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Ex 13/11 - 10772672 - Henrique Kuhlmann

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

Pelo diagrama do slide 8:

$Z = HY$
$R - E = HY$
$R - G^{-1}Y = HY$
$R = HY + G^{-1}Y$ (Álgebra)
$R = (H + G^{-1})Y$
$R = (I + HG)G^{-1}Y$

$(I+HG)^{-1}R = G^{-1}Y$
$Y = G(I+HG)^{-1}R$ $\Big\}$ $T = G(I+HG)^{-1}$
$Y = TR$

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

Pois $L \equiv HG$

2) a) $Z = HY$
$Z = HGE$
$Z = HG(R-Z)$
$(I+HG)Z = HGR$
$\boxed{Z = (I+HG)^{-1}HGR}$

b) $Y = GE$
$H^{-1}Z = G(R-Z)$
$(H^{-1}+G)Z = GR$
$(I+GH)H^{-1}Z = GR$
$\boxed{Z = H(I+GH)^{-1}GR}$

Slide está errado!

Para o caso escalar, basta tratar as variáveis com escalares e fazer $HG = GH = L$

3) $Y = GH \cdot C$

$Y = GH \cdot (A - Y)$

$Y = GHR \cdot 1/H - GHY$

$(1 + GH)Y = GR$

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

$\equiv$

$Y = GE$

$Y = G(R - Z)$

$Y = G(R - YH)$

$Y(1 + HG) = GR$

$$\boxed{\frac{Y}{R} = \frac{G}{1+HG}}$$ ✓

4) $Y = \frac{G}{1+G(H-1)}(R-Y) \rightsquigarrow Y\left(1 + \frac{G}{1+G(H-1)}\right) = \frac{GR}{1+G(H-1)}$

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

5) $G[(R-Y) - (H-1)Y] = Y$

$G(R - HY) = Y$

$GR - GHY = Y \rightarrow \boxed{\frac{Y}{R} = \frac{G}{1+GH}}$

$Y(1+GH) = GR$

6) $G[R - (H-1)Y - Y] = Y$

$G(R - HY) = Y \rightarrow \boxed{\frac{Y}{R} = \frac{G}{1+GH}}$

$GR - GHY = Y$

7) $D = 0 \rightsquigarrow (R - Y_1)\overbrace{G_1 G_2}^{\text{Produto}} = Y_1$

$G_1 G_2 R = Y_1(1 + G_1 G_2) \rightarrow \boxed{Y_1 = \frac{G_1 G_2 R}{1 + G_1 G_2}}$

8) $R = 0 \rightsquigarrow G_2(D - G_1 Y_2) = Y_2$

$G_2 D - G_1 G_2 = Y_2 \rightarrow \boxed{Y_2 = \frac{G_2 D}{1 + G_1 G_2}}$

$Y_2(1 + G_1 G_2) = G_2 D$

9) Com $R \neq 0 \neq D$

$G_2[G_1(R-Y)+D]=Y$

$G_1G_2R - G_1G_2Y + G_2D = Y$

$Y(1+G_1G_2) = G_1G_2R + G_2D \quad \rightarrow Y = \frac{G_1G_2R}{1+G_1G_2} + \frac{G_2D}{1+G_1G_2}$

$\boxed{Y = Y_1 + Y_2}$ (do ex. 7 e 8)

Note que as funções de transferência apresentam os mesmos polos!

10) $Z = W \pm X \pm Y \quad \equiv \quad Z = W + (\pm Y \pm X)$

11) $\left(G_2[G_1(R-H_3Y) - H_2Y/G_4]\right) \cdot \frac{G_3G_4}{1-G_3G_4H_1} = Y$

Isolando Y:

$\frac{Y}{R} = G_1G_2G_3G_4 \cdot \frac{1}{(1-G_3G_4H_1+G_2G_3H_2+G_1G_2G_3G_4H_3)}$

12) Seja $T = G_1 \cdot \frac{G_2G_3G_4}{1-G_3G_4H_1+G_2G_3H_2} \quad \rightarrow AT = Y$

$B = YH_3$

$A = R - B = R - YH_3$

$\frac{Y}{T} = R - YH_3$

$Y\left(\frac{1}{T} + H_3\right) = R$

$\frac{1+TH_3}{T}$

$\frac{Y}{R} = \frac{T}{1+TH_3}$

13) $\boxed{\dfrac{Y}{R} = \dfrac{G_1G_2G_3G_4}{1 - G_3G_4H_1 + G_2G_3H_2 + G_1G_2G_3G_4H_2}}$