Control Systems Course, Academic Year 2012-2013

Dr. A. D'Innocenzo and Dr. G. Pola

Exam, January 8^{th} 2013

Available time: 2h

Ex1 Given a plant characterized by the transfer function

$$G(s) = \frac{1}{(s+1)},$$

design a control scheme and a controller $G_c(s)$ such that:

1. the closed loop system is astatic with respect to a ramp additive disturbance applied to the output of the plant $G(s)$;
2. the steady state error with respect to a parabola input is smaller than 10^{-6};
3. All poles of the closed loop system have real part smaller than -1.

Compute the output time signal of the obtained closed loop system for an impulse reference signal.

Ex2 Given an actuator A characterized by the following state space representation

$$\begin{aligned} \dot{x}_1(t) &= -2x_1(t) + x_2(t) + u(t), \\ \dot{x}_2(t) &= x_1(t) + u(t), \\ y(t) &= x_1(t) + x_2(t), \quad t \geq 0. \end{aligned}$$

and a plant G characterized by the transfer function $G(s) = \frac{1}{s+2}$, design a control scheme and a controller $G_c(s)$ such that:

1. the closed loop system is astatic with respect to a step additive disturbance applied to the output of the plant;
2. the steady state error with respect to a ramp input is smaller than 0.1.

Discuss the steady state behavior of the system with respect to polynomial additive disturbances applied to the input of the actuator.

Ex3 Discuss the stability property of linear feedback systems and the Routh-Hurwitz stability criterion, and provide one illustrative example.

Note: At the end of the exam you can decide either to give us your test or not. If you give us your test, your mark obtained in a previous test, regarding this part of the Control System course, is directly replaced by the mark obtained in the current test.