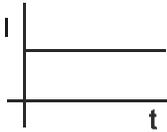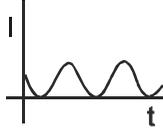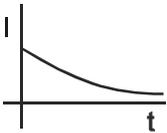# ALTERNATING CURRENT

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).
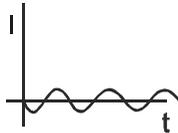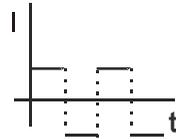

constant dc   periodic dc
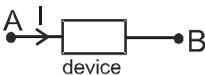

variable dc   ac   ac

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:

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

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

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 $Z = \dfrac{V_m}{I_m} = \dfrac{V_{rms}}{I_{rms}}$

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

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

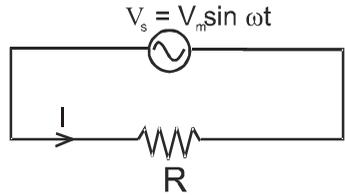**6.** **PURELY RESISTIVE CIRCUIT:**

$V_s = V_m \sin \omega t$

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

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

$I_{rms} = \dfrac{V_{rms}}{R}$
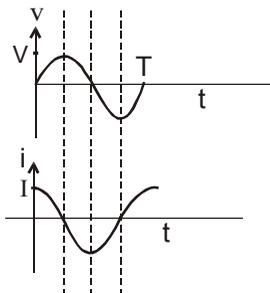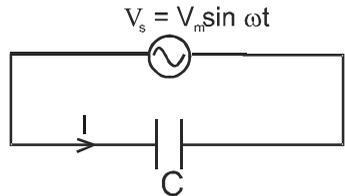
$<P> = V_{rms} I_{rms} \cos \phi = \dfrac{V_{rms}^2}{R}$

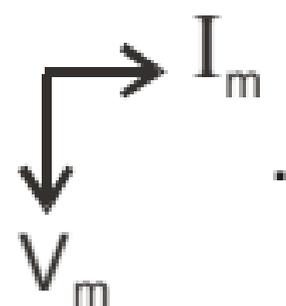**7.** **PURELY CAPACITIVE CIRCUIT:**

$V_s = V_m \sin \omega t$

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

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

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

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

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