What is impedance

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Impedance (Z) is similar to **Resistance (R)** . Impedance and Resistance both oppose the current in circuit. Both are almost the same thing , But **resistance related to DC Circuit**. Resistance oppose the steady electric current in DC circuit. **Resistance remains same** (constant) at any different frequency range.

Impedance is related with AC circuit. Impedance **vary** accordting to changing the frequency, this is not constant at different frequency range. Impedance also includes reactance (Inductive and capacitive property of the circuit).

Reactance- Reactance is the Resistance produced to AC Currents by Inductors and Capacitors only. This is a measure of the type of opposition to AC electricity due to capacitance or inductance.

The **impedance** is denoted by **Z** and unit of it is **Ohm (Ω).**

If the level of ohm is higher then level impedance is also higher.

Impedance = Resistance + Reactance (Either inductive or Capacitive or both)

In DC circuit, **Impedance** is effective Resistance of the circuit.

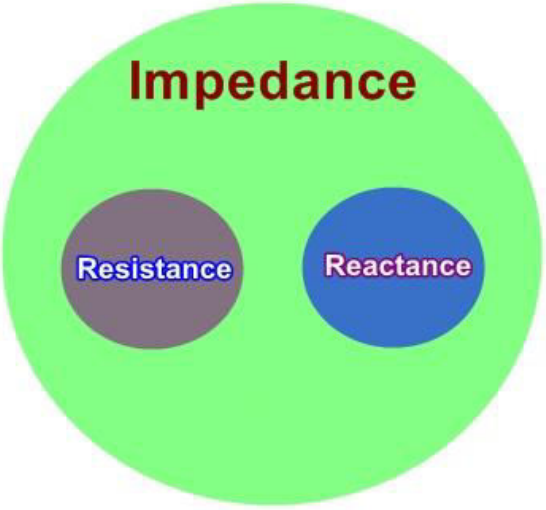
Z= R

In AC circuits, it possesses both magnitude and phase, unlike resistance, which has only magnitude.

In the case of capacitor, When the frequency increased then the resistance (Impedance) of capacitor decreases. In Inductor this is just opposite, When we increase the frequency range then Impedance increase in inductor.

Impedance $Z = \frac{V}{I}$

- **Impedance is defined as combination of resistance and reactance.**



As we cannot assume any circuit with DC Current without Resistance , We cannot assume a circuit with AC current without Impedance.

Rsistive Power- Energy burns by resistive power to Heat goes through that system ,

In Reactive Power- the energy goes to Antennas, Speaker, transmission line, cable etc represents how much energy to be stored and propagates. Not burn to heat ie Impedance.

Resistance $R = \frac{V}{I}$ If there is Only **Resistor** is connected with Load in any circuit then is called Resistor.

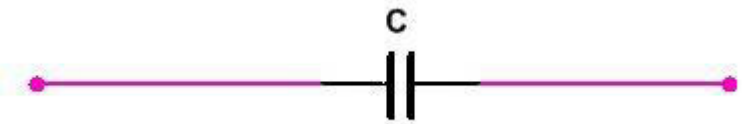
• **Reactance** $Z = \frac{V}{I}$ If any circuit there is Only **inductor** or **capacitor** connected with load. Then the value of v/I is called reactance.

In Reactance There are 2 cases

(1) If **inductor** in conneted then in this case **recatance** is called **inductive reactence**,

and its value in scaler form $X_L = wL$, and in vector form $X_L = JwL$ Where $w = 2\Pi f$. Here If frequency is increased then the value of wL is also increased.

(2) If **Capacitor** is connected then the Reactance is called **Capacitive Reactance** and it is denoted by (scaler form) Xc = $Xc = \frac{1}{C}$



In vector form $Xc = \frac{1}{j\omega C}$ Where $\omega = \frac{1}{2\pi fc}$ If frequency (f) is increased then value of Xc is decreased. ie **ω** inversly proportional to **2Πf**.

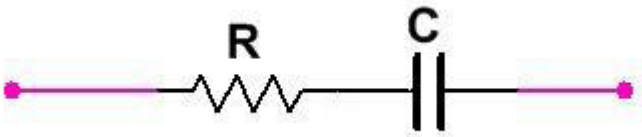
♦ **Impedance – If Any ircuit consist Resistance -*Inductor. Or Resistance - Capacitor, Or Resistance-inducter-Capacitor*. Then the value of v/I is called Impedance.**

It is denoted by $Z = \frac{V}{I}$

- **If Resistor(R) and Inductor(L) connected –The value of Impedance (scaler form)** $Z = \sqrt{R^2 + (L\omega)^2}$

In vector form Z= R+jωL

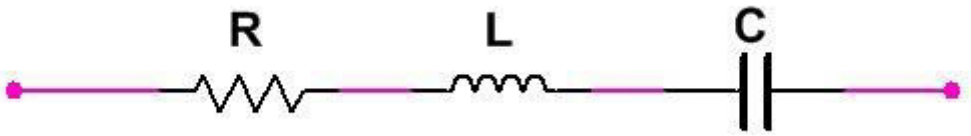
- **If Resistor (R) and Capacitor(C) connected - Then**



Impedance $Z = \sqrt{R^2 + (\frac{1}{C\omega})^2}$

And In vector form ipedance $Z = R + \frac{1}{j\omega C}$

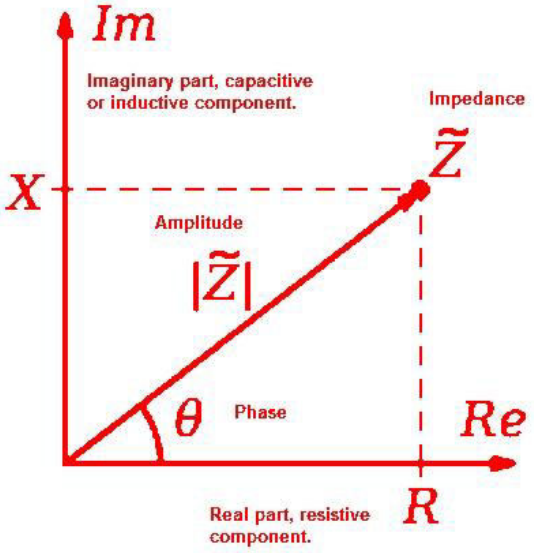
- **If Resistor (R) , Inductor (L) capacitor (C) Connected - Then**



Impedance $Z = \sqrt{R^2 + (L\omega - \frac{1}{C\omega})^2}$

In vector form $Z = R + j\omega L - \frac{1}{j\omega C}$

Phasor Diagram of Impedance



Unit

- **Impedance - Ω**
- **Reactance - Ω**
- **Resistance - Ω**

Also Read What is NOT Gate Logic