4 impairments

* Bandwith
* Attenuation
* Noise
* Interferance.

Eternal Signal is a signal that stay last forever in time.
Transient Signal is a signal that stay finite time.

Energy is the amount of energy that signal decipate when send throygh a 1 Ω resistor.

$$E = \int_{-\infty}^{\infty} s^2(t)\, dt$$

Power for a periodic Signal,

$$P = \frac{1}{T} \int_{-T/2}^{T/2} s^2(t)\, dt$$

For a aperiodic Signal,

$$P = \lim_{T \to \infty} \frac{1}{T} \int_{-T/2}^{T/2} s^2(t)\, dt$$

Calculate the avg power in $A \cos \omega t$.

$$P = \frac{1}{T}\int_{-T/2}^{T/2} S^2(t)\, dt$$

$$P = \frac{A^2}{T}\int_{-T/2}^{T/2} \cos^2 \omega t\, dt. = \frac{A^2}{T}\int_{-T/2}^{T/2} \frac{\cos 2\omega t + 1}{2}\, dt$$

$$= \frac{A^2}{2T}\left[t + \frac{\sin 2\omega t}{2\omega}\right]_{-T/2}^{T/2} = \frac{A^2}{2T}\left[T/2 + \frac{\sin 2\omega T/2}{2\omega} + T/2 - \frac{\sin 2\omega T/2}{2\omega}\right].$$

$$= \frac{A^2}{T}\int_0^T A^2 \cos^2 \omega t\, dt.$$

$$= \frac{A^2}{2T}\int_0^T \cos 2\omega t + 1\, dt =$$

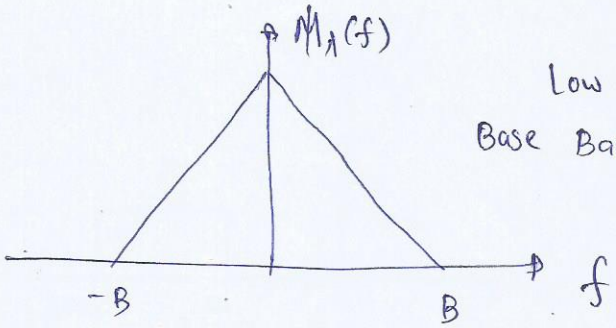
$$= \frac{A^2}{2T}\left[0 + \int_0^T \cos 2\omega t + \int_0^T dt\right]$$

$$= \frac{A^2}{2T}\left[0 + [T]_0^T\right] = \frac{A^2}{2T}[T-0]$$

$$= \frac{A^2}{2}$$

Deterministic – Any point of time we can exactly say the value of the Signal.

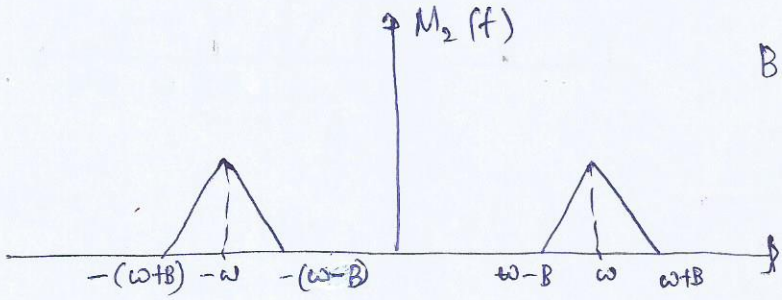
Random – At a given time we can say the value of the signal as a propability.



Low Pass Signal / Base Band Signal

Base Band Signal – A Signal comprised of frequency components close to zero.

eg:- Voice



Band Pass Signal.

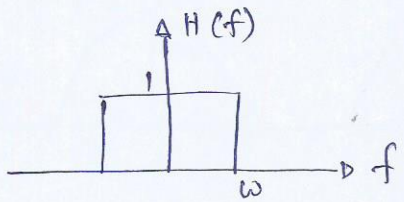
Band Pass Signal – A Signal consisting of frequency component around a value ω,

where $\omega \gg 0$

Filters

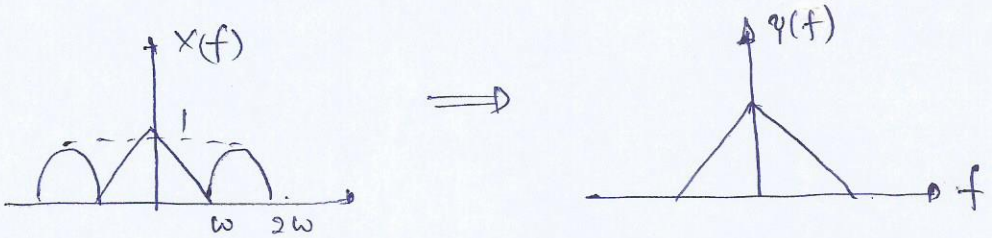
1) Lowpass

eg:

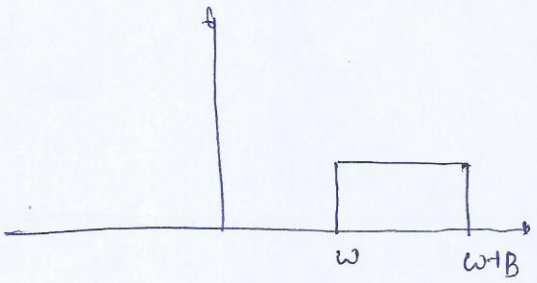


$$Y(f) = X(f) \times H(f)$$

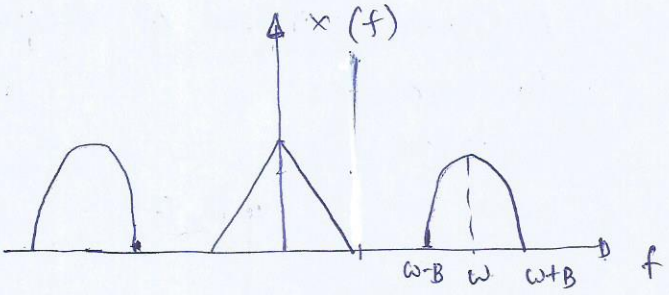
eg:

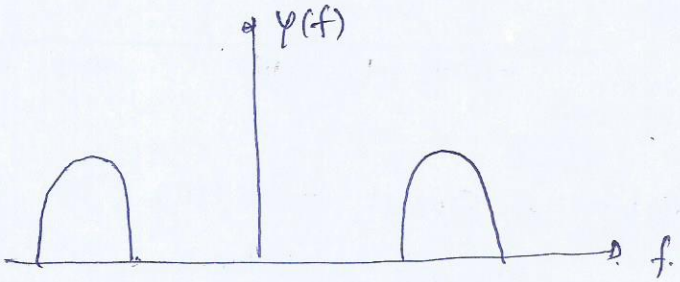


2) Band Pass



eg:





Using filters, you can separate signals,

$$y(t) = x_1(t) + x_2(t) + x_3(t)$$

eg: