# Three Week :

## Series RC (Resistor-Capacitor) Alternating Current Circuits

**Course Name**: Electrical Circuits

**Stage**: One

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## Capacitor (also known as Capacitance or Condenser)

A capacitor is a key component in electrical circuits. It is a device used to store electrical energy or charge temporarily in the form of an electric field. It consists of two conductive plates, each carrying an equal but opposite electric charge. These plates are separated by an insulating material (dielectric), such as air.
When integrated into an electrical circuit, the capacitor can discharge its stored energy instantaneously and can also be recharged. Manufactured capacitors typically consist of thin metallic plates separated by insulating layers or rolled into compact forms to reduce size. The capacitor is also known by the terms "capacitance" or "condenser."

The separation of the charged plates creates an **electric field** between them, with negative charge (-Q) on plate A and positive charge (+Q) on the opposite plate. Capacitors operate across a range of voltages—from a few tens of volts (in electronic circuits) to thousands of volts (in power systems).

## Types of Capacitors

A capacitor is made up of two conductive plates with an insulating material (dielectric) in between.

The type of dielectric used determines the classification of the capacitor:

- **Air Capacitor:** Uses air as the dielectric.
- **Plastic Capacitor:** Uses a plastic material as the dielectric.
- **Mica Capacitor:** Uses mica as the dielectric.
- **Ceramic Capacitor:** Uses ceramic materials as the dielectric.
- **Electrolytic Capacitor:** Uses a chemical solution as the dielectric and is also called a chemical or electrolytic capacitor.

Capacitors with a fixed capacitance are known as **fixed capacitors**, while those with adjustable capacitance (by altering the effective plate area) are known as **variable capacitors**.

## Factors Affecting Capacitance

There are three primary factors that directly affect the capacitance of a capacitor:

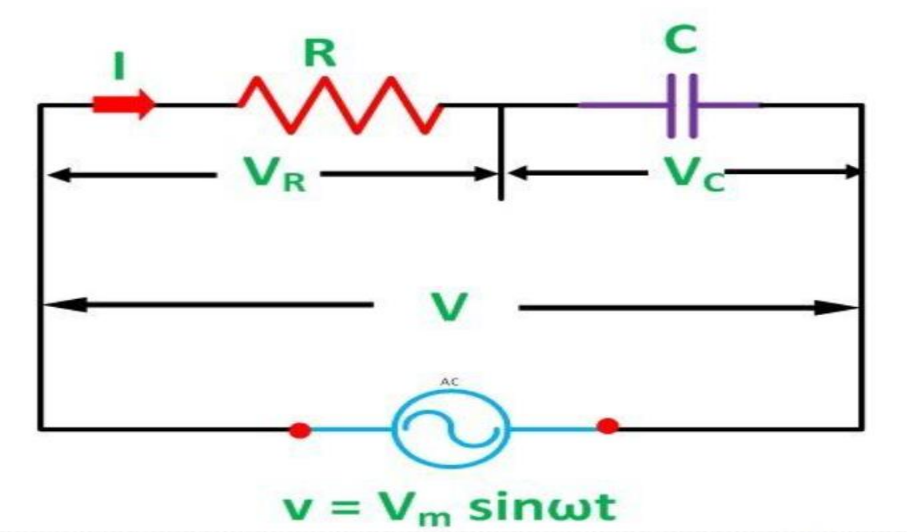
- **Surface Area of the Plates (A):**
  Capacitance is directly proportional to the surface area of the plates. Increasing the surface area increases the capacitor's ability to store charge, and vice versa.
- **Distance Between the Plates (d):**
  Capacitance is inversely proportional to the distance between the plates. As the distance increases, the capacitance decreases.
- **Dielectric Medium (ε):**
  The capacitance varies with the type of dielectric material used between the plates. Air is considered the reference standard for comparing the dielectric properties of other materials. Each dielectric has a constant known as the **dielectric constant** (ε).

Thus, the capacitance **C** of a capacitor can be expressed in terms of the plate area **A**, the distance **d** between plates, and the dielectric constant **ε** as follows:

$$C = \frac{\varepsilon A}{d}$$

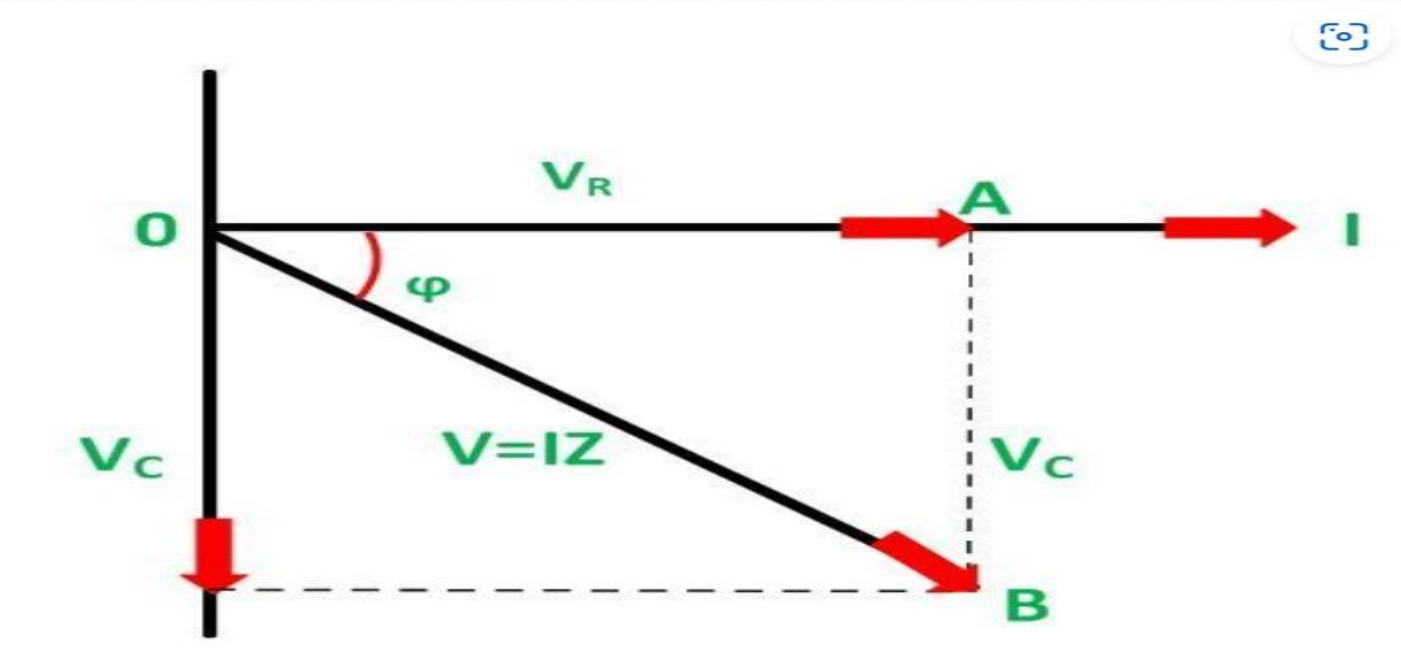
A circuit consisting of a pure **resistor (R)** in ohms connected in series with a pure **capacitor (C)** in farads is known as an **RC Series Circuit**. When an alternating sinusoidal voltage is applied, current **I** flows through both the resistor (R) and the capacitor (C).

The figure below illustrates the **RC Series Circuit**, showing:



- **VR** – Voltage across the resistor
- **VC** – Voltage across the capacitor
- **V** – Total voltage across the RC series circuit

A **diagram** of the RC series circuit is also presented to visualize the phase relationships between voltages and current.



Thank you