CPEG 572 Data and Computer Communications

ASSIGNMENT #2

Ch3:

Q.1

What is the bit rate for each of the following signals?

a. A signal in which 1 bit lasts 0.001 s

bit rate = $\frac{1}{bit\ duration} = \frac{1}{0.001} = 1000\ bps = 1kbps$

b. A signal in which 1 bit lasts 2 ms = 0.002 sec

bit rate = $\frac{1}{bit\ duration} = \frac{1}{0.002} = 500\ bps = 0.5kbps$

c. A signal in which 10 bits last 20 µs

$\frac{20}{10} = 2\ \mu s = 0.000002\ sec$

bit rate = $\frac{1}{bit\ duration} = \frac{1}{0.000002} = 500{,}000\ bps = 5{,}000kbps$

Q.2

A device is sending out data at the rate of 1000 bps.

a. How long does it take to send out 10 bits?
$\frac{10}{1000} = 0.01\ sec$
b. How long does it take to send out a single character of (8 bits)?
$\frac{8}{1000} = 0.008\ sec$
c. How long does it take to send a file of 100,000 characters?
$\frac{100000 * 8}{100} = 800\ sec$

Q.3

A TV channel has a bandwidth of 6 MHz If we send a digital signal using one channel, what are the data rates if we use one harmonic, three harmonics, and five harmonics?

Bit rate for one harmonic = 2 * Bandwidth = 2 * 6 = 12 Mbps

Bit rate for three harmonic = 2 * 6 / 3 = 4 Mbps

Bit rate at five harmonics = 2 * 6 / 5 = 2.4 Mbps

Q.4

If the bandwidth of the channel is 5 Kbps, how long does it take to send a frame of 100,000 bits out of this device?

$$\frac{100{,}000}{5{,}000} = 20\ seconds$$

Q.5

What is the theoretical capacity of a channel in each of the following cases?

$$C = B * \frac{SNR_{dB}}{3}$$

a. Bandwidth: 20 KHz SNRdB = 40

$$C = 20 * \frac{40}{3} = 266.6\ Kbps$$

b. Bandwidth: 200 KHz SNRdB = 4

$$C = 200 * \frac{4}{3} = 266.6\ Kbps$$

c. Bandwidth: 1 MHz SNRdB = 20

$$C = 1{,}000 * \frac{20}{3} = 6.66\ Mbps$$

Q.6

What is the total delay (latency) for a frame of size 5 million bits that is being sent on a link with 10 routers each having a queuing time of 2 μs and a processing time of 1 μs. The length of the link is 2000 Km.

Latency = processing time + queuing time + transmission time + propagation time

So,

$$\text{Latency} = 10 * 1\mu s + 10 * 2\mu s + \left(\frac{5{,}000{,}000}{5Mbps}\right) + \left(\frac{2000}{2*10^8}\right) = 1010.03ms$$

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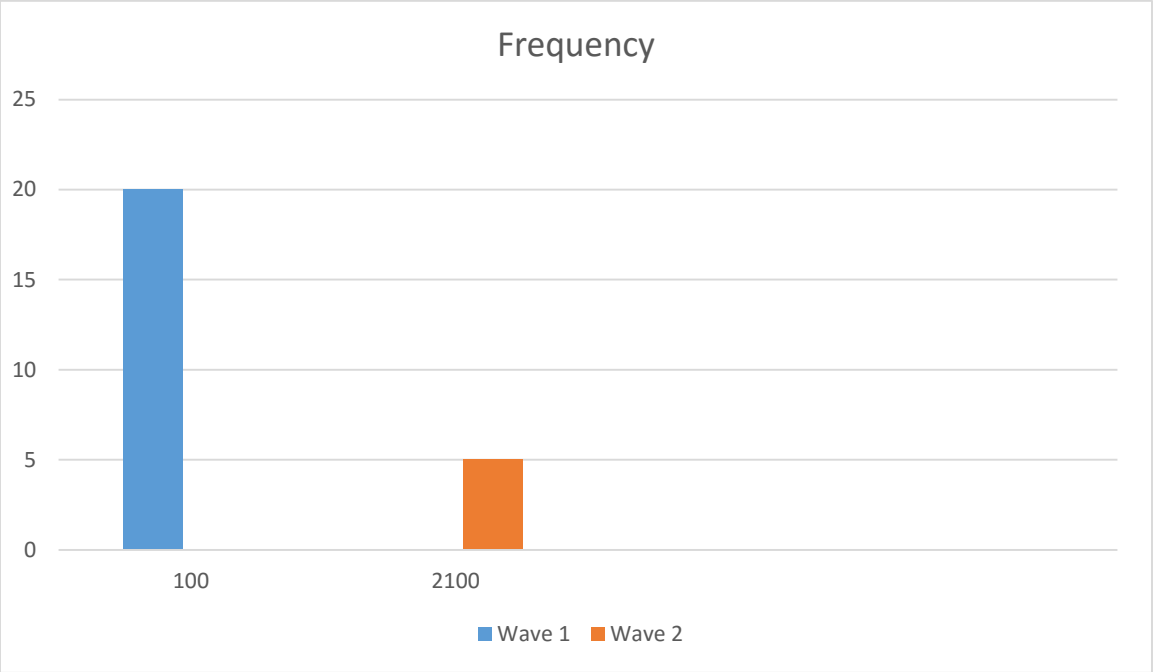
Q.7

A periodic composite signal with a bandwidth of 2000 Hz is composed of two sine waves. The first one has a frequency of 100 Hz with a maximum amplitude of 20 V; the second one has a maximum amplitude of 5 V. Draw the bandwidth.



Q.8

A signal travels from point A to point B. At point A, the signal power is 100 W. At point B, the power is 90 W. What is the attenuation in decibels?

$\text{dB} = 10 * \log_{10}\left(\frac{90}{100}\right) = -0.457$