

João Paulo Samuel Amâncio Lima
10771584

$$\textcircled{1} \quad Y = (I + GH)^{-1} GR \quad \Rightarrow \quad T = (I + GH)^{-1} G \\ Y = TR$$

$$Z = HY = R - E' = R - G^{-1}Y \quad \Rightarrow \quad R = HY + G^{-1}Y = (H + G^{-1})Y = (I + HG)G^{-1}Y \\ (I + HG)^{-1}R = G^{-1}Y \quad \Rightarrow \quad Y = G(I + HG)^{-1}R = TR \quad \Rightarrow \quad T = G(I + HG)^{-1}$$

Então:

$$L \triangleq HG$$

$$(I + GH)^{-1}G = G(I + HG)^{-1} = G(I + L)^{-1} = (I + L)^{-1}G$$

$\textcircled{2}$

$$\textcircled{a} \quad Z = HY = HGE = HG(R - Z) \quad \Rightarrow \quad (I + HG)Z = HGR \\ Z = (I + HG)^{-1}HGR$$

$$\textcircled{b} \quad Y = GE$$

$$H^{-1}Z = G(R - Z) \quad \Rightarrow \quad (H^{-1} + G)Z = GR \quad \Rightarrow \quad (I + GH)H^{-1}Z = GR \\ Z = H(I + GH)^{-1}GR$$

$$\textcircled{3} \quad Y = GH(R/H - Y) = GR - GHY \\ GR = (I + GH)R \\ Y = \frac{G}{1 + GH}R$$

$$Y = GH.C = GH(A - Y)$$

$$(1 + GH)Y = GR$$

$$Y = \frac{G}{1 + GH}R$$

$$(4) \quad y = \frac{G}{1+G(H-1)} (R-y)$$

$$y \left(1 + \frac{G}{1+G(H-1)} \right) = \frac{GR}{1+G(H-1)}$$

$$\frac{y}{R} = \frac{G}{1+GH}$$

$$(5) \quad G[(R-y) - (H-1)y] = y = G(R-Hy) = GR - GHY$$

$$y(1+GH) = GR$$

$$\frac{y}{R} = \frac{G}{1+GH}$$

$$(6) \quad G(R - (H-1)y - y) = y = G(R-Hy) = GR - GHY$$

$$\frac{y}{R} = \frac{G}{1+GH}$$

$$(7) \quad D = 0$$

$$(R - y_1)G_1G_2 = y_1$$

$$\Rightarrow y_1 = \frac{G_1G_2R}{1+G_1G_2}$$

$$G_1G_2R = y_1(1+G_1G_2)$$

$$y_2(1+G_1G_2) = G_2D$$

$$(8) \quad R = 0$$

$$G_2(D - G_1y_2) = y_2$$

$$y_2 = \frac{G_2D}{1+G_1G_2}$$

$$G_2D - G_1G_2 = y_2$$

$$(9) \quad R \neq 0; D \neq 0$$

$$G_2[G_1(R-y) + D] = y = G_1G_2R - G_1G_2y + G_2D$$

$$y(1+G_1G_2) = G_1G_2R + G_2D$$

$$y = y_1 + y_2$$

$$y = \frac{G_1G_2R}{1+G_1G_2} + \frac{G_2D}{1+G_1G_2}$$

(10)

$$Z = W \pm X \pm Y \quad e \quad Z = W \pm X \pm Y$$

(11)

$$(G_2 [G_1(R - H_3 Y) - H_2 Y / G_4]) \cdot \frac{G_3 G_4}{1 - G_3 G_4 H_1} = Y$$

$$\frac{Y}{R} = \frac{G_1 G_2 G_3 G_4}{(1 - G_3 G_4 H_1 + G_2 G_3 H_2 + G_1 G_2 G_3 G_4 H_3)}$$

(12)

$$\frac{G_2 G_3 G_4}{1 - G_3 G_4 H_1 + G_2 G_3 H_2} \cdot [G_1 (R - H_3 Y)] = Y$$

$$G_1 G_2 G_3 G_4 R = Y (1 - G_3 G_4 H_1 + G_2 G_3 H_2 + G_1 G_2 G_3 G_4 H_3)$$

$$\frac{Y}{R} = \frac{G_1 G_2 G_3 G_4}{1 - G_3 G_4 H_1 + G_2 G_3 H_2 + G_1 G_2 G_3 G_4 H_3}$$

(13)

$$\frac{Y}{R} = \frac{G_1 G_2 G_3 G_4}{1 - G_3 G_4 H_1 + G_2 G_3 H_2 + G_1 G_2 G_3 G_4 H_3}$$