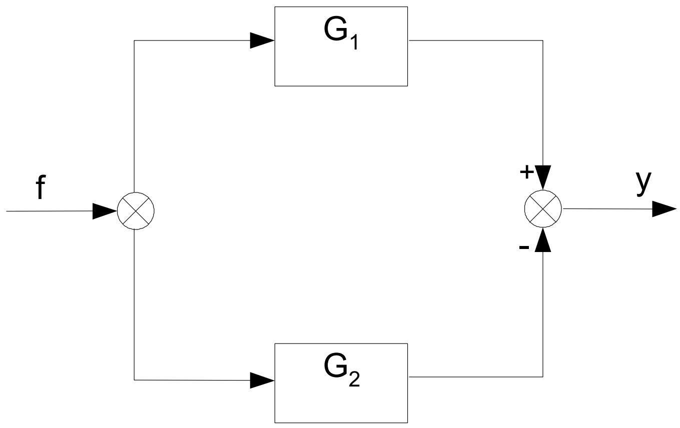
Last name **Name** **student ID No.:**

PC No. ____________

Section 4: STABILITY OF LINEAR DYNAMIC SYSTEMS

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



with transfer functions $G_1(s) = \frac{\left(\frac{1}{16}\right)}{\frac{s}{p}+0.95}$ $G_2(s) = \frac{1}{\frac{s}{1.95}+1.05}$

where:

p is a parameter

I. Determine the system $G_p(s)$ resulting from the parallel.
II. Which order is $G_p(s)$?
III. Assign a value to the parameter *p* such as the system $G_p(s)$ resulting from the parallel becomes an **inverse-response system**
IV. How much is the **gain** for such as a system $G_p(s)$ resulting from the parallel?

Part A: *Root locus*

For the **system** $G_p(s)$, use Matlab and SisoTool resources, attach here their results and answer the following questions:

1. Plot the *root locus*
2. Discuss existence of asymptotes and, if possible, calculate the gravity center and angles formed with the real axis.
3. Calculate the limiting value/values for K_c

For the **system** $G_p(s)$, add a PD controller:

4. Plot the new *root locus*
5. Calculate the new limiting value/values for K_{cD}

6. Compare K_{cD} to K_c and discuss if the "stability space" is increased or not

For the **system** $G_p(s)$, add a PI controller:

7. Plot the new *root locus*
8. Calculate the new limiting value/values for K_{cI}
9. Compare K_{cI} to K_c and discuss if the "stability space" is increased or not

Part B: Frequency response

For the **dynamic system** $G_p(s)$ and a *P controller with* K_c=1:

1) Plot the **asymptotic Bode Diagrams** by means of the ASBODE script, and attach them here
2) Does a *crossover* frequency exist? How much is it?
3) Does a *gain crossover* frequency exist? How much is it?
4) Decide if the Bode stability criterion is applicable
5) If yes, is the above system closed-loop stable?

Part C: Dynamic responses in the time domain

Come back to the original system $G_p(s)$ resulting from the parallel:

A. assign a new value to the parameter *p* such as $G_p(s)$ is NOT an **inverse-response system** anymore
B. plot the **open-loop** dynamic response to a unit step, attach it here and give your comments
C. assign a P controller with K_c=0.1 and plot the **closed-loop** dynamic response to a unit step change in *set point*, attach it here and give your comments

Part D: Inverse Response Compensator

a) write its TF