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UMSS-FCYT
DEPARTAMENTO DE ELECTRICIDAD
SEMESTRE 1-2024

Docente con quien aprobó laboratorio y gestion:

EXAMEN FINAL- CIRCUITOS ELECTRICOS III

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

1.- Se aplica la señal periódica al circuito mostrado en la figura, donde además el voltaje: $v_{2(t)} = \{40t + 50V \quad 0 < t < 1s$ que se repite con T=1s. Determine el voltaje del capacitor con 4 armónicos diferentes de cero y su valor eficaz.

2.- En el circuito de la figura, se tiene un voltaje: $v_{g(t)} = \begin{cases} 40V & t < 0 \\ 25\cos(3t)V & t > 0 \end{cases}$

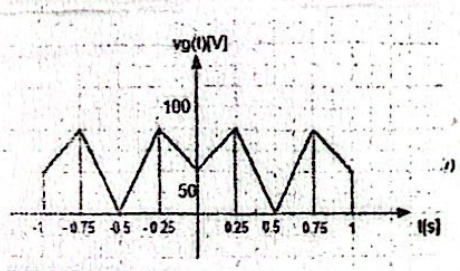
a) Determine aplicando el teorema del valor inicial: $i_{0(0^+)}$ y verifique dicho valor con las condiciones iniciales de problema.
b) Determine para t>0: $i_{0(t)}$ y verifique lo que ha hallado en el inciso a)

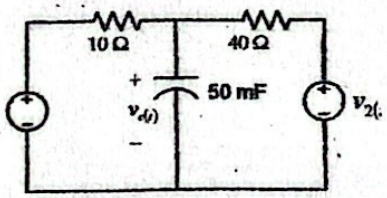
3.- En el circuito trifásico de la figura el voltaje de línea del generador es:
$\bar{U}_{ab} = 554.26\angle -65°V$ eficaces y secuencia negativa. Las impedancias: $Z_L = 6.5 + j4.8\Omega$;
$Z_Y = 15 + j18\Omega$; $Z_\Delta = 65 + j48\Omega$; $Z_1 = 45 + j28\Omega$; $Z_2 = 60 + j35\Omega$; $Z_3 = 85 + j50\Omega$.

a) Determine la corriente $\bar{I}_3$ y la potencia activa y reactiva de esa impedancia
b) Determine la potencia trifásica por el método de los dos vatímetros en las líneas "b" y "c"

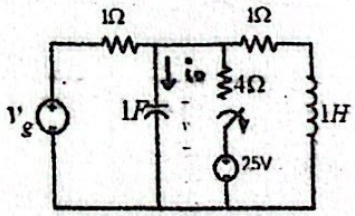
- Las redes de dos puertos se interconectan en cascada. Determine la resistencia en la salida para una máxima transferencia de potencia y dicha potencia, si en la entrada se conecta en serie: 50 V con 5Ω

PROBLEMA 1





PROBLEMA 2



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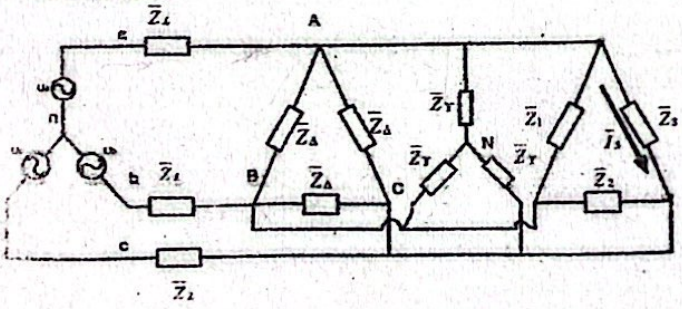
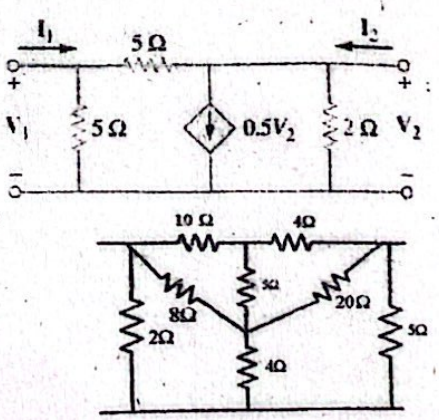


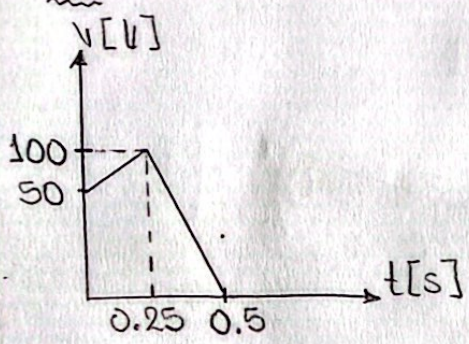
PROBLEMA 4



Examen final I/2024 Cir III

(1) V_c?

V_g



Pulso par

$$V_g(t)\begin{cases}200t+50\ V & 0<t<0.25s\\ -400t+200\ V & 0.25s<t<0.5s\end{cases}$$

$T=1s;\ \omega_0=2\pi;\ a=2n\pi$

$$C_0=2\left[\int_0^{0.25}(200t+50)dt+\int_{0.25}^{0.5}(-400t+200)dt\right]$$

$$\boxed{C_0=62.5}\qquad \boxed{b_n=0}$$

$$a_n=4\left[\int_0^{0.25}(200t+50)\cos(2n\pi t)dt+\int_{0.25}^{0.5}(-400t+200)\cos(2n\pi t)dt\right]$$

$$a_n=4\left[200\left(\frac{t}{2n\pi}\sin(2n\pi t)+\frac{1}{4n^2\pi^2}\cos(2n\pi t)\right)_0^{0.25}+50\left(\frac{1}{2n\pi}\sin(2n\pi t)\right)_0^{0.25}\right.$$
$$\left.-400\left(\frac{t}{2n\pi}\sin(2n\pi t)+\frac{1}{4n^2\pi^2}\cos(2n\pi t)\right)_{0.25}^{0.5}+200\left(\frac{1}{2n\pi}\sin(2n\pi t)\right)_{0.25}^{0.5}\right]$$

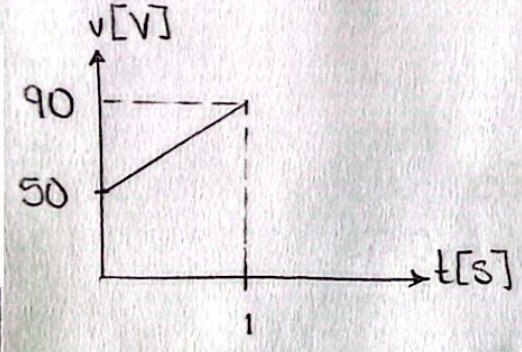
$$a_n=4\left[200\left(\frac{0.125}{n\pi}\sin\left(\frac{n\pi}{2}\right)+\frac{0.25}{n^2\pi^2}\cos\left(\frac{n\pi}{2}\right)-\frac{0.25}{n^2\pi^2}\right)+50\left(\frac{0.5}{n\pi}\sin\left(\frac{n\pi}{2}\right)\right)\right.$$
$$\left.-400\left(\frac{0.25}{n^2\pi^2}(-1)^n-\frac{0.125}{n\pi}\sin\left(\frac{n\pi}{2}\right)-\frac{0.25}{n^2\pi^2}\cos\left(\frac{n\pi}{2}\right)\right)+200\left(-\frac{0.5}{n\pi}\sin\left(\frac{n\pi}{2}\right)\right)\right]$$

$$a_n=4\left[\frac{25}{n\pi}\sin\left(\frac{n\pi}{2}\right)+\frac{50}{n^2\pi^2}\cos\left(\frac{n\pi}{2}\right)-\frac{50}{n^2\pi^2}+\frac{25}{n\pi}\sin\left(\frac{n\pi}{2}\right)-\frac{100}{n^2\pi^2}(-1)^n+\frac{50}{n\pi}\sin\left(\frac{n\pi}{2}\right)\right.$$
$$\left.+\frac{100}{n^2\pi^2}\cos\left(\frac{n\pi}{2}\right)-\frac{100}{n\pi}\sin\left(\frac{n\pi}{2}\right)\right]$$

$$a_n=\frac{600}{n^2\pi^2}\cos\left(\frac{n\pi}{2}\right)-\frac{200}{n^2\pi^2}-\frac{400}{n^2\pi^2}(-1)^n$$

$$\boxed{a_n=\frac{200}{n^2\pi^2}\left[3\cos\left(\frac{n\pi}{2}\right)-1-2(-1)^n\right]}\quad a_n=\bar{V}_g$$

V_2 $\quad v_2(t) = 40t + 50\,V \quad 0 < t < 1s$



$$C_0 = \int_0^1 40t + 50\,dt \qquad \boxed{C_0 = 70}$$

$$a_n = 2\int_0^1 (40t+50)\cos(2n\pi t)\,dt$$

$$a_n = 2\left[40\left(\frac{t}{2n\pi}\sin(2n\pi t) + \frac{1}{4n^2\pi^2}\cos(2n\pi t)\right)\Big|_0^1 + 50\left(\frac{1}{2n\pi}\sin(2n\pi t)\right)\Big|_0^1\right]$$

$T = 1s\,;\ \omega_0 = 2\pi\,;\ a = 2n\pi$

$$\boxed{a_n = 0}$$

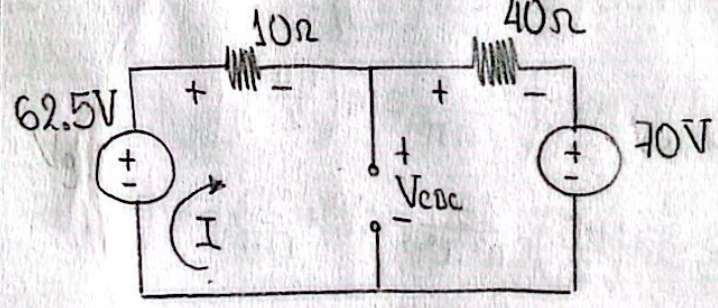
$$b_n = 2\int_0^1 (40t+50)\sin(2n\pi t)\,dt$$

$$b_n = 2\left[40\left(-\frac{t}{2n\pi}\cos(2n\pi t) + \frac{1}{4n^2\pi^2}\sin(2n\pi t)\right)\Big|_0^1 + 50\left(-\frac{1}{2n\pi}\cos(2n\pi t)\right)\Big|_0^1\right]$$

$$b_n = 2\left[40\left(-\frac{0.5}{n\pi}\right) + 50\left(-\frac{1}{2n\pi} + \frac{1}{2n\pi}\right)\right]$$

$$\boxed{b_n = -\frac{40}{n\pi}} \qquad \bar{V}_2 = j\frac{40}{n\pi}$$

Análisis en DC



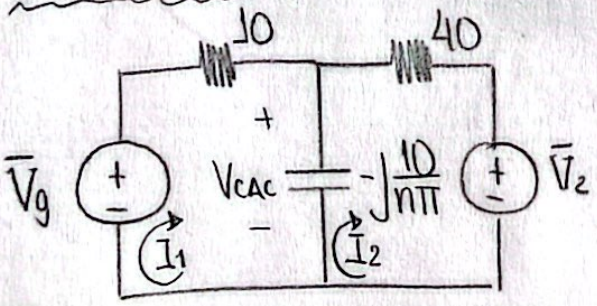
$$-62.5 + 10I + 40I + 70 = 0$$

$$I = -0.15A$$

$$-62.5 + 10I + V_{cdc} = 0$$

$$\underline{V_{cdc} = 64V}$$

Análisis AC



$$\left(10 - j\frac{10}{n\pi}\right)I_1 + j\frac{10}{n\pi}I_2 = \bar{V}_g$$

$$j\frac{10}{n\pi}I_1 + \left(40 - j\frac{10}{n\pi}\right)I_2 = -\bar{V}_2$$

$$V_{cac} = -j\frac{10}{n\pi}(I_1 - I_2)$$

$$V_{cAC} = \frac{-j4V_g - jV_c}{4n\pi - j5}$$

Para $n=1$ $\quad V_{cAC} = 6.067\angle -59.37°\ V$

Para $n=2$ $\quad V_{cAC} = 4.75\angle 98.25°\ V$

Para $n=3$ $\quad V_{cAC} = 0.26\angle -57.21°\ V$

Para $n=4$ $\quad V_{cAC} = 0.063014\angle 5.68°\ V$

$$v_c(t) = 64 + 6.067\cos(2\pi t - 59.37°) + 4.75\cos(4\pi t + 98.25°) + 0.26\cos(6\pi t - 57.21°) + 0.063014\cos(8\pi t + 5.68°) + \ldots V$$

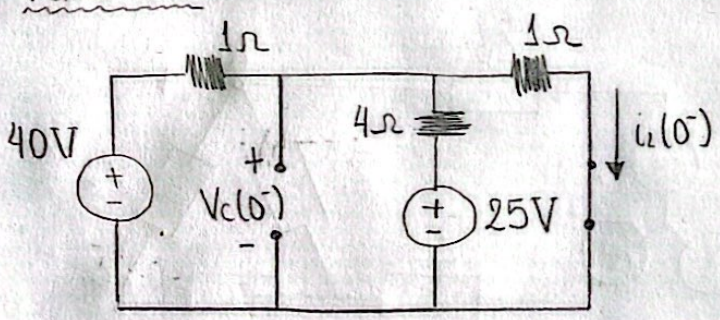
$$V_{ceff} = \sqrt{64^2 + \frac{1}{2}(6.067^2 + 4.75^2 + 0.26^2 + 0.063^2)}$$

$$\boxed{V_{ceff} = 64.23\ V}$$

(2)

a) $i_o(0^-)$?

Para $t<0$

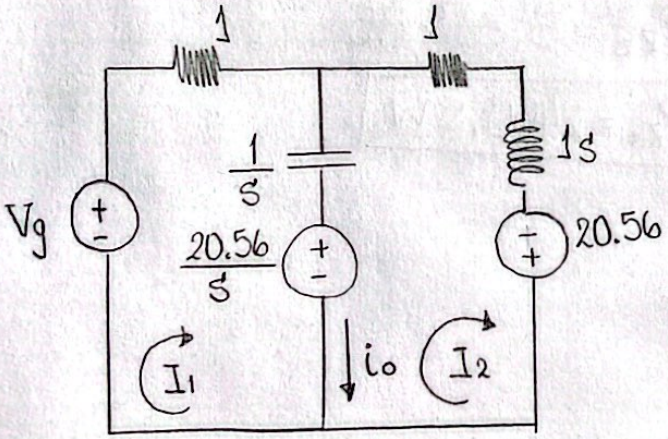


$V_c(0^-) = 20.56V$

$i_L(0^-) = 20.56\ A$

Para $t>0$

$$v_g(t) = 25\cos(3t) \longrightarrow V_g(s) = \frac{25s}{s^2+9}$$



$$\left(1 + \frac{1}{s}\right)I_1 - \frac{1}{s}I_2 = \frac{25s}{s^2+9} - \frac{20.56}{s}$$

$$-\frac{1}{s} + \left(1 + s + \frac{1}{s}\right)I_2 = 20.56 + \frac{20.56}{s}$$

$$i_o = I_1 - I_2$$

$$i_o(s) = \frac{-16.12s^7 - 16.12s^6 - 515.16s^5 - 515.16s^4 - 3330.72s^3 - 3330.72s^2}{s^8 + 2s^7 + 20s^6 + 36s^5 + 117s^4 + 162s^3 + 162s^2}$$

$$I_o(0^+) = \lim_{s\to\infty} \frac{-16.12s^8 - 16.12s^7 - 515.16s^6 - 515.16s^5 - 3330.72s^4 - 3330.72s^3}{s^8 + 2s^7 + 20s^6 + 36s^5 + 117s^4 + 162s^3 + 162s^2}$$

$$\boxed{I_o(0^+) = -16.12\,A}$$

b)

$$i_o(t) = -9.71\sin(3t) + 23.82\cos(3t) + 5.3e^{-t}\sin(t) - 39.94e^{-t}\cos(t)$$

$$\boxed{i_o(0) = -16.12\,A}$$

(3)

$\bar{V}_{ab} = 554.26\angle -65°\ V$ (-) $\rightarrow$ $\bar{V}_{ba} = 554.26\angle 115°\ V$

$\bar{V}_a = 320\angle -35°\ V$

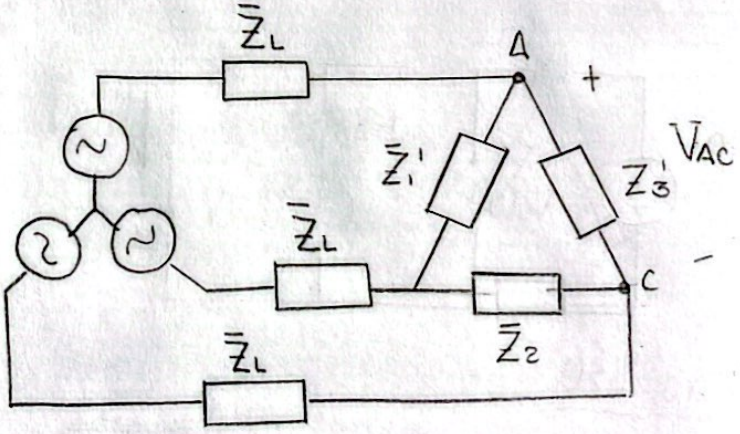
$\bar{V}_b = 320\angle 85°\ V$

$\bar{V}_c = 320\angle -155°\ V$

$\bar{V}_{ac} = 554.26\angle -5°\ V$

$-5 = \theta_f + 30$

$\theta_f = -35°$



$Z_\Delta' = 3Z_\Delta = 45 + j54\,\Omega$

$Z_1' = Z_1 // Z_\Delta // Z_\Delta' = 17.3 + j13.92\,\Omega$

$Z_2' = Z_2 // Z_\Delta // Z_\Delta' = 19.16 + j15.53\,\Omega$

$Z_3' = Z_3 // Z_\Delta // Z_\Delta' = 21.04 + j17.7\,\Omega$

a) I_3? P_{Z_3}? Q_{Z_3}?

$\bar{V}_{AC} = 524.07\angle 27.94°\ V$

$\bar{I}_3 = \frac{\bar{V}_{AC}}{Z_3} \rightarrow \boxed{\bar{I}_3 = 5.31\angle -2.52°\ A}$

$P_{Z_3} = 5.31^2 \cdot 85$

$\boxed{P_{Z_3} = 2400.5\,W}$

$Q_{Z_3} = 5.31^2 \cdot 50$

$\boxed{Q_{Z_3} = 1412\,VAR}$

$\bar{Z}_{Y1} = 6.3 + j5.2\,\Omega$

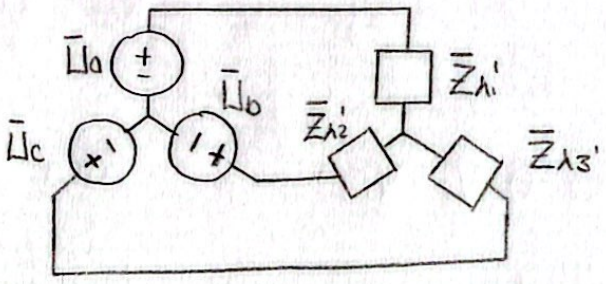
$\bar{Z}_{Y2} = 5.76 + j4.58\,\Omega$

$\bar{Z}_{Y3} = 7 + j5.83\,\Omega$

$\bar{Z}_{\lambda 1}' = Z_L + Z_{\lambda 1} = 12.83 + j10.03\,\Omega$

$\bar{Z}_{\lambda 2}' = Z_L + Z_{\lambda 2} = 12.26 + j9.38\,\Omega$

$\bar{Z}_{\lambda 3}' = Z_L + Z_{\lambda 3} = 13.5 + j10.63\,\Omega$



$\bar{U}_0 = 9.61 \angle 63.22°\ V$

$\bar{I}_b = 20.15 \angle 48.23°\ A$

$\bar{I}_c = 19.05 \angle 167.83°\ A$

$W_1 = Re\{\bar{U}_{ba} * \bar{I}_b^*\} = 4405.3\ W$

$W_2 = Re\{\bar{U}_{ca} * \bar{I}_c^*\} = 10477.3\ W$

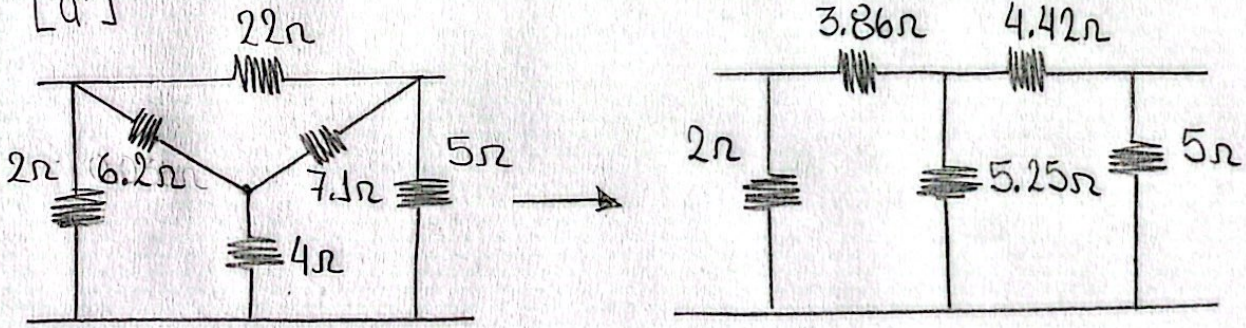
$W = W_1 + W_2$

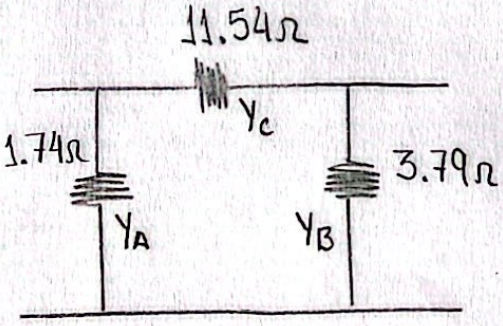
$\boxed{P_T = 14'882\ W}$

(4)

Del segundo parcial: $[a'] = \begin{bmatrix} 6 & 5\Omega \\ 2.2S & 2 \end{bmatrix}$

$[a'']$

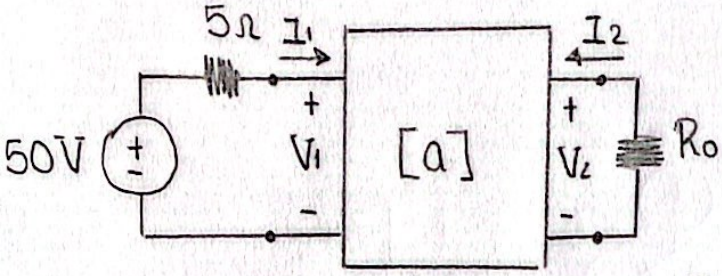




$[Y''] = \begin{bmatrix} 13.3S & -11.54S \\ -11.54S & 15.33S \end{bmatrix}$

$[a''] = \begin{bmatrix} 1.33 & 0.087\Omega \\ 6.11S & 1.15 \end{bmatrix}$

$[a] = \begin{bmatrix} 38.5 & 6.27\Omega \\ 15.14S & 2.5 \end{bmatrix}$



$V_1 = 38.5\,V_2 - 6.3\,I_2$

$I_1 = 15.14\,V_2 - 2.5\,I_2$

$-50 + 5I_1 + V_1 = 0$

Para $I_2 = 0$; $V_2 = V_{Th}$

$V_{Th} = 0.44\,V$

$R_o = 0.16\,\Omega$

$P_{MX} = 0.29\,W$

Para $V_2 = 0$; $I_N = -I_2$

$I_N = 2.66\,A$