INU PESH

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Course => Analog and Digital Communication.

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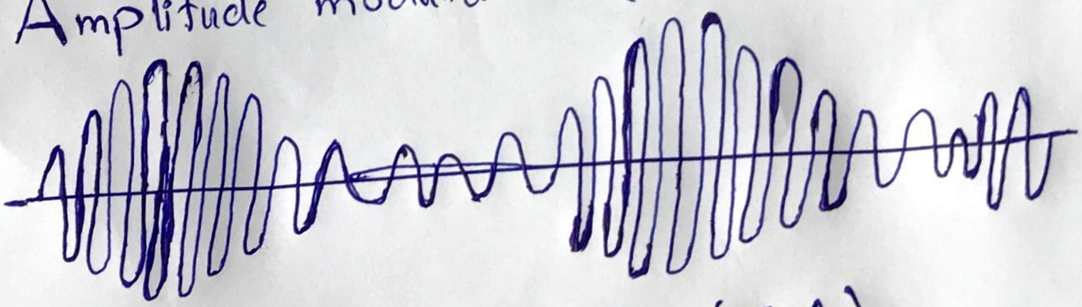
Q#1:-

PART a):- Differentiate between Amplitude modulation and frequency Modulation with example?

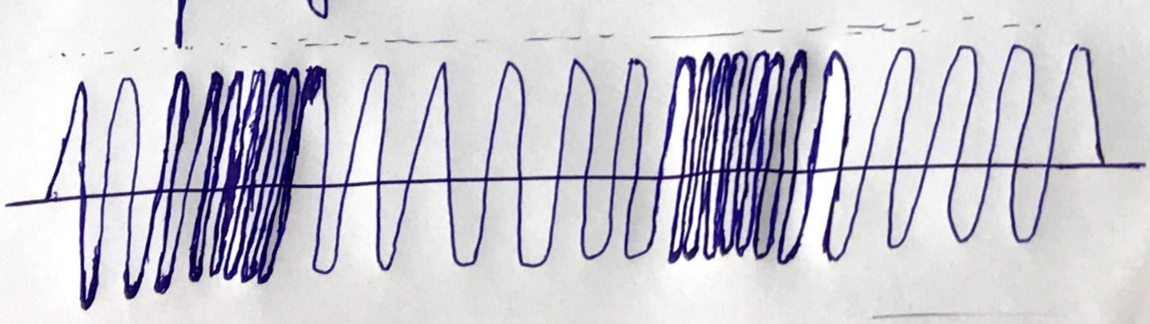
Answer:- Amplitude modulation and frequency modulation are used to transmit data using the method of modifying a Carrier Signal.

The main difference between both modulations is that in frequency modulation, the frequency of the Carrier wave is modified as per the transmit data, While in amplitude modulation, the Carrier wave is modified according data.

1:- Amplitude modulation (AM)



2:- Frequency modulation (FM)



Q# 1:

PART b): Differentiate between Signal and System and justify your answer with an example?

Answer: Differentiate between Signal and System:

A Signal is a description of how one parameter varies with another parameter. For instance, voltage changing ~~with~~ over tim in an electronic circuit, or brigthness varying with distance in an image.

A System is any process that produces an output signal in response to an input signal.

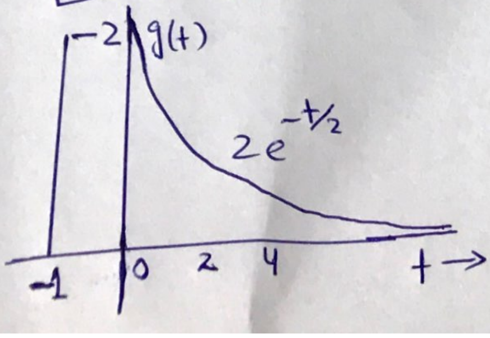
⇒ A signal is any time-varying quantity of information.

⇒ independent time variable t.
Only one-dimensional signals are considered here.

⇒ Signals are processed by system.

⇒ A System is composed of regularly interacting or interrelating groups of activities / Parts which, when taken together,

Example:



• The signal (c) $\rightarrow 0$ as $|t| \rightarrow \infty$ E_g

There fore, the suitable measures for this signal is its energy given by

$$E_g = \int_{-\infty}^{\infty} g^2(t)\,dt = \int_{-1}^{0} (2)^2\,dt + \int_{0}^{\infty} 4e^{-t}\,dt = 4+4 = 8$$

Q#2 :- Determine the Power and the rms value of

a). $g(t) = C \cos(\omega_0 t + \theta)$

b) $g(t) = C_1 \cos(\omega_1 t + \theta_1) + C_2 \cos(\omega_2 t + \theta_2)$

$\omega_1 \neq \omega_2$

c) $g(t) = D e^{j\omega_0 t}$

Answer :- $g(t) = C \cos(\omega_0 t + \theta)$

a). $$P_g = \lim_{T \to \alpha} \frac{1}{T} \int_{-T/2}^{T/2} C^2 \cos^2(\omega_0 t + \theta)\, dt$$

$$= \lim_{t \to \alpha} \frac{1}{T} \int_{-T/2}^{T/2} \frac{C^2}{C} \left[1 + \cos(2\omega_0 t + 2\theta)\right] dt$$

$$= \lim_{t \to \alpha} \frac{C^2}{2T} \int_{-T/2}^{T/2} dt + \lim_{t \to \alpha} \frac{C^2}{2T} \int_{-T/2}^{T/2} \cos(2\omega_0 t + 2\theta)\, dt$$

$$= \underbrace{\lim_{t \to \alpha} \frac{C^2}{2T} \int_{-T/2}^{T/2} dt}_{\frac{C^2}{2}} + \underbrace{\lim_{t \to \alpha} \frac{C^2}{2T} \int_{-T/2}^{T/2} \cos(2\omega_0 t + 2\theta)\, dt}_{0}$$

Remarks :

A sinosoid of ~~multiple~~ amplitude C has Power of $\frac{C^2}{2}$ regardless of its frequency ω_0 $(\omega_0 \neq 0)$ and phase θ.

PART b). $g(t) = C_1 \cos(\omega_1 t + \theta_1) + C_2 \cos(\omega_2 t + \theta_2)$

$\omega_1 \neq \omega_2$

$$P_g = \lim_{t \to \alpha} \frac{1}{T} \int_{-T/2}^{T/2} \left[C_1 \cos(\omega_1 t + \theta_1) + C_2 \cos(\omega_2 t + \theta_2)\right]^2 dt$$

$$= \lim_{t \to \alpha} \frac{1}{T} \int_{-T/2}^{T/2} C_1^2 \cos^2(\omega_1 t + \theta_1)\, dt$$

$$+ \lim_{t \to \alpha} \frac{1}{T} \int_{-T/2}^{T/2} C_2^2 \cos^2(\omega_2 t + \theta_2)\, dt$$

$$+ \lim_{t \to \alpha} \frac{2 C_1 C_2}{T} \int_{-T/2}^{T/2} \cos(\omega_1 t + \theta_1) \cos(\omega_2 t + \theta_2)\, dt$$

$$P_g = \frac{C_1^2}{2} + \frac{C_2^2}{2}$$

And rms value $P_g = \sqrt{\dfrac{C_1^2 + C_2^2}{2}}$

We Can extand this result to a Sum of any nnmber of Sinusoids with distinct frequencies.

$$g(t) = \sum_{n=1}^{\infty} C_n \cos(\omega_n t + \theta_n)$$

$$P_g = \frac{1}{2} \sum_{n=1}^{\infty} C_n^2$$

c). $g(t) = D e^{j\omega t}$

$$P_g = \frac{1}{T_0} \int_0^{T_0} \left| D e^{j\omega_0} \right|^2 dt$$

Recall that $\left| e^{j\omega_0} \right| = 1 \Rightarrow \left| D e^{j\omega_0} \right|^2 = |D|^2$

Therefore

$$P_g = \frac{|D|^2}{T_0} \int_0^{T_0} dt = |D|^2$$

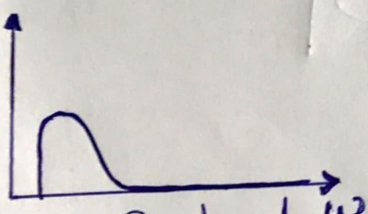
The rms value is $|D|$

Q# 3:

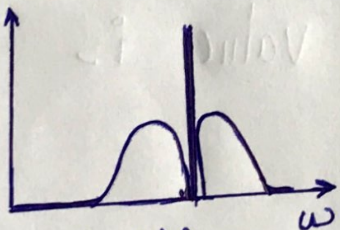
PART a):- Write your understanding on Demodulation of SSB-AM Signals?

Answer:- Demodulation : SSB-AM

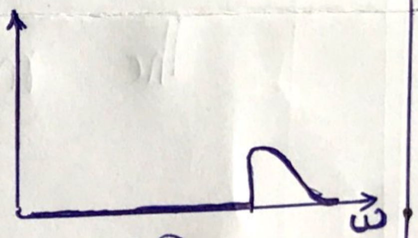
- The process of receiving the orignal Signal from the modulated Signal is called demodulation.
- Demodulation is similar to modulation and can be performed by multiplying the modulated Signal again with the Carrier Signal $(\omega_c t)$.



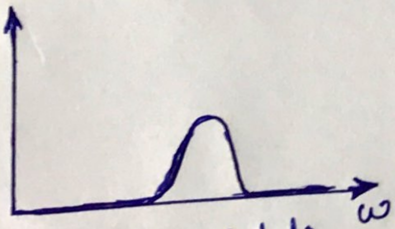
Baseband Signal



Full AM Modulation



SSB Modulation (USB)



SSB Modulation (LSB)

⇒ The front end of an SSB receiver is similar to that of an AM or FM receiver, Cosisting of a Superheterodyne RF Front end that produces a — — frequency-shifted version of radio frequency (RF) Signal within a standard intermediate frequency (IF) band.

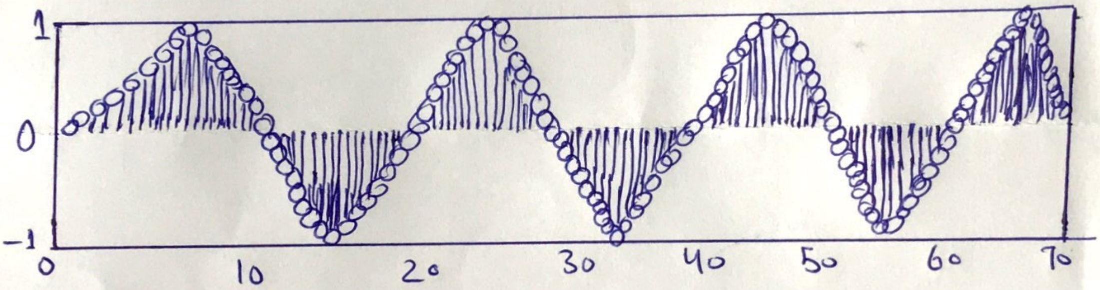
Q# 3:

PART b):- How Deterministic and Random Signals are different?

Answer:- Deterministic and Random Signals:

⇒ A Signal $g(t)$ is called deterministic, if is completely known and can be described mathematically

⇒ Model: Completely Specified functions of time.



Random Signal:-

⇒ A Signal $g(t)$ is called random, if it can be described only by terms of probabilistic description, such as

- Distribution
- mean value (The average or excepted value)
- squard mean value (The expected value of the squared error)
- standard daviation (The square root of the variance)