

Utah State University
ECE 3640
Homework # 7
Due Friday, Mar 10, 2006

- Reading

1. Chapter 3, Chapter 4.

- Homework:

1. (10 pts) Consider the following basis functions:

$$x_1(t) = u(t) - u(t - 1)$$

$$x_2(t) = u(t - 1) - u(t - 2)$$

$$x_3(t) = u(t - 2) - u(t - 3)$$

$$x_4(t) = u(t - 3) - u(t - 4)$$

- (a) Plot the basis functions and satisfy yourself that they are orthonormal.
- (b) For the functions

$$f_1(t) = 2u(t) - 3u(t - 1) + u(t - 4)$$

$$f_2(t) = -2u(t) + 3u(t - 1) - u(t - 3)$$

$$f_3(t) = u(t) - 2u(t - 1) + 2u(t - 2) - 2u(t - 3) + u(t - 4)$$

$$f_4(t) = u(t) - 3u(t - 1) + 4u(t - 3) - 2u(t - 4)$$

defined over the interval $0 \leq t \leq 4$:

- i. Plot the functions.
 - ii. Express each function $f_i(t)$ as a linear combination of the basis functions $x_i(t)$.
2. (10 pts) Problem 3.4-7(a)
 3. (5 pts) Problem 3.4-9(a,c,e)
 4. Problem 3.4-11. (There is a mistake in the book. There is nothing to do in this problem, just read it carefully. You should understand that there are such things as Walsh functions.)

5. (5 pts) Problem 3.4-12(a)
6. (10 pts) Problem 3.5-4
7. (5 pts) Problem 3.5-6
8. (10 pts) A signal $f_0(t) = \sin t$ passes through a full-wave rectifier, producing the signal $f(t) = |\sin(t)|$. This, in turn, passes through a RC lowpass filter with $C = 1\text{F}$ and $R = 1\Omega$.
 - (a) Determine a Fourier series representation for $f(t)$.
 - (b) Determine the Fourier series for the output of the filter, $y(t)$.
 - (c) Determine an expression for the rms power in the ripple. How does this compare to the total power in $y(t)$?
9. Problem 4.1-1.