SNS COLLEGE OF ENGINEERING

Coimbatore-35
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DEPARTMENT OF CSE (IoT)

23ECT102- ELECTRONIC DEVICES AND CIRCUITS

I YEAR/ II SEMESTER

UNIT 5 – **Rectifier & Filters**

TOPIC –FILTERS

Introduction to Rectifiers

- Harmonics are voltage or current waveforms with frequencies that are integer multiples of the fundamental frequency (e.g., 2×f, 3×f, etc.).

- In rectifiers, the output waveform is not purely DC—it contains distorted waveforms due to **the non-linear switching action** of diodes.

- This distortion leads to **harmonic components** in the output, especially in the absence of filtering.

- Harmonics can:
  - Reduce **efficiency** of power systems,
  - Cause **overheating** in motors and transformers,
  - Lead to **electromagnetic interference (EMI),**
  - Distort nearby signals in electronic circuits.

- Therefore, **filter circuits** are essential to **suppress harmonics** and provide a smoother DC output.

Types of Filters Used in Rectifiers

- To smooth the rectified output, different types of filters are used depending on the load requirements and ripple tolerance.
- The main types of filters are:

1. Inductor Filter

– Uses an inductor (choke) in series with the load
– Blocks AC components while allowing DC to pass

2. Capacitor Filter

– Uses a capacitor in parallel with the load
– Bypasses AC to ground, allowing DC through

3. LC Filter (L-section Filter)

– Combines inductor and capacitor
– More effective in reducing ripple than individual filters

4. CLC Filter (π-type Filter)

– Two capacitors with an inductor in between
– Provides superior ripple suppression– Common in high-quality regulated power supplies

Inductor Filter

- An **inductor filter** uses an inductor (also called a choke) placed in series with the rectifier output and the load.
- The inductor **opposes changes in current** due to its property of inductance (L), which makes it effective at **blocking AC (ripple)** components.
- It allows the **DC component** to pass through to the load with minimal resistance.
- More effective under **high load currents**, as the ripple reduction improves with increasing current.

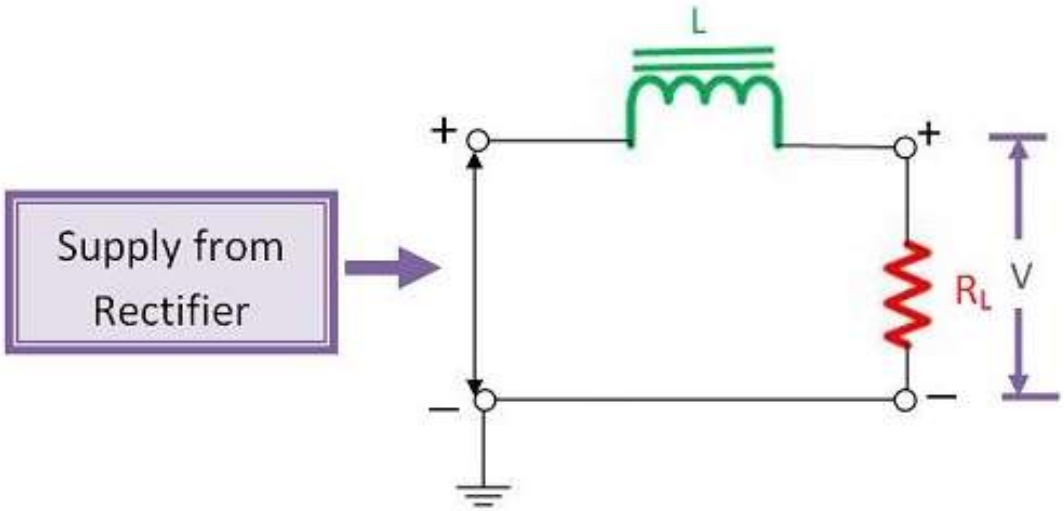
Advantages:

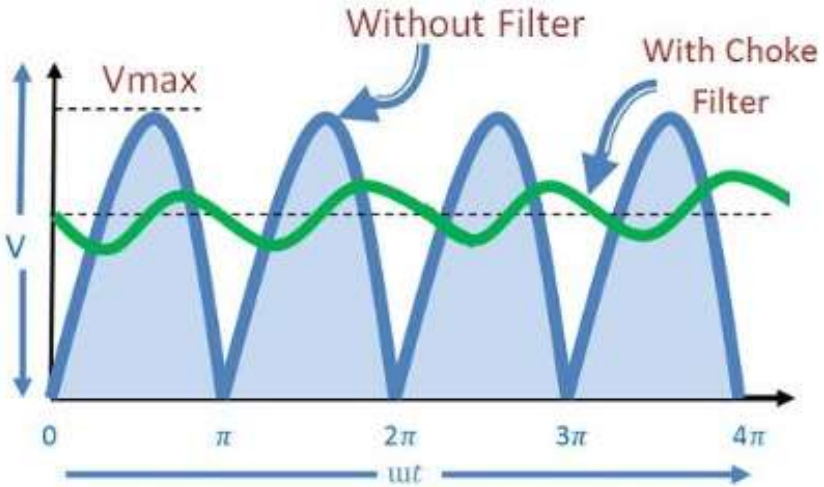
- Simple design
- Effective for high-current applications

Disadvantages:

- Bulky and expensive
- Not suitable for light loads (poor filtering at low current)

Inductor Filter





Capacitor Filter

- A **capacitor filter** uses a **capacitor connected in parallel** with the load at the output of the rectifier.

Working Principle:

– Capacitors **store charge** and resist changes in voltage.

– They **bypass AC components (ripples)** to ground while allowing **DC** to reach the load.

Ripple Reduction:

– The capacitor charges during the peaks of the waveform and discharges during valleys, smoothing the output.

– More effective for **light or moderate loads.**

Advantages:

– Simple, compact, and low cost

– Good ripple suppression at low currents

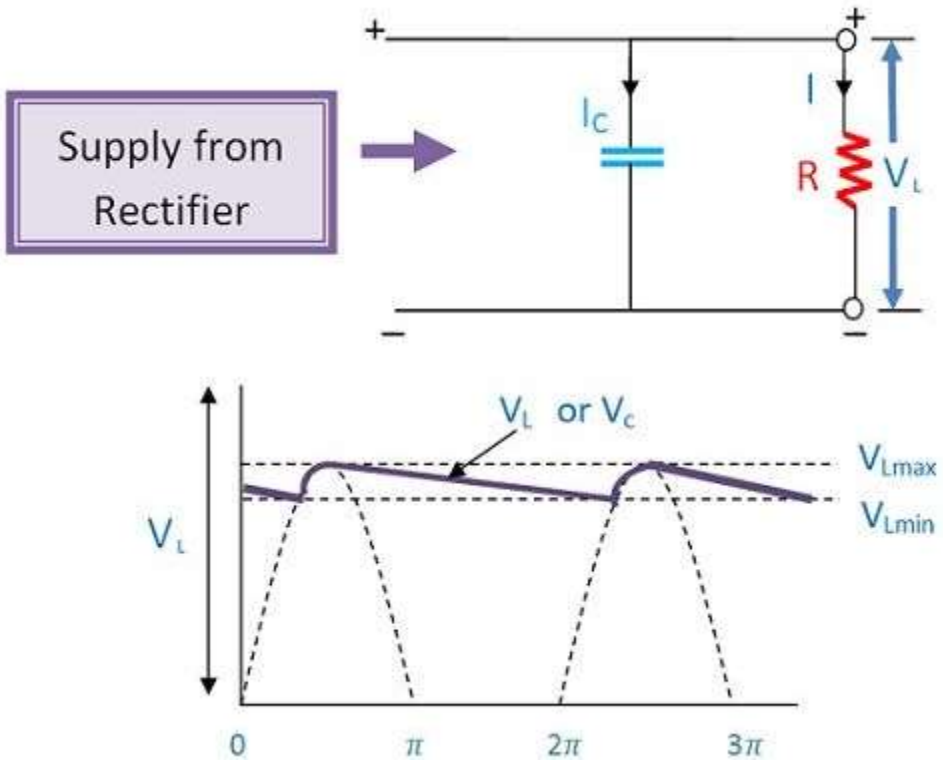
Disadvantages:

– Less effective under heavy load

– Can produce high peak currents during charging

Used in: Small DC power supplies, chargers, and electronic gadgets.

Capacitor Filter



LC (L-Section) Filter

- An **LC filter** (also called **L-section filter**) combines an **inductor (L) in series and a capacitor (C) in parallel** with the load.

Working Principle:

– The **inductor** blocks high-frequency AC (ripple).

– The **capacitor** shunts remaining AC components to ground.

– Together, they provide **better ripple reduction** than single-component filters.

Advantages:

– More effective filtering

– Suitable for medium to high load currents

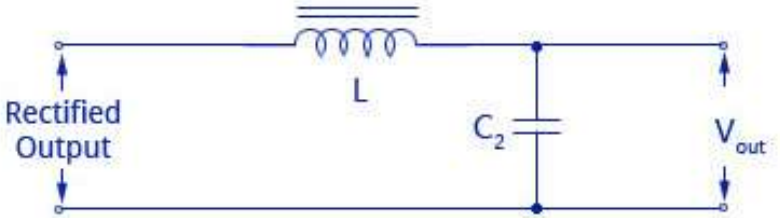
Disadvantages:

– Larger and more expensive than single filters

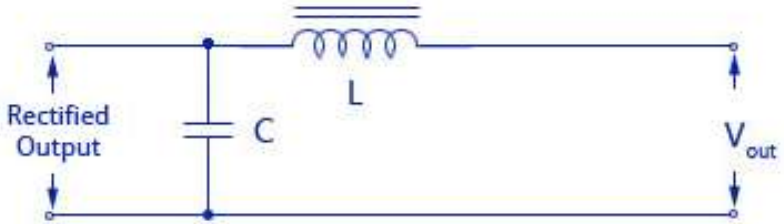
– Performance depends on load conditions.

LC (L-Section) Filter

L-C Filter - Inductor input L Section Filter



L - C Filter - Capacitor input Filter



CLC (π-Type) Filter

- A **CLC filter** (also called a **π-type filter**) consists of:
  - A **capacitor** (C_1) connected in parallel at the input,
  - An **inductor** (L) in series,
  - Another **capacitor** (C_2) in parallel at the output.
- The arrangement looks like the Greek letter **π (pi),** hence the name.

Working Principle:

•**C_1** reduces the initial ripple by bypassing AC.
•**L** blocks remaining AC components.
•**C_2** filters out any leftover ripple, giving a **smooth DC output**.

Advantages:

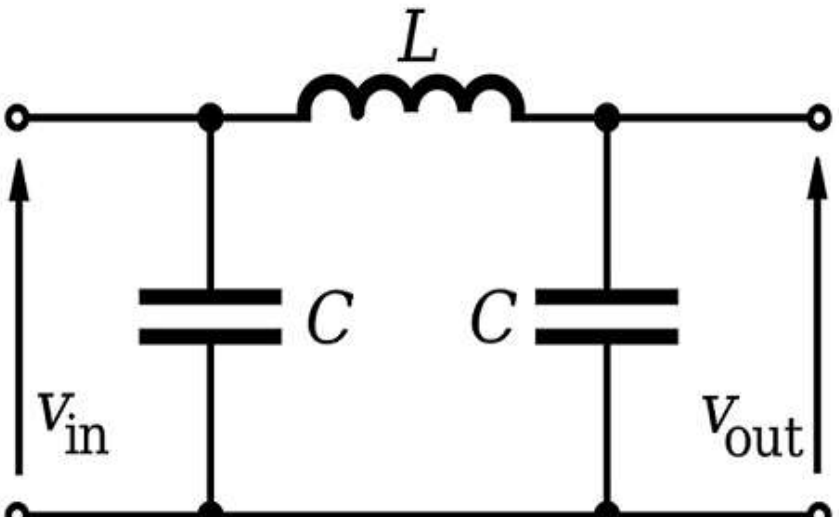
•Excellent ripple reduction—even better than LC filters.
•Provides a **very stable DC voltage**.
•Suitable for **high-load** and **sensitive electronic applications**.

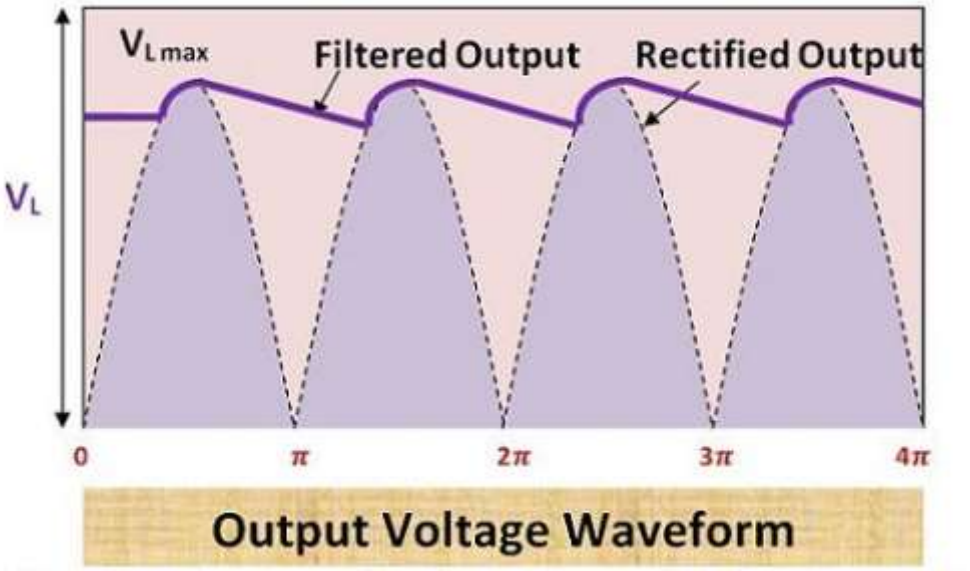
Disadvantages:

•**More costly and bulky** (uses two capacitors and one inductor).
•Requires good quality components for optimal performance.

Used in: High-end regulated power supplies, audio equipment, communication devices.

CLC (π-Type) Filter





Comparison of Filters

Filter Type	Ripple Reduction	Suitable Load	Size / Cost	Remarks
Inductor Filter	Moderate	High current	Large / Expensive	Better at high load; bulky design
Capacitor Filter	Moderate	Light load	Small / Inexpensive	Simple and low-cost; poor at high load
LC (L-section)	Good	Medium to high load	Medium / Moderate cost	Balanced performance and size
CLC (π-type)	Excellent	High & sensitive loads	Large / Expensive	Best ripple suppression; costly & bulky

Thank you!