Class: Sistem Pengaturan Berjaringan (EE185524)
Lecturer: Yurid E. Nugraha
Date and Time: 2023/06/09, 08.00–11.00
Rule: Take home

EAS 2022 Genap

Instruction: Choose five problems from Problems 2-6 below. Problem 1 is mandatory.

1. (**40%**) Design a scalar feedback system in discrete-time

$$x_{k+1} = \lambda x_k + u_k + v_k$$
$$y_k = x_k + w_k,$$

   where x_k is a state, u_k is a control signal, y_k is an output, v_k and w_k are measurement noise, and $\lambda > 1$. Suppose that there exists a uniform quantizer between the plant and the controller which makes the control signal affected by quantization error. Design a quantized-based feedback controller that can stabilize the system in a simple Matlab program. Explain how the program works and submit the m-file. (do not use simulink)

2. (**15%**) Explain a theorem that connects information theory with feedback control.

3. (**15%**) Describe the advantages and disadvantages of non-uniform quantization. Give an example in what situations non-uniform quantization may help in the context of networked control system.

4. (**15%**) Explain and give an example of a control signal that is sampled with frequency sampling $\omega_s < 2\omega_0$, i.e., does not satisfy Nyquist criterion. What are the consequences on the stability of the system? Give an example.

5. (**15%**) Let X be an fair octahedron dice with uniform probability distribution. Compute the entropy $H(X)$.

6. (**15%**) Describe what Mahler measure is in the context of control system. Give an example of Mahler measure of some system.