Control Systems Course, Academic Year 2012-2013

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

Mid Term Exam, December 4^{th} 2012

Available time: 2h

Ex1 Given a plant characterized by the transfer function

$$G(s) = \frac{s-1}{(s+1)(s+3)},$$

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 $G(s)$;
2. the steady state error with respect to a step input is smaller than 10^{-6};
3. All poles of the closed loop system have real part smaller than -2.

Compute the settling time T_s of the obtained system.

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

$$\begin{aligned} \dot{x}_1(t) &= -x_1(t) + x_2(t), \\ \dot{x}_2(t) &= u(t), \\ y(t) &= -3x_1(t) + x_2(t), \quad t \geq 0. \end{aligned}$$

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 between the actuator and the plant;
2. the steady state error with respect to a ramp input is smaller than $\frac{5}{9}$.

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

Ex3 Discuss the design specifications on the transient response of a feedback control system, and provide one illustrative example.