# Computer Controlled Systems

2nd midterm test

2017. 05. 12.

*theoretical questions* (25 points)

(The answers can be given in Hungarian)

1. Consider the following transfer function:

$$H(s) = \frac{s+2}{s^2 + 9s + 20}$$

   (a) Assume that $u(t) = 5$, $\forall t \geq 0$. To which value will the output $(y)$ converge when $t \to \infty$? (In other words: determine $\lim_{t\to\infty} y(t)$.) (3p)

   (b) Determine the gain (in dB) and the phase (in rad) of $H(s)$ at the frequency $\omega = 0$ rad/s. (2p)

2. Briefly describe PID control (controller structure, transfer function, parameters, block scheme of the PID control loop). (5p)

3. Describe the problem statement of pole placement control design. (i.e., what are the known data and what is to be computed?). What kind of feedback is obtained? (5p)

4. Consider the following state space model:

$$\dot{x} = Ax + Bu, y = x_2,$$

   where $x(t) \in \mathbb{R}^3$, $u(t) \in \mathbb{R}^2$ $\forall t \geq 0$.

   (a) Write down the equations of the state observer corresponding to the model, and give the dimensions of the vectors and matrices of it. (3p)

   (b) Give the differential equations of the estimation error dynamics. (2p)

5. Consider the following transfer function:

$$H(s) = \frac{s^2 + 3s + 1}{s^3 + 3s^2 - 2s + 2}$$

   (a) Give the controller form realization of $H(s)$. (3p)

   (b) Can $H(s)$ be stabilized by an output feedback $u = -ky$, where $k \in \mathbb{R}$? (Why?) (2p)