2 hours, 7pages, 2 parts

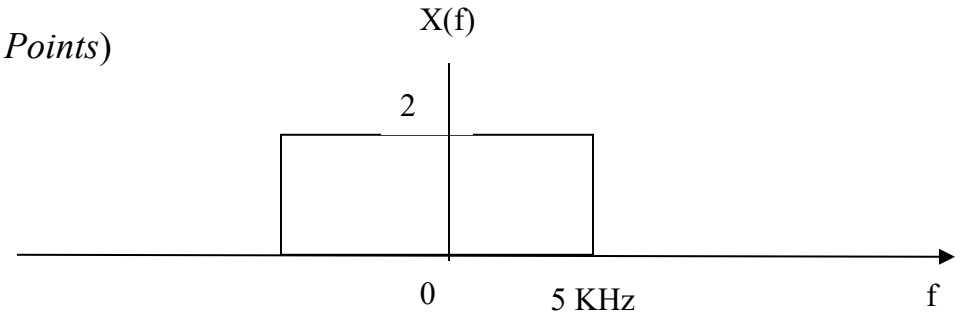
Communications

Jan. 14th, 2006

Regular Students

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

(A) *(14 Points*)



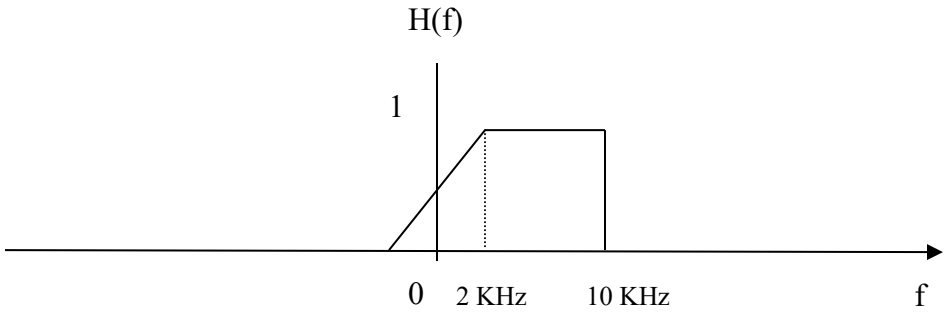
The above figure shows X(f), the Fourier transform of a signal x(t). Draw the Fourier transform of the modulated signal, if x(t) is used to modulate the carrier 5cos(2π*100e3*t), for the following **four** cases. Mark all important frequency values on the figures.

i. AM modulation with the maximum possible modulation index if you know that x(t) values range from -0.25 to 0.25.

ii. DSBSC modulation

iii. SSB modulation using the upper side band

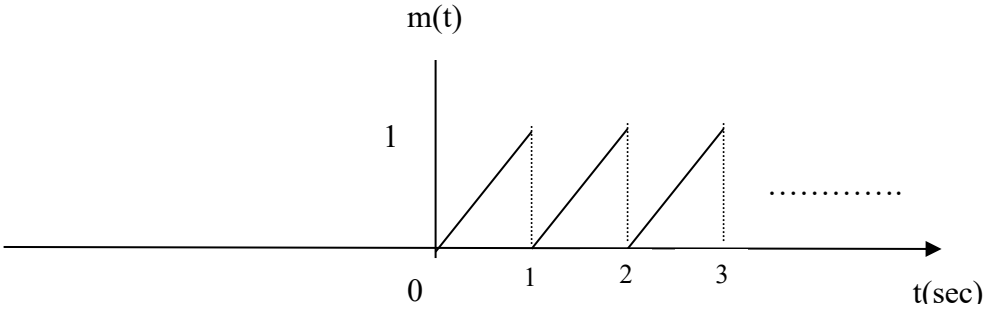
iv. VSB modulation using the filter shown below



Find the ratio between the required bandwidth for the VSB and that required for DSBSC

Find the ratio between the required bandwidth for the VSB and that required for SSB

(B) *(14 Points*)



A signal m(t) shown in the figure is to be sampled, quantized and coded to bits using 2 bits for each sample. The sampling rate used is 10 Hz

i. Design a suitable uniform quantizer. Your quantizer should take an analog value and output a stream of bits. You should specify all the input intervals and the output bits.

ii. Find the output of your quantizer, in bits, for the first five samples of m(t).

iii. If we use binary PSK to transmit the output bits, what is the bit rate that we should use?

iv. **Assume** that the bandwidth of m(t) is 10 KHz, what is the minimum sampling rate that we should have used to be able to recover m(t) from its samples ?

v. If we use the sampling rate of (iv) and use a raised cosine signal with a roll off factor r=0.2 to transmit the samples using binary PSK and a carrier of 10e6, what is required bandwidth for transmission ?

(C) *(14 Points*)

i. Plot on the same shape constellation points corresponding to
(a) 2 cos(2π*100e3*t) - 3 sin(2π*100e3*t)
(b) 3 cos(2π*100e3*t) -1 sin(2π*100e3*t)
(c) cos(2π*100e3*t) - sin(2π*100e3*t)
(d) -cos(2π*100e3*t)+sin(2π*100e3*t)
Mark your points clearly with (a), (b), (c), (d)

ii. How many bits per symbol can we transmit using this constellation ?

ii. If the above constellation is used to transmit a signal which has a rate of 10e6 bits per second, what is the passband bandwidth required for transmission if a sinc is used as the pulse shaping signal.

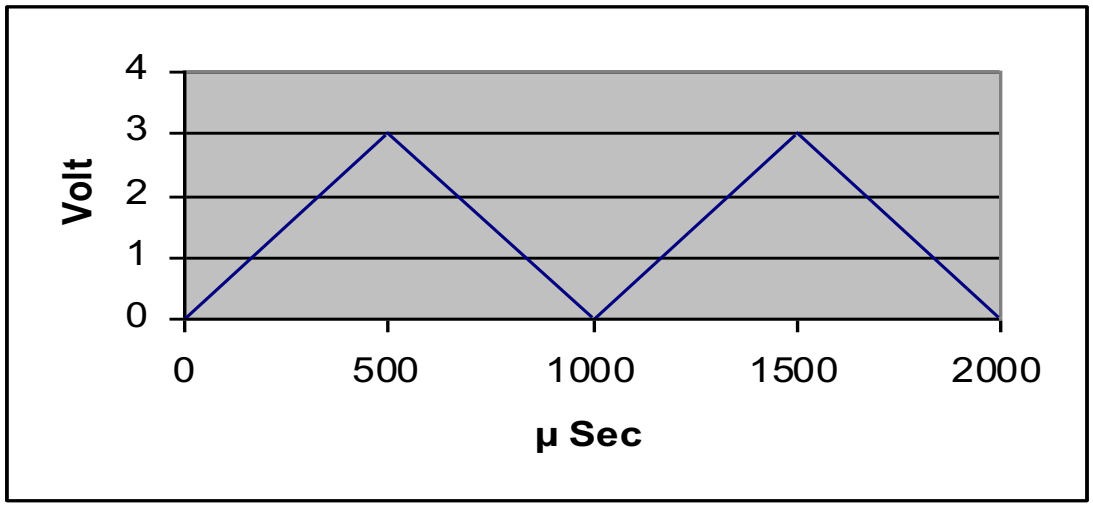
iv. Plot on the same shape constellation points corresponding to
(a) $2\cos(2*\pi*f_c+\pi/4)$
(b) $2\cos(2*\pi*f_c+3\pi/4)$
(c) $2\cos(2*\pi*f_c+5\pi/4)$
(d) $2\cos(2*\pi*f_c+7\pi/4)$
Mark your points clearly with (a), (b), (c), (d)

v. How many bits per symbol can we transmit using this constellation ?

vi. If we have 1 million bits to transmit, how long will we need to finish transmitting them if you know that we can use the bandwidth from 800 to 900 KHz. Specify which pulse shape you will use for transmission.

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 .