Problem B–3–3

A ball is dropped from a point 100 m above the ground with zero initial velocity. How long will it take until the ball hits the ground? What is the velocity when the ball hits the ground?

Problem B–3–4

A flywheel of $J = 50$ kg-m^2 initially standing still is subjected to a constant torque. If the angular velocity reaches 20 Hz in 5 s, find the torque given to the flywheel.

Problem B–3–13

Obtain a mathematical model of the system shown in Figure 3–43. The input to the system is the angle θ_i and the output is the angle θ_o.

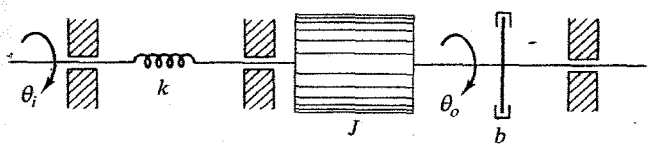

Figure 3–43 Mechanical system.

Problem B–3–14

Obtain a mathematical model for the system shown in Figure 3–44.

Problem B–3–15

Consider the system shown in Figure 3–45, where $m = 2$ kg, $b = 4$ N-s/m, and $k = 20$ N/m. Assume that $x(0) = 0.1$ m and $\dot{x}(0) = 0$. [The displacement $x(t)$ is measured from the equilibrium position.]

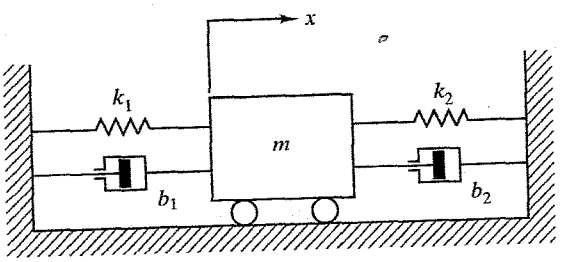

Figure 3–44 Mechanical system.

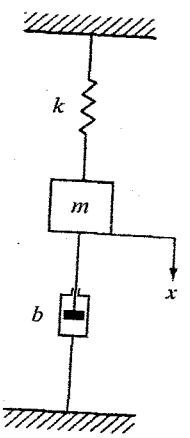

Figure 3–45 Mechanical system.

Problem B–4–4

In the mechanical system shown in Figure 4–53, the force u is the input to the system and the displacement x, measured from the equilibrium position, is the output of the system, which is initially at rest. Obtain the transfer function $X(s)/U(s)$.

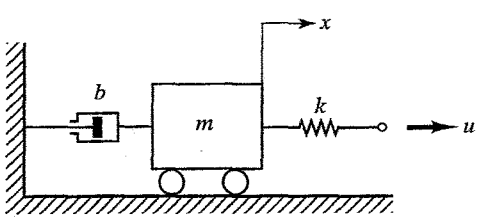

Figure 4–53 Mechanical system.

Problem B–4–12

Consider the mechanical system shown in Figure 4–59. The system is initially at rest. The displacements x_1 and x_2 are measured from their respective equilibrium positions before the input u is applied. Assume that $b_1 = 1$ N-s/m, $b_2 = 10$ N-s/m, $k_1 = 4$ N/m, and $k_2 = 20$ N/m. Obtain the displacement $x_2(t)$ when u is a step force input of 2 N. Plot the response curve $x_2(t)$ versus t with MATLAB.

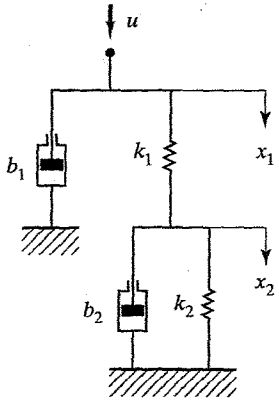

Figure 4–59 Mechanical system.

Problem B–4–15

The mechanical system shown in Figure 4–62 is initially at rest. The displacement x of mass m is measured from the rest position. At $t = 0$, mass m is set into motion by an impulsive force whose strength is unity. Using MATLAB, plot the response curve $x(t)$ versus t when $m = 10$ kg, $b = 20$ N-s/m, and $k = 50$ N/m.

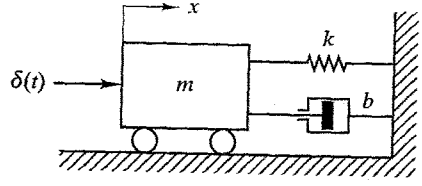

Figure 4–62 Mechanical system.