## Assignment 2

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Indholdsfortegnelse

[Assignment 2 1](#_Toc165045069)

[Task 7.16 Consider a uniform midtread quantizer (Slide 6 of the Lectures of Week 9), Assume that a Gaussian distributed random distributed random variable with zero mean and unit variance is applied to this quantizer input. 2](#_Toc165045070)

[1. Find the probability that the amplitude of the input lies outside the range of -4 to +4 (use the characteristics of a Gaussian random variable). 2](#_Toc165045071)

[2. Use the result of part a (the probability that the random variable is not between -4 and +4 is very low), to show that the output signal-to-noise ratio of the quantizer is given by: 2](#_Toc165045072)

[Task 7.17 A PCM system that uses a uniform quantizer is followed by a 7-bit binary encoder. The bit rate of the system is equal to . 4](#_Toc165045073)

[1. Find the maximum message bandwidth for which the system operates satisfactory, i.e., find the bandwidth for which the sampling rate equals the Nyquist rate. 4](#_Toc165045074)

[2. Determine the output signal-to-noise ratio when a full-load sinusoidal modulating wave of frequency 1MHz is applied to the input (Use the equation of example 7.2 (slide 12)). 4](#_Toc165045075)

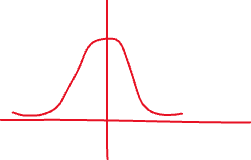
[Task 7.22 Consider a sine wave of frequency fm and amplitude Am, applied to a delta modulator of step size ∆. Assume that the sampling rate is equal to Ts. 5](#_Toc165045076)

[1. Show that slope-overload distortion will occur if 5](#_Toc165045077)

[2. Find the maximum power (A2m) that can be transmitted without slope-overload distortion. 5](#_Toc165045078)

## Task 7.16 Et billede, der indeholder diagram, tekst, linje/række, Font/skrifttype Automatisk genereret beskrivelseConsider a uniform midtread quantizer (Slide 6 of the Lectures of Week 9), Assume that a Gaussian distributed random distributed random variable with zero mean and unit variance is applied to this quantizer input.

### Find the probability that the amplitude of the input lies outside the range of -4 to +4 (use the characteristics of a Gaussian random variable).



Using r to do the calculations I find that:

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### Use the result of part a (the probability that the random variable is not between -4 and +4 is very low), to show that the output signal-to-noise ratio of the quantizer is given by:

Et billede, der indeholder Font/skrifttype, tekst, nummer/tal, linje/række

Automatisk genereret beskrivelseHint: Use the same approach as example 7.2 (Slide 12 of the Lectures of Week 9).

The can be given as:

The quantization noise can be given as:

Et billede, der indeholder Font/skrifttype, typografi, kalligrafi, håndskrift

Automatisk genereret beskrivelseEt billede, der indeholder Font/skrifttype, hvid, håndskrift, nummer/tal

Automatisk genereret beskrivelseNow substituting:

Et billede, der indeholder Font/skrifttype, håndskrift, kalligrafi, typografi

Automatisk genereret beskrivelseGetting it into dB.

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Which is my answer.

I don’t know how the assignment has come to the conclusion, that the should be

For it to be true:

Then the non-decibel answer should be

Which I don’t understand how that result has been calculated.

## Task 7.17 A PCM system that uses a uniform quantizer is followed by a 7-bit binary encoder. The bit rate of the system is equal to .

### Find the maximum message bandwidth for which the system operates satisfactory, i.e., find the bandwidth for which the sampling rate equals the Nyquist rate.

The bitrate is given by:

To fullfill the nyquist criteria, the bounds for the sampling must be given by:

For

And the Nyquist rate will be found at:

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### Determine the output signal-to-noise ratio when a full-load sinusoidal modulating wave of frequency 1MHz is applied to the input (Use the equation of example 7.2 (slide 12)).

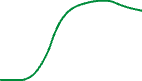
With the 7 bit encoder, the signal to noise ratio can be written as.

## Task 7.22 Consider a sine wave of frequency fm and amplitude Am, applied to a delta modulator of step size ∆. Assume that the sampling rate is equal to Ts.

### Show that slope-overload distortion will occur if

Delta modulation is known to have the slope overload distortion, if the ∆ is too low compared to the message signal.

Too prevent slope overload distortion, one should make sure, that the slope of the approximated stair signal exceeds the slope of the message signal.



Highest value of cos is 1.

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Now if exceeds this, the slope of the message signal will be larger than the step, meaning that the the approximated signal lacks behind, when the slope of the message signal is large.

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### Find the maximum power (A2m) that can be transmitted without slope-overload distortion.

The power of the signal is

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