UMSS-FCYT
DEPARTAMENTO DE ELECTRICIDAD
SEMESTRE 2-2023

PRIMER PARCIAL - CIRCUITOS ELECTRICOS III

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

1.- En el circuito trifásico de la figura el voltaje de línea del generador es $\overline{U}_{bc} = 400\angle -25° V$ r.m.s; las impedancias: $Z_L = 6.25 + j5.4\Omega$; $Z_1 = 45 + j75\Omega$; $Z_2 = 85 - j35\Omega$; $Z_3 = 60 + j70\Omega$; $Z_\Delta = 55 + j45\Omega$. Si la secuencia es negativa determinar:
a) La potencia trifásica que entrega el generador por el método de los dos vatímetros
b) La potencia activa y reactiva que consume (o entrega) la impedancia Z_2

2.- En el circuito de la figura Si $i_{g(t)} = 1.5u(-t) + 3.5u(t)\,A$ determine:

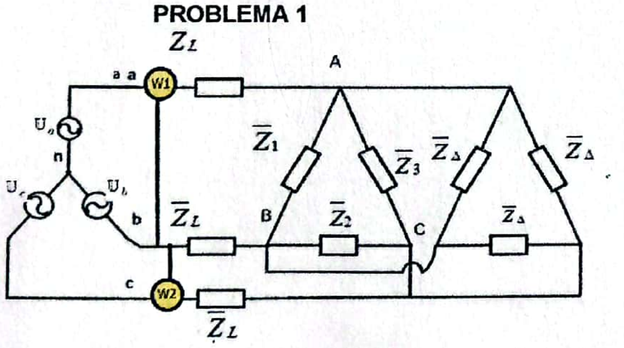
a) Los valores: $v_{0(0^+)}$ y $v_{0(\infty)}$ aplicando los teoremas del valor inicial y final

b) El voltaje para t>0 $v_{0(t)}$

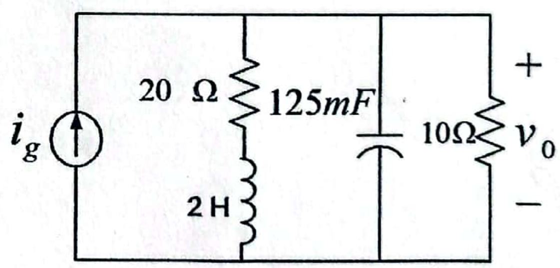
3.- En el circuito de la figura, determine el voltaje del capacitor en los instantes: t=0.15s y t=0.6s

4.- En el circuito trifásico equilibrado de la figura, $Z_L = 4.5 + j3.5\Omega$; $Z_{\Delta 1} = 75 + j90\Omega$; $Z_{\Delta 2} = 60 + j45\Omega$; $Z_Y = 55 + j60\Omega$. Si la corriente $\overline{I}_x = 8.45\angle -65° A$ r.m.s determine:
a) Las corrientes de fase de la segunda carga en delta para una secuencia positiva
b) Los voltajes de línea en la salida del generador trifásico

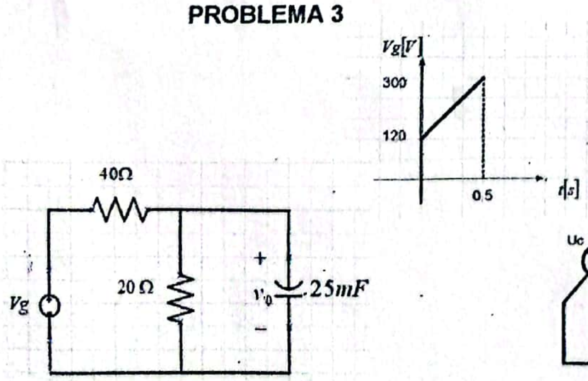
PROBLEMA 1



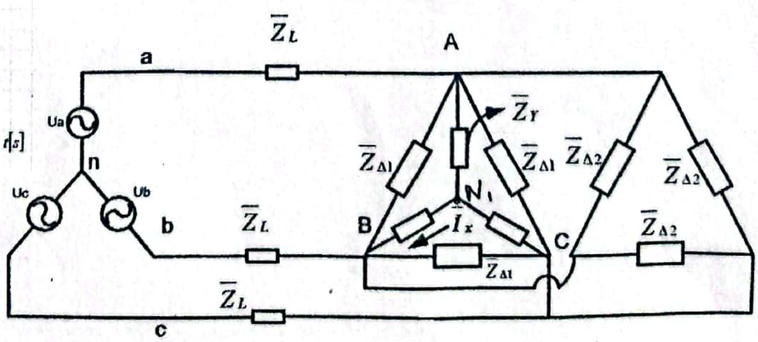
PROBLEMA 2



PROBLEMA 3



PROBLEMA 4



Escaneado con CamScanner

1er Parcial _ Circuitos III

1.- $\overline{U}_{bc} = 400\angle{-25^\circ}\ V$ $\qquad Z_1 = 45+j75\,\Omega$ $\qquad Z_\Delta = 55+j45\,\Omega$

$Z_L = 6{,}25+j5.4\,\Omega$ $\qquad Z_2 = 85-j35\,\Omega$

$Z_3 = 60+j70\,\Omega$

Sec. negativa:

$\rightarrow \overline{U}_{cb} = 400\angle{155^\circ}\ V \rightarrow \overline{U}_{ca} = 400\angle{-85^\circ}\ V \Rightarrow$

$\overline{U}_a = 230{,}94\angle{-115^\circ}\ V$

$\overline{U}_b = 230.94\angle{5^\circ}\ V$

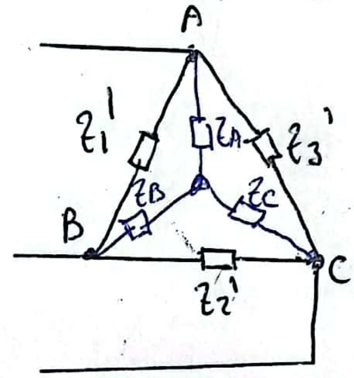
$\overline{U}_c = 230{,}94\angle{125^\circ}\ V$

$Z_1' = Z_1 \parallel Z_\Delta = 26{,}56+j29{,}63\,\Omega$

$Z_2' = Z_2 \parallel Z_\Delta = 45{,}38+j10{,}33\,\Omega$

$Z_3' = Z_3 \parallel Z_\Delta = 29{,}13+j27{,}83\,\Omega$

$Z_T = 101{,}07+j67{,}79\,\Omega$



$\Delta \rightarrow \lambda$:

$Z_A = 6{,}99+j11{,}17\,\Omega$

$Z_B = 13{,}55+j6{,}93\,\Omega$

$Z_C = 14{,}22+j5{,}94\,\Omega$

$+ Z_L$:

$Z_A' = 13{,}24+j16{,}57\,\Omega$

$Z_B' = 19{,}8+j12{,}33\,\Omega$

$Z_C' = 20{,}47+j11{,}34\,\Omega$

$$\Rightarrow \overline{U}_0 = \frac{\frac{\overline{U}_a}{Z_A'} + \frac{\overline{U}_b}{Z_B'} + \frac{\overline{U}_c}{Z_C'}}{\frac{1}{Z_A'} + \frac{1}{Z_B'} + \frac{1}{Z_C'}}$$

$\overline{U}_0 = 30{,}05\angle{173{,}05^\circ}\ V$

a) Corrientes de línea:

$\overline{I}_a = 10{,}54\angle{-159{,}02^\circ}\ A$

$\overline{I}_b = 11{,}16\angle{-28{,}28^\circ}\ A$

$\overline{I}_c = 9{,}06\angle{89{,}96^\circ}\ A$

$W_1 = \mathrm{Re}\{\overline{U}_{ab}\cdot\overline{I}_a^*\} = 4090{,}41\ W$

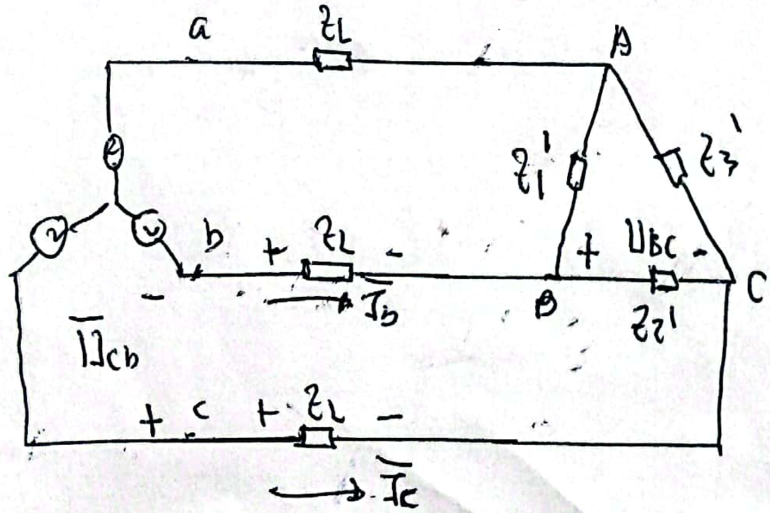
$W_2 = \mathrm{Re}\{\overline{U}_{cb}\cdot\overline{I}_c^*\} = 1529{,}28\ W$

$\overline{U}_{ba} = 400\angle{35^\circ}\ V \rightarrow \overline{U}_{ab} = 400\angle{-145^\circ}\ V$

$\overline{U}_{cb} = 400\angle{155^\circ}\ V$

$\boxed{P_T = 5619{,}7\ W}$

b)



$\overline{U}_{cb} + Z_L\overline{I}_b + \overline{U}_{BC} - Z_L\overline{I}_c = 0$

$\overline{U}_{BC} = 259{,}92\angle{-30{,}63^\circ}\ V$

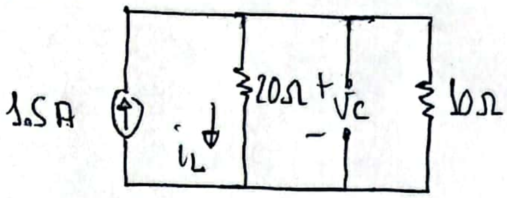
$\overline{I}_2 = \frac{\overline{U}_{BC}}{Z_2} = 2{,}83\angle{-8{,}25^\circ}\ A$

$P_2 = 2{,}83^2 \times 85 \Rightarrow$

$Q_2 = 2{,}83^2 \times -35$

$\boxed{P_2 = 680.76\ W \quad Q_2 = -280.31\ VAR}$

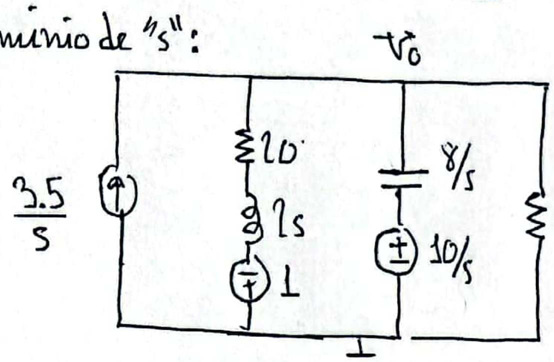
2.- $t = 0^-$:



$$i_L = \frac{10}{30} \times 1.5 \rightarrow \underline{i_L = 0{,}5\,A}$$

$$V_C = 20 \times 0{,}5 \rightarrow \underline{V_C = 10\,V}$$

Dominio de "s":



$$V_o(s)\left(\frac{1}{2s+20} + \frac{s}{8} + \frac{1}{10}\right) + \frac{1}{2s+20} - \frac{10}{8} = \frac{3.5}{s}$$

$$V_o(s) = \frac{\frac{3{,}5}{s} + \frac{5}{4} - \frac{1}{2s+20}}{\frac{1 + \frac{s}{8}(2s+20) + \frac{1}{10}(2s+20)}{2s+20}}$$

$$V_o(s) = \frac{\frac{3{,}5(2s+20) + \frac{5}{4}s(2s+20) - s}{s\,\cancel{(2s+20)}}}{\frac{\frac{1}{4}s^2 + \frac{27}{10}s + 3}{\cancel{2s+20}}}$$

$$V_o(s) = \frac{\frac{5}{2}s^2 + 31s + 70}{s\left(\frac{1}{4}s^2 + \frac{27}{10}s + 3\right)} \begin{matrix} \times 4 \\ \times 4 \end{matrix} \Rightarrow \underline{V_o(s) = \frac{10s^2 + 124s + 280}{s(s^2 + 10{,}8s + 12)}}$$

a) $$V_o(0^+) = \lim_{s \to \infty} \frac{10s^2 + 124s + 280}{s^2 + 10{,}8s + 12} \Rightarrow \boxed{V_o(0^+) = 10\,V}$$

$$V_o(\infty) = \lim_{s \to 0} \frac{10s^2 + 124s + 280}{s^2 + 10{,}8s + 12} \Rightarrow \boxed{V_o(\infty) = 23{,}33\,V}$$

b) $$\frac{10s^2 + 124s + 280}{s(s+1{,}26)(s+9{,}54)} = \frac{A}{s} + \frac{B}{s+1{,}26} + \frac{C}{s+9{,}54}$$

$s = 0$: $A = 23{,}29$

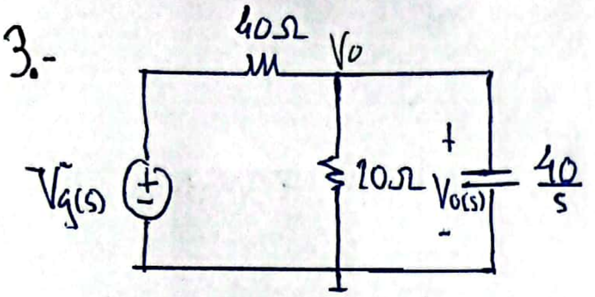
$s = -1{,}26$: $B = -13{,}38$ $\Rightarrow V_o(t) = \mathcal{L}^{-1}\left\{\frac{23{,}29}{s} - \frac{13{,}38}{s+1{,}26} + \frac{0{,}091}{s+9{,}54}\right\}$

$s = -9{,}54$: $C = 0{,}091$

$$\boxed{V_o(t) = \left(23{,}29 - 13{,}38e^{-1{,}26t} + 0{,}091e^{-9{,}54t}\right)u(t)\ V}$$

Escaneado con CamScanner

3.-



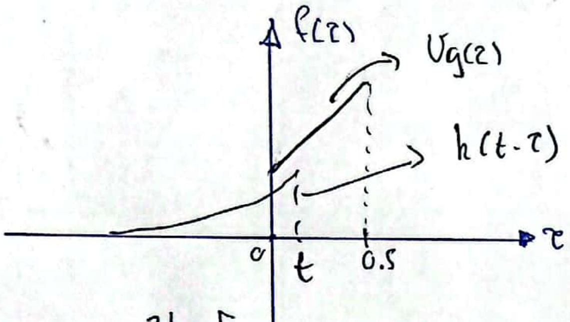
$$V_o(s)\left(\frac{1}{40}+\frac{1}{10}+\frac{s}{40}\right)-\frac{V_g(s)}{40}=0$$

$$V_o(s)=\frac{V_g(s)}{3+s} \Rightarrow V_o(t)=e^{-3t}u(t) * V_g(t)$$

$$V_o(t)=V_g(t) * e^{-3t}u(t)$$

$$V_g(t)=\begin{cases} 360t+120\ V & 0<t<0.5s \\ 0 & t>0.5s \end{cases} \Rightarrow V_g(\tau)=\begin{cases} 360\tau+120 & 0<\tau<0.5 \\ 0 & \tau>0.5 \end{cases}$$

$$h(t-\tau)=e^{-3(t-\tau)}u(t-\tau)$$



$0<t<0,5$:

$$V_o(t)=\int_0^t(360\tau+120)e^{-3(t-\tau)}\cdot d\tau$$

$$V_o(t)=e^{-3t}\cdot\int_0^t(360\tau e^{3\tau}+120e^{3\tau})d\tau$$

$$V_o(t)=e^{-3t}\cdot\left[360\left(\frac{\tau e^{3\tau}}{3}-\frac{e^{3\tau}}{9}\right)\Big|_0^t+40e^{3\tau}\Big|_0^t\right]$$

$$V_o(t)=e^{-3t}\cdot\left[360\left(\frac{te^{3t}}{3}-\frac{e^{3t}}{9}+\frac{1}{9}\right)+40e^{3t}-40\right]=e^{-3t}\cdot\left[120te^{3t}\right]\Rightarrow \cancel{V_o(t)=t}$$

$$\underline{V_o(t)=120t}$$

$t>0,5$:

$$V_o(t)=\int_0^{0,5}(360\tau+120)e^{-3(t-\tau)}d\tau=e^{-3t}\cdot\left[360\left(\frac{\tau e^{3\tau}}{3}-\cancel{\frac{e^{3\tau}}{9}}\right)+\cancel{40e^{3\tau}}\right]\Big|_0^{0,5}$$

$$V_o(t)=e^{-3t}\cdot\left[60e^{1.5}\right] \Rightarrow \underline{V_o(t)=60e^{-3t+1.5}}$$

$$V_o(t)=\begin{cases} 120t\ \ V & 0<t<0.5s \\ 60e^{-3t+1.5}\ \ V & t>0.5s \end{cases}$$

Por tanto: $t=0,15s$: $\boxed{V_o=18V}$

$t=0,6s$: $\boxed{V_o=44,45V}$

4.- $Z_L = 4.5 + j3.5\,\Omega$ $\quad Z_Y = 55 + j60\,\Omega$

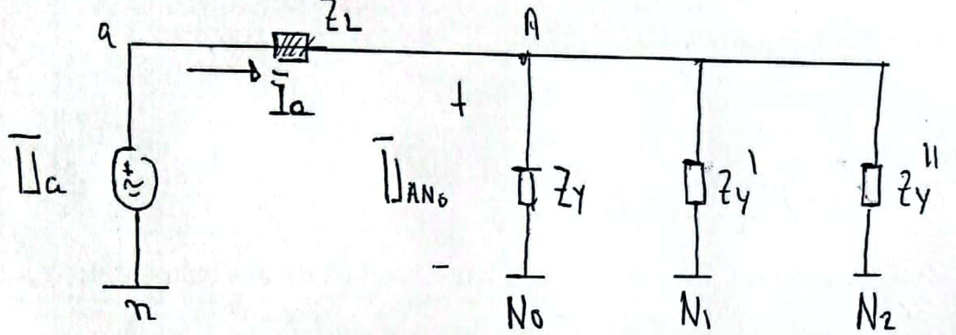
$Z_{\Delta 1} = 75 + j90\,\Omega$ $\quad \bar{I}_x = 8,45 \angle -65^\circ$ A r.m.s $\quad$ sec. positiva

$Z_{\Delta 2} = 60 + j45\,\Omega$

$\bar{U}_{N_0B} = Z_Y \cdot \bar{I}_x = 687,78 \angle -17,51^\circ$ V $\Rightarrow \bar{U}_{BN_0} = 687,78 \angle 162,49^\circ$ V

$\boxed{\bar{U}_{AN_0} = 687,78 \angle -77,51^\circ \text{ V}}$

Equivalente monofásico:



$Z_Y' = \frac{Z_{\Delta 1}}{3} = 25 + j30\,\Omega$

$Z_Y'' = \frac{Z_{\Delta 2}}{3} = 20 + j15\,\Omega$

a) $\bar{U}_{AB} = \sqrt{3} \cdot 687,78 \angle -77,51^\circ + 30^\circ \Rightarrow \bar{U}_{AB} = 1191,27 \angle -47,51^\circ$ V

$\bar{I}_{AB} = \frac{\bar{U}_{AB}}{Z_{\Delta 2}} \Rightarrow \boxed{\bar{I}_{AB} = 15,88 \angle -84,38^\circ \text{ A}}$

$\boxed{\begin{aligned} \bar{I}_{BC} &= 15,88 \angle 155,62^\circ \text{ A} \\ \bar{I}_{CA} &= 15,88 \angle 35,62^\circ \text{ A} \end{aligned}}$

b) $Z_{eq1} = Z_Y \parallel Z_Y' \parallel Z_Y'' \Rightarrow Z_{eq1} = 9,46 + j8,8\,\Omega \Rightarrow \bar{I}_a = \frac{\bar{U}_{AN_0}}{Z_{eq1}} = 53,23 \angle -120,44^\circ$ A

$\bar{U}_a = (Z_L + Z_1) \cdot \bar{I}_a \Rightarrow \bar{U}_a = 990,38 \angle -79,06^\circ$ V

$\bar{U}_{ab} = \sqrt{3} \cdot 990,38 \angle -79,06^\circ + 30^\circ$

$\boxed{\begin{aligned} \bar{U}_{ab} &= 1715,4 \angle -49,06^\circ \text{ V} \\ \bar{U}_{bc} &= 1715,4 \angle -169,06^\circ \text{ V} \\ \bar{U}_{ca} &= 1715,4 \angle 70,94^\circ \text{ V} \end{aligned}}$