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

PC No. ___________

Section 4: STABILITY OF LINEAR DYNAMIC SYSTEMS

A linear dynamic process $G_p(s)$ has the following 4 **poles**:

$$0$$
$$-0.05*(2*n+0.5)/(2*n-0.5)$$
$$-0.1$$
$$-2$$

the following 2 **zeroes**:

$$-1$$
$$-0.5*(2*n+0.5)/(2*n-0.5)$$

the following **transfer constant**:

$$k = -1$$

where:

n = N. matricola (student ID No.)

I. Is $G_p(s)$ a BIBO stable system at **open-loop**?

II. Is $G_p(s)$ an **inverse-response system**?

III. How much is the **type "g"**?

Part A: *Root locus*

For the open loop TF $G_p(s)$,

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

A2. Discuss calculate and, if any, the **breakaway points**

A3. Discuss calculate and, if any, the limiting value/values K^*

A4. After reconsidering the original 4 **poles**, suggest which one you would eliminate in order to improve the closed loop stability to the best possible

Part B: Frequency response

For the open loop TF $G_p(s)$ and *Kc=1*, answer the following questions:

B1) Plot the **Bode Diagrams** by means of Matlab/SisoTool resources, with a *log scale of the magnitude (NOT in dB)*, and attach them here

B2) With ref to the **Bode Diagrams** of the **phase**, discuss its pattern and provide a short and reasoned comment

B3) Decide if the **Bode stability criterion** is applicable

B4) If yes, is the above system closed-loop stable?

B5) Plot and attach here the **extended Nyquist diagram** *together with the unit circle and the Peak Response* by means of Matlab and SisoTool resources, then discuss it in details

B6) Is the above **Nyquist diagram** crossing the **critical point**?

B7) Check, on the base of the **Nyquist stability criterion**, if the above system is closed-loop stable

B8) Calculate the value of TF $G_p(s)$ in **polar coordinates** (AR, ϕ) at a given $\omega = 0.5$ rad/s

B9) Calculate the value of TF $G_p(s)$ in **cartesian coordinates** as a **complex number** (a + jb) at a given $\omega = 0.6$ rad/s

Part C: Dynamic responses in the time domain

C1. plot the **open-loop** dynamic response to impulse, attach it here and give your comments

C2. plot the **closed-loop** dynamic response to an impulse in **set point**, attach it here and give your comments

C3. plot the **closed-loop** dynamic response to an impulse in **process disturbance** (input named **du)**, attach it here and give your comments

Part D:

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