Supplementary Problems

6.17 Determine the steady-state amplitude of the 60-kg block of Fig. 6-7 if $F(t) = 250 \sin 40t$.

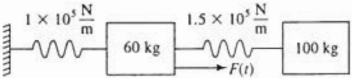

Fig. 6-7

Ans. 1.04×10^{-4} m

6.18 Determine the steady-state amplitude of the 100-kg block of Fig. 6-8 if $\omega = 80$ rad/s.

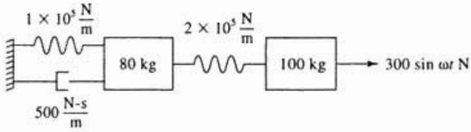

Fig. 6-8

Ans. 1.27×10^{-3} m

6.19 For what values of ω is the steady-state amplitude of the 100-kg block of Fig. 6-8 less than 1 mm?

Ans. $\omega > 81.0$ rad/s

6.20 Determine the steady-state amplitude of the 60-kg block of Fig. 6-9.

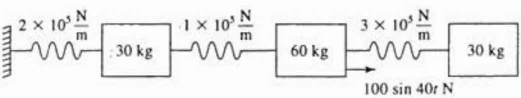

Fig. 6-9

Ans. 1.08×10^{-3} m

6.21 For what value of k is the steady-state amplitude of angular oscillation of the bar of Fig. 6-10 identically zero?

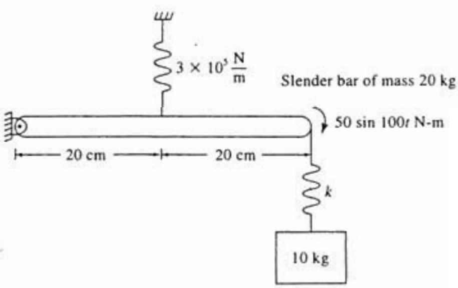

Fig. 6-10

Ans. 1×10^5 N/m

6.22 Use the Laplace transform method to solve Problem 6.17.

Ans. 1.04×10^{-4} m

6.29 Three 20-kg machines are equally spaced along the span of a 2-m simply supported beam of elastic modulus 200×10^9 N/m^2 and cross-sectional moment of inertia 1.35×10^{-6} m^4. The machine near the left support has a rotating unbalance of magnitude 0.5 kg-m and operates at 100 rad/s. Determine the steady-state amplitude of the machine at the midspan.

Ans. 0.0028 m

6.30 Repeat Problem 6.29 as if the system had proportional damping with the damping ratio for the lowest mode equal to 0.04. Assume the damping matrix is proportional to the stiffness matrix.

Ans. 0.0028 m

6.31 Use modal analysis to determine the steady-state amplitude of the 60-kg block of the system of Fig. 6-12.

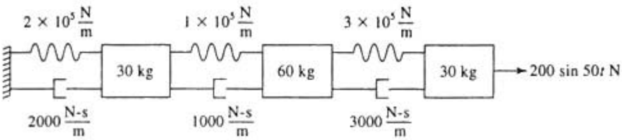

Fig. 6-12

Ans. 1.68×10^{-4} m

6.32 Use modal analysis to determine $x_1(t)$ for the system of Fig. 6-13 if the leftmost block is subjected to an impulse of magnitude 1 N-s at $t = 0$ and the rightmost block is subjected to an impulse of magnitude 1.5 N-s at $t = 0.1$ s.

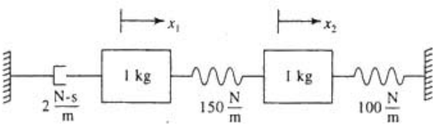

Fig. 6-13

Ans.

$$
\begin{aligned}
&e^{-0.660t}\{[-2.56 \times 10^{-3} \cos (6.647t) + 1.02 \times 10^{-1} \sin (6.47t)]\, u(t) \\
&\quad + [-4.11 \times 10^{-3} \cos (6.647t - 0.665) \\
&\quad + 1.64 \times 10^{-1} \sin (6.647t - 0.665)]\, u(t - 0.1)\} \\
&\quad + e^{-0.339t}\{[2.96 \times 10^{-3} \cos (18.893t) \\
&\quad - 1.79 \times 10^{-2} \sin (18.893t)]\, u(t) \\
&\quad + [3.91 \times 10^{-2} \sin (18.893t - 1.89) \\
&\quad + 3.91 \times 10^{-2} \sin (18.893t - 1.89)]\, u(t - 0.1)\}
\end{aligned}
$$