B **System Theory - Midterm exam** **April 18, 2016**

Name and group: _____

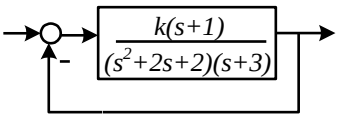
This exam is closed-books. Write your name on every page. Write clearly and legibly. Explain your work in words

P1 (0.8 points). Consider a system with the input *u(t)* and the output *y(t)*, described by the transfer function:

$$G(s) = \frac{2}{s^2 + 3s + 2}$$

A) Determine the poles and zeros (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 determine the values of k for which the closed-loop system is underdamped. (0.5p)

C) Choose a value for k for which the closed-loop system is stable and determine the steady-state error for a unit **step** 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):

$G_1(s) = \frac{1}{s^2+2s+1}$, $G_2(s) = \frac{1}{s^2+s+1}$

$G_3(s) = \frac{1}{s^2+0.2s+1}$, $G_4(s) = \frac{1}{s^2+1}$