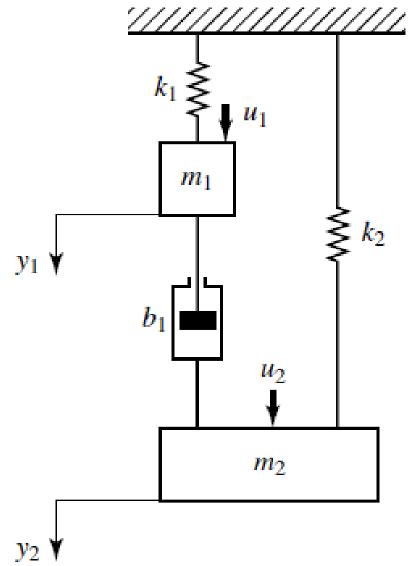
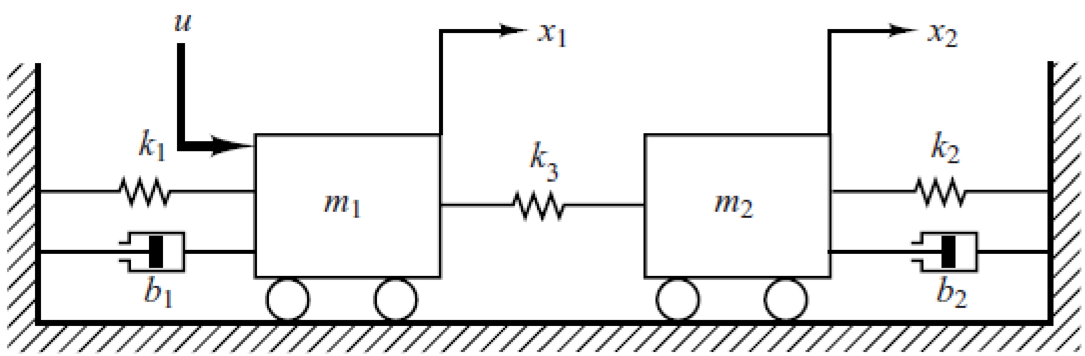
Assignment (   )

1- Obtain a state-space representation of the mechanical system shown in Figure P.1, where u_1 and u_2 are the inputs and y_1 and y_2 are the outputs.



2- Obtain the transfer functions $X_1(s)/U(s)$ and $X_2(s)/U(s)$ of the mechanical system shown in Figure P.2.



3- Consider the following transfer-function system:

$$\frac{Y(s)}{U(s)} = \frac{s+6}{s^2+5s+6}$$

Obtain the state-space representation of this system in (a) controllable canonical form and (b) observable canonical form.

4- Consider the system defined by

$$\dot{\mathbf{x}} = \mathbf{A}\mathbf{x} + \mathbf{B}u$$
$$y = \mathbf{C}\mathbf{x}$$

where

$$\mathbf{A} = \begin{bmatrix} -1 & 0 & 1 \\ 1 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \quad \mathbf{C} = [1 \quad 1 \quad 0]$$

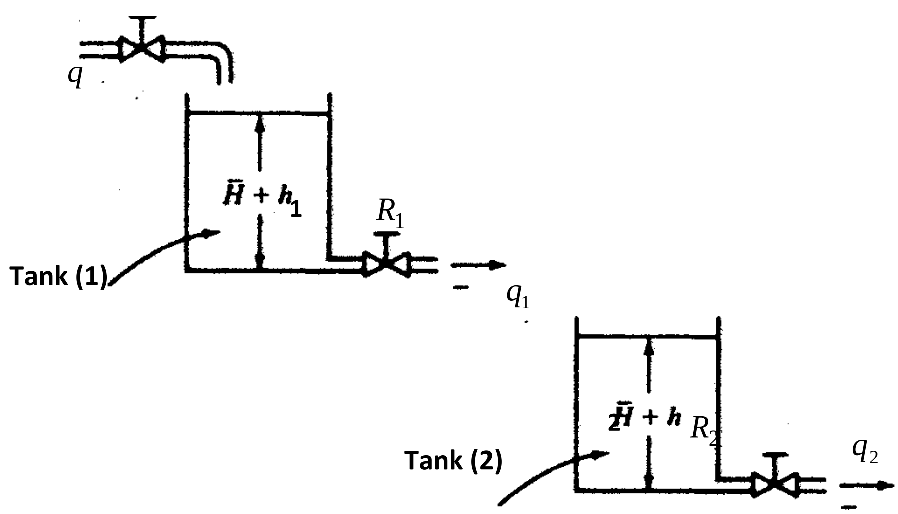
Obtain the transfer function Y(s)/U(s).

5- Is the following system completely state controllable and completely observable?

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$y = [20 \quad 9 \quad 1] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

6- For the liquid-level system shown in figure P.6, derive the state space model.



7- Refer to the mechanical system shown in fig. 7-a,b. Obtain the state-space model relating mass displacement y, to the applied force $f_o(t)$.

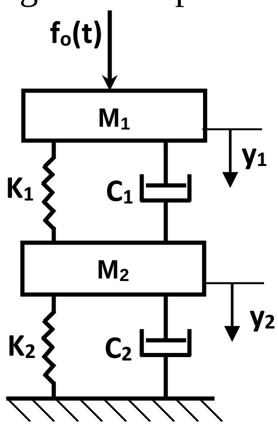


Figure (P.7-a)

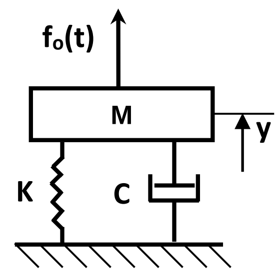
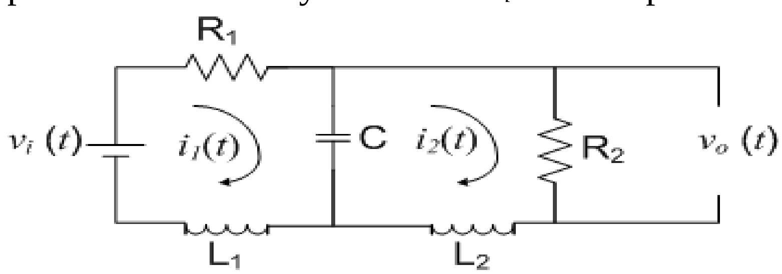


Figure (P.7-b)

8- Consider the electrical system shown in figure (P.8).

- Derive the state-space model of the system when v_i as the input and v_o as the output.

Figure (P.8)



9- Consider the dc servomotor system shown in Figure (P.9). Assume that the armature inductance is negligible. Obtain the state-space model relating where θ_2 is the output and $e_a(t)$ is the input.

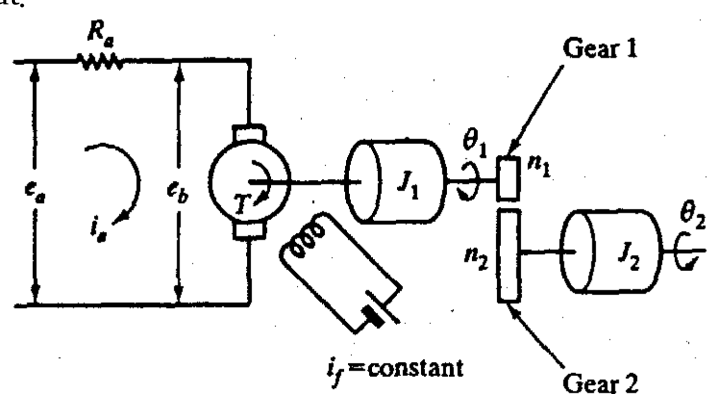


Figure (P.9) DC servomotor system

10-Consider a system described by:

$$\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \end{bmatrix} = \begin{bmatrix} 4 & 1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Study the stability of the system, Controllability of the system and the observability of the system.

11-Check the observability and controllability of following system,

$$\mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}, \quad \mathbf{A} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \quad \mathbf{C} = \begin{bmatrix} 4 & 5 & 1 \end{bmatrix}$$

12-Consider a system defined by

$$\mathbf{A} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 0 \\ 2 \end{bmatrix}, \quad \mathbf{C} = \begin{bmatrix} 1 & 0 \end{bmatrix}$$

It is desired to have eigenvalues at −3 and −5 by using a state-feedback control,

u=–Kx.

Determine the necessary feedback gain matrix K and the control signal u.