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

PC No. ___________

Section 4: STABILITY OF LINEAR DYNAMIC SYSTEMS

A dynamic process G has the following transfer function

$$G \;=\frac{s+n}{s^2\left(s+\frac{n}{2}\right)}$$

where n = PC No.

I. Is $G_p(s)$ a **minimum phase system**?
II. How much is the **gain**?

Part A: *Root locus*

For the **system** G(s), plot the *root locus* by means of Matlab and SisoTool resources, attach it and answer here the following questions:

1. Determine poles, zeroes and No. of trajectories.
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

Part B: Frequency response

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

1) Plot the **Bode Diagrams** by means of Matlab resources, with a *log scale of the magnitude (NOT in dB),* and attach them here
2) Does a **resonance** frequency exist? How much is it?
3) Does a *crossover* frequency exist? How much is it?
4) Does a *gain crossover* frequency exist? How much is it?
5) Check, on the base of the Bode stability criterion, if the above system is closed-loop stable
6) Plot the **extended Nyquist diagram** *together with the unit circle* by means of Matlab resources and attach it here
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 **dynamic system** $G_p(s)$, by means of Matlab resources:

1) plot the **open-loop** dynamic response to a unit step, attach it here and give your comments
2) plot the **closed-loop** dynamic response to a unit step change in *set point*, attach it here and give your comments

Part D:

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