Problem B–3–16

By applying Newton's second law to the spring–mass–pulley system of Figure 3–33(a), obtain the motion of mass m when it is pulled down a short distance and then released. The displacement x of a hanging mass m is measured from the equilibrium position. (The mass, the radius, and the moment of inertia of the pulley are M, R, and $J = \frac{1}{2}MR^2$, respectively.)

Problem B–3–17

Consider the mechanical system shown in Figure 3–46. Two pulleys, small and large, are bolted together and act as one piece. The total moment of inertia of the pulleys is J. The mass m is connected to the spring k_1 by a wire wrapped around the large pulley. The gravitational force mg causes static deflection of the spring such that $k_1\delta = mg$. Assume that the displacement x of mass m is measured from the equilibrium position. Two springs (denoted by k_2) are connected by a wire that passes over the small pulley as shown in the figure. Each of the two springs is prestretched by an amount y.

Obtain a mathematical model of the system. Also, obtain the natural frequency of the system.

Problem B–3–18

A disk of radius 0.5 m is subjected to a tangential force of 50 N at its periphery and is rotating at an angular velocity of 100 rad/s. Calculate the torque and power of the disk shaft.

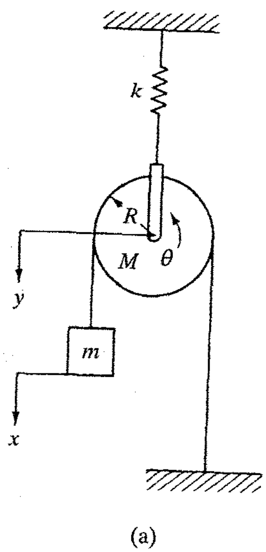

Figure 3–33 (a) Spring–mass–pulley system;

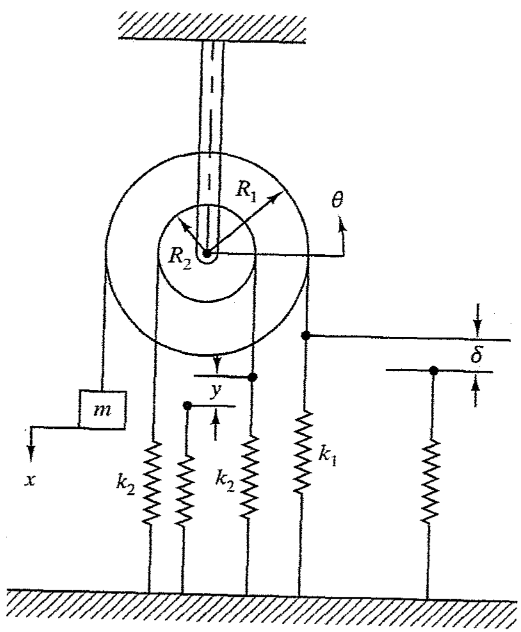

Figure 3–46 Mechanical system.

Problem B-4-6

Consider the mechanical system shown in Figure 4-55. The system is at rest for $t < 0$. The input force u is given at $t = 0$. The displacement x is the output of the system and is measured from the equilibrium position. Obtain the transfer function $X(s)/U(s)$.

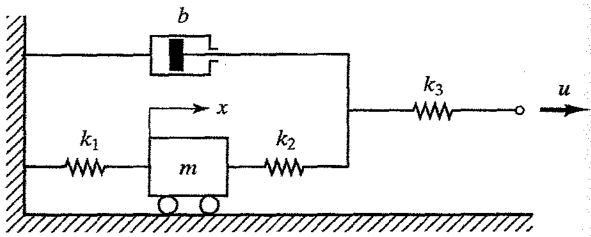

Figure 4-55 Mechanical system.

Problem B-4-11

Consider the mechanical system shown in Figure 4-58. Plot the response curve $x(t)$ versus t with MATLAB when the mass m is pulled slightly downward, generating the initial conditions $x(0) = 0.05$ m and $\dot{x}(0) = 1$ m/s, and released at $t = 0$. The displacement x is measured from the equilibrium position before m is pulled downward. Assume that $m = 1$ kg, $b_1 = 4$ N-s/m, $k_1 = 6$ N/m, and $k_2 = 10$ N/m.

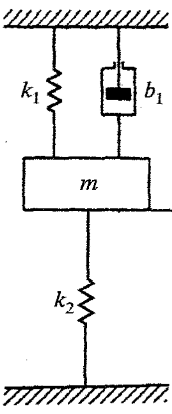

Figure 4-58 Mechanical system.

Problem B-4-17

Consider the system shown in Figure 4-64. The system is at rest for $t < 0$. Assume that the displacement x is the output of the system and is measured from the equilibrium position. At $t = 0$, the cart is given initial conditions $x(0) = x_o$ and $\dot{x}(0) = v_o$. Obtain the output motion $x(t)$. Assume that $m = 10$ kg, $b_1 = 50$ N-s/m, $b_2 = 70$ N-s/m, $k_1 = 400$ N/m, and $k_2 = 600$ N/m.

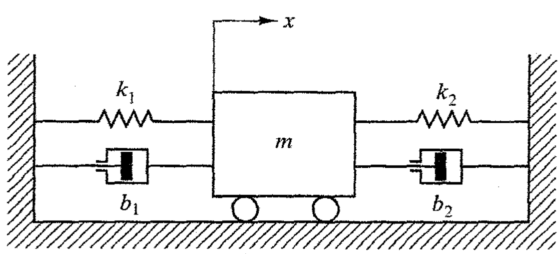

Figure 4-64 Mechanical system.