PATUAKHALI SCIENCE AND TECHNOLOGY UNIVERSITY

Course Code: CCE 211

Assignment – 04

SUBMITTED TO:

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Assignment 04

QUESTIONS:

Q3-1. Period and frequency are inversely related. The period of a signal is the time it takes for one complete cycle to occur, while the frequency is the number of cycles that occur in one second. Mathematically, frequency (f) is the reciprocal of the period (T), so f=1/T .

Q3-2. The amplitude of a signal measures its strength or intensity. The frequency of a signal measures the rate of oscillation or cycles per second. The phase of a signal measures the position of the waveform at a specific point in time relative to a reference point.

Q3-3. A composite signal can be decomposed into its individual frequencies using techniques like Fourier analysis, which breaks down a complex waveform into its constituent sinusoidal components.

Q3-4. Three types of transmission impairments are attenuation, distortion, and noise.

Q3-5. Baseband transmission involves sending a signal without modulating it onto a carrier frequency, whereas broadband transmission involves modulating a signal onto a carrier frequency for transmission.

Q3-6. A low-pass channel allows low-frequency signals to pass through while attenuating high-frequency signals, whereas a band-pass channel allows signals within a certain frequency range to pass through while attenuating frequencies outside that range.

Q3-7. The Nyquist theorem states that to accurately reconstruct a signal, the sampling rate must be at least twice the highest frequency component of the signal. In communications, this theorem ensures that signals can be accurately transmitted and reconstructed without loss of information.

Q3-8. Shannon capacity, named after Claude Shannon, refers to the maximum rate at which information can be reliably transmitted over a communication channel subject to noise interference. It provides a theoretical upper limit on the data rate of a communication channel.

Q3-9. Optical signals used in fiber optic cables have a very short wavelength to minimize signal attenuation and interference, allowing for high-speed and long-distance data transmission.

Q3-10. Yes, we can determine whether a signal is periodic or nonperiodic by looking at its frequency domain plot. If the frequency domain plot contains discrete spectral lines, the signal is periodic. If it shows a continuous spectrum, the signal is nonperiodic.

Q3-11. The frequency domain plot of a voice signal is continuous because voice signals are typically nonperiodic, containing a wide range of frequencies.

Q3-12. The frequency domain plot of an alarm system depends on its specific characteristics. If the alarm system generates a periodic signal, its frequency domain plot would be discrete. If it produces a nonperiodic signal, the frequency domain plot would be continuous.

Q3-13. Sending a voice signal from a microphone to a recorder typically involves baseband transmission because the signal is not modulated onto a carrier frequency.

Q3-14. Sending a digital signal from one station on a LAN to another station typically involves baseband transmission because digital signals are usually transmitted without modulating onto a carrier frequency.

Q3-15. Modulating several voice signals and sending them through the air involves broadband transmission because the voice signals are modulated onto carrier frequencies for transmission over a wider bandwidth.

Problems

P3-1. To calculate the periods corresponding to the given frequencies, we use the formula $T = 1/f$, where T is the period and f is the frequency.

Given frequencies:

a. f = 10Hz

b. f = 50Hz

c. f = 100 Hz

Calculations:

a. T = 1/10= 0.1 seconds

b. T = 1/50 = 0.02 seconds

c. T = 1/100 = 0.01 seconds

P3-2. To calculate the frequencies corresponding to the given periods, we use the formula $f = 1/T$, where T is the period and f is the frequency.

Given periods:

a. T = 0.2 seconds

b. T = 0.005 seconds

c. T = 0.01 seconds

Calculations:

a. f = 1/0.2 = 5 Hz

b. f = 1/0.005 = 200 Hz

c. f = 1/0.01 = 100 Hz

P3-3. The phase shift for the following scenarios:

a. For a sine wave with the maximum amplitude at time zero, there is no phase shift.

b. For a sine wave with maximum amplitude after 1/4 cycle, the phase shift is pi/2 radians or 90 degrees.

c. For a sine wave with zero amplitude after 3/4 cycle and increasing, the phase shift is 3pi/2 radians or 270 degrees.

P3-4. The bandwidth of a signal composed of five sine waves with frequencies at 0, 20, 50, 100, and 200 Hz is determined by the difference between the highest and lowest frequencies. Since the signal is decomposed into these frequencies, the bandwidth is 200 - 0 = 200 Hz.

P3-5. For a periodic composite signal composed of two sine waves with a bandwidth of 2000 Hz, we draw the bandwidth based on the frequencies given. Since one sine wave has a frequency of 100 Hz and the other has no specific frequency mentioned but contributes to the bandwidth, the bandwidth extends from 0 Hz to 2000 Hz.

P3-6. A sine wave with a frequency of 200 Hz has a wider bandwidth compared to a sine wave with a frequency of 100 Hz because the higher the frequency, the wider the bandwidth.

P3-7. Bit rate is calculated using the formula Bit rate = 1/Bit duration

a. For a signal in which 1 bit lasts 0.001 s, the bit rate is 1/0.001} = 1000 bits per second (bps).

b. For a signal in which 1 bit lasts 2 ms (0.002 s), the bit rate is 1/0.002 = 500 bps.

c. For a signal in which 10 bits last 20 μs (0.00002 s), the bit rate is 10/0.00002 = 500,000 \) bps.

P3-8.

a. If the device is sending data at the rate of 1000 bps, it takes 10/1000= 0.01 seconds to send out 10 bits.

b. Sending out a single character, which is typically 8 bits, takes 8/1000 = 0.008 seconds.

c. Sending a file of 100,000 characters takes (100,000 * 8) /1000 = 800 seconds