

EE432 Fall 2011 Quiz 1

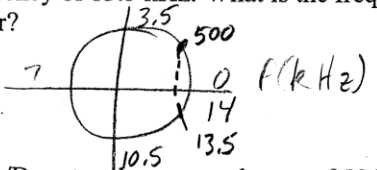
- ② 1. An A/D system has a sample rate of 11 kHz. A sinusoid is input for sampling that has a frequency of 3100 Hz. What is the frequency of the sinusoid that leaves the A/D? Did aliasing occur?

since $f_s > 2W$, no aliasing 3100 Hz

- ② 2. An A/D system has a sample rate of 20 kHz. A sinusoid is input for sampling that has a frequency of 9344 Hz. What is the frequency of the sinusoid that leaves the A/D? Did aliasing occur?

Since $f_s > 2W$, no aliasing 9344 Hz

- ② 3. An A/D system has a sample rate of 14 kHz. A sinusoid is input for sampling that has a frequency of 13.5 kHz. What is the frequency of the sinusoid that leaves the A/D? Did aliasing occur?



500 Hz
Yes, aliasing occurred

- ② 4. 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?

Nyquist range $0 - f_s/2 =$ 0-25 kHz
All freqs output will be in Nyquist range

- ① 5. An analog signal has frequency content that ranges from 0 Hz to 2.33 kHz. What is the Nyquist rate?

$2W =$ 4.66 kHz

- ② 6. If the signal from problem 5 is sampled at 1500 Hz, what is the Nyquist frequency and the Nyquist range?

Nyquist freq is $f_s/2 =$ 750 Hz

Nyquist range is 0-750 Hz

7. In a generic DSP system (which included A/D and D/A), there are two low pass filters. What are they called and what is the function of each?

Anti aliasing filter - prevents aliasing

Anti Imaging filter - recover original signal spectrum and remove images of spectrum that are produced in sampling.

8. If an A/D has a fixed sample frequency of 22 kHz, what is the max frequency that can ever possibly come out of the A/D?

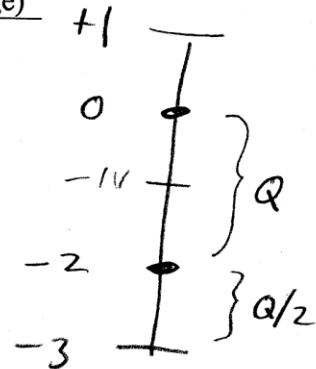
$$f_s/2 = \boxed{11 \text{ kHz}} \quad (\text{Nyquist freq})$$

9. An analog signal has a voltage range of -22 V to +48 V. If it is sampled using a 6-bit quantizer, what is the resolution of the quantizer?

$$Q = \frac{V_{\max} - V_{\min}}{2^6} = \frac{48 - (-22)}{64} = \boxed{1.0938 \text{ V}}$$

10. Design a 1-bit quantizer for an analog signal that has a voltage range of -3 V to +1 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	-2 V
1	1	0 V



$$Q = \frac{1 - (-3)}{2^1} = 2 \text{ V}$$

Bonus: What was the "Line of Death", at least as far as Muammar Gaddafi was concerned?

A line that he envisioned across the mouth of the Gulf of Sidra. He dared Reagan to send our Navy across that line.