Chapter 15 Figures From

MATHEMATICAL METHODS for Scientists and Engineers

Donald A. McQuarrie

For the Novice Acrobat User or the Forgetful

When you opened this file you should have seen a slightly modified cover of the book *Mathematical Methods for Scientists and Engineers* by Donald A. McQuarrie, a menu bar at the top, some index markers at the left hand margin, and a scroll bar at the right margin.

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In the upper right hand corner margin of the window containing this text you should see a few small boxes. DO NOT move your mouse to the box on the extreme right and click in it; your window will disappear! Move your mouse to the second box from the right and click (or left click); the window containing this text should enlarge to fill the screen. Clicking again in this box will shrink the window; clicking again will return the display to full screen.

The prefered means of navigation to any desired figure is controlled by the scroll bar in the column at the extreme right of the screen image. Move your mouse over the scroll bar slider, click, and hold the mouse button down. A small window will appear with the text "README (2 of 39)". Continuing to hold down the mouse button and dragging the button down will change the text in the small window to something like "15.4 (6 of 39)". Releasing the mouse button at this point moves you to Figure 15.4 of Chapter 15. The (6 of 39) indicates that Figure 15.4 resides on page 6 of the 39 pages of this document.

ANIMATIONS

Several figures in this chapter have an associated animation that requires QuickTime™ for display. The names of the animation files are Anim15_3.mov, Anim15_4.mov, Anim15_6.mov, Anim15_7.mov, Anim15_9.mov, Anim15_11.mov, Anim15_15.mov, Anim15_18.mov, Anim15_24.mov, Anim15_25.mov, Anim15_27.mov, Anim15_29.mov, Anim15_31.mov, and Anim15_32.mov. Each of the animatin files must be independently downloaded from the server.

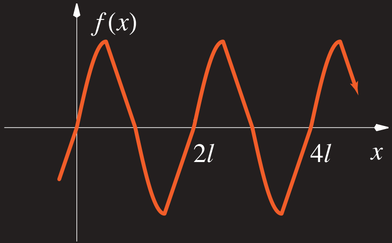

Figure 15.1
A periodic function with period $2l$.

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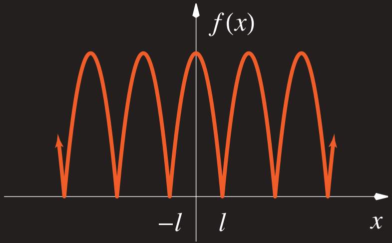

Figure 15.2
The periodic function defined by $f(x) = l^2 - x^2$ for $[-l, l)$ and $f(x + 2l) = f(x)$ outside of this interval.

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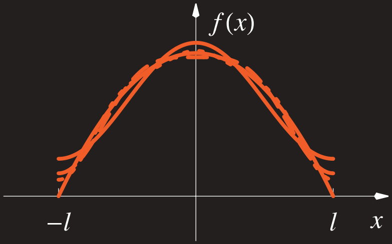

Figure 15.3
The function $f(x) = l^2 - x^2$ for $(-l, l)$ (solid) together with its 1(solid), 2(dashed), and 3 (dotted) partial sums of the series in Example 1.

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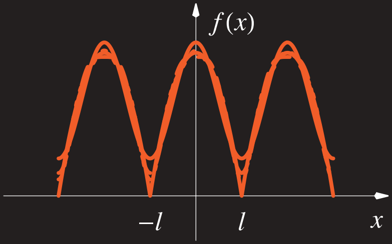

Figure 15.4
The periodic extension of the functions plotted in Figure 15.3.

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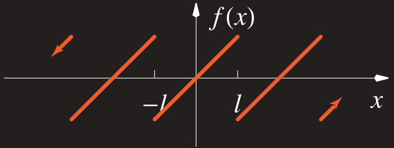

Figure 15.5
The periodic function defined by $f(x) = x$ for $[-l, l)$ and $f(x) = f(x + 2l)$ outside of this interval.

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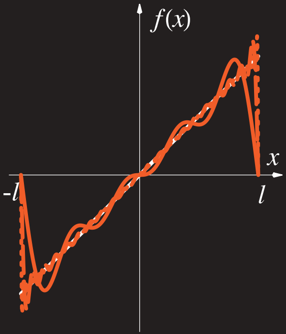

Figure 15.6

The function $f(x) = x$ (solid) on $(-l, l)$ together with its 4 (solid), 20 (dashed), and 100 (dotted) partial sums of the series in Example 2 plotted over the interval $(-l, l)$.

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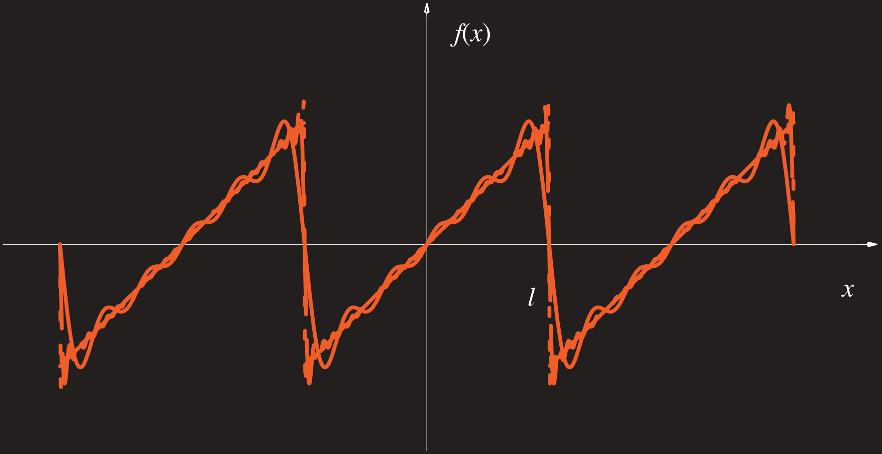

Figure 15.7
The Fourier series representation of the function $f(x)$ given in Example 1 over the interval $(-3l, 3l)$.

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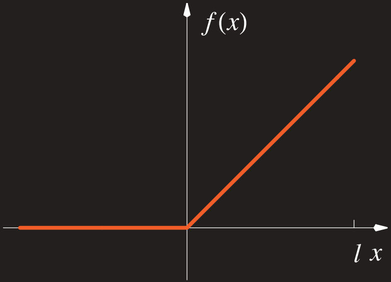

Figure 15. 8
The function $f(x)$ from Example 3.

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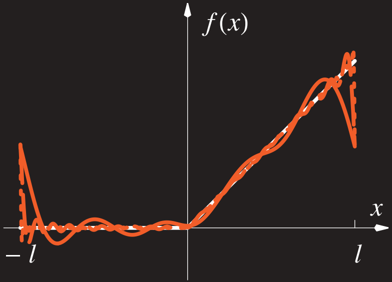

Figure 15.9
The function $f(x)$ (solid) from Example 3 together with 4 (solid color), 20 (dashed color), and 100 (dotted color) partial sums of the series in Example 3 plotted over the interval $(-l, l)$.

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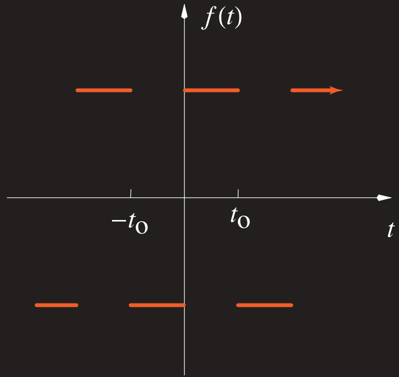

Figure 15.10
A square wave of period $2t_0$.

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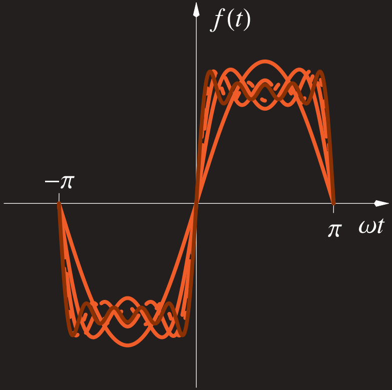

Figure 15.11
The first five partial sums of the Fourier series of the square wave in Figure 15.10 plotted against ωt.

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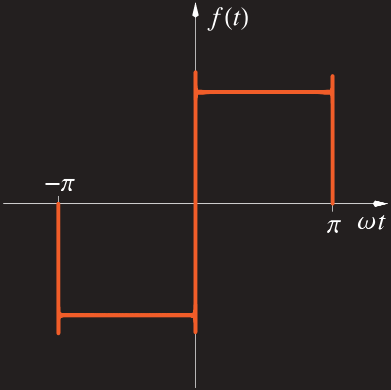

Figure 15.12
The partial sum consisting of 1000 terms of the square wave in Figure 15.10 plotted against ωt.

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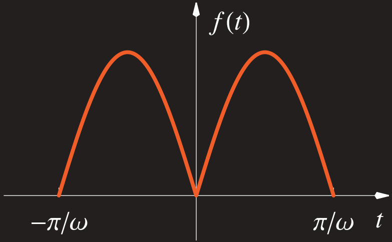

Figure 15.13
The rectified sine wave $f(x) = |\sin \omega t|$ for one period of the sine function.

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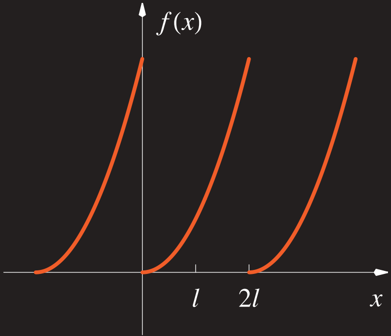

Figure 15.14
The function defined on the interval $(0, 2l)$ by $f(x) = x^2$ and $f(x + 2l) = f(x)$.

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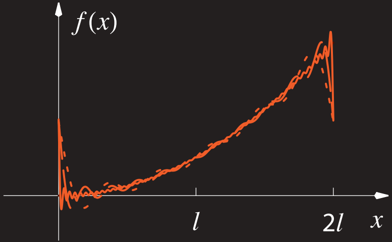

Figure 15.15
The function $f(x) = x^2$ (white) and the partial sums consisting of 5 terms (dotted color), 10 terms (long dashed color) and 50 terms (solid color) of the Fourier series representation of $f(x)$.

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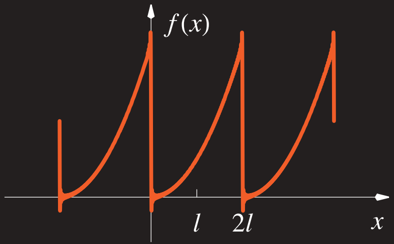

Figure 15.16
The Fourier series representation of $f(x)$ in Figure 15.15, showing that the Fourier series representation is a periodic function of period $2l$.

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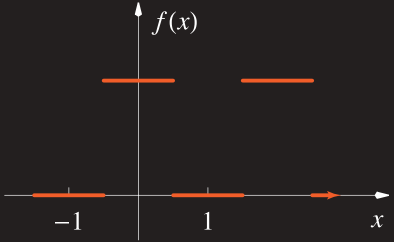

Figure 15.17
The function $f(x)$ of Example 5.

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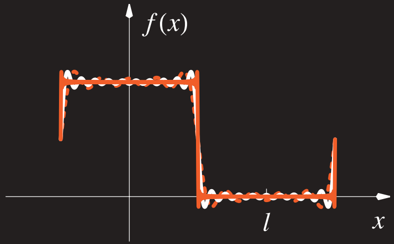

Figure 15.18

The partial sums of the Fourier series representation of $f(x)$ given in Example 5 consisting of 5(dotted), 10(solid white), and 100 (solid color) terms.

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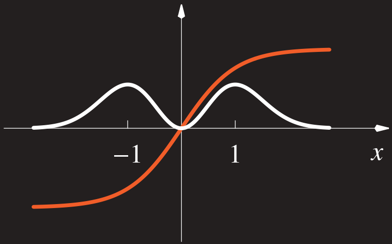

Figure 15.19
An even function (white) and an odd function (color) plotted against x.

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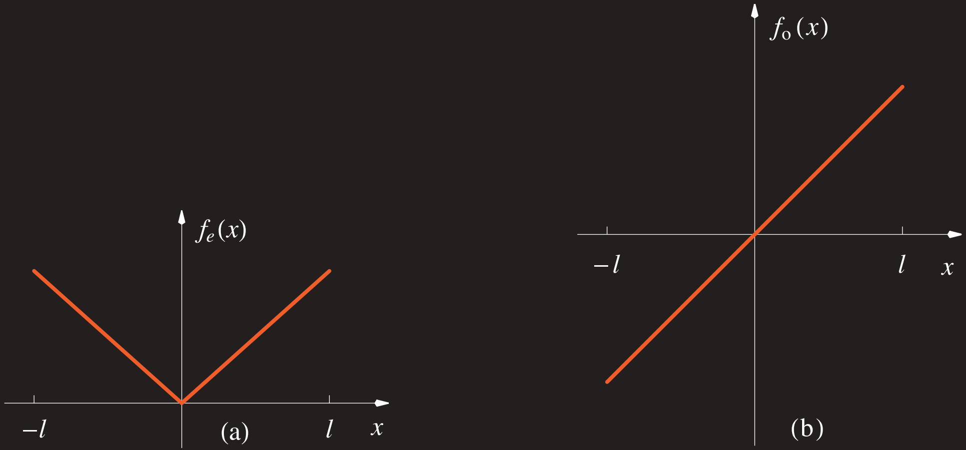

Figure 15.20
(a) The even extension of $f(x) = x$ in the interval $[0, l)$ plotted against x. (b) The odd extension of $f(x) = x$ in the interval $[0, l)$ plotted against x.

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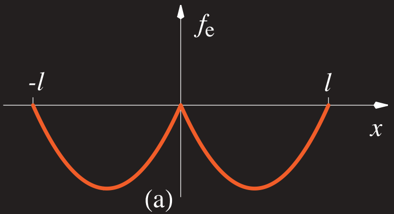

Figure 15.21
The (a) even and (b) odd extension of $f(x)$ defined by x^2 - x on $[0, l)$ plotted against x for $[-l, l)$.

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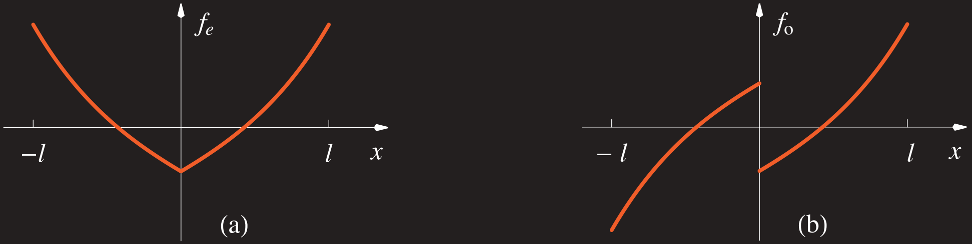

Figure 15.22
The (a) even and (b) odd extension of $f(x)$ defined in Example 1.

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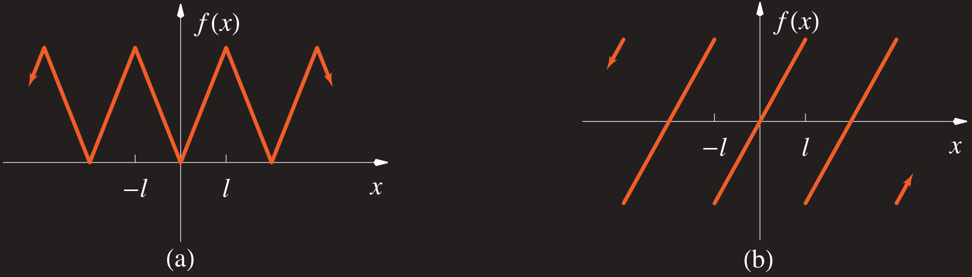

Figure 15.23
(a) The function $f(x) = x$ defined on $[0, l)$ made periodic by forming its even extension and then letting $f(x + 2l) = f(x)$. (b) The function $f(x) = x$ defined on $[0, l)$ made periodic by forming its odd extension and then letting $f(x + 2l) = f(x)$.

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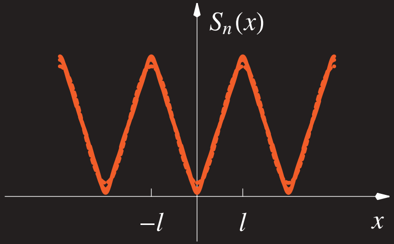

Figure 15.24
The partial sums of the function $f_e(x)$ defined by Equation 5 consisting of 1 (dotted), 2 (dashed), and 3 (solid) terms in Equation 7.

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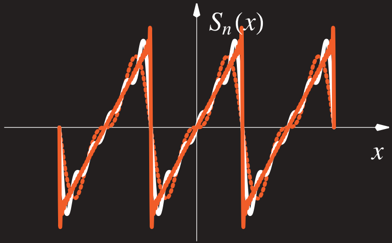

Figure 15.25
The partial sums of the function $f_o(x)$ defined by Equation 6 consisting of 5 (dotted), 10 (white), and 50 (solid) terms in Equation 8.

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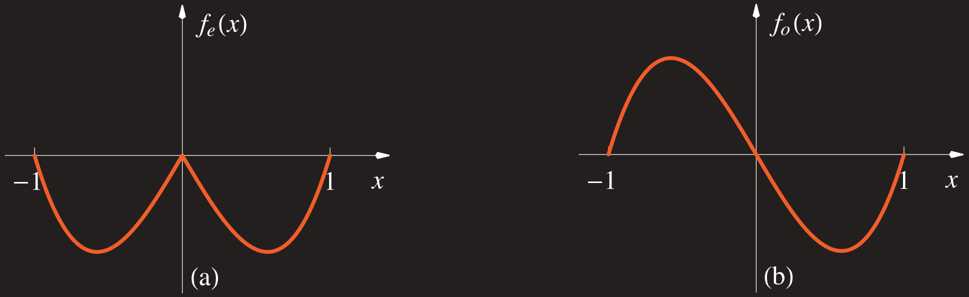

Figure 15.26
The (a) even and (b) odd extensions of $f(x)$ defined in Example 2.

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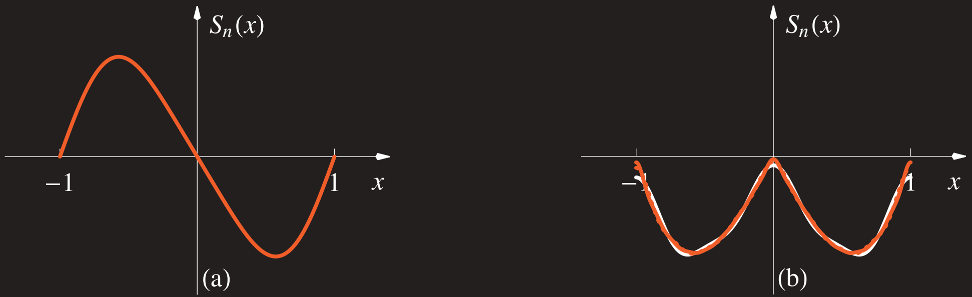

Figure 15.27
(a) The Fourier series of the odd extension of the function defined in Example 2 and the partial sums of Equation 9 containing just two terms. (b) The Fourier series of the even extension of the function defined in Example 2 and the partial sums of Equation 10 consisting of 4 terms (white), 8 terms (dotted), and 16 terms (solid color).

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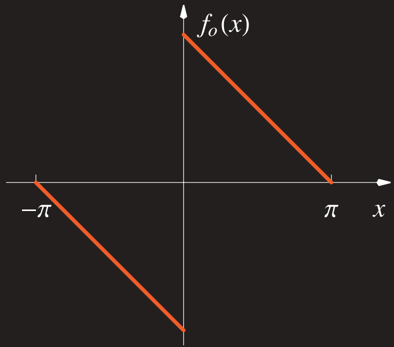

Figure 15.28
The odd extension of the function defined in Example 3 plotted against x.

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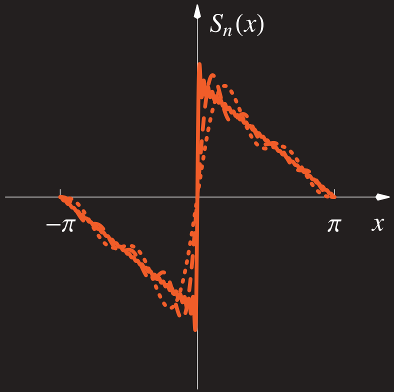

Figure 15.29
The odd extension function defined in Example 3 (color) and the partial sums of its Fourier series representation consisting of 4 (dotted), 8 (dashed), and 64 terms (solid).

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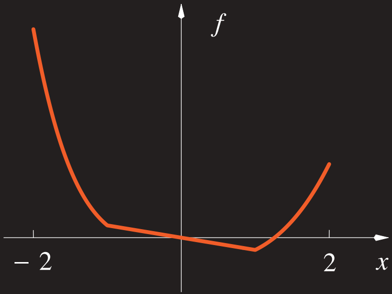

Figure 15.30
A plot of the piecewise continuous function,

$$f(x) = \begin{cases} x^4 - x - 1 & -2 \le x < -1 \\ -x & -1 \le \mathrm{x} < 1 \\ x^3 - 2 & 1 \le x < 2 \end{cases}$$

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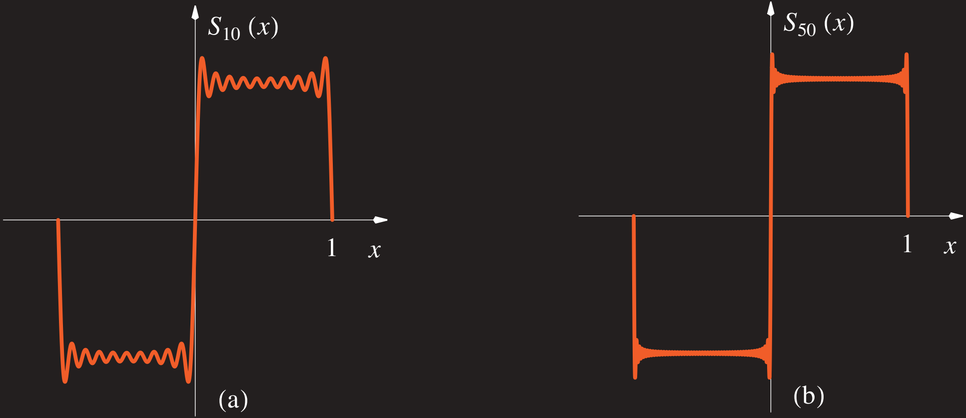

Figure 15.31
(a) The sum of the first 10 terms in Equation 15 plotted against x. (b) The sum of the first 50 terms in Equation 15 plotted against x.

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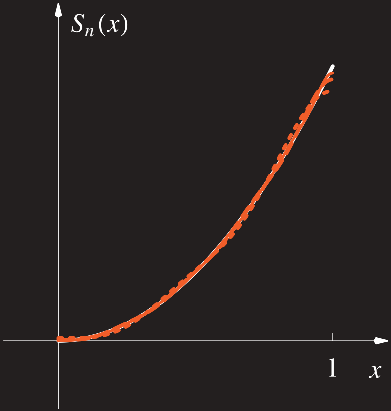

Figure 15.32
The function $f(x) = x^2$ (white) and the partial sums of the Fourier series in Example 3 consisting of 4 (dotted color), 8 (dashed color), and 16 (solid color) terms.

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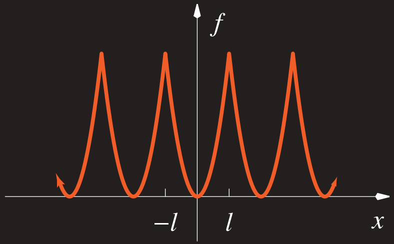

Figure 15.33
The periodic function $f(x) = x^2$, $-l \le x < l$. and its periodic extension defined by $f(x + 2l) = f(x)$.

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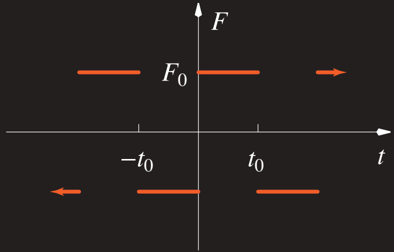

Figure 15.34

A plot of the piecewise continuous function,

$$F(t) = \begin{cases} -F_0 & -t_0 \leq t < 0 \\ F_0 & 0 \leq t < t_0 \end{cases} \quad \text{and}$$

$F(t = 2\ t_0) = F(t)$ plotted against t.

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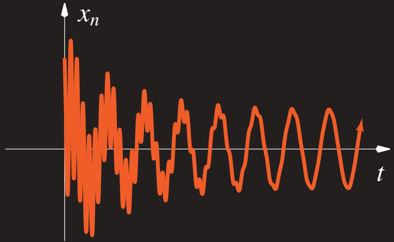

Figure 15.35
A plot of Equation 13, the general solution to Equation 11 plotted against time.

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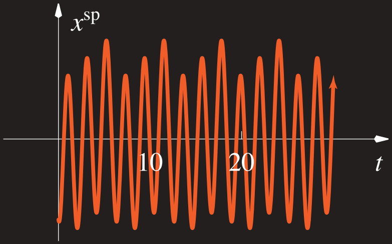

Figure 15.36
The steady periodic solution (Equation 17) of Equation 11 with the periodic forcing term shown in Figure 15.34. The values of the parameters in Equation 17 are $m = 1$, $\gamma = 1/10$, $k = 9$, and $\omega = 1$.

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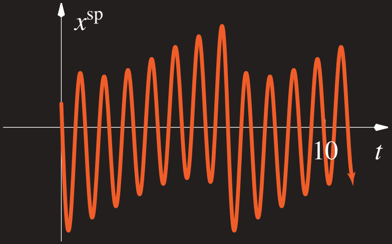

Figure 15.37
The steady periodic solution (Equation 17) of Equation 11 with $m = 2$, $\gamma = 0.10$, $k = 100$, and $\omega = 1$, as in Example 3. Note that the soluion oscillates about eleven times in the time interval (0, 10), which corresponds to $2\pi/\tau \approx 7$.

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