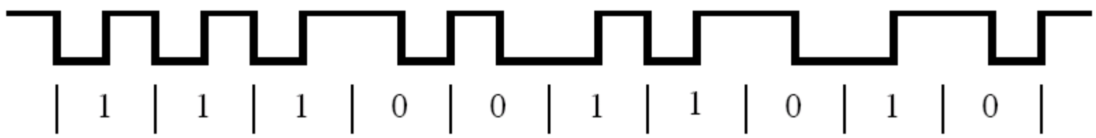
Solutions for Homework #2

5.3 First, E-NRZ provides a minimum transition rate that reduces the dc component. Second, under worst case, E-NRZ provides a minimum of one transition for every 14 bits, reducing the synchronization problem. Third, the parity bit provides an error check. The disadvantages of E-NRZ are added complexity and the overhead of the extra parity bit.

5.7 With Manchester, there is always a transition in the middle of a bit period.



5.9 The error is at bit position 7, where there is a negative pulse. For AMI, positive and negative pulses are used alternately for binary 1. The pulse in position 7 represents the third binary 1 in the data stream and should have a positive value.

5.14

$E_b/N_0 = (S/N)\ (B/R)$ (eq. 3.2)

$S/N = (R/B)\ (E_b/N_0) = 1 \times (E_b/N_0)$

$(S/N)_{dB} = (E_b/N_0)_{dB}$

For FSK and ASK, from Figure 5.4, $(E_b/N_0)_{dB}$ = 13.5 dB

(S/N)dB = 13.5 dB

For PSK, from Figure 5.4, (E_b/N_0)dB = 10.5 dB

(S/N)dB = 10.5 dB

For QPSK, if you consider the effective bandwidth is halved, then

(R/B) = 2

$(R/B)_{dB}$ = 3

$(S/N)_{dB}$ = 3 + 10.5 = 13.5 dB

If you consider the bandwidth efficiency is fixed (equals to 1.0), then

$(S/N)_{dB}$ = 10.5 dB

Both answers are O.K.

5.16

For multilevel signaling

$B_T = [(1 + r)/\log_2 L]R$ (eq. 5.10)

For 2400 bps QPSK, $\log_2 L = \log_2 4 = 2$

B_T = (2/2)2400 = 2400 Hz, which just fits the available bandwidth

For 8-level 4800 bps signaling, $\log_2 L = \log_2 8 = 3$

B_T = (2/3)(4800) = 3200 Hz, which exceeds the available bandwidth