ELECTRONIC MEASUREMENT & INSTRUMENTATION (BEC-29)

Instructor

Dr. B. P. Pandey

Assistant Professor

Department of Electronics and Communication Engineering

Madan Mohan Malaviya University of Technology , Gorakhpur

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UNIT-1
Lecture 9

Qualities, Measurements and Digital Display Devices

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- LED

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- Incandescent Display

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Lecture 9:

- Digital voltmeters
- Spectrum analyzer

Digital Voltmeters (DVM)

- A digital voltmeter (DVM) measures an unknown input voltage by converting the voltage to a digital value and then displays the voltage in numeric form.
- DVMs are usually designed around a special type of analog-to-digital converter called an integrating converter.

- DVM measurement accuracy is affected by many factors, including temperature, input impedance, and DVM power supply voltage variations.
- Less expensive DVMs often have input resistance on the order of 10 MΩ.
- Precision DVMs can have input resistances of 1 GΩ or higher for the lower voltage ranges (e.g. less than 20 V).

Spectrum Analyzer

- A Spectrum Analyzer measures the magnitude of an input signal versus frequency within the full frequency range of the instrument.
- Spectrum Analyzers usually display raw, unprocessed signal information such as voltage, power, period, wave shape, sidebands, and frequency.
- They can provide a clear and precise window into the frequency spectrum.
- Most common spectrum analyzer measurements are modulation, distortion and noise.
- There are basically **two types of spectrum analyzer**: Real Time and Swept-Tuned analyzer.

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- **Real time spectrum analyzer**
  - Despite the high performance of modern super heterodyne analyzers, they still can't evaluate frequencies simultaneously and display an entire frequency spectrum simultaneously.
  - Thus, they are not real-time analyzers. Also, the measurement times may be very long because the sweep speed of a swept-tuned analyzer is always limited by the time required for its internal filters to settle.
  - The different real time spectrum analyzers are: **Fourier Spectrum analyzers** and **Parallel Filter analyzers** .

Fourier spectrum analyzer

- It takes a time domain signal, digitizes it using digital sampling and then performs the mathematics required to convert it into frequency domain, and display the resulting spectrum.
- It is actually capturing the time domain information which contains all the frequency information stored in it.
- Both phase and magnitude.

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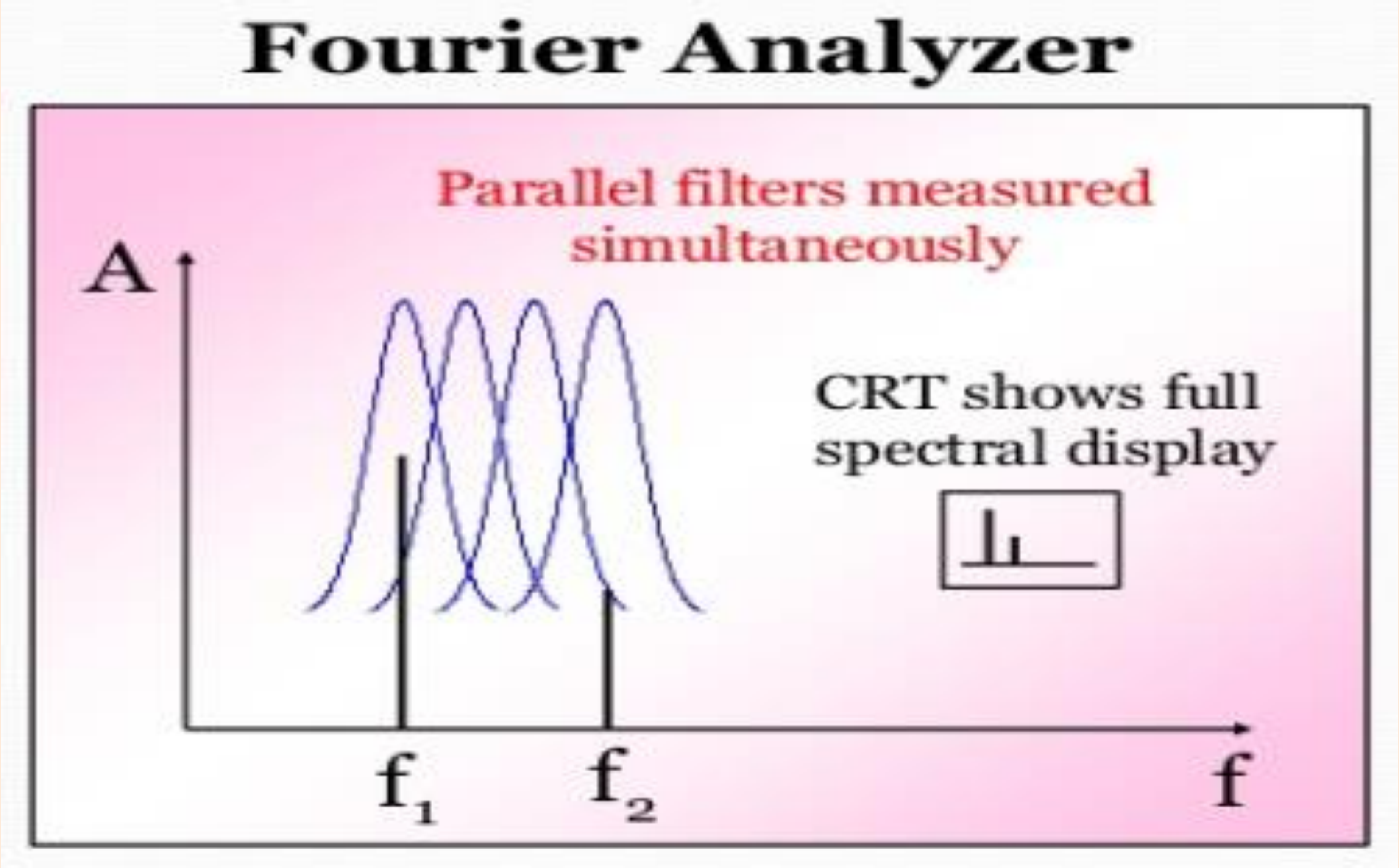
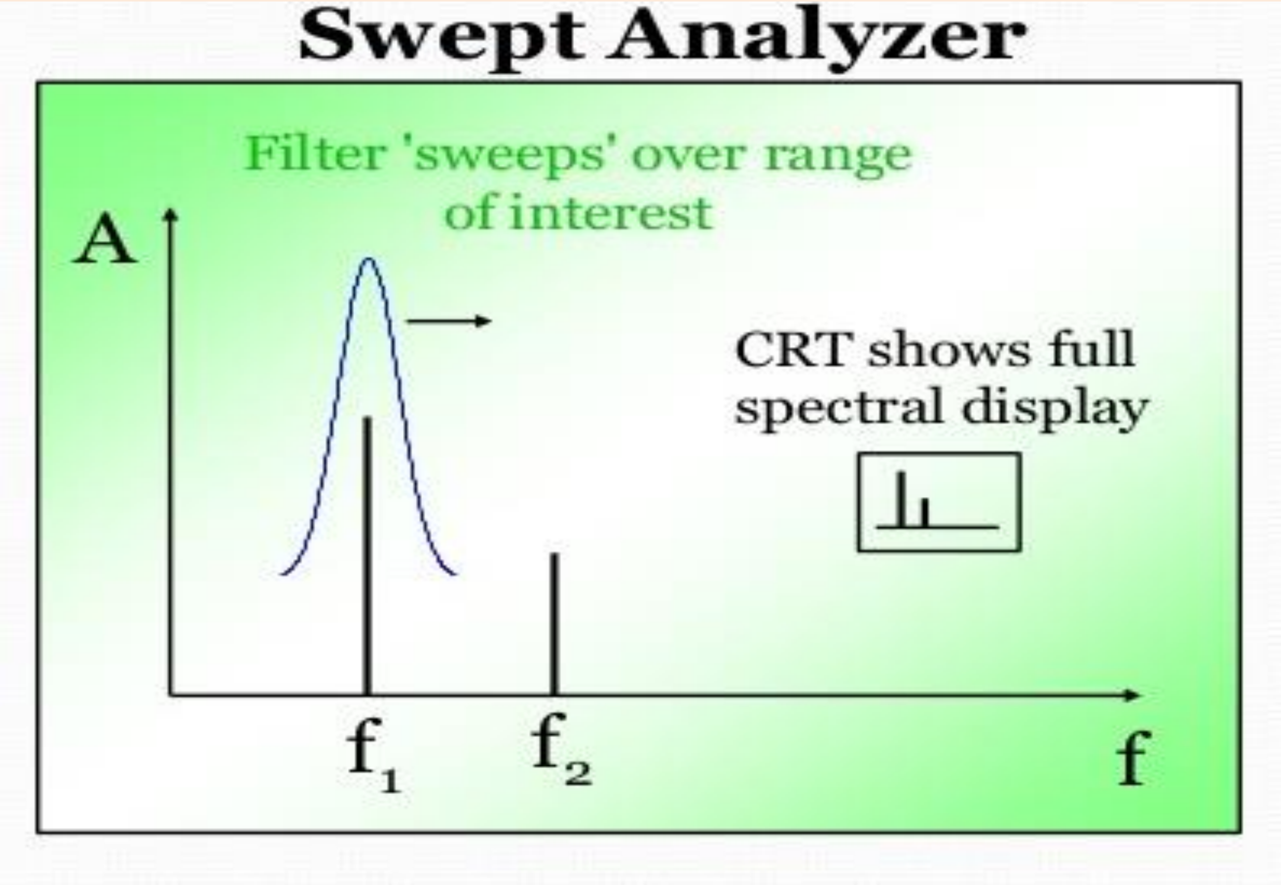

Fourier Analyzer
Parallel filters measured simultaneously
A
CRT shows full spectral display
f1
f2
f

Contd..

Parallel-Filter analyzers

- Another way to build a spectrum analyzer is to combine several band pass filters, each with a different pass band frequency.
- Each filter remains connected to the input at all times. This type of analyzer is called a parallel-filter analyzer.
- After an initial settling time, the parallel-filter analyzer can instantaneously detect and display all signals within the analyzer's measurement range. Therefore, the parallel-filter analyzer provides real-time signal analysis.
- A particular strength of the parallel-filter analyzer is its measurement speed, which allows it to measure transient and time-variant signals (also called dynamic signals).
- However, the frequency resolution of a parallel-filter analyzer is much coarser than a typical swept-tuned analyzer. This is because the resolution is determined by the width of the band pass filters. To get fine resolution over a large frequency range, need many individual filters—thus increasing the cost and complexity of such an analyzer.
- This is why all but the simplest parallel-filter analyzers are expensive.
- Typically, parallel-filter analyzers have been used in audio-frequency applications.

Swept Tuned analyzer



- It is most common type of analyzer.
- Widely used in super heterodyne.
- It analyzes the sweep across the frequency range of interest and displays the frequency information stored in it.

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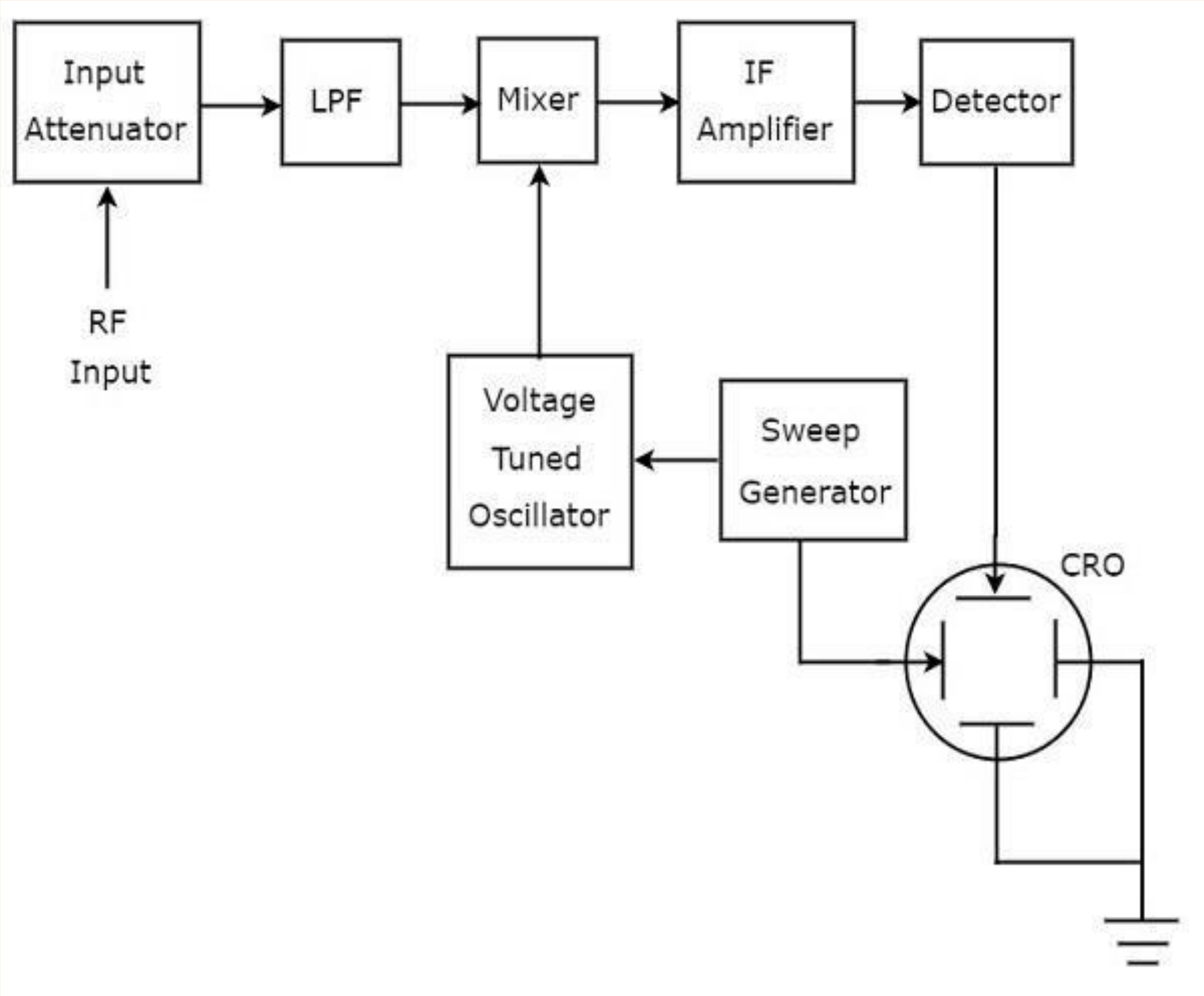
Major blocks in spectrum analyzer are:

1. RF input attenuator
2. Mixer
3. IF filter
4. Detector
5. Video filter
6. Local oscillator
7. Sweep generator
8. CRT display



Assignment Questions

- State the advantages of DVM over analog meter.
- How are DVMs classified?
- State the operating and performance characteristics of a DVM.
- Explain the operating principle of a ramp type DVM.
- State the limitations of ramp type DVM and explain how it can be overcome.
- Define the sensitivity of a digital meter.

Conceptual Questions

- **The measurement range of digital voltmeter is**
  A. 1V to 1MV
  B. 1V to 1kV
  C. 1kV to 1MV
  D. 100 kV to 100MV
- **Which among the following is not the type of digital voltmeters?**
  A. Ramp type
  B. Integrating
  C. Potentiometric type
  D. None of these
- **In a ramp type DVM, the multi vibrator determines the rate at which the**
  A. Clock pulses are generated
  B. Measurement cycles are initiated
  C. It oscillates
  D. Its amplitude varies

Contd..

- **An accurate measurement of harmonic distortion is achieved by using a ________**

A. Distortion Analyzer

B. waveform analyzer

C. transmission analyzer

D. logic analyzer

- **In the beginning, all the outputs of the successive approximation type register is at**

A. Logic zero
B. Logic one
C. Toggling
D. None of these

THANK YOU