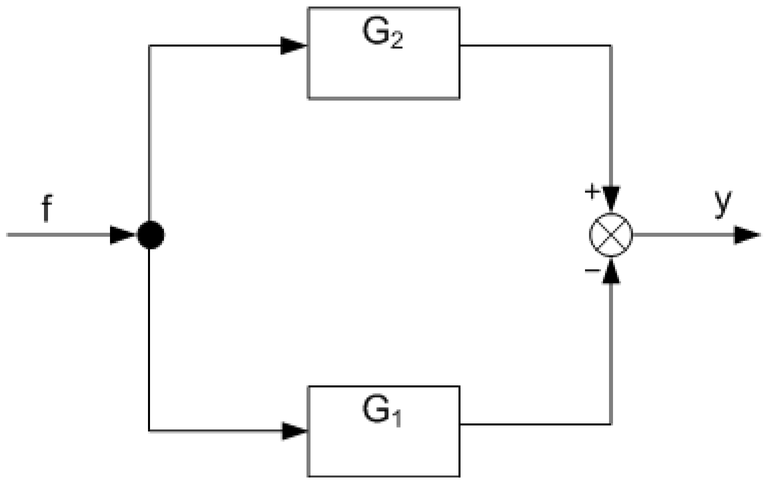
Last name **Name** **student ID No.:**

PC No. ___________

Section 4: STABILITY OF LINEAR DYNAMIC SYSTEMS

A linear dynamic system is made of two processes in this way



with transfer functions:

$$G_1(s) = (-1)^n \frac{2}{\frac{n}{4}s + 1.05} \qquad G_2(s) = (-1)^n \frac{3}{\frac{n}{2}s + 0.995}$$

where:

n = PC No.

I. Reduce each TF above to the non-Factorized Form with the trailing coefficient equal to unity

II. Is the system $G_p(s)$ resulting from the parallel is an **inverse-response system?** Why?

III. How much is the **gain** for such as a system $G_p(s)$ resulting from the parallel?

IV. Plot the system $G_p(s)$ response to a unit step change in f(s) and verify if it is actually "inverse"

Part A: *Root locus*

By using as much as possible the Matlab or SisoTool resources, answer here the following questions:

1. Explain if you've to use **direct or inverse** Root Locus rules
2. Plot the *root locus* by means of Matlab or SisoTool resources and attach it here

3. Determine, if any, and comment the **loci** on the real axis

4. Calculate, if any, and comment the value/values of the **critical gain** K*

Part B: Frequency response

For the **dynamic system** $G_p(s)$ and a *P controller with* K_c=1, by using as much as possible the Matlab or SisoTool resources, answer here the following questions:

1) Plot the **asymptotic Bode Diagrams** by means of the ASBODE script, and attach them here

2) Decide if the Bode stability criterion is applicable

3) If yes, is the above system closed-loop stable?

Part B bis: Frequency response

For the **dynamic system** $G_{pbis}(s)$

$$G_{pbis}(s)=G_p(s)e^{-\frac{n}{4}s}$$

where:

n = PC No.

and a *P controller with* K_c=1, by using as much as possible the Matlab or SisoTool resources, answer here the following questions, when the two transfer functions are changed as follows:

1) Plot the **extended Nyquist diagram** *together with the unit circle and the Peak Response* by means of Matlab resources, attach it here and give your comments in details

2) Check, on the base of the **Nyquist** stability criterion, if the above system is closed-loop stable

3) determine the **gain** margin, if any

4) determine the **phase** margin, if any

Part C: Dynamic responses in the time domain

For the **dynamic system** $G_{pbis}(s)$ and a *P controller with* K_c=0.15:

1 - Plot the **open loop response** to a unit step **input** change**,** attach it here and give your comments

Part D: compensation

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