

KFUPM - COMPUTER ENGINEERING DEPARTMENT

COE-341 – Data and Computer Communication

Quiz 5 – Due date: April 21st, 2012

Student Name:

Student Number:

Problem 1 (60 points+20 bonus): Digital Information – Analog Signals (Modulation Techniques

One the subject of multi-level Phase Shift Keying (PSK) modulation scheme. Consider the quadrature PSK scheme shown in class notes on slide 47. The corresponding signal constellation diagram is shown below in Fig 1. Assume the transmit/receive system uses a carrier with frequency $f_c = 1$ kHz and amplitude $A = 0.13583$ micro volts. The symbol duration T_s for the system is 1 milli second. Furthermore, assume the transmitter filter constant $r = 1$, and the effective noise temperature for the receiver system is $T = 70,000$ degrees Kelvin. **For all the quantities computed below; the student must specify the correct units.**

- a) (10 points) In the provided table list (specify) the 4 symbols ($S_i(t)$) used by this modulation scheme. Also calculate the energy for each symbol, E_{S_i} for $i = 1, 2, 3,$ and 4 .
- b) (2 points) Compute the symbol rate for the system, R_s , and the data rate, R_b
- c) (10 points) Compute the average noise power in the transmit/receive system.
- d) (10 points) Compute the energy-per-symbol to noise power spectral density ratio E_s/N_0 .
- e) (3 points) Compute the transmission efficiency for the system.
- f) (20 points - bonus) For the given parameters, what is the bit error rate for this transmit/receive system? Utilize the BER curves from the textbook (page 147 – Figure 5.4).
- g) (5 points) What is the corresponding SNR value in linear and in decibels.
- h) (20 points) Use the provided table at the end of the quiz to obtain a random sequence of 16 information bits. Using the random sequence specific to your student identity number and the grid in Fig 2, it is required to draw the corresponding $I(t)$ and $Q(t)$ functions for the modulation scheme in a manner similar to that on slide 48 in the class notes. Indicate on the figure any instances where the signal changes phase by 180 degrees.

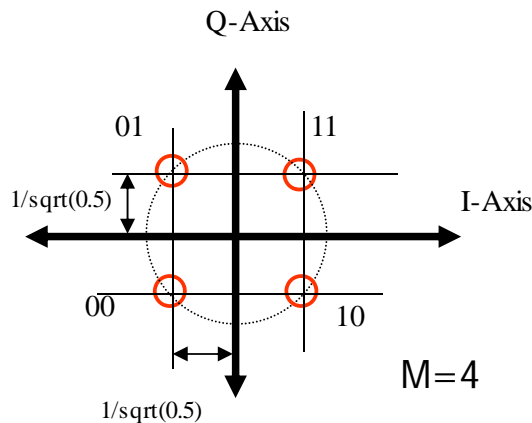


Figure 1: QPSK modulation scheme for Problem 1.

i	Phase, θ_i	Symbol,	Energy,
1			
2			
3			
4			

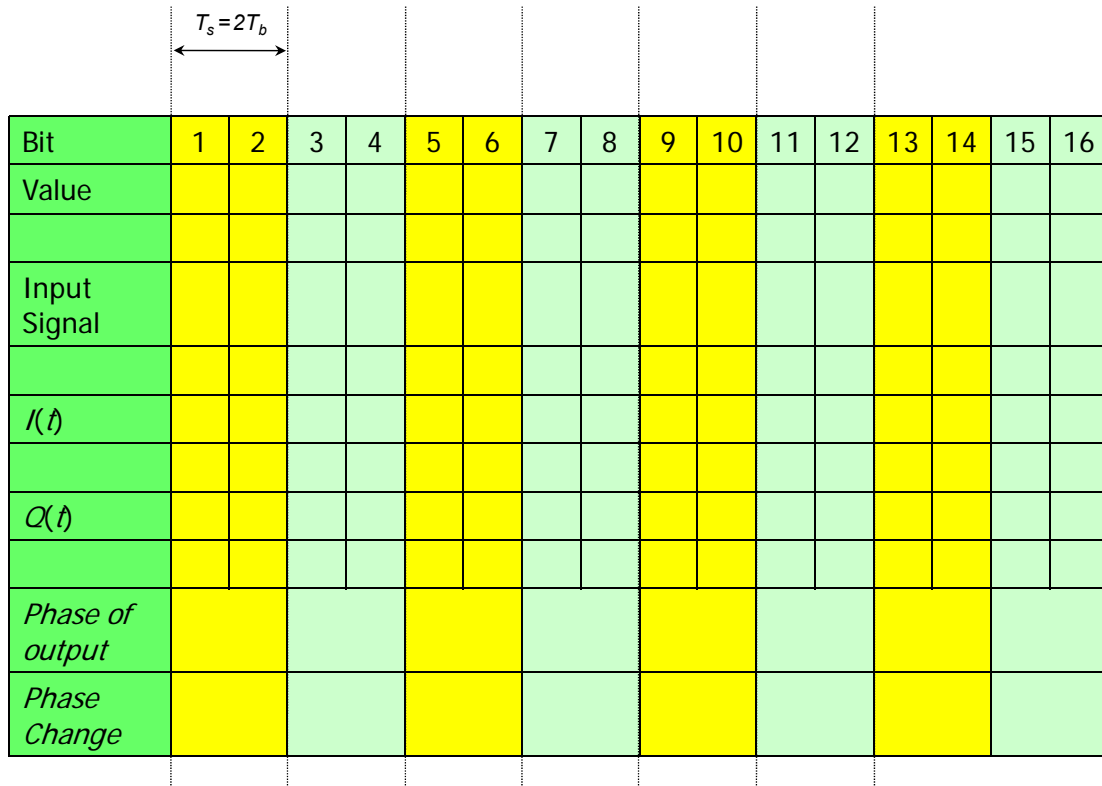


Figure 2: $I(t)$ and $Q(t)$ plots and signal phase calculations for part (h).

List of Data Sequences:

No	Student ID	Data Sequence															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	200639780	0	1	0	1	0	0	1	0	0	1	1	1	0	0	0	1
2	200815200	1	0	1	0	0	0	0	1	1	1	1	1	1	1	1	1
3	200825340	1	1	0	0	1	1	1	1	1	0	1	1	1	1	0	1
4	200828640	0	1	0	0	1	1	0	0	0	1	1	1	1	1	1	0
5	200832160	0	0	0	1	0	1	0	1	0	0	1	0	1	1	1	0
6	200835080	0	0	1	1	0	0	1	1	1	1	1	0	0	1	1	0
7	200859240	0	0	1	0	1	0	0	1	0	1	1	1	0	1	1	1
8	200874960	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	1
9	200876740	1	0	1	0	1	0	1	0	0	0	1	0	1	1	0	1
10	200881620	0	1	0	0	0	0	0	1	1	0	1	1	1	0	1	0
11	200891300	1	1	1	0	0	1	0	1	1	1	1	1	1	1	1	0
12	200937530	0	1	1	0	0	0	1	1	0	0	0	1	0	0	0	0
13	200991670	0	1	0	1	0	0	1	0	0	1	0	1	0	1	1	1
14	200995130	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0