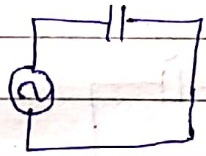
Dr. Mohammad Aslam, Dept. of physics.
B. Sc Part-2, Physics (Hons), Paper-IV
Lecture-22.

* Complex Reactances :-
There are two primary types of reactances:-
① Capacitive reactance ↳ when only capacitor is connected in the circuit.



It is denoted by X_C.

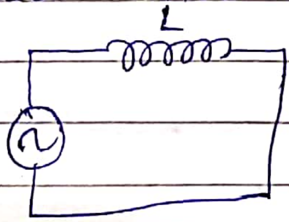
The complex form of X_C is

$$X_C = \frac{1}{jwC}$$

$$\text{or} \quad X_C = -\frac{j}{wC}$$

where j is complex number,
w is the angular frequency and C is the capacitance

② Inductive reactance :- when only inductor is connected with AC circuit.



It is denoted by X_L.

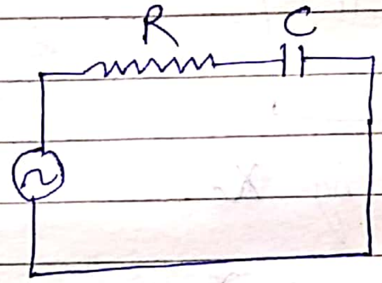
The complex form of X_L is

$$X_L = jwL$$

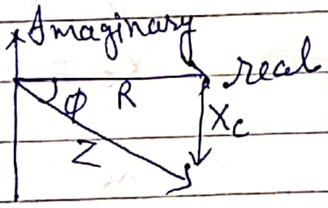
, L is the inductor

Complex Impedance :->

(1) RC Circuit :-> An AC Circuit in which a resistance and a capacitor connected in series.



Phasor diagram



Now the complex impedance is given as

$$Z = R + X_c$$

but $X_c = \frac{-j}{\omega C}$

$$Z = R - \frac{j}{\omega C}$$

or

$$Z = |Z| e^{j\phi}$$

where $|Z| = \sqrt{R^2 + \left(\frac{-1}{\omega C}\right)^2}$

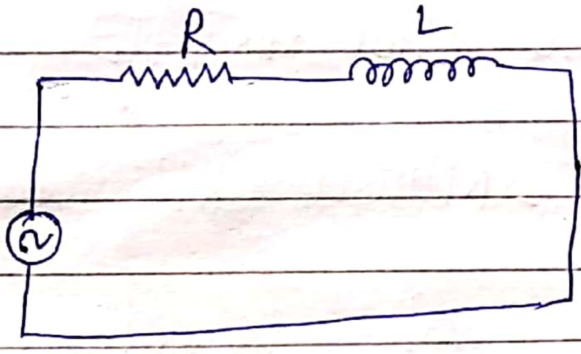
$$\boxed{|Z| = \sqrt{R^2 + \frac{1}{\omega^2 C^2}}}$$

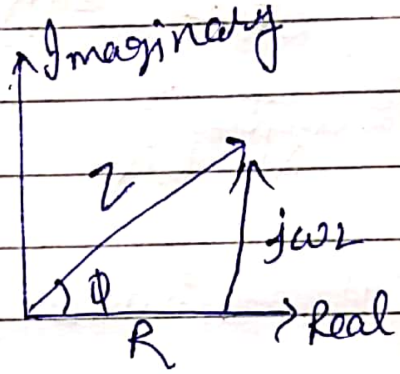
and $\tan\phi = \frac{|X_c|}{|R|} =$

$$\tan\phi = \frac{+1}{\omega C R}$$

$$\phi = \tan^{-1}\left(\frac{+1}{\omega C R}\right)$$

② RL Circuit :⇒ An AC circuit in which a resistance and an inductor is connected in series.





The complex impedance is given as

$$Z = R + X_L$$

$$Z = R + j\omega L$$

$$Z = |Z| e^{j\phi}$$

$$|Z| = \sqrt{R^2 + \omega^2 L^2}$$

$$\boxed{|Z| = \sqrt{R^2 + \omega^2 L^2}}$$

$$\tan\phi = \frac{|X_L|}{|R|}$$

$$\tan\phi = \frac{\omega L}{R}$$

$$\boxed{\phi = \tan^{-1}\left(\frac{\omega L}{R}\right)}$$