Name Key
Name

UNIVERSITY OF UTAH
ELECTRICAL AND ENGINEERING DEPARTMENT

ECE 5325

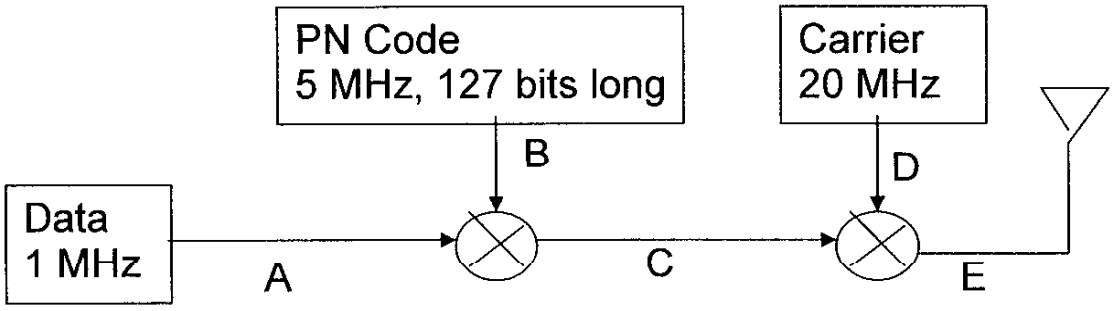
WIRELESS TRANSMISSION SYSTEMS

MIDTERM #2

**YOU MAY USE A CALCULATOR & PORTFOLIO**

March 25,2005

1. (33 points: do parts a,b,c) A DSSS system is sketched below.




(a) Sketch the signal at A,B,C,D,E AS A FUNCTION OF TIME for data = [1 0], and PN code = [1 1 0 0 1 0 1 1 1 0 0 0 1 0 ... ] All input signals are 10 Vpp. NOTE: On parts D and E, you can adjust the time scale and only sketch the first few periods of the sine wave, but PLEASE BE SPECIFIC what your new time scale is.

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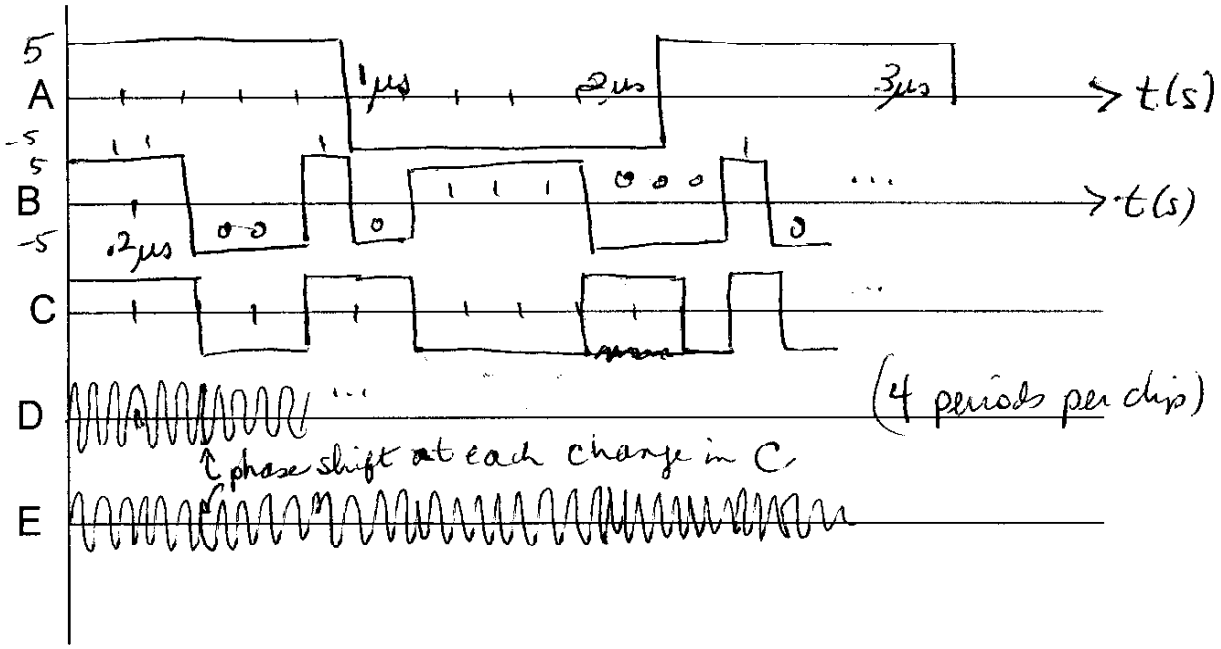
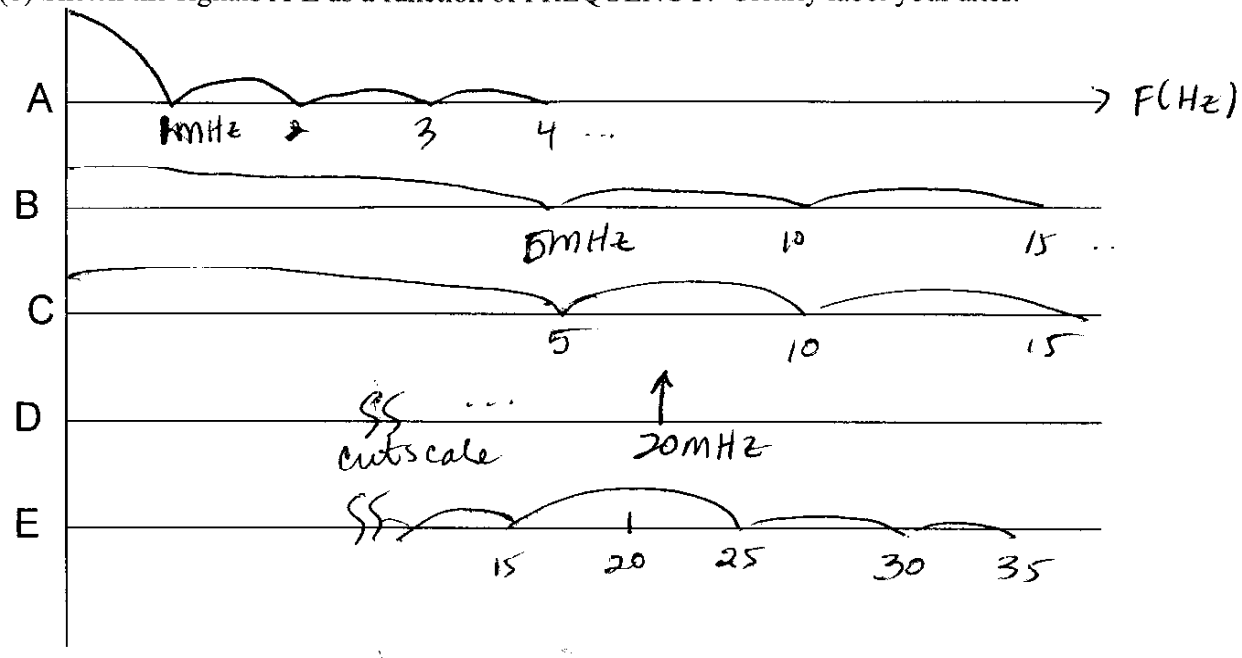
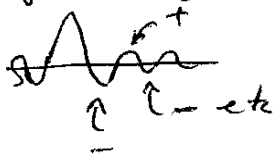


Problem 1 (continued)

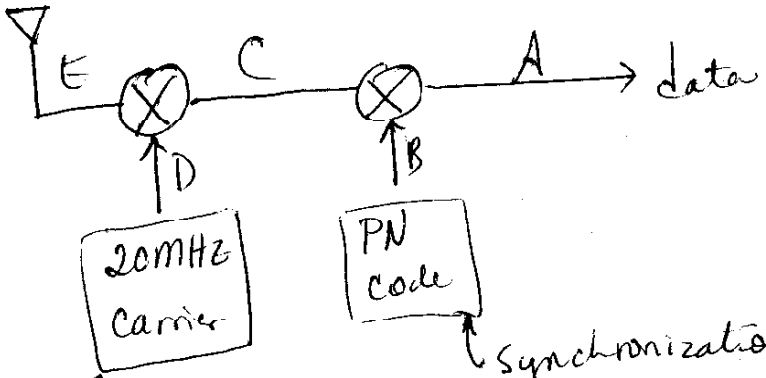
(b) Sketch the signals A-E as a function of FREQUENCY. Clearly label your axes.




[Showing power (squared) signals]
Voltage signals would be



(c ) Sketch a DSSS ~~transmitter~~ receiver, and label the nodes A-E indicating the signals observed at each node. Indicate where synchronization is required, and give an explanation for how this can be done.




Synchronization required - carrier recovery ckt or PLL

Synchronization rq'd delay on pilot until large correlation (sliding correlator)

2. (15 points) Two different DSSS devices (with different PN codes 1 and 2) are transmitting equal magnitude at the same time. (a) Show what the transmitted signal is (b) Show and explain how the PN code 1 can extract its data bit.

Transmitter:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PN 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| | Data 1 | 0 | | | | | | | | | | | | |
| a | XOR | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| | PN 2 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| | Data 2 | 0 | | | | | | | | | | | | |
| b | XOR | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| c | Noise | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| max a,b,c → | TXsignal | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |

copy

Receiver:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PN 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| | RXsignal | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| | XOR | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| | Data 1? | count 1 = 5/13 < 0.5 = 0 ☺ | | | | | | | | | | | | |

3. (33 points) The first four bits of a BPSK signal are [ 1 1 0 1] . The signal is sent using raised cosine pulse shaping. The magnitude of each pulse is 1 Vpp, and it lasts 1 ms.

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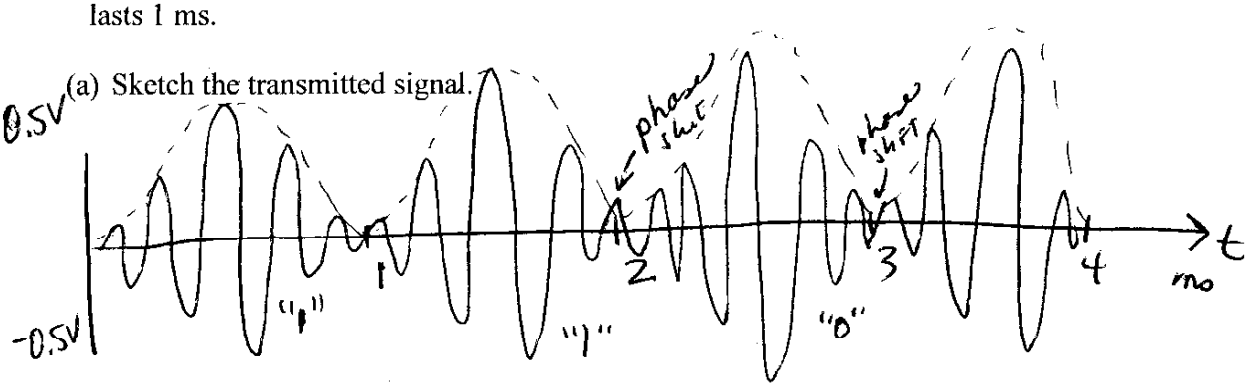
(a) Sketch the transmitted signal.

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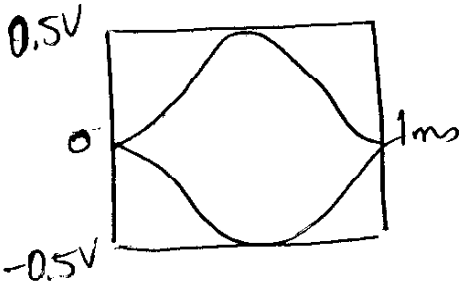
(b) Sketch the eye diagram.




(c) Sketch the eye diagram in an environment where the noise source is 0.1 Vpp, and the "timing jitter" may delay the pulse by as much as 0.1 ms.

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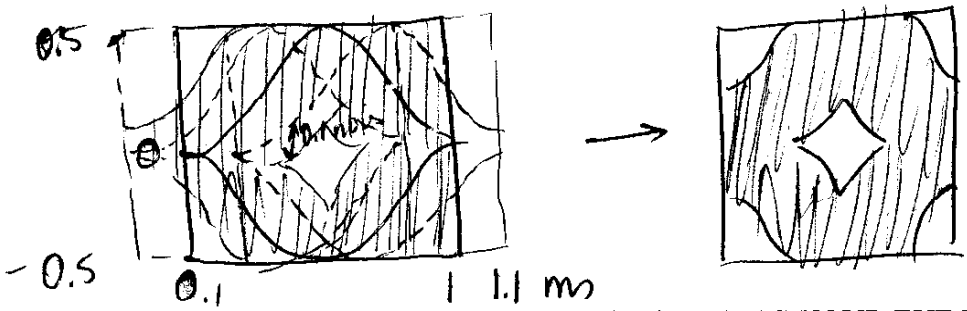


(d) EXPLAIN the impact of timing jitter and noise USING YOUR EYE DIAGRAM.

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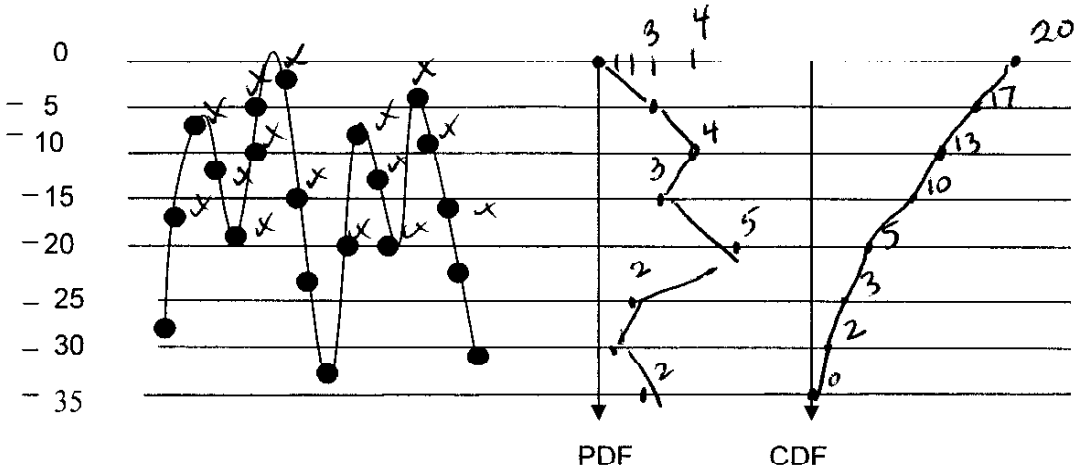
The timing jitter & noise "close" the eye diagram. This means that the threshold for detection is much lower & the timing for when the pulse should be sampled is also much more precise. Result is increased intersymbol interference (ISI)

4. (18 points) In order to understand the small scale fading in a building, the power was measured at 20 points 3" apart and is shown on the graph below. Sketch the PDF and CDF graphs for these measurements. Remember PDF and CDF graphs are given in terms of percent.




Multiply by 5 to get %