file:///D:/UNIVERSITY/Digital%20communication/notes%201.pdf

2 x B = 30000 samples /s

#1

A compact disc (CD) records audio signals digitally using PCM. Assume the audio signal bandwidth to be 15 KHz.

(a) What is the Nyquist rate?

B = 15

(b) If the Nyquist samples are quantized to $L = 65, 536$ levels and then binary coded, determine the number of bits required to encode a sample. V = log base2 L

(c) Assuming that the signal is sinusoidal and that the maximum signal amplitude is 1 (A) volt,determine the quatization step and the signal-to-quatization noise ratio.

\log_{ 2 }({ 65536 })

(d) Determine the number of bits per second (bit/s) required to encode the audio signal.

(e) For practical reasons, signals are sampled at above the Nyquist rate, as discussed in class. Practical CDs use 44,000 samples per second. For $L = 65, 536$ determine the number of bits per second required to encode the signal and the minimum bandwidth required to transmit the encoded signal.

log+65536
------------- =16
(log+2)

2*A
------------- = 2*1\2^16 2^15V
2^V

D = 30000 x 16
fs x v
= 480000 bits/s

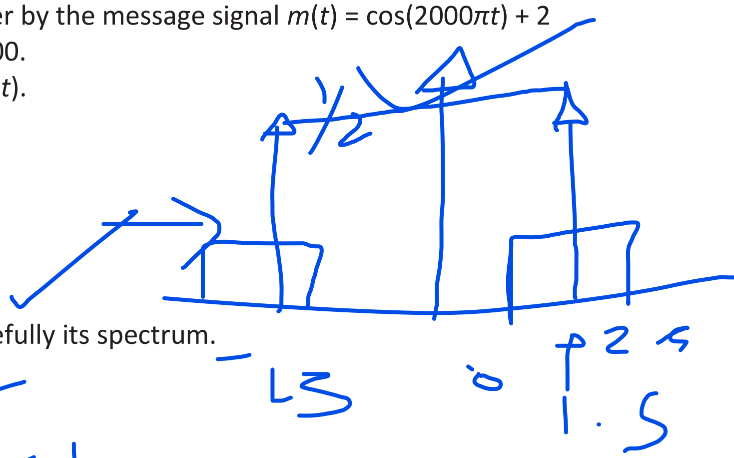
e = 44000 x 16

#2

An SSB AM signal is generated by modulating an 800 kHz carrier by the message signal $m(t) = \cos(2000\pi t) + 2 \sin(2000\pi t)$. Assume that the amplitude of the carrier is $A_c = 100$.

(a) Determine the Hilbert transform of the message signal, $\hat{m}(t)$.

(b) Determine the spectrum of the LSSB AM signal.



#3

A bandpass signal is given by

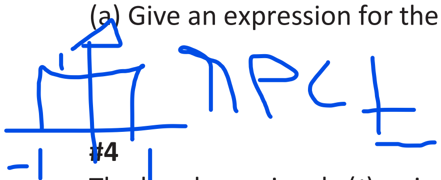
2pi f = 3pi 3/2 1.5

$x(t) = \text{sinc}(2t) \cos(3\pi t)$.

(a) Is the signal narrowband or wideband? Justify your answer.

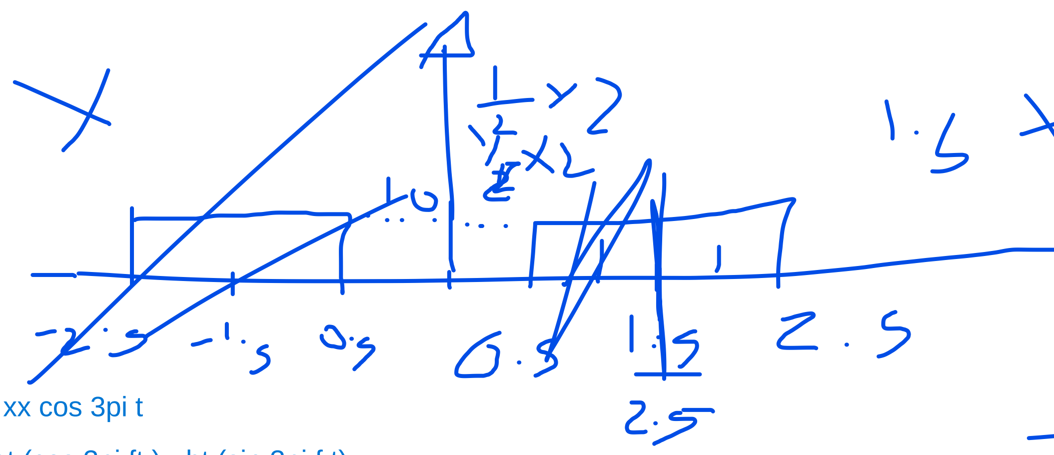
(b) Find the complex baseband equivalent $x\_(t)$ and sketch carefully its spectrum.

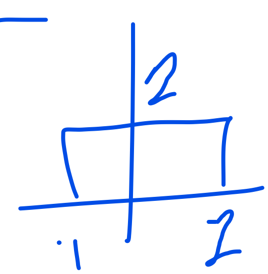
(a) Give an expression for the Hilbert transform of $x(t)$.



#4

The bandpass signal $x(t) = \text{sinc}(t) \cos(2\pi f_0 t)$ is passed through a bandpass filter with impulse response $h(t) = \text{sinc}^2(t) \sin(2\pi f_0 t)$, Using the lowpass equivalents of both input and impulse response, find the lowpass equivalent of the output and from it find the output $y(t)$.





sinc 2t xx cos 3pi t

Ct = at (cos 3pi ft) - bt (sin 3pi f t)

sinc2t 0

ht = bt (cos 3pi ft) + at (sin 3pi f t)

0

Ht = sinc 2t * sin 3 pi f t