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NET331: COMPUTER NETWORKS FUNDAMENTALS

Networks and Communication Department

Chapter # 3

Question 16

- Given the frequencies listed below, calculate the corresponding periods.

a. 24 HZ

T = 1 / f = 1 / (24 Hz) = 0.0417 s = 41.7 $\times 10^{-3}$ s = 41.7 ms

b. 8 MHz

8 MHz = (8 x 1000000)= 8000000 Hz

T = 1 / f = 1 / 8000000= 0.000000125 s = 0.125 $\times 10^{-6}$ s = 0.125 µs

c. 140 KHz

140 KHz = (140 x 1000)= 140000 Hz

T = 1 / f = 1 / (140000) = 0.00000714 s = 7.14 $\times 10^{-6}$ s = 7.14 µs

Question 17

- Given the following periods , calculate the corresponding frequencies.

a. 5 s

f = 1 / T = 1 / (5 s) = 0.2 Hz

b. 12 µs

12 µs = 12 / 1000000 = 0.000012 s

f = 1 / T = 1 / 0.000012=83333.3 Hz = 83.333 $\times 10^3$ Hz = 83.333 KHz

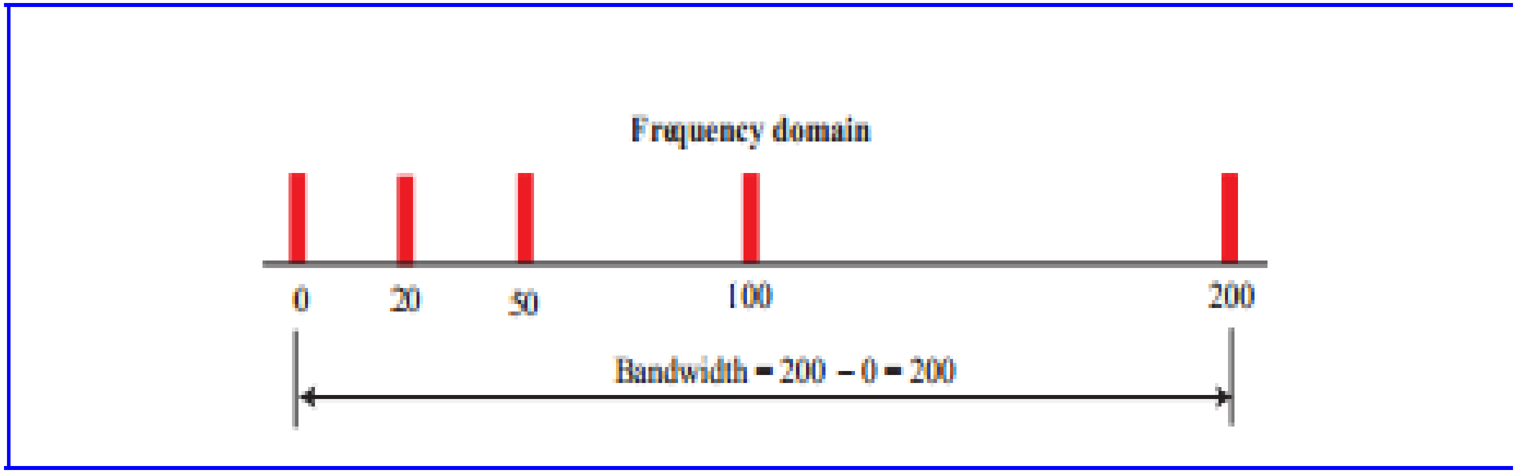
c. 220 ns

220 ns = 220 / 100,000,000 = 2.2 $\times 10^{-7}$

f = 1 / T = 1 / 2.2 $\times 10^{-7}$= 4545454.5 Hz = 4.55$\times 10^6$ Hz =4.55 MHz

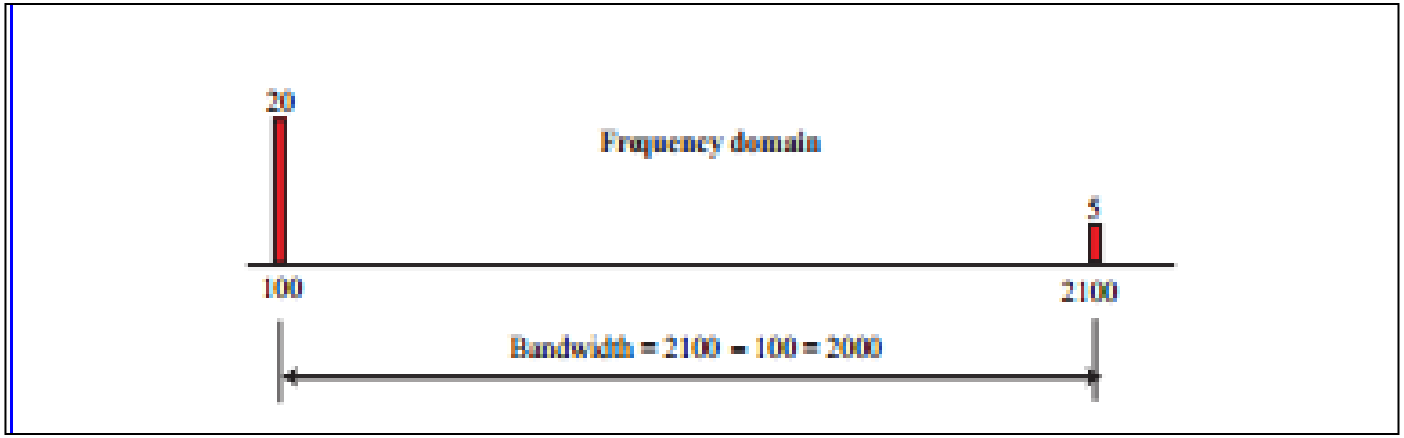
Question 19

- What is the bandwidth of a signal that can be decomposed with frequencies at 0, 20, 50, 100 and 200 Hz? All peak amplitude are the same. Draw the bandwidth.



Question 20

- A periodic composite signal with a bandwidth of 2000Hz 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



Question 22

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

a. A signal in which 1 bit lasts 0.001 s

bit rate = 1/ (bit duration) = 1 / (0.001 s) = 1000 bps = 1 Kbps

B. A signal in which 1 bit lasts 2 ms

2 ms = 2/1000 = 0.002 s

bit rate = 1/ (bit duration) = 1 / (0.002) = 500 bps

C. A signal in which 10 bit lasts 20 μs

20/10= 2 μs

2 μs = 2/1000000 = 0.000002 s

bit rate = 1/(bit duration) = 1 / (0.000002) = 500,000 bps = 500 Kbps

Question 23

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

a. How long does it take to send out 10 bits?

(10 / 1000) s = 0.01 s

a. How long does it take to send out a signal character (8 bits)?

(8 / 1000) s = 0. 008 s = 8 ms

a. How long does it take to send a file of 100,00 characters?

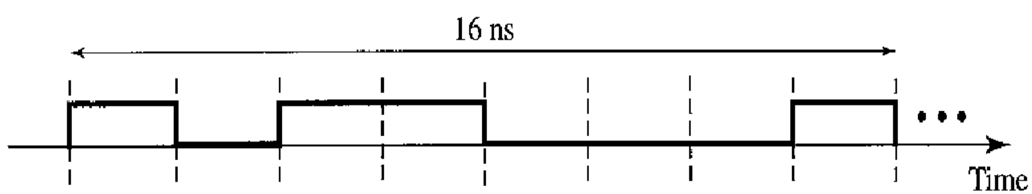
100,000 × 8 = 800,000 bits

(800,000/ 1000) s = 800 s

Question 24

- What is the bit rate for the signal in Figure 3.34

Figure 3.34 *Exercise 24*



There are 8 bits in 16 ns.

16 ns = 16×10^{-9}s= 1.6×10^{-8} s

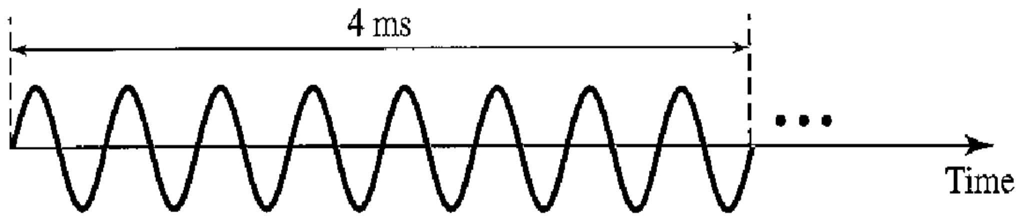
Bit rate is 8 / (1.6×10^{-8}) = 500,000,000 bps

=0.5×10^{-9} = 500 Mbps

Question 25

- What is the frequency of the signal in figure 3.35

Figure 3.35 *Exercise 25*



The signal makes 8 cycles in 4 ms.

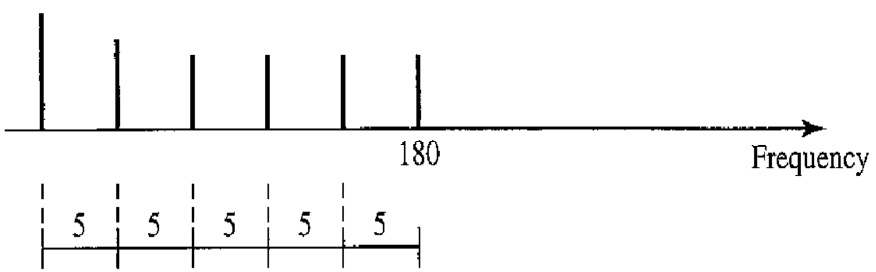
4 ms = 4/1000 = 0.004 s

The frequency is 8 /(0.004) = 2000 Hz=2 KHz

Question 26

- What is the bandwidth of the composite signal shown in figure 3.36

Figure 3.36 *Exercise 26*



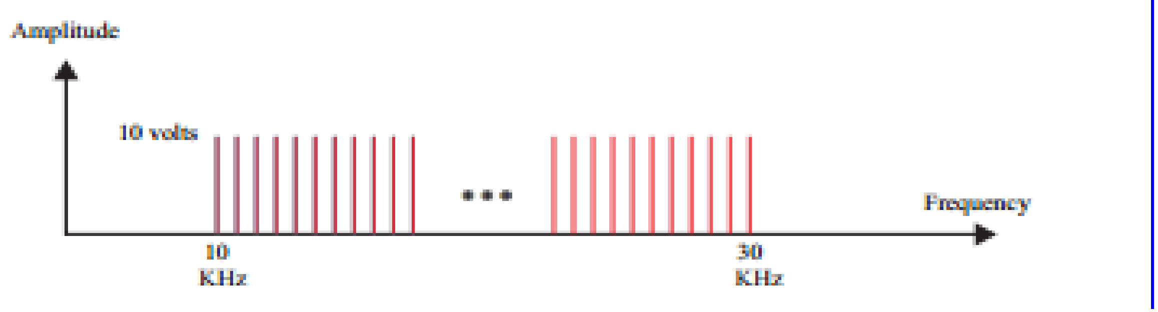
The bandwidth is $5 \times 5 = 25$ Hz.

Question 27

- A periodic composite signal contains frequencies from 10 to 30 kHz, each with an amplitude of 10V. Draw the frequency domain

The signal is periodic, so the frequency domain is made of discrete frequencies. As shown in the following figure

Figure 3.3 *Solution to Exercise 27*



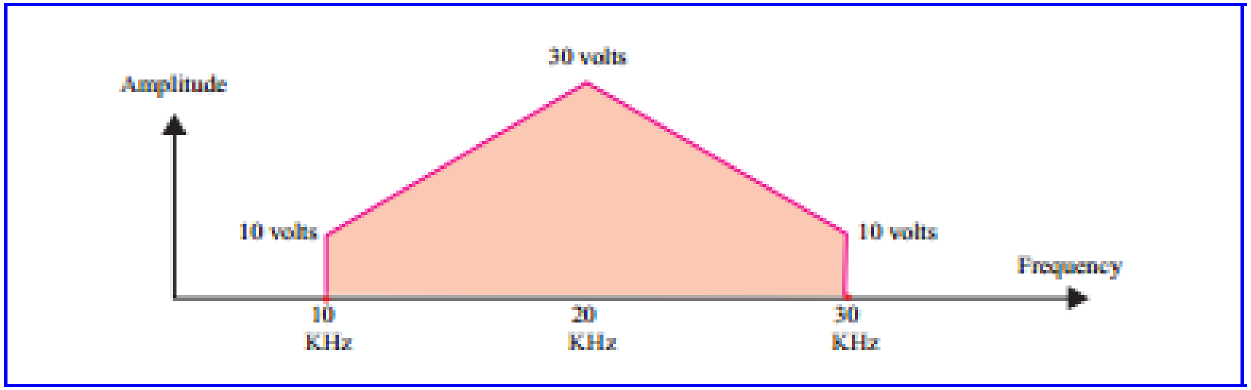
Question 28

- A non-periodic composite signal contains frequencies from 10 to 30 kHz. The peak amplitude is 10 V for the lowest and the highest signals and is 30 V for 20 KHz signal. Assuming that the amplitude change gradually from the minimum to the maximum, draw the frequency domain.

Question 28 answer

- The signal is non-periodic, so the frequency domain is made of continuous spectrum of frequencies as shown in the following figure

Figure 3.4 *Solution to Exercise 28*



Question 30

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

dB = 10 log_{10} (90 / 100) = –0.46 dB

Question 31

- The attenuation of a signal is -10dB. What is the final signal power if it was originally 5 W?

dB= 10 log_{10}(P2 / P1)

$-10 = 10\ log_{10}(P2 / 5)$

$\rightarrow log_{10}\ (P2 / 5) = -1$

$\rightarrow (P2 / 5) = 10^{-1}$

$\rightarrow$ P2 = 0.5 W

Question 36

- A line has a signal-to-noise ratio of 1000 and a bandwidth of 4000 kHz. What the maximum data rate supported by this line?

. 4000 kHz = 4,000,000 Hz

4,000,000 log_2 (1 + 1,000)

4,000,000 x 10 ≈ 40,000,000 bps ≈ 40 Mbps

Question 38

- A file contain 2 million byte. How long does it take to download this file using a 56-Kbps channel? 1 Mbps channel?
- We have transmission time = (message size)/(bandwidth)
- The file contains 2,000,000 × 8 = 16,000,000 bits.
- **With a 56-Kbps channel** = 56,000 bps

→ it takes 16,000,000/56,000 = 285.7 s.

- **With a 1-Mbps channel**= 1000,000

→ it takes 16,000,000/1000,000 =16 s

Question 45

- What is the transmission time of a packet sent by a station if the length of the packet is 1 million bytes and the bandwidth of the channel is 200 kbps?
- The packet contains 1,000,000 × 8 = 8,000,000 bits.
- Bandwidth = 200 kbps = 200,000 bps
- We have
- transmission time = (packet length)/(bandwidth) =
- (8,000,000 bits) / (200,000 bps) = 40 s

Question 48

- 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 2µs and a processing time of 1 µs . The length of the link is 2000 km. The speed of light inside the link $2x10^8$ m/s. The link has a bandwidth of 5 Mbps. Which components of the total delay is dominant5? Which one is negligible?

Question 48 answer

- . We have
- **Latency =** processing time + queuing time + transmission time + propagation time
- **Processing time =** 10 × 1 μs = 10 μs = 0.00001 s
- **Queuing time =** 10 × 2 μs = 20 μs = 0.00002 s
- **Transmission time =** 5,000,000 / (5 Mbps) = 1 s
- **Propagation time =** (2000 Km) / (2 × 108) = 0.01 s
- **Latency =** 0.00001 + 0.00002 + 1 + 0.01 = 1.01003 s
- The transmission time is dominant here because the packet size is huge