The current in a circuit is given by I = 42.42Sin(628)t Calculate

i) Frequency

ii) RMS Value

iii) Average Value

iv) Form Factor

$$I = I_m \sin \omega t$$

$$I = 42.42 \sin(628t)$$

$$I_m = 42.42A$$

$$\omega = 628$$

$$2\pi f = 628$$

$$f = \frac{628}{2\pi} = 99.95H.$$

$$\cong 100 Hz$$

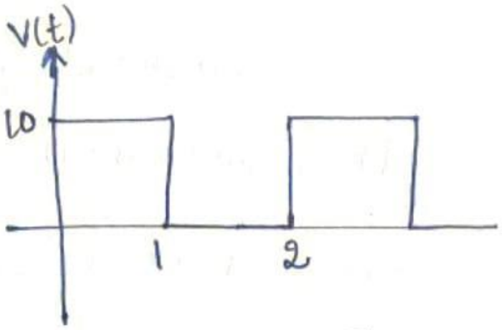
RMS $\Rightarrow$ $I_{rms} = \frac{I_m}{\sqrt{2}} = \frac{42.42}{\sqrt{2}} = 30 A.$

Average $\Rightarrow$ $I_{ave} = \frac{2I_m}{\pi} = \frac{2 \times 42.42}{\pi} = 27A$

Form factor $= \frac{I_{rms}}{I_{ave}} = \frac{I_m/\sqrt{2}}{2I_m/\pi} = \frac{30}{27} = 1.11$

Peak factor $= \frac{I_m}{I_{rms}} = \frac{I_m}{I_m/\sqrt{2}} = \sqrt{2} = 1.414.$

2. Calculate the average and RMS value of the square wave.



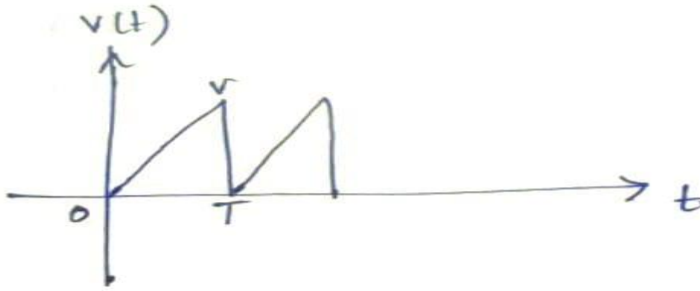
$$V_{rms} = \sqrt{\frac{\int_0^2 v^2(t)\, d(t)}{2}} = \sqrt{\frac{\int_0^1 10^2 \cdot dt + \int_1^2 0^2 \cdot dt}{2}}$$

$$= \sqrt{\frac{100(t)_0^1 + 0}{2}} = \sqrt{\frac{50}{2}} = 7.071V.$$

$$V_{ave} = \int_0^2 \frac{v(t) \cdot dt}{2} = \frac{\int_0^1 10 \cdot dt + \int_1^2 0 \cdot dt}{2}$$

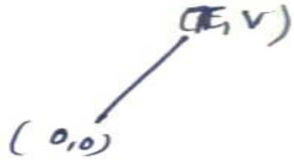
$$= \frac{10(t)_0^1}{2} = \frac{10[1]}{2} = 5V.$$

3. Calculate the form factor and peak factor of a triangular wave in which the voltage rises uniformly from 0 to V volts in time T seconds and completes the cycle by instant fall back to zero ?



$x = t$

$y = v(t)$



$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$$

$$y - 0 = \frac{V - 0}{T - 0} \cdot (t - 0)$$

$$\boxed{v(t) = \frac{V}{T} \cdot t}$$

$$V_{rms} = \sqrt{\frac{\int_0^T \left(\frac{V}{T}\right)^2 t^2 \cdot dt}{T}} = \sqrt{\frac{\frac{V^2}{T^2}\left[\frac{t^3}{3}\right]_0^T}{T}}$$

$$= \sqrt{\frac{V^2 \cdot \cancel{T^3}}{\cancel{T^3} \cdot 3}} = \frac{V}{\sqrt{3}}$$

$$V_{ave} = \frac{v(t) \cdot dt}{T} = \int_0^T \frac{\frac{V}{T} \cdot t \; dt}{T}$$

$$= \frac{V}{T^2} \int_0^T t \cdot dt = \frac{V}{T^2} \cdot \frac{T^2}{2} = \frac{V}{2}$$

$$\text{Form factor} = \frac{V_{rms}}{V_{ave}} = \frac{V/\sqrt{3}}{V/2} = 1.154$$

$$\text{Peak factor} = \frac{V_m}{V_{rms}} = \frac{V}{V/\sqrt{3}} = \sqrt{3} = 1.732$$

The current drawn by a pure capacitance of 20μF is 1.382 A from 220V ac supply, find the supply frequency?

$C = 20\mu F$

$I = 1.382A$

$V = 220V$

$$Z = X_C = \frac{V}{I} = \frac{220}{1.382} = 159\Omega$$

$$X_C = \frac{1}{2\pi f L}$$

$$f = \frac{1}{2\pi X_C L} = 49.99 Hz$$

A 300 μF capacitor is connected across is 240V, 50Hz system Determine i) the capacitance reactance ii) R.M.S value of current iii) Equations for voltages and currents

$$X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi(50)(300\times10^{-6})}$$

$$= 10\,\Omega$$

$$Z = R + j(X_L - X_C) = 0 + j(0-10) = -10j$$

$$= 10\angle{-90^\circ}$$

$$I = \frac{V}{Z} = \frac{240}{10} = 24\text{ A}. \quad (24\angle{+90^\circ})$$

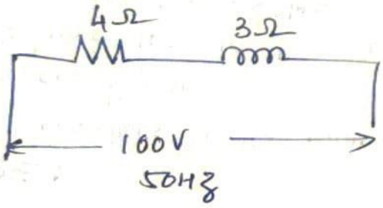
$$V_m = \sqrt{2}V = \sqrt{2}\times240 = 325\text{ V}$$

$$I_m = \sqrt{2}I = \sqrt{2}\times24 = 32.5\text{ A}$$

$$V = V_m \sin\omega t = 325\sin(100t \pm \theta)\text{ V}.$$

$$I = I_m \sin\omega t = 32\sin(100\pi t + 90^\circ)\text{ A}.$$

A Series RL circuit connected with R=4 Ωand inductive reactance XL =3Ω is connected to 100 V, 50 Hz. Find the amount of current, power drawn by the circuit and power factor?



$V = 100 \angle 0^\circ$

$Z = R + jX_L$

$Z = 4 + j3 \quad = 5 \angle 36.86^\circ \ \Omega$

$I = \frac{V}{Z} = \frac{100 \angle 0^\circ}{5 \angle 36} = 20 \angle -36.8^\circ \ A$

$P = I^2 R = (20)^2 \times 4 = 1600W$

$\cos\phi = \cos(-36.86^\circ) = 0.8$ Lagging

power $\Rightarrow$ $P = V \cdot I \cdot \cos\phi$

$= 100 \times 20 \times 0.8$

$= 1600$ watts.

③ Write the polar form of the voltage $v(t) = \sin\left(10\pi t + \frac{\pi}{3}\right)$. obtain its rectan-gular form.

Sol:- $v(t) = \sin\left(10\pi t + \frac{\pi}{3}\right)$

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

By comparison,

$V_m = 1 \quad \omega = 10\pi \quad \theta = \frac{\pi}{3} = 60^\circ.$

voltage in polar form $= V_{rms}\angle\theta = \frac{V_m}{\sqrt{2}}\angle\theta$

$$\boxed{V = \frac{1}{\sqrt{2}}\angle 60^\circ \text{ V.} = 0.707\angle 60^\circ \text{ V}}$$ polar form

voltage in rectangular form $= \frac{1}{\sqrt{2}}\cos 60^\circ + j\frac{1}{\sqrt{2}}\sin 60^\circ$

$= 0.707 \cos 60^\circ + j\, 0.707 \sin 60^\circ.$

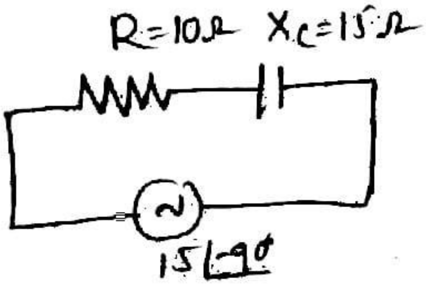
$$\boxed{V = 0.354 + j\, 0.612 \text{ V}}$$ Rectangular form.

A series circuit of R=10Ω, Xc=15Ω has an applied phase voltage V=50 (L-90) Vrms. Find the real power, reactance power, and power factor?

Resistance (R) = 10 Ω

Capacitive reactance (Xc) = 15 Ω

Applied phase voltage (V) = 50∠-90 = Vrms



$$Z = R + jX_c$$
$$= 10 + j(-15)$$
$$Z = \sqrt{10^2+15^2}\ \tan^{-1}\left(\frac{-15}{10}\right)$$
$$= 18.02\ \tan^{-1}(15/10)$$
$$Z = 18.02\angle 56.3^\circ$$

$$I_{rms} = \frac{V_{rms}}{Z} = \frac{50}{18} = 2.7\,A$$

Real power $= V_{rms} \times I_{rms} \times \cos\phi = 50 \times 2.7 \times \cos(56)$
$= 99W$

Reactive power $= V_{rms} \times I_{rms} \times \sin\phi = 109$ VAR

power factor $= \cos(\phi) = \cos(56.3) = 0.547$