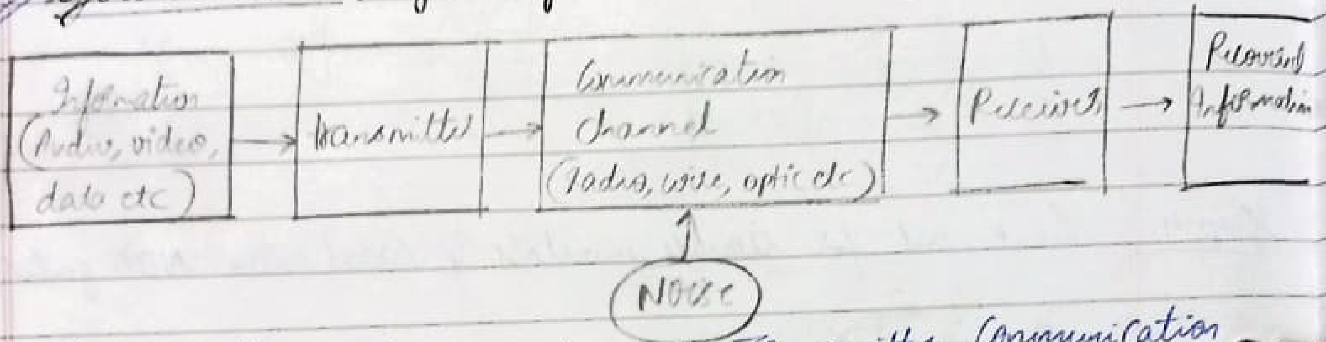
Unit-4

6M General Block Diagram of Communication System



→ Communication system is made up of Transmitter, Communication channel & Receiver.

→ Noise is any phenomenon that degrades the transmitted information.

Working of Communication System

(i) Transmitter →

→ It is a collection of electronic components & circuits designed to convert the electrical signal to signal suitable for transmission over a communication channel.

→ It is made up of amplifiers, oscillators, modulators etc.

(ii) Communication channel

→ It is a medium by which electronic signal is sent from one place to another.

→ Mediums include → wire conductors, optic-fibres, ~~free~~ vacuum.

(iii) Receivers

→ It is collection of electronic components & circuits designed to accept the transmitted message from the channel & convert it to human understandable form.

→ It is made up of amplifier, oscillator, demodulator etc

(iv) Noise → It effects are experienced at the receiver's side.

Modulation

It is a process of changing some characteristics of carrier ~~waves~~ signals in accordance with the instantaneous value of message signal.

$$c(t) = \underset{\uparrow AM}{A_c} \cos\left(2\pi \underset{\downarrow FM}{f_c}(t) + \underset{\to PM}{\phi}\right)$$

Need for Modulation

(i) Practical Antenna Length

For effective transmission of wave, length of transmitting antenna should be approx equal to $\left(\frac{\lambda}{4}\right)$ of wave

(ii) Operating Range

$\uparrow (f)$ signals radiate into space more effectively than $\downarrow (f)$ signals. This is because they have less attenuation.

(iii) Improves quality of reception

FM, PCM reduce noise significantly. This improves quality of reception

(iv) Avoid mixing of signals

Modulation permits multiplexing. It is a process of allowing two/more signals to share same channel.

Types of Modulation

(i) Amplitude Modulation (AM)

(ii) Frequency Modulation (FM)

(iii) Phase Modulation (PM).

Derivation is Coming (Step reduction)

Amplitude Modulation

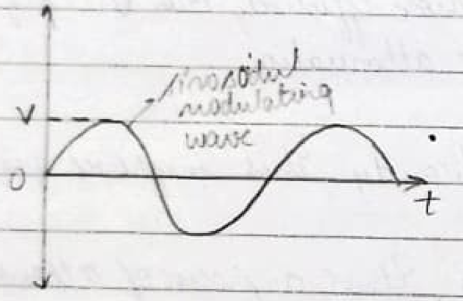
→ It is a process of changing the amplitude of carrier signal, in accordance with the instantaneous value of message signal, keeping (f) & (φ) constant.

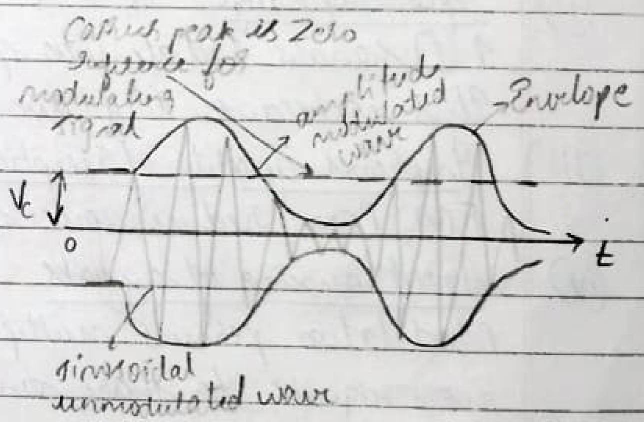
(Meaning of & Spectrum of AM)

Properties of AM

(i) ~~Am~~ (A) of carrier wave changes according to instantaneous (A) of message signal
(ii) (A) variations of the carrier wave are at signal frequency (f_m).
(iii) (f) of unmodulated wave = (f) of modulated wave.

Wave forms





Modulation index → it is defined as the ratio of modulation signal amplitude to carrier signal amplitude.

$$m = \frac{A_m}{A_c} \qquad 0 \le m \le 1$$

Distortion occurs when $(m > 1)$.

~~$V = V_c \sin(2\pi f_c t + m\, 2\pi f_m$~~

Limitations of AM

(i) Noisy Reception
(ii) Low efficiency
(iii) Lack of audio quality
(iv) Low spectrum efficiency.

$$\boxed{P_t = P_c\left(1 + \frac{m^2}{2}\right)}$$

$$V = V_c \sin\left(2\pi f_c t + m \cdot \sin(2\pi f_m t)\right)$$

$$\boxed{B.W = 2 f_m}$$

$$\boxed{m = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}}$$

Frequency Modulation

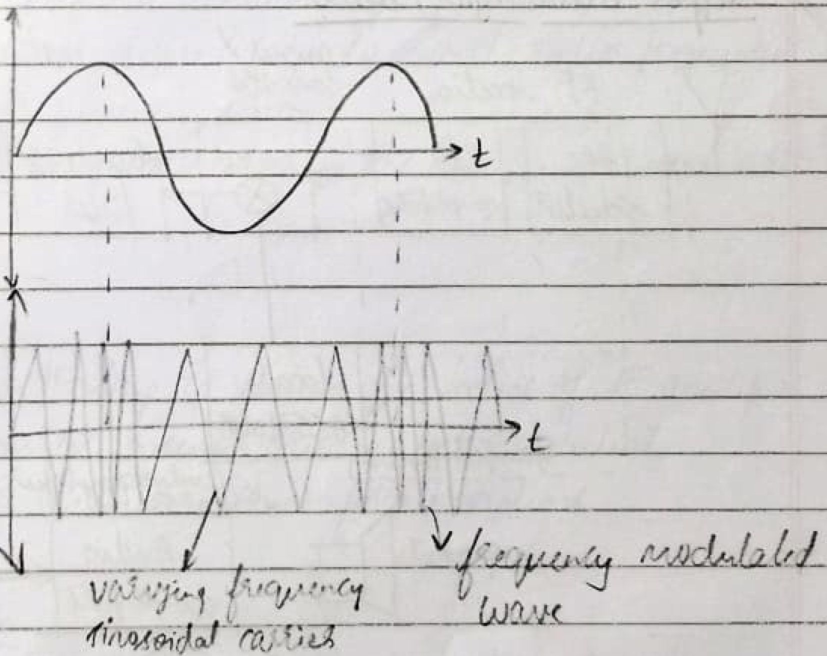
→ It is a process of changing the frequency of carrier signal, in accordance with the instantaneous value of message signal, keeping (A) & (ϕ) constant.

Properties of FM

(i) (A) of modulated wave = (A) of carrier wave

(ii) Frequency variations of carrier waves depend on upon the instantaneous (A) of signal

(iii) When signal approaches (+ve) peak, carrier frequency is increased to maximum & during (-ve) peaks, the carrier frequency is reduced to minimum.



Advantages of FM

(i) Provides noiseless reception

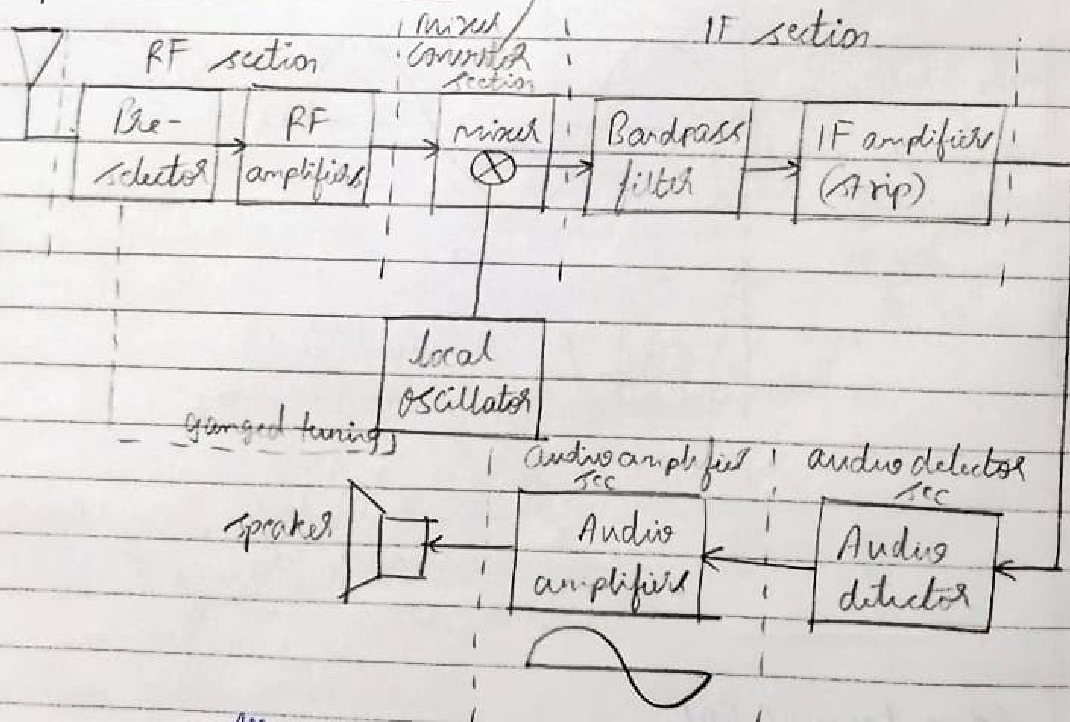
(ii) Operating range is quite large

(iii) Efficiency of transmission is very high

SM // **Difference bet^w AM & FM**

AM	FM
(i) (A) of carrier wave varies as (f) remains const	(i) (f) of carrier wave varries as (A) remains const.
(ii) Modulation index value lies bet^w 0 & 1	(ii) Modulation index value is greater than 1.
(iii) Am has only two side bands	(iii). FM has infinite side bands
(iv) susceptible to noise	(iv) Immune to noise
(v) covers longer distances	(v) covers shorter distances

Imp // **Super Hetrodyne Receiver**



Superhetrodyne AM Receiver

→ It is a radio receiver that processes AM signals using the super heterodyne principles, which involves conversion of incoming signal to IF before detection & amplification

→ Heterodyning is a process of combining two AC signals of diff frequencies in order to obtain signals of new frequencies.

Principle → hetrodyning action

Working of Superheterodyne AM receiver

(i) RF section

→ Made up of pre-selector & amplifier stage

→ Preselector provides enough initial band, preventing ~~the~~ image frequency from entering the receiver. It reduces the noise bandwidth for the receiver.

→ RF amplifier determines the sensitivity of the receiver. RF amplifiers help to increase gain, improve signal-to-noise ratio & helps in better selectivity

(ii) Mixer/converter section

→ It includes a frequency oscillator stage & a mixer/converter.

→ It is a non-linear device & helps to convert radio frequencies to intermediate frequencies.

→ Although, heterodyning takes place in the mixer, the bandwidth remains unchanged.

(iii) IF section

→ It is also called IF strip & consists of a series of IF amplifiers & filters

→ This section enables receiver gain & better selectivity.

→ IF cents (f)s & (B.W) are const for all stations.

(iv) Detector section

→ This section is used to convert signals back to ~~that~~ the original source information. Detector is (also called broadcast-band-receiver because the inform signals are audio frequencies.

→

(v) Audio amplifier section

→ It is made up of many audio amplifiers AND one/more speakers.

→ As more audio-signal power is desired, more no of amplifiers is used.

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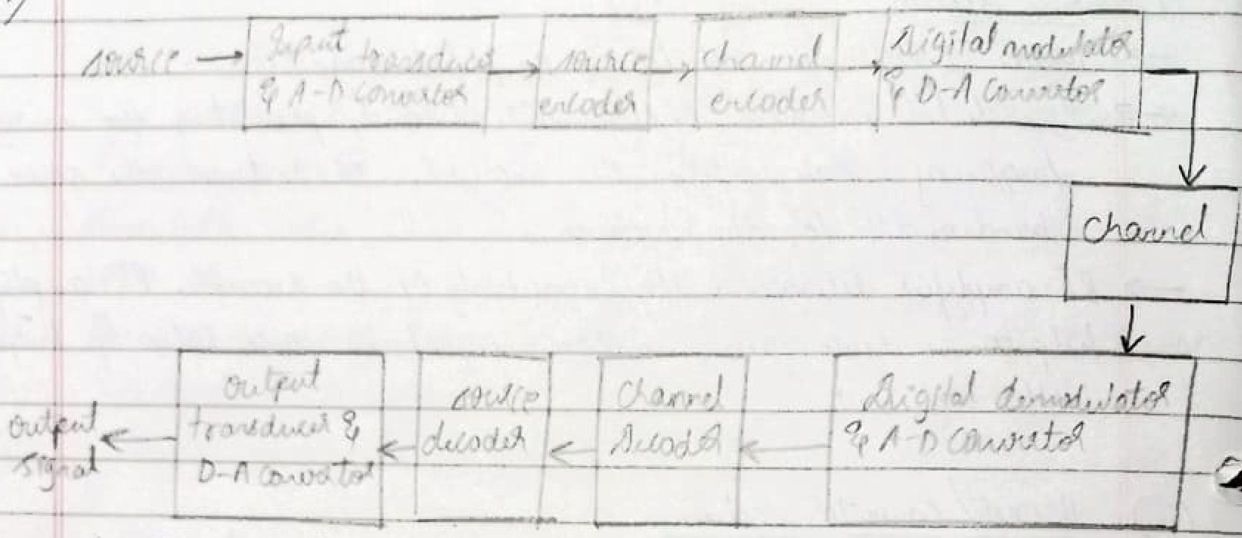
Digital Communication block diagram



Working of Digital Communication block

(i) Source → It is an analog signal.

(ii) Input transducer → It takes a physical input & converts it to electrical signal. Digital signal is represented by binary sequence

(iii) Source encoder → It compresses data into minimum no. of bits. This helps in effective utilisation of (B.W)

(iv) Channel Encoder → It codes for error correction. During transmission of signal, due to noise in channel, signal may get altered, & to avoid this, channel encoder adds some redundant bits to transmitted data

(v) Digital Modulator → The signal to be transmitted is modulated here by a carrier. It converts digital sequence to analog

(vi) Channel → It allows analog signal to transmit from transmitter end to receiver end.

(vii) Digital Demodulator → It converts analog signal to digital signal. Signal is reconstructed here

(viii) Channel Decoder → Here, the distortions occured during transmission are corrected by adding redundant bits. This process recovers original signal

(ix) Source Decoder → Here, the resultant signal is once again digitised by sampling & quantizing so that pure digital output is obtained without loss of information.

(x) <u>Output transducer</u>
It converts signal into original physical form, which was at the input of transmitter. It converts electrical signal into physical output

(xi) <u>Output signal</u>
Here the output of the entire process is obtained.

<u>Microprocessor</u>
It is a single integrated CPU that performs computational tasks. It is dependent on external components like memory, I/O ports & timers

<u>Microcontroller</u>
It is a single-chip microcontroller that consists of a CPU, memory, I/O ports, & timers integrated into one chip.
Eg: Intel 8051 microcontroller

<u>Difference between RISC & CISC CPU Architectures</u>

Reduced Instruction set Computers (RISC)	Complex Instruction set Computer (CISC)
(i) They are microcontrollers with small instruction set	(i) They are microcontrollers with complex instruction set.
(ii) Instructions take one/two cycles	(ii) Instructions take multiple cycles.
(iii) Instructions executed by hardware	(iii) Instructions executed by the microprograms.
(iv) Instructions have fixed format	(iv) Instructions have variable format.
(v) Few addressing modes	(v) Many addressing modes.
(vi) High pipelined	(vi) Less pipelined.

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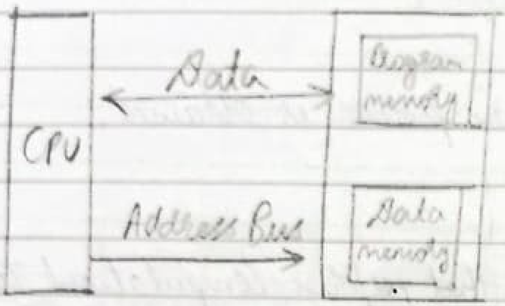
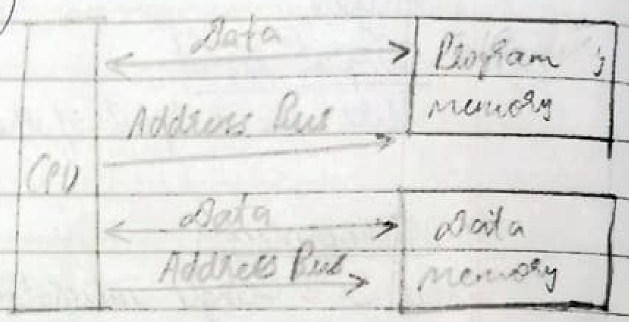
Diffrence betn Von-NeuMann & Harward CPU Architecture

Von-Neumann Architecture	Harward Architecture
(i) 	(i) 
(ii) Uses CISC Architecture	(ii) Uses RISC Architecture
(iii) Execution of instructions takes more machine cycles	(iii) Execution of instruction takes less machine cycle.
(iv) Instruction code & data cannot be fetched simultaneously	(IV) Instruction code & data can be fetched simultaneously.
(v) It uses single memory space for both instructions & data	(V) It uses seperate memory space for instructions & data
Eg: 8085, 8086,	Eg:- General purpose microcontroller.

The 8051 Architecture

Salient features of 8051 microcontroller

(i) Eight bit CPU
(ii) 8 bit PSW
(iii) 8 bit stack Pointer
(iv) 64K bytes of external program memory address ~~place~~ space
(v) 64 K bytes of external data memory address space.
(vi) One chip clock Oscillator
(vii) Two 16 bit timer : T0, T1
(viii) 32 bi-directional I/O lines.

Difference between Parallel & series Interfaces

Parallel Interfaces	Series Interfaces
(i) Sends & receives 4 bits, 8 bits or 16 bits of data at a time over multiple lines	(i) Sends & receives 1 bit of data at a time over a series of clock pulses
(ii) Requires multiple transmission lines to send data simultaneously	(ii) Requires typically one/two transmission lines to send data
(iii) Faster, as multiple bits are transmitted simultaneously	(iii) Slower, as bits are transmitted sequentially.
(iv) Used for high-speed data transfer over small distances	(iv) Used for long distance communication.

Difference bet^n micro-processor & microcontroller

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Micro-~~controller~~ Processor	Micro-~~processor~~ controller
(i) A single-integrated CPU that requires external components	(i) A single-chip microcomputer with CPU, memory & peripherals
(ii) Lacks built-in memory & peripherals	(ii) Includes memory, I/O ports & timers
(iii) Designed for general purpose	(iii) Designed for specific tasks
(iv) High cost due to external components	(iv) Low cost due to integrated components
(v) High power consumption	(v) Low power consumption
(vi) Large & occupies more space	(vi) Compact & occupies less space
(vii) Used in PCs & laptops	(vii) Used in embedded systems
(viii) Eg:- Intel Pentium	(viii) Intel 8051

AM Derivation

wave form of carrier signal $\Rightarrow c(t) = A_c \sin \omega_c t$

Wave form of message signal $\rightarrow m(t) = A_m \sin \omega_m t$.

modulation index $\Rightarrow \; m = \frac{A_m}{A_c} \Rightarrow A_m = mA_c$

overall signal can be described as $\rightarrow$

$$S_{AM}(t) = \sin \omega_c t \left(A_c + A_m \sin \omega_m t\right)$$

$$s(t) = \sin \omega_c t \left(A_c + mA_c \sin \omega_m t\right)$$

$$s(t) = A_c \sin \omega_c t + mA_c \sin \omega_c t \sin \omega_m t$$

$$s(t) = A_c \sin \omega_c t + tmA_c \left(\frac{1}{2}\left(\cos(\omega_c - \omega_m) - \cos(\omega_c + \omega_m)\right)\right)$$

$$s(t) = \underbrace{A_c \sin \omega_c t}_{\text{carrier}} + \underbrace{\frac{tmA_c}{2} \cos(\omega_c - \omega_m)}_{\text{LSB}} \underbrace{- \frac{tmA_c}{2} \cos(\omega_c + \omega_m)}_{\text{USB}}$$

side band $(A) = \frac{mA_c}{2}$, B.W of modulation signal $= 2f_m$.

Also $\Rightarrow$

$$P_T = P_c + P_{LSB} + P_{USB}$$

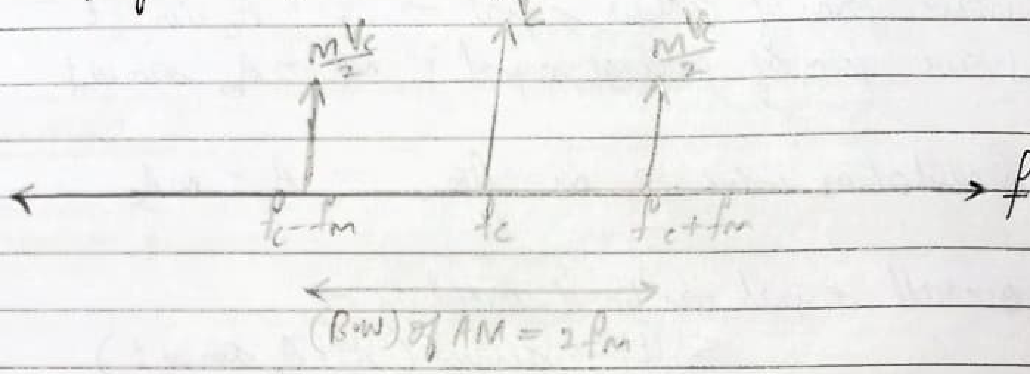
$$= A_c^2 + \left(\frac{mA_c}{2}\right)^2 + \left(\frac{mA_c}{2}\right)^2$$

$$\rightarrow \cancel{A_c^2} P_c + \frac{m^2}{4} P_c + \frac{m^2}{4} P_c$$

$$\boxed{P_t = P_c \left(1 + \frac{m^2}{2}\right)} \quad \boxed{V_T = V_c \sqrt{1 + \frac{m^2}{2}}} \quad \boxed{I_T = I_c \sqrt{1 + \frac{m^2}{2}}}$$

$$\boxed{P_c = \frac{A_c V_c^2}{2R}} \quad \boxed{\eta = \frac{P_m}{P_T}} \quad \boxed{\eta = \frac{m^2}{m^2 + 2}}$$

2nd// Mixing of (f) Spectrum of AM



→ Frequency spectrum is a graph of amplitude on Y-axis & (f) on x-axis.

From modified overall signal eqn

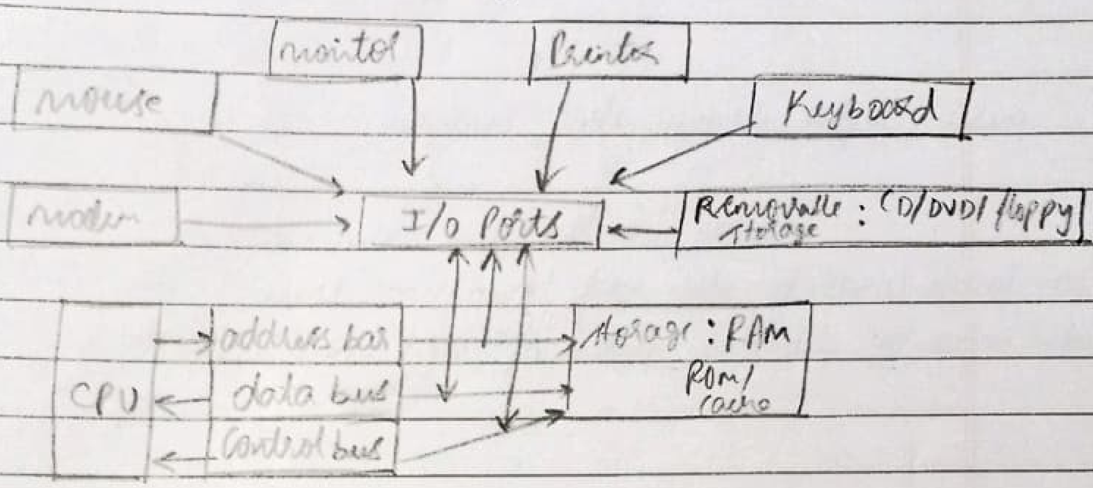
$$S(t) = \underbrace{A_c \sin \omega_c t}_{\text{Carrier}} + \underbrace{\frac{mA_c}{2} \cos(\omega_c - \omega_m)t}_{\text{LSB}} - \underbrace{\frac{mA_c}{2} \cos(\omega_c + \omega_m)t}_{\text{USB}}$$

$$B.W = \text{upper cutoff (f)} - \text{lower cutoff (f)}$$
$$= f_c + f_m - (f_c - f_m)$$
$$\boxed{B.W = 2f_m}$$

→ Upper & lower side frequencies are called sidebands. They are called sum & diff of signals.

→ Their values are $\frac{mV_c}{2}$

Block Diagram of Computer System



Working of Computer system

(i) Input stage

→ Data & instructions are provided using keyboard/mouse

→ Input devices convert info to binary format

(ii) CPU

→ Retrieves data & instructions from memory

→ Accepts instructions & understands what to do

(iii) Storage

→ Data is temporarily stored in RAM

→ Long-term storage is done in SSD/hard disk

(iv) System Bus

→ Communication channel connecting all busses

→ Data Bus : transfers data

→ Address Bus : specifies memory address

→ Control Bus : transmits control signals.