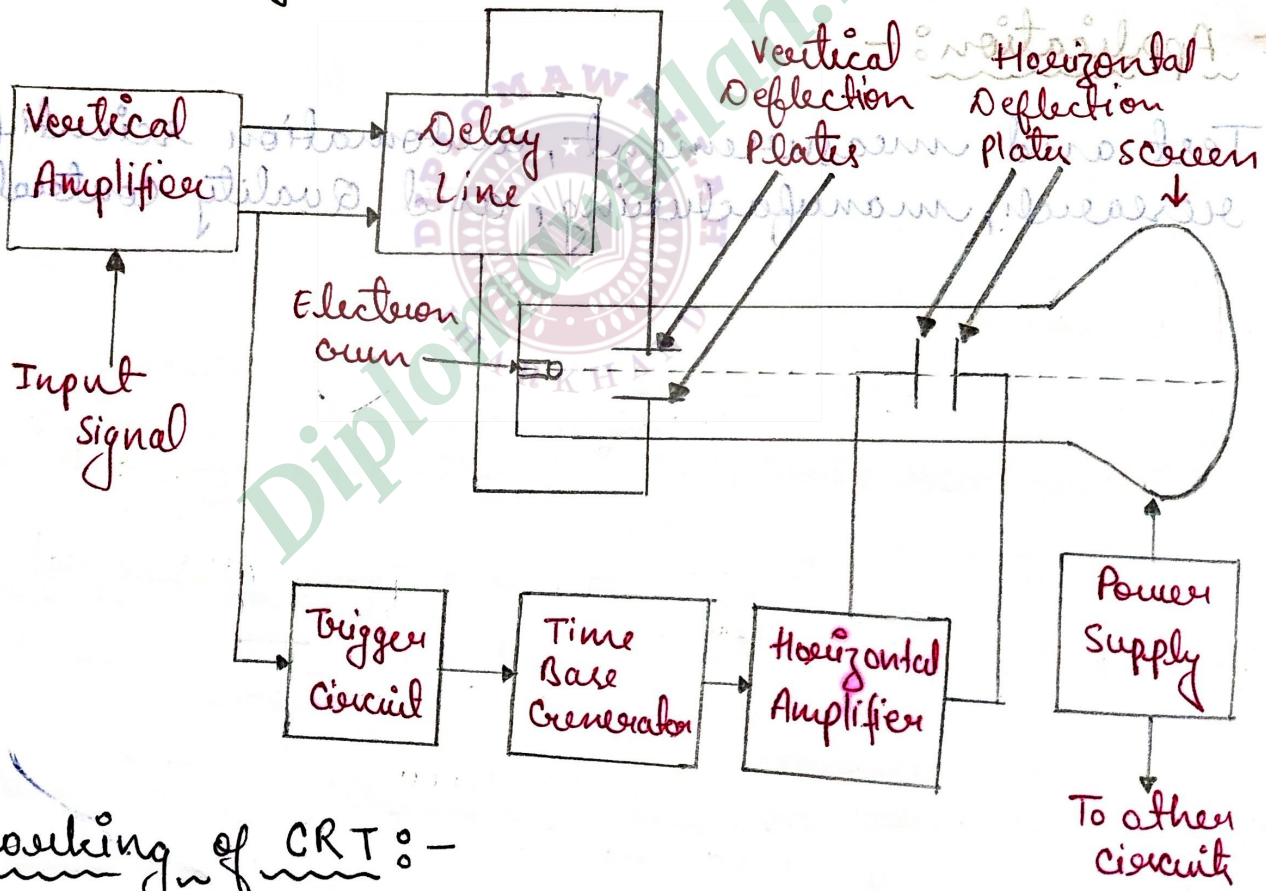
Unit:-10

1) Cathode Ray Oscilloscope :-

A cathode ray oscilloscope (CRO) is an electronic instrument used to display, analyze and measure various electrical signals in the form of waveform. It is a versatile device commonly used in laboratories and industries for testing and signal analysis.

Block diagram :-



Working of CRT :-

1) Electron Beam Generation :- The electron gun emits a focused beam of electrons.

2) Deflection of electron beam :- The input signal is applied to the vertical deflection plates moving the beam.

The time base circuit controls the horizontal deflection plates, moving the beam horizontally

iii) Display on Screen:- The electron beam strikes the phosphorescent screen, providing a visible spot. The combined vertical and horizontal deflection create a waveform representation of the input signal.

Application of CRO :-

- Signal analysis in electronics testing.
- Measurement of voltage frequency.
- Phase difference
- Troubleshooting in circuit design.
- Medical applications (like ECG analysis)
- Communication system analysis.

2) Dual Trace CRO :-

A Dual trace CRO is a type of oscilloscope that can simultaneously display two different signals on the screen. This allows the user to compare two waveforms side by side, making it useful for analyzing phase differences, signal synchronization and other comparative measurements.

Key components of Dual Trace CRO :-

i) Vertical amplifier :- Two seperate amplifiers amplify the input signals independently.

ii) Switching Circuit (Channel selector) :- Alternately or simultaneously switches the two input signals to the vertical deflection plates.

iii) Horizontal Amplifier and time base circuit :- Controls the horizontal movement of the beam to display waveforms overtime.

iv) Electron Gun and CRT :- Generates and directs the electron beam to display signals on the phosphorescent screen.

v) Deflection Plates :- Control the vertical and horizontal movement of the electron beam based on input signals.

Modes of Operation :-

i) Alternate Mode :-
- Display one trace at a time for each sweep
- Useful at higher frequencies.

ii) Chopped Mode :-
- Rapidly switches between two signals within each sweep
- Ideal for low frequency signals to avoid flicker.

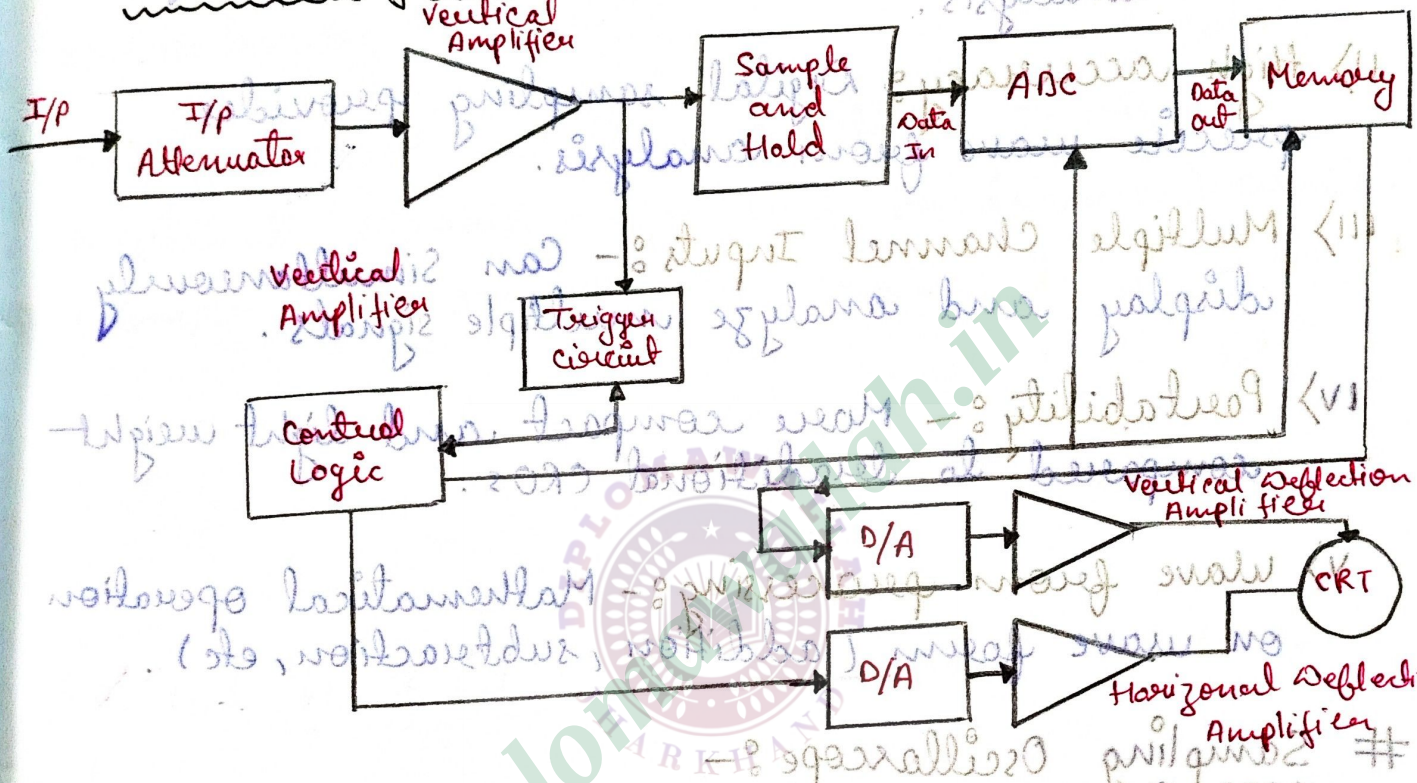
Applications :-

- Phase and frequency comparision between two signals.
- Signals synchronization testing.
- Analysis of modulation signals.

3) Digital Storage Oscilloscope (DSO) :-

Digital storage oscillascope (DSO) is an electronic test instrument used to capture display and analyze electrical signals over time.

Block diagram :-



Key components of DSO :-

1) Input Attenuator :- Reduces the input signal to a level suitable for processing.

11) Amplifier :- Amplifier weak signal for better measurement and accuracy.

111) Analog to digital converter (ADC) :- Converts the analog input signal into a digital format.

1V) Time base generator :- Controls the horizontal scanning of the waveform and synchronization.

v) Display system:- Display the captured level on a digital screen often as a high-graphical interface.

Features:-

i) Digital Storage: Store waveforms for long term analysis.

ii) High accuracy: Digital sampling provides precise wave from analysis.

iii) Multiple Channel Inputs:- Can simultaneously display and analyze multiple signals.

iv) Portability:- More compact and light weight compared to traditional CROs.

v) Wave from processing:- Mathematical operation on wave form (addition, subtraction, etc).

Sampling Oscilloscope:-

A sampling oscilloscope is a type of oscilloscope that reconstructs high-frequency signals by sampling them at discrete intervals and displaying the waveform over time. It is mainly used for analyzing very fast periodic signals.

* Applications:-

- High frequency signal analysis (GHz range).
- Telecommunication Testing (optical and RF signals)
- Radar system analysis.
- Digital circuit debugging (fast clock signals)
- High speed data transmission testing (External PCIe)

* Advantage :-

- Can measure extremely high-frequency signals (GHz range)
- Provides high resolution and accuracy
- Requires lower bandwidth than real-time oscilloscope.

* Disadvantage :-

- Only works well for repetitive signals.
- Cannot capture single-shot or transient events.
- Complex signal reconstruction process.