EECS 562

Homework 2

1. A signal is transmitted at 32 Msymbols/sec (32×10^6 symbols/sec).

a. What is the minimum bandwidth for this signal in Mhz?

b. What is the symbol time in μs?

c. If there are 8 bits/symbol what bit rate in b/s in Mb/s?

2. With a Nyquist bandwidth $= B_0$ what is the bandwidth of the signal

a. using a raised cosine pulse shape with α=0

b. using a raised cosine pulse shape with α=0.75

c. using a raised cosine pulse shape with α=1

d. What is the advantage of using a raised cosine pulse shape with α=1 over using a raised cosine pulse shape with α=0.

3. A signal x(t)=1δ(t) + 2δ(t- 1μs)-2δ(t- 2μs) + 1δ(t- 3μs) in the input to a filter with an impulse response

$$h(t) = \frac{\sin(2\pi B t)\cos(2\pi \alpha B t)}{2\pi B t\left(1 - 16\alpha^2 B^2 t^2\right)}$$

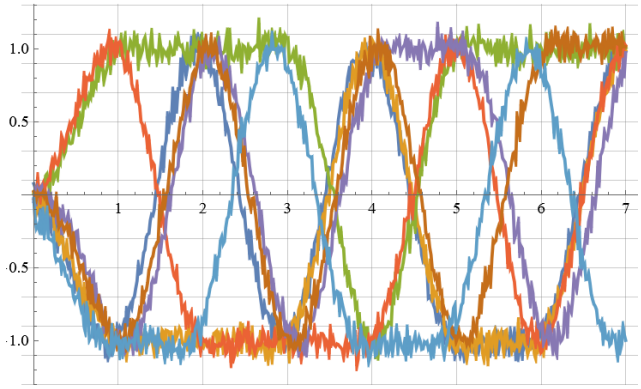
a. Plot the filter output y(t) for α = 0.3 and B =500kHz.

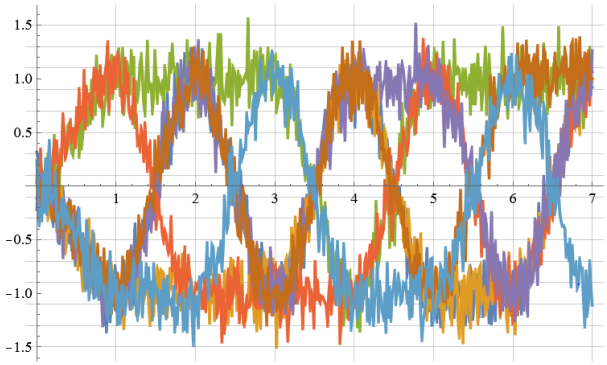
b. What is y(0), y(1μs), y(2μs), y(3μs)?

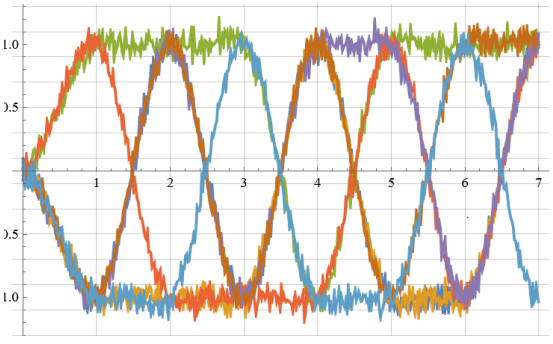
c. Is there ISI with α = 0.3 and B=500kHz?

d. Repeat c and d with B=600kHz

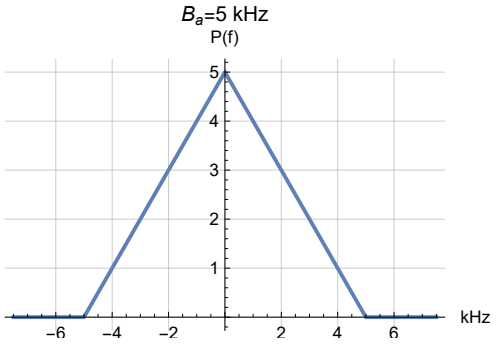
4. Rank order the eye diagrams from best to worst. For each eye diagram do you think the impairment is from imperfect pulse shape or jitter, or noise?

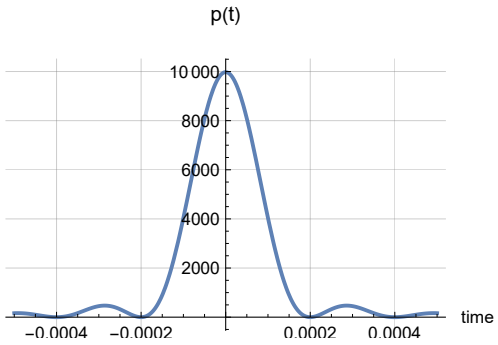






5. The pulse shaping criterion for zero ISI can be satisfied by an infinite number of pulse shapes p(t) each with their own spectrum P(f). The spectrum P(f) of a pulse shape p(t) is given below. Find the relationship between the symbol rate r_s and B_a such that there will be no ISI.





6. A signal x(t) is given as x(t)=4 $(t - 0.5)^2$rect(t-.5)
x(t) is sampled at 3 samples/sec and uniformly quantized using a 2 bit quantizer.

a. Specify the quantizer, i.e., the midpoints and quantizing thresholds and output codes.
b. The first sample is taken at t=0. What are the first 8 transmitted bits?
c. What is the output bit rate in b/s?
d. What is the minimum bandwidth in Hz for the resulting baseband signal?

7. The pulse shape p(t) at the output of the receiving filter of a baseband PAM system is defined by $p(t) = \text{sinc}\left(\frac{t}{T_s}\right)$ where T_s is the symbol duration here T_s = 1ms.

The amplitude levels at the pulse generator output are +3, +1, -1, -3 V, depending on whether the symbol at the input is 11, 10, 01, or 00, respectively.

a. What are the PAM levels in response to the input data 10 01 10 00 11.
b. Plot the waveform at the output of the receiving filter in response to the input data 10 01 10 00 11.
c. What is the output of the receiving filter at t=0, 1ms, 2ms, 3ms, 4ms
d. Is there ISI

8. An analog signal is quantized with a 7 bit quantizer, a parity bit is added to each 7 bit sample to create an 8 bit code word. The code word is transmitted using 4 bits/symbol over a 13kHz channel using raised cosine pulse shaping with $\alpha = 1.0$.

a. Find the bit rate of the information signal, that is, the rate at which quantized bits of the analog signal are transmitted (bit rate not counting the parity bits).
b. Find the maximum bandwidth for the original analog signal.

9. Manchester line coding

a. What are the benefits of using Manchester line coding?
b. What are the disadvantages of using Manchester line coding?

10. A system uses a pulse shape p(t) = Acos(πt) |t|<1/2 and p(t) = 0 elsewhere.
Flip a coin 6 times, and if heads a “1” is transmitted so A=1V and if tails a “0” is transmitted so A=-1V. Plot the resultant transmitted waveform.