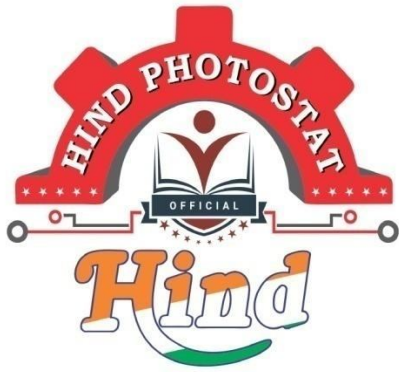




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MADE EASY ELECTRONICS ENGINEERING Communication System By-Reddy Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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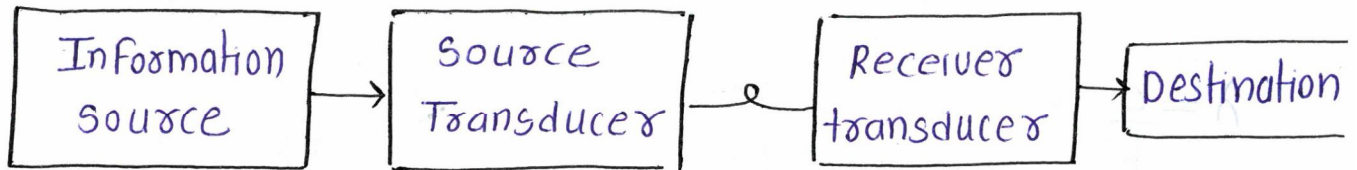
Courier Facility All Over India
(DTDC & INDIA POST)
Mob-9311989030

Date:- 23-06-2026

* Communication:-

It is the process of transmitting information from one place to another

Block diagram of communication system (Basic):-



~~Video~~ Voice signal $\rightarrow 300\text{Hz} - 3.5\text{kHz}$

Audio signal $\rightarrow 20\text{Hz} - 20\text{kHz}$

Video signal $\rightarrow 0 - 4.5\text{MHz}$

* Information source: it is a source of information

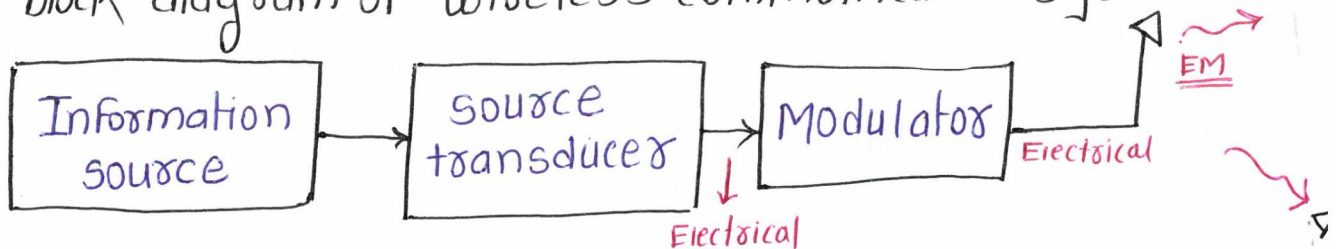
* Source Transducer:- It converts physical signal into electrical equivalent

E.x: Mic

* Receiver Transducer:- It converts electrical signal into physical equivalent

Ex: Loud speaker

* Block diagram of wireless communication system



Generally without Modulation long distance communication through Free space not possible

* Need for Modulation :-

① Reducing Antenna height :-

$$\lambda = \frac{c}{f}$$

$$h = \frac{c}{4f}$$

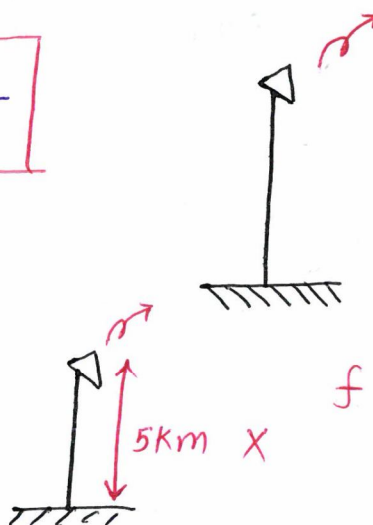
$$h_t = \frac{\lambda}{4}$$

∴ $f = 15 \text{ kHz}$

$$h_t = \frac{3 \times 10^8}{4 \times 15 \times 10^3}$$

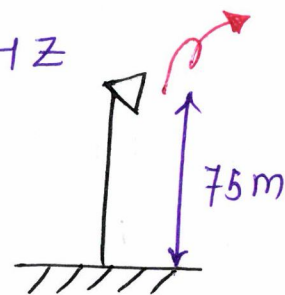
$$h_t = 5 \text{ km}$$

→ it is not possible to construct the height of antenna



15 kHz → Modulator → 1 MHz

$$h_t = \frac{3 \times 10^8}{4 \times 10^6} = 75 \text{ m}$$



→ For Faith. full radiation of a signal antenna height should be at least, of $\frac{\lambda}{4}$

Note:

→ Modulation is the process of increasing freqⁿ of the sig to reduce antenna height requirement

② Multiplexing:-

↳ It is the process of transmitting many no. of signals together through a common channel

↳ Generally without Modulation Multiplexing is not possible

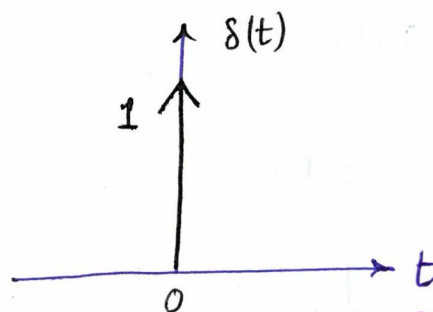
* Basic signals:-

① Unit Impulse Function:-

$$\delta(t) = \infty ; t = 0$$

$$0 ; t \neq 0$$

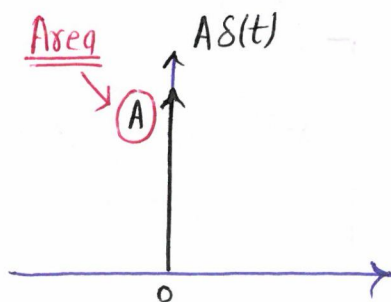
$$\int_{-\infty}^{\infty} \delta(t) dt = 1$$



$$A\delta(t) = \infty ; t = 0$$

$$0 ; t \neq 0$$

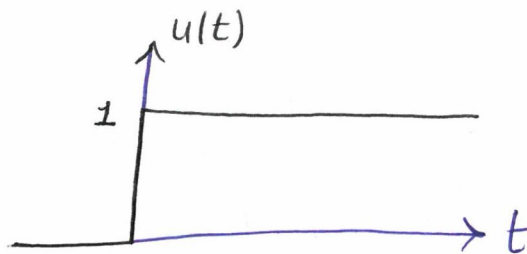
$$\int_{-\infty}^{\infty} A\delta(t) dt = A$$



② Unit Step Function:-

$$u(t) = 1 ; t \geq 0$$

$$= 0 ; t < 0$$

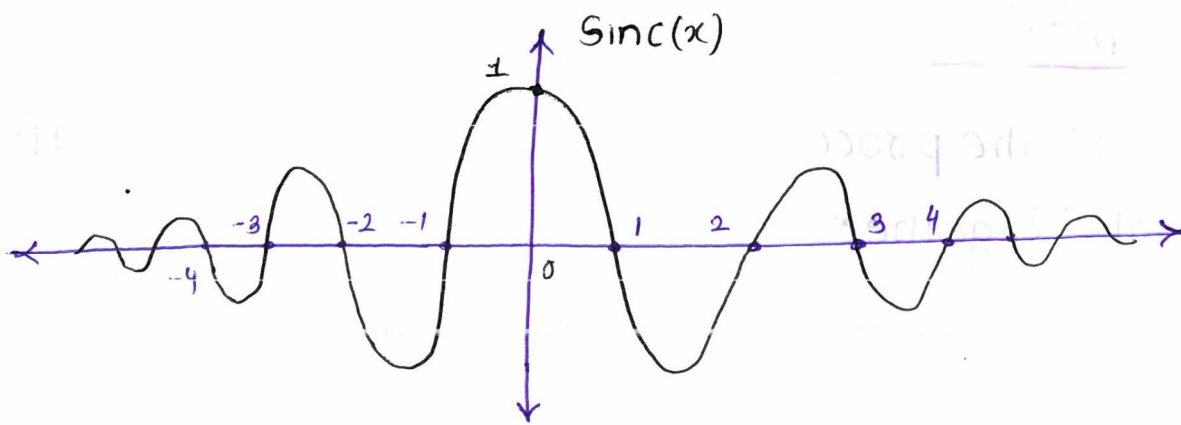


③ Sinc Function:-

$$\text{sinc}(x) = \frac{\sin(\pi x)}{\pi x}$$

$$1 ; x = 0$$

$$0 ; x = \pm 1, \pm 2, \pm 3, \dots$$



④ $\text{Sa}(x)$

$$\text{Sa}(x) = \frac{\sin x}{x}$$

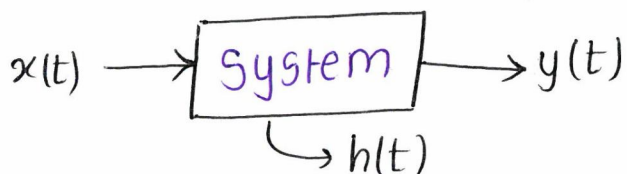
$$\text{Sinc}(x) = \text{Sa}(\pi x)$$

* Fourier transform :-

$$x(t) \longleftrightarrow x(f)$$

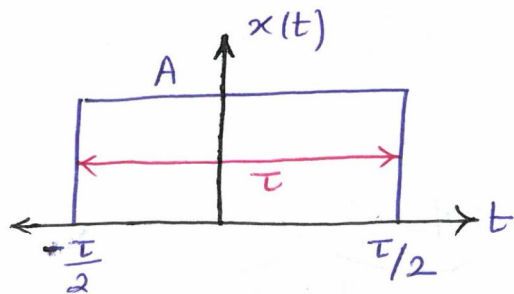
$$x(f) = \int_{-\infty}^{\infty} x(t) e^{-j2\pi ft} dt$$

↳ Fourier transform is basically used to Find Frequency present in the given time domain Signal



$$y(t) = x(t) * h(t)$$

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



$$X(f) = \int_{-\tau/2}^{\tau/2} A e^{-j2\pi f t} dt$$

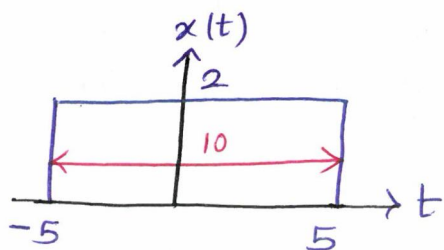
$$X(f) = \left[\frac{A e^{-j2\pi f t}}{-j2\pi f} \right]_{-\tau/2}^{\tau/2}$$

$$X(f) = \frac{A}{-j2\pi f} \left[e^{-j\pi f \tau} - e^{j\pi f \tau} \right]$$

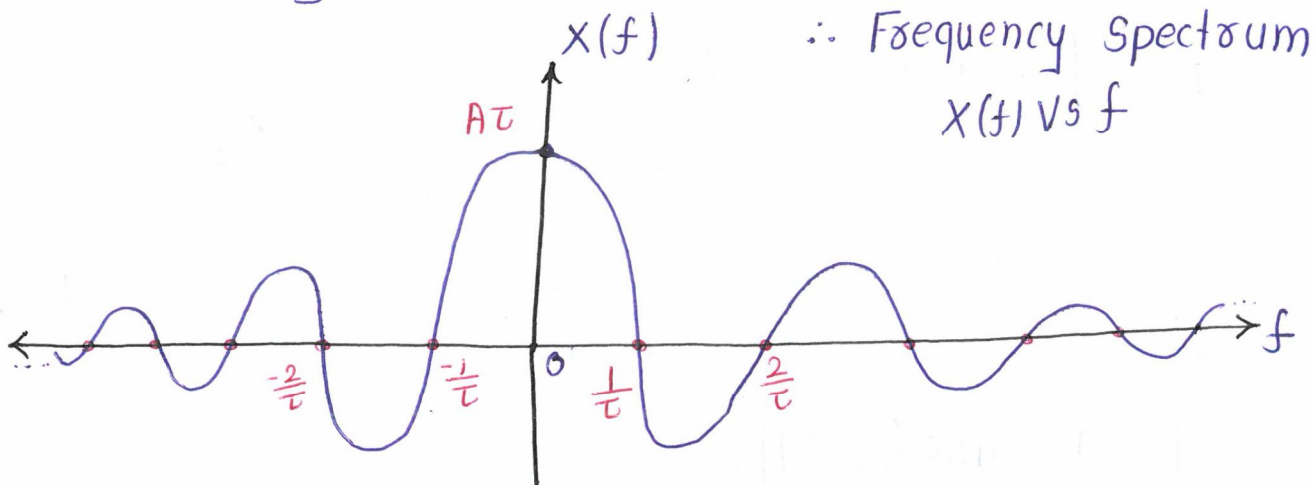
$$\boxed{X(f) = A\tau \operatorname{sinc}(f\tau)}$$

or

$$A\tau \operatorname{sinc}\left(\frac{\omega\tau}{2}\right)$$



$$\xleftrightarrow{F.T} 20 \operatorname{sinc}(10f)$$



↳ Negative Freqn is not important for practical existence it is importance of Mathematically

$$\boxed{\begin{array}{l} \text{Signal} \\ \text{Bandwidth} \end{array} = [\text{Highest +ve Freqn}] - [\text{Lowest +ve Freqn}]}$$

* Signal B.W is not exist for time domain it is exist for Frequency domain

$$\text{Signal B.W} = \infty - 0 = \infty$$

$$\begin{array}{c} 0-100\text{Hz} \\ \text{---} \\ 0-120\text{Hz} \end{array}$$

- Co-axial cable $\rightarrow 0-600\text{MHz}$
- Parallel wire $\rightarrow 0-200\text{kHz}$
- Foc $\rightarrow \text{GHz} = 1\text{GHz} = 10^9\text{Hz}$
(Fiber optic cable)

channel Band width (CB) _{min}	$\geq$	Signal Band width SB
--	--------	----------------------

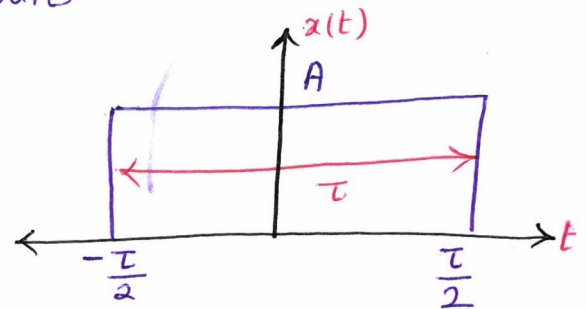
→ For proper transmission of above signal, channel Bandwidth of ∞ is required but bandwidth offer by every practical channel will be finite only so that before transmission it should be Bandlimit

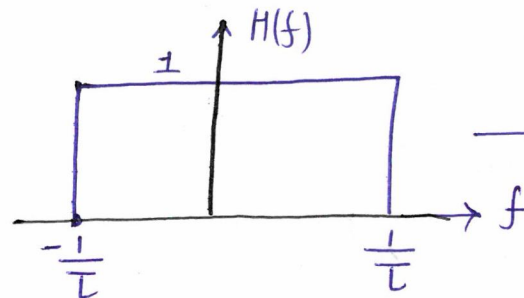
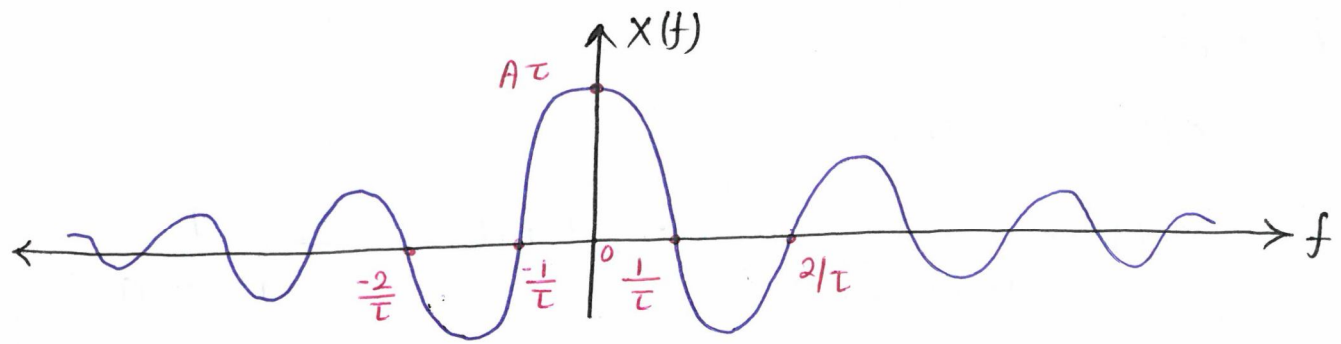
$$E = \int_{-\infty}^{\infty} x^2(t) dt = A^2 \tau \text{ Joule}$$

$$= \int_{-\infty}^{\infty} |x(f)|^2 df$$

$$\int_{-f_0}^{f_0} |A\tau \text{sinc}(f\tau)|^2 df = 0.99 A^2 \tau$$

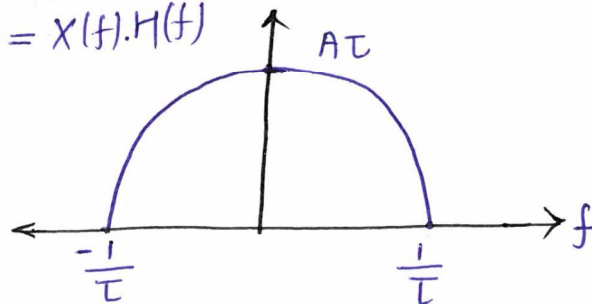
$$f_0 \approx \frac{1}{\tau}$$





→ Low pass Filter

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

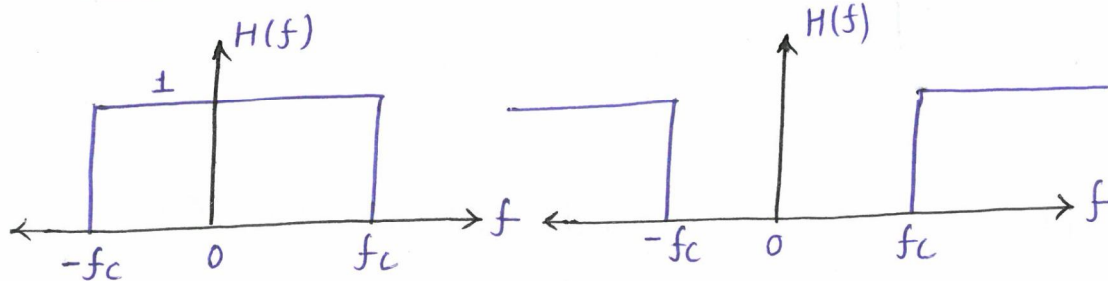


$$Bw = \frac{1}{\tau} \text{ Hz}$$

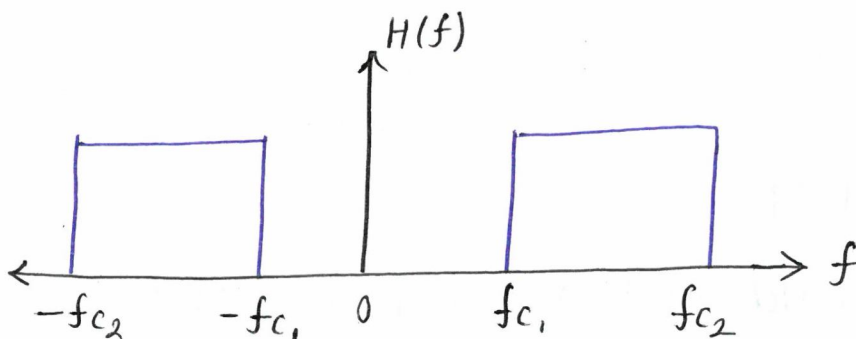
* Filters :-

1) LPF :-

2) HPF



3) BPF :-



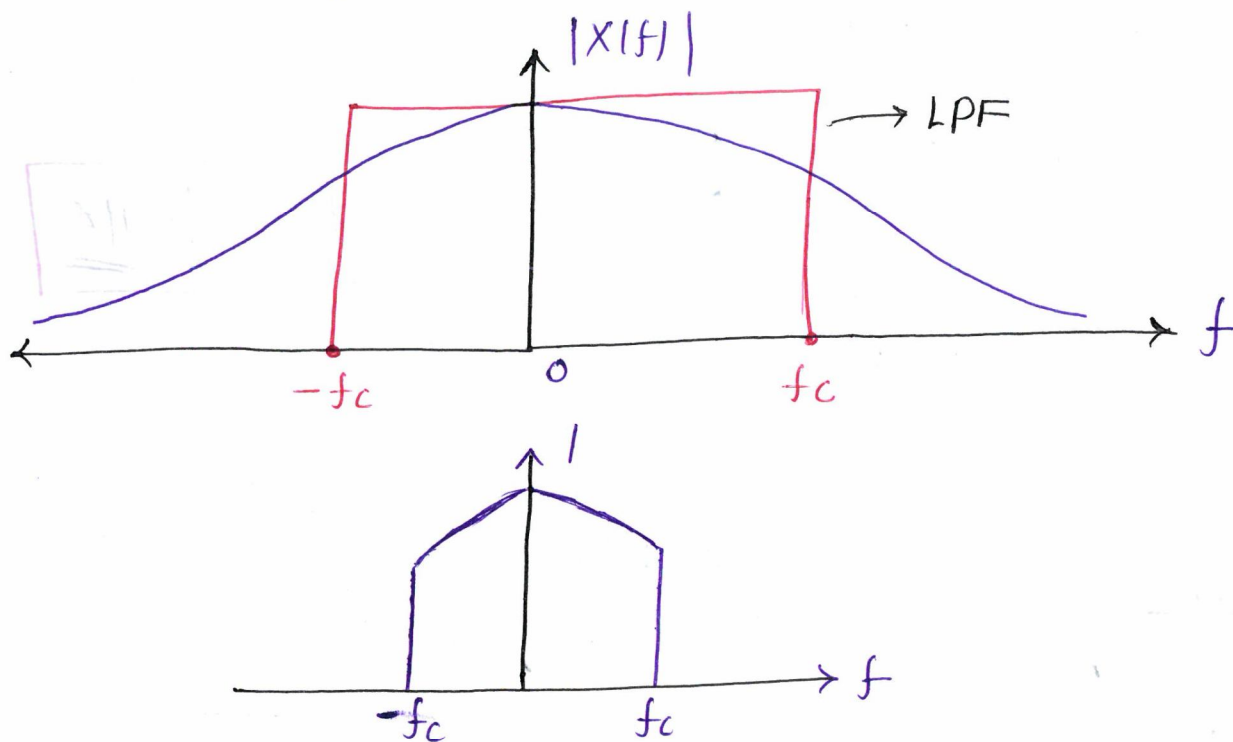
Example :-

$$x(t) = e^{-t} u(t)$$

$$X(f) = \frac{1}{j2\pi f + 1}$$

$$\therefore e^{-at} u(t) \longleftrightarrow \frac{1}{j\omega + a}$$

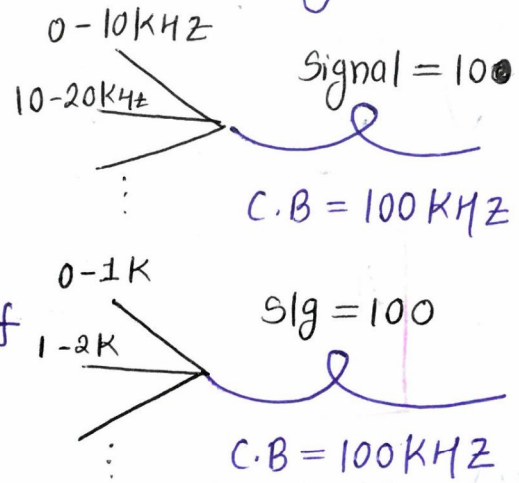
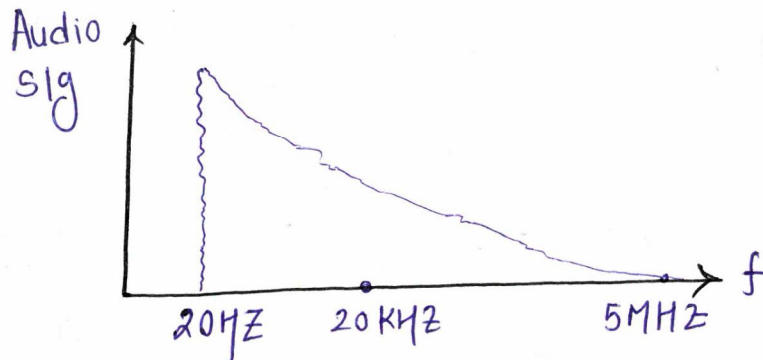
$$|X(f)| = \frac{1}{\sqrt{(2\pi f)^2 + 1}}$$



- ↳ To Bandlimit a signal significant frequencies should be retained and insignificant frequencies should be eliminated
- ↳ significant freqn contains 95% to 99% of total strength of signal
- ↳ Generally to Band limit a signal proper LPF will be used

* Audio signal :-

↳ To multiplex many no. of signals through given channel, before transmission bandlimiting has to be done



* Modulation properties :-

$$\text{If } x(t) \longleftrightarrow X(f)$$

then

$$x(t) \cos 2\pi f_0 t \longleftrightarrow \frac{X(f-f_0) + X(f+f_0)}{2}$$

(right)

Delay

(left)

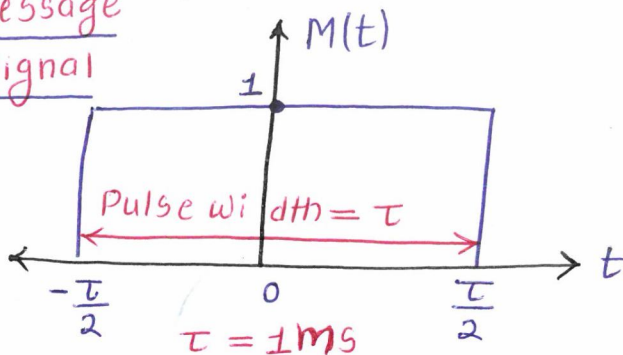
advance

* Concept of Modulation :-

(Modulating sig)

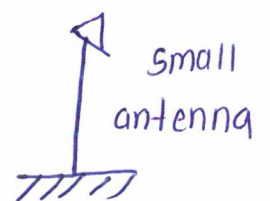
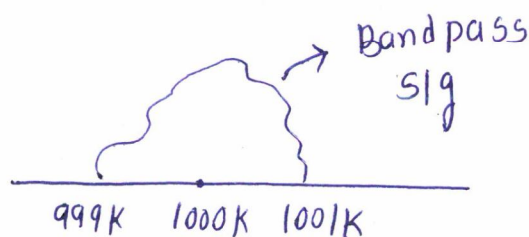
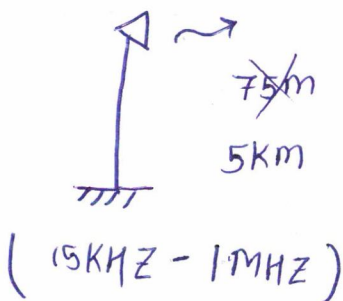
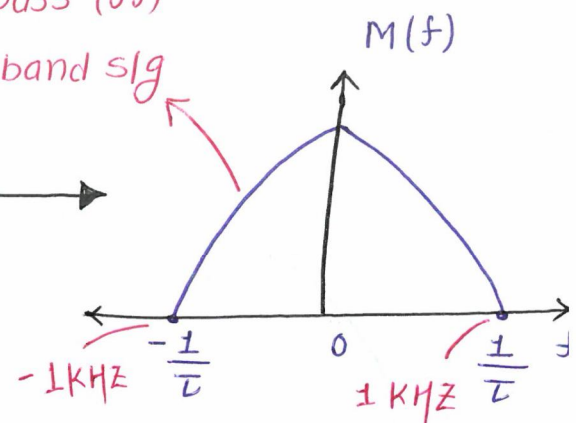
Message

Signal

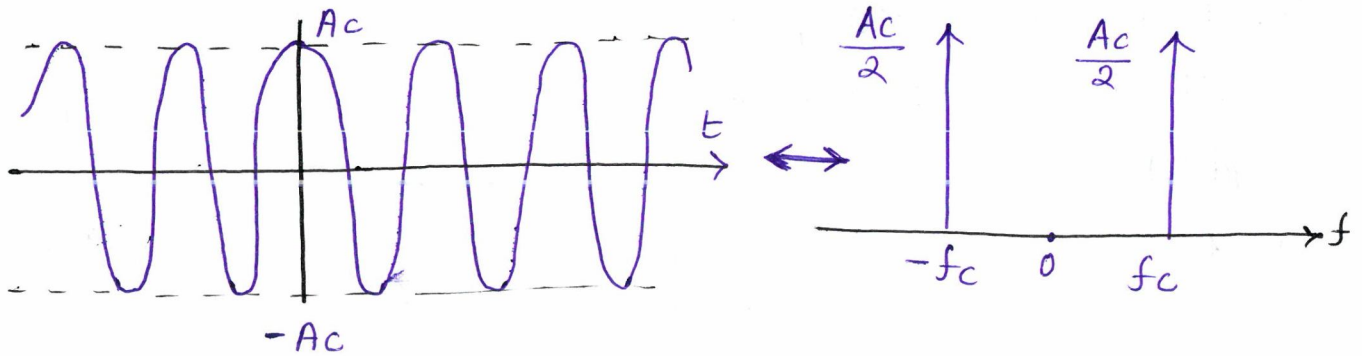


Low pass (or)

Base band sig



$$c(t) = A_c \cos 2\pi f_c t ; f_c = 1\text{MHz}$$

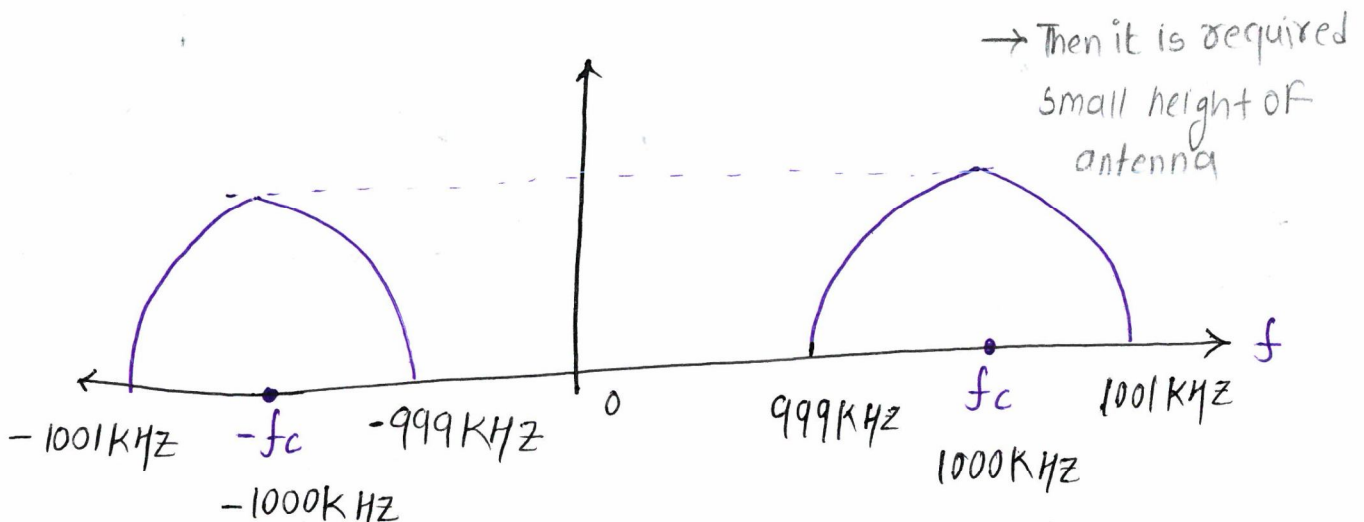
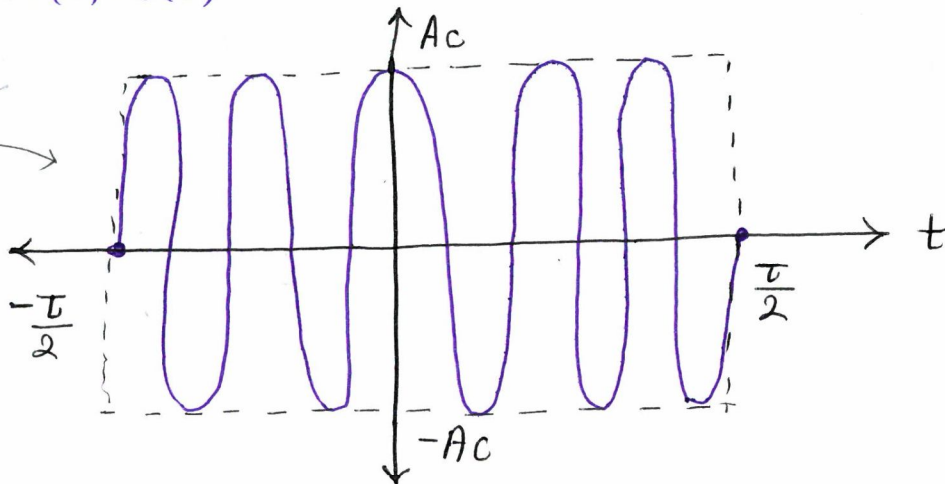


$$A_c \cos 2\pi f_c t \longleftrightarrow \frac{A_c}{2} [\delta(f - f_c) + \delta(f + f_c)]$$

$$s(t) = M(t) \cdot c(t)$$

↓
Modulated sig

This signal has
which filter
then draw
freqn
spectrum
then consider
which type of
filter



$$m(t) \cos 2\pi f_c t \longleftrightarrow \frac{M(f - f_c) + M(f + f_c)}{2}$$

↳ By ^{performing} Modulation Low pass signal becomes Band pass signal

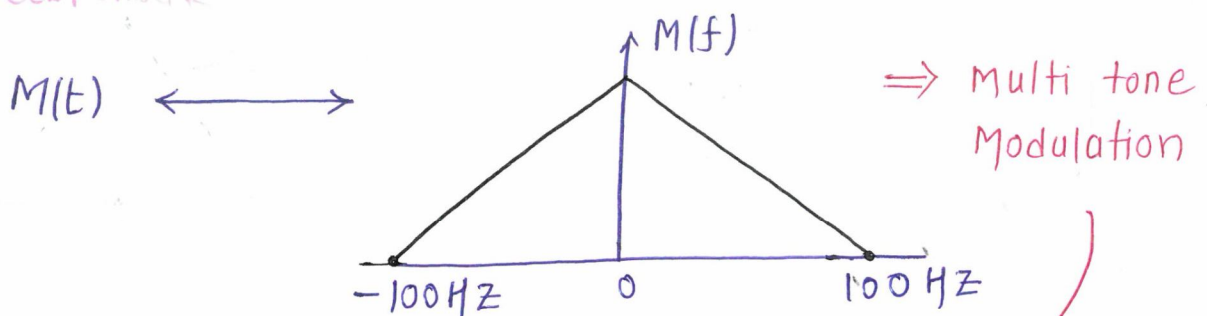
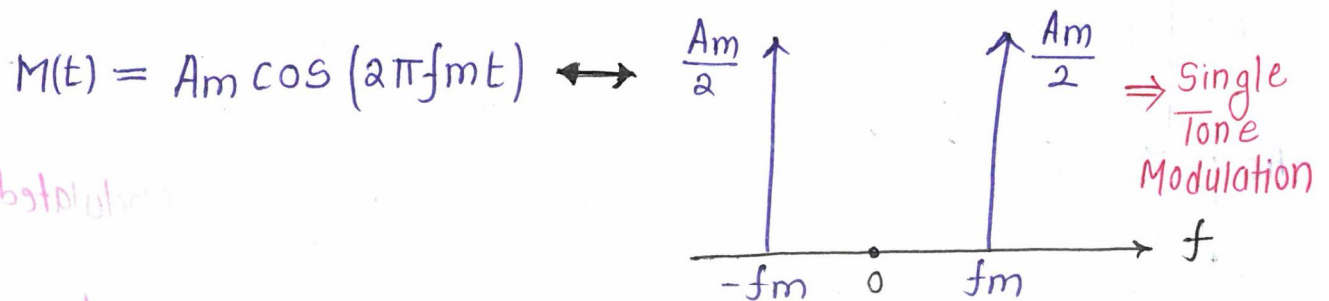
* Demodulation:

It is the process of recovering original Message sig from transmitted Modulated Signal

* Types of Modulation:-

① Single tone Modulation $\rightarrow M(t)$ having Single freq

② Multi tone Modulation $\rightarrow M(t)$ having Multiple freq
(frequency)

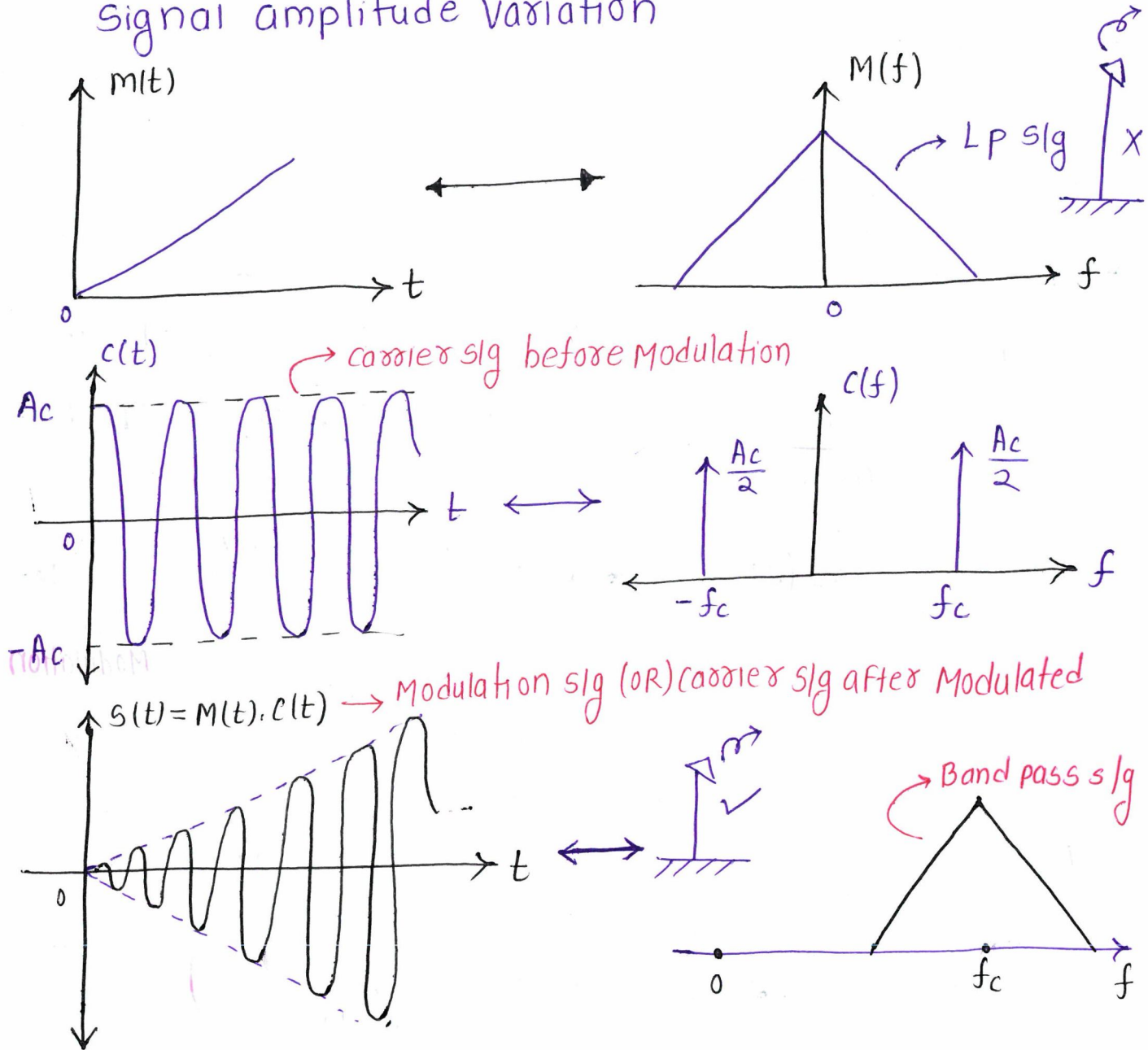


(OR)

$$M(t) = A_{m1} \cos(2\pi f_{m1} t) + A_{m2} \cos(2\pi f_{m2} t)$$

* Definition of Modulation :-

↳ It is the process in which one of parameters that is Amplitude, Frequency or phase of the carrier signal varies according to Message signal amplitude variation



* ~~Amplitude Modulation~~ :-

↳