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## Data Communication CS601 Lecture No 9

Lecture Prepared By

Muhammad Abid Ali

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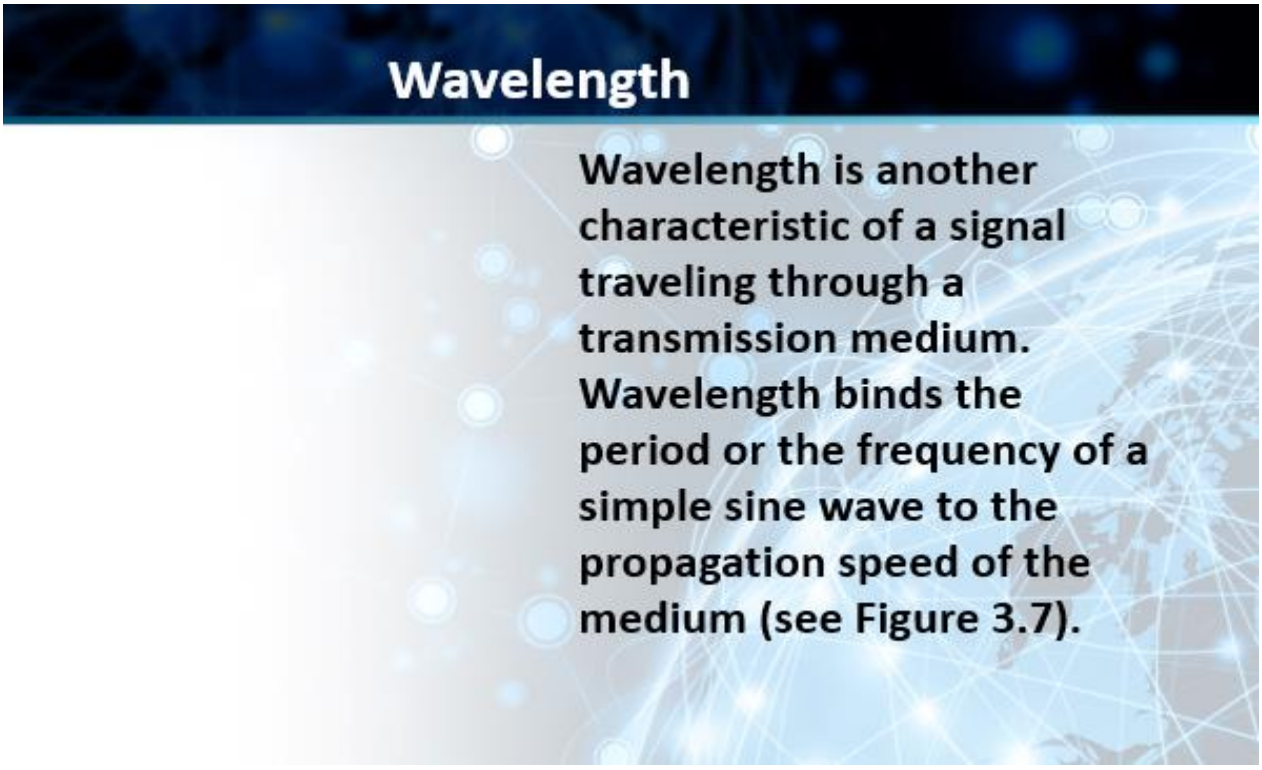
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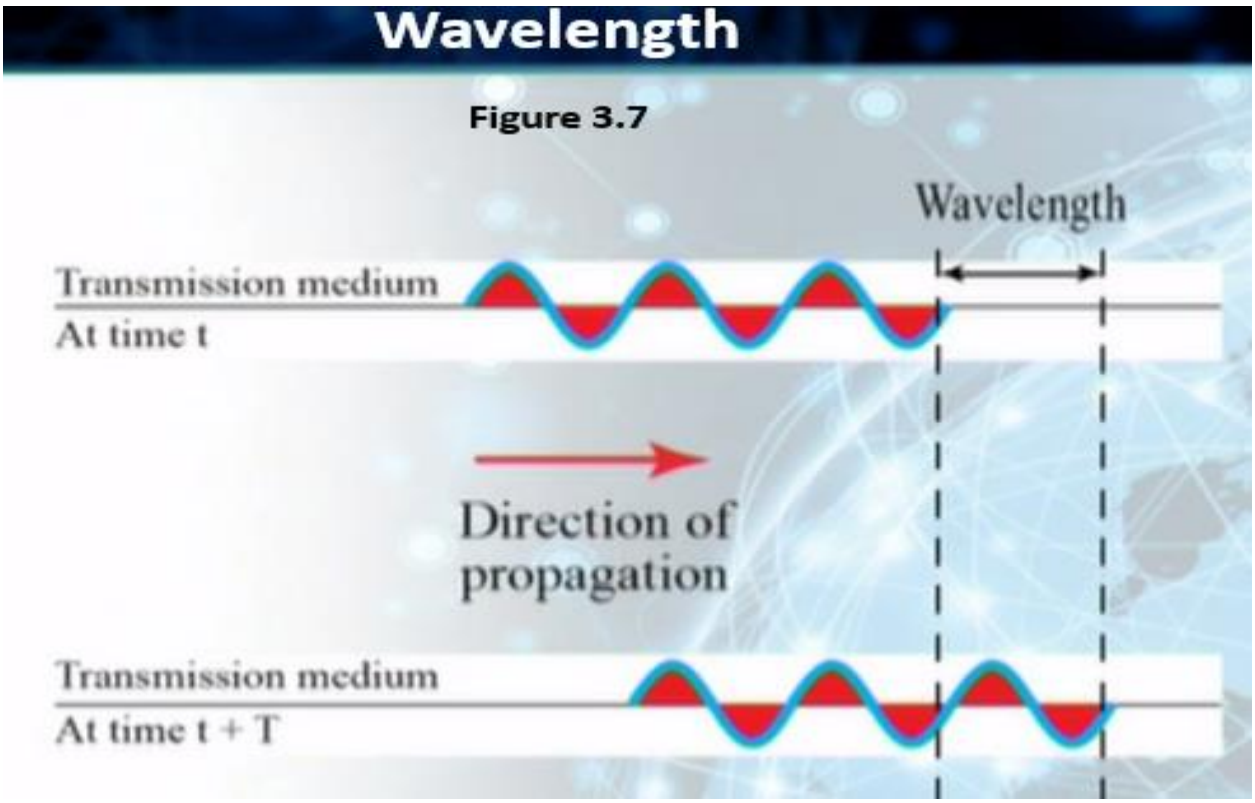
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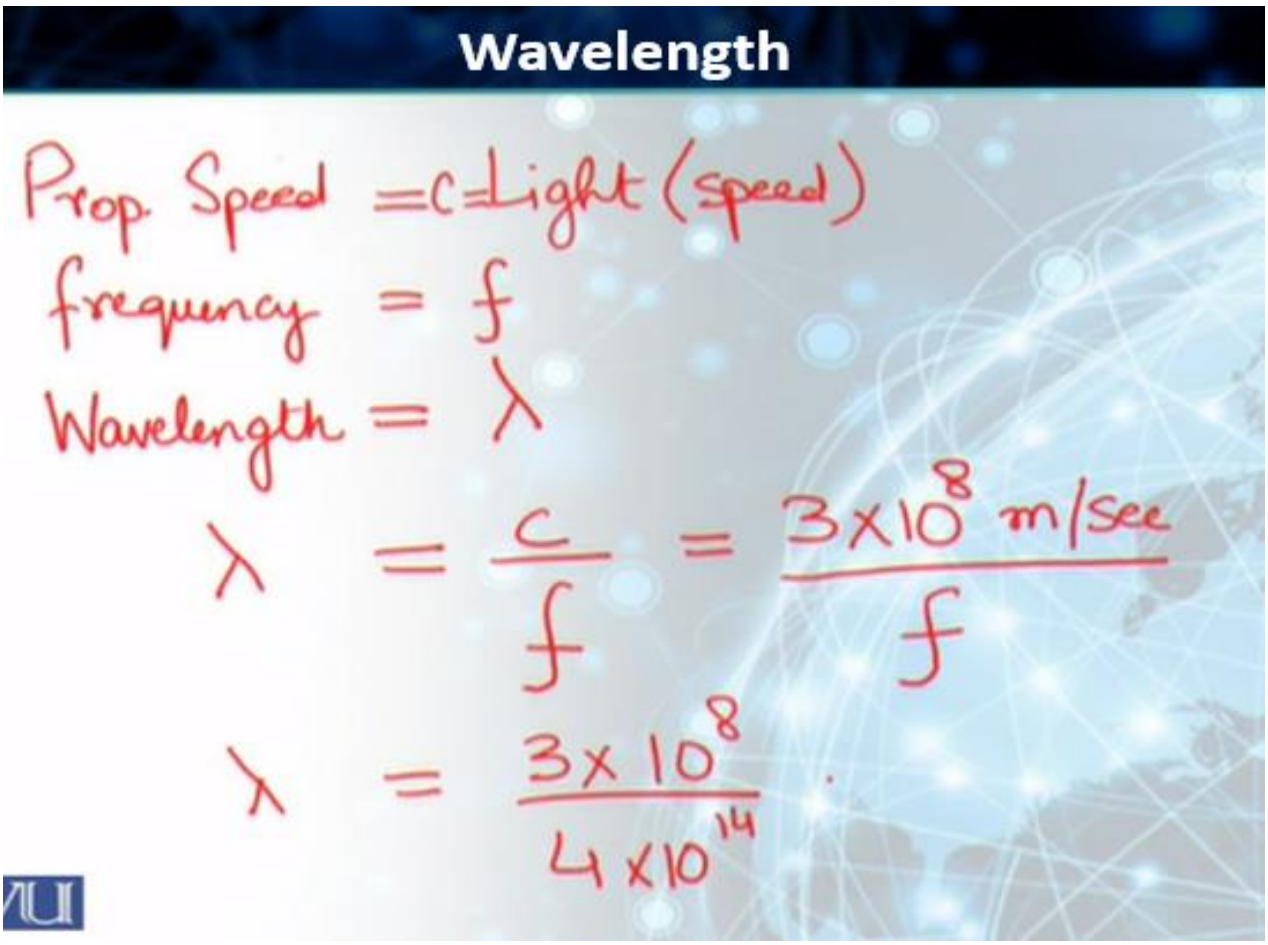
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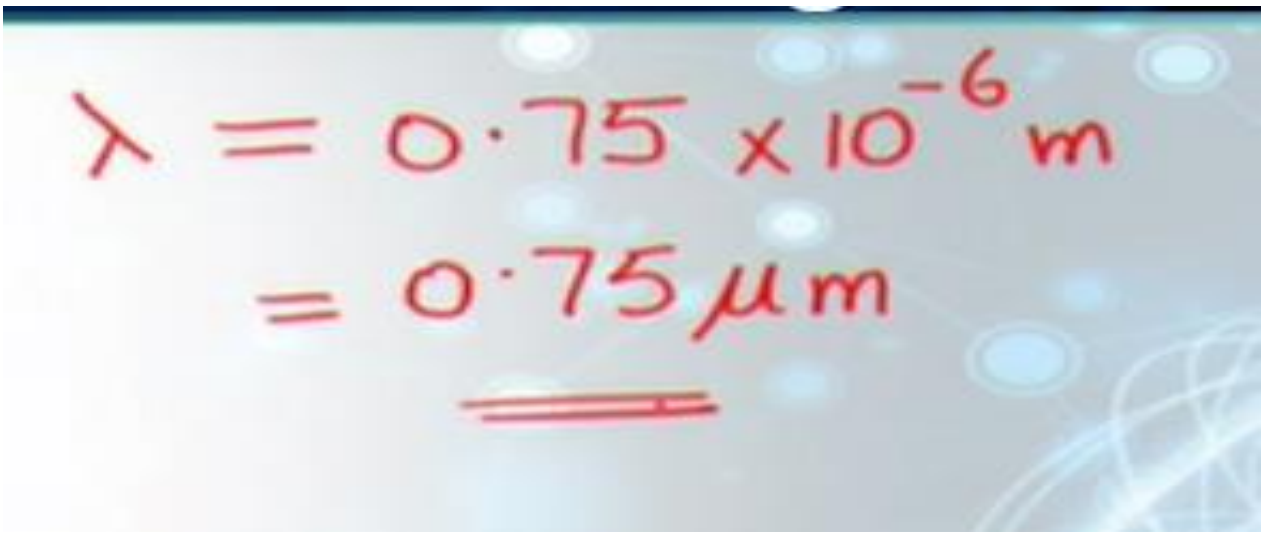
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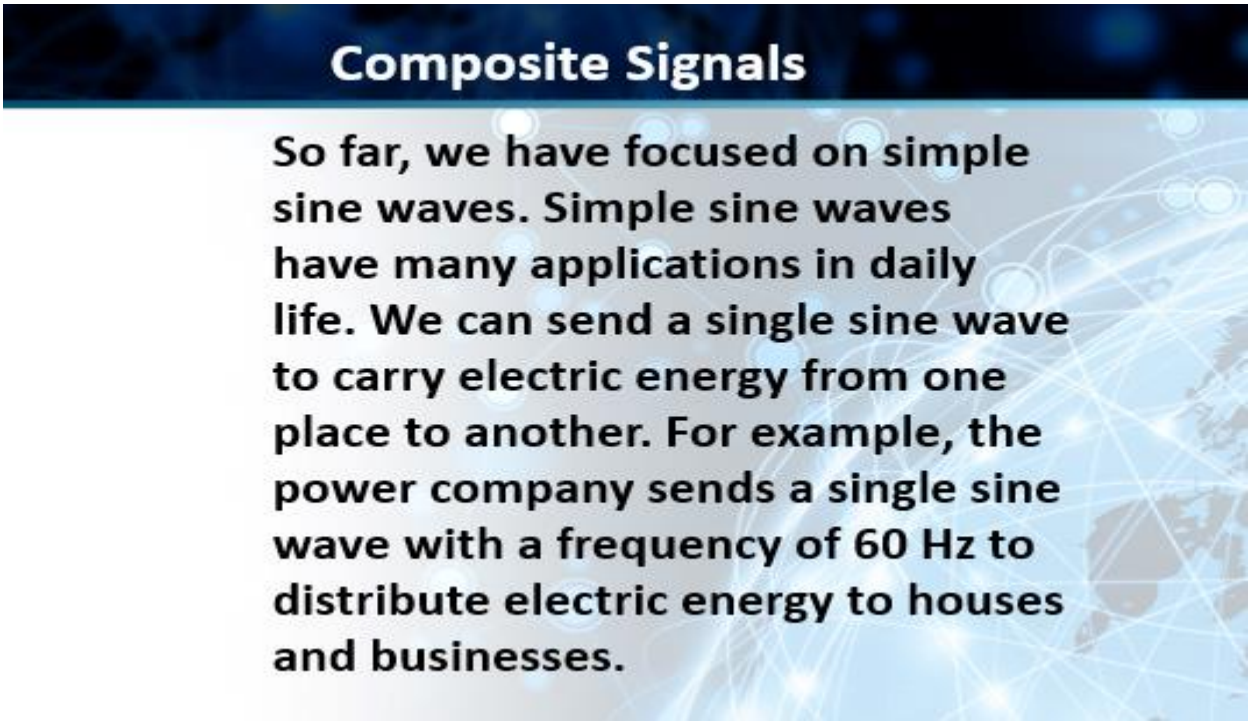


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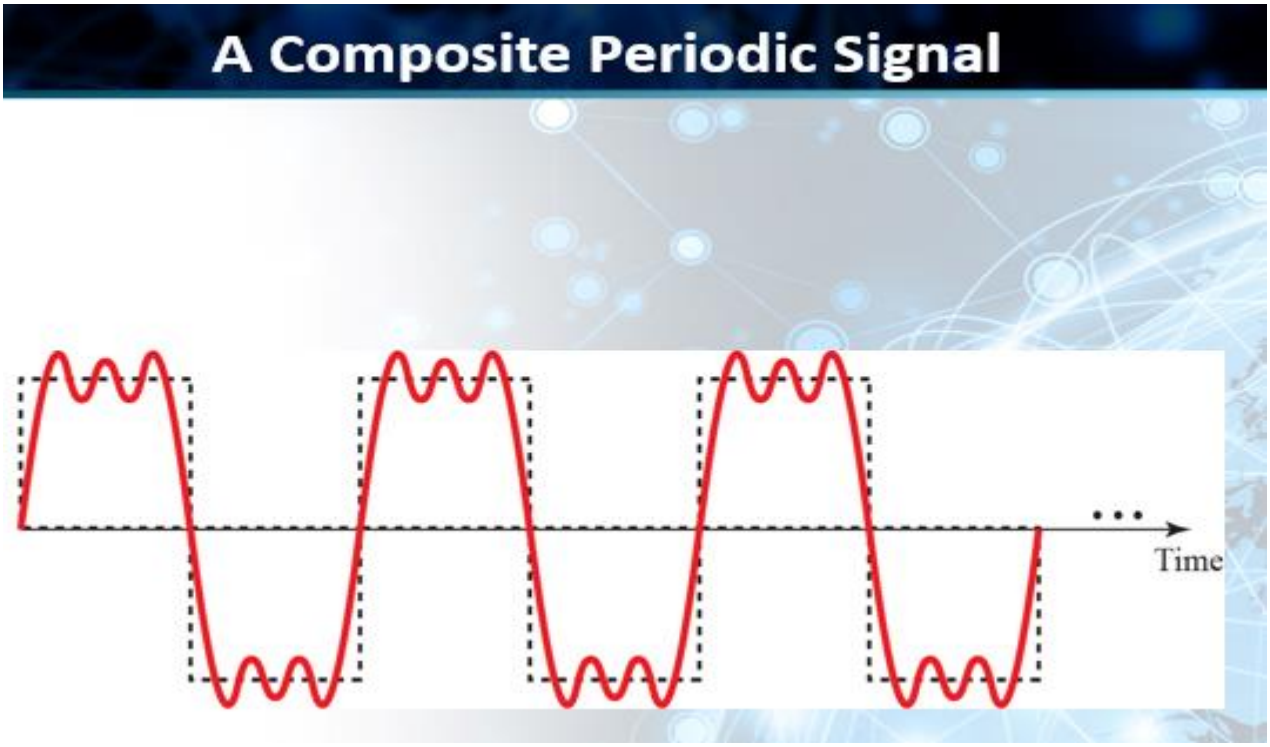
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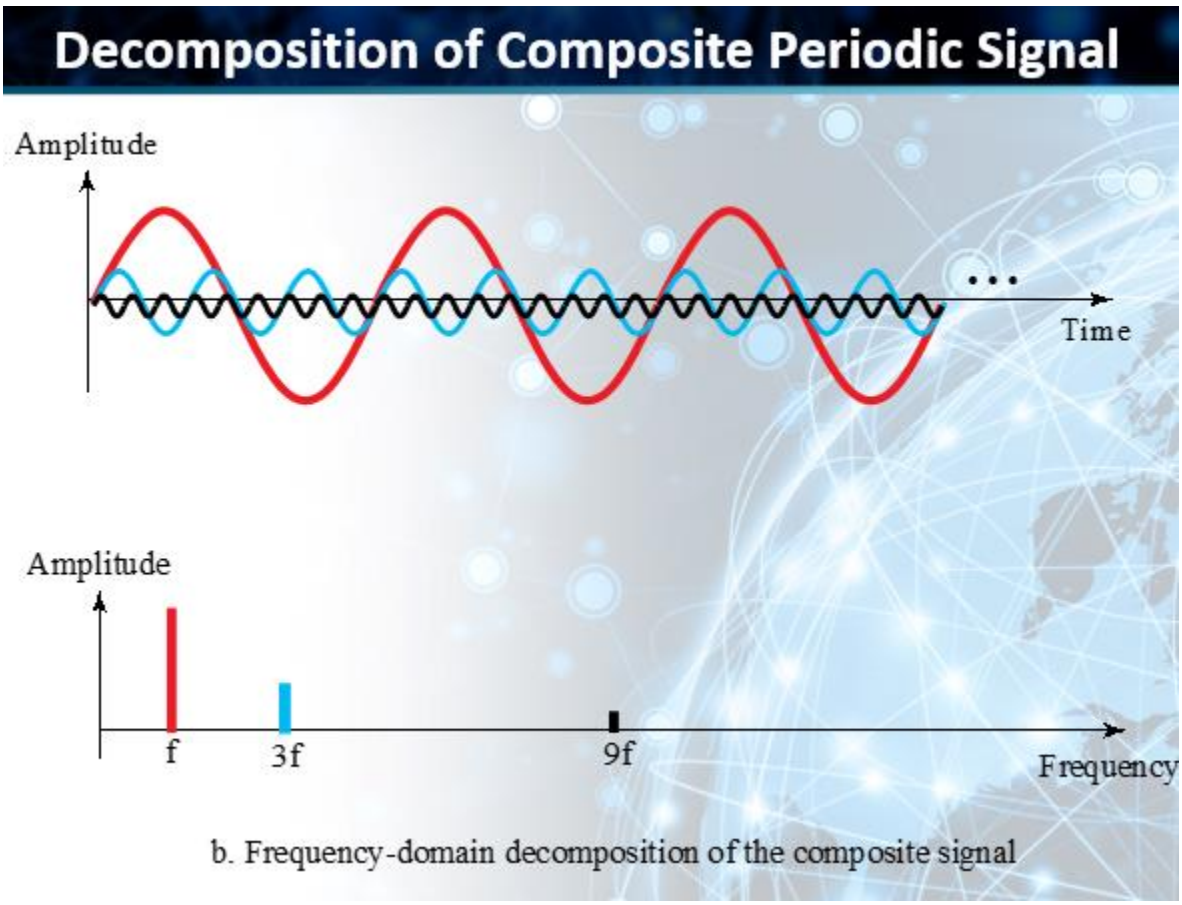
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## Bandwidth

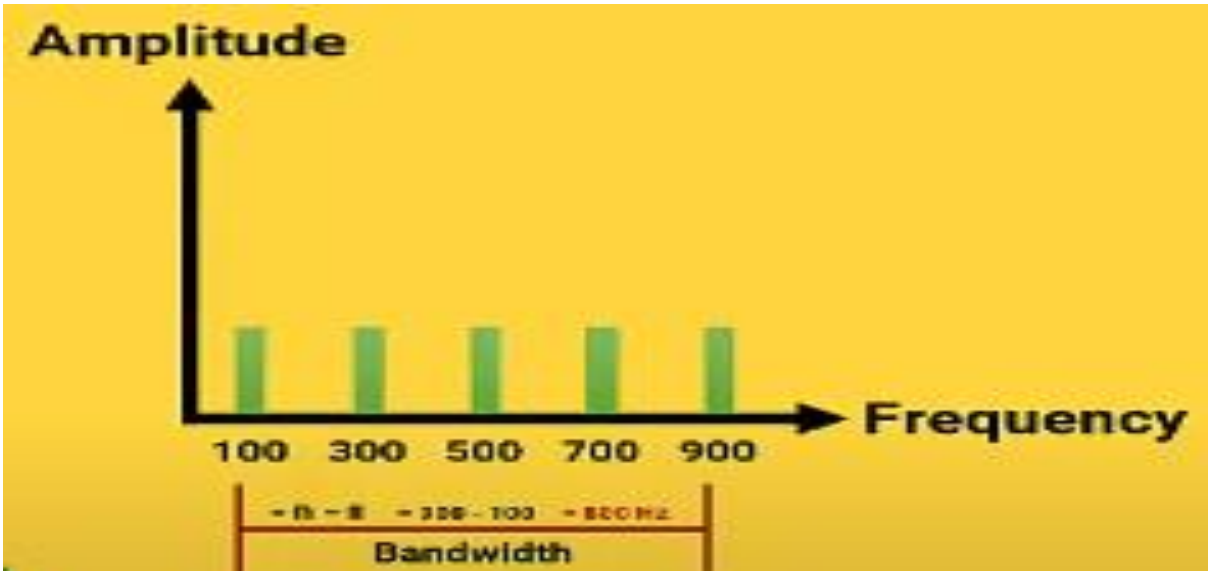
Bandwidth give us the range of frequencies contained in a composite signal. It give normally between two frequencies (High and Low).

**How to Calculate the Bandwidth:**

To calculate Bandwidth, subtract the lowest frequency from the highest frequency.

**Example:**

If a periodic signal is decomposed into five sine waves with frequencies 100, 300, 500, 700, and 900 Hz, what is the Bandwidth?



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## Example

**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.**

$B = f_h - f_l$

$= 900 - 100$

$B = 800\,Hz$



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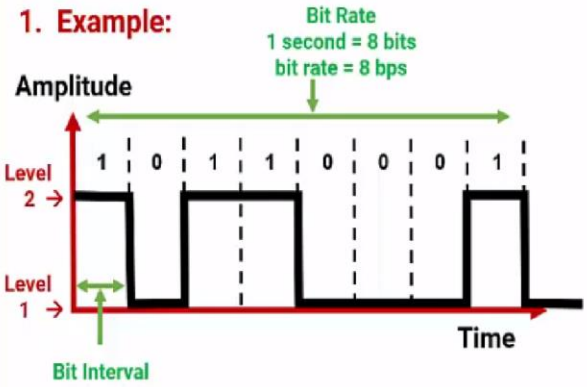
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## Digital Signal – Non-Periodic Signals

A signal in which the original information is converted into bits (0s Zero & 1s Positive) before being transmitted. And Digital Signal have more than 2 level.

**1. Example:**




**Bit Interval (Seconds):** The time required to send one signal bit.

**Bit Rate (bps):** Number of bits sent per second.

**Bit Length:** The distance one bit occupies on transmission medium.

**Signals:** It generate L level signals. If generate 1 level than $\log^2 2$. and if we have 4 level than $\log^2 4$.

**Example 1:** A digital signal has 8 Level. How many bits are needed?

**Formula:** No. of Bits = $\text{Log}_2 L$ = $\text{Log}_2 8$ = 3 bits

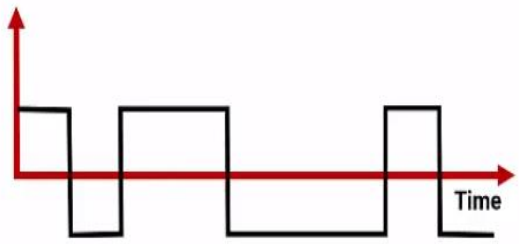
**Example 2:** Assume we need to download text documents at the rate of 100 pages per second. What is the required bit rate of the channel? 1 Page contained 24 line and 1 line contain 80 character and 1 character contain 8 bits.

**Formula:** No. of Pages x No. of Lines x No. of Character x No. of Bits

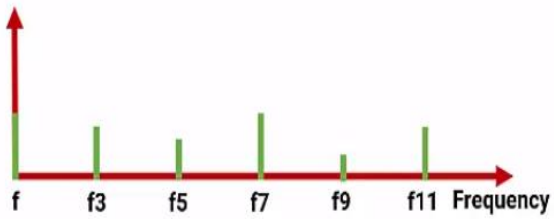
= 100 x 24 x 80 x 8 = 1.536 Mbps

## Digital Signals as Composite Analog Signal

- A method is used for converting the digital signals into composite analog signals that is Fourier Analysis. It has infinite Bandwidth.
- Vertical line in the time domain: Frequency of infinity
- Horizontal line in the time domain: Frequency of zero




Time Domain Plot




Frequency Domain Plot