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(10/17/24)

ENG ME/EC 501:

Exercises (Set 4) (Due 10/24/24)

1. Problem 3.1 in Friedland (next page).

2. Find standard "controllable" and "observable" realizations for the transfer functions given in Problem 3.2 in Friedland.

3. Problem 3.3 in Friedland. (N.B. you must assume $s_i \neq s_j$ for $i \neq j$.)

Please turn over. -->>

PROBLEMS

Problem 3.1 Exercises in resolvents and transition matrices

Find the resolvents and transition matrices for each of the following:

$$(a)\quad A_1 = \begin{bmatrix} -1 & 0 & 0 \\ 1 & -2 & 0 \\ 1 & 2 & -3 \end{bmatrix}$$

$$(b)\quad A_2 = \begin{bmatrix} -1 & 0 & 0 \\ 1 & -1 & 0 \\ 0 & 1 & -1 \end{bmatrix}$$

$$(c)\quad A_3 = \begin{bmatrix} -2 & 1 & 1 \\ 1 & -2 & 1 \\ 1 & 1 & -2 \end{bmatrix}$$

Problem 3.2 Exercises on canonical forms

Determine the canonical forms (companion and Jordan) for each of the following transfer functions:

$$(a)\quad \mathsf{H}(s) = \frac{(s+2)(s+4)}{(s+1)(s+3)(s+5)}$$

$$(b)\quad \mathsf{H}(s) = \frac{s+2}{s[(s+1)^2+4]}$$

$$(c)\quad \mathsf{H}(s) = \frac{s+3}{(s+1)^2(s+2)}$$

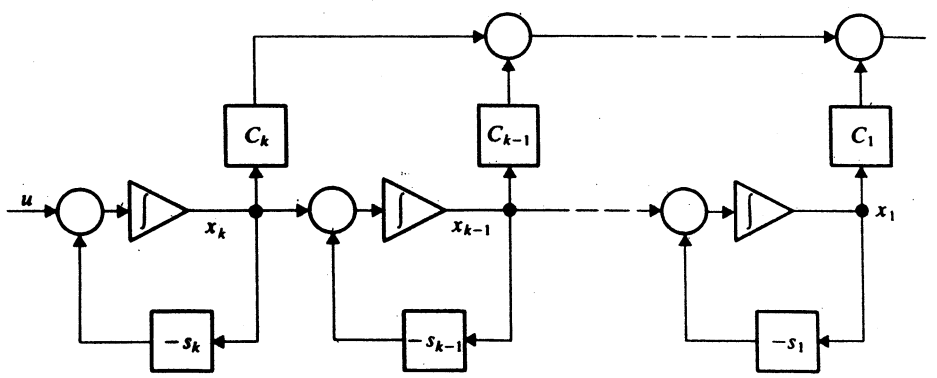

Figure P3.3 Tandem canonical form.

Problem 3.3 Another canonical form

An alternative to the Jordan canonical form for single-input, single-output systems is the "tandem form" shown in Fig. P3.3.

(*a*) Write the A, B, and C matrices for this form.

(*b*) Given the system in Jordan form $\dot{x} = \Lambda x + Bu$ where $\Lambda = \text{diag}[-s_1, -s_2, \ldots, -s_k]$, find the transformation matrix T that transforms it to the tandem form.