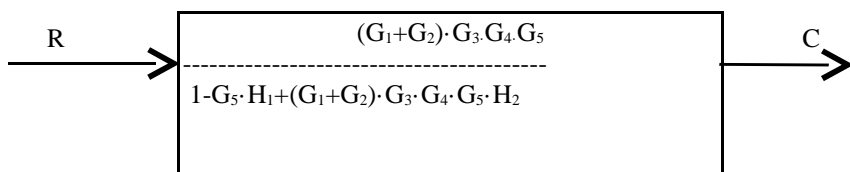
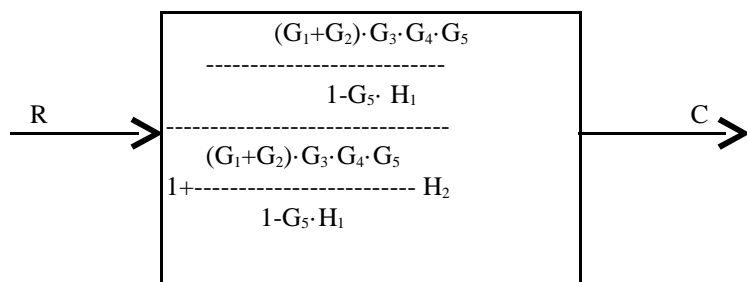
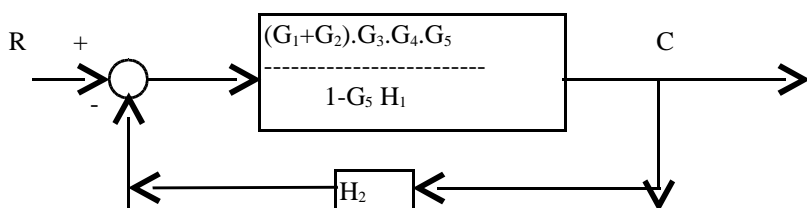
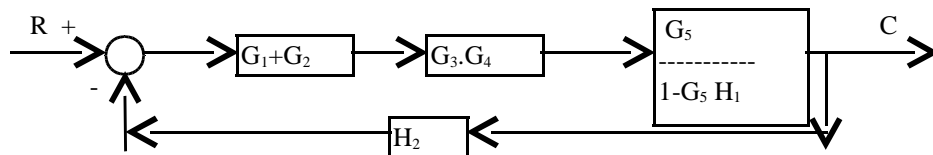
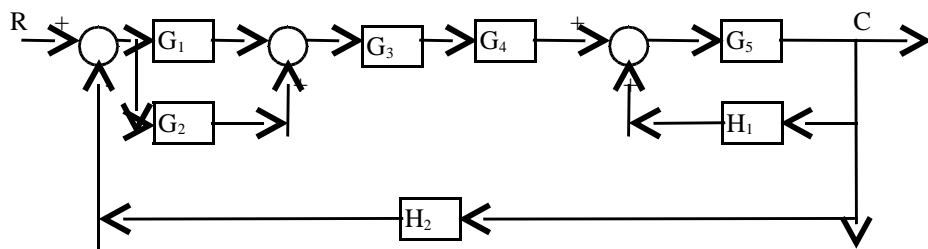


Paso 4: Realimentación

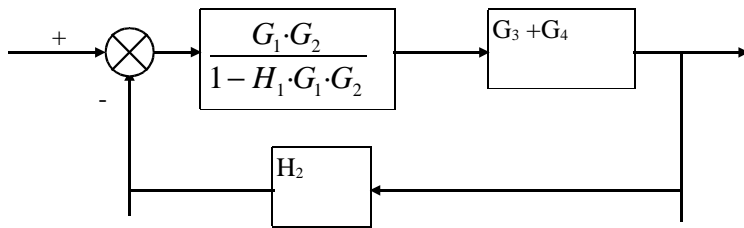
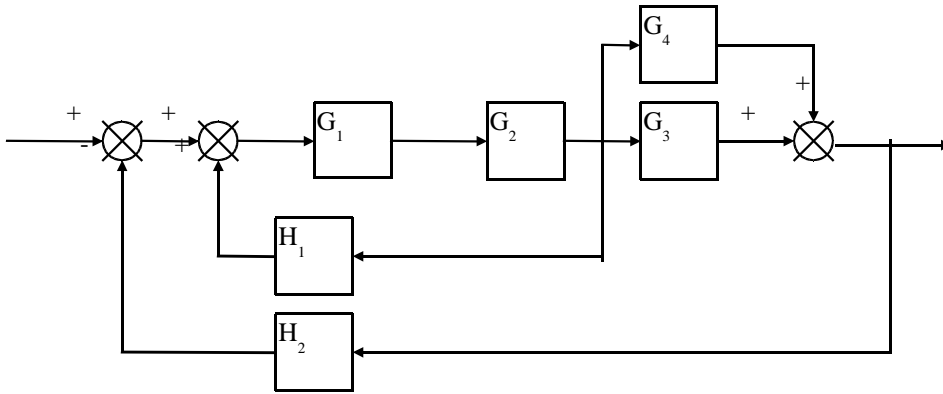
DIRECTA Negativa $\rightarrow F.T. = \frac{G}{1+G}$

$$F.T. = \frac{\frac{20}{(s+5) \cdot (s^2+s) + 40s}}{1 + \frac{20}{(s+5) \cdot (s^2+s) + 40s}} = \frac{\frac{20}{(s+5) \cdot (s^2+s) + 40s}}{\frac{(s+5) \cdot (s^2+s) + 40s + 20}{(s+5) \cdot (s^2+s) + 40s}} = \frac{20}{s \cdot (s^2 + 6s + 45) + 20}$$

6.- Simplificar el siguiente diagrama de bloque

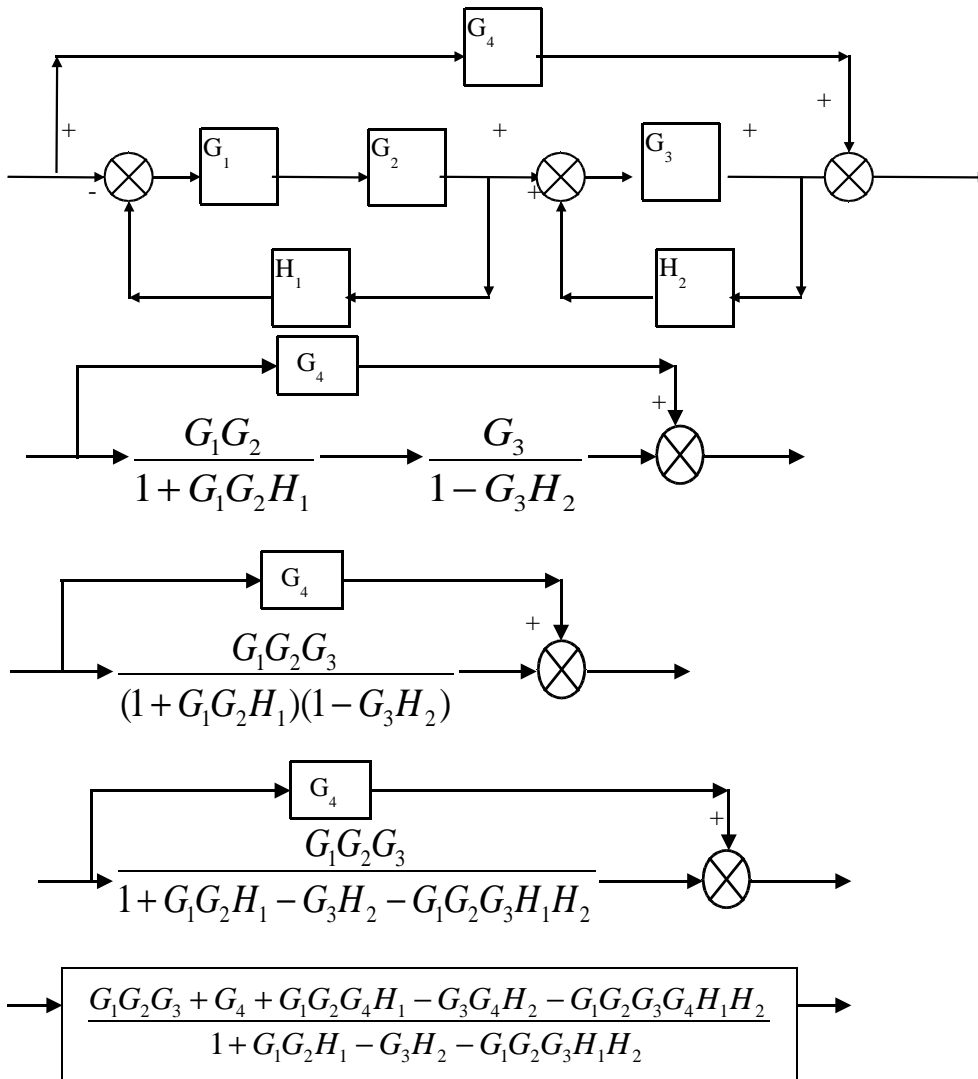


7.- Simplifica el siguiente diagrama de bloque de la figura, representando el diagrama simplificado de la función de transferencia total del sistema



$$\frac{\frac{G_1 \cdot G_2 \cdot (G_3 + G_4)}{1 - H_1 \cdot G_1 \cdot G_2}}{1 + H_2 \cdot \frac{G_1 \cdot G_2 \cdot (G_3 + G_4)}{1 - H_1 \cdot G_1 \cdot G_2}} = \frac{G_1 \cdot G_2 \cdot (G_3 + G_4)}{1 - H_1 \cdot G_1 \cdot G_2 + H_2 \cdot G_1 \cdot G_2 \cdot (G_3 + G_4)}$$

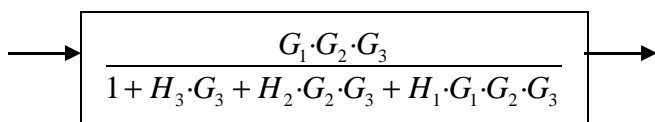
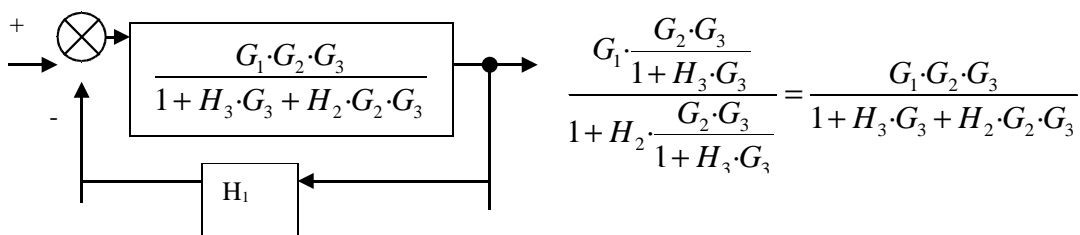
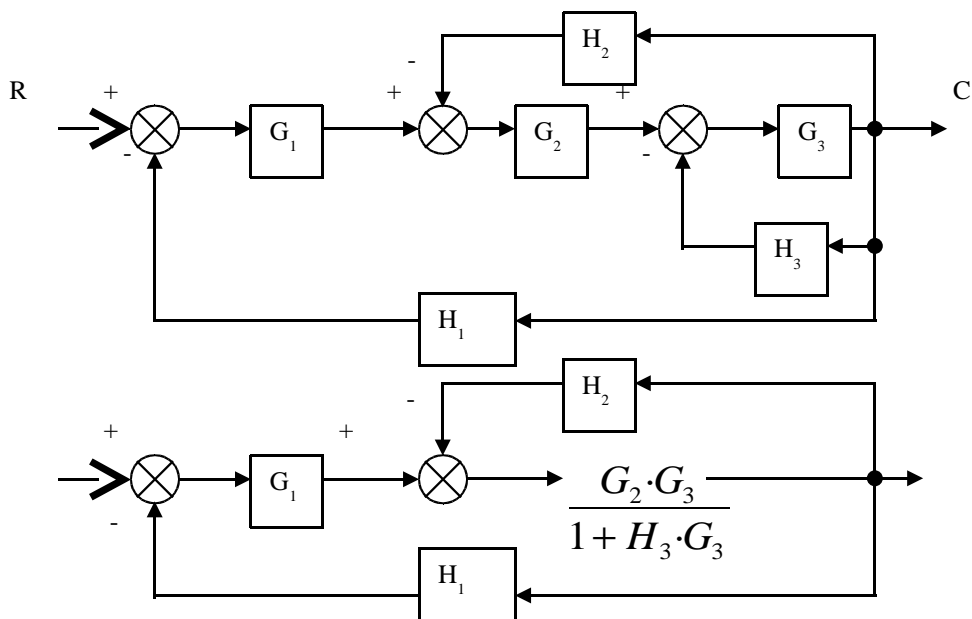
8.- Simplifica el siguiente diagrama de bloque de la figura, representando el diagrama simplificado de la función de transferencia total del sistema



9.- Dado el diagrama de bloque de la figura.

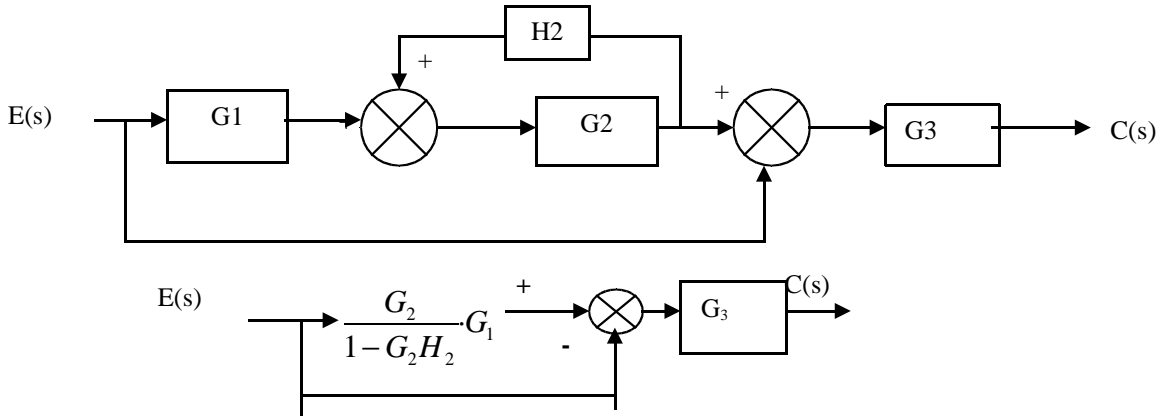
Se pide:

- Simplificar el diagrama
- Hallar al función de transferencia C/R



$$\frac{\frac{G_1 \cdot G_2 \cdot G_3}{1 + H_3 \cdot G_3 + H_2 \cdot G_2 \cdot G_3}}{1 + H_1 \cdot \frac{G_1 \cdot G_2 \cdot G_3}{1 + H_3 \cdot G_3 + H_2 \cdot G_2 \cdot G_3}} = \frac{G_1 \cdot G_2 \cdot G_3}{1 + H_3 \cdot G_3 + H_2 \cdot G_2 \cdot G_3 + H_1 \cdot G_1 \cdot G_2 \cdot G_3}$$

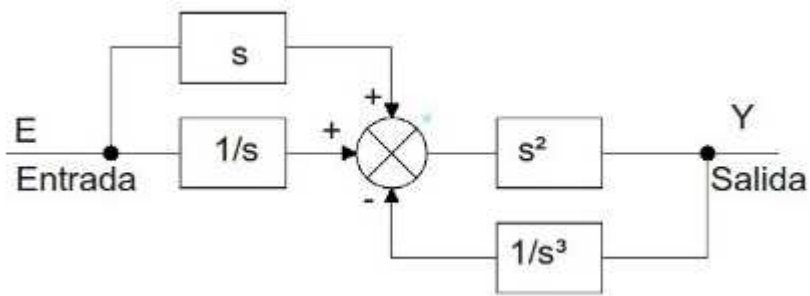
10.- Simplifica el siguiente sistema de control hasta conseguir la función de transferencia del sistema.



$$E(s) \longrightarrow \left(\frac{G_1 \cdot G_2}{1 - G_2 H_2} - 1 \right) \cdot G_3 \longrightarrow C(s)$$

$$E(s) \longrightarrow \frac{G_1 \cdot G_2 - 1 + G_2 \cdot H_2}{1 - G_2 \cdot H_2} \cdot G_3 = \frac{G_1 \cdot G_2 \cdot G_3 - G_3 + G_2 \cdot G_3 \cdot H_2}{1 - G_2 \cdot H_2} \longrightarrow C(s)$$

11.- Calcular y simplificar la función de transferencia del siguiente circuito.



Solución.

$$Y = s^2 \cdot \left(E \cdot s + \frac{E}{s} - \frac{Y}{s^3} \right)$$

$$Y = E \cdot s^3 + E \cdot s - \frac{Y}{s}$$

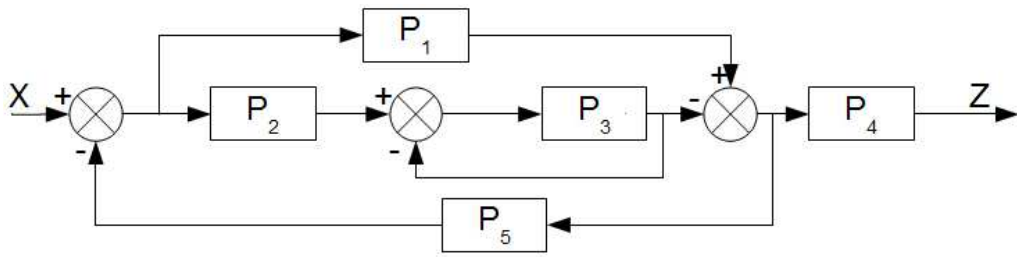
$$Y + \frac{Y}{s} = E \cdot s^3 + E \cdot s$$

$$Y \cdot \left(1 + \frac{1}{s} \right) = E \cdot (s^3 + s)$$

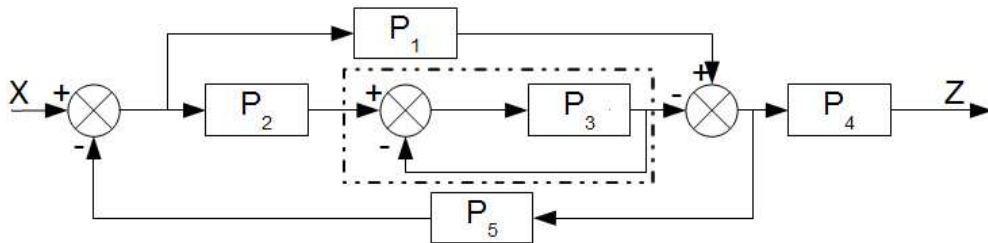
La función de transferencia nos queda:

$$\frac{Y}{E} = \frac{(s^3 + s)}{\left(1 + \frac{1}{s} \right)} = \frac{s^2 \cdot (s^2 + 1)}{(s + 1)}$$

12.- Dado el diagrama de bloques de la figura obtenga la función de transferencia Z/Y.

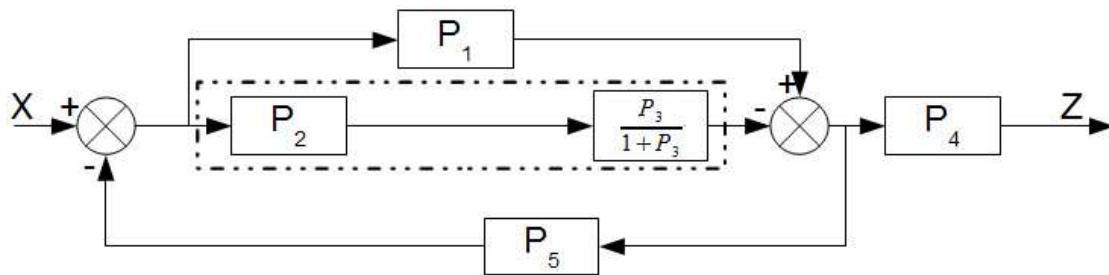


1. Bucle de realimentación negativa:



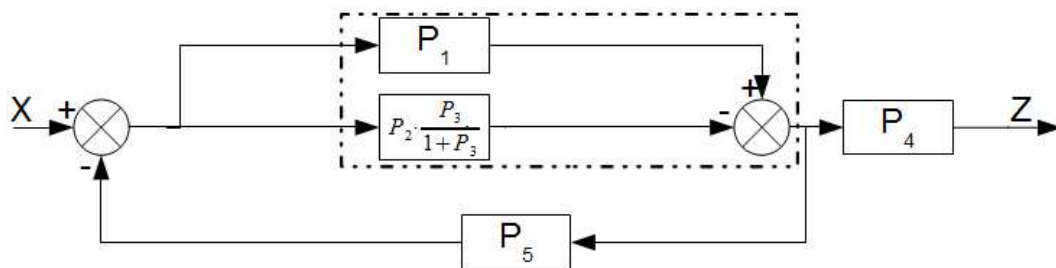
$$FT_1 = \frac{X_1}{1 + X_1 X_2} = \frac{P_3}{1 + P_3}$$

2. Bloques en serie:



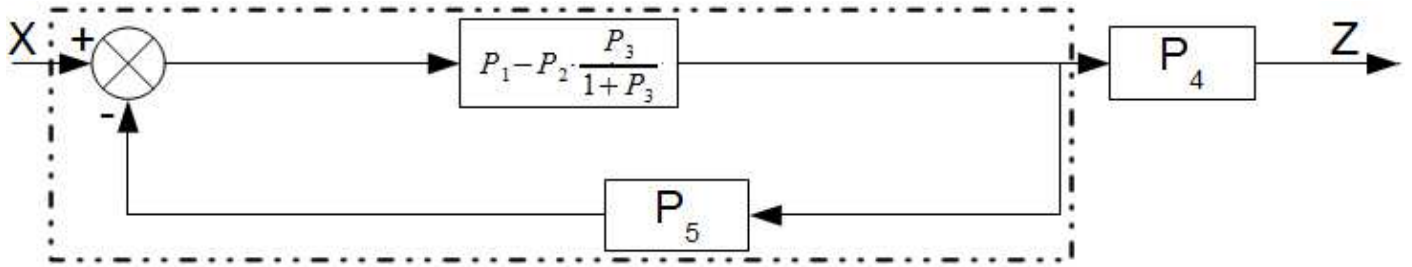
$$FT_2 = X_1 \cdot X_2 = P_2 \cdot \frac{P_3}{1 + P_3}$$

3. Bloques en paralelo:



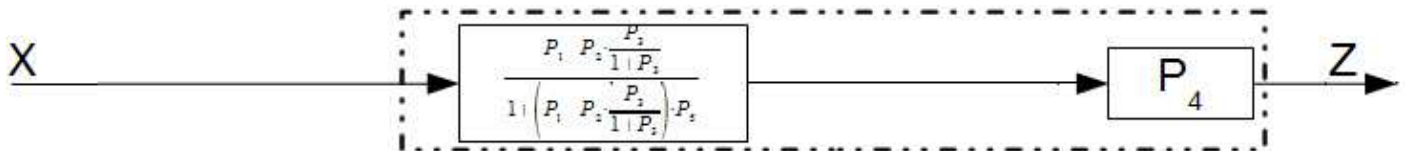
$$FT_3 = X_1 - X_2 = P_1 - P_2 \cdot \frac{P_3}{1 + P_3}$$

4. Bucle de realimentación negativa:



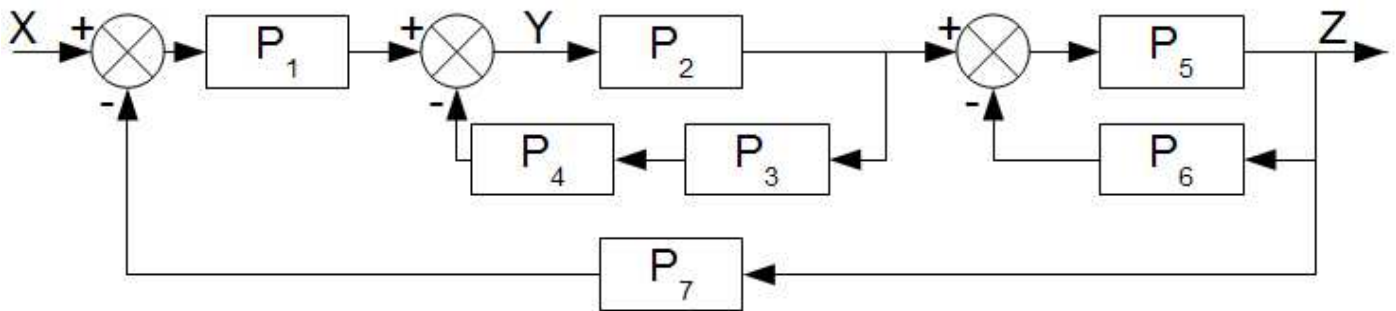
$$FT_4 = \frac{X_1}{1 + X_1 X_2} = \frac{P_1 - P_2 \cdot \frac{P_3}{1 + P_3}}{1 + \left(P_1 - P_2 \cdot \frac{P_3}{1 + P_3} \right) \cdot P_5}$$

5. Bloques en serie:



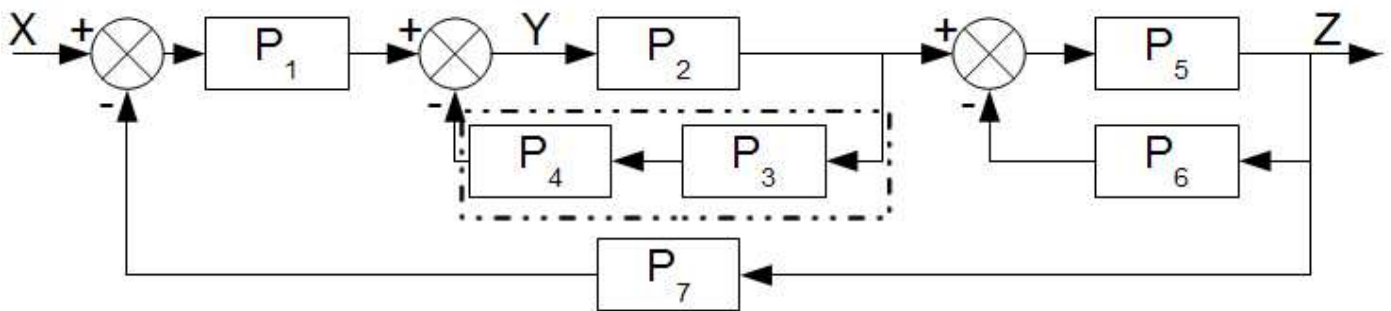
$$FT = X_1 \cdot X_2 = \frac{P_1 - P_2 \cdot \frac{P_3}{1 + P_3}}{1 + \left(P_1 - P_2 \cdot \frac{P_3}{1 + P_3} \right) \cdot P_5} \cdot P_4$$

13.- Dado el diagrama de bloques de la figura:
 a) Obtenga la función de transferencia $Z=f(X)$.



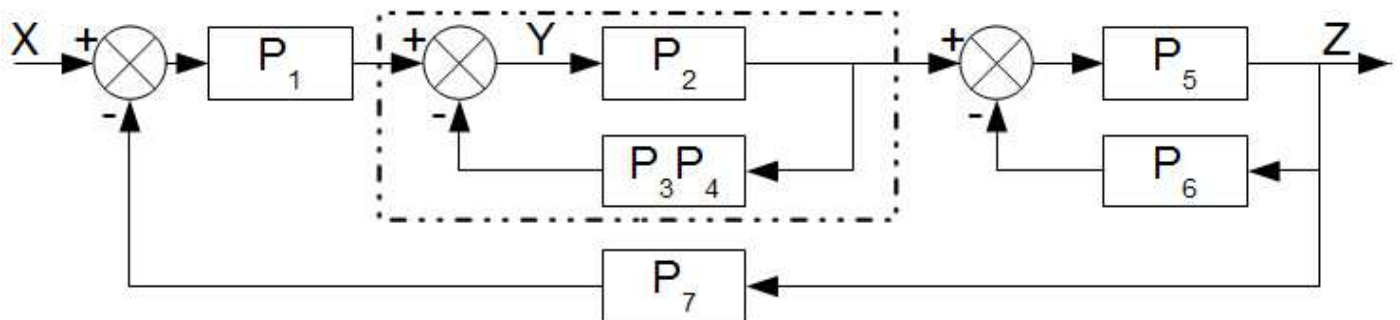
a)
 Se quiere calcular la función de transferencia Z/X .

1. Bloques en serie:



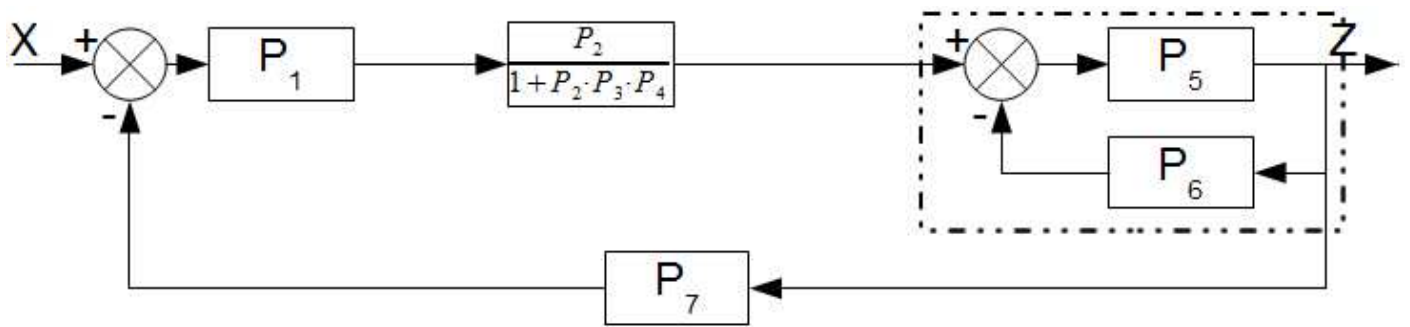
$$FT_1 = X_1 \cdot X_2 = P_3 \cdot P_4$$

2. Bucle de realimentación negativa:



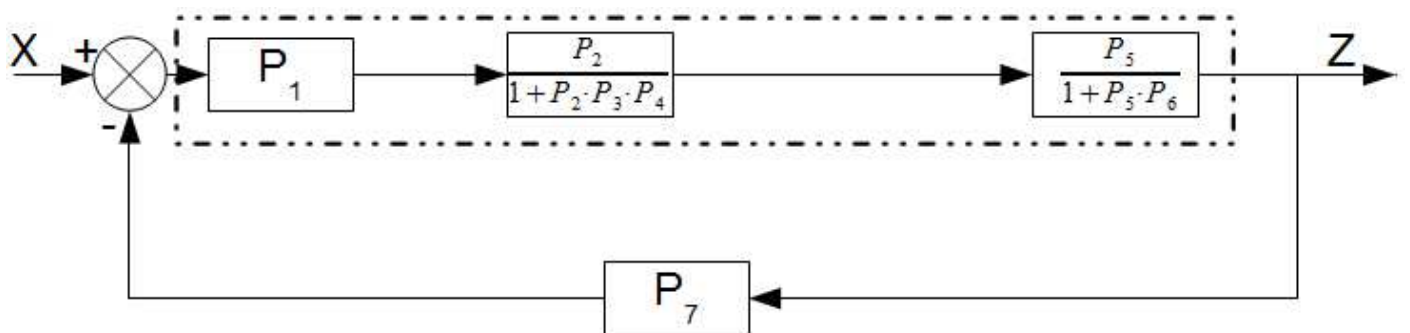
$$FT_2 = \frac{X_1}{1 + X_1 X_2} = \frac{P_2}{1 + P_2 P_3 P_4}$$

3. Bucle de realimentación negativa:



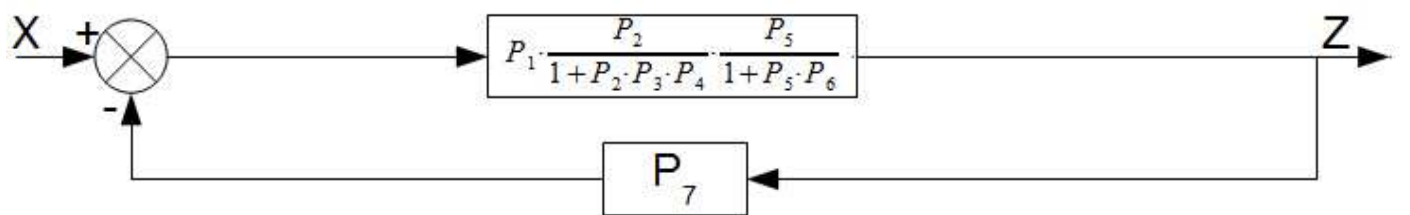
$$FT_3 = \frac{X_1}{1 + X_1 X_2} = \frac{P_5}{1 + P_5 P_6}$$

4. Bloques en serie:



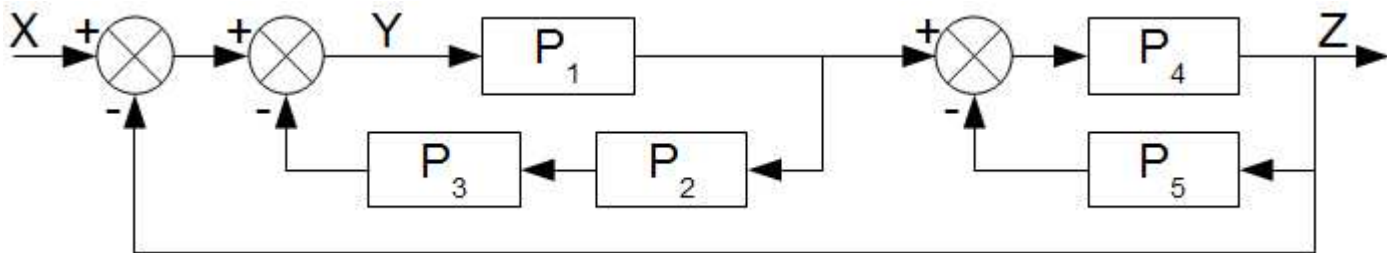
$$FT_4 = X_1 \cdot X_2 \cdot X_3 = P_1 \cdot \frac{P_2}{1 + P_2 P_3 P_4} \cdot \frac{P_5}{1 + P_5 P_6}$$

5. Bucle de realimentación negativa:



$$FT = \frac{X_1}{1 + X_1 X_2} = \frac{P_1 \cdot \frac{P_2}{1 + P_2 P_3 P_4} \cdot \frac{P_5}{1 + P_5 P_6}}{1 + P_1 \cdot \frac{P_2}{1 + P_2 P_3 P_4} \cdot \frac{P_5}{1 + P_5 P_6} \cdot P_7}$$

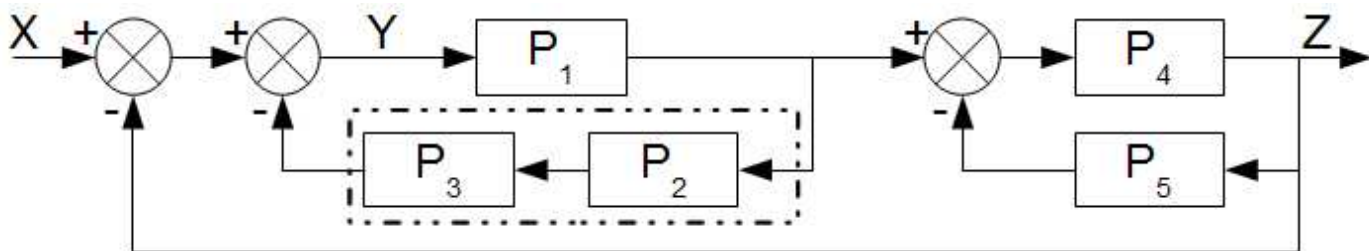
14.- Dado el diagrama de bloques de la figura:
 a) Obtenga la función de transferencia $Z=f(X)$.



SOLUCIÓN

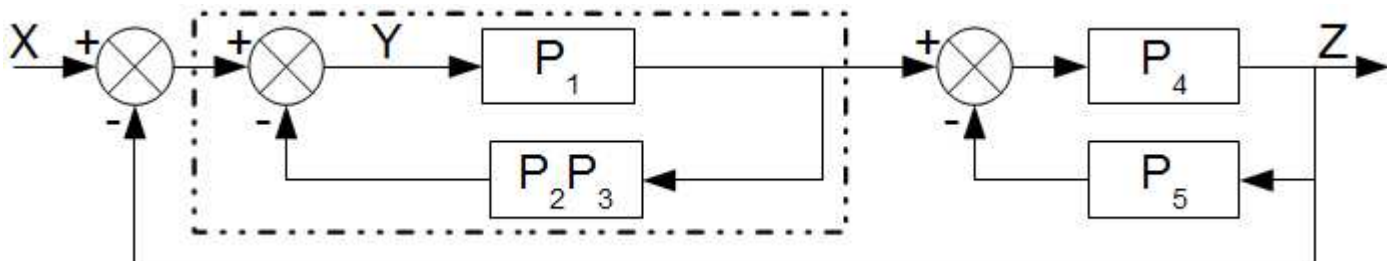
a) Se quiere calcular la función de transferencia Z/X .

1. Bloques en serie:



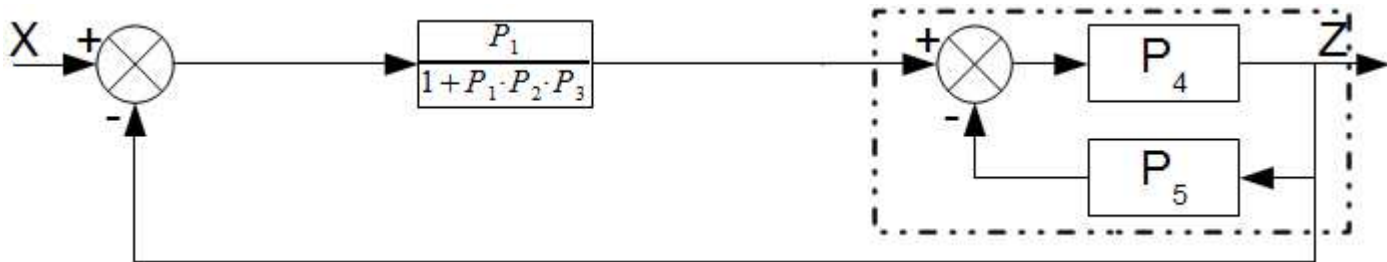
$$FT_1 = X_1 \cdot X_2 = P_2 \cdot P_3$$

2. Bucle de realimentación negativa:



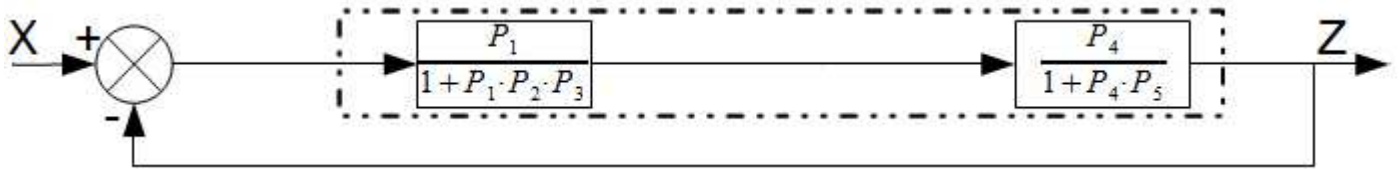
$$FT_2 = \frac{X_1}{1 + X_1 X_2} = \frac{P_1}{1 + P_1 P_2 P_3}$$

3. Bucle de realimentación negativa:



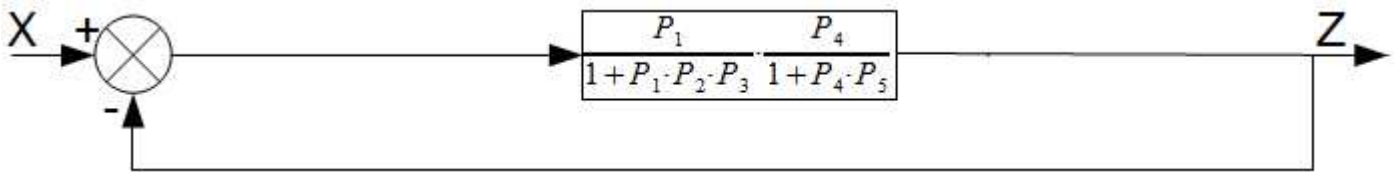
$$FT_3 = \frac{X_1}{1 + X_1 X_2} = \frac{P_4}{1 + P_4 P_5}$$

4. Bloques en serie:



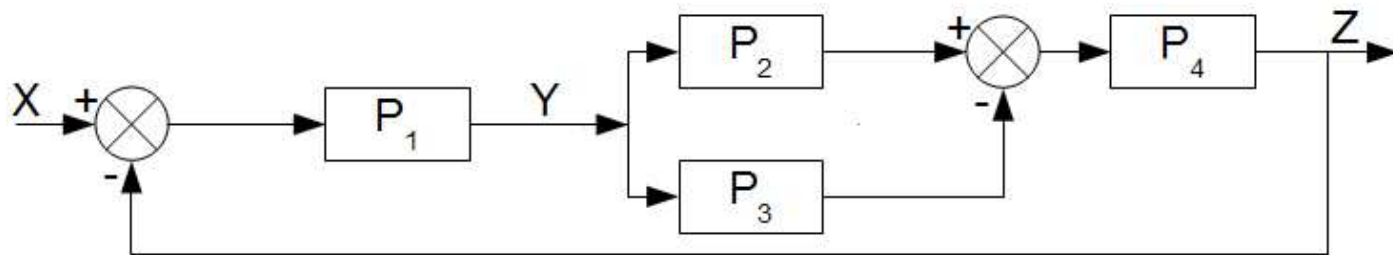
$$FT_4 = X_1 \cdot X_2 = \frac{P_1}{1 + P_1 P_2 P_3} \cdot \frac{P_4}{1 + P_4 P_5}$$

5. Bucle de realimentación negativa:



$$FT = \frac{X_1}{1 + X_1 X_2} = \frac{\frac{P_1}{1 + P_1 P_2 P_3} \cdot \frac{P_4}{1 + P_4 P_5}}{1 + \frac{P_1}{1 + P_1 P_2 P_3} \cdot \frac{P_4}{1 + P_4 P_5} \cdot 1}$$

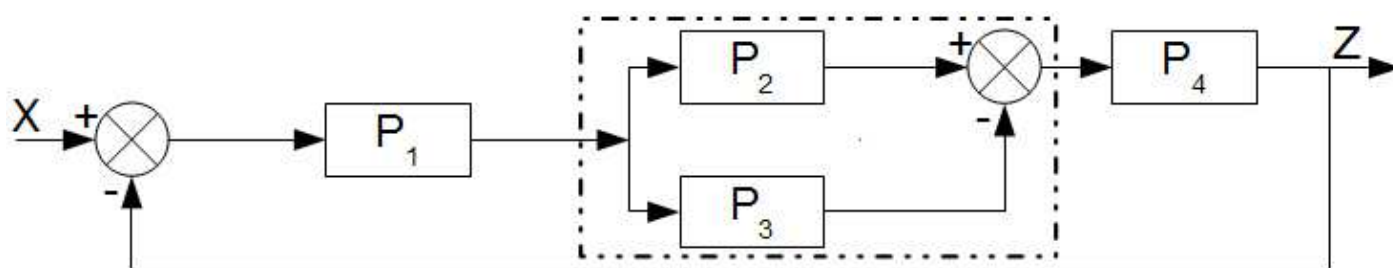
15.- Dado el diagrama de bloques de la figura:
 a) Obtenga la función de transferencia $Z=f(X)$.



SOLUCIÓN

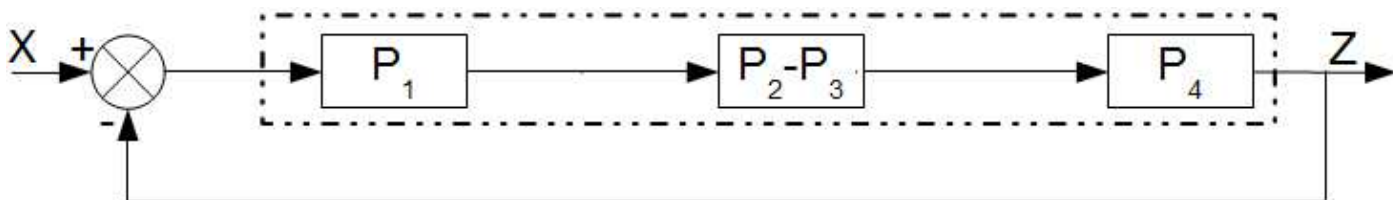
a) Se quiere calcular la función de transferencia Z/X .

1. Bloques en paralelo:



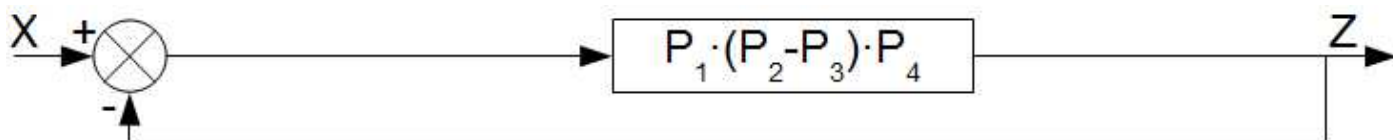
$$FT_1 = X_1 - X_2 = P_2 - P_3$$

2. Bloques en serie:



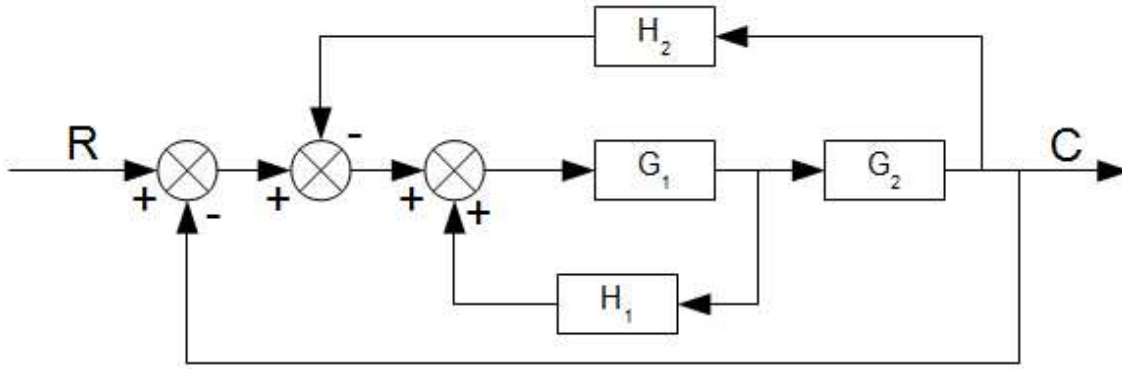
$$FT_2 = X_1 \cdot X_2 = P_1 \cdot (P_2 - P_3) \cdot P_4$$

3. Bucle de realimentación negativa:



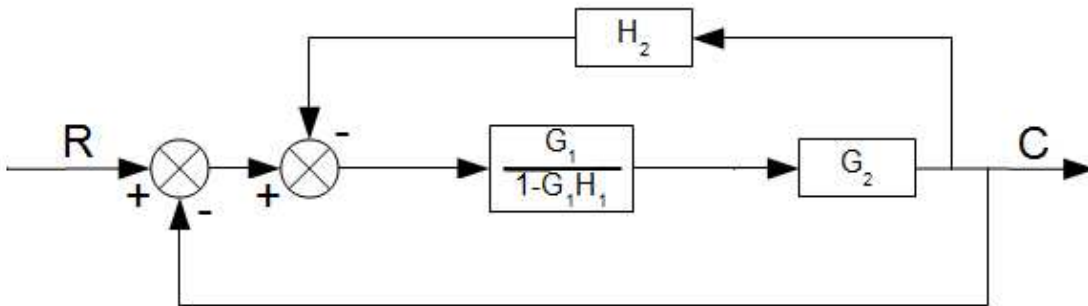
$$FT = \frac{X_1}{1 + X_1 X_2} = \frac{P_1 \cdot (P_2 - P_3) \cdot P_4}{1 + P_1 \cdot (P_2 - P_3) \cdot P_4}$$

16.- Simplifica el siguiente sistema de control hasta conseguir la función de transferencia del sistema.

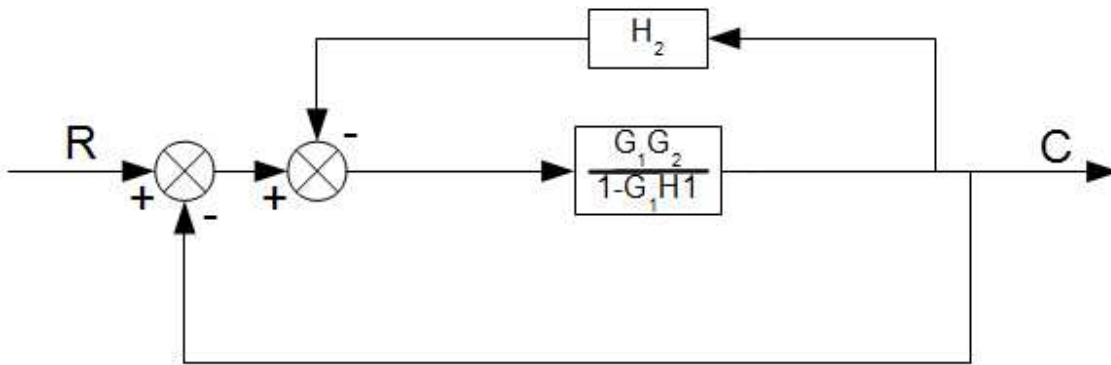


SOLUCIÓN

1º. Primer paso, realizamos el bucle cerrado G_1H_1 .

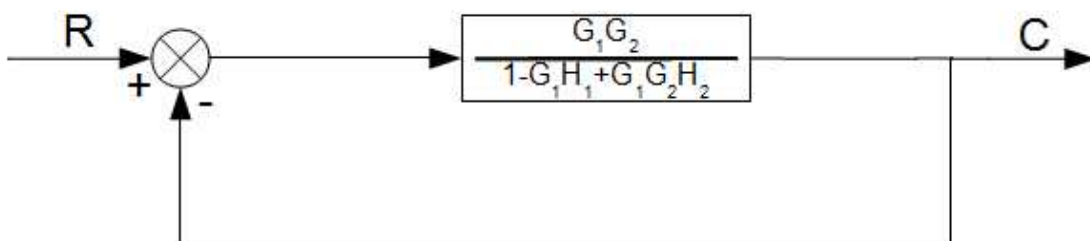


2º. Unimos la agrupación de $\frac{G_1}{1-G_1H_1}$ en serie con G_2 .



3º. Simplificamos el bloque cerrado H_2 y $\frac{G_1G_2}{1-G_1H_1}$

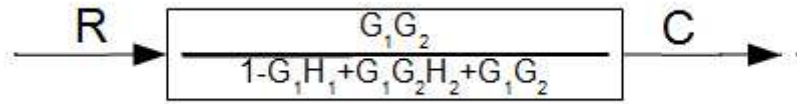
$$\frac{\frac{G_1G_2}{1-G_1H_1}}{1 + \frac{G_1G_2H_2}{1-G_1H_1}} = \frac{\frac{G_1G_2}{1-G_1H_1}}{\frac{1-G_1H_1 + G_1G_2H_2}{1-G_1H_1}} = \frac{G_1G_2}{1-G_1H_1 + G_1G_2H_2}$$



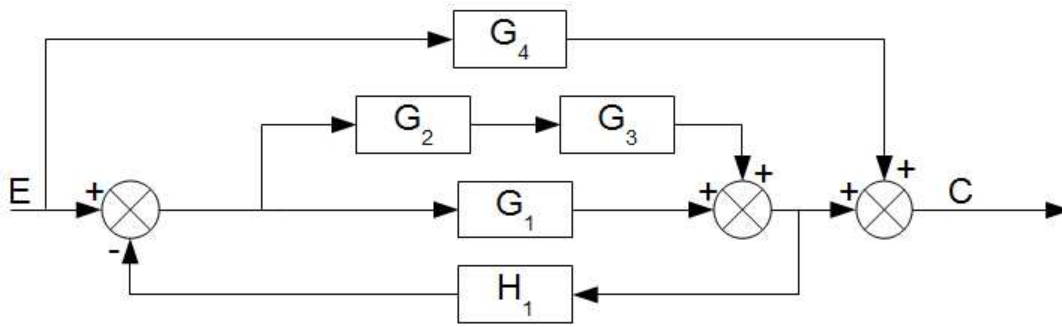
4º Simplificamos el bucle cerrado.

$$\frac{\frac{G_1 G_2}{1 - G_1 H_1 + G_1 G_2 H_2}}{1 + \frac{G_1 G_2}{1 - G_1 H_1 + G_1 G_2 H_2}} = \frac{\frac{G_1 G_2}{1 - G_1 H_1 + G_1 G_2 H_2}}{\frac{1 - G_1 H_1 + G_1 G_2 H_2 + G_1 G_2}{1 - G_1 H_1 + G_1 G_2 H_2}} = \frac{G_1 G_2}{1 - G_1 H_1 + G_1 G_2 H_2 + G_1 G_2}$$

5º La función de transferencia total será:

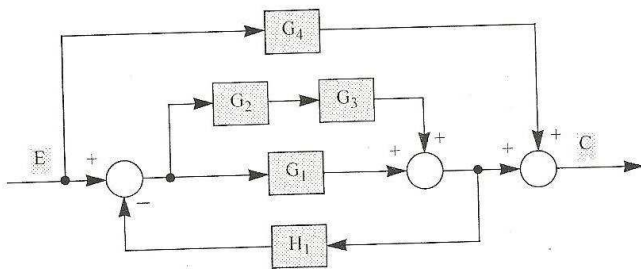


17.- Determinar la función de transferencia total del sistema caracterizado por el diagrama de bloques.

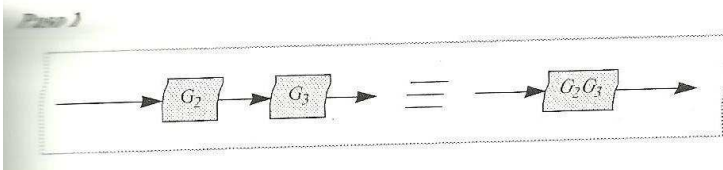


PROBLEMA 1

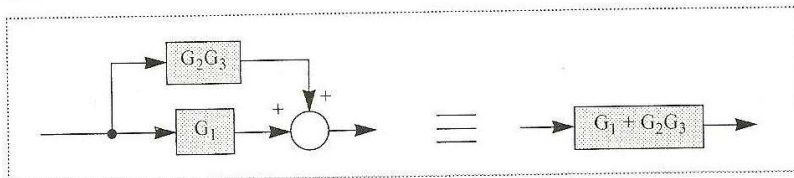
Determinar la función de transferencia total del sistema caracterizado por el diagrama de bloques inferior.



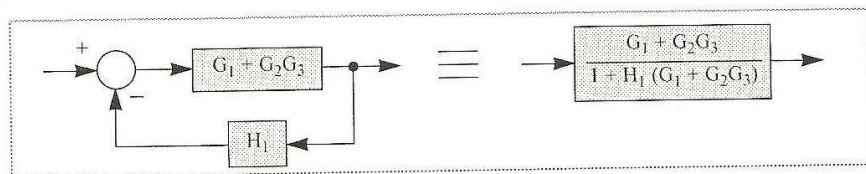
SOLUCION:



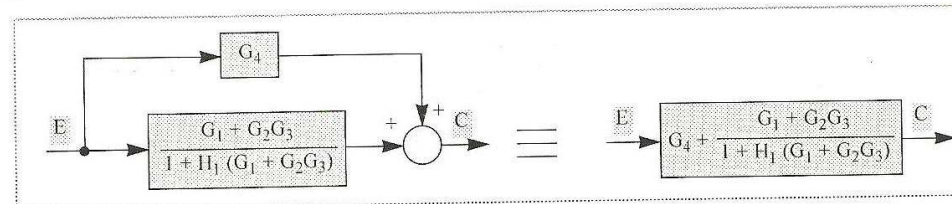
Paso 2



Paso 3



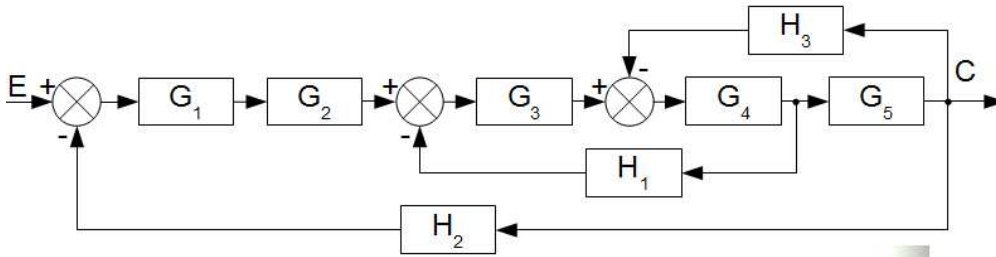
Paso 1



Operando se obtiene el siguiente bloque, que es la función de transferencia pedida.

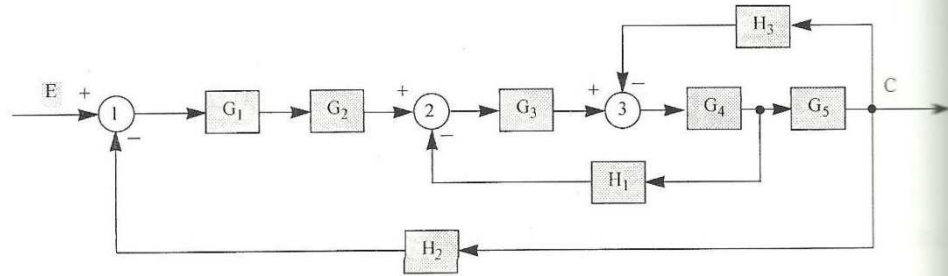
$$E \rightarrow \frac{G_4 [1 + H_1 (G_1 + G_2 G_3)] + G_1 + G_2 G_3}{1 + H_1 (G_1 + G_2 G_3)} C$$

18.- Determinar la función de transferencia total del sistema caracterizado por el diagrama de bloques.



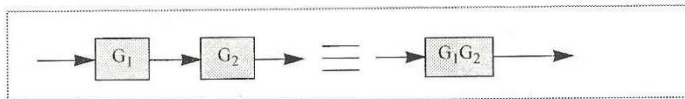
PROBLEMA 2

Determinar la función de transferencia total del sistema caracterizado por el diagrama de bloques inferior.

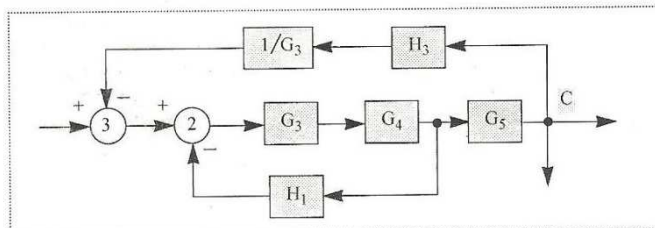


SOLUCION:

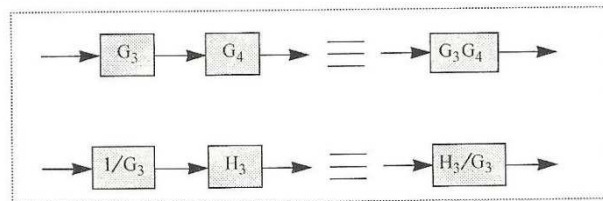
Paso 1



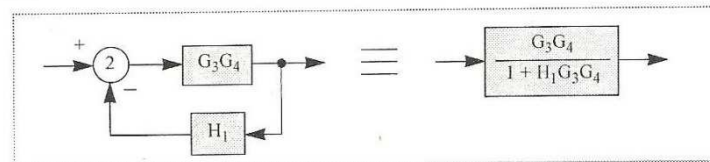
Paso 4 - se transpone el sumador 3 hacia la izquierda del bloque G_3 y del sumador 2.



Paso 1



Paso 3



Paso 1

