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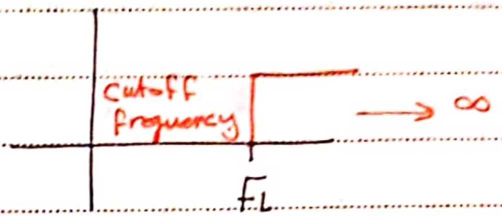
HPF (High pass filter) :-

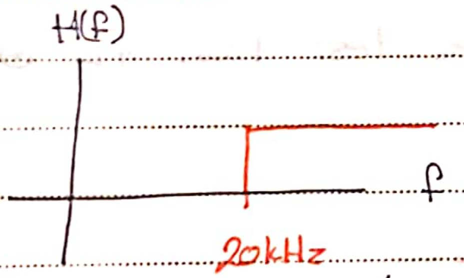
it lets any signal with frequency $(f > f_L)$ to pass through this filter.



Ex :- let we have a HPF with Cutoff frequency $(f_L = 20\ kHz)$ determine which signals Can pass through this filter :-

1) $X(t) = 2 \cos(30k\pi t)$.
2) $y(t) = 4 \sin(50\pi t)$.
3) $Z(t) = \sin^2(15k\pi t)$.

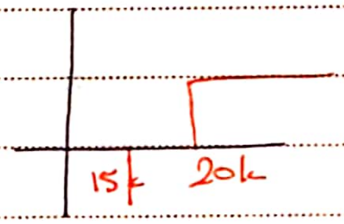
Solution :-



1) $X(t) = 2 \cos(2\pi(15000)t)$.

*) this signal Can't pass through the filter

$f = 15\ kHz < f_L$



2) $y(t) = 4 \sin(2\pi(25000)t)$ (في الامتحان نوضح السبب)

$f > f_L$

the HPF Can accept the signal.

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3) $z(t) = \sin^2(15k\pi t)$

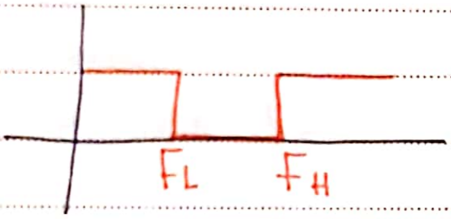
$$= \frac{1}{2} + \frac{1}{2}\sin(30k\pi t)$$

$$= \frac{1}{2} + \frac{1}{2}\sin(2\pi(15000)t).$$

$\therefore f = 15\ kHz \rightarrow F < F_L \rightarrow$ this filter reject this signal.

BSF (Band Stop filter) :-

* يمرر جميع الاشارات ما عدا التي ترددها بين f_L, f_H .



* it pass all signals with frequencies less than F_L or higher than F_H.

$f_L < f < f_H \longrightarrow$ X Can't pass.

* * *

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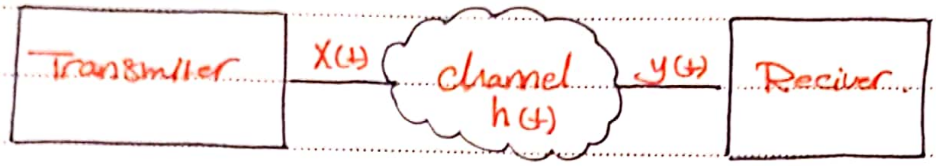
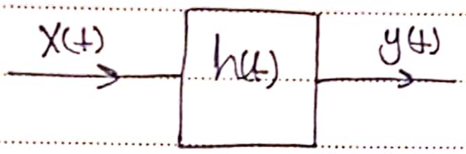
Transmission through linear system :-





$\therefore \; y(t) = X(t) \overset{\text{convolution}}{*} h(t)$

↳ by using fourier transform $\Rightarrow Y(f) = H(f) \cdot X(f)$.

$h(t) = \underset{\downarrow}{A}\, \delta(t - t_o)$.

* A represent the attenuation factor.

* $(t-t_o) \rightarrow$ to represent that the signal need time to propogate from transmitter to reciver.

* كلما زادت المسافة بين المرسل والمستقبل تقل ال received power

$Pr \propto \dfrac{1}{d^n}$ $\quad n :- 2 \rightarrow 6 \rightarrow$ كلما زادت n تقل الاشارة

سيء

Pr :- recived power.

d^n :- distance between a transmiter and a destination.

∴ As the distance (between transmitter increasing) the attenuation factor increasing and so the signal decrease.

$Y(f) = H(f) \cdot X(f) \rightarrow h(t) = A\,\delta(t-t_o)$

$\therefore H(f) = A e^{-j2\pi f t_o}$

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

$\therefore |H(f)| = \sqrt{(H(f))(H(f))^*}$

$= |A|\,|X(f)|$.

$= \sqrt{A \cancel{e^{-j2\pi f t_o}} \cdot A \cancel{e^{j2\pi f t_o}}}$

$= \sqrt{A^2} = |A|$

Signal Energy :-

$$E_x = \int_{-\infty}^{\infty} |x(t)|^2\,dt = \int_{-\infty}^{\infty} |X(f)|^2\,df.$$

$\rightarrow X(f)$ is the fourier transform of $x(t)$.

E_x ↓ energy contained in a signal x.

* Energy spectral density (ESD) :-

$\Psi_x(f) = |X(f)|^2$

↳ How the signal's energy looks like in frequency domain.

$$E_x = \int_{-\infty}^{\infty} \Psi_x(f)\,df$$

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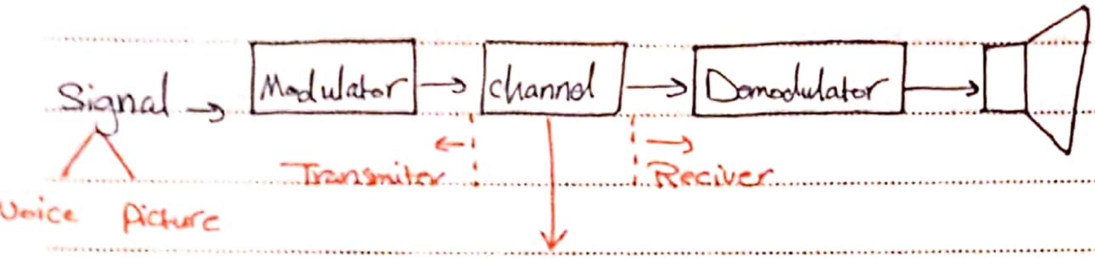
$$Y(f) = H(f) \cdot X(f).$$

$$|Y(f)|^2 = |H(f)|^2 \cdot \underbrace{|X(f)|^2}_{\text{ESD @ channel input.}}$$

$$\underbrace{\Psi_y(f)}_{\text{ESD @ the reciver output.}} = |H(f)|^2 \, \Psi_x(f).$$

Amplitude Modulation (AM) :-



medum between a given transmiter and its receiver.

* Modulation :- process that we use such that we Can easily transmit and receive a signal.

* تسهيل عملية نقل المعلومات واستقبالها.

* in analog Communication two main kinds of modulation are available :-

1) Amplitude modulation (AM) :- 540 kHz → 1600 kHz
2) Frequency modulation (FM) :- 88 MHz → 108 MHz.

* We need three parameters to represent a sinosoidal signal :-
1- amplitude 2- Frequency 3- phase.

$$X(t) = \underbrace{A}_{\text{amplitude}} \cos(\underbrace{2\pi f t}_{\text{Frequency}} + \underbrace{\phi}_{\text{phase}})$$

amplitude	Frequency	phase
by varying the amplitude of Signal ↓ amplitude modulation	by varying the frequency of a signal ↓ Frequency modulation	by varying the phase ↓ phase modulation.

* why to modulate signal ?!

1) to reduce the effective length of the used antennas.

effective of antenna in wireless Communication :-

$$L = \frac{\lambda}{2}$$

$$\lambda = \frac{c}{f} \longrightarrow$$ C : speed of light in free space.

$$C = 3*10^8$$

(without modulation)

* تردد صوت الانسان اكبر من 3.4kHz .

$\therefore$ let $f = 3\ kHz \longrightarrow \lambda = \frac{3*10^8}{3*10^3} = 1*10^5\ m$

← في هذه الحالة نحتاج 2 antenna طولها 100 km

* by using modulation, the Voice Signal with (3kHz) is Carried by another Signal Such that the Carrier Signal has a frequency between 540 kHz → 1600 Hz in AM.

or 88 MHz → 108 MHz in FM.

AM Signal with $f = 1\ MHz \longrightarrow \lambda = \frac{3*10^8}{1*10^6} = 300m \longrightarrow L = 150\ m.$

يستخدم انتينات طويلة .

FM Signal with $f = 100\ MHz \longrightarrow \lambda = \frac{3*10^8}{1*10^8} = 3\ m \longrightarrow L = 1.5\ m.$

يستخدم انتينات صغيرة -

* why ~~the~~ to modulate a signal ?

1) to reduce the effective length of the used antennas.

2) to allocate a unique frequency range for each application.

AM :- 540 kHz → 1600 kHz.

FM :- 88 MHz → 108 MHz.

T.V :- 52 MHz → 88 MHz.

mobile Communication :- 900 MHz

1800 MHz.

2100 MHz.

* كلما زادت ال frequency بيقل طول ال antenna.