Tutorial 7

1. Two users have binary data spread by the spreading codes

$$c_1 = [1 \ -1 \ 1 \ -1] \tag{1}$$

and

$$c_2 = [-1 \ 1 \ 1 \ -1] \tag{2}$$

transmitted as BPSK.

   (a) Show that the above spreading codes are orthogonal.

   (b) Draw a suitable receiver structure.

   (c) If user 1 transmits binary data [−1 1 1 −1] and user 2 transmits [1 −1 1 −1], write down the transmitted sequences.

   (d) Show the effect of de-spreading user 2's data sequence with user 1's spreading code.

   (e) In the above, we have assumed that each user's data is received synchronously. Show the effect of de-spreading user 2's data sequence with user 1's spreading code when there is a timing offset of one chip.

2. A direct sequence spread spectrum (DSSS) mobile communications transmitter employs a pseudo noise (PN) maximal-length spreading sequence to spread the transmitted signal. The PN sequence is obtained using a shift-register structure given by $c_n = c_{n-1} \bigoplus c_{n-4}$. The PN sequence has a period of 15 and is used to spread binary data b_k by a factor of 4. Given the first four initialisation bits of the registers as $[1 \ 0 \ 0 \ 1]$, write down one period of the sequence and use it to encode the following binary data for BPSK transmission

$$b_k = [1 \ 0 \ 1 \ 1 \ 1 \ 1 \ 0 \ 0 \ 1] \tag{3}$$

   Draw a suitable receiver structure.