EEE302 CONTROL SYSTEMS
PRE-LABORATORY REPORT

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ASSIGNMENT NUMBER   :   **2**

OBJECTIVES OF THE LABORATORY ASSIGNMENT:

Objectives of this lab are learning how to reduce of a block diagram with series, parallel or feedback connection by using MATLAB.

CODES:

```
% CONTROL SYSTEM LAB ASSIGNMENT-2
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clear all % clears all variable definitions
close all % closes all figures
clc       % clears the screen

%QUESTION-1)
G1=tf(10,[1 2 10]);
G2=tf(5,[1 5]);
Gk_1=feedback(G1*G2,0) % Series
Gk_2=feedback(G1+G2,0) % Parallel

%QUESTION-2)
G=tf(10,[1 2 10]);
H=tf(5,[1 5]);
Gk_3=feedback(G,H)  %'+'
Gk_4=feedback(G,-H)  %'-'


%QUESTION-3)
G1_1=tf(2,[1 9 8]);
H=0.2;
G3_1=tf([1],[1 0]);
G2_1=4;
Z=feedback(G1_1,H)
GL=feedback(Z*G2_1*G3_1,1)
```

```
% COMMAND WINDOW

Gk_1 =

              50
   -----------------------
   s^3 + 7 s^2 + 20 s + 50


Gk_2 =

     5 s^2 + 20 s + 100
   -----------------------
   s^3 + 7 s^2 + 20 s + 50


Gk_3 =

         10 s + 50
   ------------------------
   s^3 + 7 s^2 + 20 s + 100


Gk_4 =

       10 s + 50
   -------------------
   s^3 + 7 s^2 + 20 s


Z =

          2
   ----------------
   s^2 + 9 s + 8.4


GL =

              8
   ------------------------
   s^3 + 9 s^2 + 8.4 s + 8
```
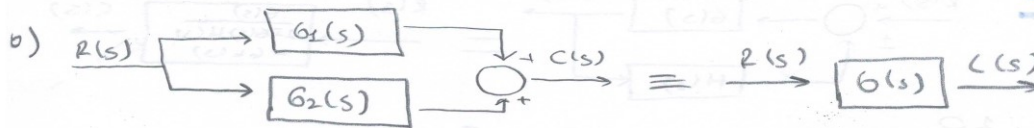
SOLUTIONS:

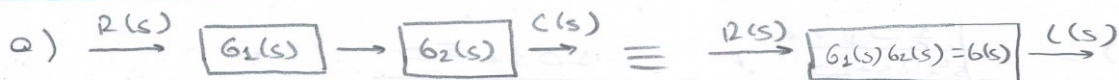**QUESTION-1 :**

Control Systems
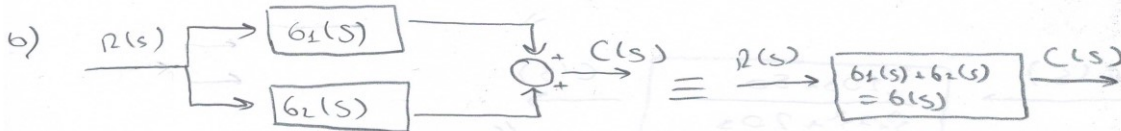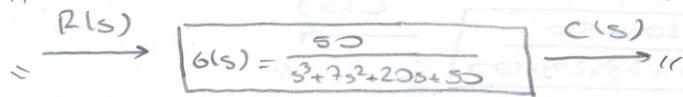LAB ASSIGNMENT-2

Turhan Can Kargın
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Question 1) : Find $G_1(s)$ and $G_2(s)$ equal $\frac{10}{s^2+2s+10}$, $\frac{5}{s+5}$ respectively, reduce the blocks connected in series and parallel
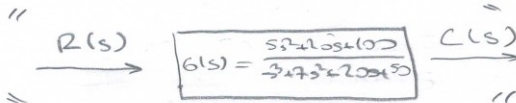
a) $\xrightarrow{R(s)}$ $\boxed{G_1(s)}$ $\longrightarrow$ $\boxed{G_2(s)}$ $\xrightarrow{C(s)}$ $\equiv$ $\xrightarrow{R(s)}$ $\boxed{G(s)}$ $\xrightarrow{C(s)}$

b) $\xrightarrow{R(s)}$ $\boxed{G_1(s)}$ $\boxed{G_2(s)}$ $\downarrow_+$ $\bigcirc$ $\xrightarrow{C(s)}$ $\uparrow_+$ $\equiv$ $\xrightarrow{R(s)}$ $\boxed{G(s)}$ $\xrightarrow{C(s)}$

Solution =

a) $\xrightarrow{R(s)}$ $\boxed{G_1(s)}$ $\longrightarrow$ $\boxed{G_2(s)}$ $\xrightarrow{C(s)}$ $\equiv$ $\xrightarrow{R(s)}$ $\boxed{G_1(s)\,G_2(s)=G(s)}$ $\xrightarrow{C(s)}$

* $G(s) = G_1(s)\,G_2(s) = \frac{10}{s^2+2s+10} \cdot \frac{5}{s+5} = \frac{50}{s^3+7s^2+20s+50}$

$\overset{''}{=}$ $\xrightarrow{R(s)}$ $\boxed{G(s) = \dfrac{50}{s^3+7s^2+20s+50}}$ $\xrightarrow{C(s)}$ ''

b) $\xrightarrow{R(s)}$ $\boxed{G_1(s)}$ $\boxed{G_2(s)}$ $\downarrow_+$ $\bigcirc$ $\xrightarrow{C(s)}$ $\uparrow_+$ $\equiv$ $\xrightarrow{R(s)}$ $\boxed{\begin{array}{c}G_1(s)+G_2(s)\\=G(s)\end{array}}$ $\xrightarrow{C(s)}$

* $G(s) = G_1(s) + G_2(s) = \frac{10}{s^2+2s+10} + \frac{5}{s+5} = \frac{5s^2+20s+100}{s^3+7s^2+20s+50}$

$\overset{''}{=}$ $\xrightarrow{R(s)}$ $\boxed{G(s) = \dfrac{5s^2+20s+100}{s^3+7s^2+20s+50}}$ $\xrightarrow{C(s)}$ ''
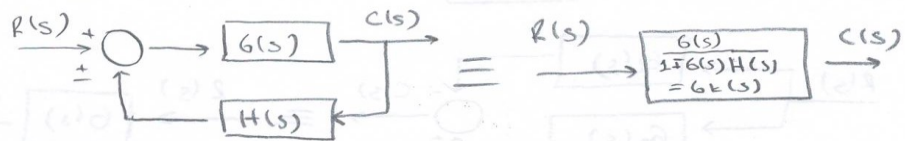
Question-2)

If G(s) and H(s) equal $\dfrac{10}{s^2+2s+10}$, $\dfrac{5}{s+5}$ respectively, reduce blocks connected with feedback connection.
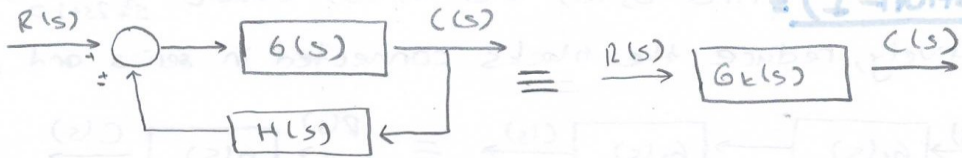
Solution=

$$G_k(s) = \dfrac{\dfrac{10}{s^2+2s+10}}{1 + \dfrac{10}{s^2+2s+10} \cdot \dfrac{5}{s+5}} = \dfrac{10s+50}{s^3+7s^2+20s+100}$$

$$G_k(s) = \dfrac{\dfrac{10}{s^2+2s+10}}{1 - \dfrac{10}{s^2+2s+10} \cdot \dfrac{5}{s+5}} = \dfrac{10s+50}{s^3+7s^2+20s}$$
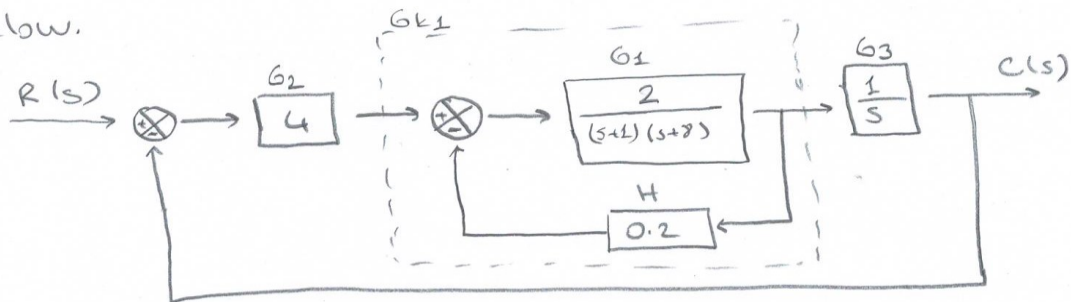
//

a)

$$\xrightarrow{R(s)} \boxed{\dfrac{10s+50}{s^3+7s^2+20s+100}} \xrightarrow{C(s)}$$

=

//

b)

$$\xrightarrow{R(s)} \boxed{\dfrac{10s+50}{s^3+7s^2+20s}} \xrightarrow{C(s)}$$

=

//

Question-3)

Find the closed loop transfer function of the system given below.

$$G_{k1}$$

$$G_1$$

$$G_3$$

$$R(s) \quad G_2 \quad \boxed{4} \quad \boxed{\dfrac{2}{(s+1)(s+8)}} \quad \boxed{\dfrac{1}{s}} \quad C(s)$$

$$H \quad \boxed{0.2}$$

Solution=

$$G_{k1} = \dfrac{\dfrac{2}{s^2 + 9s + 8}}{1 + \dfrac{2 \times 0.2}{s^2 + 9s + 8}} = \dfrac{2}{s^2 + 9s + 8.4}$$

$$G_2 \times G_{k1} \times G_3 = 4 \times \dfrac{2}{s^2 + 9s + 8.4} \times \dfrac{1}{s} = \dfrac{8}{s^3 + 9s^2 + 8.4s}$$

$$Z = \dfrac{\dfrac{8}{s^3 + 9s^2 + 8.4s}}{1 + \dfrac{8}{s^3 + 9s^2 + 8.4s}} = \dfrac{8}{s^3 + 9s^2 + 8.4s + 8}$$

$$R(s) \quad \boxed{G_L = \dfrac{8}{s^3 + 9s^2 + 8.4s + 8}} \quad C(s)$$