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

Section 4: STABILITY OF LINEAR DYNAMIC SYSTEMS

A dynamic process $G_p(s)$ has the following 5 **poles**:

$$j$$
$$-j$$
$$-0.05*(n-0.05)/(n+0.05)$$
$$-0.1$$
$$-2$$

the following 2 **zeroes**:

$$-(n-0.05)/(n+0.05)*(0.5+j)$$
$$-(n-0.05)/(n+0.05)*(0.5-j)$$

the following **transfer constant**:

$$1$$

where:

$$n = \text{PC No.}$$

I. How much is the **gain** for $G_p(s)$?

II. How much is the **type g** for $G_p(s)$?

III. Is this an **inverse response** system?

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:

a) Explain if you've to use **direct or inverse** Root Locus rules

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

c) Calculate, if any, the **breakaway points**

d) Calculate, if any, and comment the value/values of the **critical gain** K*

e) Calculate the values of the closed loop poles for **gain** $K_c=2$

f) Select one or two **poles** in $G_p(s)$ that you consider responsible of **closed loop instability** and *propose a numerical change for them*, which you consider, based on your judgement, more favorable to **closed loop stability**

Part B: Frequency response

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

1) Plot the *Asymptotic Bode Diagrams*, attach them here and give your comments in details
2) Does a **resonance** frequency exist? How much is it?
3) Calculate *precisely* AR and ϕ at ω=2 rad/s
4) Decide if the **Bode stability criterion** is applicable
5) If yes, is the above system closed-loop stable?
6) Plot the **extended Nyquist diagram** of $G_p(s)$ *together with the unit circle and the Peak Response* by means of Matlab resources, attach it here and give your comments in details
7) 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

For the **original dynamic system** $G_p(s)$:

1) plot the **open loop** system dynamic response to an **impulse** change in *input* by means of Matlab resources, attach it here and give your comments.
2) plot the **closed loop** system dynamic response to an **impulse** change in *disturbance* by means of Matlab resources, attach it here and give your comments.

Part D:

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