Cairo University
Faculty Of Engineering

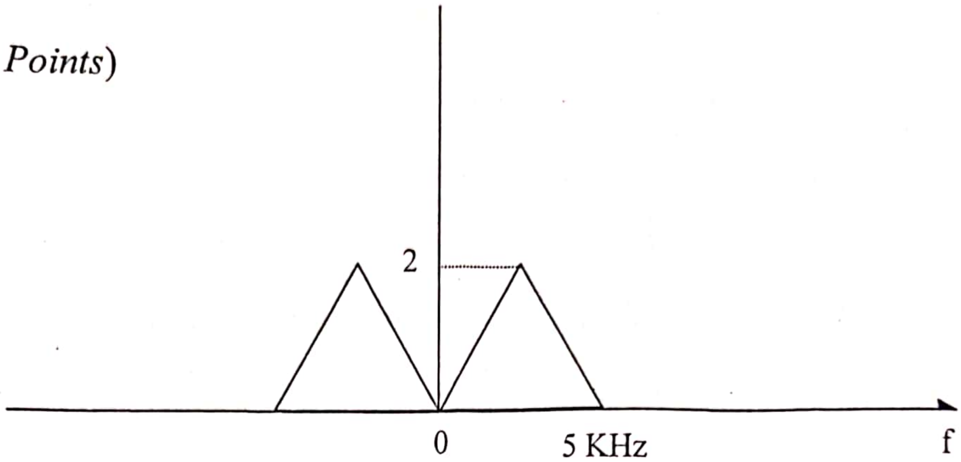
Computer Department
Third Year
4 pages, 2 parts

Communications

2013/2014

Part 1: (60 points)

(A) *(20 Points)*



The above figure shows the Fourier transform of a signal m(t). Draw the Fourier transform of the modulated signal, if m(t) is used to modulate the carrier 10cos(2π*50000*t), for the following **four** cases

i. AM modulation with modulation index = 1 (i.e. k_a=1).
ii. DSBSC modulation
iii. SSB modulation
iv. VSB modulation. Plot the filter you used.

v. What is the minimum carrier frequency that can be used so that we can recover the signal, and why? Discuss what happens if the carrier frequency is 5 KHz.

(B) *(20 Points)*

i. If the signal m(t)=5t is used to frequency modulate the carrier 10cos(2π*50000*t) using a k_f of 1.
   1. Find s(t), the FM modulated signal.
   2. Find the instantaneous frequency at t=10 msec, t= 20 msec. and t= 1 sec. Find the phase of the modulated signal at the three instances. What is the relation between the phase and the instantaneous frequency?

3. If we are going to use a PM modulator to obtain the FM signal, draw the block diagram of such system and find the signal input to the PM modulator.

ii. State if the following statements are 'right' or 'wrong', and correct the statement if you choose 'wrong':

1. If a signal with bandwidth 5 KHz is used to FM modulate a signal such that the maximum frequency deviation is 5 KHz, the modulated signal has an approximate bandwidth of 10 KHz.

2. If a signal with bandwidth 5 KHz is used to FM modulate a signal such that the maximum frequency deviation is 5 KHz, the modulated signal is a NBFM signal.

3. We can obtain a NBFM signal using a WBFM modulator and a frequency multiplier

4. We obtain a phase shift keying signal if we transmit '$\cos(2\pi f_c t)$' for a '1' and '$-\cos(2\pi f_c t)$' for a '0'

5. If we sample at a rate of more than twice the bandwidth of a signal, we get an aliased signal

6. For the same signal power, if we have higher noise power, we get higher bit error rates.

7. Binary modulation is used to transmit 2 bits per transmission

8. A raised cosine signal with a roll off factor of 0.2 has 0.9 the essential bandwidth of a rect signal whose width is the same as he main lobe of the raised cosine

9. A raised cosine signal with a roll off factor of 0.2 has 0.9 the bandwidth of a sinc signal with the same zero crossings as the raised cosine

(C) *(20 Points)*

We want to transmit the signal $m(t)=\cos(2\pi t)$ from a transmitter to a receiver using **digital** modulation.

i. Draw a block diagram of a system whose input is the signal m(t) at the transmitter and whose output is the recovered m'(t) at the receiver. Your system should include a sampler and a quantizer.

ii. How many samples per cycle would you use for your sampler in (i) ? Fully describe your quantizer, i.e. state each input interval and the corresponding output.

iii. What is the bit rate per second required to transmit m(t) using your system ?

iv. If we use 4 samples per cycle and start at t=1/12 sec, find the output of your quantizer in bits.

v. Suggest a vector space representation for a binary phase shift keying (BPSK) system to be used in transmitting m(t). Hence, draw the transmitted modulated signal for 1 cycle of the signal m(t) using the samples in (iv).

vi. Suggest a vector space representation for a quadrature phase shift keying (QPSK) system to be used in transmitting m(t). Hence. draw the transmitted modulated signal for 1 cycle of the signal m(t) using the samples in (iv).

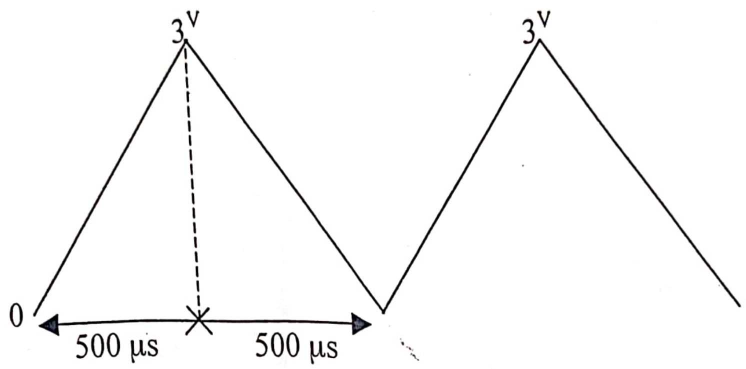
vii. If we use a raised cosine with a roll off factor of 0.2, what is the bandwidth required to transmit m(t) using BPSK and QPSK ?

Part 2: (40 points)

(A) *(30 Points)*

i. Compare between Delta modulation and adaptive delta modulation systems. Sketch the transmitter and receiver of each of them

ii. The shown waveform is applied to a delta modulation system having its DAC output from (0) to (+4) volt with 8 bits. The clock period of the up/down counter has a frequency of 200 KHZ . Draw the output waveform of the transmitter and receiver.



iii. Calculate the bit rate of each of the "E1" and "T1" PCM systems and compare between them.

(B) *(10 Points)*

Sketch a suitable coupling circuit for power line communication. Indicate how to absorb high voltage spikes, and how to prevent radiation effects on electric devices.