# ITS323 – Quiz 2

Introduction to Data Communications, Semester 1, 2011

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ITS323Y11S1Q02, Steve/Courses/ITS323/Assessment/Quiz2.tex, r1859

## Question 1 [3 marks]

Consider a signal transmitted in a noise-free channel, where the signal has [ 128 | 64 | | ] different possible signal elements. What is the required channel bandwidth to support a data rate of [ 70Mb/s | 60kb/s | | ]? Show your calculations.

**Answer.** *Using the Nyquist capacity equation, with $M = 128$ (or 64) and $C = 70Mb/s$ (or 60kb/s), we obtain a bandwidth $B = 5MHz$ (or 5kHz).*

## Question 2 [3 marks]

Consider a signal received with power of [ | | 354mW | 12.6mW ] in a channel with measured noise of [ | | 2mW | 200uW ]. What is the required channel bandwidth to support a data rate of [ | | 210kb/s | 120Mb/s ]? Show your calculations.

**Answer.** *Using the Shannon capacity equation, with $SNR = 177$ (or 63) and $C = 210kb/s$ (or 120Mb/s), we obtain a bandwidth $B = 28kHz$ (or 20MHz). (Note I made a mistake in the question: I should have used 254 instead of 354; then the logarithm is easier to calculate)*

## Question 3 [3 marks]

Select the most appropriate word/phrase from those listed below to fill in the blanks in the statements about data transmission.

bandwidth; data rate; cost; errors; bits; analog data; analog signals; analog transmission; digital data; digital signals; digital transmission

(a) Increasing bandwidth results in increased data rate and _____. *cost*

(b) Increasing signal strength results in increased _____. *data rate*

(c) Increasing noise results in decreased _____. *data rate*

(d) Increasing the number of signal levels results in increased data rate and _____. *errors*

(e) A home, fixed telephone takes as input _____ and transmits _____. *analog data, analog signals*

(f) An ADSL Internet modem takes as input _____ and transmits _____. *digital data, analog signals*

(g) Speech is an example of _____. *analog data*

(h) Text is an example of _____. *digital data*

(i) In _____, repeaters are used to cover a long distance with multiple links. *digital transmission*

(j) In _____, amplifiers are used to cover a long distance with multiple links. *analog transmission*

# Question 4 [4 marks]

Consider the general signal equation $s(t)$:

$$s(t) = \frac{A}{1}sin(2\pi 1ft) + \frac{A}{3}sin(2\pi 3ft) + \frac{A}{5}sin(2\pi 5ft) + \cdots + \frac{A}{N}sin(2\pi Nft)$$

where $N$ is an odd number.

If a signal with [ 5 | 4 | 6 | 5 ] components and bandwidth of [ 16MHz | 24MHz | 50MHz | 24MHz ] is used, then what is the period of $s(t)$? Show your calculations.

**Answer.** *With 5 components, the 5th component will have a frequency of* $9f$*. The minimum frequency (1st component) has a frequency of* $f$*. Hence the bandwidth is* $8f = 16MHz$*, implying the frequency of the signal is 2MHz. Hence the period is 0.5us.*

*The answers of the variants are:*

- $6f = 24MHz;\ f = 4MHz;\ T = 0.25us$
- $10f = 50MHz;\ f = 5MHz;\ T = 0.2us$
- $8f = 24MHz;\ f = 3MHz;\ T = 0.333us$