Cairo University
Faculty of Engineering
Elec. & Comm. Dept.

Sheet (6): SSR Canonical Forms

(1) For the system

$$\dot{\underline{x}} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} \underline{x} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u \quad , \; y = \begin{bmatrix} 1 & 2 \end{bmatrix} \underline{x}$$

Obtain the T.F. of the system and the Weighting function.

(2) Find a phase state space representation for the following systems

(a) $\dfrac{y(s)}{u(s)} = \dfrac{1}{(s+1)(s+3)}$

(b) $\dfrac{y(s)}{u(s)} = \dfrac{1}{2s^4 + s^3 + s^2 + 27s + 50}$

(c) $\dfrac{y(s)}{u(s)} = \dfrac{10s+1}{2s^3 + s^2 + s + 10}$

(d) $\dfrac{y(s)}{u(s)} = \dfrac{s^3 + 5s^2 + 6s + 4}{s^3 + s^2 + s + 1}$

(e) $\dddot{y} + 5\ddot{y} + 3\dot{y} + y = 2\dot{f}(t) + f(t)$

(3) For the following system find four different state space representations

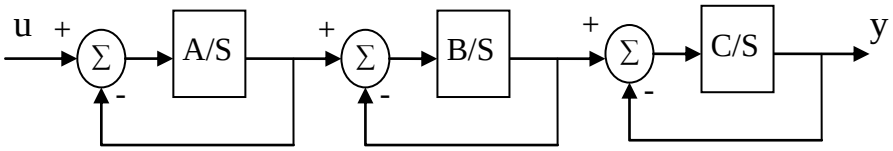
$$\frac{y(s)}{u(s)} = \frac{s^2 - 4s + 3}{s^3 + 6s^2 + 11s + 6}$$

(4) A certain system is described by the following set of DEs:

$$\ddot{y}_1 + \dot{y}_1 + 2y_1 - 2y_2 = u_1$$
$$\ddot{y}_2 - y_1 + y_2 = u_2$$

(a) Write the state and output equations of the system.
(b) Find the transfer function matrix between the outputs and inputs.

(5) Get a state space representation for the shown system directly from its block diagram.



(6) *(Jan 2004)* Consider the wiring diagram shown

(a) Write down the state and output equations.
(b) Convert the obtained state space representation in (a) into its diagonal form.
(c) Draw the wiring diagram of the obtained representation in (b).
(d) Knowing that $\begin{pmatrix} x_1(0) \\ x_2(0) \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$, find the response of the system due to a unit step input.