

## EE4440 HW#8

April 4, 2011

1. What frequency must be used for basis symbols  $\phi_1 = \sin(\omega_c t)$  and  $\phi_2 = \cos(\omega_c t)$  with a symbol period of  $1/(9600\text{Hz})$  to contain 6 cycles of the sin and cos?
2. Show that the two selected signals are orthogonal to one another over the bit period.
3. In MATLAB plot:
  - (a) The symbols for Q-PSK using the basis from problem 1
  - (b) The symbols for rectangular 16-QAM using the basis from problem 1. Assume one volt horizontal and vertical spacing from symbol to symbol in the constellation diagram.
4. Draw the block diagram for a coherent receiver for QPSK using the same basis signals as in problems 1-3. What are the impulse responses for the 4 matched filters?
5. Write a MATLAB program that takes a bit stream array (e.g bitStream=[1 0 0 0 1 0 1 1]) as input and produces a plot of an FSK waveform as output. Use the wavetable synthesis method discussed in class. Use a 256 entry table built with this command: "table=cos(2\*pi\*(0:tableLen-1)/tableLen);" where tableLen=256. Produce plots for the example bit stream where the symbols are:
  - (a) 0 represented by 1 cycle through the table, 1 represented by twice that frequency
  - (b) 1 represented by 1 cycle through the table, 0 represented by twice that frequency
  - (c) 0 represented by 2 cycles through the table, 1 represented by twice that frequency
6. Modify your program from 4 so that it now receives data which is 2 bits per symbol. Choose frequency multiples for your symbols and plot some representative messages.

7. Look up the Bell 103 modem and answer the following questions:

- (a) What year was the modem introduced?
- (b) What baud rate did the modem operate at?
- (c) What is baud rate? How is it different than bit rate?
- (d) The system uses different frequencies for the data coming from the originating station and the answering station. Why?