

Control Systems Course, Academic Year 2011-2012

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Part II Test, January 10th 2012

Available time: 2h

Ex1 Consider the transfer function

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

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

$$\begin{aligned}\dot{x}(t) &= \begin{bmatrix} 1 & 0 \\ 2 & a-1 \end{bmatrix} x(t), \\ y(t) &= \begin{bmatrix} 1 & a \end{bmatrix} x(t).\end{aligned}$$

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 $a = 0$ is it possible to design a Luenberger observer with speed of convergence given by e^{-2t} ?

Ex3 Definition and results on the reachability property of linear control systems.

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.