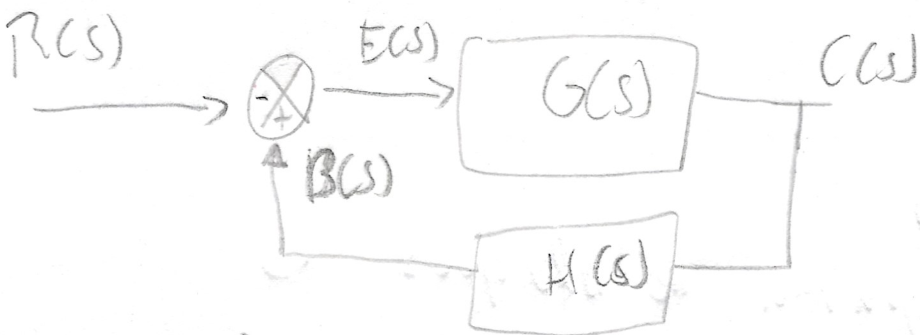
Sistema de lazo cerrado

Para el caso (-,+)

Tenemos que el diagrama de bloques es



Para G(s):

$$G(s) = \frac{C(s)}{E(s)} \iff \boxed{E(s)\,G(s) = C(s)} \quad \ldots\ldots (1)$$

Para H(s):

$$H(s) = \frac{B(s)}{C(s)} \iff \boxed{C(s)\cdot H(s) = B(s)} \quad \ldots\ldots (2)$$

Para E(s):

$$\boxed{E(s) = B(s) - R(s)} \quad \ldots\ldots (3)$$

sustituyendo (2) en la ecuación (3)

$$E(s) = C(s)H(s) - R(s) \quad \ldots\ldots (4)$$

sustituyendo (4) en la ecuacion (1)

$$[C(s)H(s) - R(s)]G(s) = C(s)$$

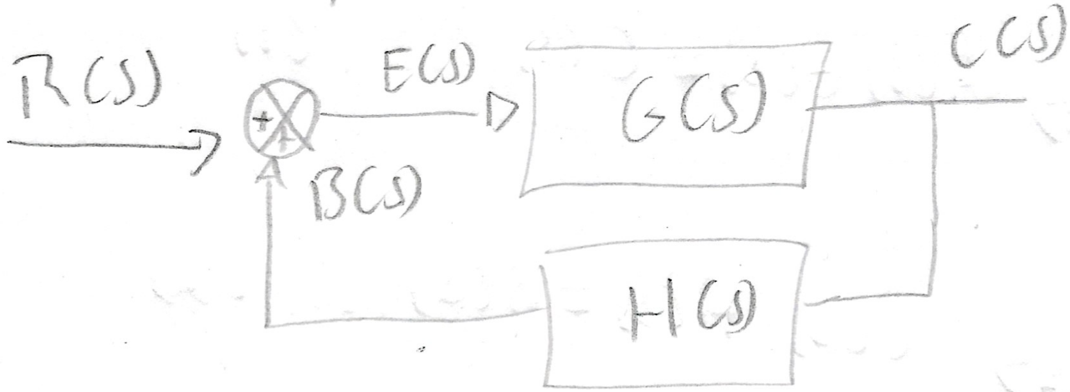
$$G(s)\cdot C(s)\cdot H(s) - R(s)G(s) = C(s)$$

$$G(s)\cdot C(s)H(s) - C(s) = R(s)G(s)$$

$$C(s)[G(s)H(s) - 1] = R(s)G(s)$$

$$\frac{G(s)}{R(s)} = \frac{G(s)}{G(s)H(s) - 1}$$ F.T de lazo cerrado para $(-,+)$

Para el caso $(+,+)$
Tenemos que el diagrama de bloques es



Para $G(s)$:

$$G(s) = \frac{C(s)}{E(s)} \Leftrightarrow E(s)G(s) = C(s) \quad \ldots (1)$$

Para $H(s)$

$$H(s) = \frac{B(s)}{C(s)} \Leftrightarrow C(s)H(s) = B(s) \quad \ldots (2)$$

Para $E(s)$

$$E(s) = R(s) + B(s) \quad \ldots (3)$$

Sustituyendo (2) en la ecuación (3)

$$E(s) = R(s) + C(s)H(s) \quad \ldots (4)$$

Sustituyendo (4) en la ecuacion (1)

$$[R(s) + G(s)H(s)]\cdot G(s) = C(s)$$

$$R(s)G(s) + C(s)H(s)G(s) = C(s)$$

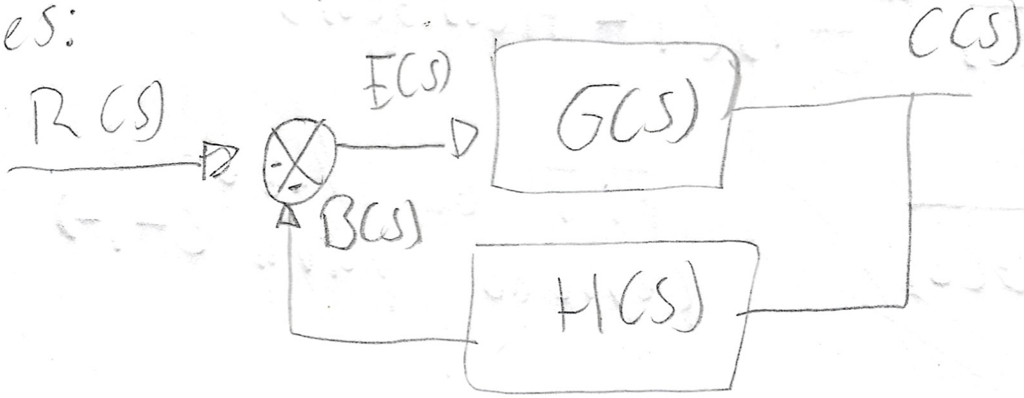
$$C(s)H(s)G(s) - C(s) = -R(s)G(s)$$

$$C(s)[H(s)G(s) - 1] = -R(s)G(s)$$

$$\frac{C(s)}{R(s)} = \frac{-G(s)}{H(s)G(s)-1} = \frac{-G(s)}{(-1)(1-H(s)G(s))} = \boxed{\frac{G(s)}{1-H(s)G(s)}}$$

F.T de lazo cerrado para (+,+)

Para el caso (−,−)
Tenemos que el diagrama de bloque es:



Para G(s)

$$G(s) = \frac{C(s)}{E(s)} \iff E(s)\cdot G(s) = C(s) \ldots (1)$$

Para H(s)

$$H(s) = \frac{B(s)}{C(s)} \iff C(s)H(s) = B(s) \ldots (2)$$

Para $E(s)$

$$E(s) = R(s) + B(s) \ldots\ldots (3)$$

Sustituyendo (2) en la ecuacion (3)

$$E(s) = R(s) + C(s) \cdot H(s) \ldots\ldots (4)$$

Sustituyendo (4) en la ecuacion (1)

$$[R(s) + C(s) H(s)] \cdot G(s) = C(s)$$

$$R(s) G(s) + C(s) H(s) G(s) = C(s)$$

$$-C(s) + C(s) H(s) G(s) = -R(s) G(s)$$

$$C(s)[-1 + H(s) G(s)] = -R(s) G(s)$$

$$\frac{C(s)}{R(s)} = \frac{-G(s)}{-1 + H(s) G(s)} = \frac{-G(s)}{(-1)(1 - H(s) G(s))}$$

$$\frac{C(s)}{R(s)} = \frac{G(s)}{1 - H(s) G(s)}$$

F.T de lazo cerrado para (−,−)