UNIVERSITY OF TEXAS AT DALLAS Department of Electrical Engineering

EE/TE 4367 - Telecommunications Switching & Transmission Solution #4

Date assigned:	2/14/2008
Date due:	2/21/2008

Solution 4.1

	011010000100011000000010
(a)	0 - +0 - 0000 + 000 - +0000000 - 0
(b)	0 + -0 + 0000 - 000 + -0000000 + 0
(c)	(+0+)0 - +0 - (00-)0 + (00+) - +(-0-)(+0+)0 - 0
(d)	0 - +0 - 0000 + 000 - +(0 + -0 - +)0 - 0

Solution 4.2

The average pulse density of bipolar line coding before the substitution is 50% if we assume that 1's and 0's in message are equally likely. Since B3ZS replaces 3 consecutive zeros, we make the following table to see how often we see at least three consecutive zeros:

First 3	Second 3 bit string to	Possibility
bit	make consecutive zeros	Of seeing three
string		consecutive
		zeros
		combination
000	All combinations	1/8
001	none	0
01 <u>0</u>	<u>00</u> 1	(1/8)(1/8)
011	none	0
1 <u>00</u>	<u>00</u> 1, <u>0</u> 10, <u>0</u> 11	3(1/8)(1/8)
101	none	0
11 <u>0</u>	<u>00</u> 1	(1/8)(1/8)
111	none	0

From the last column of the above table, on average we see at least three consecutive zeros = 1/8+5*(1/8)(1/8)=0.2031.

Since every three consecutive zeros are replaced either by two zero single pulse sequence or single two pulse sequence, on average, three zeros are replaced by 1.5 pulses 1.5 zeros. Therefore, the new pulse density after B3ZS encoding is

New Pulse density = 0.5+0.2031*0.5=0.6016

Solution 4.3

Using the probability of error formula for polar signals

$$P_b = Q\left(\frac{A}{\sigma}\right) = 10^{-6}$$
 $\frac{A}{\sigma} = Q^{-1}(10^{-6}) = 4.7534$ $SNR = \frac{A^2}{\sigma^2} = 13.6 \ dB$

Thus, the SNR requirement for a BER of 10^{-6} is determined to be 13.6 dB. Using a 1 Watt signal power for convenience, the noise power for 13.6 dB SNR is 0.043. Similarly, crosstalk power that is 16 dB below 1 Watt is 0.025 W. The transmit power required to overcome the effects of the crosstalk is determined from the ratios:

(a) (1/.043)=PT/(0.043+0.025), PT=1.48 W=1.99 dB penalty. (b) (1/.043)=PT/(0.043+0.025PT), PT=2.39 W=3.78 dB penalty