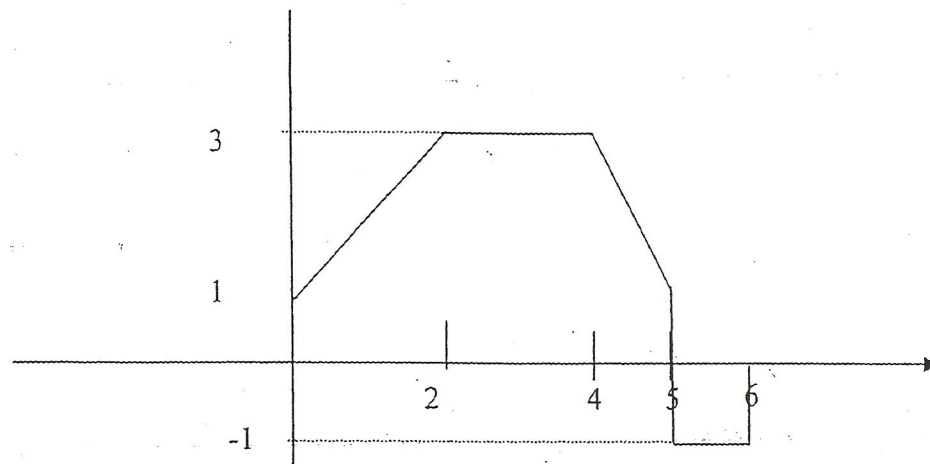# Communications

Jan. 12th, 2008
Non-Regular Students

Part 1: (42 points) to be solved in the space provided after each question

(A) *(14 Points)*

If m(t) is as shown in figure, write an expression for the transmitted signal (s(t) at t=0 to 6 for *all* t) if m(t) is used to modulate a carrier of frequency 100 KHz and maximum amplitude 2, using:

  (a) AM modulation with k_a=0.1. Find the maximum value of k_a such that we can use an envelope detector

(b) PM modulation with k_p=0.1.

(c) FM modulation with maximum frequency deviation of 300Hz.

(d) Now, assume that M(f) the frequency domain signal of *m(t)* has bandwidth of 10KHZ. What is the bandwidth required to transmit M(f) using:
AM:

DSBSC:

SSB:

VSB with a filter with 25% excess bandwidth:

FM as in (c):

(B)   (14 Points)

We want to digitize the signal $m(t)=\sin(2\pi t)$ at the rate of 4 samples per cycle, using an analog to digital converter employing a uniform quantizer (quantization intervals are equal, quantization levels are equally spaced). The "bits" output from the quantizer are then transmitted to a receiver, and passed through a digital to analog converter before the signal is to be interpolated.

(a) Design a 3-bit quantizer (i.e. specify the quantization intervals and binary outputs)

(b) Find the outputs of both the quantizer and the digital to analog converter ("levels") for the 4 samples of the cycle if we start sampling at $t=1/12$ seconds

(c) What is the minimum bit rate (in bits per second) we can transmit at to gauarantee transmitting all bits in real time?

(d) What is the symbol rate if we use:

BPSK:

QPSK:

16-QAM:

(e) Draw the waveform used to transmit the bits corresponding to the first two samples in case a BPSK modulation is used.

(f) Draw the constellation points transmitted, and number them in order, for the bits corresponding to the first two samples in case QPSK is used

(C)   *(14 Points)*

A speech signal bandlimited to 4 KHz is to be transmitted using digital modulation

(a) What is the Nyquist rate required to sample this signal ?

(b) If each sample is represented by 8 bits, what is the bit rate required to transmit the speech signal via BPSK?

(c) What is the bandwidth required for transmission if we use a rect pulse as the pulse shaper and use "pass band"?
Note: Use the BW of the main lobe only

(d) What is the bandwidth required for transmission if we use a sinc pulse as the pulse shaper and use "pass band"?

(e) What is the bandwidth required for transmission if we use a raised-cosine pulse with $r=0.2$ as the pulse shaper and use pass band?

Part 2: (28 points) to be solved in the next two blank sheets

(A)
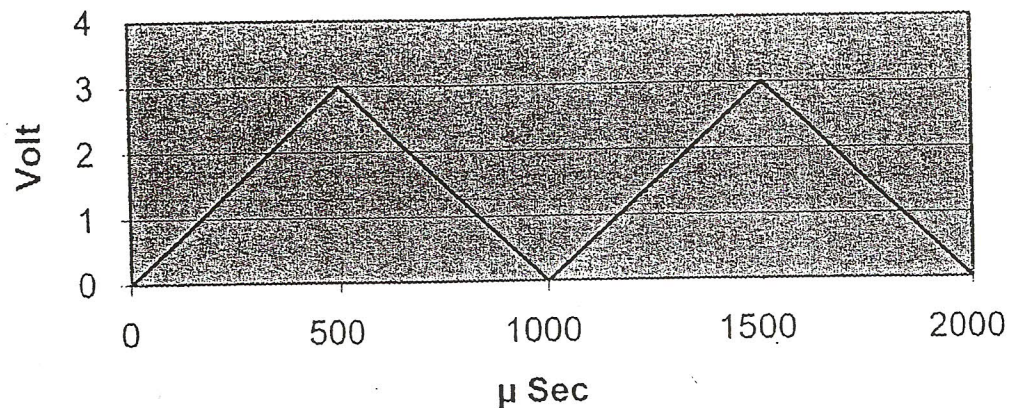
(i) The Shown waveform is applied to a differential PCM System with sampling time of 50 μSec. Sketch the transmitted signal, and show how the original signal can be obtained at the receiver output

(ii)Design a Delta modulation System that can give the receiver output close to the original signal (shown above).

(B) Choose suitable parameters of Sample and Hold and Analog to Digital converter, that can be used in a T1-PCM System .