6.2-1 : $L = 128$ characters (levels).

The source (computer) generates 100,000 characters per second.

(a) $n = \log_2 L = \log_2 128 = 7$ bits per character.

(b) The output rate is $7(100,000) = 700$ Kbits/s.

$B_T(\min) = \frac{700}{2} = 350$ KHz.

(c) For 8 bits instead of 7 bits, we have output rate = 800 kbits/s and $B_T(\min) = 400$ KHz.

6.2-2 : Bandwidth $B = 15$ KHz (audio signal).

(a) $R_{Nyquist} = 2B = 30$ K samples/s.

(b) $L = 65{,}536$ levels, then $n = \log_2 L = 16$ bits.

(c) The number of bits per second required to encode the audio signal is

$R_{source} = 30 \times 10^3 \times 16 = 480$ kbits/s.

(d) For a sampling rate equal to 44,100 samples/s, then

$R_{source} = 44{,}100 \times 16 = 705.6$ Kbits/s.

$B_T(\min) = \frac{1}{2} R_{source} = 352.8$ KHz

6.2-3 : Bandwidth $B = 4.5$ MHz.

(a) Sampling rate $= (1.2)(2)(4.5 \times 10^6) = 10.8$ M samples/s.

(b) $L = 1024$, then $n = \log_2 L = 10$ bits/sample.

(c) The bit rate of the signal is

$R_b = 10\ (10.8) \times 10^6$ bits/s $= 108$ M bits/s.

$B_T(\min) = \frac{1}{2} R_b = 54$ MHz.

Chapter 6

6.2-4 If m_p is the peak sample amplitude, then

quantization error $\leq \frac{(0.2)(m_p)}{100} = \frac{m_p}{500}$

Since maximum quantization error is $\frac{\Delta V}{2} = \frac{2m_p}{2L} = \frac{m_p}{L}$,

$$\frac{m_p}{L} = \frac{m_p}{500} \Rightarrow L = 500$$

Because L should be a power of 2, we choose $L = 512 = 2^9$. This requires 9 bit binary code.

The Nyquist rate $= 2 \times 1000 = 2000$ Hz

20% above this rate $= 2000 \times 1.2 = 2400$ Hz.

Thus each signal has 2400 samples/second and each sample is encoded with 9 bits. Hence, each signal uses 21.6 Kbits/sec. There are five such signals. Hence we need a total of $21.6 \times 5 = 108$ kbits/sec data bits. Framing and synchronization requires $108 \times 0.5/100 = 540$ bits. Hence we must transmit a total of 108.540 kbits/second. The minimum transmission bandwidth is $108.54/2 = 54.27$ kHz.

6.2-2

(a) BW = 15 kHz $\Rightarrow$ Nyquist rate = $2 \times 15 = 30$ kHz

(b) $n = \log_2 L = \log_2 65{,}536 = 16$.

(c) bit rate $= 30 \times 10^3 \times 16 = 480 \times 10^3$ bits/sec.

(d) bit rate $= 44.1 \times 10^3 \times 16 = 705.6 \times 10^3$ bits/sec
BW required $= 705.6 \times 10^3 / 2 = 352.8$ kHz