

$$1) \begin{cases} Y = (1 + GH)^{-1} GR \\ Y = TR \rightarrow T = (1 + GH)^{-1} G \end{cases}$$

$$Z = HI \rightarrow R - E = HY \rightarrow R = (G^{-1} + H)Y = (1 + HG)G^{-1} \rightarrow$$

$$\rightarrow Y = G(1 + HG)^{-1}R \Rightarrow \underline{T = G(1 + HG)^{-1}}$$

$$\text{Logo: } G(1 + HG)^{-1} = (1 + GH)^{-1}G = G(1 + HG)^{-1}$$

$$2) Z = HY \rightarrow HG R = (1 + HG)Z \rightarrow Y = GE \rightarrow (H^{-1} + G)Z = (1 + GH)H^{-1}Z$$

$$\text{Logo: } ZR^{-1} = H(I + HG)^{-1}G$$

$$\text{Assim: } \frac{Z}{R} = \frac{L}{HL} = \frac{HG}{1 + HG} \therefore Z = HY = HG(R - Z) \Rightarrow$$

$$\boxed{\frac{Z}{R} = \frac{HG}{1 + HG}}$$

$$3) Y = \left(\frac{R}{H} - Y \right) G H$$

$$Y = \frac{G H}{I + G H}$$

$$4) Y = (R - Y) G / (I + G(H - I))$$

$$Y = \frac{G R}{I + G H}$$

$$5) Y = [R - I - Y(H - I)] G$$

$$Y = \frac{G R}{I + H G}$$

$$6) Y = [R - Y(H - I) - Y I] G$$

$$Y = \frac{G R}{I + G H}$$

$$7) Y = (R - Y) G_1 G_2$$

$$Y_1 = \frac{R G_1 + G_2}{I + G_1 G_2}$$

$$8) Y_2 = (D - Y_2 G_1) G_2$$

$$Y_2 = \frac{D G_2}{I + G_2 G_1}$$

$$9) Y = [(R - Y)G_1 + D]G_2 \Rightarrow Y = \frac{(RG_1 + D)R}{I + G_1G_2}$$

10) Ambos os esquemas de blocos geram a mesma equação:

$$\boxed{Z = W \pm X \pm Y}$$

$$11) \left[(R - H_3Y)G_1 - Y \frac{H_2}{G_4} \right] G_2 \frac{G_3 G_4}{1 - G_3 G_4 H_1}$$

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

12)

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

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