Departamento de Engenharia Electrotécnica
Instituto Superior de Engenharia do Porto

TESIS
Teoria dos Sistemas

Álgebra dos Diagramas de Blocos

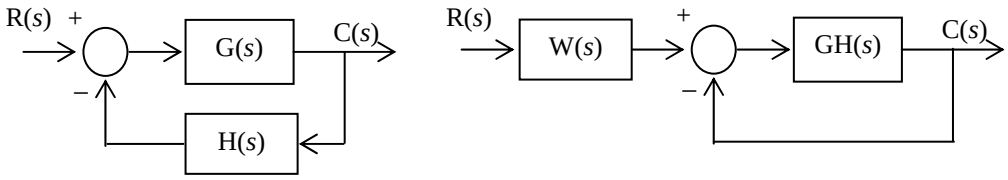
–

Exercícios Propostos e Soluções

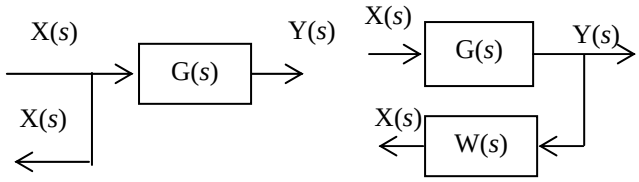
Ano Lectivo: 2007/2008

1. Considere os dois sistemas de diagrama de blocos representados nas figuras. Exprima W(*s*) em função de G(*s*) de forma a que a função de transferência dos dois sistemas seja igual.

a)



b)



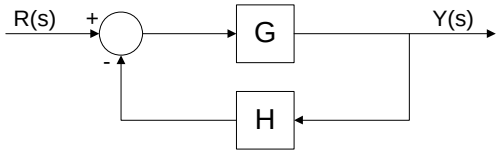
Solução:

a) $W(s) = \dfrac{1}{H(s)}$

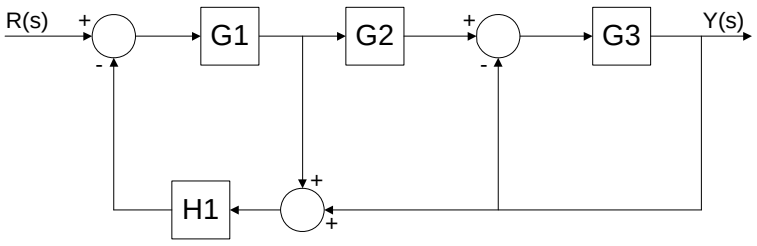
b) $W(s) = \dfrac{1}{G(s)}$

2. Determine a Função de Transferência dos diagramas de blocos representados nas figuras seguintes:

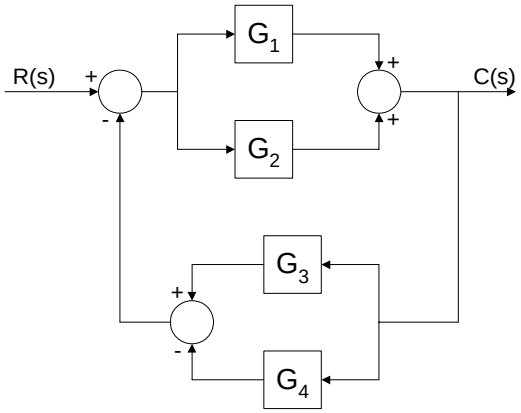
a)



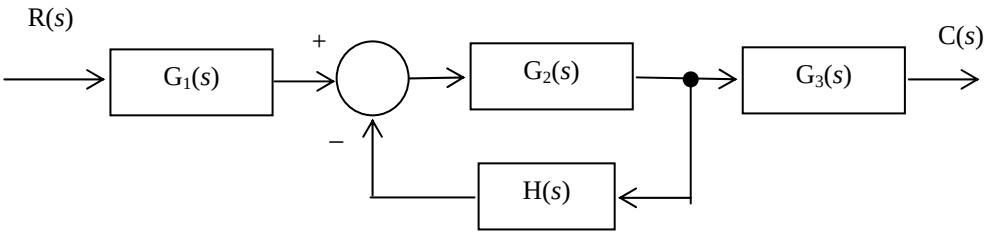
b)



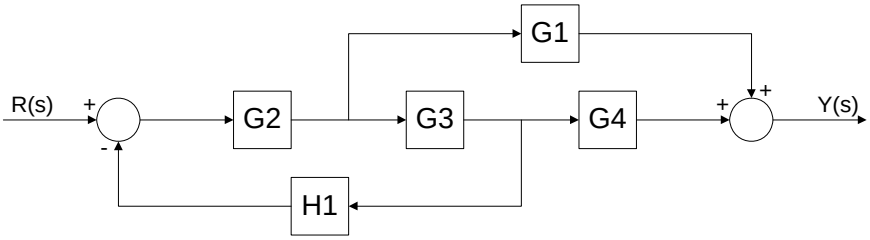
c)


R(s)
+
-
G1
G2
+
+
C(s)
G3
+
-
G4

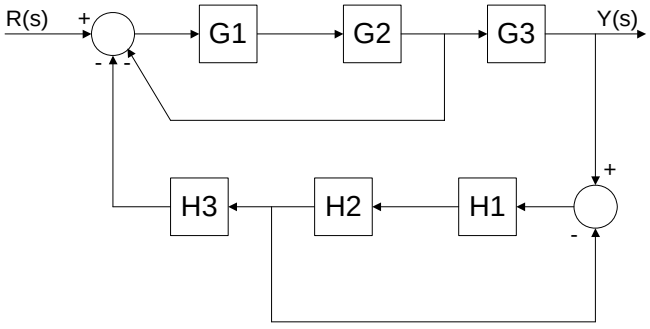
d)


R(s)
G1(s)
+
–
G2(s)
G3(s)
C(s)
H(s)

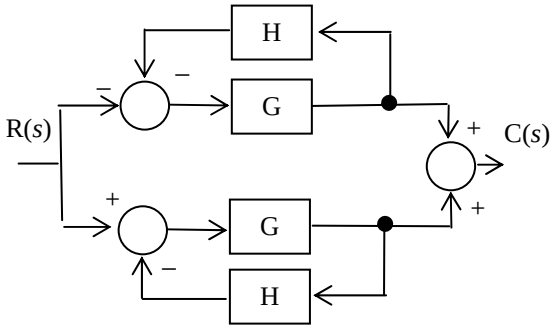
e)


G1
R(s)
+
-
G2
G3
G4
+
+
Y(s)
H1

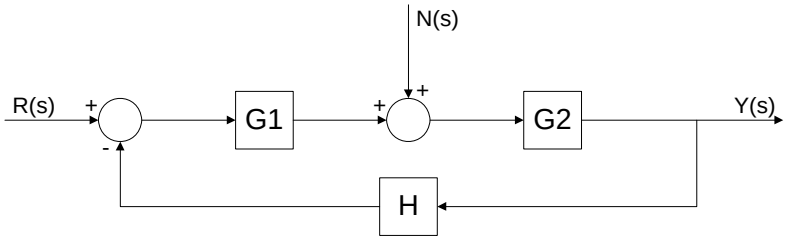
f)


R(s)
+
-
G1
G2
G3
Y(s)
+
H3
H2
H1
-

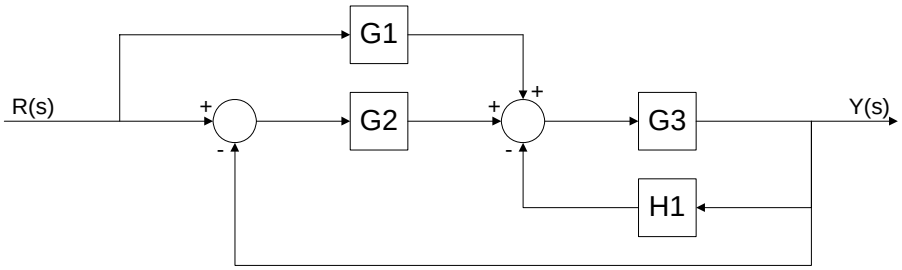
g)



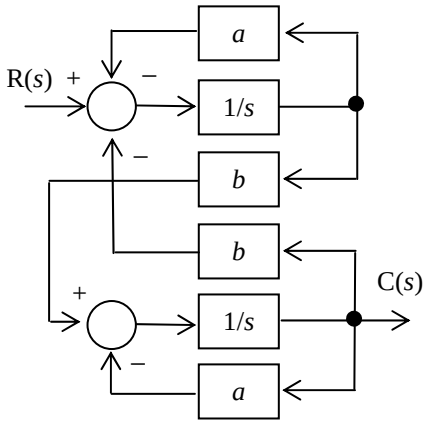
h)



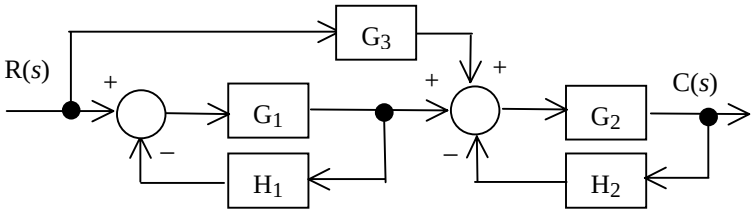
i)



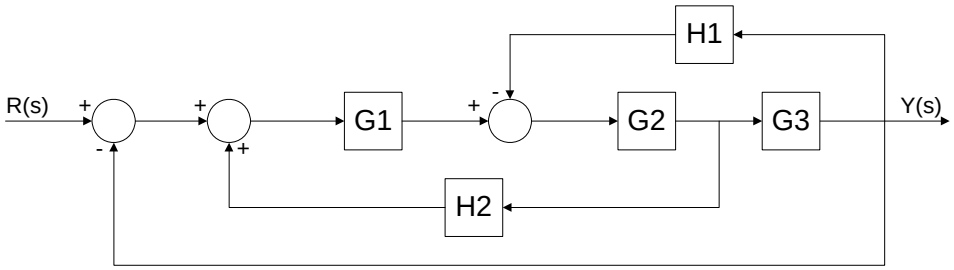
j)



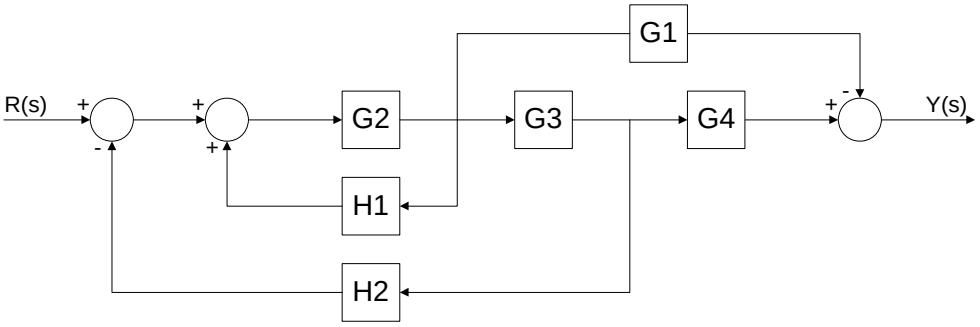
k)


R(s)
G3
+
+
+
C(s)
G1
G2
–
–
H1
H2

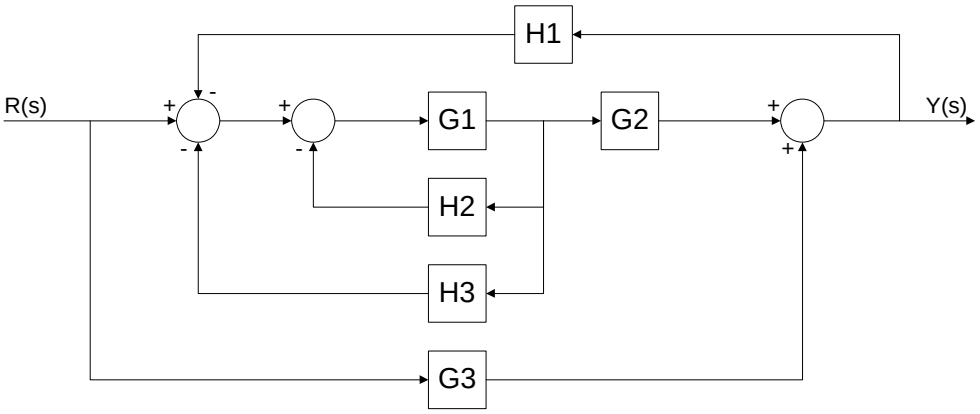
l)


H1
R(s)
+
+
+
-
G1
G2
G3
Y(s)
-
+
H2

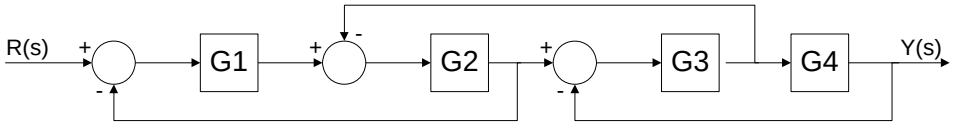
m)


G1
R(s)
+
+
G2
G3
G4
+
-
Y(s)
-
+
H1
H2

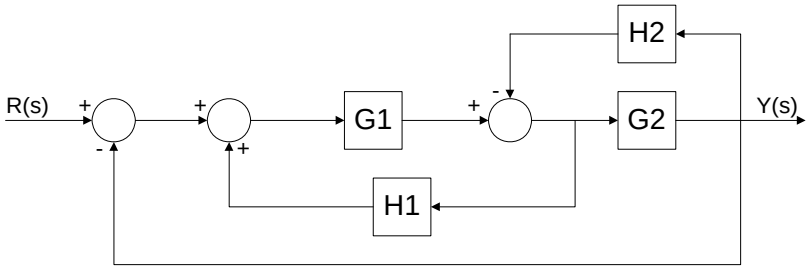
n)


H1
R(s)
+
-
+
G1
G2
+
Y(s)
-
-
+
H2
H3
G3

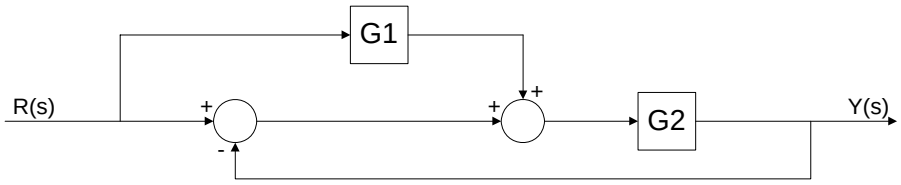
o)


R(s)
+
G1
+
-
G2
+
G3
G4
Y(s)
-
-

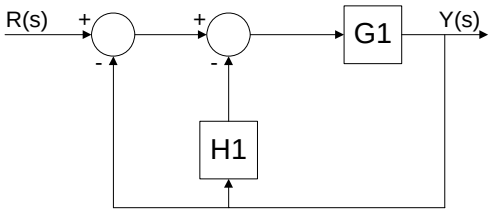
p)


H2
R(s)
+
+
G1
+
-
G2
Y(s)
-
+
H1

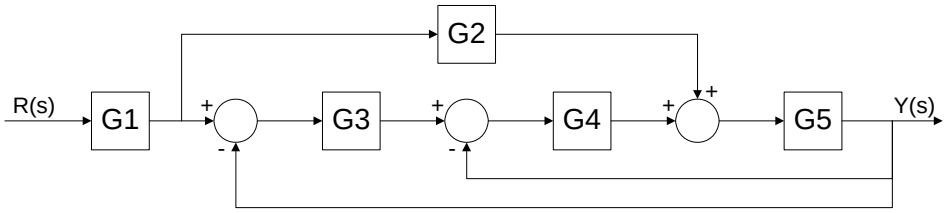
q)


G1
R(s)
+
+
+
G2
Y(s)
-

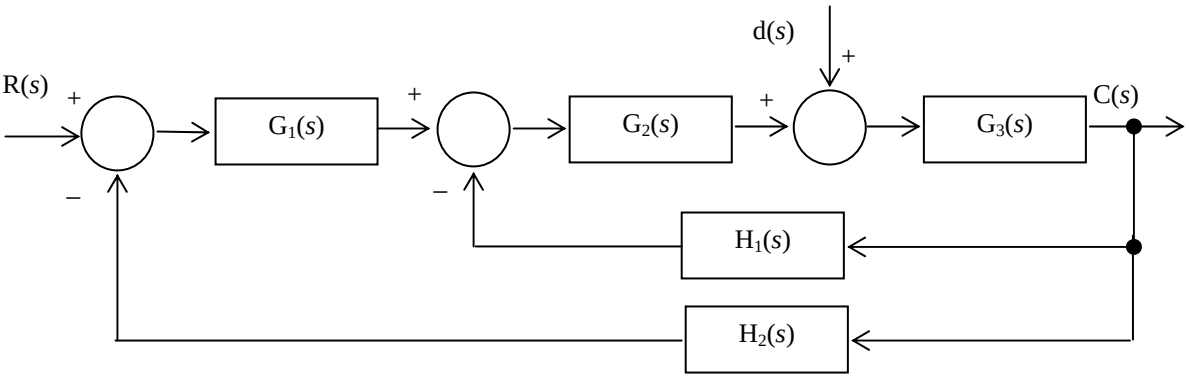
r)


R(s)
+
+
G1
Y(s)
-
-
H1

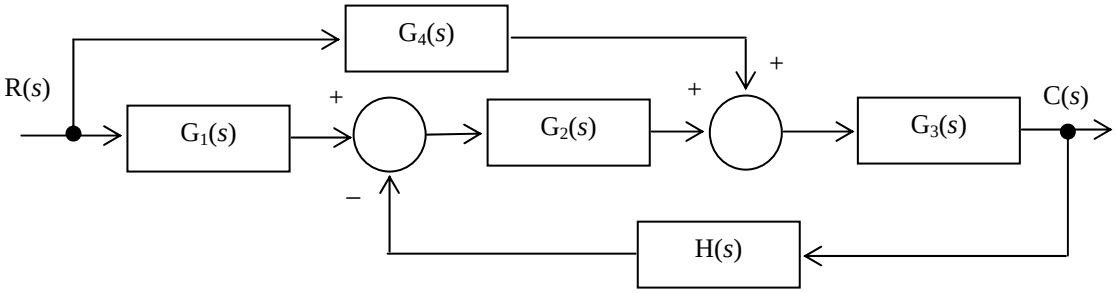
s)


G2
R(s)
G1
+
G3
+
G4
+
+
G5
Y(s)
-
-

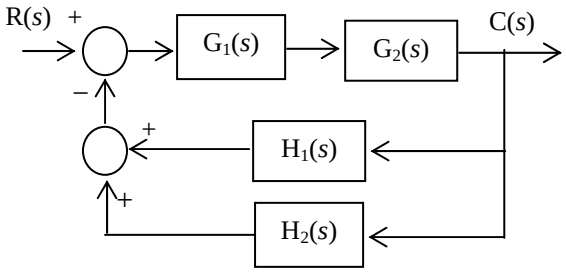
t)


d(s)
+
R(s)
+
G1(s)
+
G2(s)
+
G3(s)
C(s)
–
–
H1(s)
H2(s)

u)



v)



Solução:

a) $\frac{Y(s)}{R(s)} = \frac{G}{1+G.H}$

b) $\frac{Y(s)}{R(s)} = \frac{G1.G2.G3}{(1+G1.H1).(1+G3)+G1.G2.G3.H1}$

c) $\frac{C(s)}{R(s)} = \frac{G1+G2}{1+(G1+G2).(G3-G4)}$

d) $\frac{C(s)}{R(s)} = \frac{G_1(s)G_2(s)G_3(s)}{1+G_2(s)H(s)}$

e) $\frac{Y(s)}{R(s)} = \frac{G2.(G1+G3.G4)}{1+G2.H1.G3}$

f) $\frac{Y(s)}{R(s)} = \frac{G1.G2.G3(1+H1.H2)}{(1+G1.G2).(1+H1.H2)+G1.G2.G3.H1.H2.H3}$

g) $\frac{C(s)}{R(s)} = 0$

h) $Y(s) = \frac{G1.G2}{1+G1.G2.H}.R(s) + \frac{G2}{1+G1.G2.H}.N(s)$

i) $\frac{Y(s)}{R(s)} = \frac{G1.G3 + G2.G3}{1 + G3.H1 + G2.G3}$

j) $\frac{C(s)}{R(s)} = \frac{b}{(s+a)^2 + b^2}$

k) $\frac{C(s)}{R(s)} = \left(\frac{G_1}{1 + G_1 H_1} + G_3 \right) \frac{G_2}{1 + G_2 H_2}$

l) $\frac{Y(s)}{R(s)} = \frac{G1.G2.G3}{1 - G1.G2.H2 + G2.G3.H1 + G1.G2.G3}$

m) $\frac{Y(s)}{R(s)} = \frac{G2.G3.G4 - G1.G2}{1 - G2.H1 + G2.G3.H2}$

n) $\frac{Y(s)}{R(s)} = \frac{G1.G2 + G3.(1 + G1.H2 + G1.H3)}{1 + G1.H2 + G1.H3 + G1.G2.H1}$

o) $\frac{Y(s)}{R(s)} = \frac{G1.G2.G3.G4}{1 + G1.G2 + G3.G4 + G2.G3 + G1.G2.G3.G4}$

p) $\frac{Y(s)}{R(s)} = \frac{G1.G2}{1 + G2.H2 - G1.H1 + G1.G2}$

q) $\frac{Y(s)}{R(s)} = \frac{(1 + G1).G2}{1 + G2}$

r) $\frac{Y(s)}{R(s)} = \frac{G1}{1 + G1 + G1.H1}$

s) $\frac{Y(s)}{R(s)} = \frac{(G3.G4 + G2).G1.G5}{1 + G4.G5 + G3.G4.G5}$

t) $C(s) = \frac{G_1(s) G_2(s) G_3(s)}{1 + G_2(s) G_3(s) \left[H_1(s) + G_1(s) H_2(s) \right]} R(s) + \frac{G_3(s)}{1 + G_2(s) G_3(s) \left[H_1(s) + G_1(s) H_2(s) \right]} d(s)$

u) $\frac{C(s)}{R(s)} = \frac{G_3(s) \left[G_1(s) G_2(s) + G_4(s) \right]}{1 + G_2(s) G_3(s) H(s)}$

v) $\frac{C(s)}{R(s)} = \frac{G_1(s) G_2(s)}{1 + G_1(s) G_2(s) \left[H_1(s) + H_2(s) \right]}$