Data and Signals

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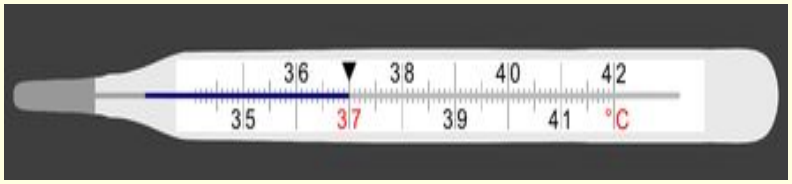
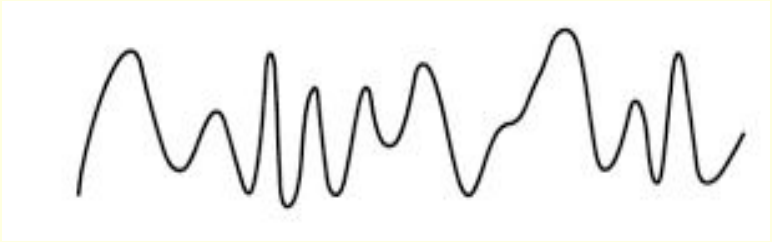
Data and Signal : Analog and Digital

Analog Data



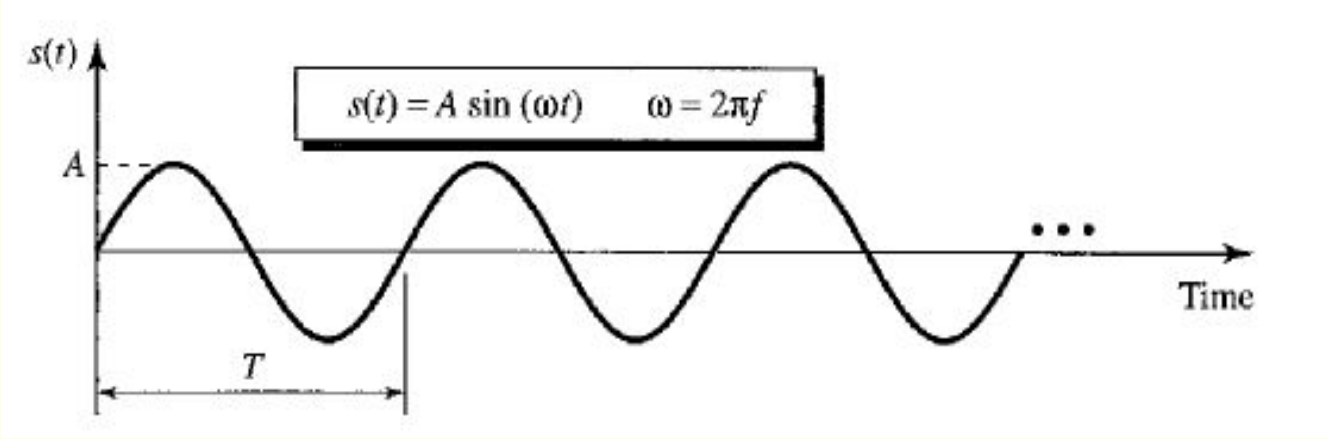
Digital Data

Analog Signal



Digital Signal

Simple Periodic Signal



s(t) □ Instantaneous Amplitude

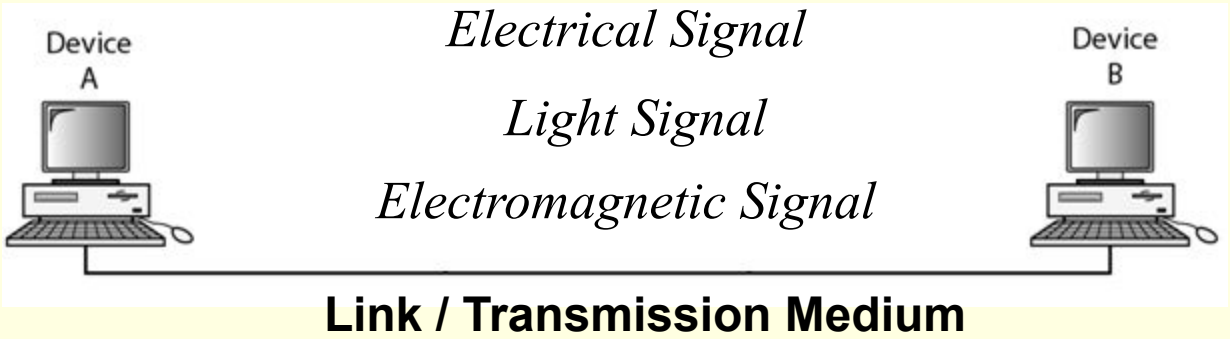
A □ Peak Amplitude

T □ Period (time needed to complete 1 cycle)

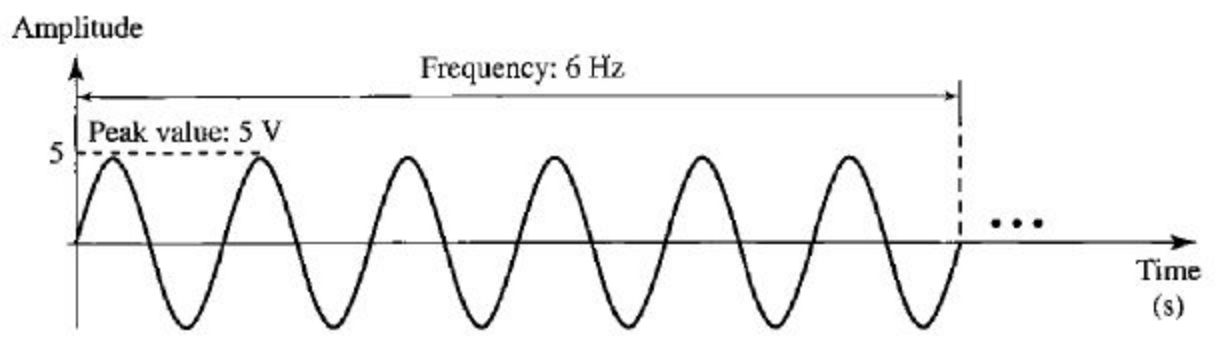
f □ Frequency (no. of cycles per second(Hz))

w = 2pf □ Angular/Radian Frequency

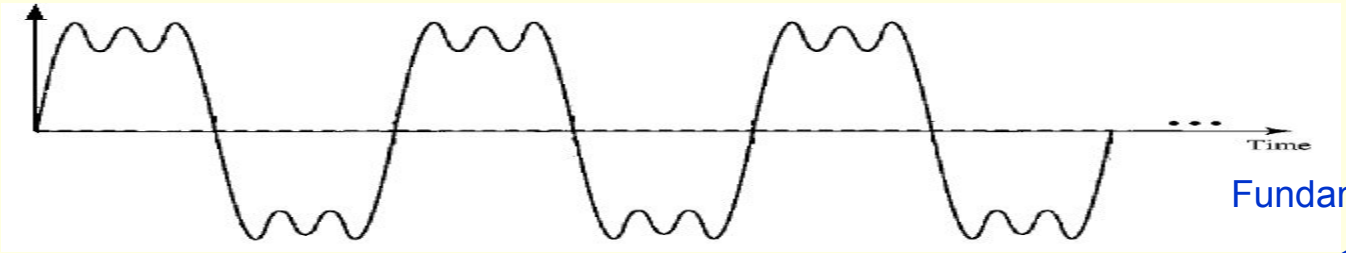
Types of Signal



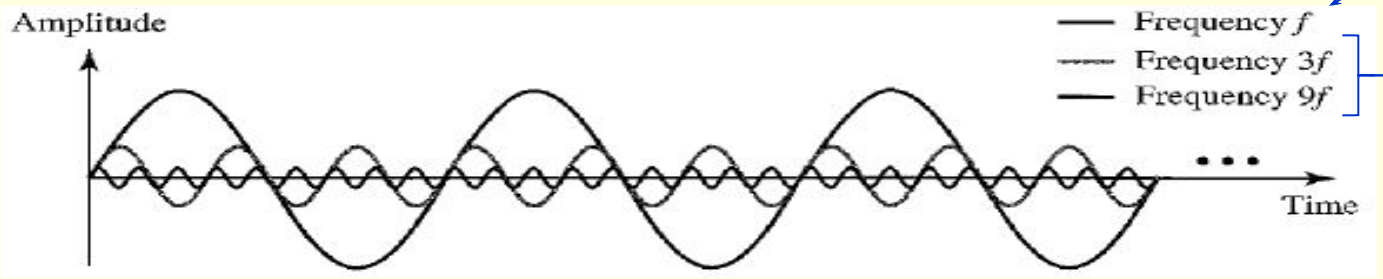
Time Domain *vs* Frequency Domain



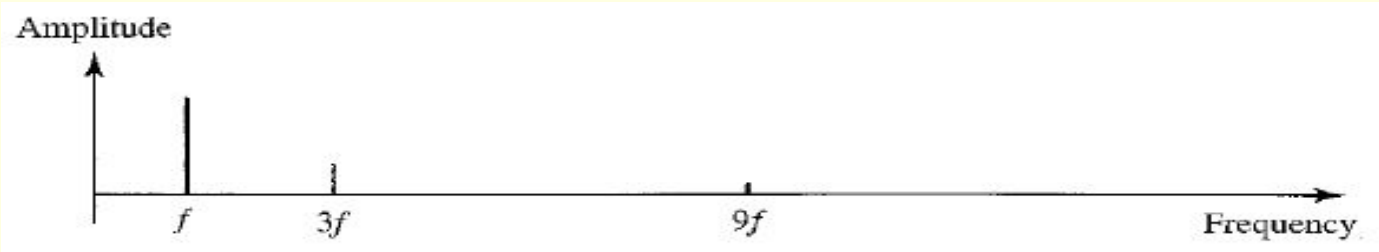
Composite Periodic Signal



Fundamental Frequency



Harmonics



Bandwidth ***of a composite signal is the difference between the highest frequency and the lowest frequency contained in the composite signal***

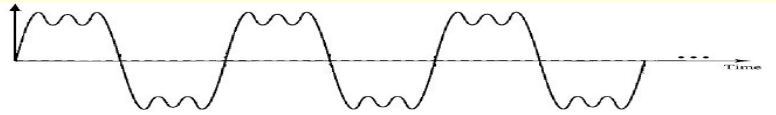
Spectrum ***of a composite signal is the set of frequencies contained in it.***

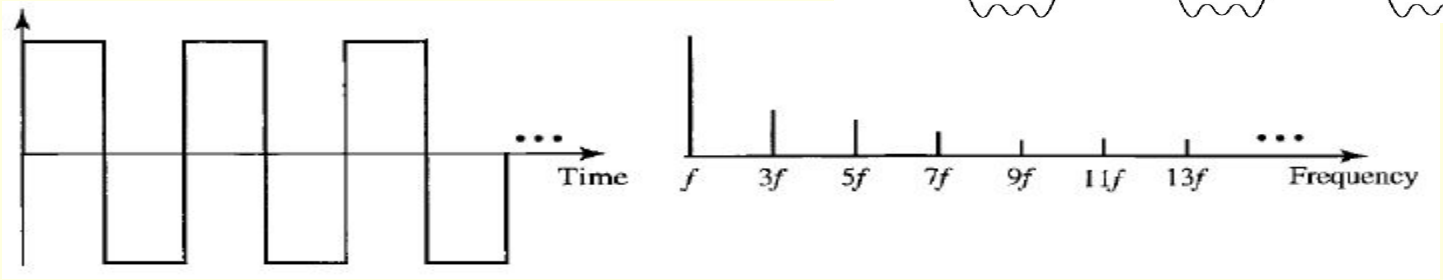
Fourier Analysis of a Composite Signal

$$g(t) = \frac{1}{2}c + \sum_{n=1}^{\infty} a_n \sin(2\pi nft) + \sum_{n=1}^{\infty} b_n \cos(2\pi nft)$$

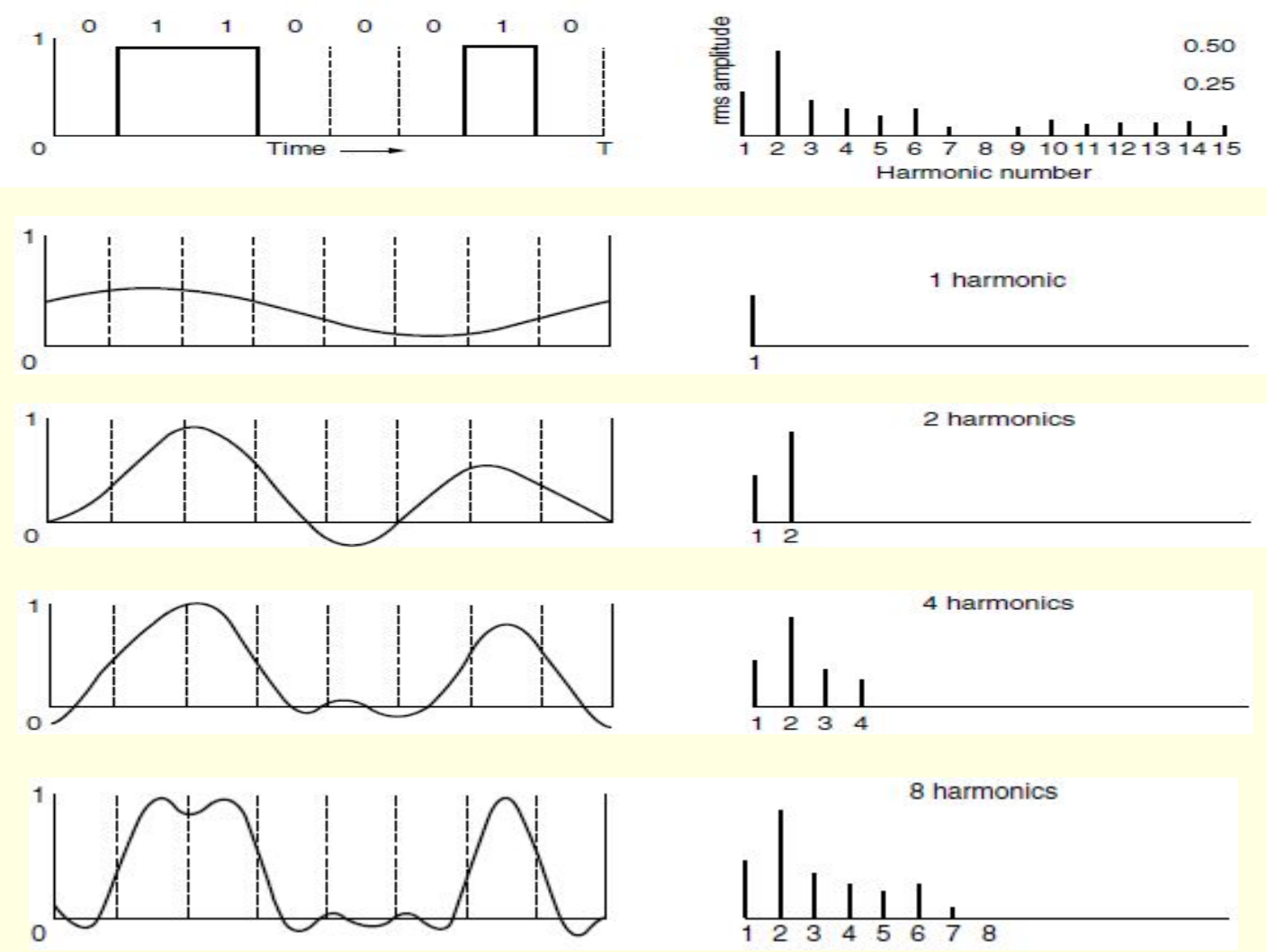
$$a_n = \frac{2}{T}\int_0^T g(t)\sin(2\pi nft)\,dt \qquad b_n = \frac{2}{T}\int_0^T g(t)\cos(2\pi nft)\,dt \qquad c = \frac{2}{T}\int_0^T g(t)\,dt$$

- A composite periodic signal with period T (frequency f) can be decomposed into an infinite series of sine and cosine functions in which each function is an integral harmonic of the fundamental frequency f.
- Fourier Analysis changes a time-domain signal to a frequency-domain signal and vice versa
- Digital Signal is a Composite Signal





Transmission of Digital Signal



Relation between Data Rate and No. of Harmonics

Given a Data Rate of b bits/second over a telephone line with $f_c = 3000Hz$

$$T = 8/b \quad and \quad f = 1/T$$

$$n.f <= f_c$$

Bps	T (msec)	First harmonic (Hz)	# Harmonics sent
300	26.67	37.5	80
600	13.33	75	40
1200	6.67	150	20
2400	3.33	300	10
4800	1.67	600	5
9600	0.83	1200	2
19200	0.42	2400	1
38400	0.21	4800	0