DSP Quiz 5
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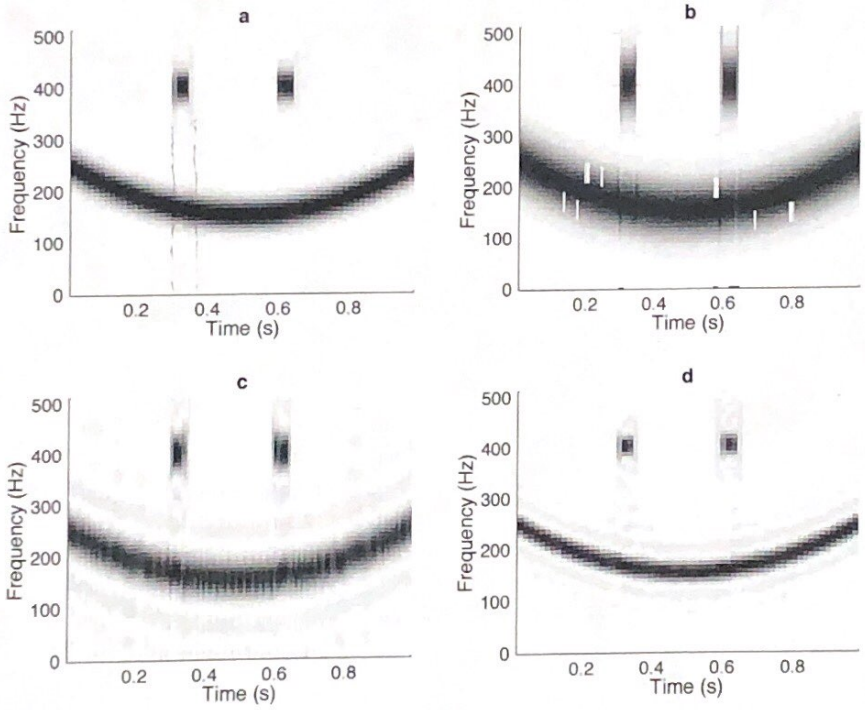
Name: Allister Liu

Question 1

The following spectrograms were computed using either rectangular or Hamming windows, on the same signal. Answer the following questions, justify your answer completely.

a) Which spectrograms were computed with a rectangular window?
b) Which spectrograms have approximately the same frequency resolution?
c) What is the approximate time window of spectrogram a? Mark the plot if it helps indicate your answer
d) Write as detailed an equation as you can for the 'eye's, assuming that only pure sinusoidal tones were used to create them.



1. a) Rectangular window: b) and c)

because of the high sidelobes.

b) a) and b) have approximately the same frequency resolution,

as do [illegible] and c).
d)

c) The approximate time window of a) is 0.05s.

d)

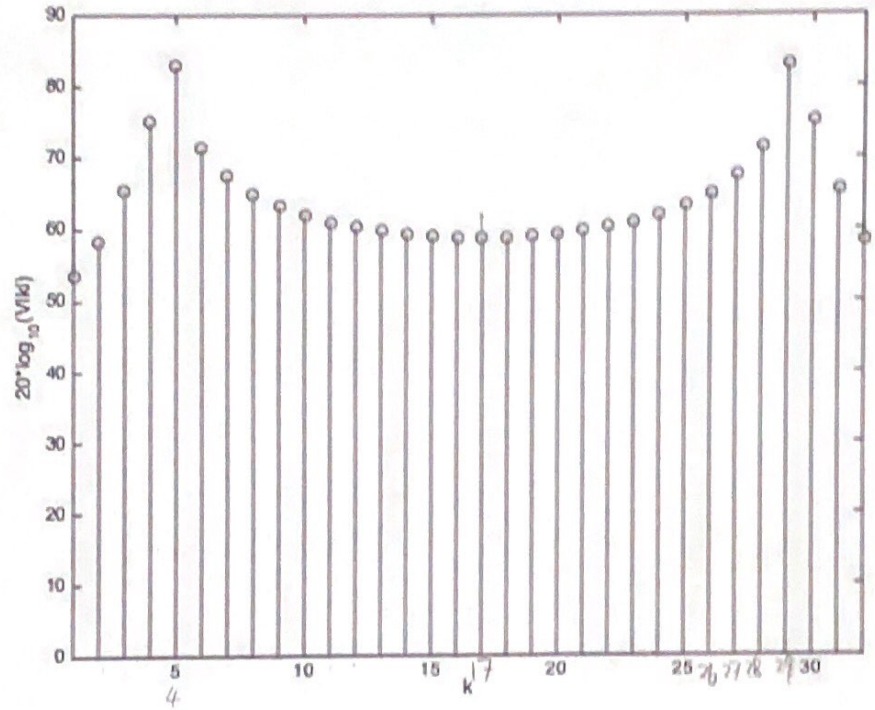
$$x_c(t) = \begin{cases} A_0 \cos(2\pi \cdot 400 \cdot t + \phi_0) & 0.3 \le t \le 0.35 \\ A_1 \cos(2\pi \cdot 400 t + \phi_1) & [illegible] \le t \le 0.65 \\ & 0.6 \end{cases}$$

~~$0.35 \le t \le 0.6$~~

~~$0.6 \le t$~~

Question 2

Consider the following plot of the magnitude, in dB, of the DFT of a continuous time signal sampled at $T = 10^{-3}$. A 32 point DFT was taken using a rectangular window.



Listed below are 10 signals, one or more of which could have been the continuous time signal that produced the above plot. Indicate which signals could have been the input signal $x_c(t)$. Justify your answer completely

$x_1(t) = 1000 \cos(230*\pi*t)$

$x_2(t) = 1000 \cos(115*\pi*t)$

$x_3(t) = 10 \exp(j*460*\pi*t)$

$x_4(t) = 1000 \exp(j*230*\pi*t)$

$x_5(t) = 10 \exp(j*230*\pi*t)$

$x_6(t) = 1000 \exp(j*250*\pi*t)$

$x_7(t) = 10 \cos(250*\pi*t)$

$x_8(t) = 1000(\cos(218.75*\pi*t)$

$x_9(t) = 10 \exp(j*200*\pi*t)$

$x_{10}(t) = 1000 \exp(j(187.5*\pi*t)$

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$$W_1 = \frac{2\pi(3)}{32} \cdot \frac{1}{10^{-3}} = 187.5\pi$$

$$W_2 = \frac{2\pi(4)}{32} \cdot \frac{1}{10^{-3}} = 250\pi$$

$\therefore 187.5\pi \le f \le 250\pi$

The graph is symmetric

It's a cos function (instead of e^{jwt})

$\therefore$ $\begin{cases} x_1(t) = \cos(230\pi t) \\ x_2(t) = \cos(218.75\pi t) \end{cases}$ satisfies the requirement.