Alternating Current

$\Rightarrow$ Capacitor groth and Decay : $t = \tau \ln 2$ $= t = \left(\frac{L}{R}\right)\ln 2.$

* Root mean square Current (Rms) :-

$$I_{rms} = \sqrt{\langle I^2 \rangle}$$

Ex! $I = I_0 \sin\omega t$ $t=0$ to $t = \frac{2\pi}{\omega}$

$= I^2 = I_0^2 \sin^2\omega t.$

Rms

$$= \int_0^{2\pi/\omega} \quad \langle I^2 \rangle = \frac{\int I^2 dt}{\int dt}$$

$$\langle I^2 \rangle = \frac{\int I_0^2 \sin^2\omega t \, dt}{\int dt}$$

$$\langle I^2 \rangle = \frac{I_0^2 \int_0^T \frac{(1-\cos 2\omega t)\,dt}{2}}{\frac{2\pi}{\omega}}$$

$-\sin 2\omega t.$

$$= \frac{\omega I_0^2}{2\pi \times 2}\left[t - \frac{\sin 2\omega t}{2\omega}\right]_0^{2\pi/\omega}$$

$$= \frac{\omega I_0^2}{4\pi}\left((t-0) - \frac{1}{2\omega}\left(\sin 2\omega \times \frac{2\pi}{\omega} - \sin 0\right)\right)_2$$

$$= \frac{\omega I_0^2}{4\pi}\left(\frac{2\pi}{\omega}\right)$$

$$\langle I^2 \rangle = \frac{\omega I_0^2}{4\pi}\left(\frac{2\pi}{\omega}\right) \qquad \langle I^2 \rangle = \frac{I_0^2}{2}$$

mean Square Current

$I_{rms} = \frac{I_{mean}\ \text{for}\ \theta_0}{\sqrt{2}}$

$I_{rms} = \sqrt{\langle I^2 \rangle} = \sqrt{\frac{I_0^2}{2}}$

Area under the curve / time int

$I_{rms} = \frac{I_0}{\sqrt{2}} = 0.707\, I_0$

*** Note:-**

$\theta = 0$ to 2π

$\langle \sin\theta \rangle = 0$

$\langle \cos\theta \rangle = 0$

$\langle \sin^2\theta \rangle = \frac{1}{2}$

$\langle \cos^2\theta \rangle = \frac{1}{2}$

$$\boxed{= \frac{\text{max value} + \text{min value}}{2}}$$

(M-2) :- $I = I_0 \sin\omega t$

$I^2 = I_0^2 \sin^2\omega t$

$\langle I^2 \rangle = I_0^2 \langle \sin^2\omega t \rangle$

$\langle I^2 \rangle = \frac{I_0^2}{2}$

$I_{rms} = \sqrt{\frac{I_0^2}{2}} = \frac{I_0}{\sqrt{2}}$

Ex! $V = V_0 \cos\omega t$.

~~$V = IR$~~ $= \cancel{I = \frac{V}{R}}$.

$V^2 = V_0^2 \cos^2\omega t$

$\langle V^2 \rangle = V_0^2 \langle \cos^2\omega t \rangle$

$\langle V^2 \rangle = V_0^2 \times \frac{1}{2}$

$V_{rms} = \sqrt{\frac{V_0^2}{2}} = \frac{V_0}{\sqrt{2}}$ Ans

Ex $I = a + b\sin\theta$ $\quad I_{rms} = ?$

$$\cancel{I^2 = a^2 + b^2\sin^2\theta}$$

$$\cancel{\langle I^2\rangle = a^2 + b^2\langle \sin^2\theta\rangle}$$

$$I_{rms} = (a^2 + b^2) \times \frac{1}{2}$$

$$I_{rms} = \sqrt{\frac{a^2+b^2}{2}} =$$

$I^2 = a^2 + b^2\sin^2\theta + 2ab\sin\theta$

$\langle I^2\rangle = a^2 + b^2\langle\sin^2\theta\rangle + 2ab\langle\sin\theta\rangle$

$\langle I^2\rangle = a^2 + b^2 \times \frac{1}{2} + 2ab\times 0$

$$\langle I^2\rangle = a^2 + \frac{b^2}{2} = \frac{2a^2+b^2}{2}$$

$$I_{rms} = \sqrt{\langle I^2\rangle}$$

$$= \sqrt{\frac{2a^2+b^2}{2}}$$

Ex: $a\sin\theta + b\cos\theta$

$$I^2 = a^2\sin^2\theta + b^2\cos^2\theta + 2a\sin\theta\, b\cos\theta$$

$$= 2\sin\theta$$

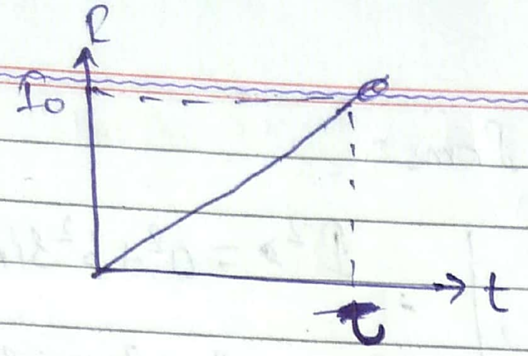
$$= a^2\sin^2\theta + b^2\cos^2\theta.$$

$$\langle I^2\rangle = \frac{a^2}{2} + \frac{b^2}{2} + \cancel{ab\langle\sin 2\theta\rangle}$$

$$I_{rms} = \sqrt{\frac{a^2}{2}+\frac{b^2}{2}} = \sqrt{\frac{a^2+b^2}{2}}$$

$$= \frac{\sqrt{a^2+b^2}}{\sqrt{2}}$$

Ex:-



$$y = mx$$

$$I = \frac{I_0}{\tau} t$$

$$I^2 = \frac{I_0^2}{\tau^2} t^2$$

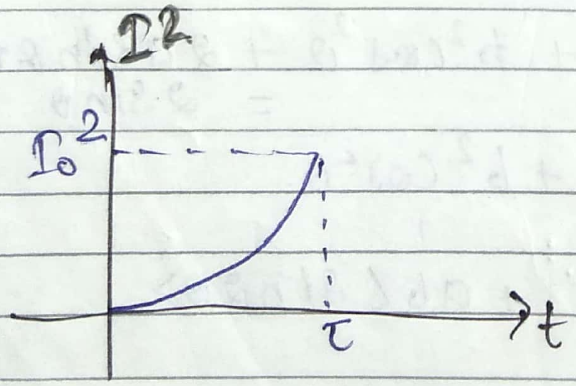
$$\langle I^2 \rangle = \frac{\int_0^\tau I^2 dt}{\int_0^\tau dt}$$

$$\langle I^2 \rangle = \frac{I_0^2}{\tau^2} \frac{\int_0^\tau t^2 dt}{\int_0^\tau dt}$$

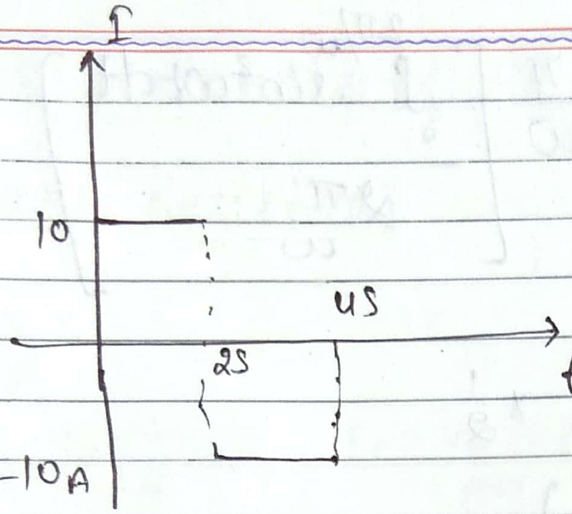
$$\langle I^2 \rangle = \frac{I_0^2}{\tau^2} \frac{\tau^3}{3\tau} = \frac{I_0^2}{3}$$

$$\Rightarrow \boxed{I_{rms} = \sqrt{\frac{I_0^2}{3}} = \frac{I_0}{\sqrt{3}}}$$ learn

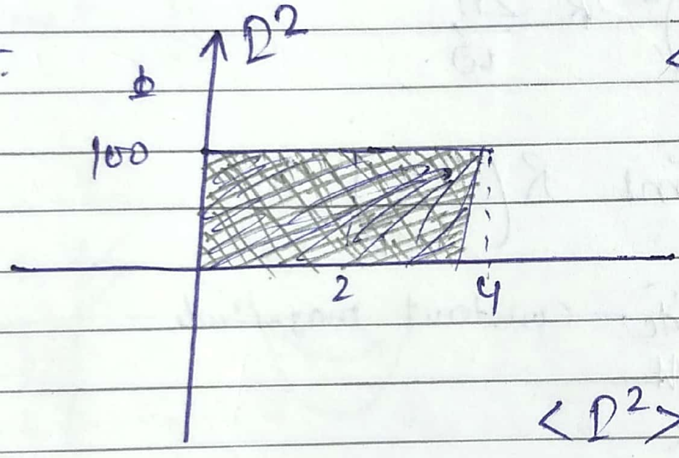
(M-2)



Ex:



find out I_{rms} b/w $t=0$ to $t=4$ Sec.



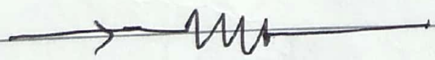
$$\langle I^2 \rangle = \frac{\int_0^4 I^2 dt}{\int_0^4 dt}$$

$$= \frac{Area}{4}$$

$$\langle I^2 \rangle = \frac{400}{4} = 100.$$

$$I_{rms} = \sqrt{100} = 10\,A$$

Ex:



$I = I_0 \sin\omega t$ $t=0$ to $t = \frac{2\pi}{\omega}$

$H = ?$

$$H = \int I^2 R\, dt$$

$$H = I_0^2 R \int_0^{2\pi/\omega} \sin\omega t\, dt =$$

$$\boxed{I_{dc} = I_{rms} = \frac{I_0}{\sqrt{2}}}$$

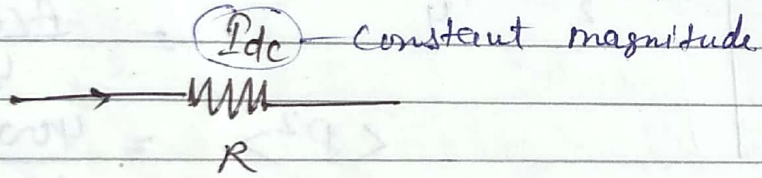
$$H = I_0^2 R \times \frac{2\pi}{\omega}\left[\frac{\int_0^{2\pi/\omega} \sin^2 \omega t\, dt}{\frac{2\pi}{\omega}}\right]$$

$$H = I_0^2 R \,\frac{2\pi}{\omega} \times \frac{1}{2}$$

$$H = \frac{I_0^2}{2} R\left(\frac{2\pi}{\omega}\right)$$

$$H = \left(\frac{I_0}{\sqrt{2}}\right)^2 R \,\frac{2\pi}{\omega}$$

$$H = I_{rms}^2 R\left(\frac{2\pi}{\omega}\right)$$



$$H = I_{dc}^2 R \,\frac{2\pi}{\omega}$$

$$\boxed{I_{dc} = I_{rms}}$$

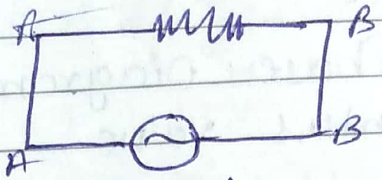
Note: Ac Ammeter and Voltmeter ~~placed~~ ~~on~~ are based on Heating effect of Current and measure rms value.

* Avg. Current and Avg. voltage for AC is Considered zero for long time interval

SI = ~~30~~ 13 — 2019
O-2 : 16, 17, 18
Race : 55

* ~~AC~~ Elements of AC:

(i) Pure Resistor:



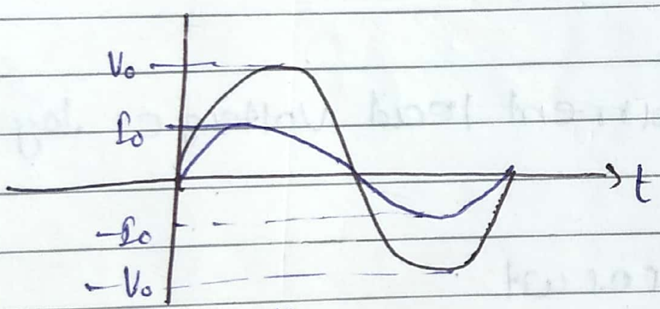
$i = \frac{V}{R}$

$V = V_0 \sin \omega t$

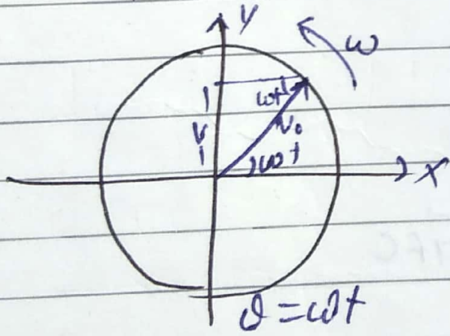
$I = \frac{V_0 \sin \omega t}{R}$ $\quad I_0 = \frac{V_0}{R}$

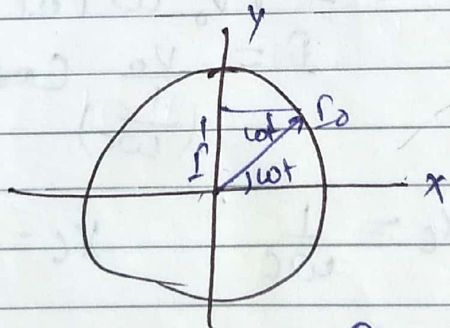
$I = \frac{I_0 \sin \omega t}{R}$ $\quad I_0 = \frac{V_0}{R}$ $\quad I = I_0 \sin \omega t$

$I_{rms} = \frac{I_0}{\sqrt{2}} \; \frac{V_0}{R}$ $\quad \boxed{I_{rms} = \frac{V_{rms}}{R}}$



$V = V_0 \sin \omega t$
$I = I_0 \sin \omega t$
$\Delta \phi = \omega t - \omega t = 0$



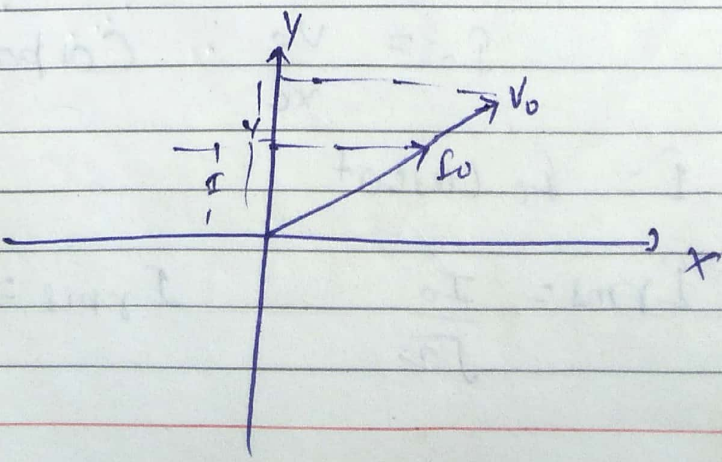


$\theta = \omega t$

$\sin \omega t = \frac{v}{V_0}$

$V = V_0 \sin \omega t$

$I = I_0 \sin \omega t$



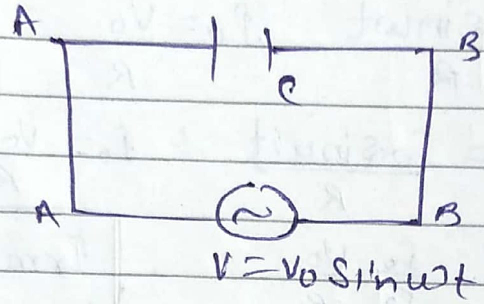
* In Pure Resistor Current and voltage are in same phase

* In Phaser Diagram Projection on Y axis Represent Instantus value

iii) <u>Pure Capacior :</u>

$q = CV$

$q = CV_0 \sin \omega t$



$I = \frac{dq}{dt}$

In Pure Capacitor current lead Voltage by an angle $\pi/2$.

$I = CV_0 \omega \cos \omega t$

$I = \frac{V_0}{\left(\frac{1}{\omega C}\right)} \cos \omega t$

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

$I = \frac{V_0}{X_C} \cos \omega t$

$I_0 = \frac{V_0}{X_C}$ Capacitive Reactance $X_C = \frac{1}{\omega C}$ unit Ω.

$I = I_0 \cos \omega t$

$I_{rms} = \frac{I_0}{\sqrt{2}}$ $\quad I_{rms} = \frac{1}{\sqrt{2}} \frac{V_0}{X_C}$

Q-2 upto 21
34, 35, 36.

J-M

$$\boxed{I_{rms} = \frac{V_{rms}}{X_C}}$$

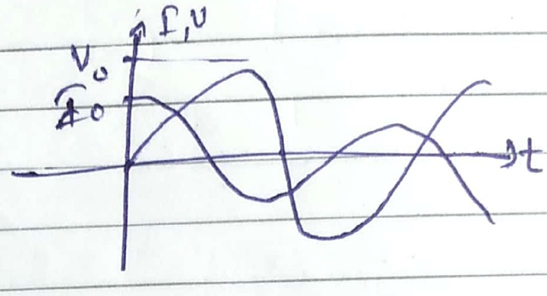
$V = V_0 \sin \omega t$

$I = I_0 \cos \omega t$

$I = I_0 \sin\left(\frac{\pi}{2} + \omega t\right)$

$\Delta\phi = \frac{\pi}{2} + \omega t - \omega t$

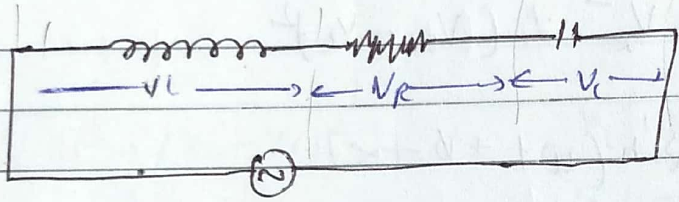
$\phi = \frac{\pi}{2}$



* LCR circuit:

(1) In series LCR circuit current remains same in all three elements why potential difference across the elements are different

2) To find Rms value, avg. value or maximum value we draw phaser for voltage and current in all the three elements



$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$V_{net} = \underbrace{V_0}_{\text{amplitude}} \sin(\omega t + \phi + \alpha)$$

$V = IR$

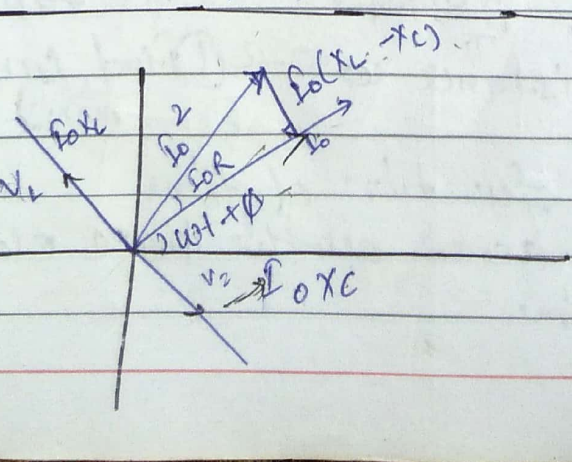
$I = \frac{V}{R}$

(1) $V_0 = \sqrt{V_R^2 + (V_L - V_C)^2}$

2) $V_0 = I^2$

(3) $Z\ (\text{Empidence}) = \sqrt{R^2 + (X_L - X_C)^2}$

(4) $\tan\alpha = \left(\frac{X_L - X_C}{R}\right)$



Important

watt less ⇒ $I_0 \sin\theta$.
Power factor = $\cos\theta$.

Phase diff = $\tan\theta$

PDP
MMB

$I = I_0 \sin(\omega t + \phi)$

$V_L = I_0 X_L \sin(\omega t + \phi + \pi/2)$

$V_R = I_0 R \sin(\omega t + \phi)$

$V_C = I_0 X_C \sin(\omega t + \phi - \pi/2)$

$V_0 = V_L + V_R + V_C$

$I_0 X_L \sin(\omega t + \phi + \pi/2) + \sin(\omega t + \phi) + I_0 X_C \sin(\omega t + \phi - \pi/2)$

$\cancel{I_0^2} Z^2 = \cancel{I_0^2} R^2 + \cancel{I_0^2} (X_L - X_C)^2$

$V_{Net}^2 = V_R^2 + (V_L - V_C)^2$.

$V = V_0 \sin(\omega t + \phi + \alpha)$

Phase Diff. ⇒ $\tan\alpha = \frac{I_0 (X_L - X_C)}{I_0 R}$

* Impidence:
Net Resistance offered by the circuit to the flow of current is known as Impidence denoted by (Z).

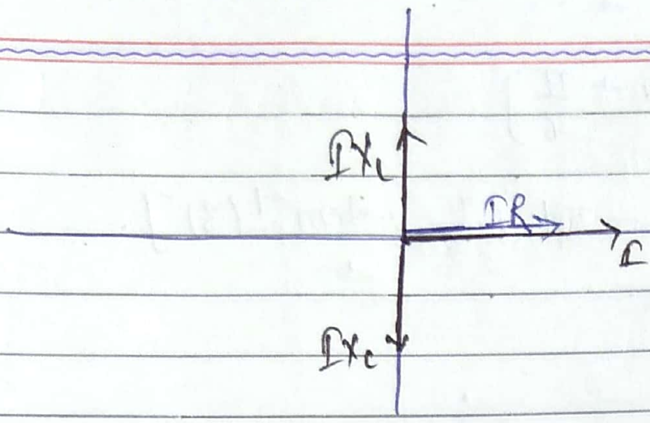
Que: Inductor, Capacitor and Resister are connected in series to an AC source of Emf $250 V \sin(100\pi t + \frac{\pi}{6})$ Capacitance having Capacitance of $\frac{500}{\pi} mf$. Inductance is of value $\frac{50}{\pi} mH$. Resistance 5Ω (i) find I_{max} current in the circuit.
(ii) Current as a function of time.
(iii) Voltage drop across all the three element as a function of time.

$P=$

$B^2 = h^2 - P^2$

$B^2 = h^2 - P^2$

$h^2 = B^2 + P^2$



$125 - 25$

$\sqrt{100} = 10$

$h^2 = 25 +$

$P^2 = h^2 - B^2$

$B^2 = h^2 - P^2$

$h^2 = B^2 + P^2$

$25 +$

$Emf = 250V \sin(100\pi t + \frac{\pi}{6})$

$C = \frac{500}{\pi} mf. \quad L = \frac{5}{\pi} mH. \quad R = 0.5\ \Omega.$

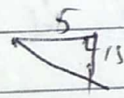
$Z = \sqrt{(R)^2 + (X_L - X_C)^2}.$

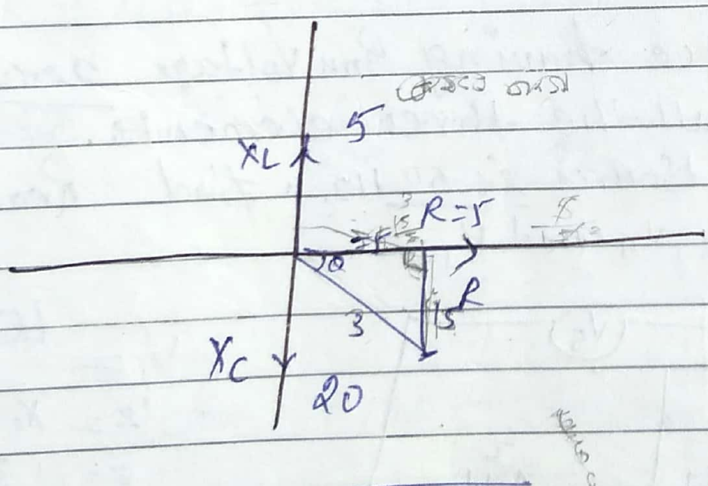
$X_L - X_C =$

$\omega L - \frac{1}{\omega C} =$

$Z = \sqrt{}$

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





$X_L = \omega L = 100\pi \times \frac{50}{\pi} \times 10^{-3}$

$= 5\ \Omega$

$X_C = \frac{1}{\omega L} = \frac{1}{100\pi \frac{500 \times 10^{-2}}{\pi}}$

$= 20$

$R = 5$

$Z = \sqrt{(15)^2 + (5)^2}$

$= 5\sqrt{10} = \sqrt{250}$

$V = IR. \Rightarrow V_0 = IZ$

$250 = I\sqrt{250} \qquad I = \sqrt{250}\ \Omega$

C — I.

L →

② $V = 250 \sin\left[100\pi + \frac{\pi}{6}\right]$

$I = \sqrt{250} \sin\left(100\pi t + \frac{\pi}{6} + \tan^{-1}(3)\right]$.

③ $V = IR$

$=$

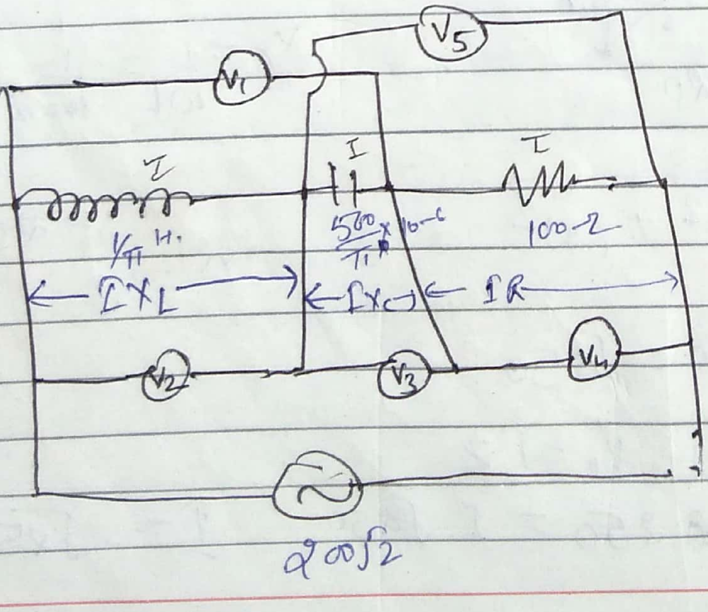
$V_L = 5\sqrt{250} \sin\left(100\pi t + \pi/6 + \tan^{-1}(3) + \frac{\pi}{2}\right)$

$V_R = 5\sqrt{250} \sin\left[100\pi t + \frac{\pi}{6} + \tan^{-1}(3)\right]$

$V_C = 20\sqrt{250} \sin\left(100\pi t + \pi/6 + \tan^{-1}(3) - \frac{\pi}{2}\right)$

Q. In an AC circuit L C R are in series comb. L of inductor = 1000 mH. = $\frac{1}{\pi}$ H. C have value of $\frac{500}{\pi}$ μF Resistance of Resistor is 100 Ω.

An AC source having Rms Voltage $200\sqrt{2}$ is applied across all the three elements. frequency of AC source is 50 Hz. find Reading of Voltmeter V_1, V_2, V_3, V_4 and V_5



LC.

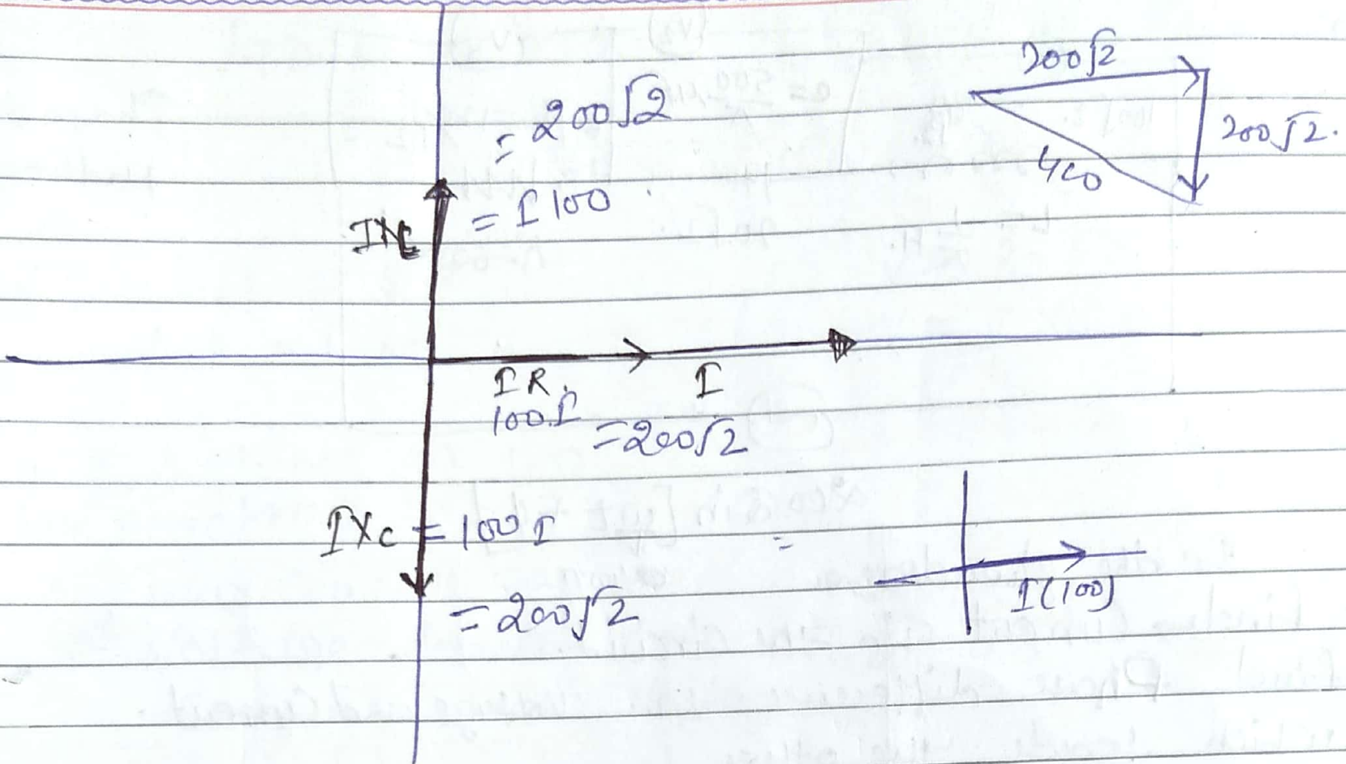
$V_1 =$

$Z = X_C^2 + X_L^2$

$Z = \left(\frac{1}{\omega C}\right)^2 + (\omega L)^2$

$Z = \frac{1}{2\pi f \times C} + 2\pi f L$

$= \frac{1}{2\pi\, 50 \times \frac{500}{\pi} \times 10^{-6}}$



$$X_L = \omega L = 2\pi 50 \; \frac{1000}{\pi} \times 10^{-3}$$

$$I = \frac{V}{R}$$

$$V = 100I$$

$$X_L = 100$$

$$\frac{200\sqrt{2}}{100} = I$$

$$I = 2\sqrt{2}$$

$$\cancel{X_C} = X_C = \frac{1}{\omega C} = \frac{1}{2\pi 50 \times \frac{100}{\pi} \times 10^{-6}}$$

$$X_L = \frac{100}{\quad}$$

$$\cancel{\text{So}} \quad I 100 = 200\sqrt{2}$$

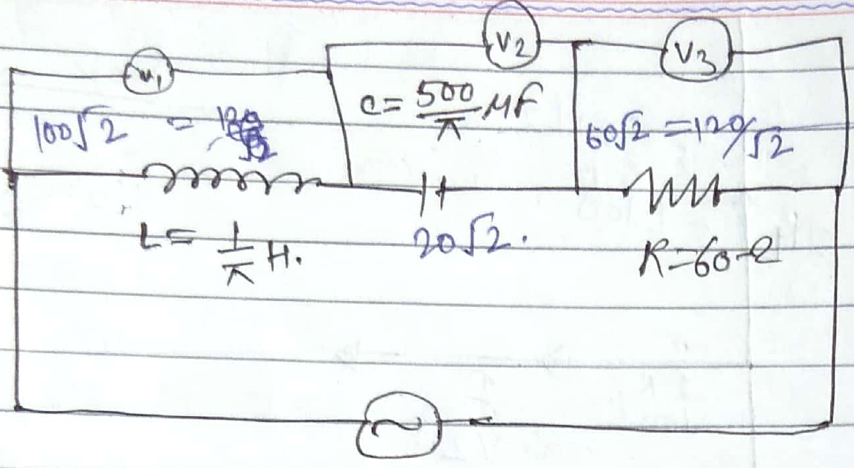
$$\boxed{I = 2\sqrt{2}}$$

$$V_{Total} = IZ$$

$$200\sqrt{2} = 2\sqrt{2}\,Z = Z = 100 \text{ Ans}$$

~~Based on 1st Ans.~~

Q=>



Phased Method.

$200 \sin[\underset{100\pi}{\omega} t + \phi]$

In the given diagram

(i) find max Current in the Circuit.

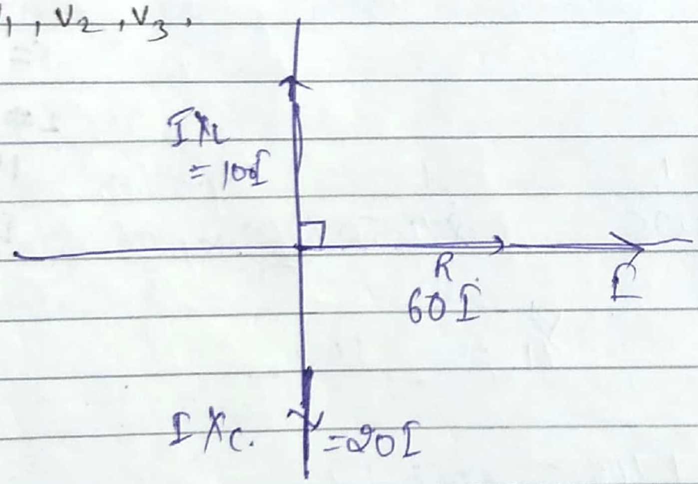
(ii) find Phase difference b/w Voltage and Current. which leads the other.

(iii) find current as a f^n of time.

(iv) find voltage across each element at $t = \frac{1}{50}$ secs.

(v) find V_1, V_2, V_3.

$V = IR$

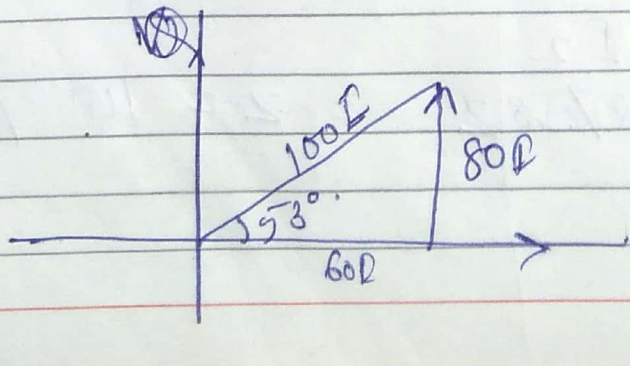


$X_L = \omega L$
$= 100\pi \times \frac{1}{\pi}$
$= 100$

$X_C = \frac{1}{\omega C} = \frac{1}{100\pi \times \frac{500}{\pi} \times 10^{-6}}$
$= \frac{1 \times 10^2}{5} = \frac{100}{5} = 20$

$X_C = 20.$

(vi) find Z in the Circuit.



$Z = \sqrt{3600 + 6400}$
$\sqrt{10000}$
$= 100$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$\frac{4}{5}$ $\sin 53°$

$$X = |X_L - X_C|$$

$\cos 53 = \frac{3}{5}$

(1) $100\, I = 200$

$$I = \frac{200}{100} = 2.$$

(2) $V_{net} = I Z$ $\qquad V = 80\, I$

$V_{net} = I\, 100.$ $\qquad V = I X.$

(1) Impidence $\Rightarrow$ 100

(2) Reactance = 80

(3) max Current = 2

(4) Voltage leads Current By $53°$.

Current leak Voltage.

(5) $I = I_0 \sin[\omega t + \phi]$

$$= 2 \sin[100\pi t - 53°]$$

$I = \frac{8}{5}$ $\qquad I = 2\sin\left[\cancel{100}^{2}\, \pi \times \frac{1}{\cancel{50}} - 53°\right] =$

$$I = \frac{8}{5}$$

$V_R = IR = 2\left[\frac{-4}{5}\right]60 = -96 = 120 \sin[100\pi t - 53°].$

$V_L = \overset{V_C}{200} \sin[100\pi t - 53° + 90°] = 200 \times \frac{3}{5}$

$V_C = 40 \sin[100\pi t - 53 - 90]$ $\qquad = 120,$

$$= \frac{40}{8}\left[\frac{-3}{5}\right] = -24 \;A$$

A.C Race ← S.A ← 0-1 → 1 to 10 Race   4 to AC.

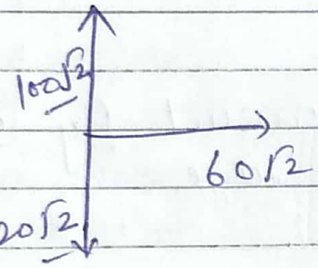
avg ⇒ Reading : Only use vector method.

$P = VI$

Net Voltage.

$$V = 200 \sin\left(100\pi \times \frac{1}{50}\right)$$

Instantinous $= 200 \sin 2\pi$
$= 0.$



$$= \sqrt{(V_L - V_C)^2 + V_R^2}$$

× Power factor:

Power factor is define as the Ratio of Power desipated in the AC Circuit to det. of ~~max.~~ Rms Power in the desipated in the circuit

$$P = VI$$
$$= \varepsilon_0 \sin(\omega t)\, I_0 \sin(\omega t + \phi)$$

$$\langle P \rangle = \frac{\int P\,dt}{\int dt} = \frac{\varepsilon_0 I_0}{2} \cos\phi$$

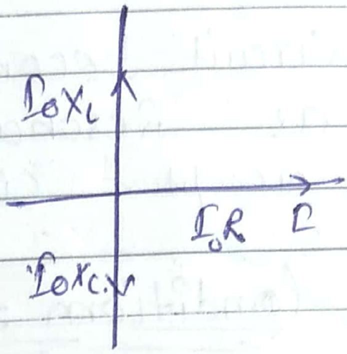
$$= E_{rms} I_{rms} \cos\phi$$

$$\langle P_{max} = E_{rms} I_{rms}$$

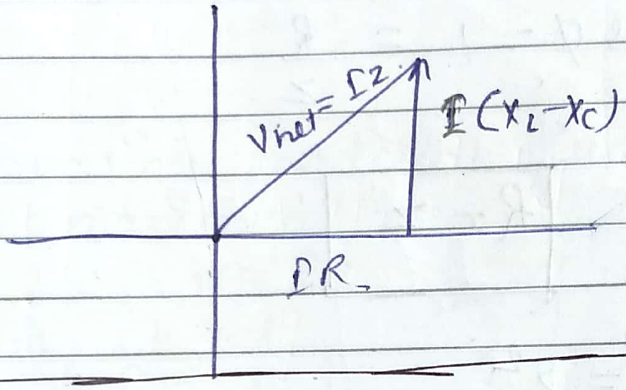
LWZ: 0.0693

Power factor = $\cos\phi$

$\cos\phi = \frac{IR}{IZ}$



Power factor → $\boxed{\cos\phi = \frac{R}{Z}}$

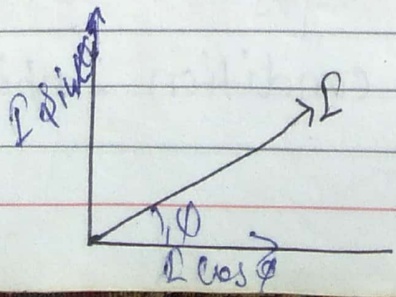


Power desipate :	Erms Irms $\cos\phi$

* Wattless Current : (Power less current) :

Component of portion of a current which does not contribute to Power desipated in the circuit is known as watt less current.

$\boxed{\text{Watt less Current} = I \sin\theta}$



* Resonating circuit:

When power desipated in this circuit become maximum this circuit is known as Resonating circuit. It is also known as acceptor circuit.

* Condition for Resonance:

$$\cos\phi = 1 = \frac{R}{Z}$$

$$\boxed{R = Z}$$

$$R^2 = Z^2$$

$$R^2 = R^2 + (X_L - X_C)^2$$

$$\boxed{X_L = X_C}$$ Resonance

$$\omega L = \frac{1}{\omega C} \qquad \omega^2 = \frac{1}{LC}$$

$$\omega = \frac{1}{\sqrt{LC}}$$

$$2\pi f = \frac{1}{\sqrt{LC}} \qquad \boxed{f = \frac{1}{2\pi\sqrt{LC}}}$$

frequency

freq.

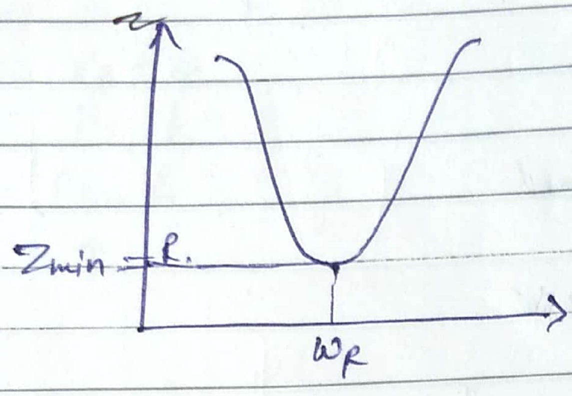
Imp

* Important Point for Resonance or Circuit:

1) In Resonating condition Impidence (Z) of a circuit is minimum.

HLO: O-1 & S-1
Raci - 2
Emi-HCV.

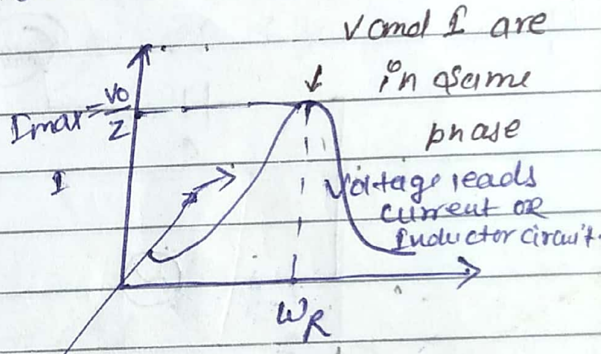
$$\boxed{Z_{min} = R}$$



(2) In Resonating condition current in the circuit is maximum

$$V = IZ.$$

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



$X_L = \omega L$

$X_L = J\omega L$

Current leads Voltage or Capacitive circuit.

$$\boxed{C \quad R \quad L}$$

* $\omega_0 = \omega_R$ $\theta = 0$ Current and Resistance are in same phase.

* During Resonance Power factor of circuit is One.

Que 1 $V = 100 \sin 100\pi t$

$I = 2 \sin(100\pi t + \frac{\pi}{3})$

$V = IR$

$R = \frac{V}{I} = 50$

$= \frac{100}{\sqrt{2}} \times \sqrt{2} \times \frac{2}{50}$

$= 200$

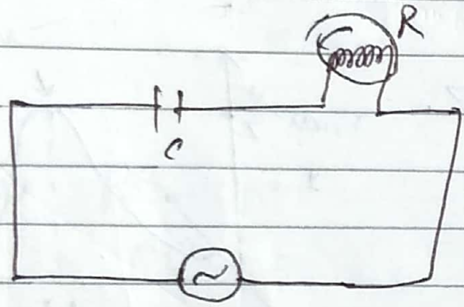
find avg power

$P_{avg} = V_{rms} I_{rms} \cos\phi$

$P_{avg} = \frac{100 \times 2}{2} \cos 60°$

$P_{av} = 50\, watt$

Q.



If dielectric is introduced b/w the plates of Capacitor then what will be change in Brightness of the Bulb?

$P\uparrow$

$P = I_{rms}^2 R$

$I_{rms} = \frac{V_{rms}}{Z}$ $\quad I_{rms} = \frac{V_{rms}}{\sqrt{R^2 + X_C^2}}$

$X_C \downarrow = \frac{1}{\omega C \uparrow}$ $\quad Z \downarrow = \sqrt{R^2 + X_C^2 \downarrow}$

$I_{rms} \uparrow = \frac{V_{rms}}{Z \downarrow}$ $\quad P \uparrow = I_{rms}^2 \uparrow R$

(ii) What will be change in Rms Voltage across the Capacitor

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

Co

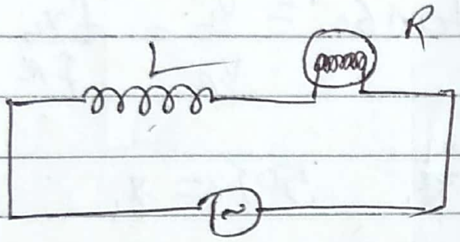
$\boxed{V/I_{rms}}$

$V_C = I X_C = \frac{1}{\omega C}$

$$V^2 = V_R^2 + V_C^2$$
$$\uparrow \quad \uparrow \quad \downarrow$$

$$V_R = I_{rms} R$$
$$\uparrow \quad \uparrow$$

Ex:



If ~~iron~~ iron rod is incereted inside the inducter then what be change of Brightnes of change in bulb

$$V^2 = V_R^2 + V_L^2$$

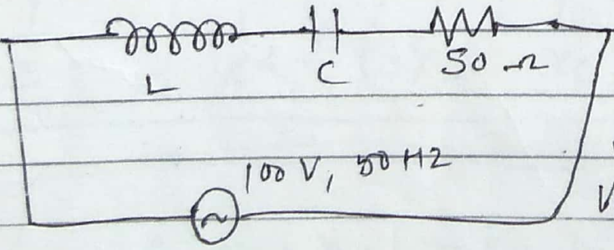
$$\uparrow X_L = \omega L \uparrow \qquad L = \mu_0 n^2 \pi R^2 l$$
$$L' = \mu_r \mu_0 n^2 \pi R^2 l$$

$$L' > L$$

$$Z = \sqrt{R^2 + X_L^2} \qquad \downarrow I_{rms} = \frac{V_{rms}}{Z \uparrow}$$
$$\uparrow \qquad\qquad \uparrow$$

$$P = I_{rms} R$$
$$\downarrow \qquad \downarrow$$

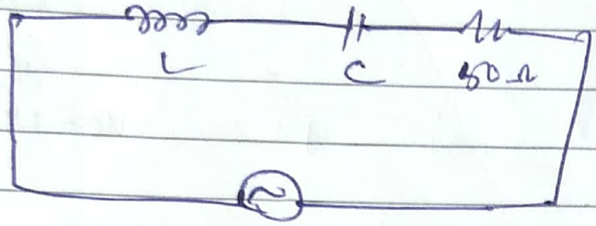
Q.

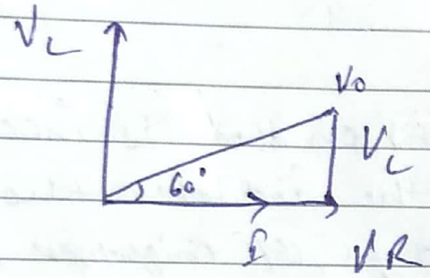


If only capacitor is removed then Current ~~lead~~ lag Voltage by an angle 60°;

and if only Inductor is removed the current lead voltange by and 60° then find out rms Current ~~in all th~~ when

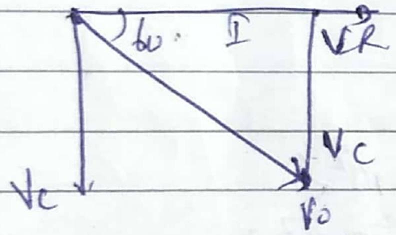
When all three element are connected





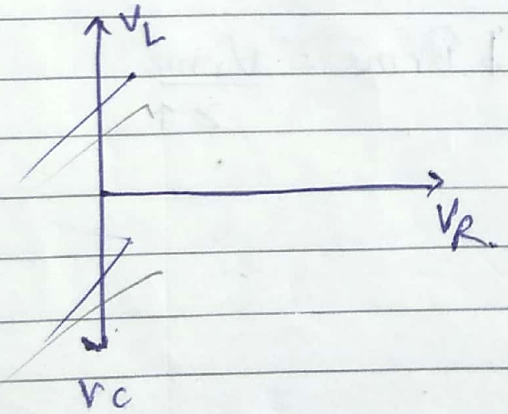
$\tan 60° = \frac{V_L}{V_R} = \frac{I X_L}{I R}$

$\tan 60 = \frac{X_L}{R}$. $\quad 50\sqrt{3} = X_L$



$\tan 60° = \frac{V_C}{V_R} = \frac{I X_L}{I R}$

$X_C = 50\sqrt{3}$



$X_L = X_C$

$Z = R = 50\,\Omega$

$I_{rms} = \frac{V_{rms}}{Z} = \frac{100}{50} = 2A$

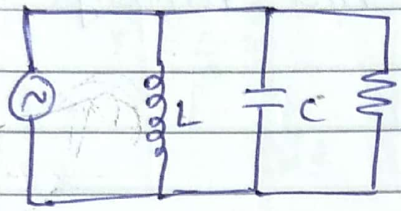
Series Voltage
Parallel current

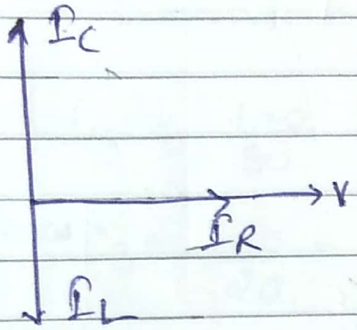
Parallel ⇒ Voltage same
Series ⇒ Current same

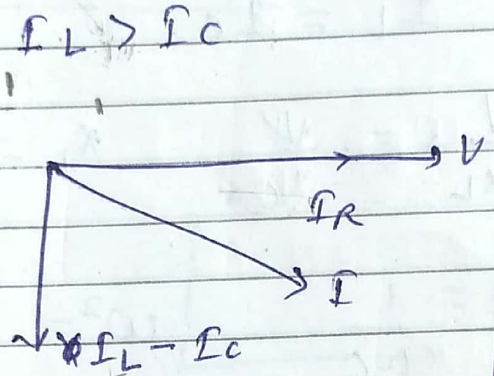
Same voltage

* Parallel LCR:

In Parallel LCR Circuit Phases Diagram.
Voltage Same. I ch







$V = IR$

$\frac{V}{I} = R$

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

$$I = \sqrt{I_R^2 + (I_L - I_C)^2}$$

$$I = \sqrt{\left(\frac{V}{R}\right)^2 + \left(\frac{V}{X_L} - \frac{V}{X_C}\right)^2}$$

$$I = V\sqrt{\frac{1}{R^2} + \left(\frac{1}{X_L} - \frac{1}{X_C}\right)^2}$$

$$\frac{I}{V} = \sqrt{\frac{1}{R^2} + \left(\frac{1}{X_L} - \frac{1}{X_C}\right)^2}$$

$$\boxed{\frac{1}{Z} = \sqrt{\frac{1}{R^2} + \left(\frac{1}{X_L} - \frac{1}{X_C}\right)^2}}$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

Series LCR:

- In Resonance current and voltage will be in same phase.

$$I_L = I_C$$

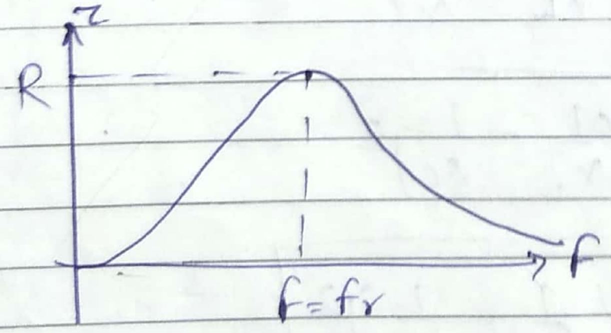
$$\frac{V}{X_L} = \frac{V}{X_C} \qquad X_L = X_C$$

$\omega = 2\pi f$

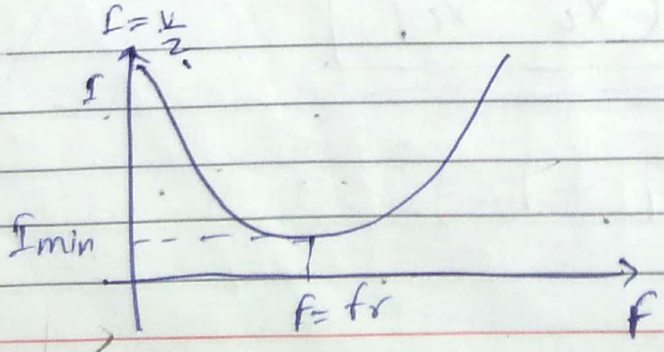
$$\omega L = \frac{1}{\omega C} \qquad \omega^2 = \frac{1}{LC}$$

$$\omega = \frac{1}{\sqrt{LC}}$$

(i) $f = 0$, $Z = 0$
(ii) $f = \infty$, $Z = 0$
(iii) $f_z = f_r$, $X_L = X_C$, $Z_{max} = R$

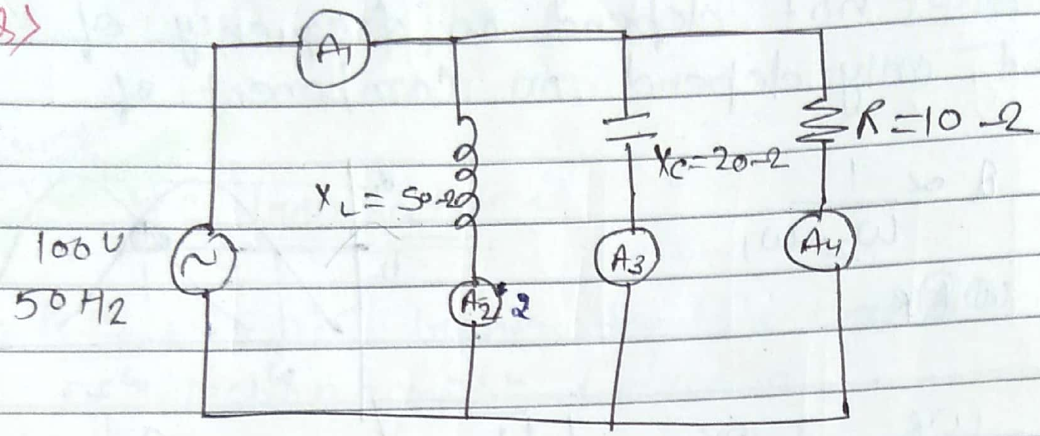


[Current same]



$B^2 = H^2 + P^2$

Q>



$Z = \sqrt{\frac{1}{100} + \left(\frac{1}{50} - \frac{1}{20}\right)^2}$

$Z = \sqrt{\frac{1}{100} + \left(\frac{2-5}{100}\right)^2}$

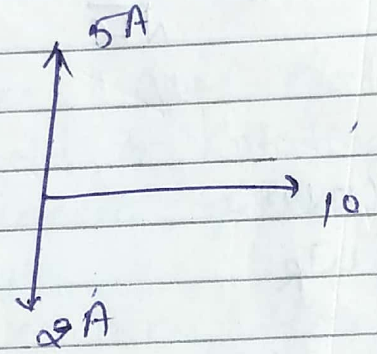
$Z = \sqrt{\frac{1}{100} + \left(\frac{3}{100}\right)^2}$

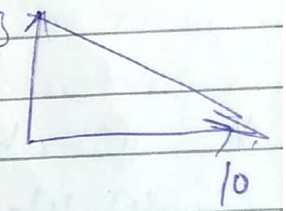
$Z =$

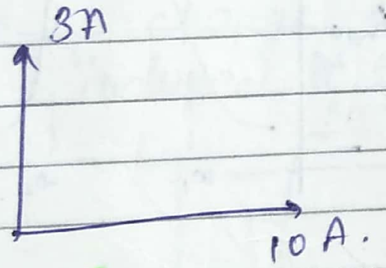
$I_2 = \frac{100}{50} = 2A$

$I_3 = \frac{100}{20} = 5A$

$I_4 = \frac{100}{10} = 10A$







$I_1 = \sqrt{100+9}$.

* Quality factor: (Q-factor) It is defined as ratio of Resonating frequency to that of Bend width of the circuit

* Band width: is defined as frequency of the source when power in the circuit is half of the maximum power of the circuit.

C1 P. factor = 1 in Resonance

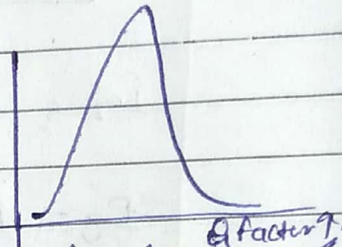
* Q-factor does not depend on frequency of source. It only depend on component of circuit.

$$Q \propto \frac{1}{\omega_2 - \omega_1}$$

$$Q \propto \omega_R$$

$$\boxed{Q = \frac{\omega_R}{\omega_2 - \omega_1} \quad \text{or} \quad \frac{1}{R}\sqrt{\frac{L}{C}}}$$

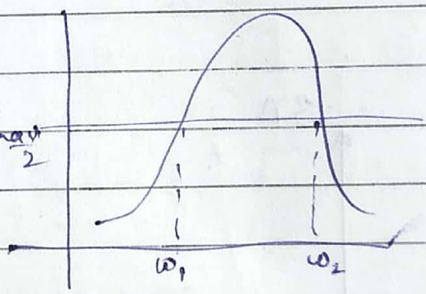
$$\omega_R = \frac{1}{\sqrt{LC}}$$



Q factor ↑ sharpness

* $P = VI\cos\theta$

$\omega_1, \omega_2 = \omega_R$



$$P = V\frac{V}{2}\left(\frac{R}{Z}\right)$$

$$= \left[\frac{V^2 R}{Z^2}\right] = \frac{V^2}{2R}$$

$$2R^2 = Z^2$$

$$2R = R^2 + (X_L - X_C)^2$$

$$(X_L - X_C)^2 = R^2$$

$$X_L - X_C = \pm R$$

$$\omega_1 L - \frac{1}{\omega_1 C} = -R \quad -(1) \qquad \omega_2 L - \frac{1}{\omega_2 C} = +R \quad -(2)$$

eq^n. (2) − (1) $\qquad \frac{1}{\sqrt{LC}}$

$$(\omega_2 - \omega_1)L - \left[\frac{1}{\omega_2 C} - \frac{1}{\omega_1 C}\right] = 2R$$

End Advanced

DC / AC

Slip Ring → Split Ring..

J. Advanced 1-25

$$[\omega_2 - \omega_1] = \frac{R}{L}$$ Band width.

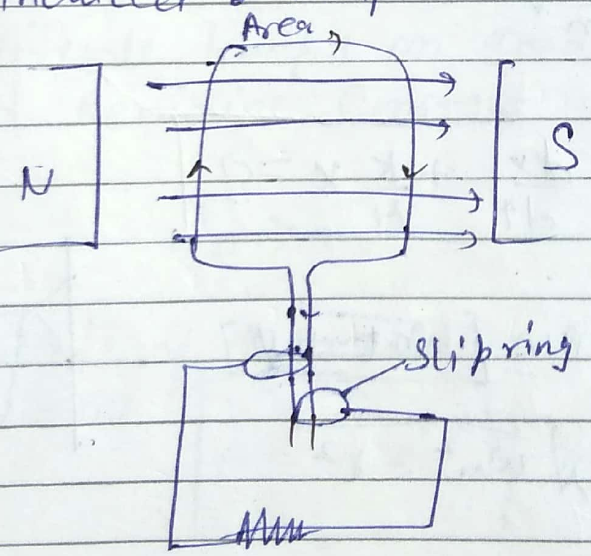
Mains.

* AC Generator :

* Principle: AC Generator is Based on Principle of Electromagnetic Induction.

$$E = \frac{d\phi}{dt}$$

* Construction :
An Armature coil Placed inside a uniform magnetic field on Rotating Armature Coil in a uniform magnetic field flux (ϕ) linked with coil change.
Rate of change of flux w.r.t time is known as induced Emf.



$$\phi = NBA\cos\theta$$

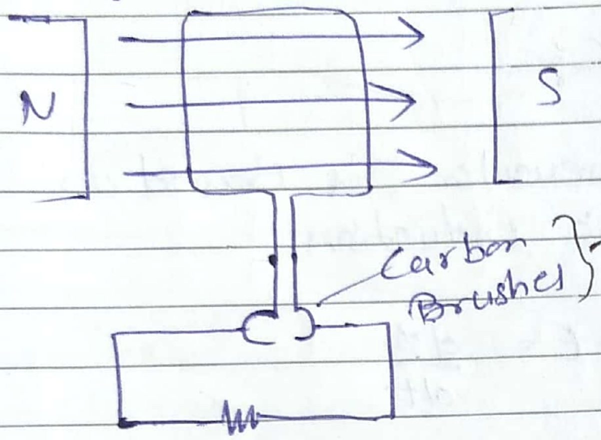
$$e = \underbrace{NBA\omega}\sin\theta$$

$$\boxed{e = E_0\sin(\omega t)}$$

AC Slip ring   DC Split ring

Viscous force $= 6\pi r \beta v$

* In DC Generator Instead of ~~Slip ring~~ Split ring with carbon brushes are used.



DC

Difference in DC and AC only the ring

* Damped Oscillation:

Not Important

$$ma = -Kx - bv$$

$$a = -\frac{Kx}{m}$$

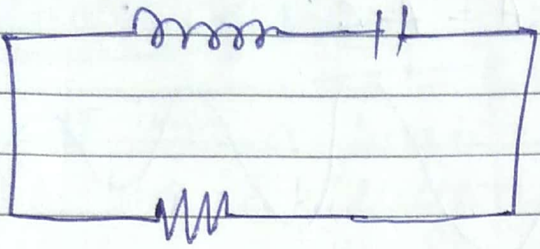
$$\gamma = \frac{b}{2m}$$

$$\frac{d^2x}{dt^2} + \frac{K}{M}x + \frac{b}{m}v = 0$$

$$\boxed{\frac{d^2x}{dt} + \frac{b}{2m}\frac{dx}{dt} + \frac{K}{M}x = 0}$$

$$y = A_0 e^{-\gamma t} \sin[\omega_D t + \phi]$$

where $\omega_D = \sqrt{\omega_N^2 - \gamma^2}$



x — q
Bm

By K.V.L
$$-iR - L\frac{di}{dt} - \frac{q}{c} = 0$$

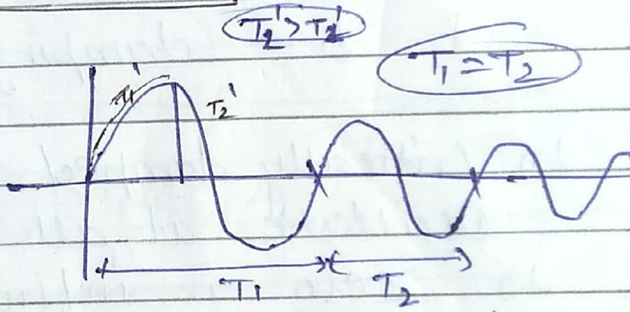
Time Constant

$$\frac{d^2q}{dt^2} + \frac{R}{L}\frac{dq}{dt} + \frac{q}{LC} = 0$$

$$\boxed{\gamma = \frac{R}{2L}}$$

$$\boxed{q = Q_0 e^{-\gamma t} \sin(\omega_0 t + \phi)}$$

Damping Cofficient ⇒ b.



* Important Key Points :

(1) Amplitude keeps on Decreasing while time Period Remains Constant.

$$T_2' > T_1'$$

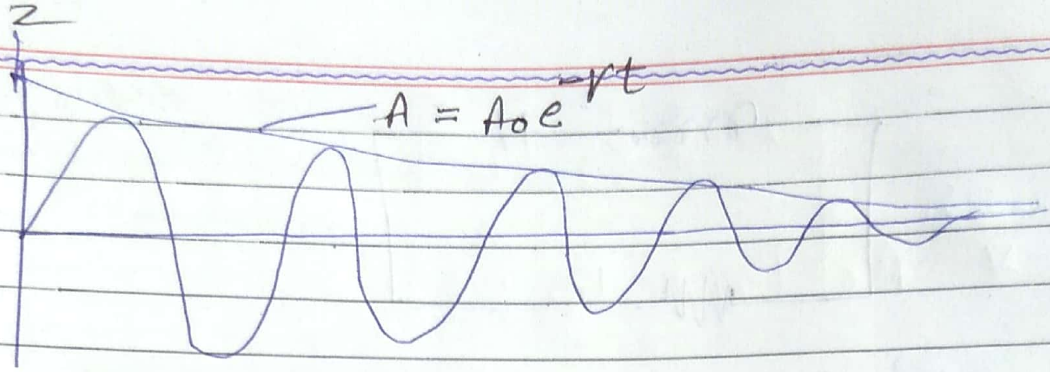
(2) Amplitude of Oscillation decreases Exponantly with time

$$\boxed{A = A_0 e^{-\gamma t}}$$ Imp

$$A \xrightarrow{t} KA_0$$

$$A \xrightarrow{nt} K^n A_0$$

Over damped cond. ① Plastic Ball to Push, in water.
Critically damp. ② Ball iron.
③



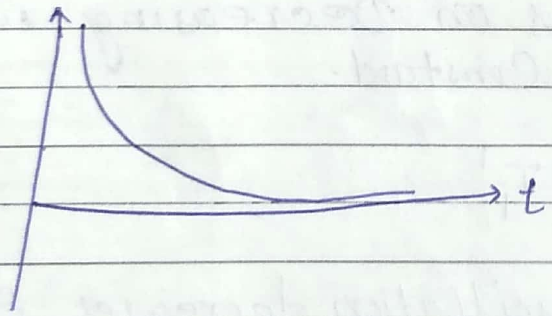
Critically damped oscillation :- $(r = \omega_0)$

~~if~~ when r is damping cofficient $= \omega_0$

$$r = \frac{b}{2M} \quad \Big/ \quad r = \frac{R}{2L}$$

$b \rightarrow$ damping constant.

In critically damped oscillation particle does not oscillate at all. Amplitude of particle decreases to zero in infinite time. ~~Amplitude~~



* Over damped Condition :-

$$r > \omega_0$$

Same particle does not oscillate with time. But amplitude decays to zero in ~~a~~ finite of time.
But amplitude decreases to zero.

* Forced oscillation:-

If external force is applied on a particle in damped oscillation then the Oscillation is known as forced oscillation. in force oscillation a external forced applied Periodically varies Periodically. with a phase difference of $\pi/2$.

$$\frac{d^2x}{dt^2} + \frac{dx}{dt} + \omega_n^2 x = \frac{f_0}{M} \cos\omega t.$$

RLC:

$$\frac{d^2Q}{dt^2} + \frac{dQ}{dt} + \omega_0^2 Q = V_0 \cos\omega t.$$

Imp.

$$\boxed{\text{Amplitude} \Rightarrow A \Rightarrow \frac{f}{m(\omega^2 - \omega_0^2) + 4\omega_0^2 \gamma^2}}$$

Imp.

Que: A Particles oscillates in a space such that its amplitude decreases with time exponently in 2 second amplitude of particles becomes 90% of its initial value. find the Amplitude after 6 sec of Motion.

$$A = A_0 e^{-\gamma t}$$

damping coefficient — $\gamma = \frac{b}{2M}$.

$$A \xrightarrow{2\text{ sec}} 0.9 A_0$$

$$A \xrightarrow{6\text{ sec}} (.9)^3 A_0 = 0.729 A_0.$$