

# EEL6503: Spread Spectrum and CDMA

## Problem Set 3 (Fall 2001)

### (due Class 21)

1. Prove Properties 3.1–3.7 stated in Section 3.1 of the notes.
2. Show that  $z_{x,y}(\tau)$  defined in (3.13) can be expressed in the form of (3.14).
3. Show that the periodic crosscorrelation function,  $\theta_{x,y}(k)$ , can be expressed in terms of the aperiodic crosscorrelation function  $C_{x,y}(k)$  as in (3.16).
4. Suppose the initial contents of the storage elements in the shift register in Figure 3.2 are set up in such a way that the output sequence is  $u_0, u_1, u_2, u_3, \dots$ . Now we want to use the configuration in Figure 3.3 to generate the same sequence. To do so, we only need to properly set up the initial contents of the storage elements in Figure 3.3. Explain why this is true and determine the corresponding initial contents of the storage elements.
5. **MATLAB Problem:**
  - (a) Write a MATLAB program to generate all the possible m-sequences of length 63. Find the characteristic phase of each set of m-sequences generated by the same primitive polynomial.
  - (b) Write a MATLAB program to calculate the periodic autocorrelation functions of all the m-sequences generated in (a). Check your results against Property 3.17.
  - (c) Construct a diagram (with the help of MATLAB programs to perform decimation) similar to Figure 3.4 showing the decimation relationship between the m-sequences generated in (a). Determine all maximal connected sets.

- (d) Write a MATLAB program to calculate the periodic cross-correlation functions between pairs of sequences in each maximal connected set. Check your results against Property 3.29.
- (e) (BONUS) Write a MATLAB program to calculate the odd cross-correlation functions between pairs of sequences in each maximal connected set.