



Solution Sample
The Islamic University of Gaza-IUG
Electrical Engineering Department

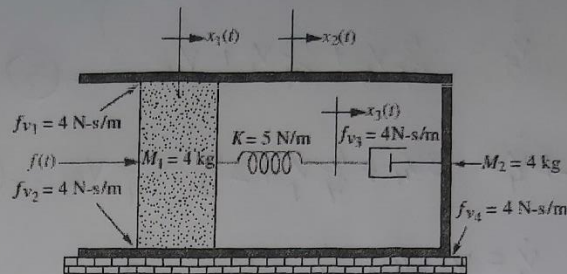


Linear Control Systems Quiz (1-A)

Name: ... ID: DIV: Mark:

Problem:

Represent the system shown in Figure in state space where the output is $x_3(t)$.



Solution:

$$f(t) = 4\ddot{x}_1 + 8\dot{x}_1 + 5x_1 - 8\dot{x}_2 - 5x_3$$

$$0 = 4\ddot{x}_2 + 16\dot{x}_2 - 8\dot{x}_1 - 4\dot{x}_3$$

$$0 = 4\ddot{x}_3 + 5\dot{x}_3 - 5\dot{x}_1 - 4\dot{x}_2$$

$$\ddot{x}_1 = \frac{1}{4}f(t) - 2\dot{x}_1 - 5/4x_1 + 2\dot{x}_2 + 5/4x_3$$

$$\ddot{x}_2 = -4\dot{x}_2 + 2\dot{x}_1 + \dot{x}_3$$

$$\dot{x}_3 = -5/4x_3 + 5/4x_1 + \dot{x}_2$$

* Assumptions:

$$v_1 = x_1, \quad v_2 = \dot{v}_1 = \dot{x}_1$$

$$v_3 = x_2, \quad v_4 = \dot{v}_3 = \dot{x}_2$$

$$v_5 = x_3$$

$$\dot{V}_2 = \frac{1}{4} f(t) - 2V_2 - \frac{5}{4}V_1 + 2V_4 + \frac{5}{4}V_5 \quad (2)$$

$$\dot{V}_4 = -4V_4 + 2V_2 + \dot{V}_5$$

$$\dot{V}_5 = -\frac{5}{4}V_5 + \frac{5}{4}V_1 + V_4 \quad (5)$$

$$\dot{V}_4 = -3V_4 + \frac{5}{4}V_1 + 2V_2 - \frac{5}{4}V_5 \quad (4)$$

$$\dot{V}_1 = V_2 \quad (1), \quad \dot{V}_3 = V_4 \quad (3)$$

$$Y(t) = V_5$$