Problem 7.30

(a) Running the Matlab script provided in Appendix 7, the plots shown in Fig. 1 are obtained. The top plot of the figure shows the time-domain version of the bandpass signal. The carrier appears to show a small amount of amplitude modulation but this is due to the sampling process; if the sampling rate is increased by a factor of four, this amplitude modulation disappears as we would expect with rectangular pulse-shaping. The bottom plot of Fig. 1 shows the frequency-domain version of the bandpass signal. The plot is in the form of a (sin *x*)/*x* spectrum that is centered at the carrier frequency of 10 Hz, and the first null is offset by the bit rate of 1 Hz. The spectrum is not perfectly symmetric about the carrier due to aliasing, which affects the higher frequency components.

(b) We modify the provided Matlab script by inserting the statement
b = bIp + j*bQp;
and modifying the two statements
subplot(2,1,1), plot(t,real(b)); % time display
[spec,freq] = spectrum(b,nFFT,nFFT/4,nFFT/2,Fs);
With these changes, we obtain the plots shown in Fig. 2. The top plot of the figure shows the time-domain sequence of random data with rectangular pulse shaping. The bottom plot shows the (sin *x*)/*x* magnitude spectrum centered at the origin. In part (a), distortion of both the time-domain and frequency domain signals was noted due to the limitations of the sampling rate. In part (b), these distortions are much less evident. Consequently, if we simulate signals at complex baseband, then we may use much lower sampling rates (and thus less computational requirements) than for bandpass signals and obtain the same accuracy.

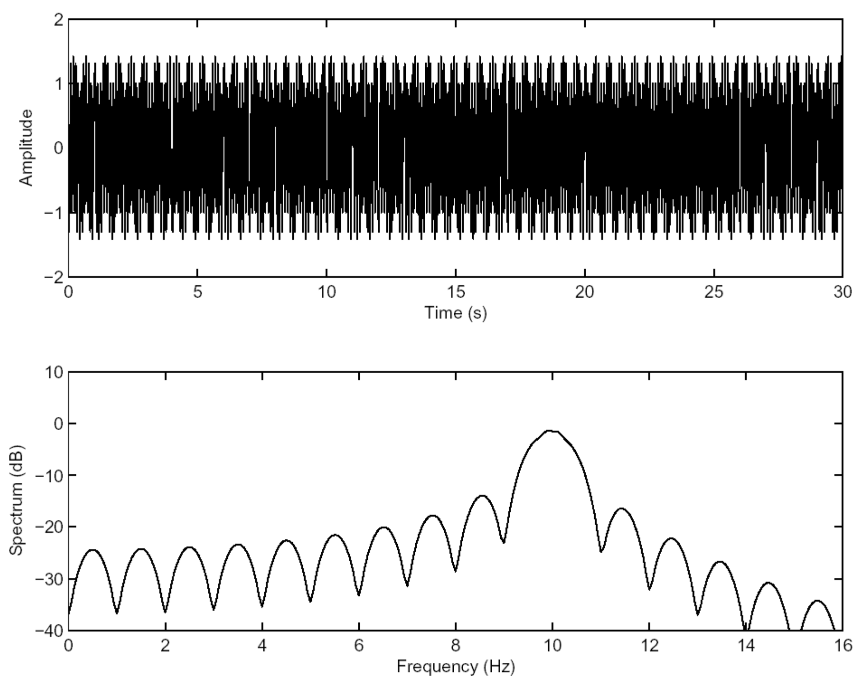

Figure 1

Continued on next slide

Problem 7-30 continued

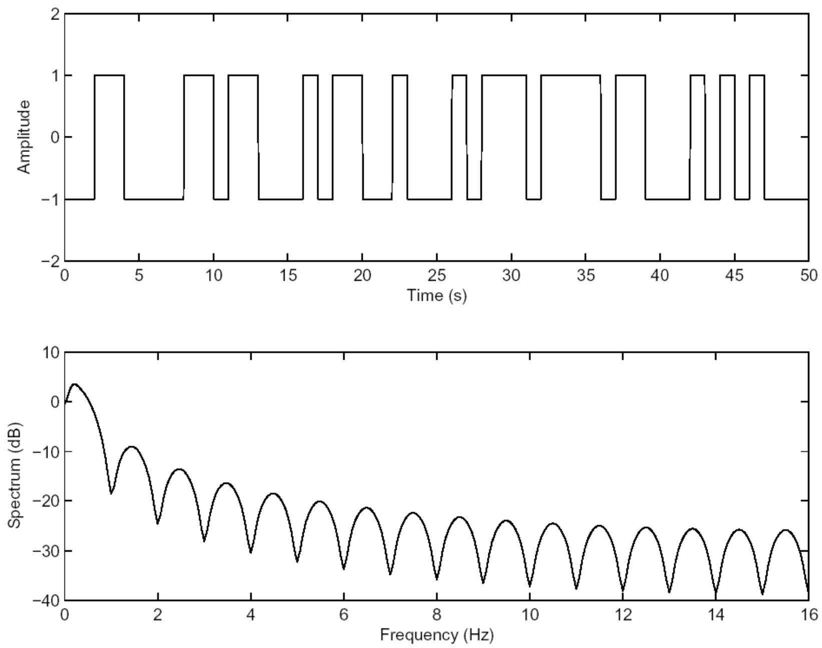

Figure 2