9.63 An air compressor of mass 200 kg, with an unbalance of 0.01 kg-m, is found to have a large amplitude of vibration while running at 1200 rpm. Determine the mass and spring constant of the absorber to be added if the natural frequencies of the system are to be at least 20 percent from the impressed frequency.

9.64 An electric motor, having an unbalance of 2 kg-cm, is mounted at the end of a steel cantilever beam, as shown in Fig. 9.50. The beam is observed to vibrate with large amplitudes at the operating speed of 1500 rpm of the motor. It is proposed to add a vibration absorber to reduce the vibration of the beam. Determine the ratio of the absorber mass to the mass of the motor needed in order to have the lower frequency of the resulting system equal to 75 percent of the operating speed of the motor. If the mass of the motor is 300 kg, determine the stiffness and mass of the absorber. Also find the amplitude of vibration of the absorber mass.

9.65* The pipe carrying feedwater to a boiler in a thermal power plant has been found to vibrate violently at a pump speed of 800 rpm. In order to reduce the vibrations, an absorber consisting of a spring of stiffness k_2 and a trial mass m_2' of 1 kg is attached to the pipe. This arrangement is found to give the natural frequencies of the system as 750 rpm and 1000 rpm. It is desired to keep the natural frequencies of the system outside the operating speed range of the pump, which is 700 rpm to 1040 rpm. Determine the values of k_2 and m_2 that satisfy this requirement.

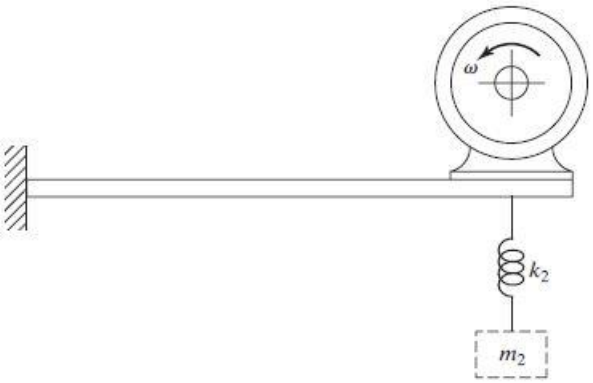

FIGURE 9.50

9.69* A rotor, having a mass moment of inertia $J_1 = 15$ kg-m^2, is mounted at the end of a steel shaft having a torsional stiffness of 0.6 MN-m/rad. The rotor is found to vibrate violently when subjected to a harmonic torque of 300 cos 200t N-m. A tuned absorber, consisting of a torsional spring and a mass moment of inertia (k_{t2} and J_2), is to be attached to the first rotor to absorb the vibrations. Find the values of k_{t2} and J_2 such that the natural frequencies of the system are away from the forcing frequency by at least 20 percent.

9.71 Determine the operating range of the frequency ratio ω/ω_2 for an undamped vibration absorber to limit the value of $|X_1/\delta_{st}|$ to 0.5. Assume that $\omega_1 = \omega_2$ and $m_2 = 0.1m_1$.

9.72 When an undamped vibration absorber, having a mass 30 kg and a stiffness k, is added to a spring-mass system, of mass 40 kg and stiffness 0.1 MN/m, the main mass (40 kg mass) is found to have zero amplitude during its steady-state operation under a harmonic force of amplitude 300 N. Determine the steady-state amplitude of the absorber mass.

9.73 An electric motor, of mass 20 kg and operating speed 1350 rpm, is placed on a fixed-fixed steel beam of width 15 cm and depth 12 cm, as shown in Fig. 9.52. The motor has a rotating unbalance of 0.1 kg-m. The amplitude of vibration of the beam under steady-state operation

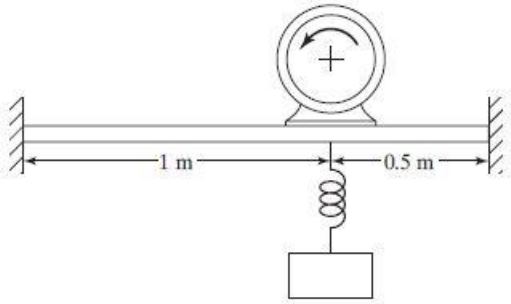

FIGURE 9.52

of the motor is suppressed by attaching an undamped vibration absorber underneath the motor, as shown in Fig. 9.52. Determine the mass and stiffness of the absorber such that the amplitude of the absorber mass is less than 2 cm.

9.74 A bridge is found to vibrate violently when a vehicle, producing a harmonic load of magnitude 600 N, crosses it. By modeling the bridge as an undamped spring-mass system with a mass 15,000 kg and a stiffness 2 MN/m, design a suitable tuned damped vibration absorber. Determine the improvement achieved in the amplitude of the bridge with the absorber.

Fonte: Rao, S.S. *Mechanical Vibrations*, 5th Ed., Prentice Hall, 2011