

Control Systems Course, Academic Year 2011-2012

Dr. A. D’Innocenzo and Dr. G. Pola

Final Test, December 21th 2011

Available time: 2h

Ex1 Consider the transfer function

$$P(s) = k \frac{(s+10)^2}{(s-1)^3(s-2)},$$

where k is a real parameter.

1. Sketch the root locus of $P(s)$.
2. Design a feedback controller so that the closed-loop system is bounded input bounded output stable.
3. Use the Routh criterion to establish values of k for which the closed-loop system is bounded input bounded output stable.

Ex2 Consider the system

$$\begin{aligned}\dot{x}(t) &= \begin{bmatrix} 2 & 0 \\ 3 & a \end{bmatrix} x(t), \\ y(t) &= \begin{bmatrix} 2 & a \end{bmatrix} x(t).\end{aligned}$$

1. Discuss the observability properties of the system for any $a \in \mathbb{R}$.
2. Set $a = 1$ and design a Luenberger observer so that the output of the observer converges to the state of the system with speed given by e^{-2t} .
3. For $a = -4$ is it possible to design a Luenberger observer with speed of convergence given by e^{-5t} ?

Ex3 Discuss the Eigenvalues Assignment Problem.