NOTE:
I would greatly appreciate to be notified of any typographical errors in the textbook, the slides for the textbook, and the solutions of the end-of-chapter problems found at this website. Comments and suggestions for the next edition are especially welcome.

Author

Preface

- **Page xxiii** Replace line –7 (a negative number indicates lines from the bottom of the page) by the following:
  between pages 454 and 455 for more details. The software can be downloaded from the textbook’s website:

Chapter 2

- **Page 58** The reference citation just after Theorem 2.5 should read as follows:
  (See pp. 9 and 29–30 of [5].)
- **Page 72** Table 2.1, column 2, replace \( a \) by \( \bar{a} \) in the bottom two entries, as follows:
  \[
  \begin{array}{cc}
  \frac{1}{\alpha + j\omega} & \frac{\omega_0}{(\alpha + j\omega)^2 + \omega_0^2} \\
  \end{array}
  \]
- **Page 75** Prob. 2.12, part (a), should read as follows:
  \[
  x(t) = \alpha t \quad \text{for} \quad -\tau_0/2 \leq t \leq \tau_0/2
  \]
- **Page 75** Prob. 2.13, part (b), should read as follows:
  \[
  x(t) = \begin{cases} 
  0 & \text{for } -\tau_0/2 \leq t < 0 \\
  \sin \omega_0 t & \text{for } 0 \leq t \leq \tau_0/2
  \end{cases}
  \]
- **Page 75** Prob. 2.16, part (a), should read as follows:
  \[
  X(-j\omega) = X^*(j\omega)
  \]
- **Page 75** Prob. 2.17, parts (b) and (c), should read as follows:
  \( b \) Assuming that \( x(t) \) is purely imaginary and an even function of time, show that \( \Re X(j\omega) = 0 \) and \( \Im X(j\omega) \) is an even function of frequency.
  \( c \) Assuming that \( x(t) \) is purely imaginary and an odd function of time, show that \( \Im X(j\omega) = 0 \) and \( \Re X(j\omega) \) is an odd function of frequency.
- **Page 76** Prob. 2.23, parts (a) and (b), should read as follows:
  \( a \) \( X_2(j\omega) = X^*(-j\omega) \)
  \( b \) \( X_2(-j\omega) = X^*(j\omega) \)
- **Page 76** Prob. 2.25, part (b), should read as follows:
  \( b \) Sketch the waveform of
  \[
  x_2(t) = \sum_{n=-\infty}^{\infty} x_1(t - nT)
  \]
  assuming that \( T > \tau \).
Page 77  Prob. 2.29, part (b), delete the parenthesis (See Prob. 2.25 for the definition of \( u(t) \).)

Page 77  Prob. 2.31, part (a), should read as follows:

\( x(t) = \begin{cases} e^{-at} \sinh \omega_0 t & \text{for } -1 \leq t \leq 1 \\ 0 & \text{otherwise} \end{cases} \)

where \( \omega_0 = 2\pi/\tau_0 \).

Page 77  Prob. 2.32, part (b), should read as follows:

\( x(t) = \begin{cases} \sin \omega_0 t & 0 \leq t \leq \tau_0/2 \\ 0 & \text{otherwise} \end{cases} \)

where \( \omega_0 = 2\pi/\tau_0 \).

Page 77  Prob. 2.34, part (b), should read as follows:

Using the result in part (a) find the Fourier transform of

\( x(t) = \begin{cases} at & -\tau_0/2 \leq t \leq \tau_0/2 \\ 0 & \text{otherwise} \end{cases} \)

Page 77  Prob. 2.35, part (b), should read as follows:

\( x(t) = \begin{cases} 1 + t & -\tau_0/2 \leq t < 0 \\ 1 - t & 0 \leq t \leq \tau_0/2 \\ 0 & \text{otherwise} \end{cases} \)

Page 78  Prob. 2.36, should read as follows:

Find the Fourier transforms of

\( x(t) = \begin{cases} j t & -\tau_0/2 \leq t \leq \tau_0/2 \\ 0 & \text{otherwise} \end{cases} \)

\( x(t) = \begin{cases} j |t| & -\tau_0/2 \leq t \leq \tau_0/2 \\ 0 & \text{otherwise} \end{cases} \)

Page 78  Prob. 2.37, part (a), should read as follows:

\( x(t) = u(t)e^{-at} \cos^2 \omega_0 t \)

where \( \alpha > 0 \).

Chapter 3

Page 90  The equation in the last line should read as follows:

\[ Z[x(nT + T) - x(nT)] = \lim_{n \to \infty} \sum_{k=-n}^{n} [x(kT + T) - x(kT)]z^{-k} \]

Page 98  Line 3 should read as follows:

where \( \alpha > 0 \).

Page 98  Line 12 should read as follows:

and with \( \alpha \) assumed to be positive . . .

Page 101  Line -3, change ‘one-sided signal” to “right-sided signal”.
• **Page 115**  Line 3 should read as follows:
  polynomial and the poles of \( X(z) \) are simple, then the inverse of \( X(z) \) can very quickly be obtained through the use of partial fractions.

• **Page 123**  The formula on line \(-4^1\) should read as follows:
  \[
  \text{arg} \ a_1 = \begin{cases} 
  0 & \text{if } a_1 \geq 0 \\
  -\pi & \text{otherwise}
  \end{cases}
  \]

• **Page 128**  Prob. 3.15, part (b), should read as follows:
  \[
  (b) \quad x(nT) = \begin{cases} 
  0 & \text{for } n < 0 \\
  nT & \text{for } 0 \leq n < 5 \\
  (n-5)T & \text{for } 5 \leq n < 10 \\
  (n-10)T & \text{for } n \geq 10
  \end{cases}
  \]

• **Page 128**  Prob. 3.16, part (a), should read as follows:
  \[
  (a) \quad x(nT) = \begin{cases} 
  0 & \text{for } n < 0 \\
  1 & \text{for } 0 \leq n < 9 \\
  2 & \text{for } 10 \leq n < 19 \\
  -1 & \text{for } n \geq 20
  \end{cases}
  \]

• **Page 128**  Prob. 3.17, part (a), should read as follows:
  \[
  (a) \quad x(nT) = \begin{cases} 
  0 & \text{for } n < 0 \\
  2 + nT & \text{for } n \geq 0
  \end{cases}
  \]

• **Page 128**  The first line of Prob. 3.21 should read as follows:
  Find \( x(0) \) and \( x(\infty) \) for the following \( z \) transforms:

• **Page 130**  Prob. 3.39, part (a), should read as follows:
  (a) Show that the amplitude spectrum of the signal is given by
  \[
  |X(e^{j\omega T})| = \frac{\sqrt{1 + a_0^2 + a_1^2 + a_2(1 + a_0) \cos \omega T + 2a_0 \cos 2\omega T}}{\sqrt{1 + b_0^2 + b_1^2 + b_2(1 + b_0) \cos \omega T + 2b_0 \cos 2\omega T}}
  \]

Chapter 4

• **Page 158**  Line \(-2\), delete extra right parenthesis, i.e., line should read as follows:
  \[
  = u(nT)e^{j\omega nT} (1 + pe^{-j\omega T} + \cdots + p^n e^{-j\omega T})
  \]

• **Page 167**  Line 2, the equation should read as follows:
  \[
  y(nT) = 1 + p^1 + p^2 + \cdots + p^n = 1 + \sum_{k=1}^{n} p^k
  \]

• **Page 171**  Correct Fig. 4.16 as shown in the revised figure shown below.

• **Page 179**  Line \(-1\), add \( T \) in equation as follows:
  \[
  y(nT) = q_1(nT) + q_2(nT) + 2q_3(nT)
  \]

• **Page 180**  Line 3, add \( T \) in equation as follows:
  \[
  y(nT) = e^T q(nT) + dx(nT)
  \]

\footnote{Fourth line from the bottom of the page.}
Figure 4.16

- Page 186  Prob. 4.4, change “Prob. 1.1” to “Prob. 4.1”.
- Page 193  Prob. 4.21, part (c), should read as follows:
  (c) Sketch the response for \( p = e^{\alpha} \) with \( \alpha > 0, \alpha = 0 \), and \( \alpha < 0 \).

Chapter 5
- Page 203  Line –7, replace “\( pN \)” by “\( pp \)” as follows:
- Page 208  The equation in line –4 should read as follows:

\[
\sum_{n=0}^{\infty} |h(nT)| = |h(0)| + \sum_{n=1}^{\infty} \sum_{i=1}^{N} r_i^{n-1} e^{j(n-1)\psi_i} \text{Re} \left( \frac{H(z)}{z=p_i} \right)
\]

17

- Page 208  The equation in line –4 should read as follows:

\[
\sum_{n=0}^{\infty} |h(nT)| = |h(0)| + \sum_{n=1}^{\infty} \sum_{i=1}^{N} r_i^{n-1} e^{j(n-1)\psi_i} \text{Re} \left( \frac{H(z)}{z=p_i} \right)
\]

- Page 208  Eq. (5.17) should read as follows:

\[
\sum_{n=0}^{\infty} |h(nT)| \leq |h(0)| + \sum_{n=1}^{\infty} \sum_{i=1}^{N} |r_i^{n-1} \text{Re} \left( \frac{H(z)}{z=p_i} \right)|
\]

(E)

- Page 209  Line 10, the equation should read as follows:

\[
\sum_{n=0}^{\infty} |h(nT)| \leq |h(0)| + \frac{NR_{\max}}{r_{\max}} \sum_{n=1}^{\infty} r_{\max}^n
\]

- Page 209  Line 13, line should read as follows:

the series converges and since \( h(0) \) is finite we conclude that
The equation should read as follows:

$$\sum_{n=0}^{\infty} |h(nT)| \leq |R_0| + \frac{NR_{\max}}{r_{\max}} + \frac{NR_{\max}}{r_{\max}} \sum_{n=1}^{\infty} r_n^{\max}$$

The equations in the middle of the page should read as follows:

and from Eq. (5.11a), we obtain

$$(zI - A)^{-1} = \frac{1}{\det(zI - A)} \begin{bmatrix} z^2 - (\frac{1}{2}z + \frac{1}{4}) & z & 1 \\ -(\frac{1}{2}z + \frac{1}{4}) & (z + \frac{1}{2}) & \frac{1}{z} \\ -\frac{1}{2}z & z + \frac{1}{2} & (z + \frac{1}{2})z + \frac{1}{4} \end{bmatrix}^T$$

Hence Eq. (5.9) yields

$$\frac{Y(z)}{X(z)} = H(z) = \frac{N(z)}{D(z)} = c^T(zI - A)^{-1}b + d$$

$$= \frac{1}{\det(zI - A)} \begin{bmatrix} \frac{1}{4} & \frac{1}{6} & \frac{1}{12} \end{bmatrix} \begin{bmatrix} z^2 & -(\frac{1}{2}z + \frac{1}{4}z) & 1 \\ z & (z + \frac{1}{2}) & \frac{1}{z} \\ 1 & z + \frac{1}{2} & (z + \frac{1}{2})z + \frac{1}{4} \end{bmatrix} \begin{bmatrix} 2 \\ 0 \\ 0 \end{bmatrix} + 2$$

$$= \frac{1}{\det(zI - A)} \begin{bmatrix} \frac{1}{4} & \frac{1}{6} & \frac{1}{12} \end{bmatrix} \begin{bmatrix} 2z^2 \\ 2z \\ 2 \end{bmatrix} + 2$$

Thus polynomials $N(z)$ and $D(z)$ can be deduced as

$$N(z) = \begin{bmatrix} -\frac{1}{4} & \frac{1}{6} & \frac{1}{12} \end{bmatrix} \begin{bmatrix} 2z^2 \\ 2z \\ 2 \end{bmatrix} + 2 \det(zI - A)$$

and

**Page 229** Lines 12 and 13, add square brackets in $\sin(\omega + k\omega_n T)$ twice as follows:

We conclude that discrete-time signals $\sin(\omega + k\omega_n nT)$ and $\sin \omega nT$ are numerically identical for any value of $k$ as illustrated in Fig. 5.8. Consequently, if signal $\sin(\omega + k\omega_n T)$ is sampled at a sampling

**Page 230** Replace the sentence in lines 7 to 9 of the third paragraph by “In this context, the sampling frequency, $\omega_n$, is analogous to the number of wheel revolutions per second times the number of film frames per second whereas the number of revolutions per second is analogous the frequency of a signal component.”

**Page 244** Caption of Fig. 5.13c and d, replace “arg $|H(e^{j\alpha T})|$” by “arg $H(e^{j\alpha T})$”, as follows:

**Figure 5.13 Cont’d** Frequency response of bandpass filter (Example 5.11): (c) Plot of $20 \log |H(e^{j\alpha T})|$ versus $\omega$; (d) corrected plot of arg $H(e^{j\alpha T})$ versus $\omega$.

**Page 250** Correct the legend in the left-hand graph of Fig. 5.17b as follows:

**Page 251** Eq. (5.41) should read as follows:

$$H_{AP}(z) = \frac{r^2 z^2 - 2r(\cos \phi)z + 1}{z^2 - 2r(\cos \phi)z + r^2}$$
Figure 5.17

- Page 251  The equations in the middle of the page should read as follows:

\[
M_{AP}(\omega) = \left\{ H_{AP}(z) \cdot H_{AP}(z^{-1}) \right\}_{z = e^{j\omega T}}^{1/2} \\
= \left\{ \frac{r^2 z^2 + 2 r (\cos \phi) z + 1}{z^2 + 2 r (\cos \phi) z + r^2} \cdot \frac{r^2 z^{-2} + 2 r (\cos \phi) z^{-1} + 1}{z^{-2} + 2 r (\cos \phi) z^{-1} + r^2} \right\}_{z = e^{j\omega T}}^{1/2} \\
= \left\{ \frac{r^2 z^2 + 2 r (\cos \phi) z + 1}{z^2 + 2 r (\cos \phi) z + r^2} \cdot \frac{r^2 + 2 r (\cos \phi) z + z^2}{1 + 2 r (\cos \phi) z + z^2 r^2} \right\}_{z = e^{j\omega T}}^{1/2} = 1
\]

- Page 252  Eqs. (5.42a) and (5.42b) should read as follows: 42

\[
\tau_a(\omega) = -\frac{\theta(\omega)}{\omega} \quad \text{(Ea)}
\]
\[
\tau_g(\omega) = -\frac{d\theta(\omega)}{d\omega} \quad \text{(Eb)}
\]

- Page 252  Correct the labels in Fig. 5.18 as follows:

Figure 5.18

- Page 258  Prob. 5.28 should read as follows:

5.28 (a)  A system has a transfer function of the form

\[
H(z) = \frac{N(z)}{(z - p)^k}
\]
Assuming that the system is stable, i.e., \(|p| < 1\), show that the steady-state sinusoidal response of the system is given by Eq. (5.30).

(b) Show that Eq. (5.30) applies equally well to systems with more than one higher-order pole in addition to several simple poles.

Chapter 6

- **Page 267** The formula at the bottom of the page should read as follows:

  \[
  x(t) = x(0) \quad \text{for } |t| \leq \epsilon/2
  \]

- **Page 268** Line 1, delete one “give”.

- **Page 268** The formula after Eq. (6.10) should read, as follows:

  \[
  i'(\omega) \simeq 1 \quad \text{for } |\omega| \leq \omega_\infty/2
  \]

- **Page 268** The footnote should read as follows:

  \(^2\text{See pp. 278–281 in Ref. [4] for a relevant discussion.}\)

- **Page 269** Insert equation numbers in Theorem 6.1A as follows:

  \[\begin{align*}
  (a) \quad \int_{-\infty}^{\infty} \delta(t-\tau)x(t) \, dt &= \int_{-\infty}^{\infty} \delta(-t+\tau)x(t) \, dt = x(\tau) \\
  (b) \quad \delta(t-\tau)x(t) = \delta(-t+\tau)x(t) \simeq \delta(t-\tau)x(\tau) \\
  (c) \quad \delta(t)x(t) &= \delta(-t)x(t) \simeq \delta(t)x(0)
  \end{align*}\]

- **Page 275** Table 6.2, column 2, replace \(a\) by \(\alpha\) in the bottom two entries, as follows:

  \[
  \begin{array}{cc}
  1 & \omega_0 \\
  \alpha + j\omega & (\alpha + j\omega)^2 + \omega_0^2
  \end{array}
  \]

- **Page 278** Change the index of the summations in Eq. (6.25) from \(k\) to \(n\), as follows:

  \[
  \begin{aligned}
  \mathcal{F}\tilde{x}(t) &= a_0 \pi \delta(\omega) + \sum_{n=1}^{\infty} a_n \pi \left[ \delta(\omega + n\omega_0) + \delta(\omega - n\omega_0) \right] \\
  &+ \sum_{n=1}^{\infty} j\beta_n \pi [\delta(\omega + n\omega_0) - \delta(\omega - n\omega_0)] \quad (6.25)
  \end{aligned}
  \]

- **Page 284** Eq. (6.40) should read as follows:

  \[
  \sum_{n=-\infty}^{\infty} x(t + nT) = \frac{1}{T} \sum_{n=-\infty}^{\infty} X(jn\omega_s)e^{jn\omega_s t} \quad (6.40)
  \]

- **Page 289** Line 2, insert a minus as follows:

  \[
  x(t) = \begin{cases} 0 & \text{for } t < -3.5 \, \text{s} \\
  1 & \text{for } -3.5 \leq t < -2.5 \\
  2 & \text{for } -2.5 \leq t < 2.5 \\
  1 & \text{for } 2.5 \leq t \leq 3.5 \\
  0 & \text{for } t > 3.5
  \end{cases}
  \]
Page 301  Change $k$ to $n$ twice in Eq. (6.59) as follows:

$$X_1(j\omega) = \mathcal{F}x_1(t) = a_0\pi \delta(\omega) + \sum_{n=1}^{\infty} a_n\pi [\delta(\omega + n\omega_0) + \delta(\omega - n\omega_0)]$$

$$+ \sum_{n=1}^{\infty} jb_n\pi [\delta(\omega + n\omega_0) - \delta(\omega - n\omega_0)] \quad \blacksquare \quad (F)$$

Page 307  Line -11, change “converted” to “converter”.

Page 311  The second equation in Prob. 6.1, part (a), should read as follows:

$$\hat{p}_\pi(\omega) = \begin{cases} 1/\pi & \text{for } |\omega| \leq \pi/2 \\ 0 & \text{otherwise} \end{cases}$$

Page 311  Line -6, mark footnote 6 as follows:

Obtain the Fourier transform of $\hat{x}(t)$.\(^6\)

Page 311  Insert the following footnote at the bottom of the page:

\(^6\)In Probs. 6.2–6.7, assume that $T > \tau$ or $\tau_0$.

Page 315  The third line of Prob. 6.21, part (a), should read as follows:

where $\tau = (N - 1)T$ and $N$ is odd. The sampling frequency is $\omega_s = 2\pi/T$.

Page 315  The equation in Prob. 6.22 should read as follows:

$$x(t) = \begin{cases} \alpha + (1 - \alpha) \cos \frac{2\pi t}{\tau} & \text{for } |t| \leq \tau/2 \\ 0 & \text{otherwise} \end{cases}$$

where $\tau = (N - 1)T$.

Page 317  Line 1, insert “transform” after Fourier as follows:

Obtain the Fourier transform of

Page 317  Line 6, replace “$\omega_s \gg 16/\pi N$” by “$N \gg 4/\pi$” twice, as follows:

if $N \gg 4/\pi$. (Hint: Note that $X(j\omega) \to 0$ if $N \gg 4/\pi$.)

Page 317  Replace Figure P6.29 by the following revised figure:

![Figure P6.29](image)

Page 318  Replace Figure P6.30 by the following revised figure shown on p. 9.
• Page 352  Insert the following new paragraph just before Sec. 7.8.3 as shown.

On the basis of Eq. (7.34b), we note that for the special case where $X(e^{j(\omega-n)T}) = 1$ for $0 \leq \omega \leq 2\pi/T$, we have

$$X_w(e^{j\omega T}) = \frac{T}{2\pi} \int_0^{2\pi/T} W(e^{j\omega T}) d\omega$$

Therefore, $X_w(e^{j\omega T})$ would be equal to unity over the frequency range 0 to $2\pi/T$ only if

$$\int_0^{2\pi/T} W(e^{j\omega T}) d\omega = \frac{2\pi}{T}$$

In other words, the level of the amplitude spectrum of the signal will be preserved only if the area under the window function is equal to $2\pi/T$. The rectangular and Kaiser windows have this property but some of the other windows described in Chap. 9, for example, the Dolph-Chebyshev window, do not and a scaling factor would be required to restore the correct level.

• Page 352  Replace ‘right-side’ by ‘right-sided’ in the last line.

• Page 353  The page should read as follows:

be readily obtained as

$$\tilde{w}_K(nT) = \begin{cases} w_K(nT) & \text{for } 0 \leq n \leq (N_w - 1)/2 \\ 0 & \text{for } [(N_w - 1)/2 + 1] \leq n \leq [N - (N_w + 1)/2] \\ w_K[(n-N)T] & \text{for } [N - (N_w - 1)/2] \leq n \leq (N-1) \end{cases}$$  \hspace{1cm} (7.35a)$$

and a corresponding periodic version can be constructed through periodic continuation as

$$\tilde{w}_K(nT) = \sum_{r=-\infty}^{\infty} \tilde{w}_K(nT + rNT)$$  \hspace{1cm} (7.35b)$$

as illustrated in Fig. 7.19.
The values of the periodic Kaiser window can be obtained as shown in column 2 of Table 7.1 by using Eq. (7.35a). The numerical values of the Kaiser window can be calculated using Eqs. (7.28), (7.29), and (7.26).

Table 7.1 Values of periodic Kaiser window of length 13 (Example 7.4)

<table>
<thead>
<tr>
<th>( \bar{w}_K(nT) )</th>
<th>( \bar{w}_K(nT) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( w_K(0) )</td>
<td>( w_K(0) )</td>
</tr>
<tr>
<td>( w_K(T) )</td>
<td>( w_K(T) )</td>
</tr>
<tr>
<td>( w_K(2T) )</td>
<td>( w_K(2T) )</td>
</tr>
<tr>
<td>( w_K(3T) )</td>
<td>( w_K(3T) )</td>
</tr>
<tr>
<td>( w_K(4T) )</td>
<td>( w_K(4T) )</td>
</tr>
<tr>
<td>( w_K(5T) )</td>
<td>( w_K(5T) )</td>
</tr>
<tr>
<td>( w_K(6T) )</td>
<td>( w_K(6T) )</td>
</tr>
<tr>
<td>( w_K(7T) )</td>
<td>0</td>
</tr>
<tr>
<td>( w_K(8T) )</td>
<td>0</td>
</tr>
<tr>
<td>( w_K(9T) )</td>
<td>0</td>
</tr>
<tr>
<td>( w_K(10T) )</td>
<td>( w_K(-6T) )</td>
</tr>
<tr>
<td>( w_K(11T) )</td>
<td>( w_K(-5T) )</td>
</tr>
<tr>
<td>( w_K(12T) )</td>
<td>( w_K(-4T) )</td>
</tr>
<tr>
<td>( w_K(13T) )</td>
<td>( w_K(-3T) )</td>
</tr>
<tr>
<td>( w_K(14T) )</td>
<td>( w_K(-2T) )</td>
</tr>
<tr>
<td>( w_K(15T) )</td>
<td>( w_K(-T) )</td>
</tr>
</tbody>
</table>

The last paragraph should read as follows:
A problem of this type can be solved by obtaining the DFT of the signal for several increasing sampling frequencies until two consecutive DFTs differ from one another by an error that is considered acceptable for the application at hand. The last or last-but-one DFT can be deemed to be free of aliasing and the sampling frequency used in that evaluation can be taken to be the required one.
Table 7.2 Values of $N$, $T$, and $\omega_s$ for Example 7.5

<table>
<thead>
<tr>
<th>$N$</th>
<th>$T$</th>
<th>$\omega_s$</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>1.6</td>
<td>3.9270</td>
</tr>
<tr>
<td>32</td>
<td>0.8</td>
<td>7.8540</td>
</tr>
<tr>
<td>64</td>
<td>0.4</td>
<td>15.7080</td>
</tr>
<tr>
<td>128</td>
<td>0.2</td>
<td>31.4159</td>
</tr>
</tbody>
</table>

Upon obtaining the DFT of $\tilde{x}_w(nT)$ for the sets of parameters shown in Table 7.2, the results plotted in Fig. 7.21 can be obtained. As can be seen, the difference between the amplitude spectrums for the last two cases is barely noticeable and we conclude, therefore, that the use of a sampling frequency of 15.7080 or 31.4159 rad/s would result in a negligible amount of aliasing.

Prob. 7.16 should read as follows:

7.16. Construct Table 7.1 for a Kaiser window of length 31 for a 32-point DFT.

Part (a) for Prob. 7.19 should read as follows:

(a) Obtain an approximate expression for $W_{TR}(e^{j\omega T})$.

 probs. 7.20–7.23 should read as follows:

7.20. An infinite duration discrete-time signal is described by

$$x(nT) = u(nT) \left[ A_0 e^{\theta_0 nT} + 2M_1 e^{\sigma_1 nT} \cos(\omega_1 nT + \theta_1) \right]$$

where $A_0 = 4.532$, $M_1 = 2.350$, $\theta_1 = -2.873$ rad, $\rho_0 = -0.05$, $\sigma_1 = -0.5$, and $\omega_1 = 1.754$.

(a) Obtain an expression for the frequency spectrum of the signal.

(b) Plot the amplitude spectrum over the range $0 \leq \omega \leq \omega_s/2$ assuming a sampling frequency $\omega_s = 10$ rad/s.

(c) Repeat part (b) if the signal is truncated through the use of a rectangular window of length 31.

(d) Repeat part (b) if the signal is truncated through the use of a Kaiser window of length 31 and $\alpha = 1.0$.

(e) Compare the results obtained in parts (c) and (d).
7.21. An infinite-duration right-sided discrete-time signal $x(nT)$ is obtained by sampling the continuous-time signal

$$x(t) = u(t) \left[ A_0 e^{\theta_1 t} + 2M_1 e^{\sigma_1 t} \cos(\omega_1 t + \theta_1) \right]$$

where $A_0 = 5.0, M_1 = 3.0, \theta_1 = -2.556 \text{ rad}, p_0 = -2.0, \sigma_1 = -1.5, \text{ and } \omega_1 = 2.5$. A finite duration signal can be obtained by applying the discrete-time Kaiser window with $\alpha = 2.0$. Following the approach in Example 7.5, find the lowest sampling frequency that would result in negligible aliasing error.

7.22. Repeat Prob. 7.21 if $A_0 = 5.0, M_1 = 3.0, \theta_1 = -2.556 \text{ rad}, p_0 = -0.05, \sigma_1 = -0.5, \omega_1 = 2.5$, and $\alpha = 3.0$.

7.22. Prove Theorem 7.2 B.

- Page 386 The first line of Prob. 7.25 should read as follows:

  (a) Two periodic signals are given by

- Page 387 Replace Prob. 7.26 by the following new problem:

7.26 Two periodic signals $x(n)$ and $h(n)$ can be represented by

$$x(n) = \sum_{r=-\infty}^{\infty} x_0(n + 10r) \quad \text{and} \quad h(n) = \sum_{r=-\infty}^{\infty} h_0(n + 10r)$$

where

$$x_0(n) = \begin{cases} 
-\alpha n & \text{for } -5 \leq n \leq 0 \\
\alpha n & \text{for } 0 \leq n \leq 5 \\
0 & \text{otherwise}
\end{cases}$$

and

$$h_0(n) = \begin{cases} 
1 & \text{for } n = -2, -1, 1, 2 \\
0 & \text{otherwise}
\end{cases}$$

Find the periodic convolution of $x(n)$ and $h(n)$ at $n = 6$.

Chapter 8

- Page 402 Eqs. (8.8c) and (8.8d) should read as follows:

$$N_{j-1}(z) = N_j(z) - v_j P_j(z) = \sum_{i=0}^{j-1} a_{(j-1)i} z^{-i}$$  \hspace{1cm} (8.8c)

$$D_{j-1}(z) = D_j(z) - \frac{\mu_j P_j(z)}{1 - \mu_j^2} = \sum_{i=0}^{j-1} b_{(j-1)i} z^{-i}$$  \hspace{1cm} (8.8d)

- Page 406 Line 3 Add missing $z$ in equation as follows:

$$= 9 \times \frac{1}{1 + \frac{1}{2} z^{-1}} \times \frac{1 + \frac{1}{2} z^{-1} + \frac{1}{4} z^{-2}}{1 + \frac{3}{12} z^{-1} + \frac{1}{12} z^{-2}}$$

- Page 408 Line 2, change a plus to a minus sign in the equation as follows:

$$H(z) = \frac{10z^4 - 3.7z^3 - 1.28z^2 + 0.99z}{(z^2 - z + 0.34)(z^2 + 0.9z + 0.2)}$$

- Page 408 In Example 8.5, the transfer function of the filter should be

$$H(z) = \frac{10z^4 - 3.7z^3 - 1.28z^2 + 0.99z}{(z^2 - z + 0.34)(z^2 + 0.9z + 0.2)}$$

i.e., the coefficient of $z$ in the first quadratic factor in the denominator should be $-1$. 
• **Page 423** Replace Fig. P8.27 by the revised Fig. P8.27 shown below.

• **Page 423** The last line in Prob. 8.28 should read as follows:
  using as many VLSI chips of the type shown in Fig. P8.27c as necessary and a 2-input adder of the type shown in Fig. P8.27b.

• **Page 423** The transfer function in Prob. 8.29 should read as follows:

\[
H(z) = H_0 \frac{z + 1}{z + b_{11}} \cdot \frac{z^2 + a_{22}}{z^2 + b_{12}z + b_{22}}
\]

Chapter 9

• **Page 441** The formula for the \( k \)th-order Chebyshev polynomial should read as follows:

\[
T_k(x) = \begin{cases} 
\cos(k \cos^{-1} x) & \text{for } |x| \leq 1 \\
\cosh(k \cosh^{-1} x) & \text{for } |x| > 1 
\end{cases}
\]

• **Page 443** Eq. (9.24) and the line before it should read as follows:

and hence we get

\[
h(nT) = \begin{cases} 
1 - \frac{\omega_c T}{\pi} & \text{for } n = 0 \\
-\frac{1}{n\pi} \sin \omega_c n T & \text{otherwise}
\end{cases}
\]

(9.24)

• **Page 452** The equations for \( h(nT) \) and the line that follows should read as follows:

\[
h(nT) = \frac{1}{\omega_s} \left[ \int_{-\omega_c}^{\omega_c} e^{j\omega n T} d\omega + \int_{\omega_c}^{\omega_s} e^{j\omega n T} d\omega \right] \\
= \frac{1}{\omega_s} \left[ \frac{e^{-j\omega_c n T} - e^{-j\omega_s n T}}{jn T} + \frac{e^{j\omega_c n T} - e^{j\omega_s n T}}{jn T} \right] \\
= \frac{1}{n\pi} \left[ \frac{e^{j\omega_c n T} - e^{-j\omega_c n T}}{2j} - \frac{e^{j\omega_s n T} - e^{-j\omega_s n T}}{2j} \right] \\
= \frac{1}{n\pi} (\sin \omega_c n T - \sin \omega_c n T)
\]

where \( h(0) = (\omega_c - \omega_c) T/\pi \). Now according to step 2,

• **Page 459** In Prob. 9.3, change the second “(a)” to “(b)”.

• **Page 460** In Prob. 9.4, change the second “(a)” to “(b)”.
• Page 461  Prob. 9.12, part (b), should read as follows:

(b) Assuming that the passband extends from 3.8 to 6.2 rad/s modify the design in part (a) so as to achieve an amplitude response that oscillates about unity.

• Page 461  Prob. 9.13 should read as follows:

(a) Repeat Prob. 9.12 assuming a ripple ratio of −25 dB, a passband that extends from 3.91 to 6.09 rad/s, and stopbands that extend from 0 to 2.0 and 8.0 to 10 rad/s.

(b) Compare the design of this problem with that of Prob. 9.12.

• Page 462  Delete part (c) in Prob. 9.20.

Chapter 10

• Page 497  The line after Eq. (10.58) should read as follows:

are the selectivity constant and discrimination constant, respectively. The loss is given by

• Page 516  The equation should read as follows:

\[ H_{LP}(\tilde{s}) = H_N(s) \bigg|_{\tilde{s}=\lambda \tilde{s}} \]

• Page 520  The first line of Prob. 10.4 should read as follows:

10.4 Filter specifications are often described pictorially as in Fig. P10.4, where \( \omega_p \) and \( \omega_a \) are the desired passband

• Page 522  The first line of Prob. 10.13 should read as follows:

A fourth-order normalized lowpass inverse-Chebyshev filter with a minimum stopband loss of 40 dB is required.

• Page 523  Prob. 10.17 should read as follows:

In a particular application an elliptic lowpass filter is required. The specifications are

- Selectivity \( k \): 0.6
- Maximum passband loss \( A_p \): 0.5 dB
- Minimum stopband loss \( A_a \): 40.0 dB

(a) Determine the order of the transfer function.
(b) Determine the minimum stopband loss.
(c) Obtain the transfer function.

• Page 523  Prob. 10.18 should read as follows:

An elliptic lowpass filter satisfying the specifications

- Selectivity \( k \): 0.95
- Maximum passband loss \( A_p \): 0.3 dB
- Minimum stopband loss \( A_a \): 60.0 dB

is required.

(a) Determine the order of the transfer function.
(b) Determine the minimum stopband loss.
(c) Obtain the transfer function.

• Page 525  Prob. 10.27, part (a), replace \( B_0 \) by \( B \).
Page 525  Prob. 10.28, part (a), replace $B_0$ by $B$.

Page 526  Prob. 10.38, replace the second “Lower stopband edge” by “Upper stopband edge”.

Page 527  Prob. 10.43, replace the second “Lower stopband edge” by “Upper stopband edge”.

Chapter 11

Page 556  The value of parameter $R_1$ in Prob. 11.4 should be as follows:

$$R_1 = -2.26 - j0.624$$

Page 558  Prob. 11.12, part (a), should read as follows:

(a) Redesign the filter of Prob. 11.5 by employing the invariant sinusoid-response method (see Prob. 11.11). The value of $\omega_0$ may be assumed to be 1 rad/s.

Chapter 12

Page 572  Line 3, replace “$\tan \Omega T/2$” by “$\tan(\Omega T/2)$”.

Page 572  Line 11, replace

$$\frac{\omega_p}{\omega_p} \geq K_2$$

by

$$\frac{\omega_p}{\omega_a} \geq K_2$$

Page 572  Line -10, replace “$\Omega_a \geq \Omega_{a1}$” by “$\Omega_a \geq \Omega_{a1}$”.

Chapter 14

Page 622  Line 8 should read as follows:

system (i.e., $-8/8$ in Table 14.1) but not in the other two.

Page 645  The paragraph after Eq. (14.48) should read as follows:

In the case of parallel or cascade realizations, efficient scaling can be accomplished by using one scaling multiplier at the input of each section and, if necessary, one at the output of the realization to maximize the output level.

Page 646  The equations for $\lambda_0$, $\lambda_1$, ..., should read as follows:

$$\lambda_0 = \frac{1}{\max(\|F_1^t\|_{\infty}, \|F_1\|_{\infty})} \quad \lambda_1 = \frac{1}{\lambda_0 \max(\|F_1 F_2^t\|_{\infty}, \|F_1 F_2\|_{\infty})} \quad \lambda_2 = \frac{1}{\lambda_0 \lambda_1 \max(\|F_1 F_2 F_3^t\|_{\infty}, \|F_1 F_2 F_3\|_{\infty})}$$

Page 646  Replace Fig. 14.9 by the revised figure shown below.

Page 656  Line -7, the formula should read as follows:

$$\theta = \cos^{-1} \frac{b_1}{2 b_0}$$


Chapter 15

Page 698  Caption of Fig. 15.5, change “gain” to “error”.

Page 699  Caption of Fig. 15.6, change “gain” to “error”.

Page 703  Caption of Fig. 15.7, change “gain” to “error”.

Page 714  Caption of Fig. 15.10, change “gain” to “error”.
Chapter 16

- **Page 746**  Line 9, put square brackets in equation as follows:

\[ \nabla |e_i(x)| = [\text{sgn} \ e_i(x)] \nabla e_i(x) \]

Appendix A

- **Page 912**  Replace Theorem A.3 by Theorems A.3a and A.3b as follows:

Theorem A.3a Ratio Test  If \( w_n \neq 0 \) for \( n = 0, 1, 2, \ldots \) and in addition

\[ \frac{|w_{n+1}|}{w_n} \leq q \quad \text{for all} \ n > N \]

where \( q \) is a fixed number less than 1, then the series in Eq. (A.39) converges. On the other hand, if

\[ \frac{|w_{n+1}|}{w_n} \geq 1 \quad \text{for all} \ n > N \]

then the series diverges.  ▲

Theorem A.3b Root Test  If

\[ \sqrt[n]{|w_n|} \leq q \quad \text{for all} \ n > N \]

where \( q \) is a fixed number less than 1, then the series in Eq. (A.39) converges. On the other hand, if

\[ \sqrt[n]{|w_n|} \geq 1 \quad \text{for all} \ n > N \]

then the series diverges.  ▲

- **Page 920**  Line 9, replace “can obtained” by “can be obtained”.

- **Page 920**  Line 13, replace “can obtained” by “can be obtained”.

- **Page 922**  Line −3, replace “5. Inversion and scaling” by “6. Inversion and scaling”.

Figure 14.9