SNS COLLEGE OF TECHNOLOGY

Kurumbapalayam (Po), Coimbatore – 641 107

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A' Grade

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF COMPUTER SCIENCE AND DESIGN

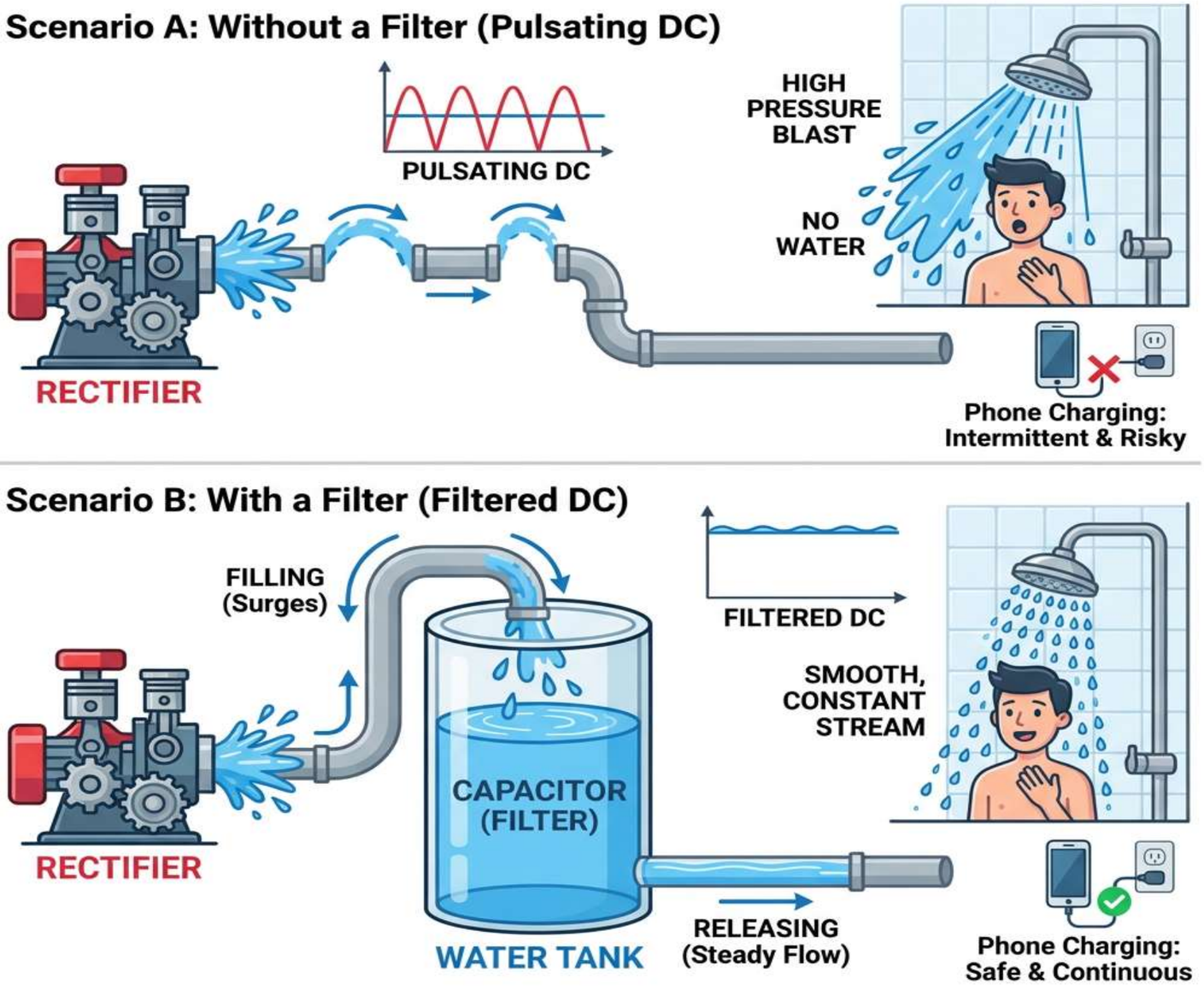
COURSE NAME : 23EET103- ELECTRIC CIRCUITS AND ELECTRON DEVICES

I YEAR /II SEMESTER

Unit-5 - RECTIFIERS AND POWER SUPPLIES

Topic : **Filters**

The Water Tank Analogy for Capacitor Filtering



Story telling

An electronic circuit called a filter circuit is made to either pass or block specific frequencies from an electrical signal. It is an essential part of many electrical systems and applications because it shapes a circuit's frequency response by blocking out undesired frequencies and letting in desired ones. Many electrical devices, including power supply, signal processing applications, audio systems, and communication systems, use filters.

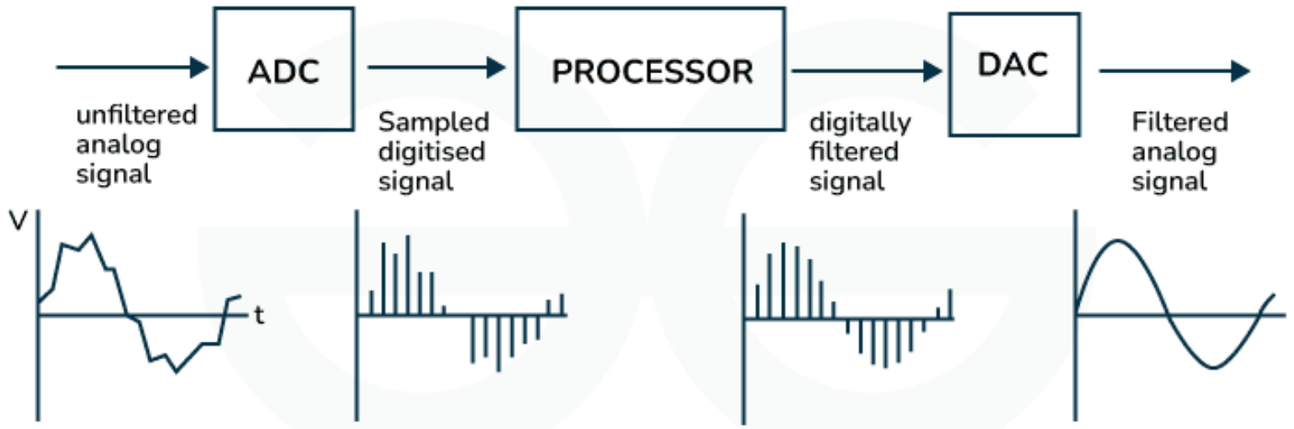
Content

Need for Filtering

DT-DEFINE

The output of a rectifier is **pulsating DC**.
It contains **AC ripples**, which are undesirable.
Electronic circuits require **smooth and steady DC**.

☞ **Filter** is a circuit used to **remove AC ripples** from rectifier output and produce **pure DC**.



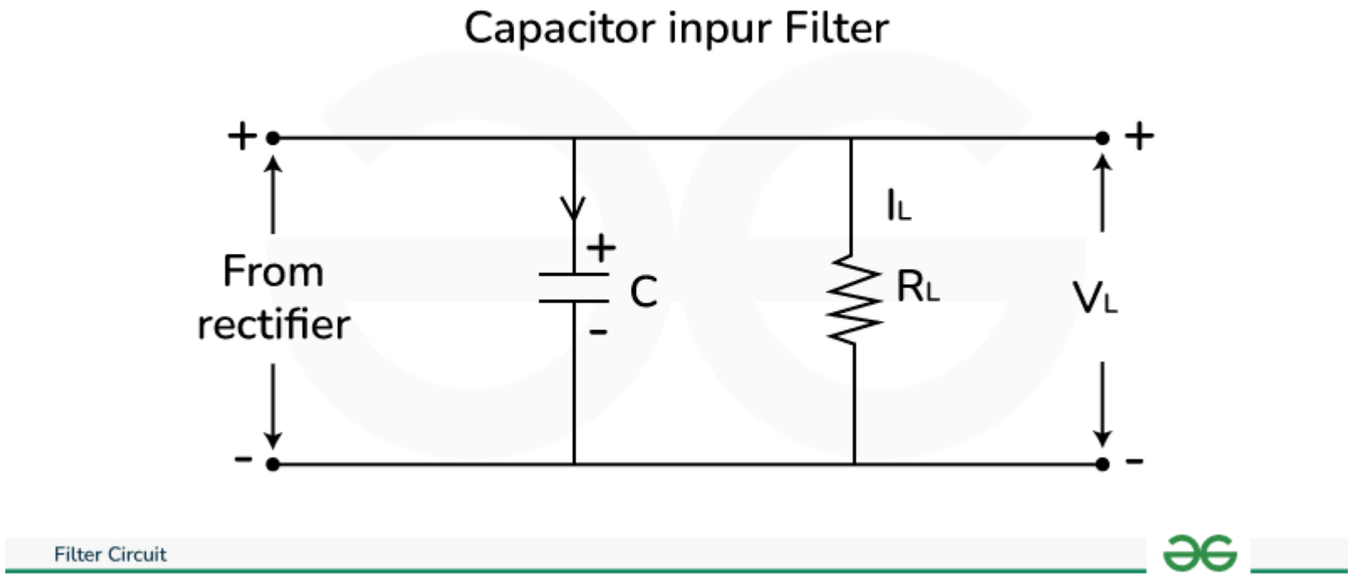
Filter Circuit

Why Do We Need Filters?

In high-performance stereo systems, filter circuits are frequently required because, in order to achieve the highest possible sound quality and power efficiency, specific audio frequency ranges must be increased or suppressed.

Noise Reduction: To remove undesired noise or interference from a signal, filters are frequently utilized. This is essential for applications requiring a clean signal, such as audio processing and communication systems.

Signal smoothing: Filters are employed in many electrical systems, particularly power supply, to reduce fluctuations in the signal and produce an output that is more steady and continuous.



The components of the rectified output to reach the load while removing the A.C. components from it. An LC filter circuit is a type of filter circuit that typically consists of an inductor (L) and a capacitor (C).

An inductor only permits D.C. to flow, while a capacitor only permits A.C. to do so. Thus, the A.C. component of the rectified wave can be efficiently filtered out using an appropriate L and C network.

Components of a Filter Circuit

The components of a filter circuit are as follows:

Resistor

Capacitor

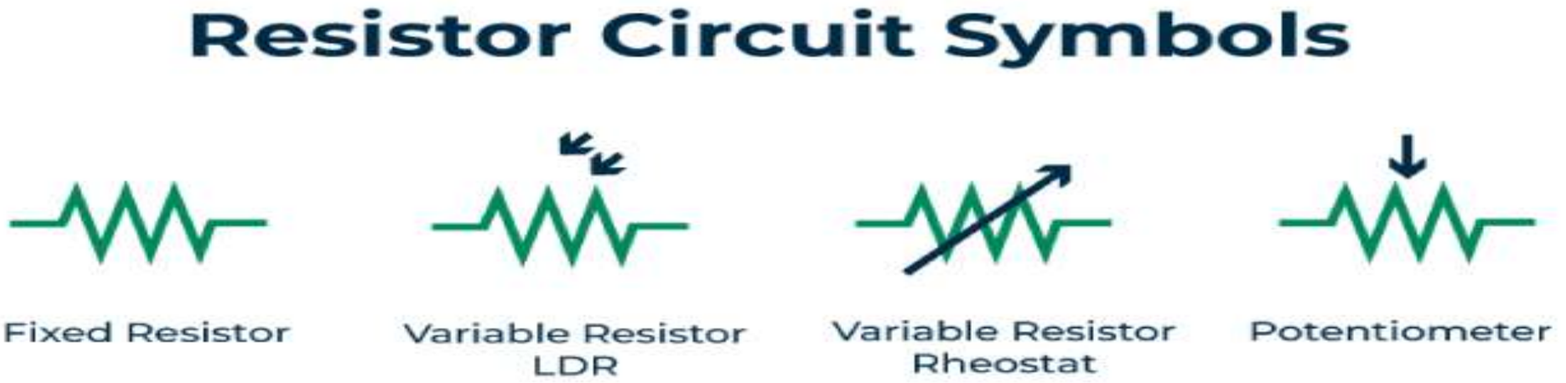
Inductor

DT-IDEATE

Resistor (R)

Function: The circuit's current flow is managed by a resistor. It is frequently used in filter circuits to set the time constants in conjunction with capacitors.

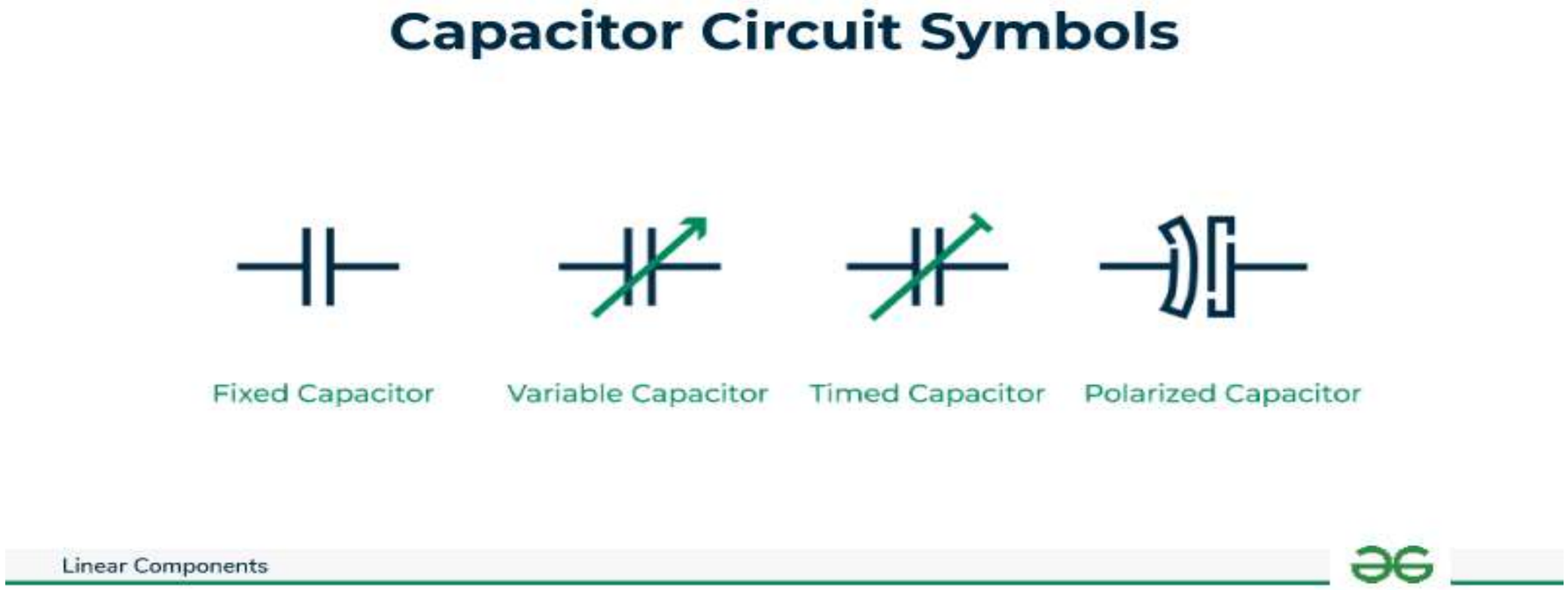
Symbol: The symbol of resistor is given below with its representations.



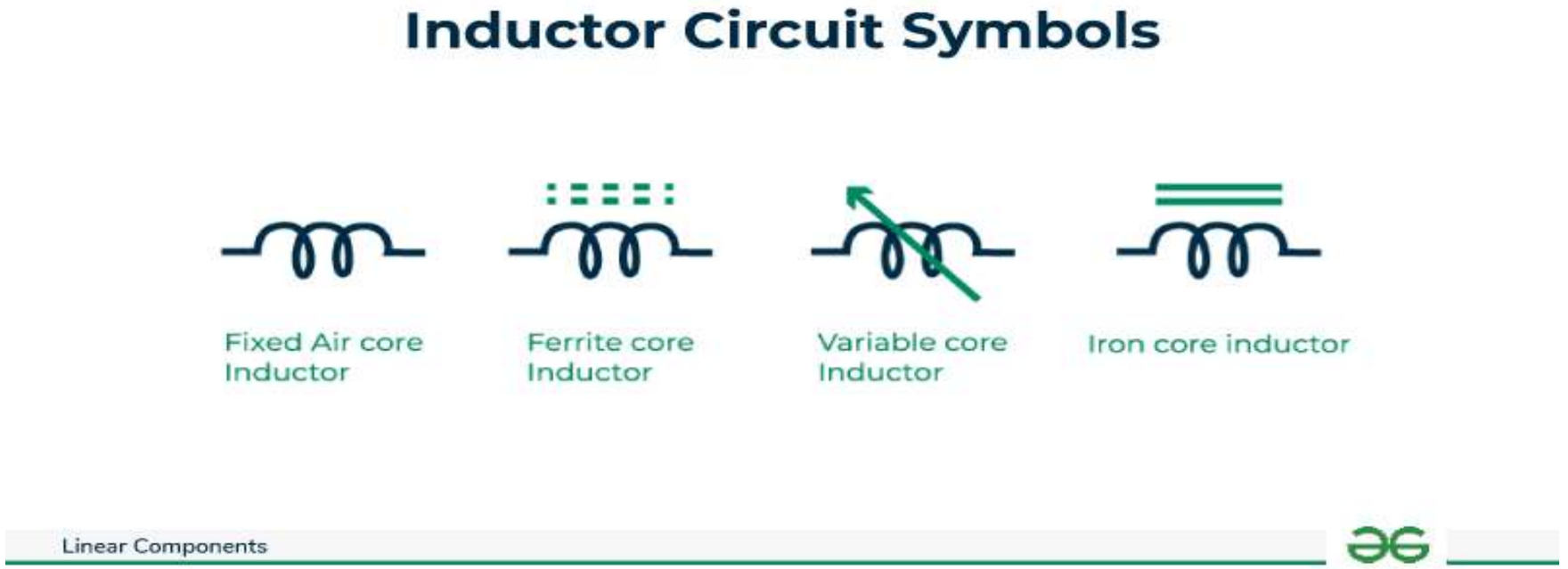
Capacitor (C)

Symbol: The symbol of Capacitor is given below with its representations.

Function: Electrical energy is stored and released by capacitors. Capacitors are frequently employed in filter circuits to pass AC signals while blocking DC signals.



Inductor (L)
Symbol: The symbol of Inductor is given below with its representations.
Function: Inductors store energy in their magnetic fields and resist changes in current. They are frequently employed in filter circuits to allow high-frequency signals to be blocked and low-frequency signals to be passed.



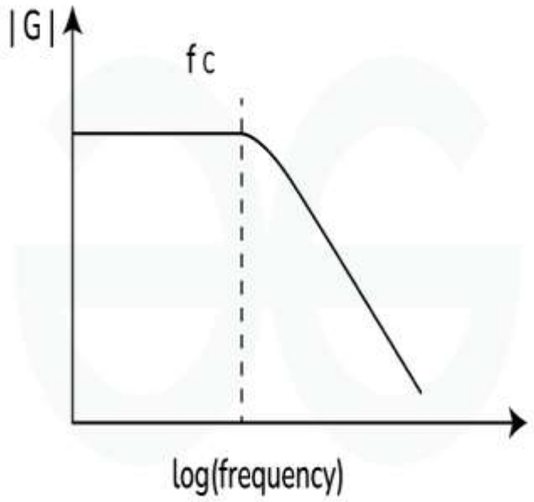
Types of Filter Circuits

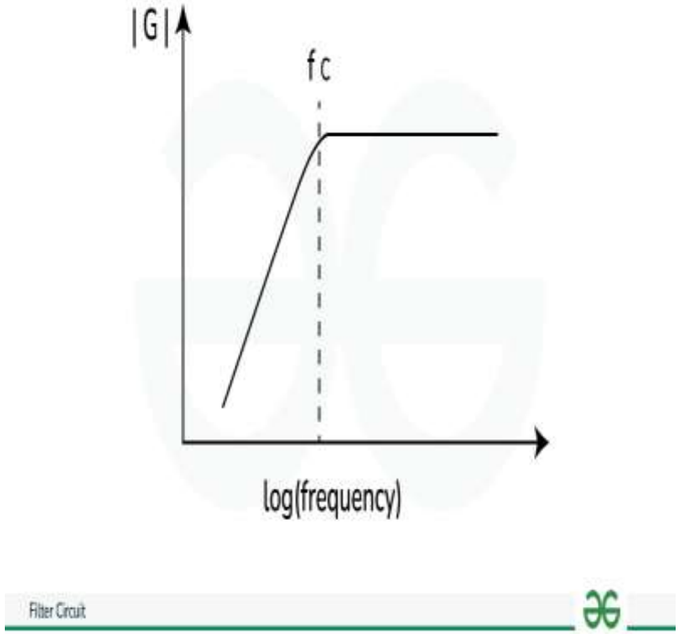
Low-Pass Filter (LPF)

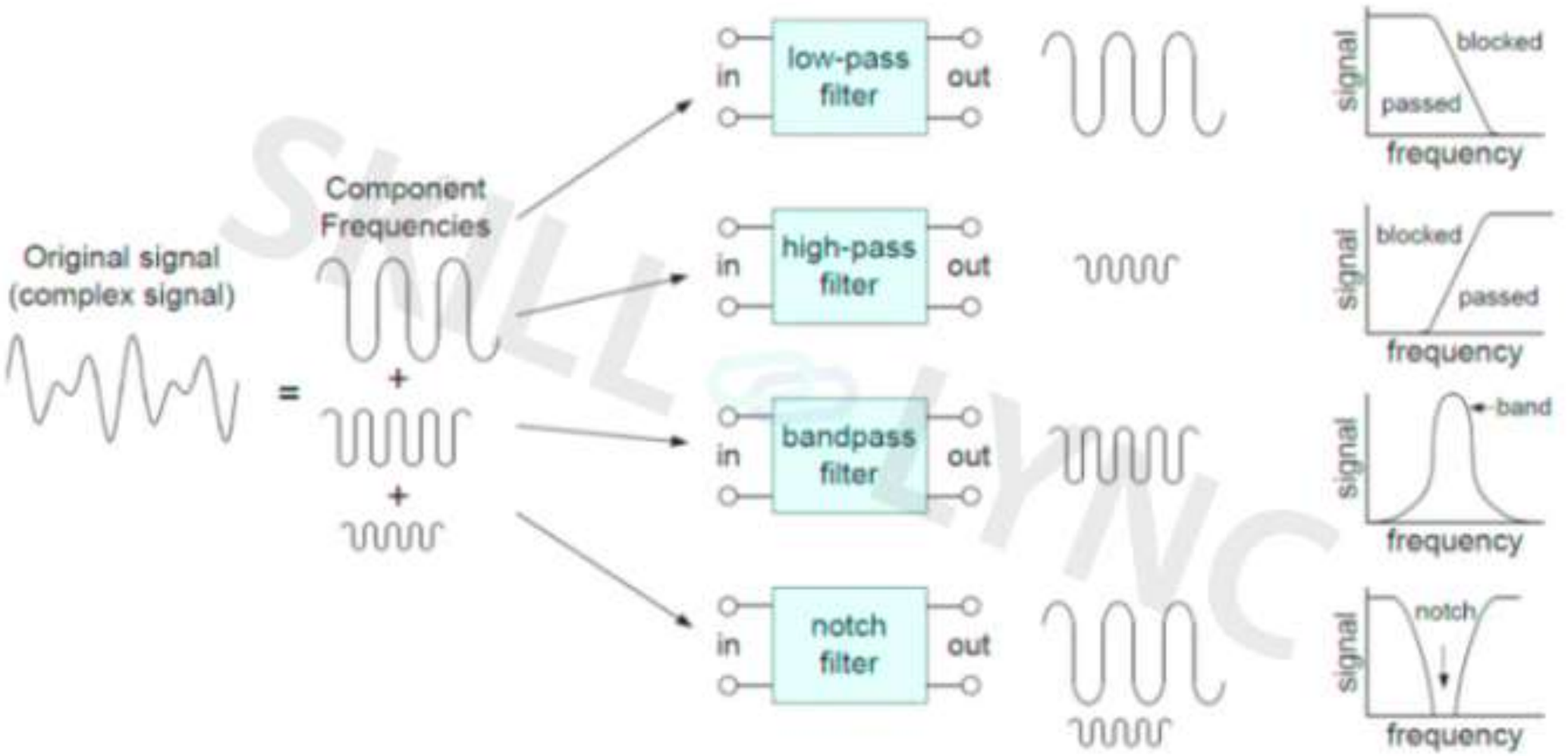
High- Pass Filter (HPF)

Band-Pass Filter (BPF)

Band -Stop Filter (BSF) or Notch filter






Original signal
(complex signal)
=
Component
Frequencies
+
+
in
low-pass
filter
out
in
high-pass
filter
out
in
bandpass
filter
out
in
notch
filter
out
signal
blocked
passed
frequency
signal
blocked
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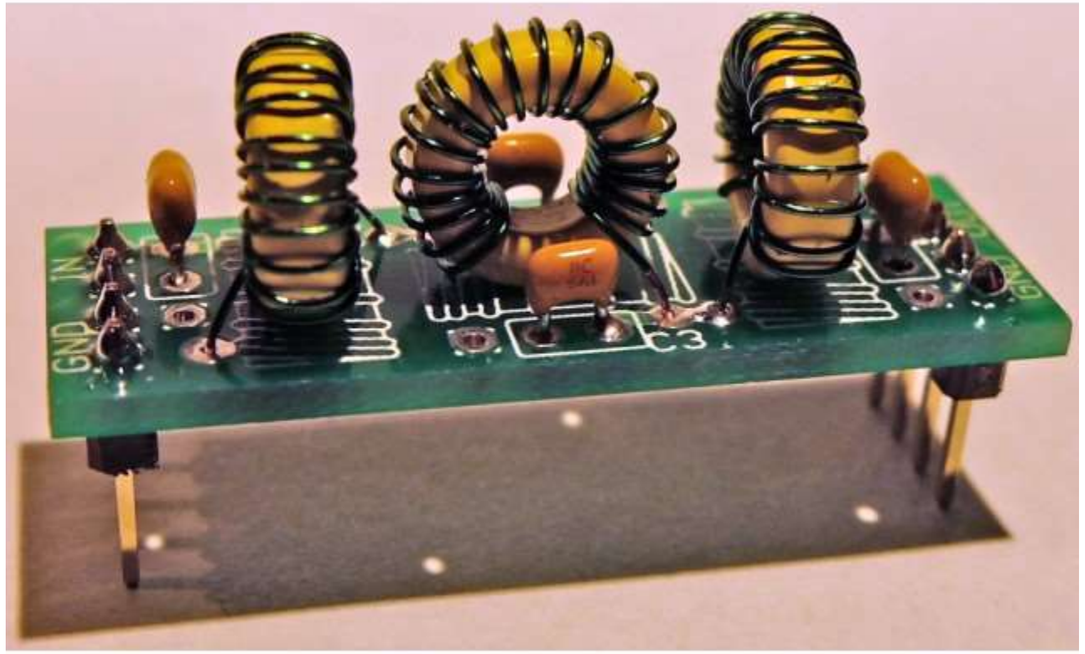
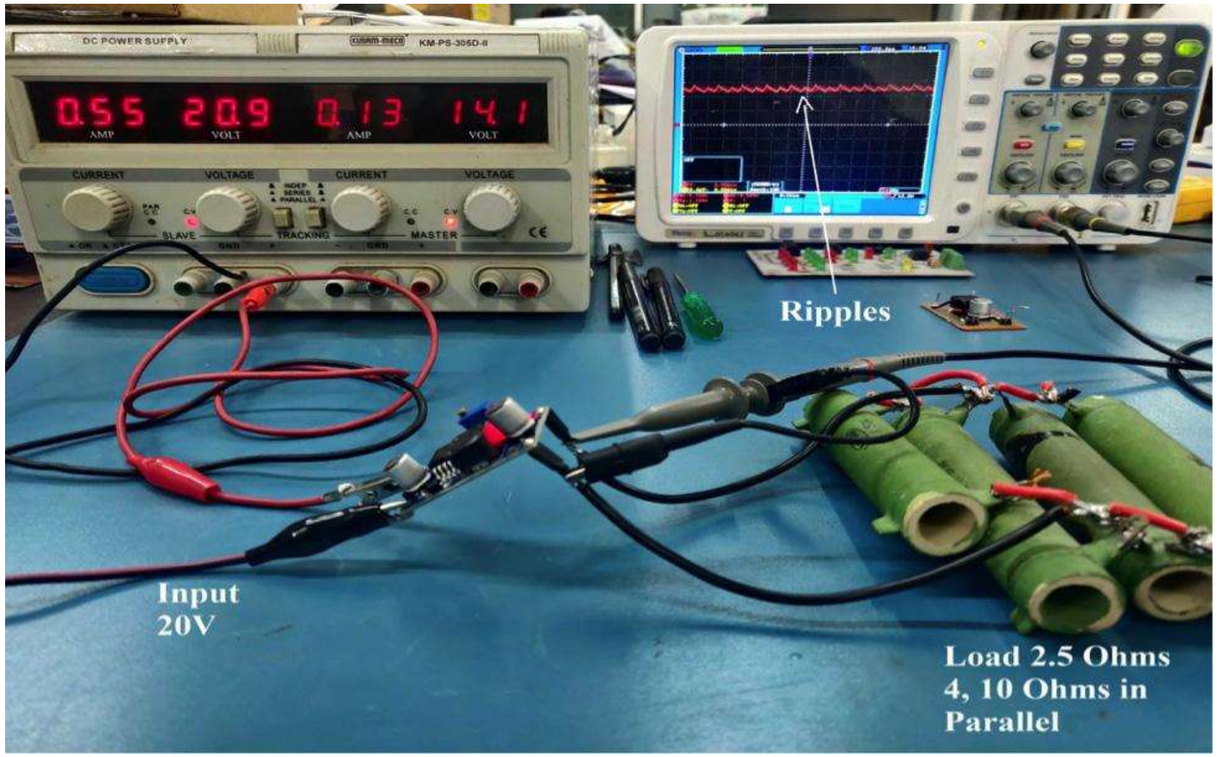
frequency



Low Pass Filter kit



Practical application of hardware filters

Ripple Reduction Concept

Ripple = unwanted AC component in DC output.

Filters work by:
Allowing **DC to pass**
Blocking or reducing **AC components**
Ripple Factor (r):

$$r = \frac{AC\ component}{DC\ component}$$

Lower ripple factor = better DC output

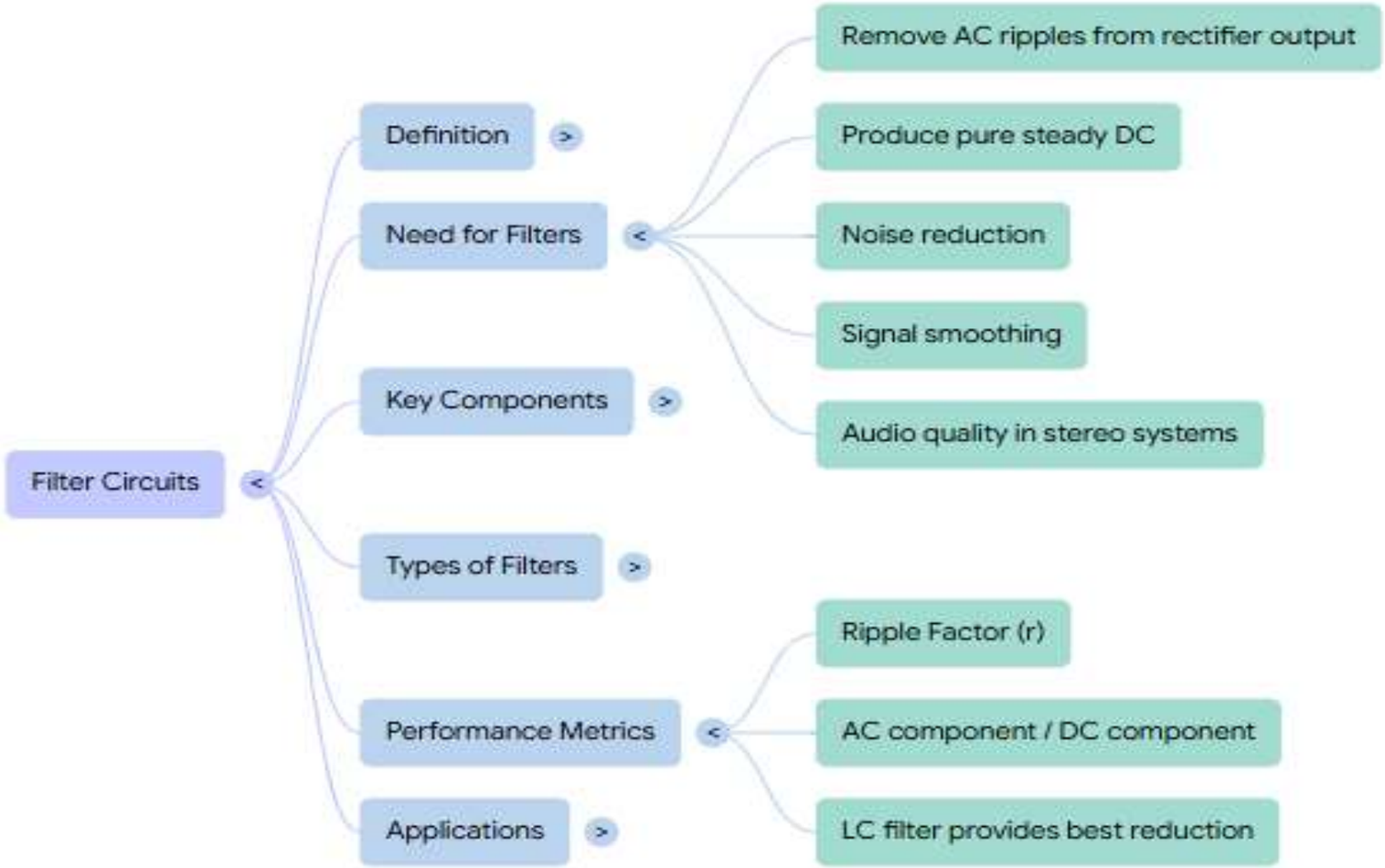
Applications of Filter Circuits

Anti-Alias Filtering : Because digital systems may only represent a signal at specific points in time, aliasing is a phenomenon that occurs.

Noise Rejection : All of the frequencies present in a circuit's components contribute to noise generation. This implies that the output of a circuit that responds to a smaller frequency range will be less noisy. Thus, filters that restrict the frequency range in their output can be helpful in reducing the quantity of noise.

Interference Rejection : It is feasible to minimize interference by a factor of 400 without weakening the signal at 500 Hz by using a band-pass filter with a characteristic frequency of 500 Hz.

Summary


Filter Circuits
Definition
Remove AC ripples from rectifier output
Need for Filters
Produce pure steady DC
Noise reduction
Signal smoothing
Key Components
Audio quality in stereo systems
Types of Filters
Performance Metrics
Ripple Factor (r)
AC component / DC component
LC filter provides best reduction
Applications

1.Quiz: Which filter provides the best ripple reduction for DC output?
A) Capacitor filter
B) Inductor filter
C) LC filter
D) No filter
(Correct: C)

1.Scenario: You are powering a microcontroller that cannot tolerate voltage fluctuations. Which filter type would you use and why?

1.Real-time: A capacitor filter has 1000μF across a 1kΩ load with 10V peak voltage. Calculate the ripple voltage approximately.

References

Muthusubramanian R, Salivahanan S, "Basic Electrical and Electronics Engineering", TataMcGrawHillPublishers,2014.
Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020.

Thank you