Course of Optical Communications – Telecommunication Engineering

Prof. Maria-Gabriella Di Benedetto

Practice Work n°7 – 01/06/2006

Last Name: _____ **First Name:** _____

PROBLEMS

7.1 Let us consider a CDMA system using binary spreading codes, with three users in the system. Each user is assigned a unique binary code of fixed length L=5, following the table below:

User	Assigned Code
User 1	1 1 1 1 -1
User 2	1 -1 -1 1 -1
User 3	1 -1 -1 -1 -1

How would the sequence 1, -1, 1 be encoded for User 2? And for User 3?

7.2 Considering the same system of exercise 7.1
a) describe briefly (one sentence) how a user receives a signal

Assuming that the sequence 1, -1, 1 was encoded for User 2
b) How will User 2 decode the encoded bits?

c) How will User 1 decode the encoded bits?

7.3 Let us consider a Spread Spectrum system using spreading codes with chip duration T_c = 90.9 ns, and a data bit rate R_b= 1 Mb/s. Determine the processing gain of the system.

7.4 Let us consider a system using spreading codes that lead to a bandwidth of the spread signal W = 10 MHz and user bit rates R_b= 25 kbits/s.
a) Determine the processing gain G_P

Consider two users A and B, using the same transmit power P_{TX} = 20 dBm. User A is transmitting to a third user, C, over a distance d_{AC} = 300 m, and the channel introduces an attenuation A_{dB} given by:

$$A_{dB}(d_{Km}) = 100 + 20\log_{10} d_{Km}$$

b) Determine the minimum distance d_{BC} between users B and C, that guarantees an acceptable near-far effect.
(Note: assume that the near-far effect caused by user B on user A is acceptable if the condition $P_{RxB}/ P_{RxA} \leq G_P$ is met)

7.5 Determine the chip values for the following optical orthogonal codes:
a) C(3,7,9) mod.13

b) C(0,1) mod. 5

c) C(1,7,10) mod. 11

7.6 Consider a CDMA optical system using optical codes and OOK modulation for data bits. Four users are in the system, and adopt the following codewords of length L = 7 in encoding the transmitted signal:

User	Codeword
1	1001011
2	0110110
3	1110001
4	1101100

a) Determine and represent graphically the signal transmitted by User 2 if the bits 1, 0, 1 are transferred.

Assuming that the following data bit sequences are transmitted:

User	Bit sequence
1	010
2	101
3	111
4	001

b) determine the received bits at a receiver tuned on the codeword of User 1, assuming that the receiver multiplies the received sequence of chips by the codeword and compares the output with a threshold set at L/2.

c) determine the received bits if the system adopts the scheme represented in slide 16 of Lecture 7 (Modulation Part II), that is:
    - the user transmits the codeword if the data bit is 1, and the inverted codeword if the data bit is 0
    - the receiver multiplies the received sequence of chips by the codeword represented with bipolar values (0 $\Leftrightarrow$ -1, 1 $\Leftrightarrow$ 1) and compares the output with a threshold set at 0.