AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH

Faculty of Science and Technology

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Course Teacher:	Abir Ahmed		

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Data Communication Mid Assignment

Q4-4. Define baseline wandering and its effect on digital transmission.

Q4-5. Define a DC component and its effect on digital transmission.

P4-2. In a digital transmission, the sender clock is 0.2 percent faster than the receiver clock. How many extra bits per second does the sender send if the data rate is 1 Mbps?

P4-15. What is the Nyquist sampling rate for each of the following signals?

a. A low-pass signal with bandwidth of 200 KHz?

b. A band-pass signal with bandwidth of 200 KHz if the lowest frequency is 100 KHz?

P4-16. We have sampled a low-pass signal with a bandwidth of 200 KHz using 1024 levels of quantization.

a. Calculate the bit rate of the digitized signal.

b. Calculate the SNRdB for this signal.

c. Calculate the PCM bandwidth of this signal.

P4-17. What is the maximum data rate of a channel with a bandwidth of 200 KHz if we use four levels of digital signaling.

P4-18. An analog signal has a bandwidth of 20 KHz. If we sample this signal and send it through a 30 Kbps channel, what is the SNRdB?

P4-19. We have a baseband channel with a 1-MHz bandwidth. What is the data rate for this channel if we use each of the following line coding schemes?

a. NRZ-L

b. Manchester

c. MLT-3

d. 2B1Q

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Q-4-4)

Define baseline wandering and it's effect on digital transmission.

Answer: The receiver calculates a running average of the received signal power when decoding a digital signal. The average is referred to as the "baseline". A long string of 0s or 1s might induce baseline drifting, making it harder for the receiver to decode correctly. A good line coding scheme needs to prevent baseline wandering.

Q-4-5) Define a DC component and its effect on digital transmission.

Answer: When the voltage level in a digital signal is constant for a while, the spectrum creates very low frequencies. These frequencies around zero, called DC components, present problems for a system that cannot pass low frequencies or a system that uses electrical coupling (via transformer).

For example, a telephone line cannot pass frequencies below 200Hz. Also a long-distance link may use one or more transformers to isolate different parts of the line electrically. For these systems, we need a sheme with no DC component.

P-4-2)

Number of bits sent $= 10^6 \times \frac{0.2}{100}$
$= 2000$ bits

Given that, bandwidth $= 1$ Mbps
$= 10^6$ bps

$\therefore$ 2000 extra bits are sent from the source.

(Ans.)

P-4-15)

a) Given that,

A low-pass signal with bandwidth $= 200$ KHz
$= 200 \times 1000$ Hz
$= 200000$ Hz

Nyquist sampling rate $= 2 \times f_{max}$
$= 2 \times 200000$
$= 400000$ samples/s

(Ans.)

b) Given that, bandwidth = 200 kHz

Lowest Frequency = 100 kHz

∴ Band pass signal, $F_{max} = 200 + 100$

$= 300 kHz$

$= 300 \times 10^3 Hz$

$= 300000 Hz$

The Nyquist sampling rate, $F_s = 2 \times F_{max}$

$= 2 \times 300000$

$= 600000$ samples

P-4-16)

a) In lowpass signal, minimum frequency is 0,

$F_{max} = 0 + 200 = 200 kHz$

So, the sample rate, $f_s = 2 \times 200\,kHz$

$= 400\,kHz$

$= 400000\,Hz$

The number of bits per level,

$n_b = \log_2 1024$

$= 10$ bits / sample

Bit rate, N = sampling rate × number of bits per sample

$= f_s \times n_b$

$= 400000 \times 10$ bps

$= 4 \times 10^6$ bps

$= 4$ Mbps

(Ans.)

b) Signal to noise ratio,

$SNR_{dB} = 6.02\, n_b + 1.76\, dB$

$= 6.02 \times 10 + 1.76$

$= 61.96\, dB$

(Ans.)

c) the PCM bandwidth,

$$B_{min} = n_b \times B_{analog}$$
$$= 10 \times 200$$
$$= 2000 \, Hz$$
$$= 2 \, MHz$$

(Ans)

P4-17)

Given data,

Bandwidth, $B = 200 \, kHz$

the maximum data rate,

$$N_{max} = 2 \times B \times n_b$$
$$= 2 \times B \times \log_2 L$$
$$= 2 \times 200 \times \log_2 4$$
$$= 800 \, kbps$$

(Ans.)

P4 – 18)

Given data,

$B = 20\,kHz$

Sample signal channel $= 300\,kbps$

$= 300000\,bps$

$f_{max} = 0 + 20 = 20\,kHz$

the sample rate, $f_s = 2 \times 20$

$= 40000$ samples / second

the number of bits per level,

$$n_b = \frac{30000}{40000}$$

$= 0.75$ bits/sample

Signal to noise ratio,

$$SNR_{dB} = 6.02\, n_b + 1.76\, dB$$

$= 6.02 \times 0.75 + 1.76$

$= 6.275\, dB$

(Ans.)

P4-19) Given that,

$B = 1 MHz$

a) NRZ-L,

data rate, $N = B \times 2$

$= 1 \times 2$

$= 2 Mbps$

(Ans.)

b) Manchester,

data rate, $N = B \times 1$

$= 1 \times 1$

$= 1 Mbps$

(Ans.)

c) MLT-3,

data rate, $N = B \times 3$

$= 1 \times 3$

$= 3 Mbps$ (Ans)

d) 2B1Q,

data rate, $N = B \times 4$

$= 1 \times 4$

$= 4 Mbps$ (Answer)