B **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.

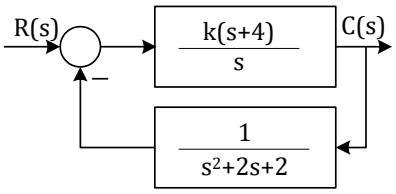
[True False IDK] The settling time of a first-order system is equal to one time constant.

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

[True False IDK] The root locus is the geometrical locus of the open-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 steady-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):

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