

Control Systems Course, Academic Year 2011-2012

Dr. A. D’Innocenzo and Dr. G. Pola

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Available time: 2h

Ex1 Consider the transfer function

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

where k is a real parameter.

1. Sketch the root locus of $P(s)$.
2. Evaluate the breakaway points of the root locus obtained.
3. Design a feedback controller so that the closed-loop system is bounded input bounded output stable.
4. 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

$$\dot{x}(t) = \begin{bmatrix} 1 & 2 \\ 0 & a \end{bmatrix} x(t) + \begin{bmatrix} 1 \\ a \end{bmatrix} u(t),$$

1. Discuss the reachability properties of the system for any $a \in \mathbb{R}$.
2. Set $a = 1$ and design a feedback controller $u = Kx$ so that the eigenvalues of the closed-loop system coincide with -1 .
3. For $a = -1$ is it possible to design a feedback controller $u = Kx$ so that the eigenvalues of the closed-loop system coincide with -1 ?

Ex3 Discuss the Luenberger Observer.