EIPC (NEE-403)
Unit-4
Display Devices & Recorders

Wave Analyzers

- Complex Waveform is made up of a fundamental frequency and its harmonics.

- Wave Analyzers are used to measure the amplitude of fundamental frequency and each harmonics individually. (AF range only)

- Wave analyzers are also referred to as frequency selective voltmeters such that it is tuned to the frequency of one component whose amplitude is measured

Wave Analyzers

- The analyzer consists of a primary detector : **LC circuit** passes only the frequency to which it is tuned and provides a high attenuation to all other frequencies . **The full wave rectifier** is used to get the average value of the input signal . The indicating device is a **D.C voltmeter**, used to read the peak value of the sinusoidal

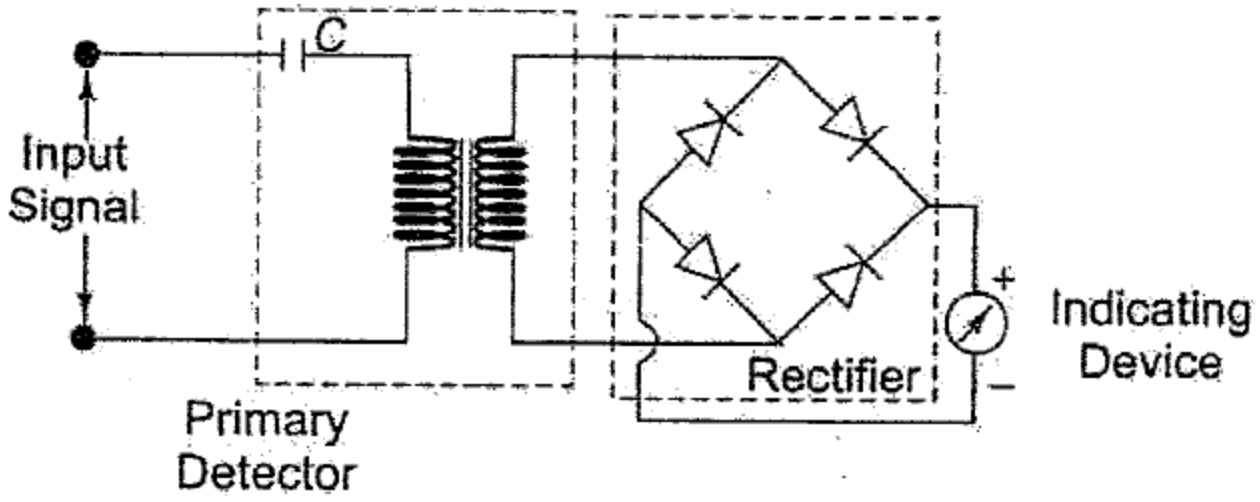
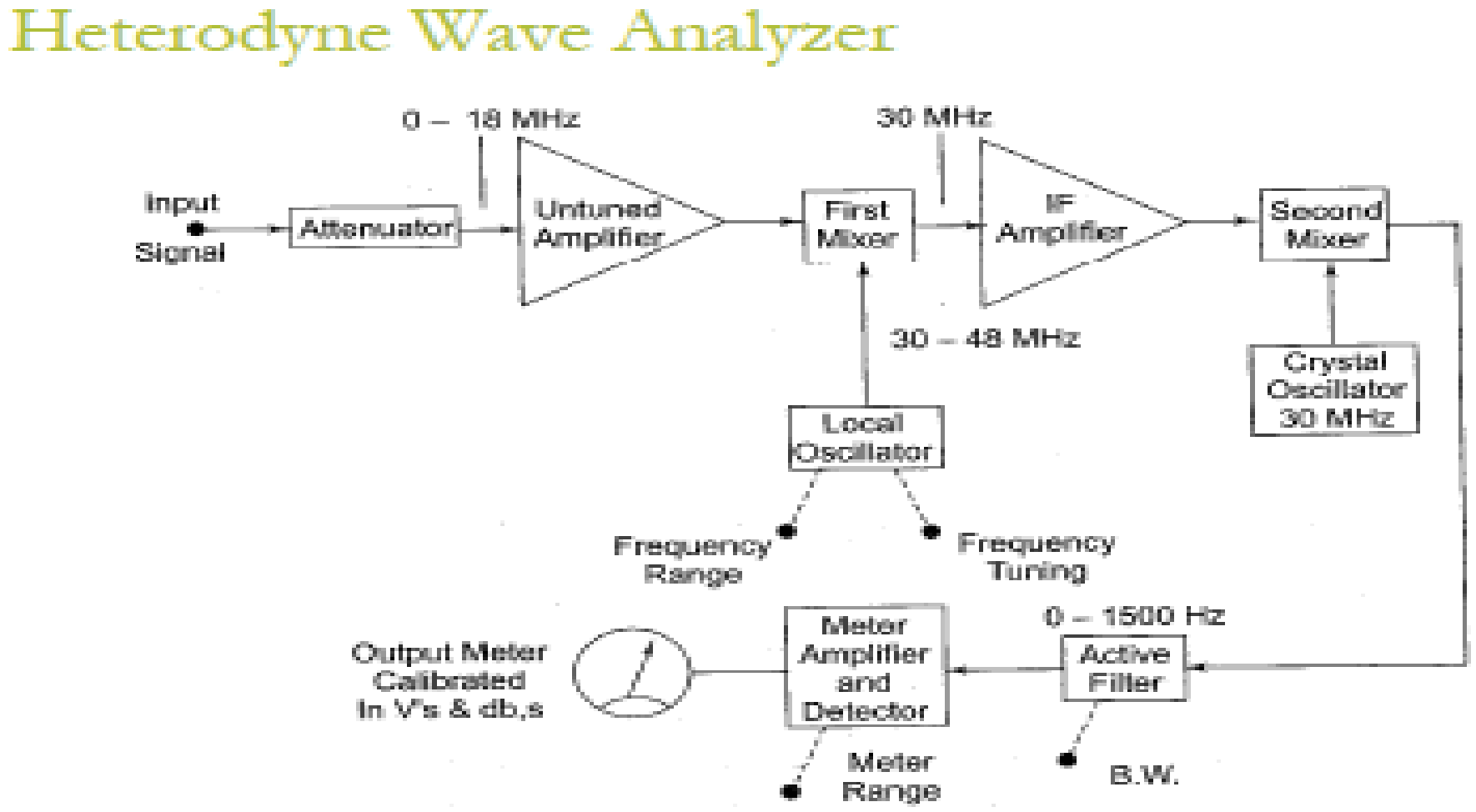


Fig. 9.1 (a) Basic Wave Analyzer

Heterodyne Wave Analyzer

- **Heterodyne wave analyzers are used to analyze signal in the RF range and above (MHz range).**



Heterodyne Wave Analyzer

- Attenuator is used to modify the amplitude of the input signal .
- In this analyzer, the input signal is mixed with the internal signal to produce a higher IF frequency.
- The local oscillator is tunable to get all the frequency components of the input signal.
- The first mixer stage produces an output of 30Mhz which is a difference between the input and oscillator signal.
- This 30MHz signal will be amplified by IF amplifier and fed to the second mixer.

Heterodyne Wave Analyzer

- The second mixer will produce a 0 Hz signal which is the difference between IF and crystal oscillator signal

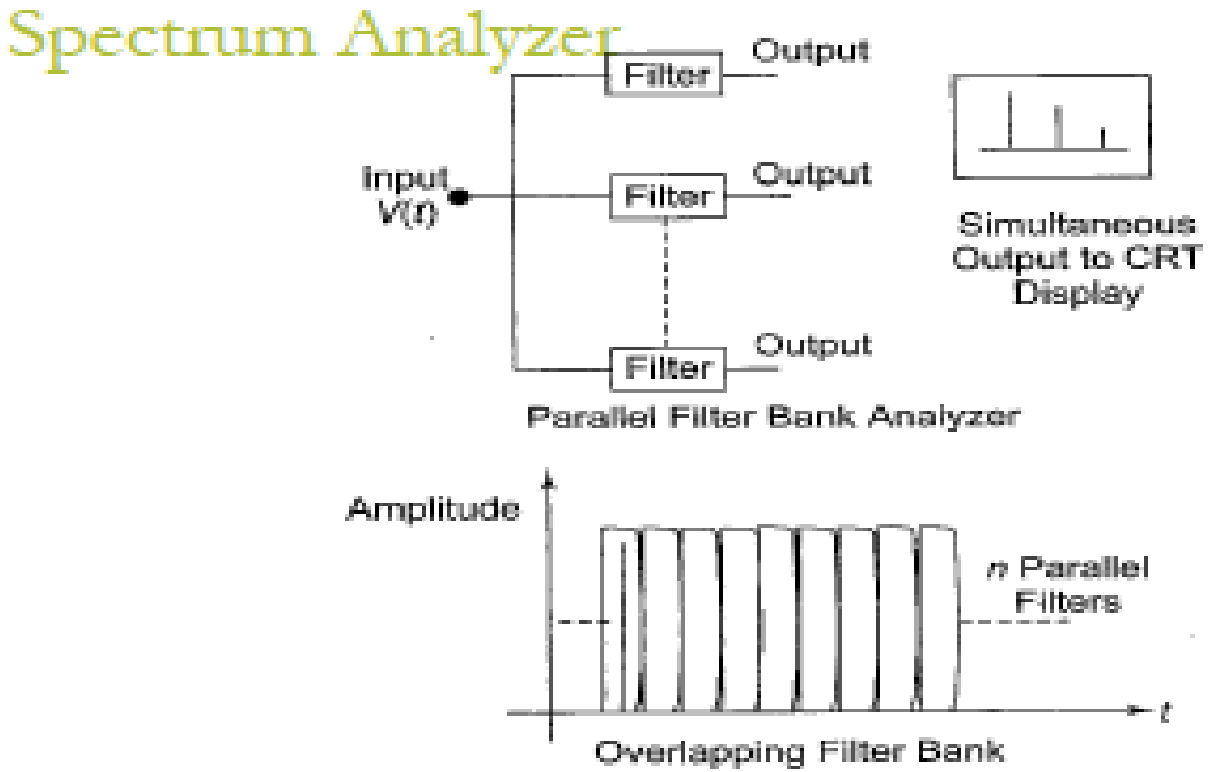
- This signal will then be filtered by the active filter of a bandwidth less than 1500Hz
- The amplitude of the selected frequency component can be read from the output meter in Volt or dB.
- This wave analyzer is operated in the RF range of 10kHz – 18MHz

Spectrum Analyser

- **Oscilloscope** is used to display and measure signal in **a time domain**.
- The instrument providing this **frequency domain** view is the **spectrum analyzer**
- **A spectrum analyzer display signal on its CRT with frequency on the horizontal axis and amplitude (voltage) on the vertical axis**.
- Spectrum analyzers use either **a parallel filter bank or a swept frequency technique**

Parallel filter bank Spectrum Analyzer

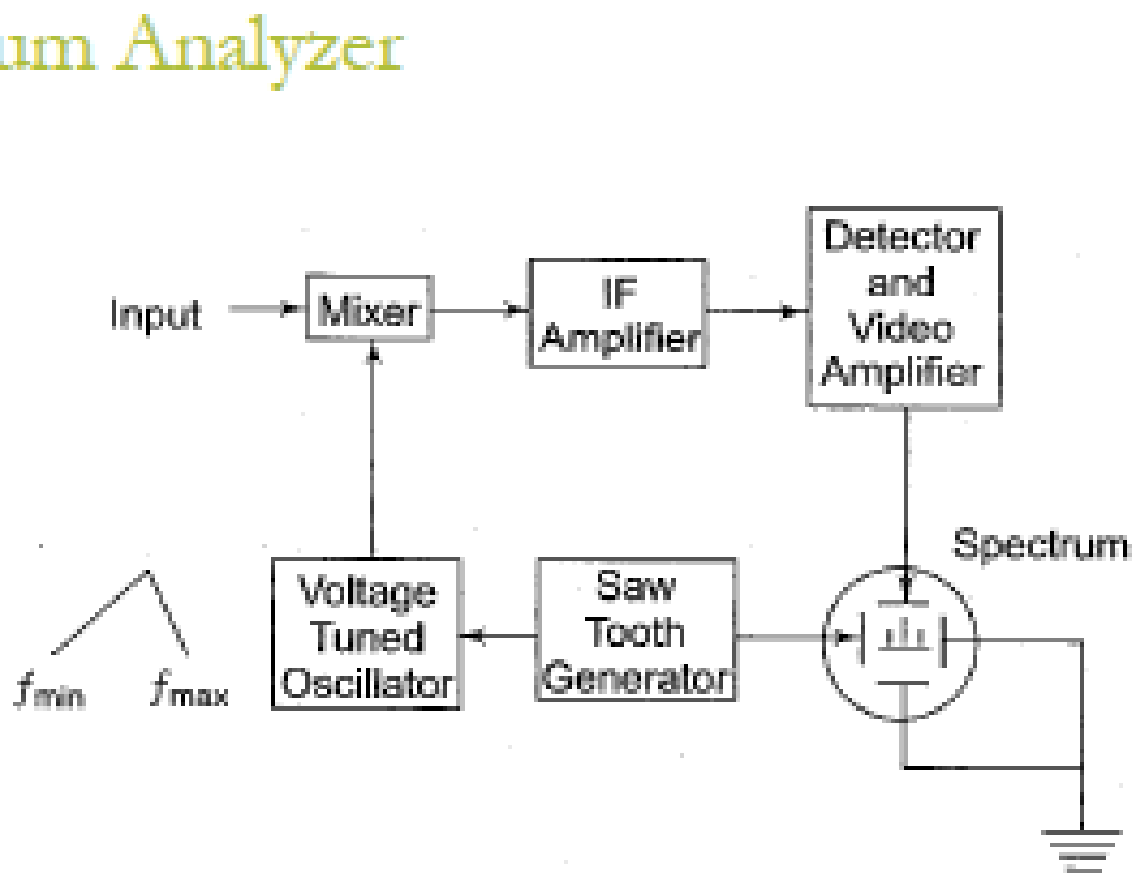
- In a parallel filter bank analyzer, the **frequency range is covered by a series of filters whose central frequencies and bandwidth are so selected that they overlap each other**
- **Parallel filter bank Spectrum analyser**



Spectrum analyzer (swept receiver design)

- **For the RF or microwave signals, the swept technique is preferred**

Spectrum analyzer using swept receiver design.



Spectrum analyzer (swept receiver design)

- The sawtooth generator provides the sawtooth voltage which drives the horizontal movement of the scope and the frequency controlled element of the voltage tuned oscillator.
- The voltage tuned oscillator will sweep from fmin to fmax of its frequency band at a linear recurring rate.

- The frequency component and voltage tuned oscillator frequency beats together to produce a difference frequency, i.e. IF (intermediate frequency)
- This IF will be amplified and displayed on the CRT screen of the spectrum analyzer

Distortion Analyser

- **Function of distortion analyzer : measures the total harmonic power in the test wave rather than the distortion caused by each component.**

- **Simplest method is to suppress the fundamental frequency of the signal with a notch filter , leaving only harmonics plus noise.**

Distortion Analyser

- **The total harmonic distortion (THD) can also be written as**

$$THD = \frac{\sqrt{E_2^2 + E_3^2 + \ldots + E_n^2}}{E_f}$$

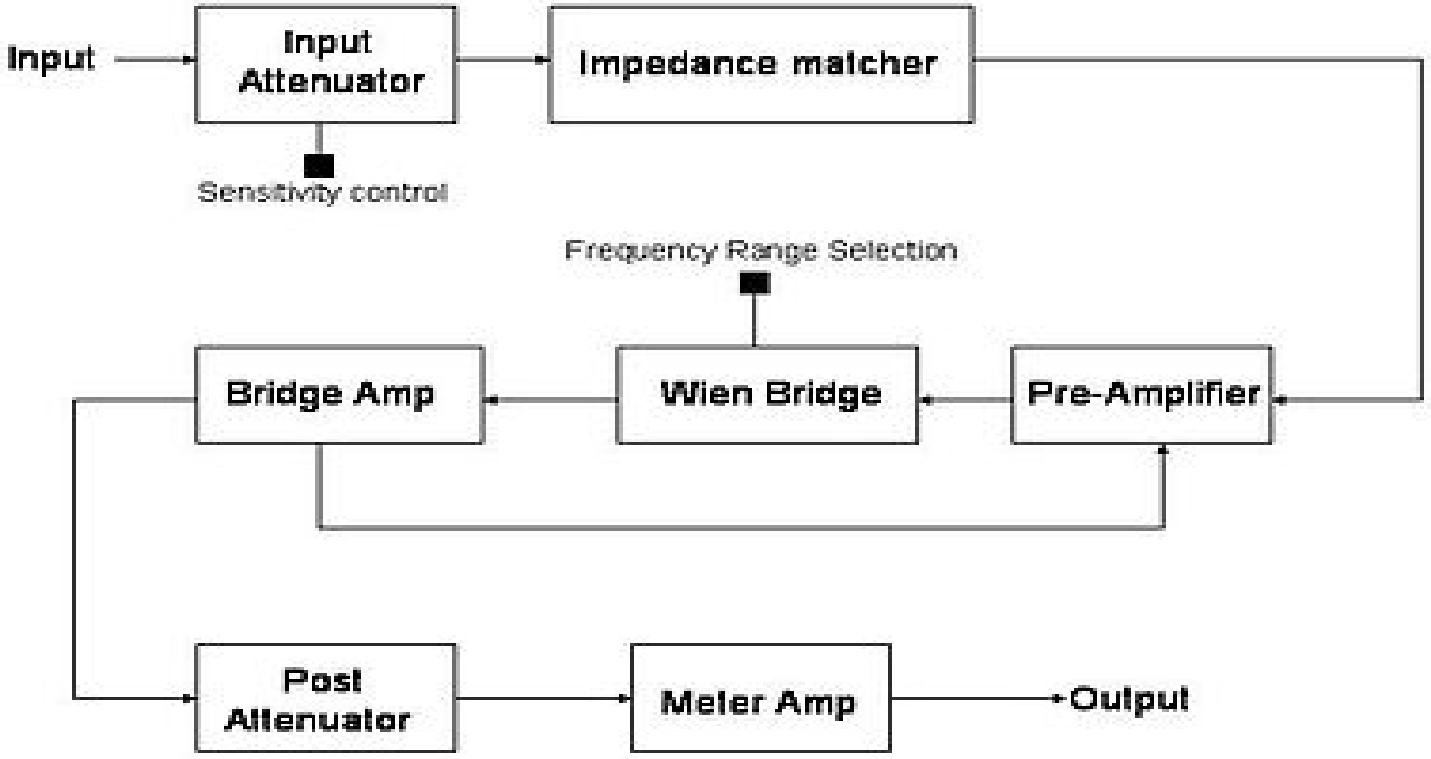
Where THD = the total harmonic distortion

- Ef = the amplitude of fundamental frequency including fundamental frequency. E2,E3 … ,En = the amplitude of the individual harmonics

Distortion Analyzer

- Consists of **three main Parts**

  Input section with Impedance matcher, Notch filter and amplifier section, An output metering circuit.



Distortion Analyzer

- The input is impedence -matched t with the help of an attenuator and an impedance matcher.

- This signal is then preamplifier to a desired level and applied to a Wien bridge notch filter, tuned to reject the fundamental frequency and balanced for minimum output by adjusting the bridge controls.

Distortion Analyzer

- A feedback loop from the bridge amplifier output to the pre-amp input helps to eliminate any remaining contribution from the fundamental frequency

- The remaining signal after the fundamental has been suppressed, is amplified to a measurable level.

Thank You