Quiz Submissions - Exam 01 Answers d   ✕

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Attempt 1

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Submission View

Your quiz has been submitted successfully.

Problem 1 (20 Points)

Answer the following questions regarding statistics and signal to noise ratio (SNR)

Question 1

a) A signal has the following statistics

$$\mu = 4.6, \sigma_{noise} = 0.85$$

If the signal is defined as the mean, what is the signal to noise ratio as a numerical value?

Answer:

5.41

Question 2

b) What is the signal to noise ratio in decibels?

Answer:

14.6

Question 3

c) A signal has the following statistics

$$\sigma_{signal} = 6.4, \sigma_{noise} = 2.05$$

If the signal level is defined as the standard deviation, what is the signal to noise ratio as a numerical value?

Answer:

3.12

Question 4

d) What is the signal to noise ratio in decibels?

Answer:

9.88

Question 5

e) Two signals have the following statistics

$$\mu_1 = 5.7, \sigma_1 = 0.95$$

$$\mu_2 = 6.3, \sigma_2 = 1.05$$

What is the mean of the two signals added together?

Answer:

12

Question 6

f) What is the standard deviation of the two signals added together?

Answer:

1.41

Question 7

g) For the signals described above in part e, if the signal level is defined as the mean, what is the SNR in decibels of the two signals added together?

Answer:

18.56

Problem 2 (20 Points)

A sinewave of 12 kHz is being sampled at a rate of 20 kHz.

Question 8

a) After sampling what are the positive and negative frequency components that fall within the range of -20 kHz to +20 kHz?

○ -12, -2, +2, +12

○ -12, -8, +8, +12

○ -10, -2, +2, +10

○ -20, -12, +12, +20

○ -20, -10, +10, +20

Question 9

b) At what frequencies within -20 kHz to +20 kHz are the aliases of the 12 kHz signal located?

○ -2, +2

○ -12, +12

○ -16, +16

○ -22, +22

○ -8, +8

Question 10

c) Does this system meet the Nyquist criteria for sampling?

○ Yes, it does meet the Nyquist criteriea for sampling

○ No, it does not meet the Nyquist criteriea for sampling

Problem 3 (20 Points)

A 12-bit ADC has a full scale input range of 5.0 volts. An input signal has a standard deviation of 18.0 mV and a noise standard deviation of 0.62 mV

Answer the following questions.

Question 11

a) What is the SNR of the input signal in decibels?

Answer:

29.25

Question 12

b) What is the magnitude of a Code Value or quantization level (in mV) of this ADC?

Answer:

1.221

Question 13

c) What is the quantization noise (in mV) added by this ADC?

Answer:

0.354

Question 14

d) What is the total noise (in mV) of the signal after sampling?

Answer:

0.7139

Question 15

e) What is the signal to noise ratio in decibels after sampling?

Answer:

28.03

Question 16

f) What is the SNR degradation (in decibels) due to sampling?

Answer:

1.22

Problem 4 (20 Points)

You are working on a system that samples the voltage output of a pressure gauge. The noise level of the pressure gauge as measured by its standard deviation is 3.80 mV. The pressure gauge is being read by an ADC with a full-scale range of 5.00 V and 10 bits of resolution. Dither noise is being added to the input signal with a standard deviation of 7.30 mV. You only need to collect samples at a rate of 12 kHz; however, the ADC system can be sampled as fast as 15 MHz. Oversampling and averaging will be used in the system.

Question 17

a) What is the magnitude of a Code Value or quantization level (in mV) of this ADC?

Answer:

4.88

Question 18

b) What is the quantization noise (in mV) added by this ADC?

Answer:

1.415

Question 19

c) What is the standard deviation (in mV) of the total noise from the sensor, the dither noise and the quantization noise?

Answer:

8.35

Question 20

d) How many samples are required to be averaged to reduce the standard deviation of the output noise of the samples at   12 kHz to 0.50 mV?

Answer:

279

Question 21

e) For the number of samples you need to average as computed above in (d), what is the oversampling rate (in kHz) when the desired output sample rate is 12 kHz?

Answer:

279

Question 22

f) What is the improvement in SNR in decibels that is achieved using Oversample Averaging and Dither?

Answer:

17.6

Problem 5 (20 Points)

You are coding with single precision floating point numbers. Recall that single precision floating point numbers have 8 bits in the exponent and 23 bits in the mantissa.

Answer the following questions about floating point values.

Question 23

a) For the decimal number 55296 what is the sign bit in the binary representation of the single precision floating point number?

○ The sign bit is 1

○ The sign bit is 0

Question 24

b) For the decimal number 55296 what is binary representation of the Exponent term used in the single precision floating point number?

Write your answer below

　01000111010110000000000000000000

Question 25

c) For the decimal number 55296 what is binary representation of the mantissa term used in the single precision floating point number? Show all 23 bits.

Write your answer below

　10110000000000000000000

Question 26

d) For the decimal number 55296 what is the next largest number that can be represented using single precision floating point number? Represent the number using 12 decimal places.

Write your answer below

　55296.039062500000

Done