# Errata
# Signals and Systems - M. J. Roberts

**Chapter 1**

Page 16

Last two lines. Replace “signal processing and analysis” with “signal processing and system analysis”.

**Chapter 2**

Page 23

After Eq. 2.7 in item “3.”. Delete “and Laplace transforms”.

Page 29

In the captions under Figures 2.14 and 2.15 change “unit area” to “unit-area”. (Add hyphen).

Page 40

Fourth line. change “of *t* itself” to “of *t*, itself”. (Add comma)

Page 65

In the line before item “b.”. Change $T_0 = 200$ to $T_0 = 1/200$.

Page 67

In the line after Eq. 2.118. Change (2.108) to (2.118).

Page 73

In all MATLAB functions on pages 73 and 74, the instruction sequence

```
ss = find(round(n)~=n) ;   %      Find all noninteger
                           %      n's.
y(ss) = NaN ;              %      Set the corresponding
                           %      outputs all to NaN.
```

does not work with MATLAB 6.5 although it works fine with MATLAB 5.2. Replace all occurrences of that instruction sequence with

```
I = find(round(n)==n) ;          %  Find all integer "n's"
NaNs = NaN + 0*y ;               %  Create an array of NaN's the same
                                 %    size as y
NaNs(I) = 0 ;                    %  Replace NaN with 0 where the
                                 %    function result is defined
y = y + NaNs ;                   %  "Un-define" the values of y
                                 %    computed for non-integer
                                 %    arguments
```

Page 77

Replace the instruction sequence,

```
nonInt = find(round(n)~=n) ;     %      Find all noninteger n's.
x(nonInt) = NaN ;                %      Set the corresponding x's to NaN.
```

with the instruction sequence,

```
I = find(round(n)==n) ;          %  Find all integer "n's"
NaNs = NaN + 0*x ;               %  Create an array of NaN's the same
                                 %    size as x
NaNs(I) = 0 ;                    %  Replace NaN with 0 where the
                                 %    function result is defined
x = x + NaNs ;                   %  "Un-define" the values of x
                                 %    computed for non-integer
                                 %    arguments
```

Page 79

Replace the instruction sequence,

```
ss = find(round(n)~=n) ;   %      Find all noninteger n's.
n(ss) = NaN ;              %      Set them all to NaN.
```

with  the instruction sequence,

```
I = find(round(n)==n) ;          % Find all integer "n's"
NaNs = NaN + 0*n ;               % Create an array of NaN's the same
                                 %   size as n
NaNs(I) = 0 ;                    % Replace NaN with 0 where the
                                 %   function result is defined
n = n + NaNs ;                   % "Un-define" the values of n
                                 %   computed for non-integer
                                 %   arguments
```

Page 91

Eq. 2.166

The "*x*" in $\sum_{n=-\infty}^{\infty} |x[n]|^2$ should be Roman instead of Italic, as below.

$$\sum_{n=-\infty}^{\infty} |\mathrm{x}[n]|^2$$

Page 92

Eq. 2.175

The lower limit, "*T*", on the last integral, $\frac{1}{T}\int_{T} |\mathrm{x}(t)|^2\, dt$, should be moved to the right and up like this: $\frac{1}{T}\int_{T} |\mathrm{x}(t)|^2\, dt$

Page 93

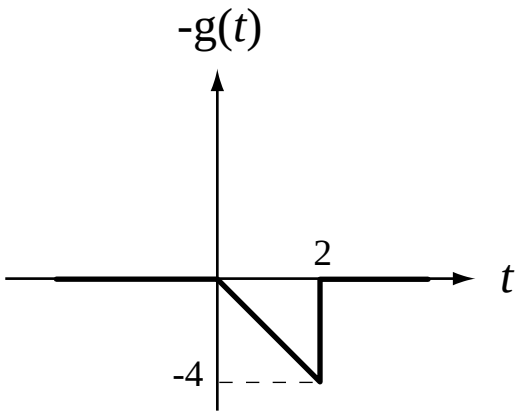
Eq. 2.178

The lower limit, "*T*", on the first integral, $\frac{1}{T}\int_{T} |A\cos(2\pi f_0 t + \theta)|^2\, dt$, should be moved to the right and up like this: $\frac{1}{T}\int_{T} |A\cos(2\pi f_0 t + \theta)|^2\, dt$

Page 100

Exercise 5

Third solution figure from the left, upper graph. Change g(-*t*) to -g(*t*). New figure should look something like this:




Page 113

Exercise 30

Delete the words, “combinations of”.

Should read “Sketch these CT functions”.

Page 124

Exercise 72(f)

Change $\sum_{n=-\infty}^{\infty} \text{sinc}[n]$ to $\sum_{n=-\infty}^{\infty} \text{sinc}(n)$ .

**Chapter 3**

Page 153

Equation 3.115. Change to $y[n] = e^{-(n/4)}\,u[n] + e^{((n-1)/4)}\,u[n-1]$ . (Add a pair of parentheses).

Page 174

In the line following Eq. 3.218. Change (3.318) to (3.218) and change (3.317) to (3.217).

Page 181

Change Eq. 3.251 to

$$v_{out}(t) = \int_0^t \frac{e^{-[(t-\tau)/RC]}}{RC}\, d\tau = \left[e^{-[(t-\tau)/RC]}\right]_0^t = 1 - e^{-(t/RC)} \quad , \quad t > 0$$

(Remove a minus sign and reverse the order of two terms.)

Change Eq. 3.252 to

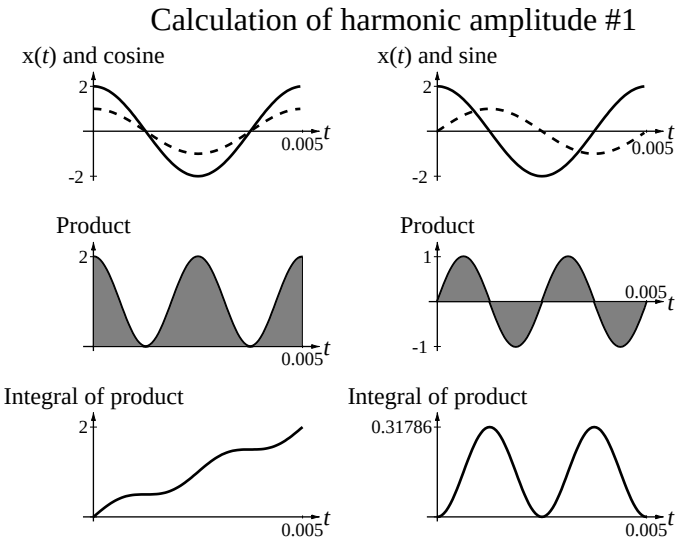
$$v_{out}(t) = \left(1 - e^{-(t/RC)}\right) u(t)$$

(Reverse the order of two terms)

**Chapter 4**

Page 221

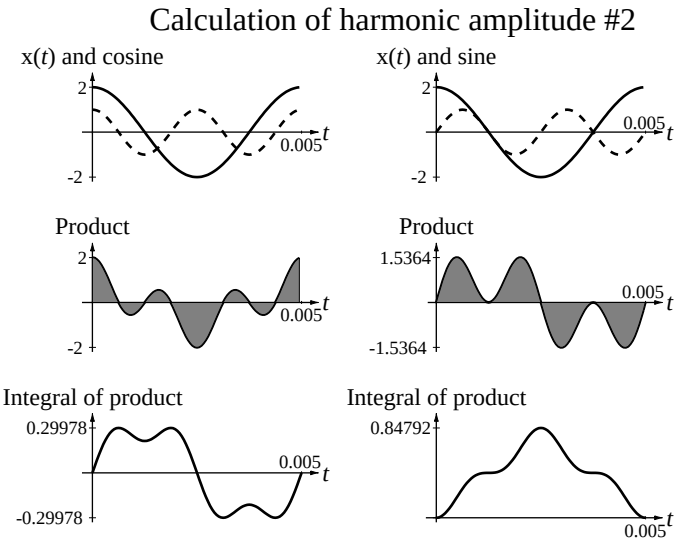
Replace bottom graphs in Figure 4.9. New figure should be




(Only significant change is the vertical scale number in the lower right graph.)

Page 222

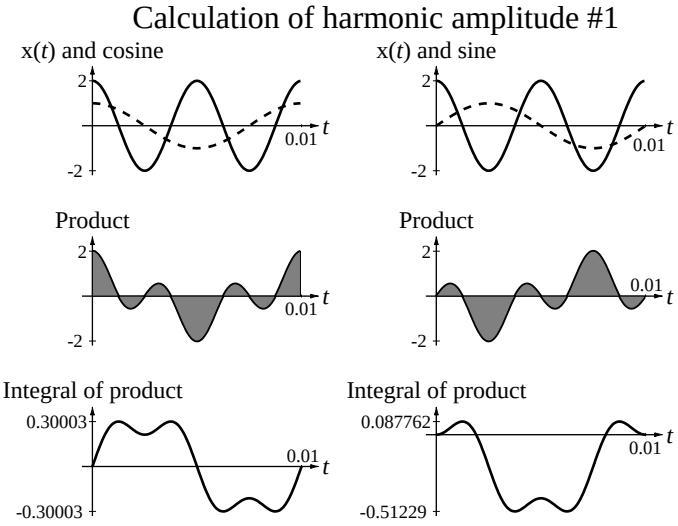
Replace bottom graphs in Figure 4.10. New figure should be




(Bottom graphs have been re-drawn and re-scaled. Do not simply change the numbers)

Page 223

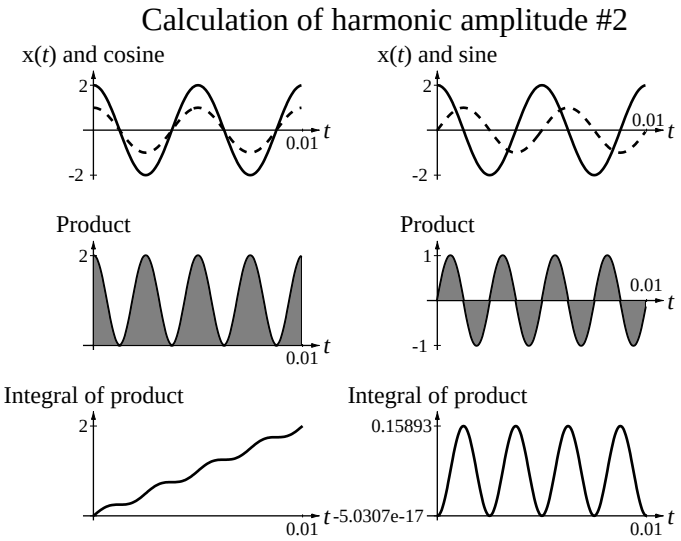
Replace bottom graphs in Figure 4.11. New figure should be




(Bottom graphs have been re-drawn and re-scaled. Do not simply change the numbers)

Page 224

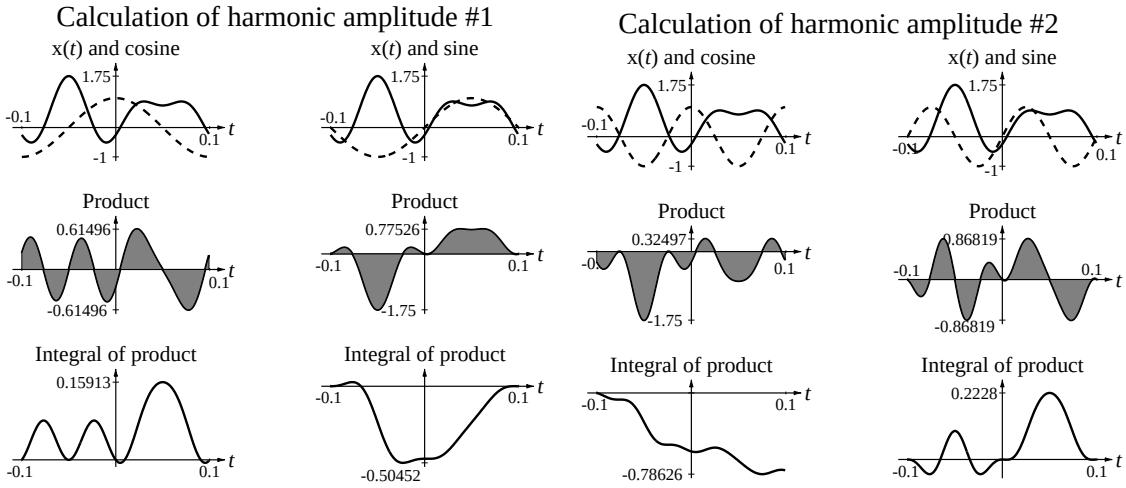
Replace bottom graphs in Figure 4.12. New figure should be

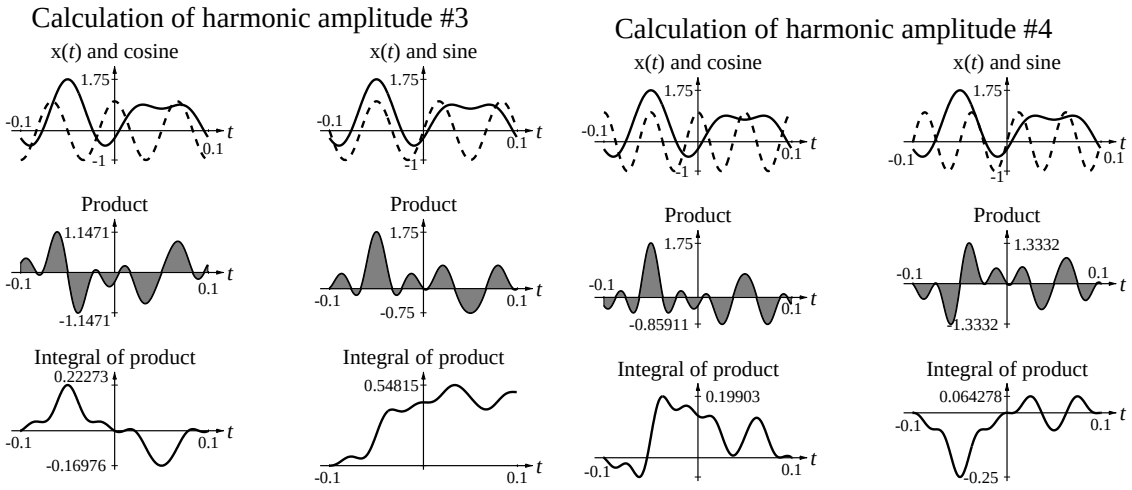



(Bottom graphs have been re-drawn and re-scaled. Do not simply change the numbers)

Page 226

Replace 8 bottom graphs in both figures (4.13 and 4.14). New figures should be

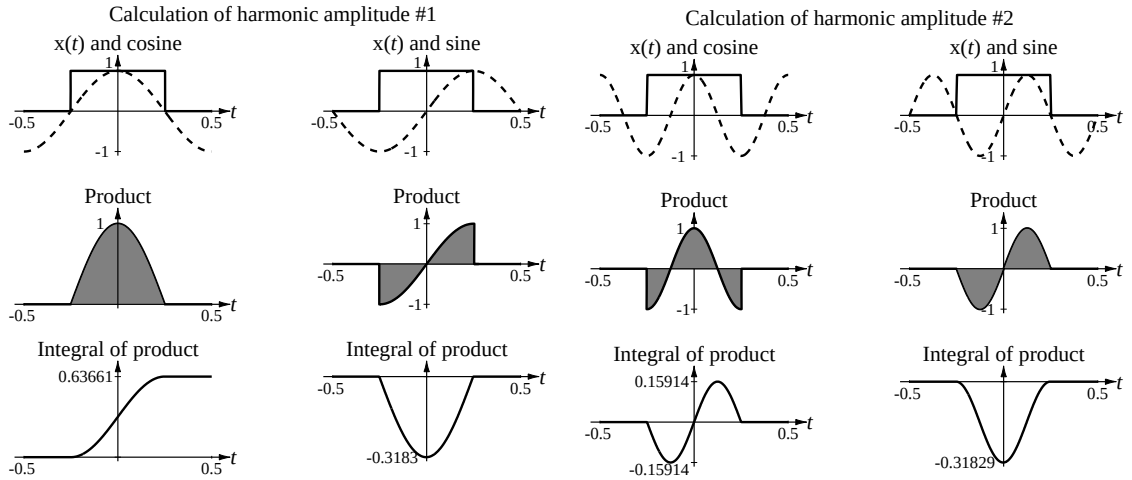





(Bottom graphs have been re-drawn and re-scaled. Do not simply change the numbers)

Page 229

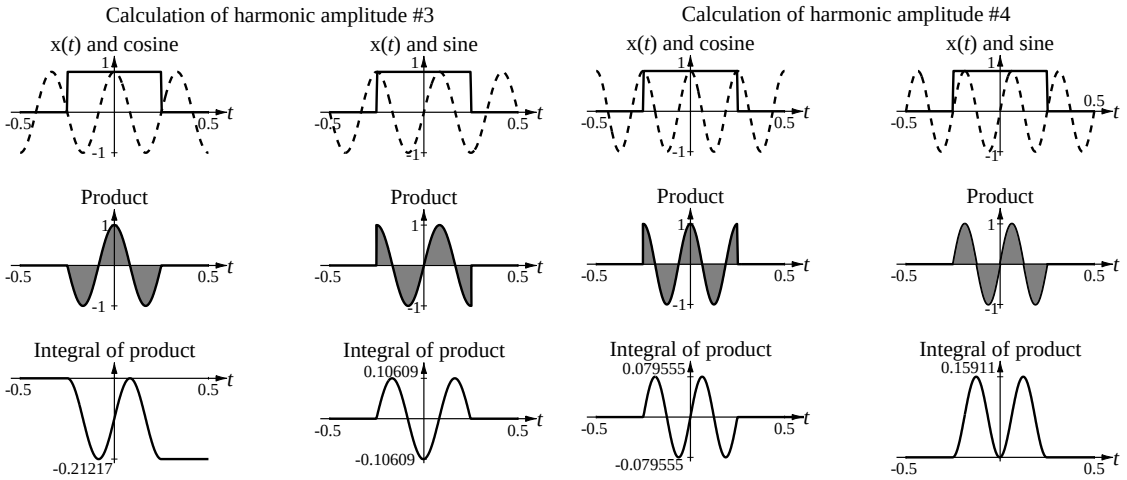
Replace 4 bottom graphs in Figure 4.16. New figure should be




(Bottom graphs have been re-drawn and re-scaled. Do not simply change the numbers)

Page 230

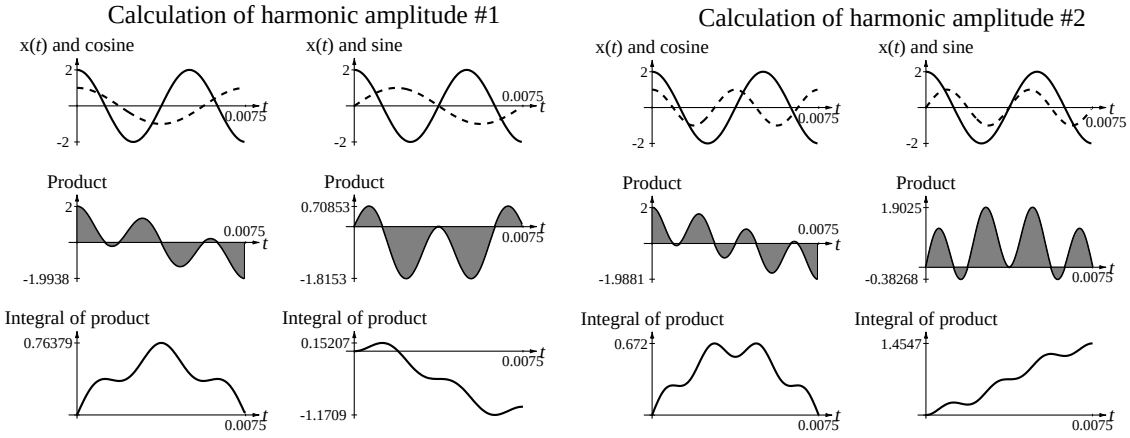
Replace bottom graphs in Figure 4.17. New figure should be




(Bottom graphs have been re-drawn and re-scaled. Do not simply change the numbers

Page 231

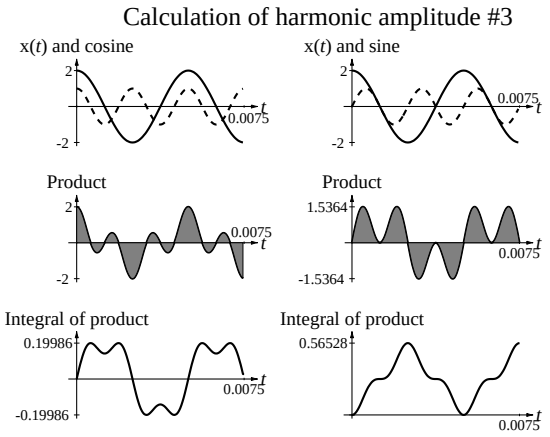
Replace bottom graphs in Figure 4.19. New figure should be




(Bottom graphs have been re-drawn and re-scaled. Do not simply change the numbers

Page 232

Replace bottom graphs in Figure 4.20. New figure should be



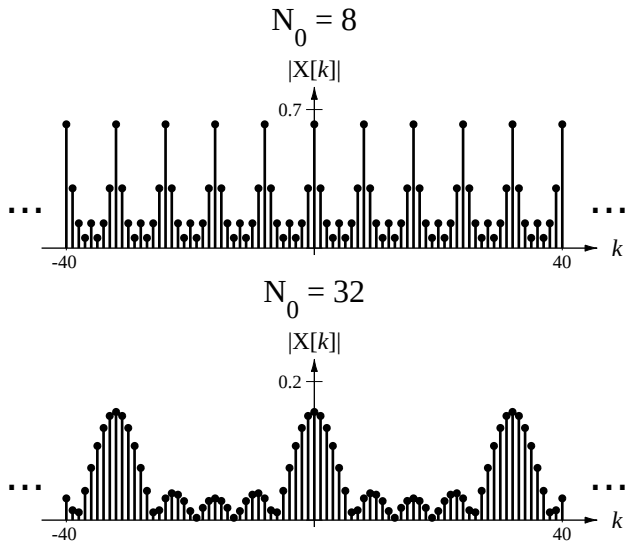

(Bottom graphs have been re-drawn and re-scaled. Do not simply change the numbers

Page 263

Last sentence in the paragraph following Eq 4.237. Change "x[*k*] and X[*k*]" to "x[*n*] and X[*k*]". (Replace one, and only one, *k* by an *n*.)

Page 266

Figure 4.43. Add ellipses (...) to both sides of the graphs as below. (Graphs themselves do not change.)




Page 270

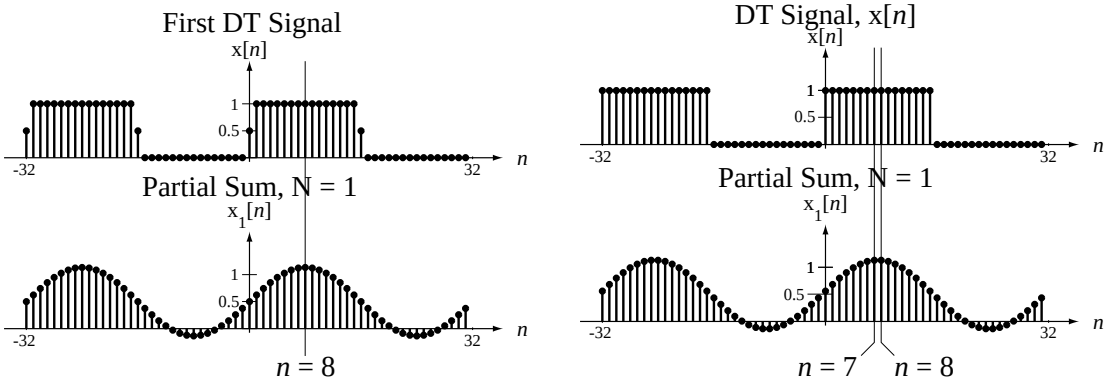
Last line. Change "$N_{0x}.= N_0$" to "$N_{0x} = N_0$". (Delete the period ".".)

Page 272

7th Line from the top. Make the "$1/2N_0$" the same size as in previous lines.

Page 283

Figure 4.55. Change x($n$) to x[$n$] in upper right hand graph. New figure should be




(Graphs themselves do not change.)

Page 286

Eq. 4.331. Lower the "$N_w$" after the "rect" as shown below

$$\text{rect}_{N_w}[n] * \text{comb}_{N_0}[n] \overset{\mathcal{FS}}{\longleftrightarrow} \frac{2N_w+1}{N_0}\text{drcl}\left(\frac{k}{N_0}, 2N_w+1\right)$$

Page 290

Exercise 6.

The answer, $X_s[k] = j2\dfrac{\cos(\pi k/2)-1}{\pi k}$ is wrong. Change it to $X_s[k] = -2\dfrac{\cos(\pi k/2)-1}{\pi k}$.

Page 291

Exercise 13(a). Change "$T_F = T_0 = 1$" to "$T_F = 1$". Should then read

Find the time functions associated with these harmonic functions assuming $T_F = 1$.

Page 296

Exercise 28(a). Change $e^{-j(\pi n/16)}$ to $e^{-j(\pi n/8)}$ . Everything else on that line is ok.

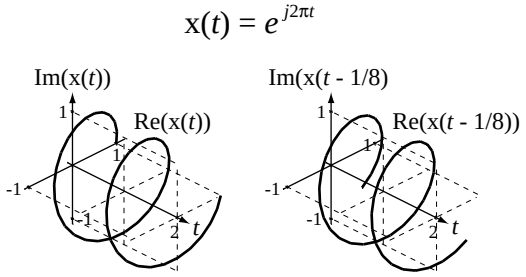
**Chapter 5**

Page 313

Second line after Eq. 5.58. Change "$A\cos(2\pi f_0 t + \theta)$" to "$A\cos(2\pi f_0 t - \theta)$".

Page 315

Figure 5.12. The graphs were changed from my originals and are now inaccurate. Replace with the figure below.

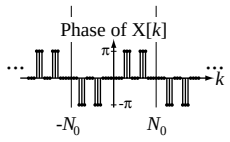


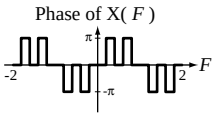

Page 316

Eq. 5.76. Change the "$\mathrm{X}(\omega - \omega_0)$" to $\mathrm{X}\left(j(\omega - \omega_0)\right)$".

Page 355

Figure 5.31. Change the bottom two phase graphs. The two "pulse pairs" on the ends should be flipped vertically as illustrated below. Otherwise the graphs are ok. The locations of the changes are indicate by carets (^).



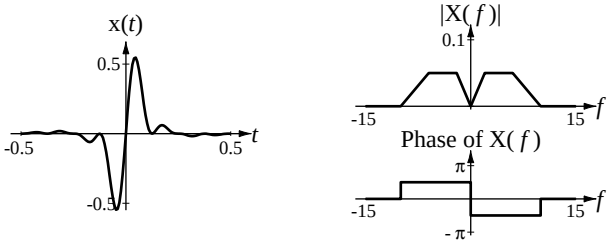




Page 356

Figure 5.32. The "$f$ " in the lower right-hand corner at the extreme right edge seems to be cut off slightly. This can probably be cured by placing a space after the "$f$ " in the figure.

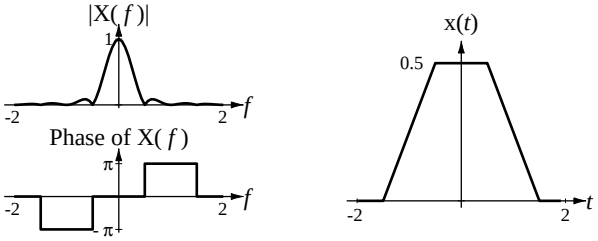
Page 378

Exercise 22c. Change third answer graph to



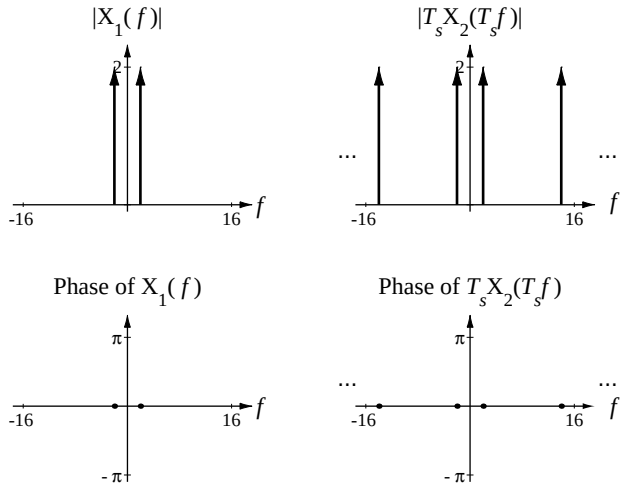

Page 381

Exercise 26. Change third answer graph to




Page 385

Exercise 39. Change the answer graph to

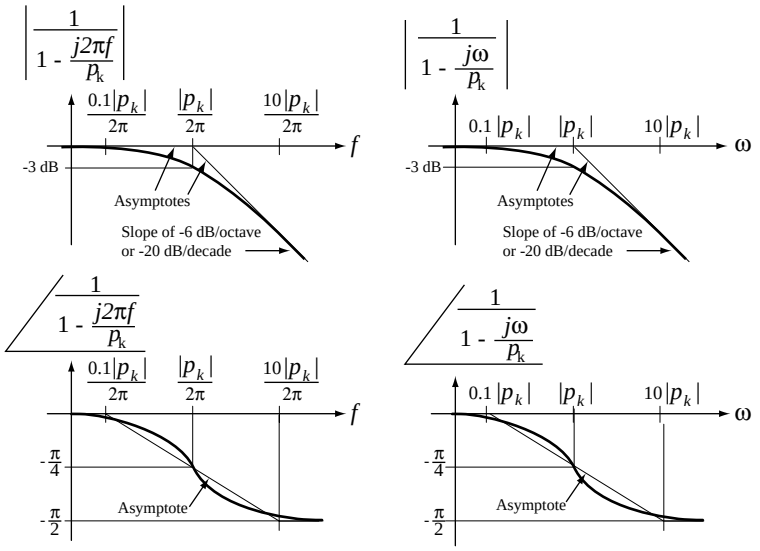



(On the two right-hand graphs the abscissa label is changed from "$T_s f$" to "$f$".)

**Chapter 6**

Page 423

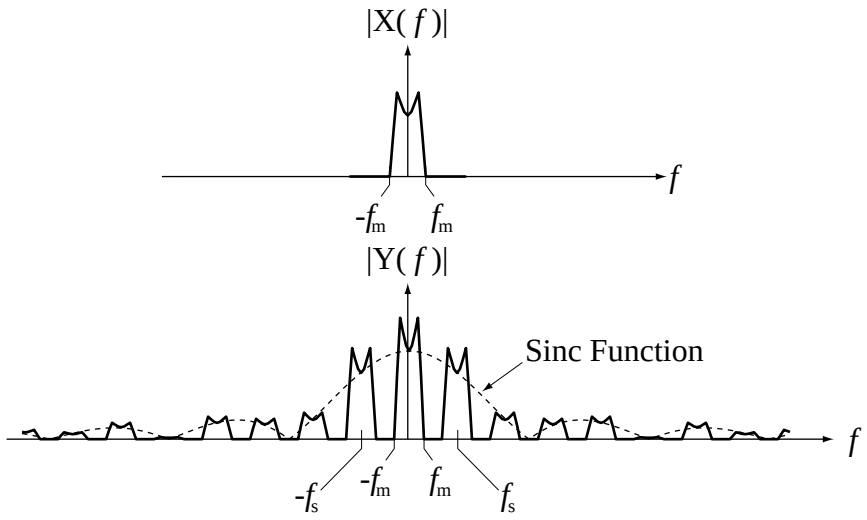
Figure 6.43. There are four occurrences of a "p" with a subscript, "1". Those subscripts should all be "*k*", not "1". New figure should be




(Graphs themselves do not change.)

Page 465

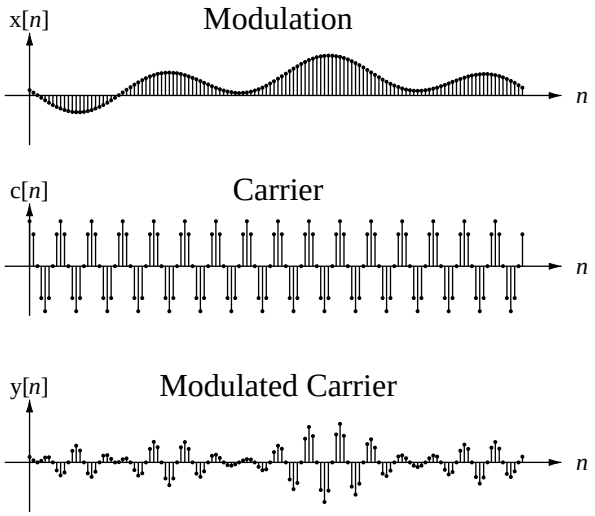
Figure 6.114. The capital X, along with its subscript, p, in the lower graph should be simply replaced by a capital Y (with no subscript). New figure should be




(Graphs themselves do not change.)

Page 467

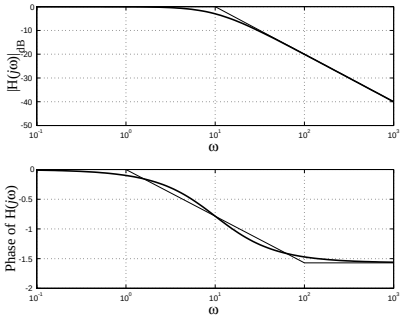
Figure 6.116. In the <u>bottom graph only</u>, the c[*n*] should be a y[*n*]. New figure should be




(Graphs themselves do not change.)

Page 477

Exercise 12. Right hand pair of graphs is wrong. Replace with

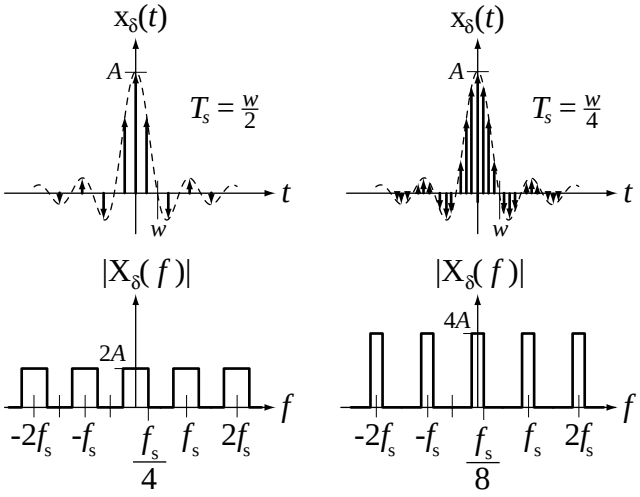



Left-hand pair of graphs is ok as is.

**Chapter 7**

Page 501

In Figure 7.15. Change *n* to *t* (twice) and change *F* to *f* (once). New figure should be




(Graphs themselves do not change.)

Page 538

In Eq. 7.141. Change *n* to *k* (in two places). New equation should be

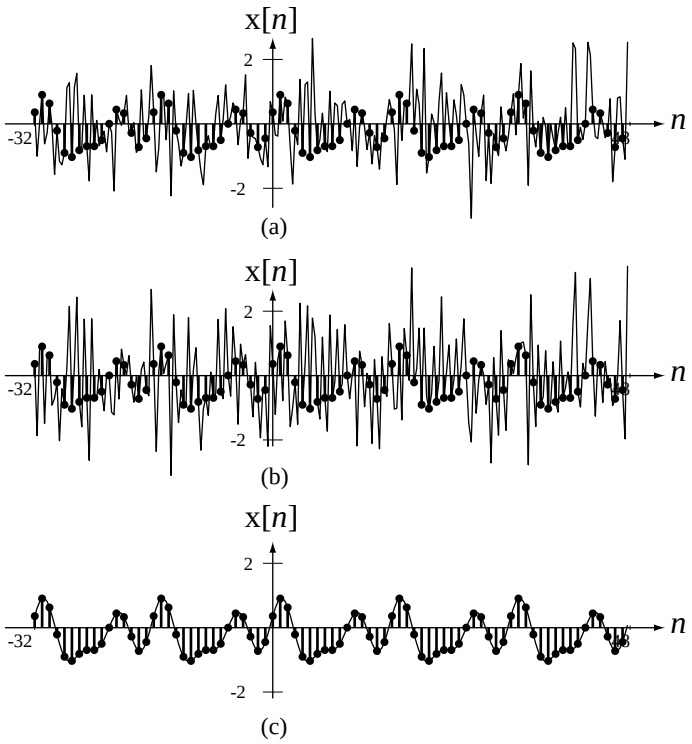
$$\mathrm{X}(f) = \sum_{k=-\frac{N_0}{2}}^{\frac{N_0}{2}} \mathrm{X}_{CTFS}[k]\delta(f - kf_0)$$

Page 539

Second line after Eq. 7.149. Delete ", and compare with the CFT of the signal".

Page 547

Change Figure 7.75 to add (a) (b) and (c). New figure should be




(Graphs have not changed. Just add the letters.)

Page 551

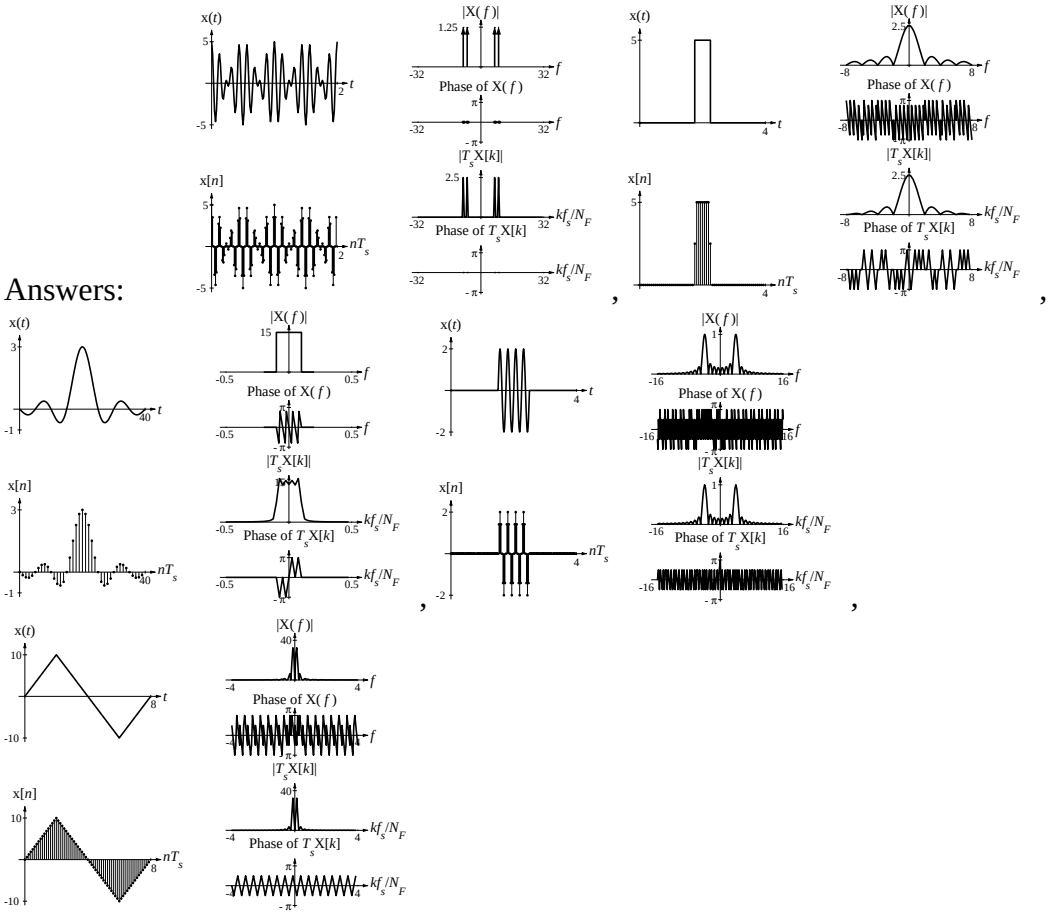
Eq. 7.161. Change $N_0$ to $N_F$ and change $N$ to $N_F$. New equation should be

$$\mathrm{X}[k] = \sum_{n=0}^{N_F-1} \mathrm{x}[n]e^{-j2\pi nk/N_F}$$

Page 566

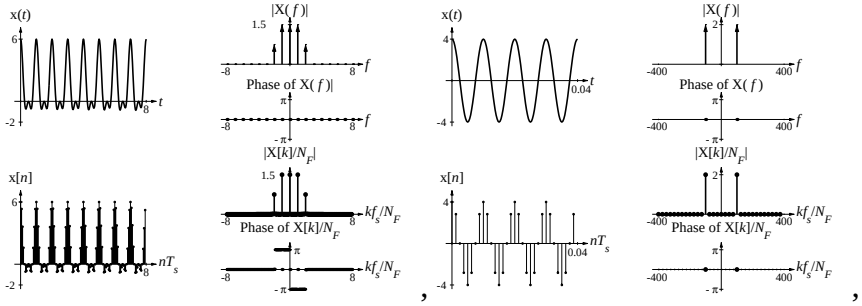
Exercise 25. Change “CT function using” to “continuous function of $k\Delta f$ using”. Also change the answer figures to

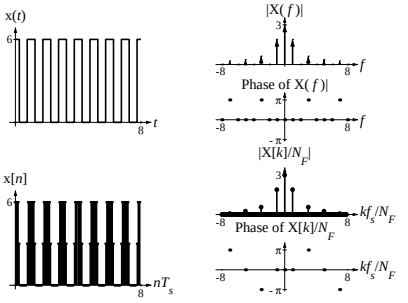
Answers:

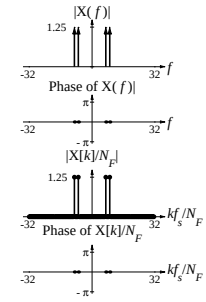



Page 567

Exercise 26. Change “a CT impulse function using” to “an impulse function of $k\Delta f$ using”. Also change the answer figures to

Answers: 

, 

, 

,

## Chapter 8

Page 591

Change $x_1$ to $x_2$ <u>in the second line only</u>. New equation should be

$$x_1(t) = A_1 \cos(2\pi f_{01} t + \theta_1) \quad \text{and}$$
$$x_2(t) = A_2 \cos(2\pi f_{02} t + \theta_2) \qquad f_{01} \neq f_{02}$$

Page 615

Exercise 1. First line. Change “pair” to “pairs”.

## Chapter 9

Page 630

Example 9.2. Eq. 9.30. Add a minus sign. New equation should be

$$e^{2t}\,\mathrm{u}(-t) \overset{L}{\longleftrightarrow} -\frac{1}{s-2} \qquad \sigma < 2$$

Page 630

Example 9.2. Eq. 9.31. Change "+" to "-". New equation should be

$$e^{-t}\,\mathrm{u}(t) + e^{2t}\,\mathrm{u}(-t) \overset{L}{\longleftrightarrow} \frac{1}{s+1} - \frac{1}{s-2} \qquad -1 < \sigma < 2$$

Page 654

Equation 9.176. New equation should be

$$e^{-\alpha t}\sin(\beta t)\,\mathrm{u}(t) \overset{L}{\longleftrightarrow} \frac{\beta}{(s+\alpha)^2 + \beta^2} \qquad \sigma > -\alpha$$

(Add a minus sign on the left side and change a "-" to a "+" on the right side.)

Page 661

Eq. 9.224. New equation should be

$$e^{-\alpha t}\cos(\omega_0 t)\,\mathrm{u}(t) \overset{L}{\longleftrightarrow} \frac{s+\alpha}{(s+\alpha)^2 + \omega_0^2} \qquad \sigma > \alpha$$

(Add a minus sign on the left side and change two, and only two, "-" signs to "+" signs on the right side.)

**Chapter 10**

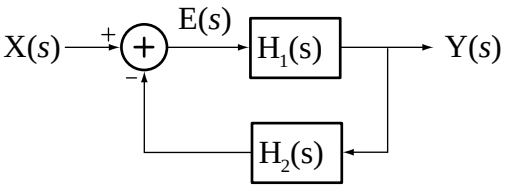
Page 676

In Table 10.1 under "Marginal Stability". Change "multiple" to "repeated". New table should be

| Stability | Marginally Stability | Instability |
|---|---|---|
| All poles in the open LHP | One or more simple poles on the $\omega$ axis but no repeated poles on the $\omega$ axis and no poles in the open RHP | One or more poles in the open RHP or one or more multiple poles on the $\omega$ axis |

Page 690

Change Figure to be identical to Figure 10.9.

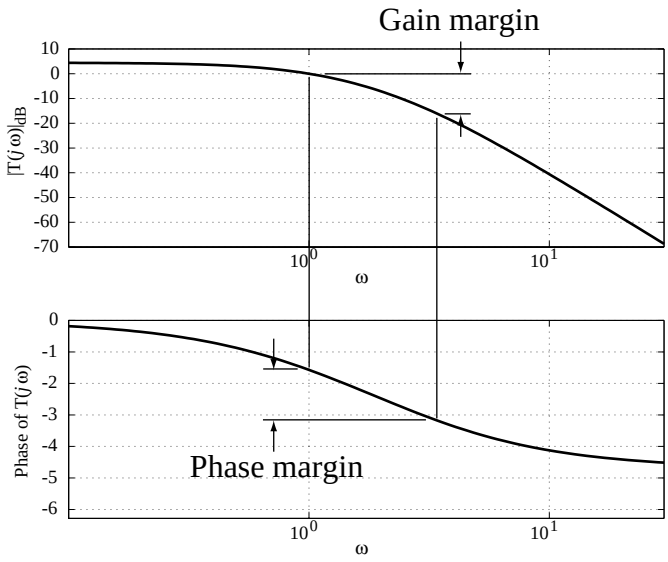



Page 695

Under the heading “The Root-Locus Method”. In the third line. Delete “without loss of generality”.

Page 700

In Figure 10.33 change the “H” to a “T” in the two graphs. The new figure should be




(Graphs themselves do not change.)

Pages 716-760

Pages 716-760 have the wrong heading at the top of the page. Should be “Laplace

Transform Analysis of Signals and Systems" instead of "Sampling and the Discrete

Fourier Transform".

Page 758

Exercise 44d. Add an *s* after 1.618 and an *s* after 0.618. New equation should be

$$\mathrm{H}(s) = \frac{1}{(s+1)\left(s^2 + 1.618s + 1\right)\left(s^2 + 0.618s + 1\right)}$$

**Chapter 11**

Page 776

In Example 11.7. Eq. 11.90. Change *n* to *m* (on the right side only, two occurrences). Also change ∞ to *n* on the right side.) New equation should be

$$n\,\mathrm{u}[n] = \sum_{m=0}^{n} \mathrm{u}[m-1]$$

In equation 11.92, make similar changes. New equation should be

$$n\,\mathrm{u}[n] = \sum_{m=0}^{n} \mathrm{u}[m-1] \xleftrightarrow{Z} \left(\frac{z}{z-1}\right)\frac{1}{z-1} = \frac{z}{(z-1)^2}$$

Page 784

Eqs. 11.140 and 11.141. In both equations, change the lower summation limit from $-\infty$ to 0. The new equations should be

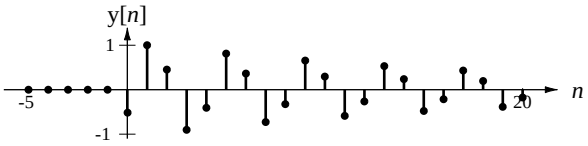
$$\mathrm{H}(z) = \sum_{n=0}^{\infty} \mathrm{h}[n] z^{-n}$$

and

$$\mathrm{H}_{\delta}(s) = \sum_{n=0}^{\infty} \mathrm{h}[n] e^{-nT_s s} \quad .$$

Page 794

Exercise 15. The middle answer graph should be changed to




(The dot on the vertical line (at $n$ =0) is moved from -1 to -1/2. Otherwise, no graphical changes.)

**Chapter 12**

Page 802

Eq. 12.21. Delete one $z$ on the right side. New equation should be

$$Y(z) = \frac{z}{z-1}\frac{Kz}{z-p} = \frac{K}{1-p}\left(\frac{z}{z-1} - \frac{pz}{z-p}\right)$$

Page 815

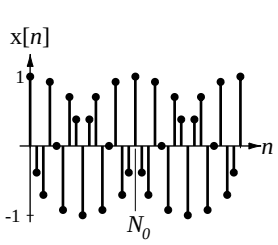
After Eq. 12.83. Second line. Before $K$, add "positive". Line should then end with "stable for any finite positive $K$."

Page 836

In Example 12.13. First line. Change "backward" to "forward".

**Appendix E**

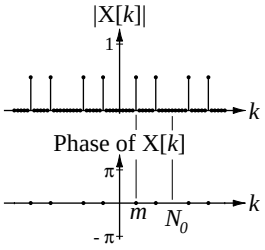
Page 944 Insert the additional transform pairs (below) in the fourth and fifth positions in the table and shift all the others back by two thereby preserving all the old table entries

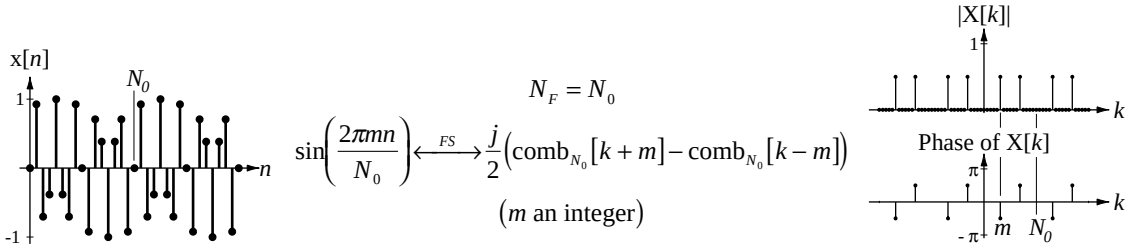



$$\cos\left(\frac{2\pi mn}{N_0}\right) \overset{FS}{\longleftrightarrow} \frac{1}{2}\left(\text{comb}_{N_0}[k-m] + \text{comb}_{N_0}[k+m]\right)$$

$N_F = N_0$

($m$ an integer)






Page 956

Bottom of page. Last equation. Delete one "π" in denominator on lower right side. New equation should be

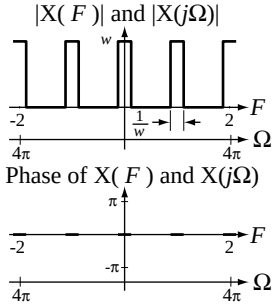
$$\text{u}[n-n_0]-\text{u}[n-n_1] \overset{F}{\longleftrightarrow} \frac{e^{-j\pi F(n_0+n_1)}}{e^{-j\pi F}}(n_1-n_0)\,\text{drcl}(F, n_1-n_0)$$

$$\text{u}[n-n_0]-\text{u}[n-n_1] \overset{F}{\longleftrightarrow} \frac{e^{-j\frac{\Omega}{2}(n_0+n_1)}}{e^{-j\frac{\Omega}{2}}}(n_1-n_0)\,\text{drcl}\left(\frac{\Omega}{2\pi}, n_1-n_0\right)$$

($n_0$ and $n_1$ integers and $n_1 > n_0$)

Page 957

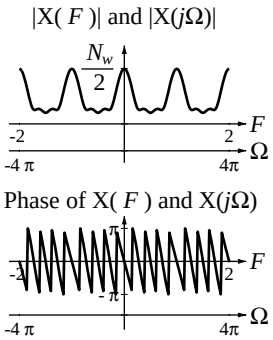
Bottom of page. Next-to-bottom graph on right side. Change "1" on vertical scale to "*w*". Figure should be




(Graphs themselves do not change.)

Page 958

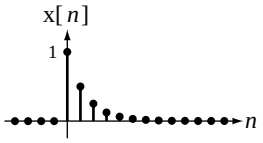
Upper right-hand graph. The "Nw/2" and its associated tick mark should both be lowered so that the tick mark touches the peak of the plot. Figure should be




Otherwise the graph is ok.

Page 959

Middle graph on left side. Add a dot next to the "1" on the vertical scale. New figure should be




(Otherwise the graph stays the same.)

**Appendix I**

Page 1000

Eq. I.87. Make the y's roman instead of italic. The equation should be

$$\mathrm{y}_{1p}(t) = K_{1p} \quad \text{and} \quad \mathrm{y}_{2p}(t) = K_{2p}$$

Page 1012

Answer in Exercise 3. Make the y's roman instead of italic. The equations should be

$$\mathrm{y}_1(t) = -1.844e^{-7.844t} + 5.686e^{4.844t} - 0.8421$$

$$\mathrm{y}_2(t) = -1.347e^{-7.844t} - 4.864e^{4.844t} + 0.2105$$

**Appendix J**

Page 1025

3 lines before equation J.37. It should say “the product of the element and the determinant of its cofactor” not “the product of the element and its cofactor”.

Page 1027

Take the text in item 7 and place that text at the end of the paragraph which ends just before Eq. J.55. The end of that paragraph should then read (after Eq. J.54) as follows:

So a straightforward way of solving a matrix equation of the form, $\mathbf{Aq} = \mathbf{x}$, is to premultiply both sides by the inverse of **A**. This directly yields the solution, $\mathbf{q} = \mathbf{A}^{-1}\mathbf{x}$, *if* $|\mathbf{A}| \neq 0$. The determinant of the inverse of a matrix is the reciprocal of the determinant of the matrix.

$$\left|\mathbf{A}^{-1}\right| = \frac{1}{|\mathbf{A}|}$$

(This removes an equation and replaces it later. Renumber equations accordingly.)