

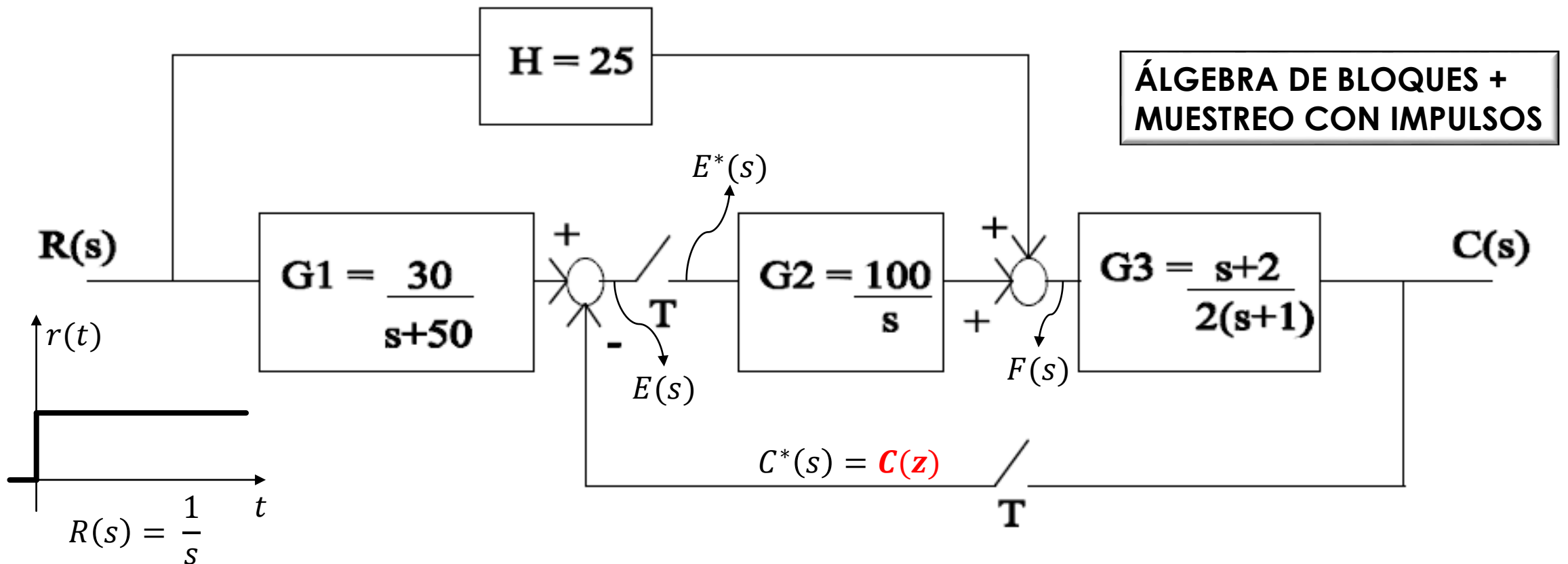


# Sistemas Discretos

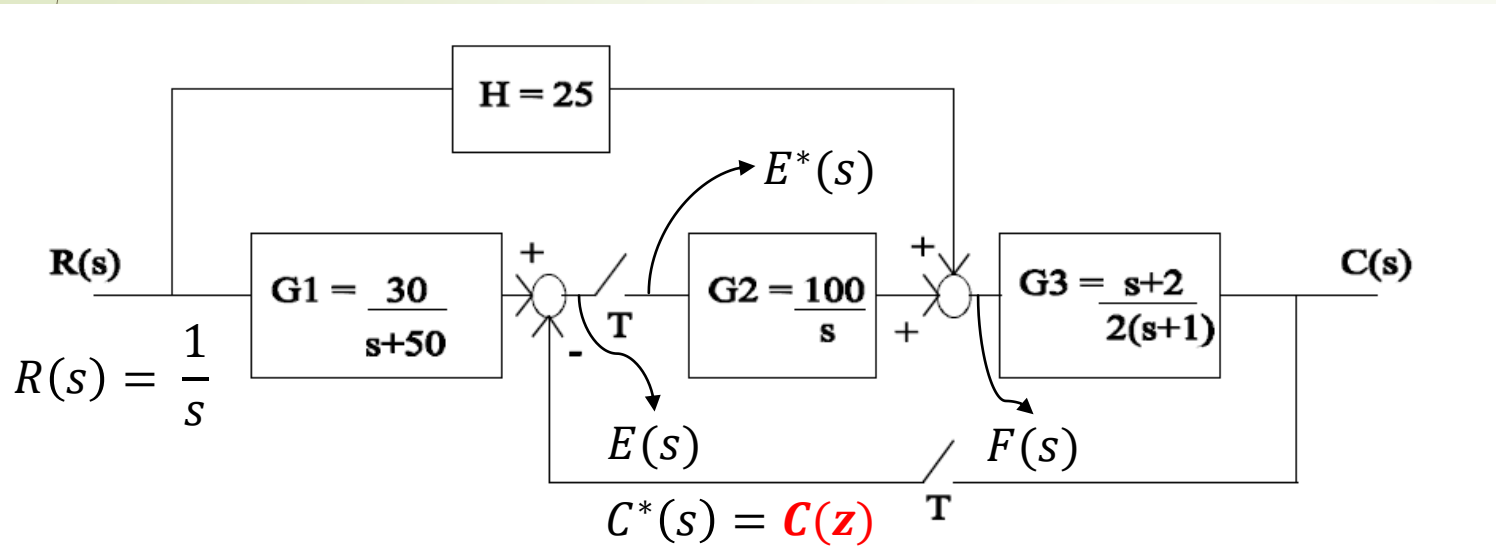
Ejercicio 4-2

# Enunciado

- El siguiente diagrama representa un sistema muestreado de control.
- Obtenga una expresión para la salida  $C(z)$  cuando se le aplica una entrada  $R(s)$  en forma de escalón de amplitud unitaria.



# Muestreo con impulsos



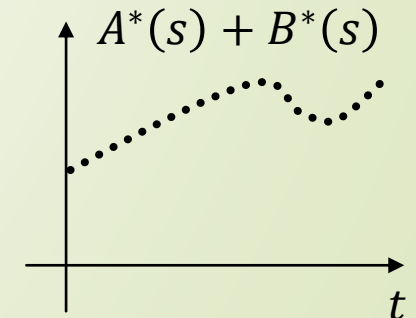
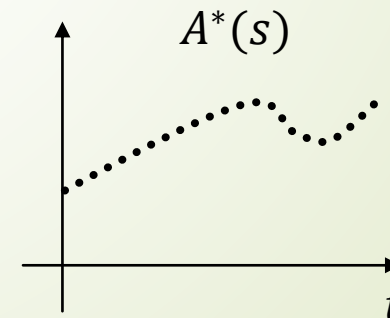
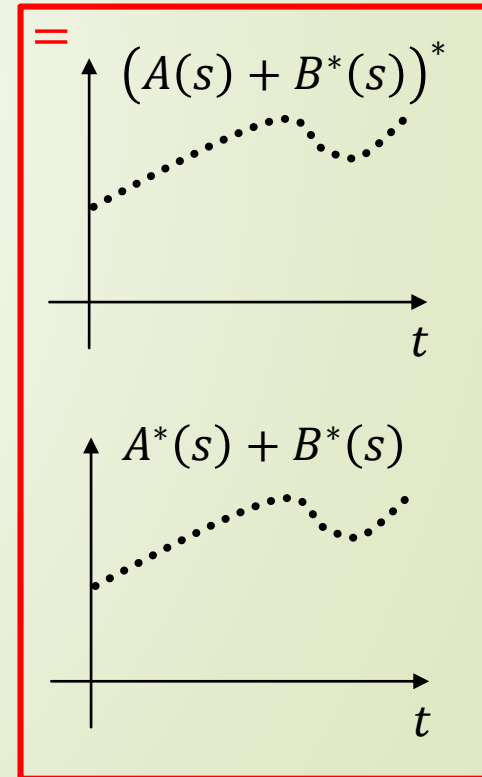
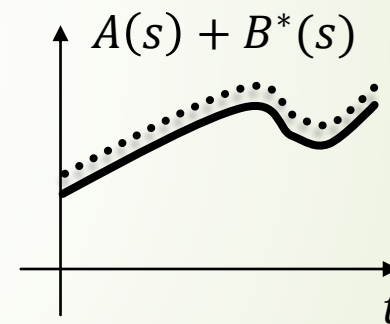
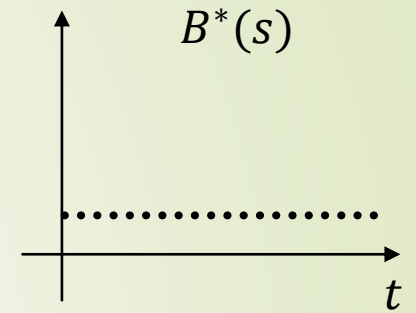
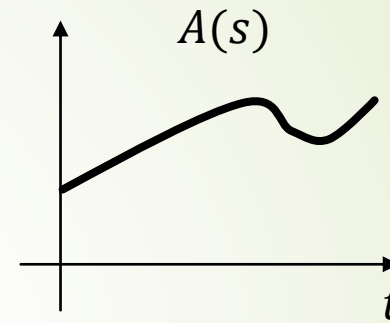
$$E(s) = G_1(s)R(s) - C^*(s)$$

$$E^*(s) = (G_1R)^*(s) - C^*(s)$$

$$F(s) = G_2(s)E^*(s) + H(s)R(s)$$

$$C(s) = G_3(s)F(s)$$

$$C^*(s) = (G_3F)^*(s)$$



# Muestreo con impulsos

$$E(s) = G_1(s)R(s) - C^*(s)$$

$$E^*(s) = (G_1R)^*(s) - C^*(s)$$

$$F(s) = G_2(s)E^*(s) + H(s)R(s)$$

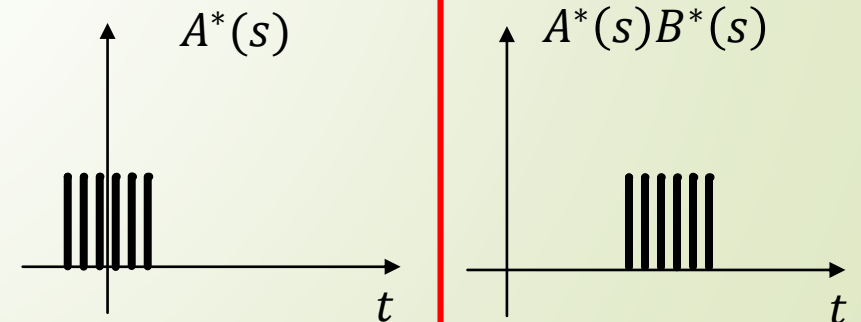
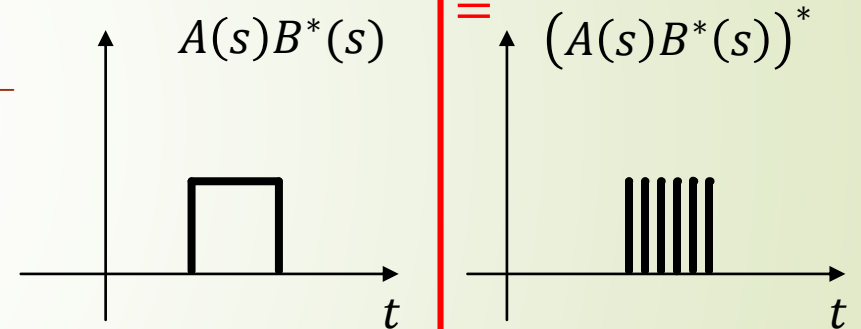
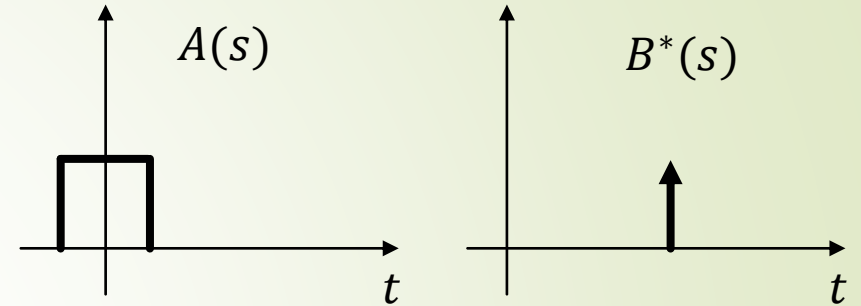
$$C(s) = G_3(s)F(s)$$

$$C^*(s) = (G_3F)^*(s)$$

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$$F(s) = G_2(s)[(G_1R)^*(s) - C^*(s)] + H(s)R(s)$$

$$C(s) = G_3(s)G_2(s)[(G_1R)^*(s) - C^*(s)] + G_3(s)H(s)R(s)$$



# Muestreo con impulsos

$$E(s) = G_1(s)R(s) - C^*(s)$$

$$E^*(s) = (G_1R)^*(s) - C^*(s)$$

$$F(s) = G_2(s)E^*(s) + H(s)R(s)$$

$$C(s) = G_3(s)F(s)$$

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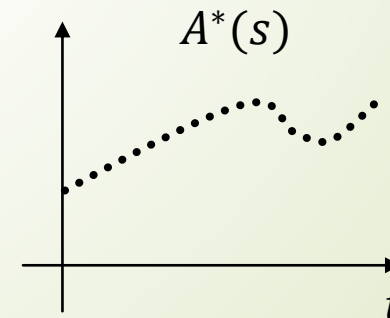
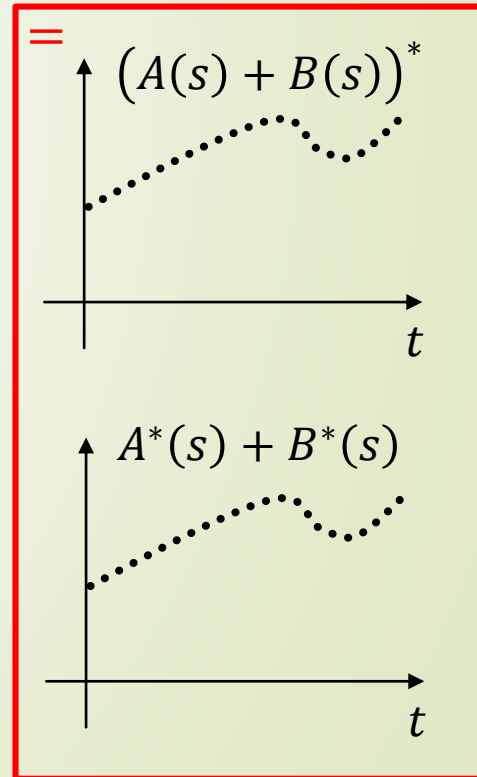
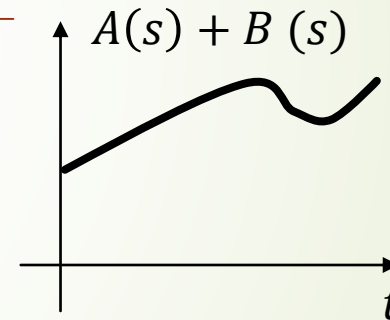
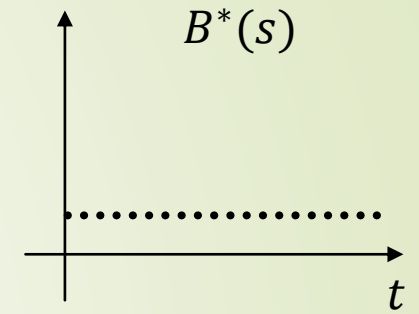
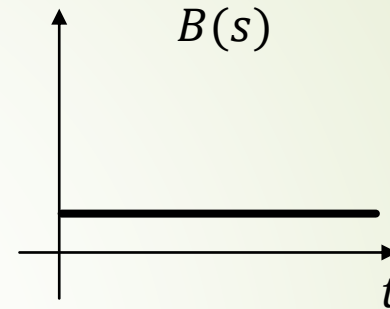
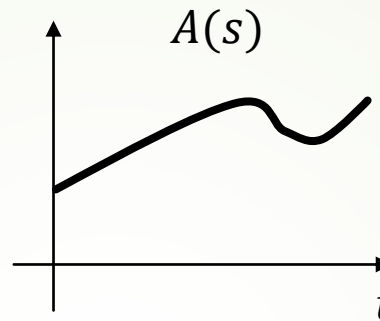
$$F(s) = G_2(s)[(G_1R)^*(s) - C^*(s)] + H(s)R(s)$$

$$C(s) = G_3(s)G_2(s)[(G_1R)^*(s) - C^*(s)] + G_3(s)H(s)R(s)$$

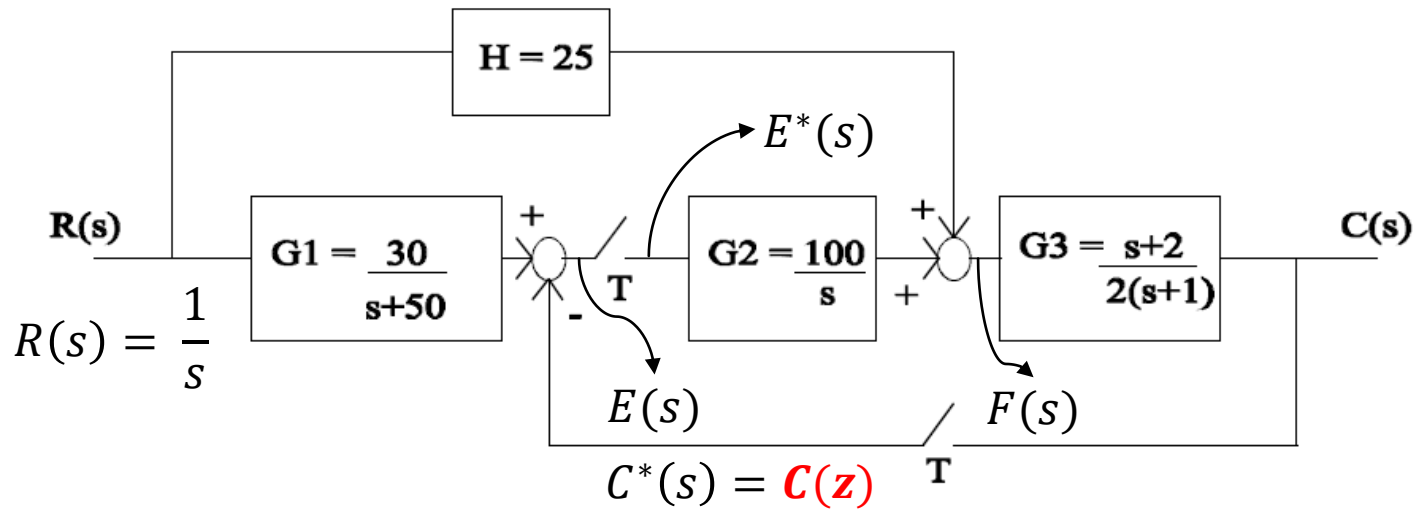
$$C^*(s) = (G_3G_2)^*(s)[(G_1R)^*(s) - C^*(s)] + (G_3HR)^*(s)$$

$$C^*(s) = \frac{(G_3G_2)^*(s)(G_1R)^*(s) + (G_3HR)^*(s)}{1 + (G_3G_2)^*(s)}$$

$$C(z) = \frac{(G_3G_2)(z)(G_1R)(z) + (G_3HR)(z)}{1 + (G_3G_2)(z)}$$



# Muestreo con impulsos



$$C(z) = \frac{\overset{1}{(G_3 G_2)(z)} \overset{2}{(G_1 R)(z)} + \overset{3}{(G_3 H R)(z)}}{1 + \underset{1}{(G_3 G_2)(z)}}$$

$$\underline{\mathbf{Z}} = \underline{\mathbf{Z}}[L^{-1}]$$

No hacemos todo el proceso. Usamos Tabla de Transformada Z

EFP

$$1 \quad (G_3 G_2)(z) = \underline{\mathbf{Z}} \left[ \frac{100(s+2)}{2(s+1)s} \right] = \underline{\mathbf{Z}} \left[ -\frac{50}{s+1} + \frac{100}{s} \right] = -\frac{50z}{z - e^{-T}} + \frac{100z}{z - 1}$$

$$2 \quad (G_1 R)(z) = \underline{\mathbf{Z}} \left[ \frac{30}{(s+50)s} \right] = \underline{\mathbf{Z}} \left[ -\frac{3}{5} \frac{1}{s+50} + \frac{3}{5} \frac{1}{s} \right] = \frac{3}{5} \frac{z}{z - 1} - \frac{3}{5} \frac{z}{z - e^{-50T}}$$

$$3 \quad (G_3 H R)(z) = \underline{\mathbf{Z}} \left[ \frac{25(s+2)}{2(s+1)s} \right] = \underline{\mathbf{Z}} \left[ -\frac{12,5}{s+1} + \frac{25}{s} \right] = -\frac{12,5z}{z - e^{-T}} + \frac{25z}{z - 1}$$

# Muestreo con impulsos

$$C(z) = \frac{\overset{1}{(G_3 G_2)(z)} \overset{2}{(G_1 R)(z)} + \overset{3}{(G_3 H R)(z)}}{1 + \underset{1}{(G_3 G_2)(z)}}$$

$$1 \quad (G_3 G_2)(z) = -\frac{50z}{z - e^{-T}} + \frac{100z}{z - 1}$$

$$2 \quad (G_1 R)(z) = \frac{3}{5} \frac{z}{z - 1} - \frac{3}{5} \frac{z}{z - e^{-50T}}$$

$$3 \quad (G_3 H R)(z) = -\frac{12,5z}{z - e^{-T}} + \frac{25z}{z - 1}$$

$$C(z) = \frac{\left(-\frac{50z}{z - e^{-T}} + \frac{100z}{z - 1}\right) \left(\frac{3}{5} \frac{z}{z - 1} - \frac{3}{5} \frac{z}{z - e^{-50T}}\right) + \left(-\frac{12,5z}{z - e^{-T}} + \frac{25z}{z - 1}\right)}{1 + \left(-\frac{50z}{z - e^{-T}} + \frac{100z}{z - 1}\right)}$$