Computer Controlled Systems
2nd midterm test
December 7, 2017
theoretical questions (25 points)
(The answers can be given in Hungarian)

1. Give the transfer function of a continuous time PID controller. What are the parameters of the controller? Draw the block scheme of a complete PID control loop, where a system with transfer function $G(s)$ is controlled. (5p)

2. What is the task of a state observer? Give the equations of a state observer for a continuous time LTI system given by the matrices (A, B, C). What are the known data, and what is to be computed and how? What are the input and output of a state observer? (5p)

3. Describe briefly the linear quadratic (LQR) control problem and its solution (objective function, design parameters, type of the obtained feedback, properties of the closed loop system). (No detailed computations or proofs are necessary.) (5p)

4. Give the general form of state space models for discrete time LTI systems with the dimensions of vectors and matrices. How do the matrices of the discrete time model depend on the (A, B, C) matrices of the continuous time model, if the sampling time is h and zero order hold is applied at the input? (5p)

5. Consider the following transfer function

$$H(s) = \frac{s^2 + 2s + 1}{s^4 + 2s^3 + as^2 - 3s + 1},$$

   where $a \in \mathbb{R}$.

   (a) Is there any choice of a such that $H(s)$ is asymptotically stable? Why? (2p)

   (b) For any finite value of a, is it possible to asymptotically stabilize $H(s)$ by a linear output feedback $u = -ky$, where $k \in \mathbb{R}$ is appropriately selected? Why? (3p)