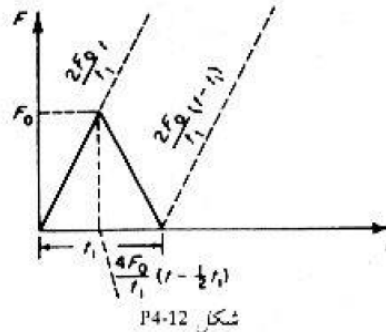


### بر انگیزش اختیاری

4-12 برای ضربه مثلثی نشان داده در شکل P4-12، نشان دهید که پاسخ چنین است:

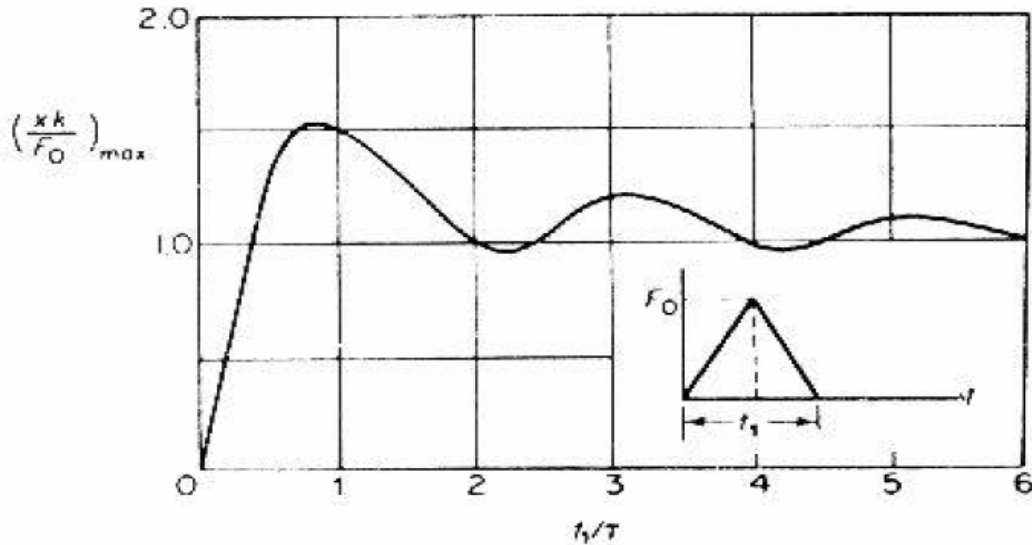
$$\begin{aligned}
 x &= \frac{2F_0}{k} \left( \frac{t}{t_1} \frac{\tau}{2\pi t_1} \sin 2\pi \frac{t}{\tau} \right) & 0 < t < \frac{1}{2} t_1 \\
 x &= \frac{2F_0}{k} \left\{ 1 - \frac{t}{t_1} + \frac{\tau}{2\pi t_1} \left[ 2 \sin \frac{2\pi}{\tau} \left( t - \frac{1}{2} t_1 \right) - \sin 2\pi \frac{t}{\tau} \right] \right\} & \frac{1}{2} t_1 < t < t_1 \\
 x &= \frac{2F_0}{k} \left\{ \frac{\tau}{2\pi t_1} \left[ 2 \sin \frac{2\pi}{\tau} \left( t - \frac{1}{2} t_1 \right) - \sin \frac{2\pi}{\tau} (t - t_1) - \sin 2\pi \frac{t}{\tau} \right] \right\} & t > t_1
 \end{aligned}$$



4-21 برای ضربه مثلثی که در مدت  $t_1$  نشان دهید هنگامی که  $\frac{t_1}{\tau} = \frac{1}{2}$  است، پاسخ بیشینه در  $t = t_1$  رخ می دهد و می توان آن را از معادله زیر یافت:

$$2 \cos \frac{2\pi t_1}{\tau} \left( \frac{t_p}{t_1} - 0.5 \right) - \cos 2\pi \frac{t_1}{\tau} \left( \frac{t_p}{t_1} - 1 \right) - \cos \frac{2\pi t_1}{\tau} \frac{t_p}{t_1} = 0$$

این را می توان با دیفرانسیل گیری از معادله تغییر مکان در بازه  $t > t_1$  به دست آورد. پاسخ طیف برای ضربه مثلثی در شکل P4-21 نشان داده شده است.



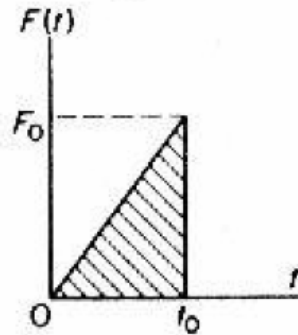
شکل P4-21

4-23 یک سیستم جرم-فنر نامیرا با نیروی تحریک مانند شکل P4-23 است. نشان دهید که:

$$\frac{kx(t)}{F_0} = \frac{1}{\omega_n t_0} (\omega_n t - \sin \omega_n t) \quad t < t_0$$

$$\frac{kx(t)}{F_0} = \frac{1}{\omega_n t_0} [\sin \omega_n (t-t_0) - \sin \omega_n t] + \cos \omega_n (t-t_0) \quad t > t_0$$

$$F = F_0 \frac{t}{t_0} \quad t < t_0 \quad F = 0 \quad t > t_0 \quad h(t) = \frac{1}{m\omega_n} \sin \omega_n t$$



شکل P4-23

4.10–4.16. A machine tool of mass 30 kg is mounted on an undamped foundation of stiffness 1500 N/m. During operation it is subject to one of the machining forces shown. Use the principle of superposition and the convolution integral to determine the response of the system to each force.

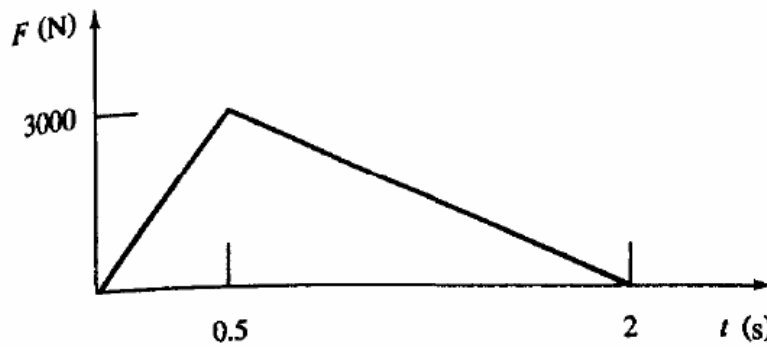
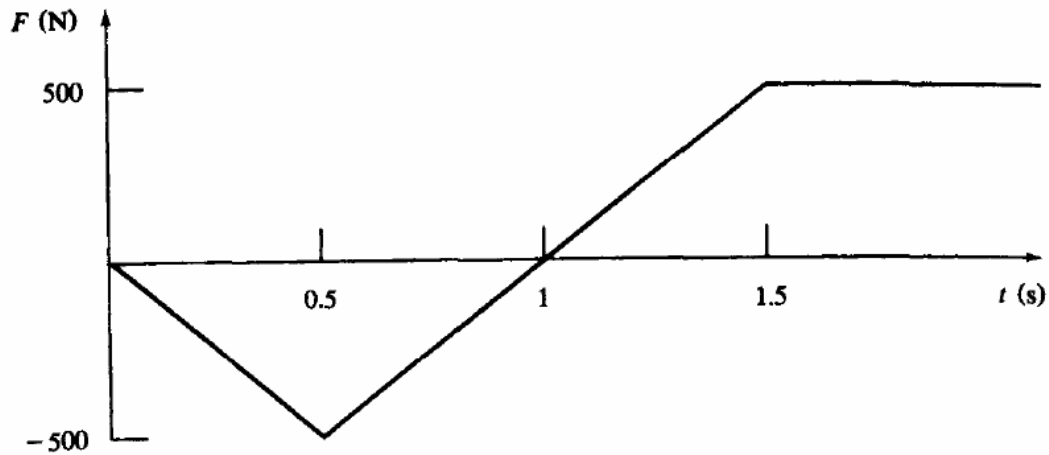
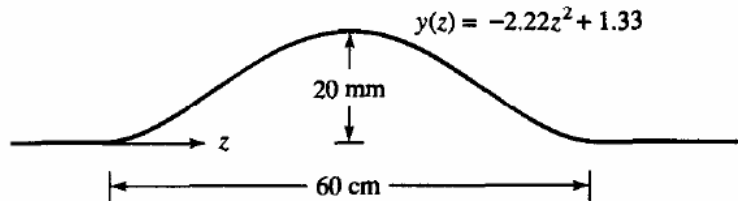


FIGURE P4.10



**FIGURE P4.14**

- 4.20–4.23. A 500-kg vehicle is traveling at 45 m/s when it encounters a pothole or bump in the road, as illustrated. The deflection of the suspension spring under the weight of the vehicle is 7.2 mm. The shock absorber has a damping ratio of 0.3. Using a one-degree-of-freedom system to model the vehicle and its suspension system, approximate the maximum vertical displacement of the vehicle, assuming it maintains its horizontal speed as it encounters the pothole or bump.



**FIGURE P4.23**