Eastern Mediterranean University
Faculty of Engineering
Department of Mechanical Engineering

Course: MENG331
Dynamics of Machinery

Instructor: Assistant Professor Dr. Mostafa Ranjbar

Homework # 1
Date: 24.10.2013
Deadline

1.7 Determine the equivalent spring constant of the system shown in Fig. 1.67.

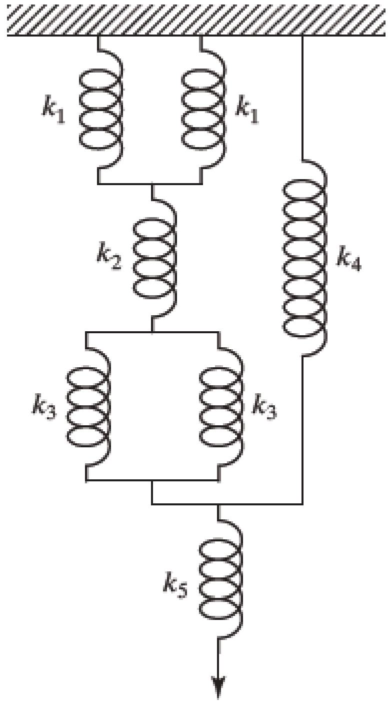

FIGURE 1.67 Springs in series-parallel.

1.18 The static equilibrium position of a massless rigid bar, hinged at point O and connected with springs k_1 and k_2, is shown in Fig. 1.74. Assuming that the displacement (x) resulting from the application of a force F at point A is small, find the equivalent spring constant of the system, k_e, that relates the applied force F to the displacement x as $F = k_e x$.

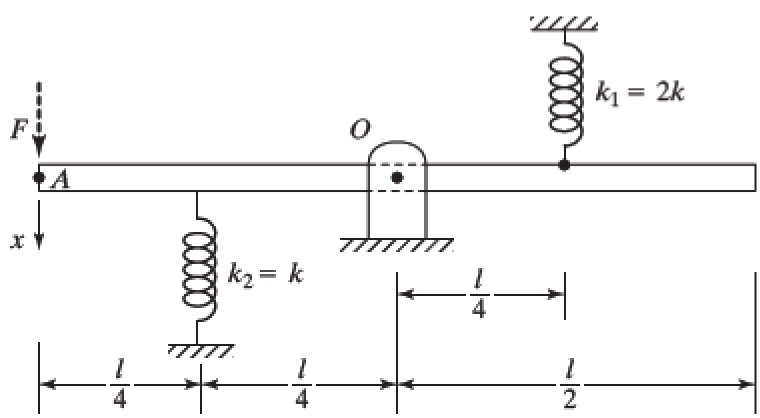

FIGURE 1.74 Rigid bar connected by springs.

1.20 Figure 1.76 shows a uniform rigid bar of mass m that is pivoted at point O and connected by springs of stiffnesses k_1 and k_2. Considering a small angular displacement θ of the rigid bar about the point O, determine the equivalent spring constant associated with the restoring moment.

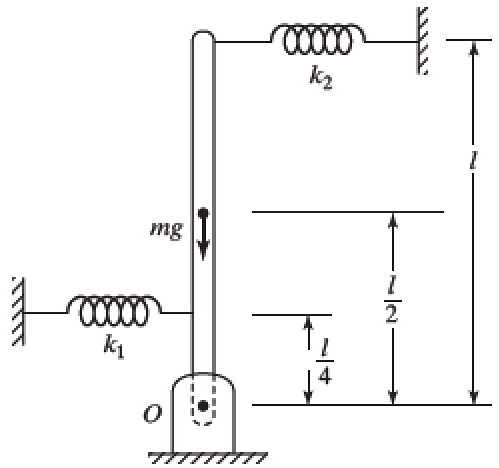

FIGURE 1.76 Rigid bar connected by springs.

1.31 Derive the expression for the equivalent spring constant that relates the applied force F to the resulting displacement x of the system shown in Fig. 1.86. Assume the displacement of the link to be small.

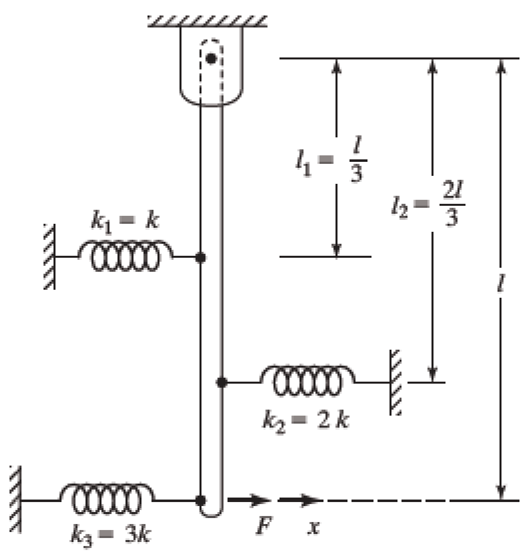

FIGURE 1.86 Rigid bar connected by springs.

1.55 Find a single equivalent damping constant for the following cases:

a. When three dampers are parallel.
b. When three dampers are in series.
c. When three dampers are connected to a rigid bar (Fig. 1.102) and the equivalent damper is at site c_1.

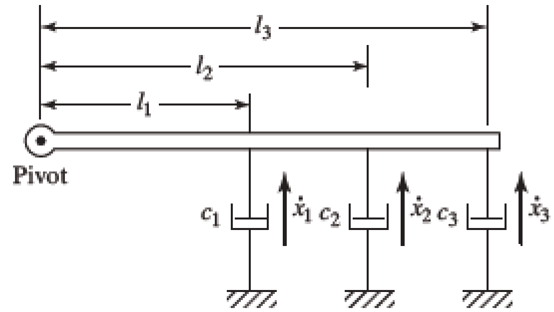

FIGURE 1.102 Dampers connected to a rigid bar.

2.7 Three springs and a mass are attached to a rigid, weightless bar PQ as shown in Fig. 2.51. Find the natural frequency of vibration of the system.

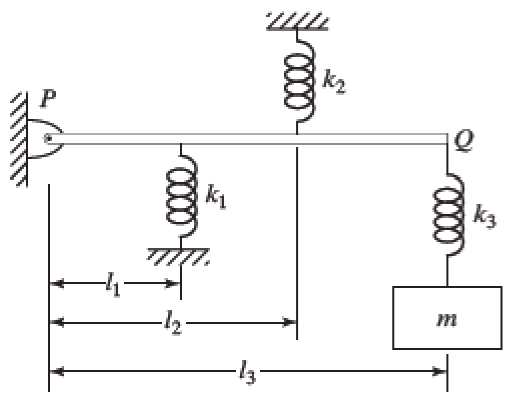

FIGURE 2.51

2.8 An automobile having a mass of 2,000 kg deflects its suspension springs 0.02 m under static conditions. Determine the natural frequency of the automobile in the vertical direction by assuming damping to be negligible.

2.9 Find the natural frequency of vibration of a spring-mass system arranged on an inclined plane, as shown in Fig. 2.52.

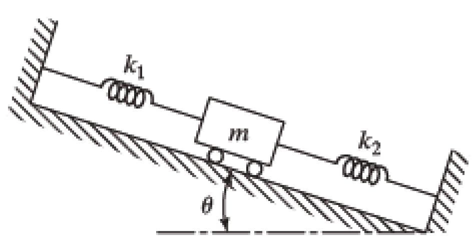

FIGURE 2.52

2.14 A weight W is supported by three frictionless and massless pulleys and a spring of stiffness k, as shown in Fig. 2.57. Find the natural frequency of vibration of weight W for small oscillations.

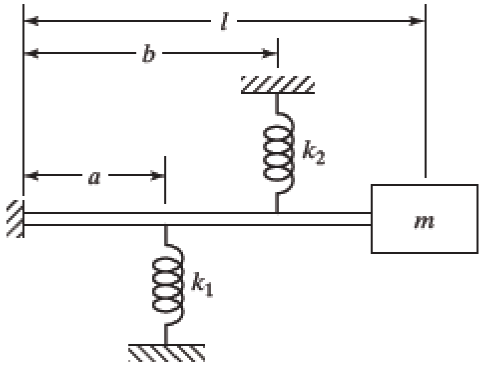

FIGURE 2.55

2.67 A mass m is attached at the end of a bar of negligible mass and is made to vibrate in three different configurations, as indicated in Fig. 2.91. Find the configuration corresponding to the highest natural frequency.

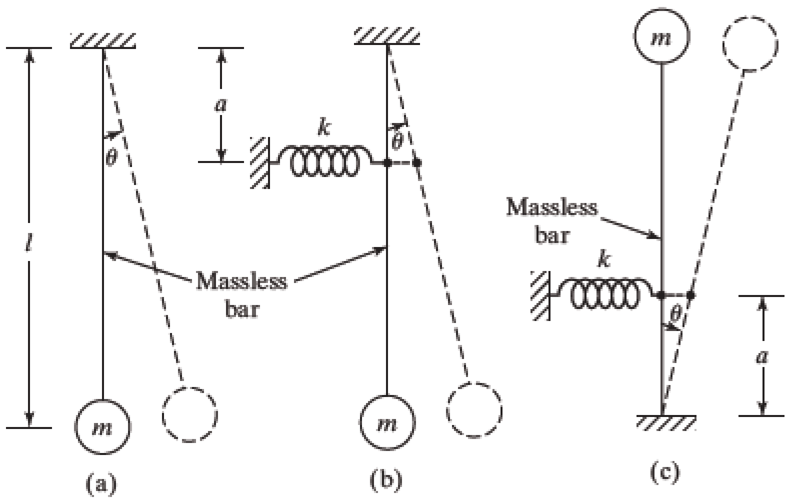

FIGURE 2.91

2.71 Find the natural frequency of the pendulum shown in Fig. 2.95 when the mass of the connecting bar is not negligible compared to the mass of the pendulum bob.

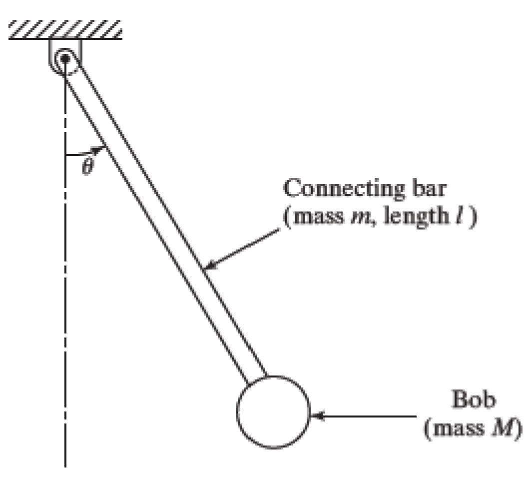

FIGURE 2.95

2.78 Derive the equation of motion of the system shown in Fig. 2.100, using the following methods: (a) Newton's second law of motion, (b) D'Alembert's principle, and (c) principle of virtual work.

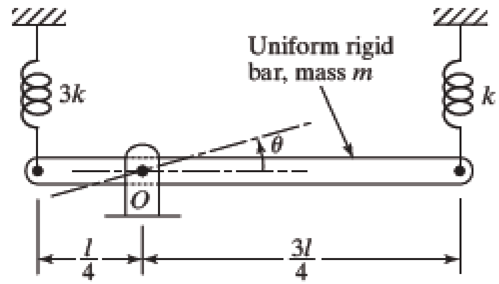

FIGURE 2.100

2.102 The free-vibration responses of an electric motor of weight 500 N mounted on different types of foundations are shown in Figs. 2.107(a) and (b). Identify the following in each case: (i) the nature of damping provided by the foundation, (ii) the spring constant and damping coefficient of the foundation, and (iii) the undamped and damped natural frequencies of the electric motor.

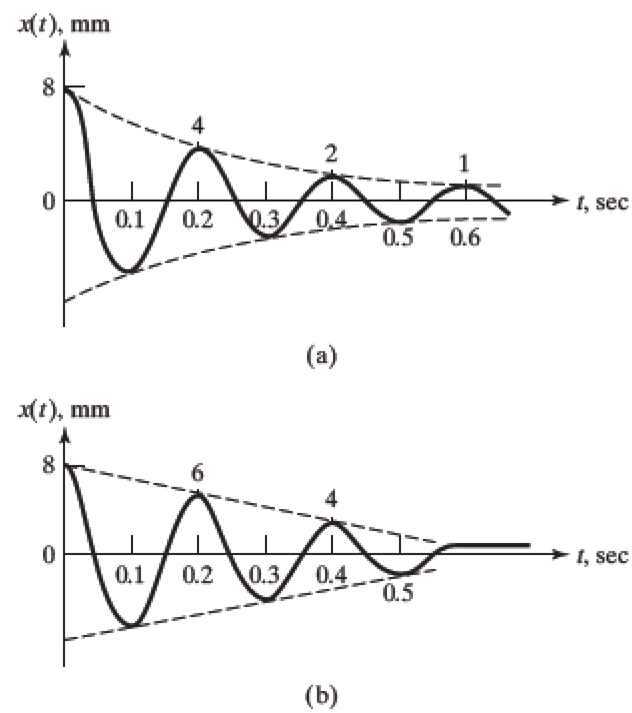

FIGURE 2.107

2.112–2.114 Derive the equation of motion and find the natural frequency of vibration of each of the systems shown in Figs. 2.110 to 2.112.

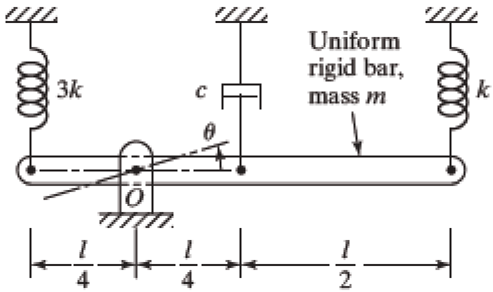

FIGURE 2.112