

Name and group: _____

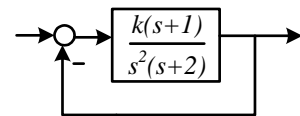
This exam is closed-books. Write your name on every page. Write clearly and legibly. Explain your work in words

P1 (0.8 points). Consider a system with the input $u(t)$ and the output $y(t)$, described by the following differential equation:

$$\frac{d^2 y(t)}{dt^2} + 2 \frac{dy(t)}{dt} + 2y(t) = u(t)$$

A) Determine the transfer function (0.3p). **B)** Determine the state-space model in the standard matrix form (0.5p)

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



A) Sketch the root locus for $k \in [0, \infty)$. (Determine the location of the open-loop poles and zeros, the asymptotes, the root locus plot) (1p)

B) Use the root locus to analyze the stability of the closed-loop system. (0.5p)

C) Determine the steady-state error of the closed-loop system for a unit **ramp** input. (0.5p)

P3 (1.2 points). Match the following transfer functions with the unit step responses (0.2 p) and explain your choice (1 p):

$$G_1(s) = \frac{10}{s+10}, \quad G_2(s) = \frac{1}{s+1}$$

$$G_3(s) = \frac{1}{s^2+1}, \quad G_4(s) = \frac{1}{s^2-1}$$

