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UMSS-FCYT
DEPARTAMENTO DE ELECTRICIDAD
SEMESTRE 1-2024

PRIMER PARCIAL - CIRCUITOS ELECTRICOS III

APELLIDOS:..... NOMBRES:.....
CARRERA:..... CARNET DE IDENTIDAD:.....

1.- En el circuito trifásico de la figura si $\overline{U}_{bc} = 324\angle -150°\ V\ rms$; R=45Ω; $Z_1 = 55 + j45\Omega$; $Z_2 = 65 - j35\Omega$; $Z_3 = 75 + j80\Omega$; $Z_L = 5.2 + j6.5\Omega$; secuencia negativa

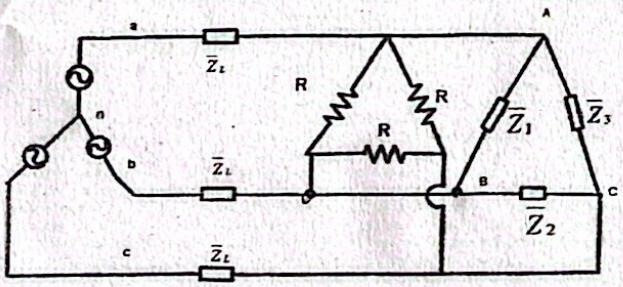
a) La potencia trifásica de la carga delta combinada
b) La potencia trifásica total por el método de los dos vatímetos conectados en las líneas a y b

2.- En el circuito trifásico de la figura, si $Z_\Delta = 90 + j60\Omega$; $Z_Y = 60 + j45\Omega$; $Z_L = 10 + j6\Omega$. Si la corriente de la carga delta es $\overline{I}_{AC} = 4.5\angle -65° A$, determine:
a) La potencia trifásica que consume la carga en estrella.
b) Los voltajes de línea del generador trifásico para una secuencia positiva.

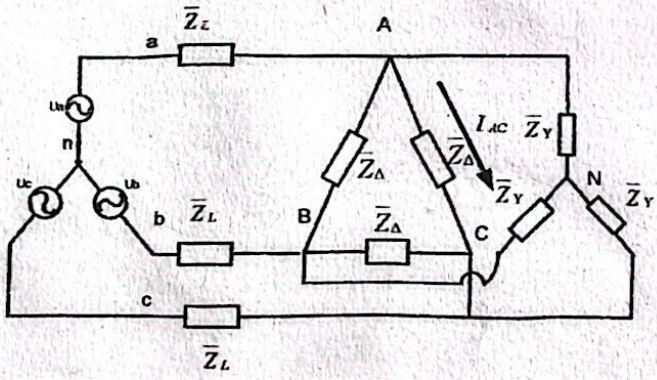
3.- En el circuito de la figura determinar:
a) La función de transferencia, polos y ceros si V_0 es la señal de salida
b) Hallar $v_{0(t)}$ para t>0 si $v_{g(t)} = \begin{cases} 40t + 20V & 0 < t < 2 \\ 0 & t > 2 \end{cases}$ (t en segundos)

4.- En el circuito de la figura determine la corriente i_0 en función del tiempo (t>0) si:
$v_{g(t)} = 60u(-t) + 100\cos(5t)u(t)V$

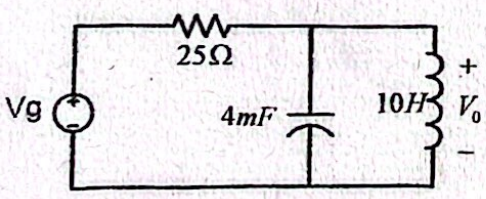
EJERCICIO 1



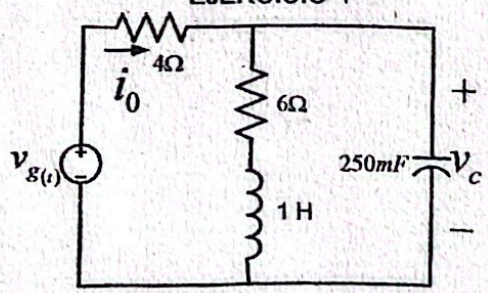
EJERCICIO 2



EJERCICIO 3



EJERCICIO 4



Resolución Primer Parcial Circuitos III 1/2024

①

$\bar{U}_{bc} = 324 \angle -150° \text{ V}$ (-)

$\bar{U}_{ac} = 324 \angle 150° \text{ V}$

$\bar{U}_{cb} = 324 \angle 30° \text{ V}$ $-120°$

$\bar{U}_{ba} = 324 \angle -90° \text{ V}$ $+120°$

$Z_1' = R // Z_1 = 28,16 + j7,58 \Omega$

$Z_2' = R // Z_2 = 28,28 - j5,32 \Omega$

$Z_3 = R // Z_3 = 33,32 + j7,79 \Omega$

$\bar{Z}_a = 10,25 + j4,11 \Omega$

$\bar{Z}_b = 9,286 - j0,32 \Omega$

$\bar{Z}_c = 10,88 - j0,74 \Omega$

$Z_a' = Z_a + Z_L = 15,45 + j10,61 \Omega$

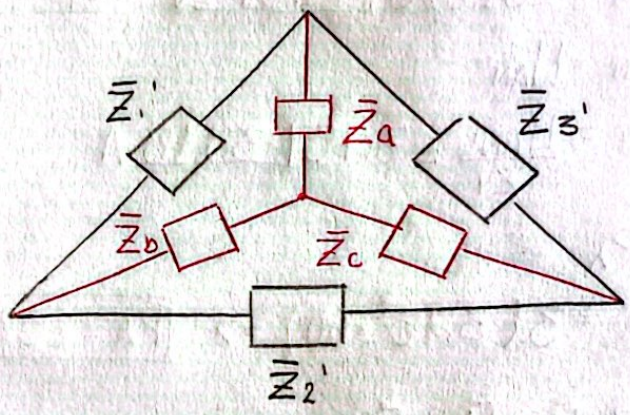
$Z_b' = Z_b + Z_L = 14,49 + j6,18 \Omega$

$Z_c' = Z_c + Z_L = 16,08 + j5,76 \Omega$

$\bar{U}_a = 187,06 \angle 120° \text{ V}$

$\bar{U}_b = 187,06 \angle -120° \text{ V}$

$\bar{U}_c = 187,06 \angle 0° \text{ V}$



$\bar{U}_0 = 10,41 \angle -3,5° \text{ V}$

$\bar{I}_a = 10,296 \angle 88,11° \text{ A}$

$\bar{I}_b = 12,19 \angle -145,88° \text{ A}$

$\bar{I}_c = 10,34 \angle -19,51° \text{ A}$

a) P en la carga delta combinada

$W = 10,25 \cdot 10,296^2 + 9,286 \cdot 12,19^2 + 10,88 \cdot 10,34^2$

$\boxed{W = 3'630,25 \text{ W}}$

b) P_T

$W_1 = \text{Re}\{\bar{U}_{ac} \cdot \bar{I}_a^*\} = 1'571,89 \text{ W}$

$W_2 = \text{Re}\{\bar{U}_{bc} \cdot \bar{I}_b^*\} = 3'938,35 \text{ W}$

$P_T = W_1 + W_2$

$\boxed{P_T = 5'510 \text{ W}}$

(2)

$\bar{I}_{AC} = 4{,}5 \angle -65° \text{ A}$

$\bar{I}_{CA} = 4{,}5 \angle 115° \text{ A}$

$\bar{I}_{AB} = 4{,}5 \angle -5° \text{ A}$

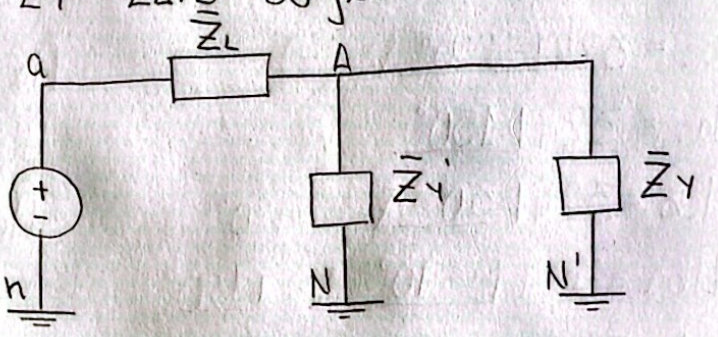
$\bar{U}_{AB} = 486{,}75 \angle 28{,}69° \text{ V}$

$\bar{U}_{AN} = 281{,}025 \angle -1{,}31° \text{ V}$

$\bar{U}_{AN} = \bar{U}_{AN'}$

$\bar{I}_Y = \frac{\bar{U}_{AN'}}{Z_Y} = 3{,}75 \angle -38{,}18° \text{ A}$

$Z_Y' = Z_\Delta / 3 = 30 + j20\,\Omega$



a) P_λ

$P_\lambda = 3(3{,}75^2 \cdot 60) \Rightarrow \boxed{P_\lambda = 2527{,}2\,W}$

b) $Z_1, \bar{U}_a; \bar{U}_b; \bar{U}_c$

$Z_1 = Z_Y // Z_\lambda' = 20{,}02 + j13{,}87\,\Omega$

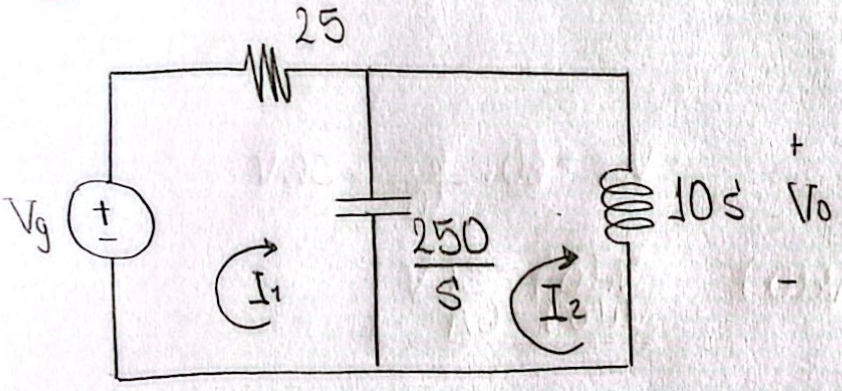
$\bar{I}_a = \frac{\bar{U}_{AN'}}{Z_1} = 11{,}54 \angle -36{,}03° \text{ A}$

$\bar{Z}_T = \bar{Z}_1 + \bar{Z}_L = 30{,}02 + j19{,}87\,\Omega$

$\bar{U}_a = \bar{Z}_T \cdot \bar{I}_a = 415{,}38 \angle -2{,}53° \text{ V}$

$$\boxed{\begin{aligned} \bar{U}_a &= 415{,}38 \angle -2{,}53° \text{ V} \\ \bar{U}_b &= 415{,}38 \angle -122{,}53° \text{ V} \\ \bar{U}_c &= 415{,}38 \angle 117{,}47° \text{ V} \end{aligned}}$$

③



$$\left(25+\frac{250}{s}\right)I_1-\left(\frac{250}{s}\right)I_2=V_g$$

$$-\left(\frac{250}{s}\right)I_1+\left(\frac{250}{s}+10s\right)I_2=0$$

$$\begin{bmatrix} 25+\frac{250}{s} & -\frac{250}{s} \\ -\frac{250}{s} & \frac{250}{s}+10s \end{bmatrix}\begin{bmatrix} I_1 \\ I_2 \end{bmatrix}=\begin{bmatrix} V_g \\ 0 \end{bmatrix}$$

$$I_2 = V_g \cdot \frac{1}{s^2+10s+25}$$

$$V_o = 10s \cdot I_2 = V_g \cdot \frac{10s}{s^2+10s+25}$$

$$H(s)=\frac{V_o}{V_g}=\frac{\cancel{V_g}\cdot\frac{10s}{s^2+10s+25}}{\cancel{V_g}}$$

$$\boxed{H(s)=\frac{10s}{s^2+10s+25}}$$

a)

Ceros: $\boxed{s_1=0}$

Polos: $\boxed{s_2=-5}$

b) $V_g(t)=(40t+20)(u(t)-u(t-2))$

$$V_g(s)=\frac{-40e^{-2s}+40}{s^2}+\frac{-100e^{-2s}+20}{s}$$

$$H(s)=\frac{V_o(s)}{V_g(s)} \longrightarrow V_o(s)=\frac{-16e^{-2s}+16}{s}+\frac{-920e^{-2s}+120}{(s+5)^2}+\frac{16e^{-2s}-16}{s+5}$$

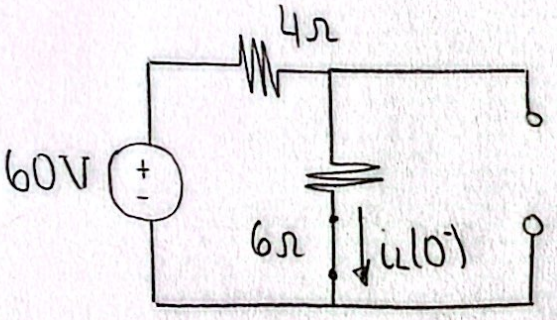
$$V_o(t)=\mathcal{L}^{-1}\{V_o(s)\}$$

$$\boxed{V_o(t)=(-16e^{-5t}+120te^{-5t}+16)u(t)+(-16+16e^{-5t+10}+(-920t+1840)\cdot e^{-5t+10}))u(t-2)\ V}$$

$$\boxed{V_o(t)=(16+e^{-5t}(120t-16))u(t)+(-16+e^{-5t+10}(1856-920t))u(t-2)\ V}$$

(4)

$t<0$



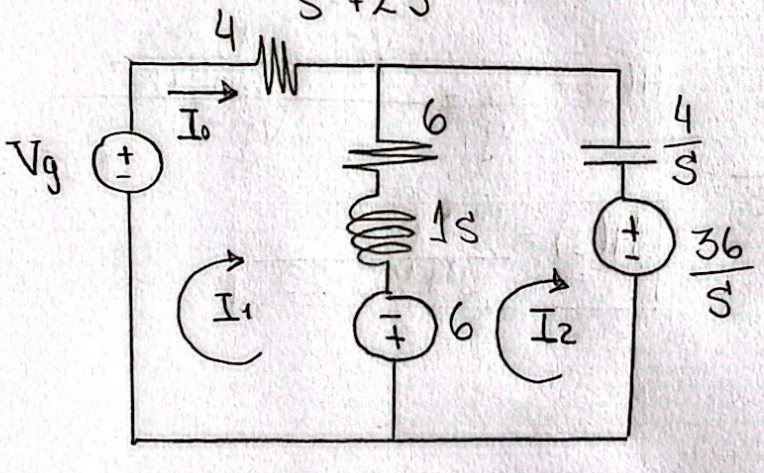
$V_{6\Omega} = 60 \cdot \frac{6}{10} = 36V$

$V_c(0^-) = 36V$
$i_L(0^-) = 6A$

$t>0$

$V_g(t) = 100\cos(5t)\,V \qquad V_g(s) = \mathcal{L}\{V_g(t)\}$

$V_g(s) = \frac{100s}{s^2+25}$



$I_0 = I_1$

$$\begin{bmatrix} 10+s & -6-s \\ -6-s & 6+s+\frac{4}{s} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} \frac{100s}{s^2+25} + 6 \\ -6-\frac{36}{s} \end{bmatrix}$$

$$(10+1s)I_1 - (6+1s)I_2 = \frac{100s}{s^2+25} + 6$$

$$-(6+1s)I_1 + \left(6+1s+\frac{4}{s}\right)I_2 = -6-\frac{36}{s}$$

$$I_1 = I_0 = -\frac{+7.7}{s+2} + \frac{0.167}{s+5} + \frac{23.53s - 24.57}{s^2+25}$$

$i_0(t) = \mathcal{L}^{-1}\{I_0(s)\}$

$$\boxed{i_0(t) = (-7.7e^{-2t} + 0.167e^{-5t} + 23.53\cos 5t - 4.91\sin 5t)u(t)\,A}$$