Admittance (Y)

It is defined as the reciprocal of Impedance ohm Ω

Admittance, $Y = \frac{1}{Z} = \frac{I}{V}$

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

Unit = mho, ℧

If Admittance ↑, current ↑

* Components of Admittance

' Admittance triangle is opposite to Impedance triangle.

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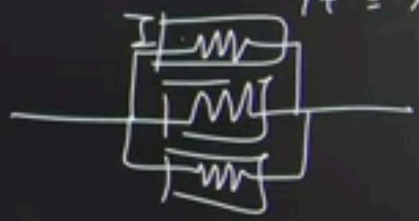

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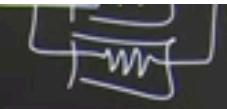

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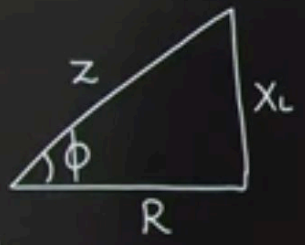
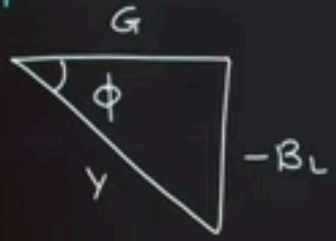


Impedance



Admittance.

G = conductance

$G = Y\cos\phi = \frac{R}{Z^2}$

B_L = Susceptance

$B_L = Y\sin\phi = \frac{X_L}{Z^2}$

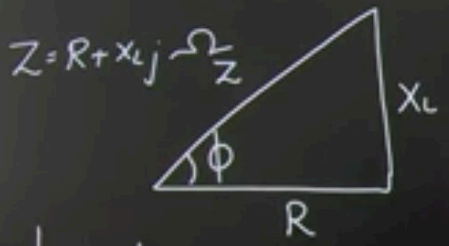
$Y\cos\phi$

$\frac{1}{Z} \times \frac{R}{Z}$

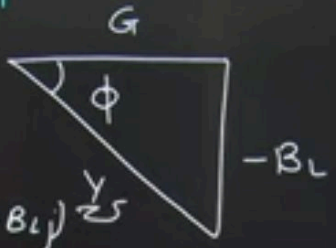
$\frac{R}{Z^2}$.

In admittance the angle becomes - ve.

Admittance triangle is opposite to Impedance triangle.



Impedance



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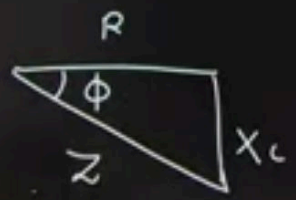
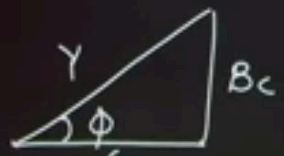


Z = R - XCj Ω



Y = G + BCj S

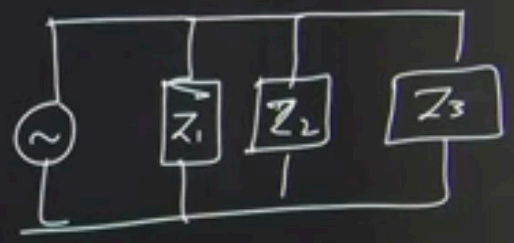
Q. Three loads are placed across 230V, 50Hz supply. The loads are $(10\angle -30)\,\Omega$, $(20\angle 60)\,\Omega$ and $(40\angle 0)\,\Omega$.

Find i) Admittance (Y) | ii) Equivalent Impedance iii) Power consumed & iv) power factor

$Z_1 = 10\angle -30\,\Omega = 8.66 - 5j\,\Omega$

$Z_2 = 20\angle 60\,\Omega = 10 + 17.32j\,\Omega$

$Z_3 = 40\angle 0\,\Omega = 40\,\Omega$



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$Y_1 = \frac{1}{Z_1} = \frac{1}{10\angle -30} = \frac{1}{10}\angle 30 = 0.1\angle 30 = 0.086 + 0.05j$

$Y_2 = \frac{1}{Z_2} = \frac{1}{20\angle 60} = 0.05\angle -60 = 0.025 - 0.043j$

$Y_3 = \frac{1}{Z_3} = \frac{1}{40\angle 0} = 0.025\angle 0 = 0.025 + 0j$

Total Admittance.

$Y_T = Y_1 + Y_2 + Y_3$

$=$

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$\frac{1}{Z} \quad \frac{1}{10\angle -30} = \frac{1}{10}\angle 30 = 0.1\angle 30 = 0.086 + 0.05j$

$\frac{1}{Z_2} \quad \frac{1}{20\angle 60} = 0.05\angle -60 = 0.025 - 0.043j$

$\frac{1}{40\angle 0} = 0.025\angle 0 = 0.025 + 0j$

Total Admittance.

$Y_T = Y_1 + Y_2 + Y_3$

$= 0.086 + 0.05j + 0.025 - 0.043j + 1$

$Y_T = 0.136 + 0.007j$ $[0.136\angle$

Equivalent Impedance Z

$Z = \frac{1}{Y}$

$= \frac{1}{0.136\angle 2.94} = 7.35\angle -2.94$

$= 7.34 - 0.37j$

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Find i) Admittance (Y) | ii) Equivalent Impedance iii) Power consumed & iv) powe fac

$P = VI\cos\phi$

$= 230 \times 31.35 \times \cos(-2.94)$

$= 7201\ W$

$= 7.2\ kW$

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

$= \frac{230\angle 0}{7.34\angle -2.94}$

$= 31.35\angle 2.94$

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$= 7.34 - 0.37j$

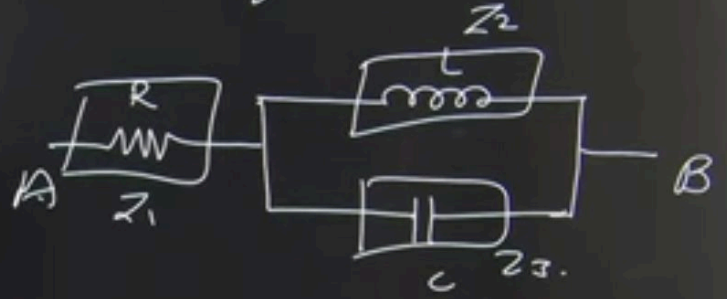
Power factor $= \cos\phi = \cos(-2.94)$

$= 0.99 = 1$ // leading.

Q. Draw the admittance triangle between the terminals A & B labelling its sides with appropriate value & units in case of.

i) $X_L = 4\Omega$, $X_C = 8\Omega$, $R = 1\Omega$

ii) $X_L = 10\Omega$, $X_C = 5\Omega$, $R = 1\Omega$



Case (i)

$Z_1 = 1 + 0j = (1 \angle 0)\ \Omega$

$Z_2 = 0 + 4j = (4 \angle 90)\ \Omega$

$Z_3 = 0 - 8j = (8 \angle -90)\ \Omega$

Total impedance

$$Z_T = Z_1 + \frac{Z_2 \cdot Z_3}{Z_1 + Z_2}.$$

Q. Draw the admittance triangle between the terminals A & B labelling its sides with appropriate value & units in case of.

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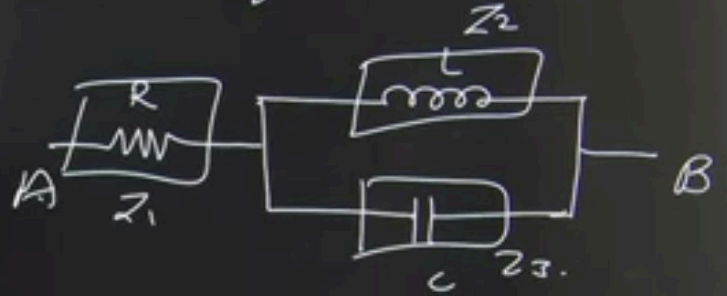
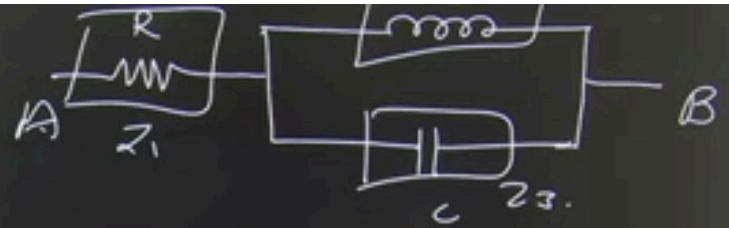


$$= 1 + 0j + \frac{(4\angle 90)(8\angle -90)}{0 + 4j + 0 - 8j}$$

$$= 1 + 0j + \frac{(32\angle 0)}{(4\angle -90}$$

$$= 1 + 0j + (8\angle 90)$$

$$= 1 + 0j + 0 + 8j = 1 + 8j$$



$X_L = 10\,\Omega$, $X_C = 5\,\Omega$, $R = 1\,\Omega$

Case (1)

$Z_1 = 1 + 0j = (1 \angle 0)\,\Omega$

$Z_2 = 0 + 4j = (4, \angle 90)\,\Omega$

$Z_3 = 0 - 8j = (8, \angle -90)\,\Omega$

Total impedance

$$Z_T = Z_1 + \frac{Z_2 \cdot Z_3}{Z_1 + Z_2}$$

$$= 1 + 0j + \frac{(4, \angle 90)(8, \angle -90)}{0 + 4j + 0 - 8j}$$

$$= 1 + 0j + \frac{(32 \angle 0)}{(4, \angle -90)}$$

$$= 1 + 0j + (8, \angle 90)$$

$$= 1 + 0j + 0 + 8j = \boxed{1 + 8j}$$

$Z_T = (1 + 8j) = (8.062 \angle 82.87)\,\Omega$

$$Y_T = \frac{1}{Z_T} = \frac{1}{(8.062 \angle 82.87)} = (0.124 \angle -82.87)$$

$$= 0.0153 - 0.123j$$

$$Z_T = Z_1 + \frac{Z_2 \cdot Z_3}{Z_1 + Z_2}$$

$$= 1 + 0j + (8, \angle 90) \quad (4, \angle 90$$

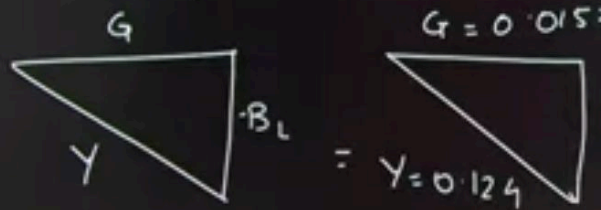
$$= 1 + 0j + 0 + 8j = \boxed{1 + 8j}$$

$$Z_T = (1 + 8j) = (8.062 \angle 82.87)\ \Omega$$

$$Y_T = \frac{1}{Z_T} = \frac{1}{(8.06 \angle 82.87)} = (0.124 \angle -82.87)$$

$$= 0.0153 - 0.123j\ \mho$$

Here complex part is negative



$= Y = 0.124$

$B_L = -0.123\ \mho$