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

PC No. _____

Section 4: STABILITY OF LINEAR DYNAMIC SYSTEMS

A dynamic process $G_p(s)$ has the following transfer function

$$G_p = \frac{\left(\frac{-n-0.25}{n+0.25}\right)^n}{\left(s^2 + \frac{n-0.5}{n+0.5}\right)}$$

where:

n = N. matricola (student ID No.)

I. How much is the **type g** for such as a system $G_p(s)$?

II. Is $G_p(s)$ a **minimum phase system**?

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

IV. Convert $G_p(s)$ into the **canonical form**

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.

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

A2. Is it a direct or inverse *root locus*?

A3. Calculate the limiting value/values K^*

A4. Calculate, if any, the value of **all closed loop poles** just corresponding at K^*

Part B: Frequency response

For the **dynamic system** $G_p(s)$,

and $\mathcal{K}c=1$,

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

B1) Plot the **Asymptotic Bode Diagrams** by means of ASBode in Matlab resources and attach them here

B2) Determine the low-frequency **asymptotic** values of **AR** and **ϕ**

B3) Determine the high-frequency **asymptotic** values of **AR** and **ϕ**

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

B5) Does a *resonance* frequency exist? How much is it?

B6) Decide if the **Bode stability criterion** is applicable

B7) If yes, is the above system closed-loop stable?

B8) Plot the **extended Nyquist diagram** *together with the unit circle and the Peak Response*, and attach it here

B9) Is the **Nyquist diagram** crossing the **critical point**?

B10) Check, on the base of the **Nyquist stability criterion**, if the above system is closed-loop stable

A measuring device is adopted with the following transfer function

$$G_m(s) = e^{-\frac{n-0.1}{n+0.1}s}$$

B11) How much is the **dead time**?

B12) Determine the **open loop** transfer function $G_{OL}(s)$

B13) Plot the **extended Nyquist diagram** of $G_{OL}(s)$ *together with the unit circle and the Peak Response*, and attach it here

B14) Check, on the base of the **Nyquist stability criterion**, if such a system $G_{OL}(s)$ will be closed-loop stable

B15) *Compare and comment* the two different **Nyquist diagrams** as obtained above

Part C: Dynamic responses in the time domain

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Part D:

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