Instituto Federal de Educação, Ciência e Tecnologia do Ceará
Departamento de Telemática
Disciplina Aplicação de Controle
Prof. Paulo Régis C. de Araújo

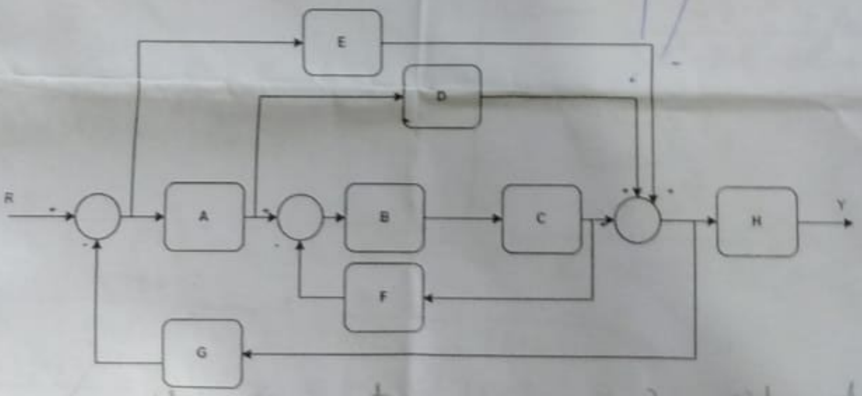
9,4

Nome: JOÃO GABRIEL CARNEIRO MEDEIROS

1. Utilizando a transformada de Laplace, converta as seguintes funções para o domínio da frequência (Obs: apresentar na forma simplificada, através de uma única fração): (4 escores)
A) $x(t) = 3.e^{-3t} + 4.e^{-2t}$
B) $x(t) = 2.e^{-4t} + 5.e^{-5t}$

3. Encontre a transformada Z das seguintes funções de transferência (Obs: apresentar na forma simplificada, através de uma única fração): (4 escores)
A) $F(s) = 5/(s+1).(s+3)$
B) $G(s) = (s+4)/(s+1).(s+2)$

4. Analisando o diagrama de blocos abaixo, realize a redução a apenas um bloco e determine a função de transferência Y/R. A FT de cada bloco é representada pela letra dentro do bloco. (8 escores)



$$\left(\frac{z}{z-e^{-t}} - \frac{z}{z-e^{-3t}}\right) = \frac{5}{2}\cdot\left(\frac{z\cdot(z-e^{-3t})-z(z-e^{-t})}{(z-e^{-t})(z-e^{-3t})}\right)$$

$$= \frac{5}{2}\cdot\left(\frac{}{z^2-2\cdot e^{-t}\cdot(e^{-2t}+1)+e^{-4t}}\right)$$

*Obs: $t^{(n-1)}/(n-1)! = 1/S^n$
$e^{-at} \Rightarrow 1/s+a \Rightarrow z/z - e^{-aT} \Rightarrow e^{-akT}$
$L[f(t)] = \int f(t).e^{-st}\,dt$

Aluno: João Gabriel Carneiro Medeiros

10,0

01. a) $x(t) = 3 \cdot e^{-3t} + 4 \cdot e^{-2t} \xrightarrow{L(x(t))} X(t) = 3 \cdot \left(\frac{1}{s+3}\right) + 4 \cdot \left(\frac{1}{s+2}\right) =$

$$= \frac{3 \cdot (s+2) + 4 \cdot (s+3)}{(s+3) \cdot (s+2)}$$

$$= \frac{3 \cdot s + 6 + 4 \cdot s + 12}{s^2 + 2 \cdot s + 3 \cdot s + 6} =$$

$$\text{Sol} \left\{ = \frac{7 \cdot s + 18}{s^2 + 5 \cdot s + 6} \right. //$$

$$\frac{7 \cdot s + 18}{s^2 + 5 \cdot s + 6} //$$

b) $x(t) = 2 \cdot e^{-4t} + 5 \cdot e^{-5t} \xrightarrow{L(x(t))} X(t) = 2 \cdot \left(\frac{1}{s+4}\right) + 5 \cdot \left(\frac{1}{s+5}\right) =$

$$= \frac{2 \cdot (s+5) + 5 \cdot (s+4)}{(s+4) \cdot (s+5)} =$$

$$= \frac{2 \cdot s + 10 + 5 \cdot s + 20}{s^2 + 5 \cdot s + 4 \cdot s + 20} =$$

$$\text{Sol} \left\{ = \frac{7 \cdot s + 30}{s^2 + 9 \cdot s + 20} \right. //$$

$$\frac{7 \cdot s + 30}{s^2 + 9 \cdot s + 20} //$$

03. a) $F(s) = \frac{5}{(s+1) \cdot (s+3)} \xrightarrow{Z(F(s))} \frac{5}{(s+1) \cdot (s+3)} = \frac{A}{s+1} + \frac{B}{s+3} \longrightarrow$

$$Sol\left\{ = \frac{7\cdot s + 30}{s^2 + 9\cdot s + 20} \right. //$$

03. a) $F(s) = \frac{5}{(s+1)\cdot(s+3)} \xrightarrow{Z(F(s))} \frac{5}{(s+1)\cdot(s+3)} = \frac{A}{s+1} + \frac{B}{s+3} \rightarrow$

$A = ?$ $\frac{5\cdot\cancel{(s+1)}}{\cancel{(s+1)}\cdot\underbrace{(s+3)}_{2}} = \frac{A\cdot\cancel{(s+1)}}{\cancel{(s+1)}} + \frac{B\cdot\cancel{(s+1)}^{0}}{\cancel{(s+3)}}\Big|^{s=-1} \therefore \frac{5}{2} = A //$

$B = ?$ $\frac{5\cdot\cancel{(s+3)}}{\underbrace{(s+1)}_{-2}\cdot\cancel{(s+3)}} = \frac{A\cdot\cancel{(s+3)}^{0}}{\cancel{(s+1)}} + \frac{B\cdot\cancel{(s+3)}}{\cancel{(s+3)}}\Big|^{s=-3} \therefore -\frac{5}{2} = B //$

$\rightarrow F(s) = \frac{5}{2}\cdot\left(\frac{1}{s+1}\right) - \frac{5}{2}\cdot\left(\frac{1}{s+3}\right) \xrightarrow{Z(F(s))} F(s) = \frac{5}{2}\cdot\left(\frac{z}{z-e^{-t}}\right) - \frac{5}{2}\cdot\left(\frac{z}{z-e^{-3t}}\right) =$

$\rightarrow = \frac{5\cdot z}{2\cdot z - 2\cdot e^{-t}} - \frac{5\cdot z}{2\cdot z - 2\cdot e^{-3t}} = \frac{5z(2\cdot z - 2\cdot e^{-3t}) - 5z(2z - 2\cdot e^{-t})}{(2z - 2\cdot e^{-t})\cdot(2z - 2\cdot e^{-3t})} =$

$$= \frac{\cancel{10z^2} - 10z\cdot e^{-3t} - \cancel{10z^2} + 10e^{-t}}{4\cdot z^2 - 4ze^{-3t} - 4ze^{-t} + 4e^{-4t}} =$$

$$= \frac{10\cdot e^{-t} - 10\cdot z\cdot e^{-3t}}{4\cdot z^2 - 4ze^{-3t} - 4ze^{-t} + 4e^{-4t}} //$$

03) Transf Z

A) $F(s) = \frac{5}{(s+1)(s+3)}$

B) $G(s) = \frac{(s+4)}{(s+1)\cdot(s+2)}$ Pg. 02

01

b) $G(s) = \dfrac{s+4}{(s+1)\cdot(s+2)} \rightarrow \dfrac{s+4}{(s+1)\cdot(s+2)} = \dfrac{A}{s+1} + \dfrac{B}{s+2}$

$$A=?\quad \frac{\overset{3}{\overbrace{s+4}}\cdot\cancel{(s+1)}}{\cancel{(s+1)}\cdot\underset{1}{\underbrace{(s+2)}}} = \frac{A\cdot\cancel{(s+1)}}{\cancel{s+1}} + \frac{B\cdot\overset{0}{\cancel{(s+1)}}}{\cancel{s+2}}\Bigg|^{s=-1} \therefore\ 3 = A //$$

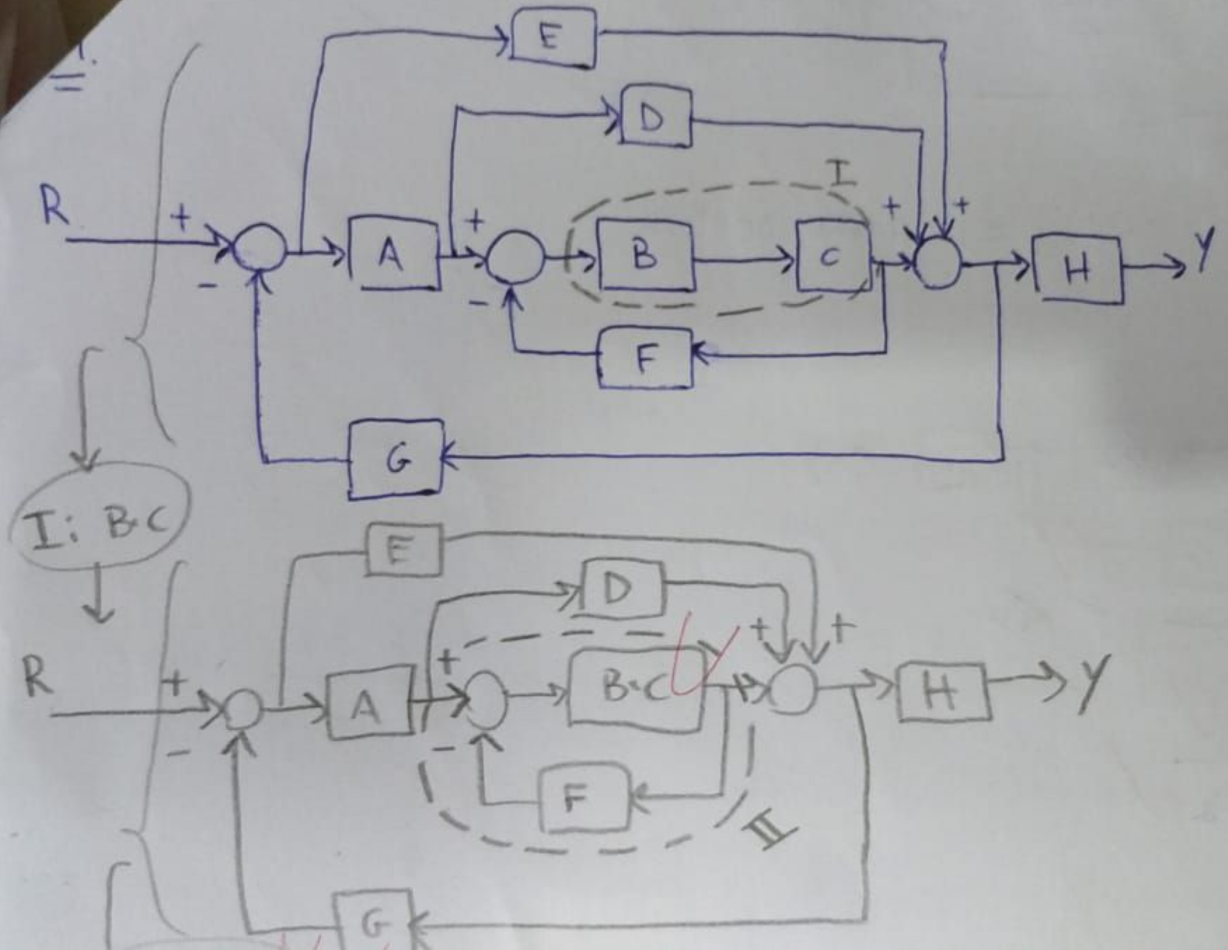
$$B=?\quad \frac{\overset{2}{\overbrace{s+4}}\cdot\cancel{(s+2)}}{\underset{-1}{\underbrace{(s+1)}}\cdot\cancel{(s+2)}} = \frac{A\cdot\overset{0}{\cancel{(s+2)}}}{\cancel{s+1}} + \frac{B\cdot\cancel{(s+2)}}{\cancel{s+2}}\Bigg|^{s=-2} \therefore\ -2 = B //$$

$$\rightarrow G(s) = \frac{3}{s+1} - \frac{2}{s+2} \xrightarrow{Z(G(s))} 3\cdot\left(\frac{z}{z-e^{-t}}\right) - 2\cdot\left(\frac{z}{z-e^{-2t}}\right) =$$

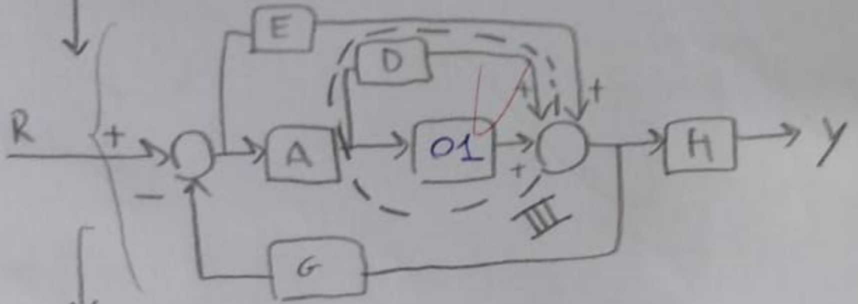
$$= \frac{3\cdot z\cdot(z-e^{-2t}) - 2\cdot z(z-e^{-t})}{(z-e^{-t})\cdot(z-e^{-2t})} = \frac{3z^2 - 3ze^{-2t} - 2z^2 + 2ze^{-t}}{z^2 - z\cdot e^{-2t} - z\cdot e^{-t} + e^{-3t}} =$$

$$= \frac{z^2 + 2ze^{-t} - 3ze^{-2t}}{z^2 - ze^{-t} - ze^{-2t} + e^{-3t}} \rightarrow \frac{z^2 + 2ze^{-t} - 3ze^{-2t}}{z^2 - ze^{-t} - ze^{-2t} + e^{-3t}} //$$

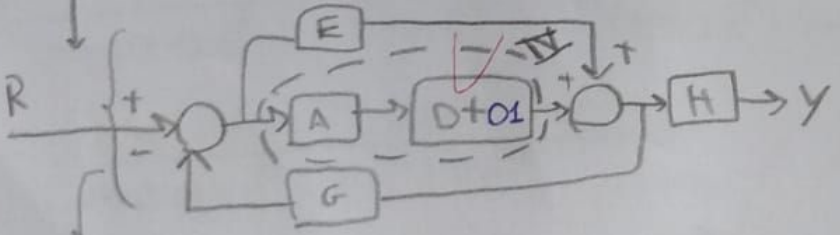
…o: João Gabriel Carneiro Medeiros//



$$\mathrm{II}: \frac{(B\cdot C)}{1+F\cdot(B\cdot C)} \Rightarrow \text{CHAME DE "O1" } (\mathrm{II} = O1)$$

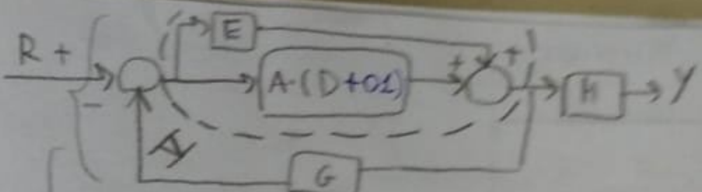


$\mathrm{III}: D+O1$

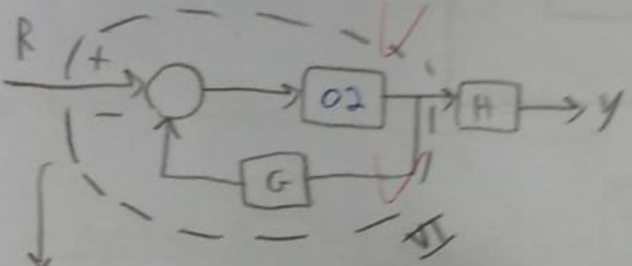


$\mathrm{IV}: A\cdot(D+O1)$

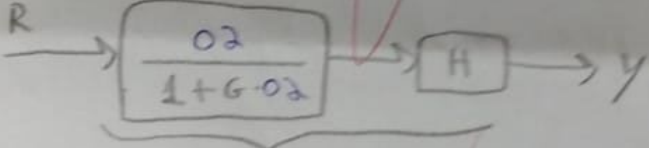
CONTINUA ATRÁS DA FOLHA...



V: $E + [A \cdot (D + O1)] \Rightarrow$ CHAME DE "O2"



VI: $\dfrac{O2}{1 + G \cdot O2}$



$$\frac{Y}{R} = \left(\frac{O2}{1+G \cdot O2}\right) \cdot H$$