A **System Theory - Midterm exam**

Name and group: _____

This exam is closed-books. Write your name on every page. Write clearly and legibly. Explain your work in words

P1 (1 point). Circle the right answer: (True OR False OR IDK - I Don't Know). (5 x 0.2 points, wrong answer: -0.1 points).

[True False IDK] A system having the poles: +1,-2 is stable.

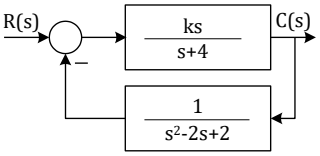
[True False IDK] The time constant of a system with a transfer function $\frac{1}{s+9}$ is 9.

[True False IDK] A second-order system with $\zeta>1$ has complex poles.

[True False IDK] The root locus is the geometrical locus of the closed-loop system poles when a parameter varies between 0 and infinity.

[True False IDK] The steady-state error is the difference between the input signal and the output signal in transient state.

P2 (2 points). Consider the feedback control system shown in the figure.



A) Determine the closed-loop transfer function from the input R(s) to the output C(s). (0.2p)

B) Determine the values of k for which the closed-loop system is stable. (0.5p)

C) For values of k for which the closed-loop system is stable determine the steady-state error for a unit step input ($r(t) =1,\ t\geq 0$).(0.5p)

D) Sketch the root locus for $k\in [0, \infty)$. (*Determine the location of the open-loop poles and zeros, the asymptotes, the intersection with the immaginary axis, the root locus plot*) (0.8p)

P3 (1 point). Match the following transfer functions with the unit step responses (0.2 points) and explain your choice (0.8 points):

$G_1(s) = \frac{9}{s^2+s+9}$ $G_2(s) = \frac{9}{s^2+9}$ $G_3(s) = \frac{1}{3s+1}$ $G_4(s) = \frac{1}{9s+1}$