

E6201 Linear Systems

Homework 11 (due: Apr. 19)

1. (Appendix 33.1) Show  $(sI - A_c)^{-1}b_c = [s^{n-1} \ s^{n-2} \ \dots \ s \ 1]^T/a(s)$ , where

$$A_c = \begin{bmatrix} -a_1 & -a_2 & & -a_{n-1} & -a_n \\ 1 & 0 & & 0 & 0 \\ 0 & 1 & & 0 & 0 \\ & & \ddots & & \\ 0 & 0 & & 1 & 0 \end{bmatrix}, \quad b_c = \begin{bmatrix} 1 \\ 0 \\ \vdots \\ 0 \end{bmatrix}$$

and  $a(s) = \det(sI - A_c)$ .

2. Show  $\det(I + Abc^T) = 1 + c^T Ab$ .
3. (Example 3.3-6) Suppose  $\{A, b, c\}$  is a minimal realization. Can the observability of  $\{c, A\}$  be affected by
- Linear state feedback:  $u = v - k^T x$ ?
  - Linear output feedback:  $u = v - ly$ ?
  - Can the above results be generalized to non-minimal systems?
4. Kailath, exercise 3.3-1.