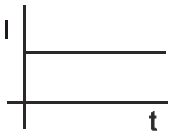
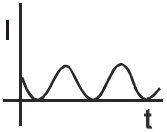
ALTERNATING CURRENT

1. AC AND DC CURRENT :

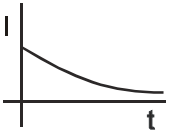
A current that changes its direction periodically is called alternating current (AC). If a current maintains its direction constant it is called direct current (DC).



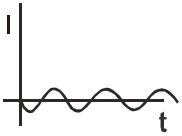
constant dc



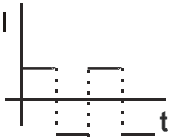
periodic dc



variable dc



ac



ac

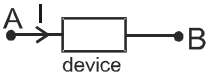
3. ROOT MEAN SQUARE VALUE:

Root Mean Square Value of a function, from t_1 to t_2, is defined as

$$f_{rms} = \sqrt{\frac{\int_{t_1}^{t_2} f^2 dt}{t_2 - t_1}} \ .$$

4. POWER CONSUMED OR SUPPLIED IN AN AC CIRCUIT:

$$\text{Average power consumed in a cycle} = \frac{\int_0^{\frac{2\pi}{\omega}} P dt}{\frac{2\pi}{\omega}} = \frac{1}{2} V_m I_m \cos\phi$$



$$= \frac{V_m}{\sqrt{2}} \cdot \frac{I_m}{\sqrt{2}} \cdot \cos\phi = V_{rms} I_{rms} \cos\phi$$

Here $\cos\phi$ is called **power factor**.

5. SOME DEFINITIONS:

The factor **cos ϕ** is called **Power factor**.

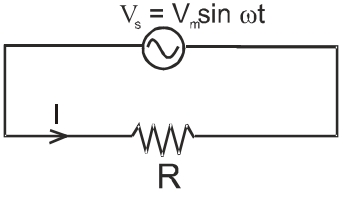
I_m sin ϕ is called **wattless current**.

Impedance Z is defined as $Z = \frac{V_m}{I_m} = \frac{V_{rms}}{I_{rms}}$

ωL is called **inductive reactance** and is denoted by X_L.

$\frac{1}{\omega C}$ is called **capacitive reactance** and is denoted by X_C.

6. PURELY RESISTIVE CIRCUIT:



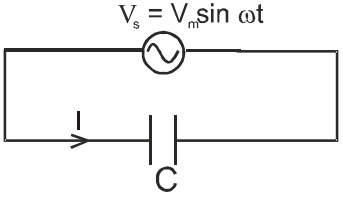
$$I = \frac{v_s}{R} = \frac{V_m \sin \omega t}{R} = I_m \sin \omega t$$

$$I_m = \frac{V_m}{R}$$

$$I_{rms} = \frac{V_{rms}}{R}$$

$$\langle P \rangle = V_{rms} I_{rms} \cos \phi = \frac{V_{rms}^2}{R}$$

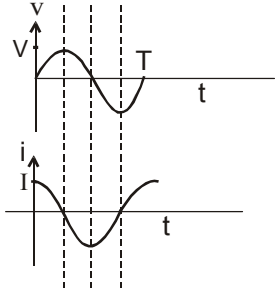
7. PURELY CAPACITIVE CIRCUIT:



$$I = = \frac{V_m}{1/\omega C} \cos \omega t$$

$$= \frac{V_m}{X_C} \cos \omega t = I_m \cos \omega t.$$

$X_C = \frac{1}{\omega C}$ and is called capacitive reactance.



I_C leads by v_C by $\pi/2$ Diagrammatically (phasor diagram) it is represented as

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Since $\phi = 90^o$, <P> = $V_{rms}\ I_{rms} \cos\phi = 0$