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

PC No. ____________

Section 4: STABILITY OF LINEAR DYNAMIC SYSTEMS

A linear dynamic process has the following transfer function:

$$G_p(s)=1.3889\frac{(n-0.05)}{(n+0.05)}\cdot\frac{(s+1)(s+0.8333)}{s(s+0.08333)/(s+0.1)}$$

where:

n = N. matricola (student ID No.)

I. Which **order** is the system $G_p(s)$?

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

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

Part A: *Root locus*

For the open loop TF $G_{OL}(s)$, use Matlab and SisoTool resources, attach here their results and answer the following questions:

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

A2. Calculate, if any, the **breakaway points** and discuss them

A3. Calculate, if any, the limiting value/values K^* and discuss them

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

A5. Provide an example of a completely different rational transfer function SYS(s) that has the root locus with the property that no trajectory lies on the real axis

Part B: Frequency response

For the same **dynamic system** $G_p(s)$
and ***Kc=1***,
use Matlab and SisoTool resources, attach here their results and answer the following questions:

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

B2)Does a *resonance* frequency exist? How much is it?

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

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

B5)Plot the extended Nyquist diagram together with *the unit circle and the Peak Response*, and attach it here

B6) Is the 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 $G_p(j\omega)$ as a **complex number** just corresponding to a phase angle $\phi=\pi$ rad

Part C: Dynamic responses in the time domain

For the same **dynamic system** $G_p(s)$
and ***Kc=1***,
use Matlab and SisoTool resources, attach here their results and answer the following questions:

C1) Plot the **open loop response** to an **impulse** input change**,** attach it here and give your comments

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

Part D:

= = =