CALIFORNIA INSTITUTE OF TECHNOLOGY
Control and Dynamical Systems

CDS 210

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Problem Set #5

Issued: 3 Nov 08
Due: 10 Nov 08

Note: In the upper left hand corner of the *second* page of your homework set, please put the number of hours that you spent on this homework set (including reading).

1. (ÅM08, Exercise 8.6)

   Consider the linear state space system

   $$\frac{dx}{dt} = Ax + Bu, \qquad y = Cx.$$

   (a) Show that the transfer function is

   $$G(s) = \frac{b_1 s^{n-1} + b_2 s^{n-2} + \cdots + b_n}{s^n + a_1 s^{n-1} + \cdots + a_n},$$

   where

   $$b_1 = CB, \quad b_2 = CAB + a_1 CB, \quad \ldots, \quad b_n = CA^{n-1}B + a_1 CA^{n-1}B + \cdots + a_{n-1}CB$$

   and $\lambda(s) = s^n + a_1 s^{n-1} + \cdots + a_n$ is the characteristic polynomial for A.

   (b) Compute the transfer function for a linear system in reachable canonical form and show that it matches the transfer function given above.

2. Åström and Murray, Exercise 8.7

3. Åström and Murray, Exercise 8.11

4. Choose one of the following problems below:

   (a) Åström and Murray, Exercise 8.12
   (b) Åström and Murray, Exercise 8.14
   (c) Åström and Murray, Exercise 8.15

5. DFT 2.4

6. DFT 2.8