

Academic Year **2024/2025**
Semester **Spring**
Academic Level: **Level 1**
Tutorial No.: **5**

Subject: (ECT 141) Networks and Communication Technologies

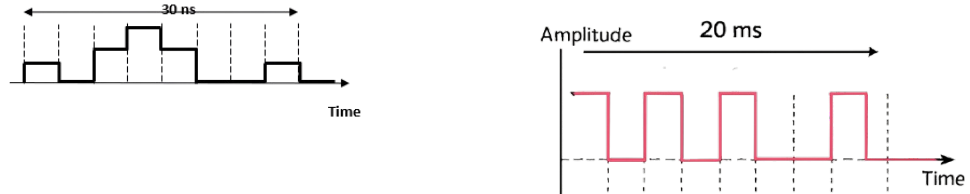
Bandwidth Questions

1. If a periodic signal is decomposed into five sine waves with frequencies of 100, 300, 500, 700, and 900 Hz, what is its bandwidth? Draw the spectrum, assuming all components have a maximum amplitude of 10 V.
2. A periodic signal has a bandwidth of 20 Hz. The highest frequency is 60 Hz. What is the lowest frequency? Draw the spectrum if the signal contains all frequencies of the same amplitude.
3. A nonperiodic composite signal has a bandwidth of 200 kHz, with a middle frequency of 140 kHz and peak amplitude of 20 V. The two extreme frequencies have an amplitude of 0. Draw the frequency domain of the signal.
4. 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.
5. Which signal has a wider bandwidth, a sine wave with a frequency of 100 Hz or a sine wave with a frequency of 200 Hz?

Bit Rate Questions

1. A digital signal has eight levels. How many bits are needed per level? Calculate the number of bits using the appropriate formula.
2. A digitized voice channel is made by digitizing a 4-kHz bandwidth analog voice signal. The signal is sampled at twice the highest frequency, and each sample requires 8 bits. What is the required bit rate?
3. What is the bit rate for each of the following signals?
 - (a) A signal in which 1 bit lasts 0.001 s
 - (b) A signal in which 1 bit lasts 2 ms
 - (c) A signal in which 10 bits last 20 μ s

4. What is bit representation in the provided graph and bit rate.



figureDigital signal graphs (a.png, b.png)

Signal Power and Decibels Questions

- A signal travels through a transmission medium and its power is reduced to one-half, so $P_2 = \frac{1}{2}P_1$. Calculate the attenuation in decibels.
- A signal travels through an amplifier, and its power is increased 10 times, so $P_2 = 10P_1$. Calculate the amplification (gain) in decibels.
- Refer to Figure 3.27 in the textbook: a signal travels from point 1 to point 4 through multiple stages. Calculate the total decibel value for the signal strength change.
- The decibel is sometimes used to measure signal power in milliwatts, referred to as dBm, calculated as $dBm = 10 \log_{10} P_m$, where P_m is the power in milliwatts. Calculate the power of a signal in milliwatts if its dBm value is -30.
- The loss in a cable is defined as 0.3 dB/km. If the signal at the beginning of the cable has a power of 2 mW, what is the power of the signal at 5 km?