Prob. 1

(a) Listed below are the frequencies, ω; spectrum, $X(\omega)$; and magnitude spectrum, $|X(\omega)|$.

```
  1.0e+02 *
 -0.0314            0.0069 - 0.0095i   0.0118
 -0.0283            0.0041 - 0.0081i   0.0091
 -0.0251            0.0019 - 0.0059i   0.0062
 -0.0220            0.0005 - 0.0031i   0.0031
 -0.0188                 0 - 0.0000i   0.0000
 -0.0157            0.0005 + 0.0031i   0.0031
 -0.0126            0.0015 + 0.0055i   0.0057
 -0.0126            0.0019 + 0.0059i   0.0062
 -0.0126            0.0024 + 0.0062i   0.0066
 -0.0094            0.0041 + 0.0081i   0.0091
 -0.0063            0.0069 + 0.0095i   0.0118
 -0.0031            0.0100 + 0.0100i   0.0141
       0            0.0131 + 0.0095i   0.0162
  0.0031            0.0159 + 0.0081i   0.0178
  0.0063            0.0181 + 0.0059i   0.0190
  0.0094            0.0195 + 0.0031i   0.0198
  0.0126            1.0183 + 0.0515i   1.0196
  0.0126            1.0200             1.0200  <<--
  0.0126            1.0183 - 0.0515i   1.0196
  0.0157            0.0195 - 0.0031i   0.0198
  0.0188            0.0181 - 0.0059i   0.0190
  0.0220            0.0159 - 0.0081i   0.0178
  0.0251            0.0131 - 0.0095i   0.0162
  0.0283            0.0100 - 0.0100i   0.0141
  0.0314            0.0069 - 0.0095i   0.0118
```

The figure on p. 199 shows a peak at ω_0. We see a similar peak (denoted with `<<--`) in the magnitude spectrum values.

(b) Since the samples $x(n)$ are complex-valued, $X(\omega)$ does NOT have the Hermitian symmetry property, i.e. $X(\omega) = X^*(-\omega)$.

Prob. 2

(a) Listed below are the frequencies, ω; spectrum, $X(\omega)$; and magnitude spectrum, $|X(\omega)|$.

-3.1416	0.6910 + 0.0000i	0.6910	
-2.8274	0.7061 + 0.0955i	0.7125	
-2.5133	0.7500 + 0.1816i	0.7717	
-2.1991	0.8184 + 0.2500i	0.8557	
-1.8850	0.9045 + 0.2939i	0.9511	
-1.5708	1.0000 + 0.3090i	1.0467	
-1.2576	50.9877 + 2.8503i	51.0673	
-1.2566	51.0955 + 0.2939i	51.0963	<<--
-1.2556	51.0307 - 2.2647i	51.0809	
-0.9425	1.1816 + 0.2500i	1.2078	
-0.6283	1.2500 + 0.1816i	1.2631	
-0.3142	1.2939 + 0.0955i	1.2974	
0	1.3090	1.3090	
0.3142	1.2939 - 0.0955i	1.2974	
0.6283	1.2500 - 0.1816i	1.2631	
0.9425	1.1816 - 0.2500i	1.2078	
1.2556	51.0307 + 2.2647i	51.0809	
1.2566	51.0955 - 0.2939i	51.0963	<<--
1.2576	50.9877 - 2.8503i	51.0673	
1.5708	1.0000 - 0.3090i	1.0467	
1.8850	0.9045 - 0.2939i	0.9511	
2.1991	0.8184 - 0.2500i	0.8557	
2.5133	0.7500 - 0.1816i	0.7717	
2.8274	0.7061 - 0.0955i	0.7125	
3.1416	0.6910 - 0.0000i	0.6910	

The cosine signal has two spectral peaks at $\pm\omega_0$. We see similar peaks (denoted with `<<--`) in the magnitude spectrum values.

(b) Since the samples $x(n)$ are real-valued, $X(\omega)$ does have the Hermitian symmetry property, i.e. $X(\omega) = X^*(-\omega)$.

Prob. 3

(a) Listed below are the DFT indices, k; spectrum, $X(\omega_k)$; and magnitude spectrum, $|X(\omega_k)|$.

```
  1.0e+02 *
       0              0.0131 + 0.0095i   0.0162
  0.0100              0.0159 + 0.0081i   0.0178
  0.0200              0.0181 + 0.0059i   0.0190
  0.0300              0.0195 + 0.0031i   0.0198
  0.0400              1.0200 + 0.0000i   1.0200  <<--
  0.0500              0.0195 - 0.0031i   0.0198
  0.0600              0.0181 - 0.0059i   0.0190
  0.0700              0.0159 - 0.0081i   0.0178
  0.0800              0.0131 - 0.0095i   0.0162
  0.0900              0.0100 - 0.0100i   0.0141
  0.1000              0.0069 - 0.0095i   0.0118
  0.1100              0.0041 - 0.0081i   0.0091
  0.1200              0.0019 - 0.0059i   0.0062
  0.1300              0.0005 - 0.0031i   0.0031
  0.1400                   0 - 0.0000i   0.0000
  0.1500              0.0005 + 0.0031i   0.0031
  0.1600              0.0019 + 0.0059i   0.0062
  0.1700              0.0041 + 0.0081i   0.0091
  0.1800              0.0069 + 0.0095i   0.0118
  0.1900              0.0100 + 0.0100i   0.0141
```

The peak in the magnitude spectra at $k = 4$ is denoted with `<<--`. This corresponds to the frequency $\omega = 4\pi/10$.

Prob. 4

(a) Listed below are the DFT indices, k; spectrum, $X(\omega_k)$; and magnitude spectrum, $|X(\omega_k)|$.

```
       0              1.3090             1.3090
  1.0000              1.2939 - 0.0955i   1.2974
  2.0000              1.2500 - 0.1816i   1.2631
  3.0000              1.1816 - 0.2500i   1.2078
  4.0000             51.0955 - 0.2939i  51.0963
  5.0000              1.0000 - 0.3090i   1.0467
  6.0000              0.9045 - 0.2939i   0.9511
  7.0000              0.8184 - 0.2500i   0.8557
  8.0000              0.7500 - 0.1816i   0.7717
  9.0000              0.7061 - 0.0955i   0.7125
 10.0000              0.6910 + 0.0000i   0.6910
 11.0000              0.7061 + 0.0955i   0.7125
 12.0000              0.7500 + 0.1816i   0.7717
 13.0000              0.8184 + 0.2500i   0.8557
 14.0000              0.9045 + 0.2939i   0.9511
 15.0000              1.0000 + 0.3090i   1.0467
 16.0000             51.0955 + 0.2939i  51.0963
 17.0000              1.1816 + 0.2500i   1.2078
 18.0000              1.2500 + 0.1816i   1.2631
 19.0000              1.2939 + 0.0955i   1.2974
```

The peaks in the magnitude spectra at $k = 4$ and $k = 16$ are denoted with `<<--`. These correspond to the frequencies $\omega = 4\pi/10$ and $\omega = -4\pi/10 = 16\pi/10$.

Textbook Problems

Solutions to textbook problems may be found in the online solution manual.