UNIT - 2

A.C Circuits

Phase: It is defined as the friction of times Period alternating quantity from reference point is known as phase

Phase difference: It is defined as angular displacement between the Voltage and current two phasor quantities is known as phase difference.

Phase angle: It is defined as the phase difference between voltage and current is known as phase angle

Power factor: Powerfactor is defined as the ratio of active power to apparent power is known as power factor. It is ~~defined~~ denoted by ϕ

$$\phi = \frac{\text{Active power}}{\text{Apparent power}}$$

form factor: The ratio of RMS Value to average value is known as form factor

$$\text{form factor} = \frac{\text{RMS Value}}{\text{Average Value}} = 1.11$$

R.M.S Value: It is defined as the square root of average value of squares of time period of alternating current in the circuit and phase angle of instant value over one complete cycle

R.M.S Value $= \frac{1}{T}\int_0^T f^2(t)\cdot dt$

Average Value: It is defined as the value of direct current which gives total amount of charge to the network in same time and given by alternating current to same electrical network.

average value $= \frac{1}{T}\int_0^T f(t)\,dt$

Impedance: (Z): It is defined as the ratio of phasor voltage to phasor current is known as impedance. It is denoted by Z $\boxed{Z = R+jX_L}$

Admittance (Y): It is denoted by Y. It is defined as the reciprocal of impedance is known as Admittance (℧) (or) (Ω^{-1})

$$\boxed{Y = \frac{1}{R+jX_L}}$$

Susceptance (B): It is imaginary part of Admittance. It is denoted by 'B' and the units are (℧)

The Signifance of Susceptance:

⇒ It is to predict the nature of electrical circuit (C, L)

$$B = \pm \frac{X}{R^2+X^2}$$

Peak factor: It is defined as the ratio of Peak value to rms value

$$\text{Peak factor} = \frac{\text{Peak Value}}{\text{RMS Value}} = 1.34$$

Resonance: It is defined as the phenomenon which net reactance of the circuit is zero is known as Resonance.

(or)

It is defined as inductive reactance is equal to capacitive reactance is known as resonance.

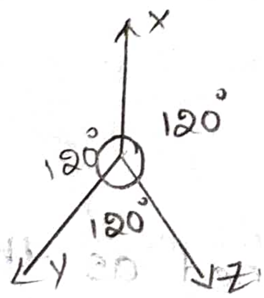
The resonance are classified into two types.

i) Series resonance
ii) Parallel resonance

phase Sequence: The sequence of maximum value by 3-ø voltage (or) current then the system is known as phase sequence. It is determined the direction of rotation.

Symmetric Sequence:

The 3-ø system if the magnitude and frequency of voltage (or) current are same and which is displayed by angle 120° from each other then the system is called Symmetric Sequence



Battery Supply: If the supply as equal to line to line voltage which are displayed phase angle 120° from each other then the supply is known as battery supply

Ex: $V_L \angle 0^\circ$

$V_L \angle -120^\circ$

$V_L \angle -240^\circ$

Battery load: If the load is equal if the magnitude of impedance which are displayed phase angle and passes the same nature of the load is known as battery load.

Ex: $Z\angle\phi_1 = Z\angle\phi_2$

Apparent Power: It is defined as the product of rms voltage and current is known as Apparent power.

Apparent power = EI

$= E_{rms} \times I_{rms}$

Reactance: The Opposition of capacitance (or) Inductance in AC circuit to the flow of current through it is known as Reactance

(or)

The Product of RMS voltage and current and $\sin\phi$ sign of power factor is known as reactive Power

Reactive power = $EI \sin\phi$

Form factor: It is defined as the ratio of RMS value to the average value

⇒ form factor is denoted by 'K_f'

⇒ This form factor which is represented for both voltages and current.

$$K_f = \frac{V_{rms}}{V_{avg}} = \frac{0.707 V_m}{0.637 V_m}$$

$$K_f = \frac{0.707}{0.637}$$

$$K_f = 1.11$$

⇒ The form factor for voltage representation is 1.11

⇒ form factor for current representation

$$K_f = \frac{I_{rms}}{I_{avg}} = \frac{0.707 I_m}{0.637 I_m}$$

$$K_f = \frac{0.707}{0.637}$$

$$K_f = 1.11$$

Peak factor: It is defined as the ratio of maximum value of AC quantity to the rms value of an AC quantity.

⇒ Peak factor is denoted by "K_p"

⇒ The peak factor can be represented for both current and voltages.

$$K_p = \frac{\text{Maximum value}}{\text{RMS Value}}$$

$$K_p = \frac{I_m}{0.707 I_m} \Rightarrow K_p = 1.414$$

$$K_p = \frac{V_m}{0.707 V_m}$$

$$K_p = 1.414$$

$$K_f = \frac{V_{rms}}{V_{avg}} = \frac{0.707 V_m}{0.637 V_m}$$

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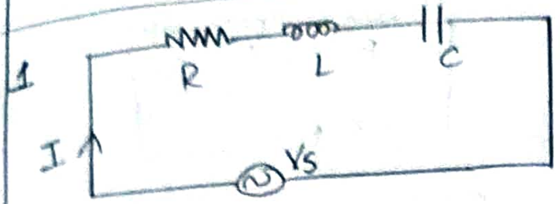
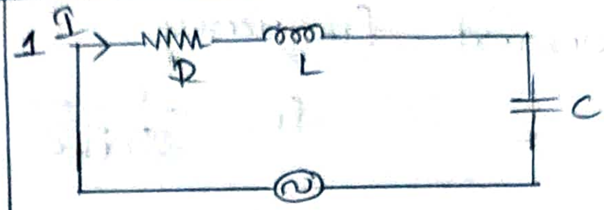
$$K_p = \frac{V_m}{0.707 V_m}$$

$$K_p = 1.414$$

Difference between RLC Series and RL (or) LC Series.

RLC	RL
1 	1 
2 Resonant frequency $f_r = \frac{1}{2\pi\sqrt{LC}}$	2 Resonant frequency $f_r = \frac{1}{\sqrt{LC}}$
3 Quality factor $\frac{1}{R}\sqrt{\frac{L}{C}}$	3 Quality factor $\frac{WL}{R}$
4 Band width $\frac{R}{2\pi L}$	4 Band width $\frac{R}{L}$
5 Half power frequency i) Lowercutt-off frequency $f_1 = f_r - \frac{R}{4\pi L}$ ii) uppercutt off frequency $f_2 = f_r + \frac{R}{4\pi L}$	5 Half power frequency i) Lowercutt off frequency $\omega_1 = \frac{-R}{2L} + \sqrt{\left(\frac{R}{2l}\right)^2 + \frac{1}{LC}}$ ii) upper cutt-off frequency $\omega_2 = \frac{R}{2L} + \sqrt{\left(\frac{R}{2l}\right)^2 + \frac{1}{LC}}$

1) In RLC circuit in consisting of $R = 1K\Omega$ $L = 100mh$ and $C = 10mf$ with the voltage of 100v is appiled across the combination determine the resonance frequency, quality factor and Band width.

Sol: given

$R = 1K\Omega = 1000\Omega$

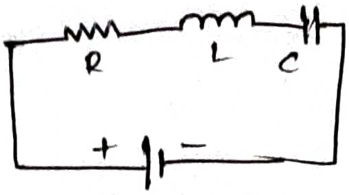
$L = 100mh = 100 \times 10^{-3}$

$= 0.1$

$C = 10mf$

$= 10 \times 10^{-6} f$

Resonant frequency



$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$= \frac{1}{2 \times 3.14 \sqrt{0.1 \times 10 \times 10^{-6}}}$$

$= 159.23 Hz$

Quality factor $= \frac{1}{R} \times \sqrt{\frac{L}{C}}$

$$= \frac{1}{1000} \times \sqrt{\frac{0.1}{10 \times 10^{-6}}}$$

$$\boxed{Qf = 0.1}$$

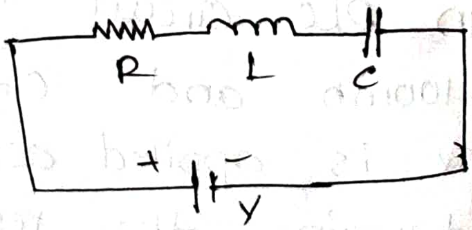
Band width $= \frac{R}{2\pi L} \Rightarrow \frac{1000}{2 \times 3.14 \times 0.1}$

$= 1592.35$

3) An Inductance 0.5 H, resistance 5 Ω, capacitance 8mf across 220V AC supply. calculate the frequency at which circuit resonant and current resonant, Band width and Half power frequency, Voltage capacitance at resonant

Given data

In RLC series



$R = 5\Omega$

$C = 8 \times 10^{-6}$

$L = 0.5H$

$V = 220V$

calculate;

$f_r = ?$

Bandwidth = ?

Half power = ?
current
V_C = ?

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$f_r = \frac{1}{2\times3.14\sqrt{0.5\times8\times10^{-6}}}$$

$$\boxed{f_r = 79.61\,Hz}$$

$$B = \frac{R}{2\pi L} = \frac{5}{2\times3.14\times0.5}$$

$$\boxed{B = 1.59}$$

Half power ~~efficiency~~ frequency

lower cutt off frequency

$$f_1 = f_r - \frac{R}{4\pi L}$$

$$f_1 = 79.61 - \frac{5}{4\times3.14\times0.5}$$

$$\boxed{f_1 = 78.81\,Hz}$$

copper cutt off frequency

$$f_2 = f_r + \frac{R}{4\pi L}$$

$$f_2 = 79.61 + \frac{5}{4\times3.14\times0.5}$$

$$\boxed{f_2 = 80.40\,Hz}$$

Current in resonance

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

$$Z = R + jX_L$$

$Z = R + j(X_L - X_C)$

$Z = R + j(X_L - X_L)$

$Z = R$

$\left[X_L - X_C \quad \therefore X_L = X_C \right]$

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

$I = \frac{220}{5}$

$\boxed{I = 44A}$

Voltage across capacitance

$V_C = I \times X_C$

$X_C = \frac{1}{2\pi \times f_r \times C}$

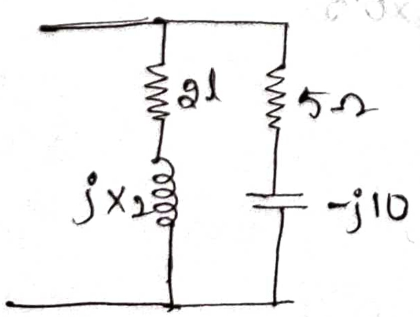
$V_C = I \times \frac{1}{2\pi \times f_r \times C}$

$V_C = \frac{44}{2 \times 3.14 \times 79.61 \times 8 \times 10^{-6}}$

$\boxed{V_C = 11001.08V}$

H/w

1) find the value of L for the circuit shown in fig at the resosant frequency $\omega = 500$r per second.



Total admitance of circuit

$$Y_T = Y_L + Y_C$$

$$Y_T = \frac{1}{Z_L} + \frac{1}{Z_C}$$

$$\boxed{Z = R + jX_L} \text{ —— I}$$

$$Z_L = 2 \times jX_L \text{ —— ①}$$

$$Z_C = 5 - j10 \text{ —— ②}$$

Sub ①, ② in I

$$Y_T = \frac{1}{(2+jX_L)} + \frac{1}{(5-j10)} \text{ —— ③}$$

Based on ③ multiply & divide (2−jXL) and (5+j10)

$$Y_T = \frac{2-jX_L}{(2-jX_L)(2+jX_L)} + \frac{5+j10}{(5+j10)(5-j10)}$$

$$Y_T = \frac{2-jX_L}{4+X_L^2} + \frac{5+j10}{25+100} \quad (v^2 = -1)$$

$$Y_T = \frac{2}{4+X_L^2} + \frac{\cancel{5}}{1\cancel{25}_{25}} + \frac{j\cancel{10}^2}{1\cancel{25}_{25}} - \frac{jX_L}{4+X_L^2}$$

$$\left(\frac{2}{(4+X_L)^2} + \frac{1}{25}\right) + j\left(\frac{2}{25} - \frac{X_L}{4+X_L^2}\right)$$

$$\frac{2}{25} - \frac{X_L}{4+X_L^2} = 0$$

$$8 + 2X_L^2 - 25X_L = 0$$

$$2X_L^2 - 25X_L + 8 = 0$$

$$ax^2 + bx + c = 0$$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$a=1$, $b=-25$, $c=8$

$$\frac{-(-25)\pm\sqrt{(25)^2-4(1)(8)}}{2(1)}$$

$$= 25+\sqrt{561}$$

$$=12.171$$

$$X_L = \omega \times L$$

$$L = \frac{X_L}{\omega}$$

$$L = \frac{12.17}{500}$$

$$\boxed{L = 24 mH}$$

$$L = 0.024 \times 1000$$

$$\boxed{L = 24 mH}$$

(or)

$$L = \frac{0.328}{500}$$

$$\boxed{L = 0.64 mH}$$

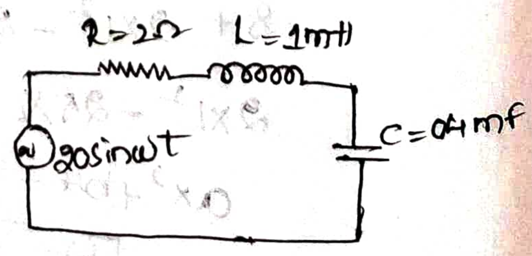
Q) In the circuit shown in fig $r=2\Omega$, $L=1mH$, $c=0.4MF$. find the resonant frequency in half power frequency, determine the quality factor and Band width amplitude of current at resonant frequency $\omega_0, \omega_1, \omega_2$ in the circuit shown in fig.

Given data

$R_L = 2\Omega$

$L = 1\ mH \Rightarrow 1\times10^{-3} H$

$C = 0.0mf \Rightarrow 0.4\times10^{-6} f$



Determine:

$f_r = ?$

$Q.F = ?$

Band width = ?

Half power frequency = ?

Amplitude Current = ?

i) Resonant frequency

$$\omega_0 = \frac{1}{\sqrt{LC}}$$

$$= \frac{1}{\sqrt{1\times10^{-3}\times 0.4\times10^{-6}}}$$

$$= 50,000$$

$$\boxed{\omega_0 = 50K\ rad/sec}$$

ii) Quality factor

$$\frac{\omega_0 \times L}{R}$$

$$= \frac{50,000\times 1\times10^{-3}}{2}$$

$$\boxed{Q.F = 25}$$

iii) Band width $\frac{R}{L}$

$$\frac{2}{1\times10^{-3}}$$

$$\boxed{B.\omega = 2000\ rad/sec}$$

iv) Half power frequency

Lower power cut off frequency

$$\omega_1 = \frac{-R}{2L} + \sqrt{\left(\frac{R}{2L}\right)^2 + \frac{1}{LC}}$$

$$\omega_1 = \frac{-2}{2\times1\times10^{-3}} + \sqrt{\left(\frac{2}{2\times1\times10^{-3}}\right)^2 + \frac{1}{1\times10^{-3}\times0.4\times10^{-6}}}$$

$= 49009.99$ rad/sec

$$\boxed{\omega_1 = 49.09K \text{ rad/sec}}$$

Upper power cut off frequency

$$\omega_2 = \frac{R}{2L} + \sqrt{\left(\frac{R}{2L}\right)^2 + \frac{3}{LC}}$$

$$\omega_2 = \frac{2}{2\times1\times10^{-3}} + \sqrt{\left(\frac{2}{2\times1\times10^{-3}}\right)^2 + \frac{1}{1\times10^{-3}\times0.4\times10^{-6}}}$$

$= 51009.99$ rad/sec

$$\boxed{\omega_2 = 51.009K \text{ rad/sec}}$$

v) Amplitude current

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

$$Z = R + jX_L$$

$$Z = R + j(X_L - X_c)$$

$$Z = R + j(X_L - X_c)$$

$$Z = R$$

$$I = \frac{20}{2}$$

$$\boxed{I = 10A}$$

$$I + \omega_0 = \omega_1 = \omega_2$$

$$I_A = \frac{V_M}{\sqrt{2}\times2} = \frac{20}{\sqrt{2}\times2}$$

$$\boxed{I_A = 7.07A}$$

Q) calculate the RMS value, Average value, form factor and peak factor for the current over one cycle of an alternating voltage $V = 200\sin(314T)$ applied to the resistal of 20A which offers the flow of current in one direction only.

Given data.

$V(t) = 200(314t)$

$V_m = 200V$

$R = 20\Omega$

Determine

RMS value = ?

Average value = ?

form factor = ?

Peak factor = ?

i) RMS value of current

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

$$I_M = \frac{V_m}{R} = \frac{200}{20} = 10A$$

$$I_{rms} = \frac{10}{2}$$

$$\boxed{I_{rms} = 5A}$$

ii) Average value of current

$$I_{rms} = \frac{I_M}{\pi} = \frac{10}{\pi}$$

$$\boxed{I_{rms} = 3.18A}$$

iii) form factor = $\dfrac{\text{RMS value}}{\text{Avg value}}$

$$= \frac{5}{3.18}$$

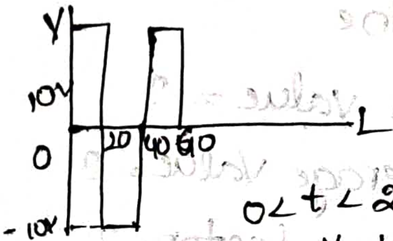
$$\boxed{f.f = 1.57}$$

iv) Peak factor = $\frac{\text{Peak Value}}{\text{RMS Value}}$

$$\frac{I_M}{I_{rms}} = \frac{10}{5}$$

$$\boxed{P.F = 2}$$

Q) Obtain RMS value, Average value, form factor Peak factor for voltage of symmetrical square shape whose amplitude is 10V and Time period is 40 sec for given data



$0 < t < 20$
$V = 10$
$20 < t < 40$
$V = -10$
$T = 40 sec$

RMS value

$$= \sqrt{\frac{1}{T}\int_0^T v(t^2)dt}$$

$$= \sqrt{\frac{1}{40}\int_0^{20} 100dt + \int_{10}^{40} 100dt}$$

$$= \sqrt{\frac{1}{40}(100 \times dt)_0^{20} + (100\,dt)_{20}^{40}}$$

$$= \sqrt{\frac{1}{40}(100 \times 20 - 100 \times 0) + (100 \times 40 - 100 \times 20)}$$

$$= \sqrt{\frac{1}{40}(2000) + (4000 - 2000)}$$

$$\sqrt{\frac{1}{40}(4000)}$$

$$\sqrt{\frac{4000}{40}}$$

$$= \sqrt{100}$$

$$= 10$$

$$\boxed{\text{RMS value} = 10}$$

i) Average value

$$= \frac{1}{T}\int_0^T v(t)dt$$

$$= \frac{1}{20}\int_0^{20} 10dt$$

$= \frac{1}{20}\left[10t\right]_0^{20}$

$= \frac{1}{20}\left[10 \times 20 - 10 \times 0\right]$

$= \frac{200}{20}$

$\boxed{\text{Avg value} = 10}$

iii) form factor = $\frac{\text{RMS value}}{\text{Avg value}}$

$= \frac{10}{10}$

$\boxed{f.f = 1}$

iv) Peak factor = $\frac{\text{Peak value}}{\text{RMS value}}$

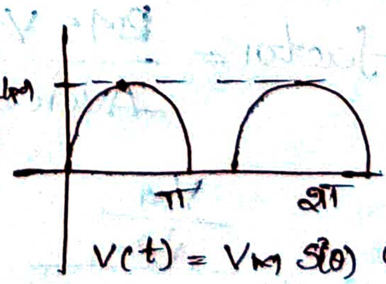
$= \frac{10}{10}$

$\boxed{P.f = 1}$

Q) obtain the RMS value, Average value, form factor, Peak factor of Half wave indifier. sin wave

[when sin waves is mentioned, diagram must be drawn by ourself]

i) RMS value



$v(t) = V_m \sin(\theta)\,\omega t$

$= V_m \sin\theta$

$= \sqrt{\frac{1}{T}\int_0^T v(t^2)\,dt}$

$= \sqrt{\frac{1}{2\pi}\int_0^{2\pi} (V_m \sin\theta)\,d\theta}$

$= \sqrt{\frac{1}{2\pi}\int_0^{2\pi} V_m^2 \sin^2\theta\,d\theta}$

$\frac{V_m^2}{\pi}\int_0^{\pi}\left(\frac{1-\cos 2\theta}{2}\right)d\theta$

$$= \sqrt{\frac{V_M^2}{2\pi} \times (\theta)_0^{\pi}}$$

$$= \sqrt{\frac{V_M^2}{2\pi} (\pi - 0)}$$

$$= \sqrt{\frac{V_M^2}{2}}$$

$$\boxed{\text{RMS value} = \frac{V_M}{\sqrt{2}}}$$

ii) Average Value $= \frac{1}{T}\int_0^T v(t)\,dt$

$$\frac{1}{2\pi}\int_0^{\pi} V_M \sin\theta\, dt$$

$$\frac{V_M}{2\pi} (-\cos\theta)_0^{\pi}\, d\theta$$

$$\frac{V_M}{2\pi} [-\cos\pi - \cos 0]$$

$$\frac{V_M}{2\pi} (1+1)$$

$$\frac{V_M}{2\pi} \times 2$$

$$\boxed{\text{Average value} = \frac{V_M}{\pi}}$$

iii) form factor $= \frac{\text{RMS Value}}{\text{Average value}}$

$$\frac{\frac{V_M}{\sqrt{2}}}{\frac{V_M}{\pi}}$$

$$\frac{1}{10}(100 \times dt)_0^{10} + (100 dt)$$

$$\frac{V_M}{\sqrt{2}} \times \frac{\pi}{V_M}$$

$$\boxed{f.f = \frac{\pi}{\sqrt{2}}}$$

iv) ...

$= \frac{V_M}{\sqrt{\ldots}}$

V_M

P.F =

formulae :

⇒ form fac

⇒ Peak fac

⇒ RMS val

⇒ Average

⇒ RMS

⇒ Averag

$$= \sqrt{\frac{V_M^2}{2\pi} \times (\theta)_0^{\pi}}$$

$$= \sqrt{\frac{V_M^2}{2\pi}(\pi - 0)}$$

$$= \sqrt{\frac{V_M^2}{2}}$$

$$\boxed{\text{RMS value} = \frac{V_M}{\sqrt{2}}}$$

ii) Average Value $= \frac{1}{T}\int_0^T v(t)\,dt$

$$\frac{1}{2\pi}\int_0^{\pi} V_M \sin\theta\,dt$$

$$\frac{V_M}{2\pi}(-\cos\theta)_0^{\pi}\,d\theta$$

$$\frac{V_M}{2\pi}[-\cos\pi - \cos 0]$$

$$\frac{V_M}{2\pi}(1+1)$$

$$\frac{V_M}{2\pi} \times 2$$

$$\boxed{\text{Average value} = \frac{V_M}{\pi}}$$

iii) form factor $= \frac{\text{RMS Value}}{\text{Average value}}$

$$\frac{\frac{V_M}{\sqrt{2}}}{\frac{V_M}{\pi}}$$

$\frac{1}{40}$ ~~(100 × dt)~~ $\cancel{{}^{20}_{10}}$ + (100dt)

$$\frac{V_M}{\sqrt{2}} \times \frac{\pi}{V_M}$$

$$\boxed{f.f = \frac{\pi}{\sqrt{2}}}$$

iv) Peak factor = $\frac{\text{Peak value}}{\text{RMS value}}$

$$= \frac{V_M}{V_M/\sqrt{2}}$$

$$V_M \times \frac{\sqrt{2}}{V_M}$$

$$\boxed{P.F = \sqrt{2}}$$

formuale :

⇒ form factor = $\frac{\text{RMS value}}{\text{Average value}}$

⇒ Peak factor = $\frac{\text{Peak value}}{\text{RMS value}}$

⇒ RMS value w.r.to current ⇒ $I_{rms} = \frac{I_m}{2}$

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

⇒ Average value w.r.to current ⇒ $I_{avg} = \frac{I_M}{\pi}$

⇒ RMS value w.r.to voltage = $\sqrt{\frac{1}{T}\int_0^T v(t)^2 dt}$

⇒ Average value w.r.to voltage = $\frac{1}{T}\int_0^T v(t) dt$

Q) Obtain the RMS value Average value form factor and peak factor of full wave rectifier sine wave

RMS value:

$= \sqrt{\frac{1}{T}\int_0^T v(t)^2 dt}$

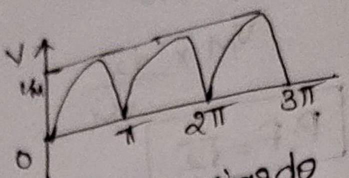
$= \sqrt{\frac{1}{\pi}\int_0^\pi (V_M \sin\theta)^2 d\theta}$

$= \sqrt{\frac{V_M^2}{\pi}\int_0^\pi \sin^2\theta\, d\theta}$

$= \sqrt{\frac{V_M^2}{\pi}\int_0^\pi \frac{1-\cos 2\theta}{\theta} d\theta}$

$\sqrt{\frac{V_M^2}{2\pi}(\pi - 0)}$

$\boxed{\text{RMS value} = \frac{V_M}{\sqrt{2}}}$



$V = V_M \sin\theta\, d\theta$

$T = \pi$

ii) Average value

$\frac{1}{T}\int_0^T v(t)\,dt$

$\frac{1}{\pi}\int_0^\pi V_M \sin\theta\, d\theta$

$\frac{V_M}{\pi}(-\cos\theta)_0^\pi$

$\frac{V_M}{\pi}(-\cos\pi - (-\cos 0))$

$\frac{V_M}{\pi}(1+1)$

$\boxed{\text{Average value} = \frac{2V_M}{\pi}}$

iii) form factor: $\frac{\text{RMS Value}}{\text{Average value}}$

$= \frac{\frac{V_M}{\sqrt{2}}}{\frac{2V_M}{\pi}}$

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

$\boxed{f.f = 1.57}$

iv) Peak factor: $\frac{\text{Peak value}}{\text{RMS value}}$

$= \frac{V_M}{V_M/\sqrt{2}}$

$= \sqrt{2}$

$\boxed{P.f = 1.414}$

AC throu...
Consider a ...
an a.c current ...
through that p...

I

According ...
$I = V/R$ ...
But from ...
Sub ②

$I = \frac{V_m}{...}$

$I = (\frac{V_m}{R}...$

Compare eq...
$I = $ ...

from eq ...
we ...

The mo...
through ...
Phasor ...

Q) Obtain the RMS Value Average Value form factor and peak factor of full wave rectifier sine wave

RMS Value:

$$= \sqrt{\frac{1}{T}\int_0^T v(t)^2\,dt}$$

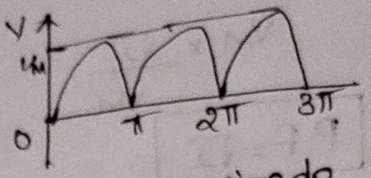
$$= \sqrt{\frac{1}{\pi}\int_0^{\pi}(V_M \sin\theta)^2\,d\theta}$$

$$= \sqrt{\frac{V_M^2}{\pi}\int_0^{\pi}\sin^2\theta\,d\theta}$$

$$= \sqrt{\frac{V_M^2}{\pi}\int_0^{\pi}\frac{1-\cos 2\theta}{\theta}\,d\theta}$$

$$\sqrt{\frac{V_M^2}{2\pi}(\pi - 0)}$$

$$\boxed{\text{RMS value} = \frac{V_M}{\sqrt{2}}}$$



$V = V_M \sin\theta\, d\theta$

$T = \pi$

ii) Average value

$$\frac{1}{T}\int_0^T v(t)\,dt$$

$$\frac{1}{\pi}\int_0^{\pi} V_M \sin\theta\,d\theta$$

$$\frac{V_M}{\pi}(-\cos\theta)_0^{\pi}$$

$$\frac{V_M}{\pi}(-\cos\pi - (-\cos 0))$$

$$\frac{V_M}{\pi}(1+1)$$

$$\boxed{\text{Average value} = \frac{2V_M}{\pi}}$$

iii) form factor: $\dfrac{\text{RMS Value}}{\text{Average value}}$

$$= \frac{\frac{V_M}{\sqrt{2}}}{\frac{2V_M}{\pi}}$$

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

$$\boxed{f.f = 1.57}$$

iv) Peak factor: $\dfrac{\text{Peak value}}{\text{RMS value}}$

$$= \frac{V_M}{V_M/\sqrt{2}}$$

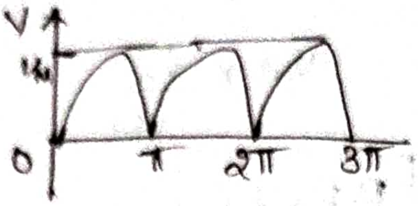
$$= \sqrt{2}$$

$$\boxed{P.f = 1.414}$$

Q) Obtain the RMS value, Average value, form factor and peak factor of full wave rectifier sine wave

RMS Value:

$$= \sqrt{\frac{1}{T}\int_0^T v(t)^2 dt}$$



$V = V_M \sin\theta \, d\theta$

$T = \pi$

$$= \sqrt{\frac{1}{\pi}\int_0^{\pi} (V_M \sin\theta)^2 d\theta}$$

$$= \sqrt{\frac{V_M^2}{\pi}\int_0^{\pi} \sin^2\theta \, d\theta}$$

$$= \sqrt{\frac{V_M^2}{\pi}\int_0^{\pi} \frac{1-\cos 2\theta}{2} d\theta}$$

$$\sqrt{\frac{V_M^2}{2\pi}(\pi - 0)}$$

$$\boxed{\text{RMS value} = \frac{V_M}{\sqrt{2}}}$$

ii) Average value

$$\frac{1}{T}\int_0^T v(t)\,dt$$

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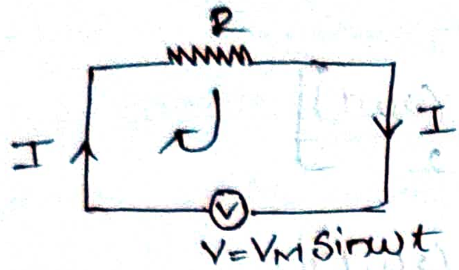
AC through pure Resistance:

Consider a pure resistor (R) through which an a.c current (or) voltage which is passed through that pure resistor



According to the ohm's law

$I = V/R$ —— ①

But from diagram $V = V_M \sin\omega t$ —— ②

Sub ② in ①

$$I = \frac{V_m \sin\omega t}{R} \text{ —— ③}$$

$$I = \left(\frac{V_m}{R}\right) \times \sin\omega t \text{ —— ④}$$

Compare eq ④ with standard eq

$I = I_m \sin(\omega t + \phi)$ —— ⑤

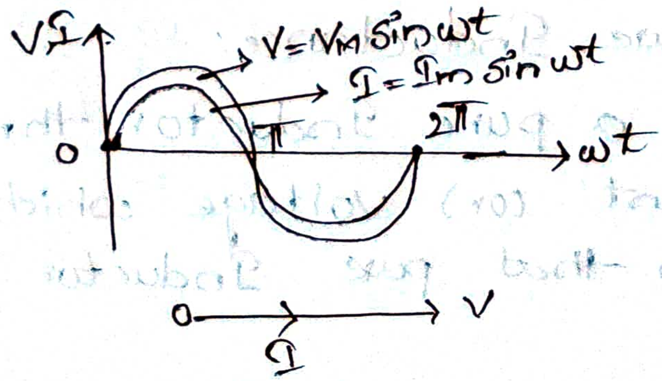
from eq ④ & eq ⑤

we get $I_m = \frac{V_m}{R}$ and

$\phi = 0^\circ$

The maximum value of the current flowing through the resistor $I_m = \frac{V_m}{R}$

Phasor diagram for pure resistance



The power consumed by the resistor:

$$P = VI$$

from the diagram

$$P = V_m \sin \omega t \times I_m \sin \omega t$$

$$P = V_m I_m \sin^2 \omega t$$

$$P = V_m I_m \left[\frac{1-\cos(2\omega t)}{2}\right]$$

$$P = \frac{V_m I_m}{2}\left[1-\cos(2\omega t)\right]$$

$$P = \frac{V_m I_m}{2} - \frac{V_m I_m \cos(2\omega t)}{2} \quad \text{——— ⑥}$$

from eq ⑥ the first component

$\frac{V_m I_m}{2}$ = Actual power component

$\frac{-V_m I_m \cos(2\omega t)}{2}$ = fluctuating power component

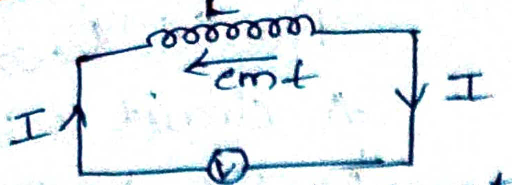
But in the resistor fluctuating power component is almost double the cosine value. Hence, it is considered as zero

∴ The total power consumed by the resistor is $P = \frac{V_m I_m}{2}$

$$\boxed{P = \sqrt{\frac{V_m I_m}{2}}}$$

Ac through pure Inductance:

consider a pure Inductor through which an A.C current (or) voltage which is passed through that pure Inductor



$V = V_m \sin\omega t$

When the supply voltage which is given to the inductor a magnetic field which is going to set up around the inductor

Due to this magnetic field a change flux takes place

Due to this change in flux an Emf will be induced at the inductor that emf is always opposite to that of voltage

$$V = -e$$

$$e = -L\frac{di}{dt}$$

$$V = -\left(-L\frac{di}{dt}\right)$$

$$V = L\frac{di}{dt}$$

$$Vdt = L \cdot di$$

But $V = V_m \sin\omega t$

$$V_m \sin\omega t \cdot dt = L\,di$$

$$di = \frac{V_m}{L}\sin\omega t\, dt \quad \text{—— (1)}$$

$$\int di = \int \frac{V_m}{L}\sin\omega t \cdot dt$$

$$i = \frac{V_m}{L}\int \sin\omega t \cdot dt$$

$$i = \frac{V_m}{L}\left(\frac{-\cos\omega t}{\omega}\right)$$

$$i = \frac{-V_m}{\omega L}\cos\omega t$$

Series Resonance	Parallel Resonance
1) A circuit is said to be in series resonance when impedance is minimum (or) when net reactance is zero $\omega L - \frac{1}{\omega C} = 0$, $\omega = \frac{1}{\sqrt{LC}}$	A circuit said to be in the resonance when I/p admittance is minimum and Input impedance is maximum.
2) The current in the circuit is maximum and is given by $I_{se} = \left(\frac{V}{R}\right) A$	The current in the circuit is minimum $I_{pa} = \frac{V}{\left(\frac{L}{CR}\right)} A$
3) Impedance has resistive part only	The net impedance of parallel circuit is max and given by $Z_{pb} = \left(\frac{L}{CR}\right) \Omega$
4) Power factor of the circuit is unity	At parallel resonance who power factor is unity
5) The Resonant frequency (fr) is given by $f_r = \frac{1}{2\pi\sqrt{LC}} Hz$	The resonant frequency is given by $f_r = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}} Hz$
6) The Voltage across capacitance and Inductance are equal in magnitude & 180° out of phase each other	The two branch current are equal in magnitude & 180° out of phase with each other