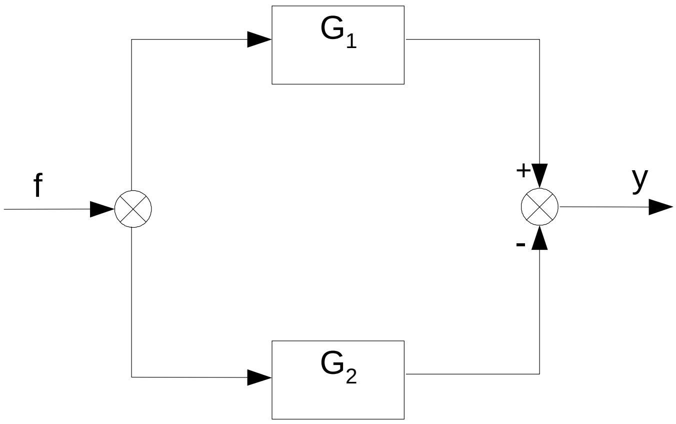
Last name **Name** **student ID No.:**

PC No. ___________

Section 4: STABILITY OF LINEAR DYNAMIC SYSTEMS

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



with transfer functions $G_1(s) = \dfrac{\frac{n-0.05}{n+0.05}}{\frac{s}{p}+1}$ $\qquad G_2(s) = \dfrac{1}{\frac{s}{2.01}+\frac{n-0.05}{n+0.05}}$

where:

n = PC No.
p is a parameter

I. Which **order** is the system $G_P(s)$ resulting from the parallel?

II. How much is the **type** for such as a system $G_P(s)$ resulting from the parallel?

Part A: *Root locus*

For the **dynamic system** $G_P(s)$, by using as much as possible the Matlab or SisoTool resources, answer here the following questions.

Choose a value for p such as the system $G_P(s)$ resulting from the parallel is an inverse-response system

A1. Plot the *root locus* by means of Matlab or SisoTool resources and attach it here

A2. Calculate the limiting value/values for K_c

Choose a value for p such as the system $G_p(s)$ resulting from the parallel has a double pole

A3. Adopt a PD controller with τ_D=1 min and the resulting TF $G_{PD}(s)$

A4. Plot the *root locus* by means of Matlab or SisoTool resources of $G_{OL}(s)=G_p(s)\bullet G_{PD}(s)$ and attach it here

A5. Discuss existence of asymptotes and, if possible, calculate the gravity center and angles formed with the real axis.

Part B: Frequency response

For the **dynamic system** $G_p(s)$, by using as much as possible the Matlab or SisoTool resources, answer here the following questions:

With ref. to the system $G_p(s)$ resulting from the parallel an inverse-response system

B1) Plot the **extended Nyquist Diagram** *together with the unit circle and the Peak Response*, attach it here and comment it

B2) Plot the **asymptotic Bode Diagrams** by means of the ASBODE script, and attach them here

B3) Does a *crossover* frequency exist? How much is it?

B4) Does a *gain crossover* frequency exist? How much is it?

B5) Decide if the Bode stability criterion is applicable

B6) If yes, is the above system closed-loop stable?

B7) Plot the **extended Nyquist diagram** *together with the unit circle and the Peak Response*, and attach it here

B8) Check, on the base of the **Nyquist** stability criterion, if the above system is closed-loop stable

Part C: Dynamic responses in the time domain

With ref. to the system $G_p(s)$ resulting from the parallel an inverse-response system

C1) Plot the **open loop response** to a **unit step** input change**,** attach it here and give your comments

C2) Plot the **closed loop response** to a **unit step** input change in **disturbance,** attach it here and give your comments

C3) assign a P controller with K_c=20 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

D1) write its TF