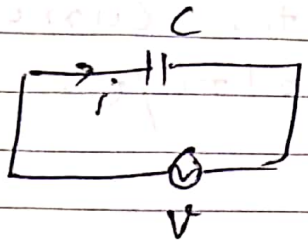
A.C CIRCUIT CONTAINING PURE capacitor.



We know that,

$$v = V_m \sin \omega t \quad \text{——} (1)$$

$$i = \frac{dq}{dt} \quad \text{(in case of capacitance)}$$

$$q = CV$$
$$= C V_m \sin \omega t$$

So, $$i = \frac{d}{dt} C V_m \sin \omega t$$

$$= C V_m \frac{d}{dt} \sin \omega t$$

$$i = C V_m \omega \cos \omega t$$

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

We know that $\sin\left(\frac{\pi}{2} + \theta\right) = \cos\theta$

and $I_m = \frac{V_m}{1/\omega C}$

$$i = I_m \sin\left(\omega t + \frac{\pi}{2}\right) \quad \text{——} (2)$$

Sunday 17

Notes

Appointment

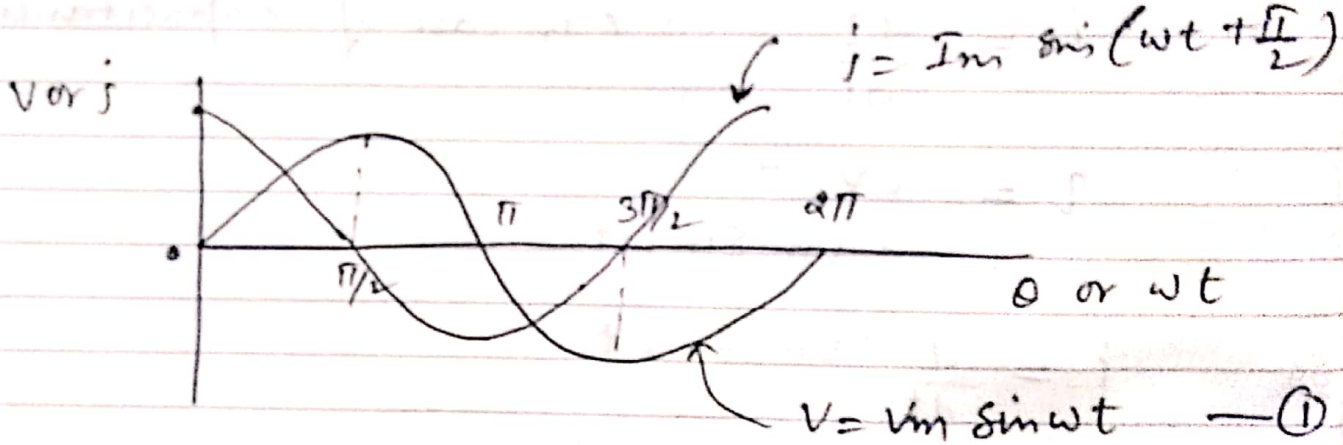
August'11

Monday	1	8	15	22	29
Tuesday	2	9	16	23	30
Wednesday	3	10	17	24	31
Thursday	4	11	18	25	
Friday	5	12	19	26	
Saturday	6	13	20	27	
Sunday	7	14	21	28	

Comparision eqⁿ ① and eqⁿ ②

in case of capacitance the current is leading 90° as compared to voltage.

wave diagram



in the case of pure capacitance current is leading to the applied voltage by 90°

Instantaneous Power

$$p = vi$$

$$= V_m \sin\omega t \cdot I_m \sin\left(\omega t + \frac{\pi}{2}\right)$$

$$= \frac{V_m I_m}{2} 2 \sin\omega t \cos\omega t$$

$$= \frac{V_m}{\sqrt{2}} \frac{I_m}{\sqrt{2}} \sin 2\omega t$$

$$= V_{rms} I_{rms} \sin 2\omega t$$

Average Power

$$P_{av} = V_{rms} \cdot I_{rms} \cdot (0)$$

$$= (0) \quad \text{zero}$$

Capacitive Reactance:

in the expression: $I_m = \frac{V_m}{1/\omega C}$

$\frac{1}{\omega C}$ ⟶ is the capacitive reactance

and is denoted by X_C

$$\therefore X_C = \frac{1}{\omega C}$$

Ex = A capacitor of 100 μf is connected across a 200 V, 50 Hz single phase supply. Calculate
(i) the reactance of the capacitor
(ii) rms value of the current
(iii) maximum current

Ans = given, $C = 100\,\mu f$
$V = 200\,V \rightarrow V_{rms}$
$f = 50\,Hz$

(i) Reactance of capacitor.

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$$

$$= \frac{1}{2\pi \times 50 \times 100}$$

$$= 31.83\,\Omega.$$

(ii) Rms value of current

$$I_m = \frac{V_m}{1/\omega C} = \frac{V_m}{X_C}$$

$$\frac{I_m}{\sqrt{2}} = \frac{V_m/\sqrt{2}}{X_C}$$

$$I_{rms} = \frac{V_{rms}}{X_C} = \frac{200}{31.83}$$

$I_{rms} = 6.283\ A$

(iii)

$$I_{rms} = \frac{I_m}{\sqrt{2}}$$

$$I_m = I_{rms}\sqrt{2}$$
$$= 6.283 \times \sqrt{2}$$
$$= 8.886\ A$$