

EE 311
Hour Exam 2

Name _____
March 4, 2016

1. An FIR filter transfer function is given by:

$$H(z) = 0.5 \frac{z+1}{z}$$

Write the equation for the phase curve as a function of frequency in terms of sine, cosine, and tangent functions.

2. A low pass filter has 70db attenuation in the stop band. How many bits are needed in the A/D converter?

3. The unit step response of a difference equation is given by

$$y(nT)|_{x=step} = \{0.4, 1.0, 1.18, 1.09, 0.991, 0.97, 0.987, 1.003, 1.005, 1.00, 1.00, 1.00, \dots\}$$

From looking at the step response alone, what can you conclude about the frequency response of this difference equation?

4. Describe a method whereby you could determine the frequency response plot for a filter when you have measurements of the impulse response for that filter.

5. A signal is sampled at f_s and is found to have aliases at 9,500 Hz, 14,500 Hz, and 21,500 Hz.

A) If these are the first three aliases that the signal produces as the frequency increases, what is the sample frequency?

B) What is the frequency of the signal?

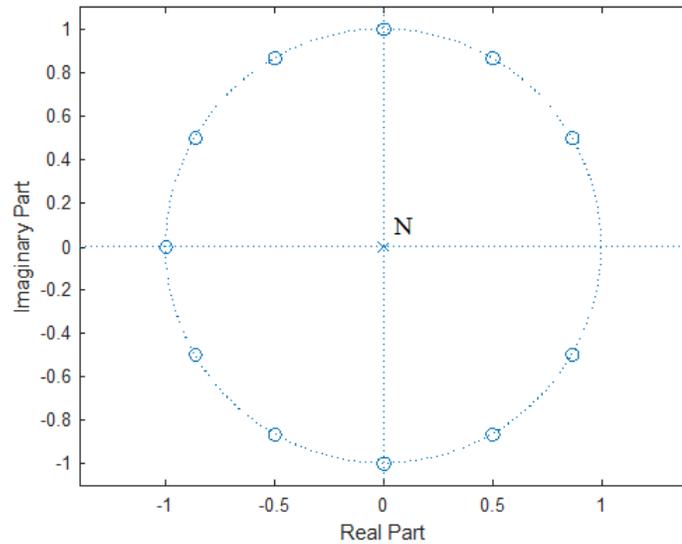
6. The Parks-McClellan FIR design technique provides a method of designing an FIR filter that is optimal in the minimax sense. What does this mean?

7. The zPlane plot below is that of an Nth order filter.

A) What is the filter order N?

B) What type of filter is this?

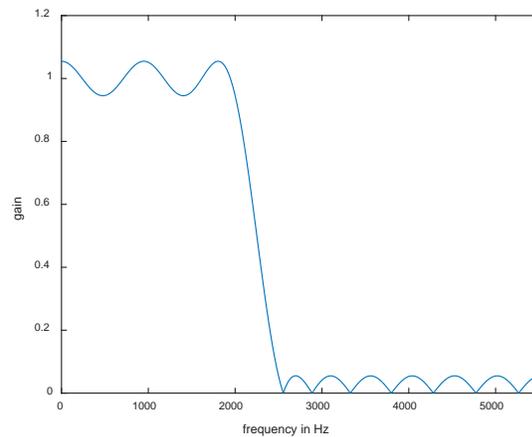
C) Write the transfer function for the filter.



8. The figure below is that of a low pass filter designed using the Parks-McClellan method.

A) How many zeros will be located on the unit circle for this filter?

B) Assuming the filter has linear phase will the filter order be even or odd. Justify your answer. Answers without explanation will be counted wrong.



9. You are sitting in a bar on Saturday night discussing digital filters with a friend of another gender. She tells you about a filter that was described in the specs for a CD player and it is a low pass FIR filter of order 31. It has linear phase and at least one zero is at $z = -0.75$. She was vague about other details but seems to remember that there were other zeros on the real axis but not at $z = -1$. You immediately decide to end your relationship with this person because critical information in this description is wrong. What was the problem?

10. The impulse response for an ideal filter is used to create a windowed digital filter. The impulse response is given by:

$$h(n) = \sum_{n=-\infty}^{\infty} \frac{1}{2^{|n|}}$$

A Hamming window function is defined in MATLAB[®] as:

```
>> hamming(5)
```

```
ans =
```

```
0.0800
```

```
0.5400
```

```
1.0000
```

```
0.5400
```

```
0.0800
```

Find the transfer function for the filter.