

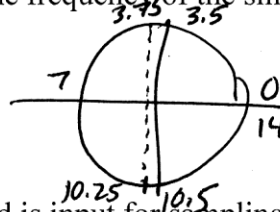
Name: Key

EE432 Fall 2011 Quiz 2

1. An A/D system has a sample rate of 14 kHz. A sinusoid is input for sampling that has a frequency of 10.25 kHz. Did aliasing occur? What is the frequency of the sinusoid that leaves the A/D?

yes-aliasing occurred

$$\boxed{3.75 \text{ kHz}}$$



2. An A/D system has a sample rate of 50 kHz. A sinusoid is input for sampling that has a frequency of 31 kHz. Will any sinusoid that comes out have a frequency in the Nyquist range? If not, why not? If so, why?

Yes - Any freq. into the sample process must come out in the range  $0 - f_s/2$

3. A signal with max frequency content 1700 Hz is sampled at 1500 Hz, what is the Nyquist frequency and the Nyquist range?

$$\text{Nyquist freq} = f_s/2 = \boxed{750 \text{ Hz}}$$

$$\text{Nyquist range} = [0, f_s/2] = \boxed{[0, 750 \text{ Hz}]}$$

4. What is the purpose of an anti-imaging filter in a DSP system?

To remove replications (images) of the original spectrum which show up as a result of sampling.

5. If an A/D has a fixed sample frequency of 16 MHz, what is the max frequency that can ever possibly come out of the A/D?

$$f_s/2 = \boxed{8 \text{ MHz}}$$

6. An analog signal has a voltage range of -23 V to +16 V. If it is sampled using a 4-bit quantizer what is the resolution of the quantizer? What is the smallest max quantization error if the quantizer is designed properly?

$$\frac{16 - (-23)}{2^4} = \frac{39}{16} = \boxed{2.4375 \text{ V}}$$

7. Design a 2-bit quantizer for an analog signal that has a voltage range of -3 V to +9 V. Ensure there are no "wasted" voltage levels (i.e., design for the actual voltage range of the analog signal). Fill in the following table:

Digital code (bits)	Decimal Value	Quantization Level (Voltage)
0 0	0	$-3 + Q/2 = -1.5$
0 1	1	1.5V
1 0	2	4.5V
1 1	3	7.5V

$$\frac{9 - (-3)}{2^2} = \frac{12}{4} = 3V = Q$$

$$Q/2 = 1.5V$$

Bonus: Who were the two countries that fought in the Falklands war in 1982? Hint: it was the year I graduated from USNA.

U.K., Argentina