

EE 311
Hour Exam 2

Name _____
March 3, 2017

1. When you watch a movie you often see the wheel of vehicles moving backwards even though the vehicle is moving forward. Explain this phenomenon in terms of aliasing. What is being sampled and how is it aliased?

2. A sinusoid at 400 Hz is sampled at 5000 Hz. If the sinusoid is down sampled by a factor of 10 by removing 9 samples out of each set of 10, the frequency of the down sampled sinusoid will be 100 Hz. Explain.

3. Is it possible for two filters to have identical magnitude plots but different impulse response functions? If so, explain how, if not why not?

4. I want to design a low pass filter with the following specifications:

Sample frequency	22050Hz
Pass band	0 Hz to 2 KHz
Stop band	4KHz to $f_s/2$
Pass band ripple	0.05
Stop band ripple	0.001

Answer the following:

A) Can I do this with a Parks-McClellan filter even though the pass band ripple and stop band ripple are not the same?

B) What is the minimum number of bits needed for the A/D converter?

C) Would changing the stop band from 4 KHz to 5 KHz increase or decrease the required order for the filter? Explain

D) If the resulting filter is of order 17 how many complex zeros will there be?

5. The equation for the magnitude of the frequency response of an FIR filter is given by:

$$H(z) = 0.2102 \sqrt{[\cos(3\Omega) + 1.6 \cos(2\Omega) + 1.6 \cos(\Omega) + 1]^2 + [\sin(3\Omega) + 1.6 \sin(2\Omega) + 1.6 \sin(\Omega)]^2}$$

What is the transfer function in z ?

6. It's Saturday night and you are out on a first date with someone and you are trying to make a good impression. You order a grape Nehi soda and explain that you designed a digital filter but its phase curve appeared to be discontinuous in several places. You then ask your date if he/she can explain this or otherwise provide some help with this mysterious problem. Your date gives you two explanations for discontinuities in the phase curve. What are they?

7. Suppose your senior project requires a sensor that has an output ranging from 0 to 10 volts with an accuracy of 3%. What is the minimum number of bits you need for an A/D converter to convert this analog input to a digital signal?

8. If a step response is given by $s(n) = \{0.25, 0.75, 1.5, 1.75, 0.9, 1.0, 1.0, 1.0, \dots\}$, find the *maximum* and *minimum* values of the impulse response.

9. Three FIR filters are shown in the figure below. All three filters were created from the same ideal filter using the Fourier series method with different window functions applied. Answer the following questions:

A) From the filter plot, what is the number N such that the filter order is greater than or equal to N . Explain how you got your answer.

B) Of the three filter plots (1, 2, and 3) which of the three was created with the window function having the narrowest main lobe width. Explain.

C) If the three window functions were the *rectangular*, *hamming*, and *blackman* which curve used which window:

Filter 1 - _____ window

Filter 2 - _____ window

Filter 3 - _____ window

D) Does the filter have any real zeros. If so, where are they located?

