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UMSS-FCYT
DEPARTAMENTO DE ELECTRICIDAD
SEMESTRE 2-2024 (17/12/2024)

Docente con quien aprobó laboratorio y gestión:

SEGUNDO PARCIAL - CIRCUITOS ELECTRICOS III

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

1.- El voltaje de la figura se repite periódicamente con T=0.4s.
a) Determine el valor eficaz de la corriente i_0 con 4 armónicos diferentes de cero
b) Determine la potencia entregada por la fuente al circuito **30pts.**

2.- En una red de dos puertos se efectuaron las siguientes mediciones para el puerto 1 y el puerto 2:

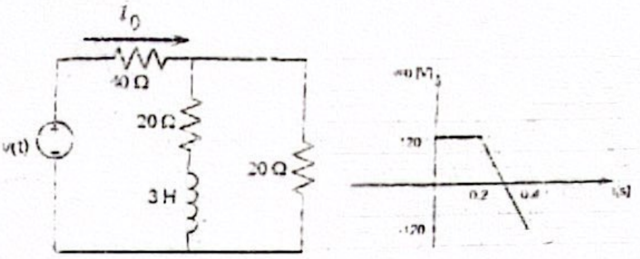
Medición 1	Medición 2
V_1=35 V	V_1=50 V
I_1=2 A	I_1=4 A
V_2=0 V	V_2=25 V
I_2=-0.5 A	I_2=0 A

a) Determine los parámetros [z] de la red
b) Se conecta al puerto 1 una fuente de voltaje de 150 V en serie con una resistencia de 20 Ω y en el puerto 2 una resistencia R_L. Determine el valor de R_L para una máxima transferencia de potencia y el valor de dicha potencia. **20 pts.**

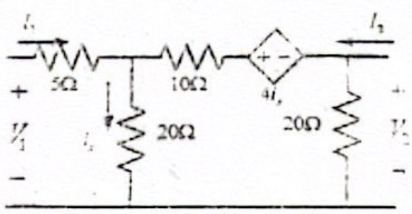
3.- En la red de dos puertos de la figura determinar:
a) Los parámetros [a] b) Los Parámetros [h] **25 pts.**

4.- En la red de dos puertos combinada, si $[z]=\begin{bmatrix}40\Omega & 12\Omega\\ 25\Omega & 10\Omega\end{bmatrix}$, en la entrada se conecta una fuente de 200 V en serie con 5Ω y en la salida R_L=80Ω. Determine la potencia que entrega la fuente y la que consume R_L

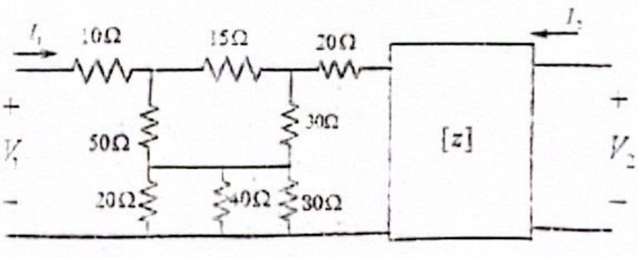
PROBLEMA 1



PROBLEMA 3



Problema 4



①

$$V_g(t)\begin{cases}120\ V & 0<t<0{,}2s\\ -1200t+360\ V & 0{,}2s<t<0{,}4s\end{cases}\qquad T=0{,}4s \quad \omega_0=\frac{2\pi}{T} \quad \omega_0=5\pi$$

$$C_0=\frac{1}{0{,}4}\left[\int_0^{0{,}2}120\,dt+\int_{0{,}2}^{0{,}4}(-1200t+360)\,dt\right] \Rightarrow \underline{C_0=60}$$

$$a_n=\frac{2}{0{,}4}\left[\int_0^{0{,}2}120\cos(5n\pi t)\,dt+\int_{0{,}2}^{0{,}4}(-1200t+360)\cos(5n\pi t)\,dt\right]$$

$$a_n=5\left[120\int_0^{0{,}2}\cos(5n\pi t)\,dt-1200\int_{0{,}2}^{0{,}4}t\cos(5n\pi t)\,dt+360\int_{0{,}2}^{0{,}4}\cos(5n\pi t)\,dt\right]$$

$$a_n=5\left[\cancel{120\left(\frac{1}{5n\pi}\sin(5n\pi t)\right)\Big|_0^{0{,}2}}-1200\left(\cancel{\frac{t}{5n\pi}\sin(5n\pi t)}+\frac{1}{25n^2\pi^2}\cos(5n\pi t)\right)\Big|_{0{,}2}^{0{,}4}\right.$$

$$\left.\cancel{+360\left(\frac{1}{5n\pi}\sin(5n\pi t)\right)\Big|_{0{,}2}^{0{,}4}}\right]$$

$$a_n=5\left[\frac{1}{25n^2\pi^2}-\frac{1}{25n^2\pi^2}(-1)^n\right]\cdot(-1200) \quad \underline{a_n=\frac{240}{n^2\pi^2}\left((-1)^n-1\right)}$$

$$b_n=5\left[120\int_0^{0{,}2}\sin(5n\pi t)\,dt-1200\int_{0{,}2}^{0{,}4}t\sin(5n\pi t)\,dt+360\int_{0{,}2}^{0{,}4}\sin(5n\pi t)\,dt\right]$$

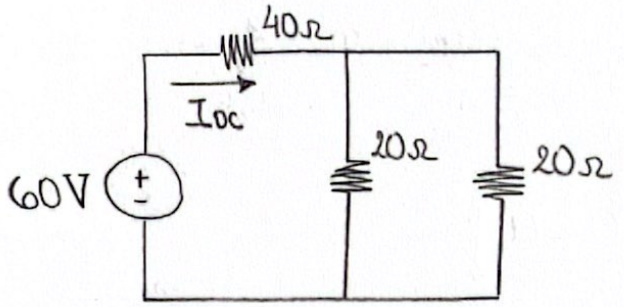
$$b_n=5\left[120\left(-\frac{1}{5n\pi}\cos(5n\pi t)\right)\Big|_0^{0{,}2}-1200\left(-\frac{t}{5n\pi}\cos(5n\pi t)+\cancel{\frac{1}{25n^2\pi^2}\sin(5n\pi t)}\right)\Big|_{0{,}2}^{0{,}4}\right.$$

$$\left.+360\left(-\frac{1}{5n\pi}\cos(5n\pi t)\right)\Big|_{0{,}2}^{0{,}4}\right]$$

$$b_n=5\left[120\left(-\cancel{\frac{1}{5n\pi}(-1)^n}+\frac{1}{5n\pi}\right)-1200\left(-\frac{0{,}4}{5n\pi}+\cancel{\frac{0{,}2}{5n\pi}(-1)^n}\right)+360\left(-\frac{1}{5n\pi}+\cancel{\frac{1}{5n\pi}(-1)^n}\right)\right.$$

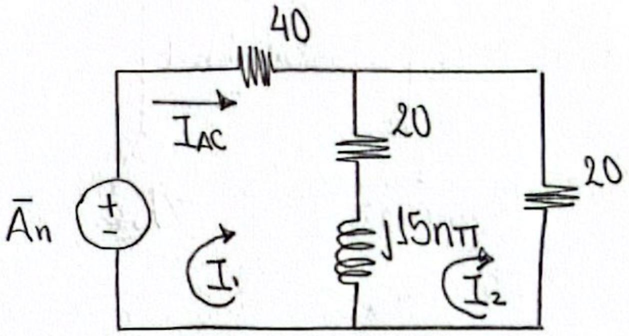
$$\underline{b_n=\frac{240}{n\pi}} \qquad \underline{A_n=\frac{240}{n^2\pi^2}\left[(-1)^n-1\right]-j\frac{240}{n\pi}}$$

Análisis DC



$$I_{DC} = 1.2\,A$$

Análisis AC



$$(60+j15n\pi)I_1 - (20+j15n\pi)I_2 = \bar{A}_n$$
$$-(20+j15n\pi)I_1 + (40+j15n\pi)I_2 = 0$$
$$I_1 = I_{AC}$$

$$\begin{bmatrix} 60+j15n\pi & -20-j15n\pi \\ -20-j15n\pi & 40+j15n\pi \end{bmatrix}\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} \frac{240}{n^2\pi^2}\left[(-1)^n-1\right] - j\frac{240}{n\pi} \\ 0 \end{bmatrix}$$

$$I_{AC} = \frac{12(j3n\pi+8)((-1)^n - jn\pi - 1)}{n^2\pi^2(j9n\pi+20)}$$

Para
$n=1$ $I_{AC} = 1.62\angle -127.53°$ A
$n=2$ $I_{AC} = 0.65\angle -93.52°$ A
$n=3$ $I_{AC} = 0.44\angle -104.51°$ A
$n=4$ $I_{AC} = 0.32\angle -91.95°$ A

a) I_{eff}?

$$I_{eff} = \sqrt{1.2^2 + \frac{1}{2}(1.62^2+0.65^2+0.44^2+0.32^2)}$$

$$\boxed{I_{eff} = 1.76\,A}$$

b) P_f?

$$A_n = \frac{240}{n^2\pi^2}\left[(-1)^n-1\right] - j\frac{240}{n\pi}$$

Para
$n=1$ $V_{AC} = 90.56\angle -122.48°$ V
$n=2$ $V_{AC} = 38.2\angle -90°$ V
$n=3$ $V_{AC} = 26.03\angle -101.98°$ V
$n=4$ $V_{AC} = 19.1\angle -90°$ V

$$V_{eff} = \sqrt{60^2 + \frac{1}{2}\left(90{,}56^2 + 38{,}2^2 + 26{,}03^2 + 19{,}1^2\right)}$$

$$V_{eff} = 94{,}61\ V$$

$$P_f = I_{eff} \cdot V_{eff} \longrightarrow \boxed{P_f = 166{,}75\ W}$$

2

Para $V_2 = 0$

$$a_{12} = -\frac{V_1}{I_2} = \frac{35}{0{,}5} = 70\ \Omega$$

$$a_{22} = -\frac{I_1}{I_2} = \frac{2}{0{,}5} = 4$$

Para $I_2 = 0$

$$a_{11} = \frac{V_1}{V_2} = \frac{50}{25} = 2$$

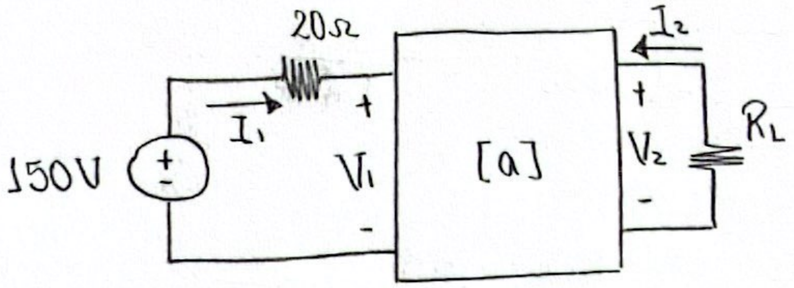
$$a_{21} = \frac{I_1}{V_2} = \frac{4}{25} = 0{,}16\ S$$

$$[a] = \begin{bmatrix} 2 & 70\ \Omega \\ 0{,}16\ S & 4 \end{bmatrix}$$

a) $[z]$?

$$\boxed{[z] = \begin{bmatrix} 12{,}5\ \Omega & -20\ \Omega \\ 6{,}25\ \Omega & 25\ \Omega \end{bmatrix}}$$

b) R_L? P_{MX}?



$$-150 + 20 I_1 + V_1 = 0 \ldots\ldots (1)$$

$$V_1 = 2V_2 - 70 I_2 \ldots\ldots (2)$$

$$I_1 = 0{,}16 V_2 - 4 I_2 \ldots\ldots (3)$$

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

$$\begin{bmatrix} 1 & 20 & 0 \\ 1 & 0 & 70 \\ 0 & 1 & 4 \end{bmatrix} \begin{bmatrix} V_1 \\ I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 150 \\ 0 \\ 0 \end{bmatrix}$$

$I_N = 1A$

$$\boxed{R_L = 28{,}85\ [\Omega]}$$

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

$$\begin{bmatrix} 1 & 20 & 0 \\ 1 & 0 & -2 \\ 0 & 1 & -0{,}16 \end{bmatrix} \begin{bmatrix} V_1 \\ I_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 150 \\ 0 \\ 0 \end{bmatrix}$$

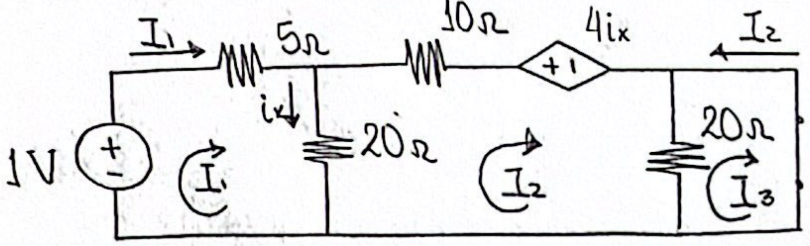
$V_2 = V_{Th} = 28{,}85\ V$

$$P_L = \frac{\left(\frac{28{,}85}{2}\right)^2}{28{,}85} \longrightarrow \boxed{P_L = 7{,}21\ W}$$

③ a) [a]? b) [h]?

Para [h]

$V_2 = 0$; $V_1 = 1V$



$h_{11} = \frac{V_1}{I_1}$ $h_{21} = \frac{I_2}{I_1}$

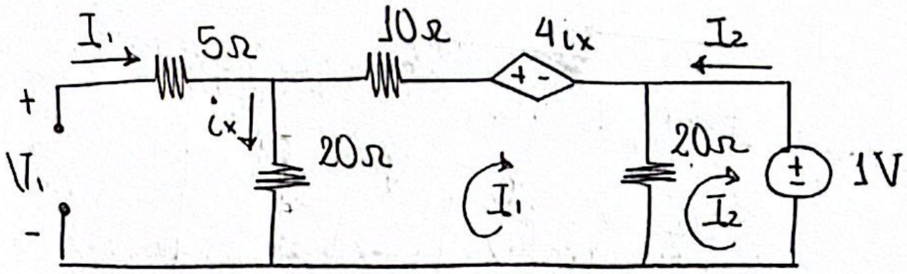
$25I_1 - 20I_2 = 1$
$i_x = I_1 - I_2$
$-20I_1 + 50I_2 - 20I_3 = -4i_x$
$-20I_2 + 20I_3 = 0$

$$\begin{bmatrix} 25 & -20 & 0 & 0 \\ -1 & 1 & 0 & 1 \\ -20 & 50 & -20 & 4 \\ 0 & -20 & 20 & 0 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ i_x \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$I_1 = 0{,}08A$; $I_2 = -0{,}05A$

$h_{11} = \frac{1}{0{,}08} = 12{,}5\Omega$ $h_{21} = \frac{-0{,}05}{0{,}08} = -0{,}63$

$I_1 = 0$; $V_2 = 1V$



$h_{12} = \frac{V_1}{V_2}$ $h_{22} = \frac{I_2}{V_2}$

$50I_1 - 20I_2 = -4i_x$
$i_x = -I_1$
$-20I_1 + 20I_2 = -1$

$$\begin{bmatrix} 46 & -20 \\ -20 & 20 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 0 \\ -1 \end{bmatrix}$$

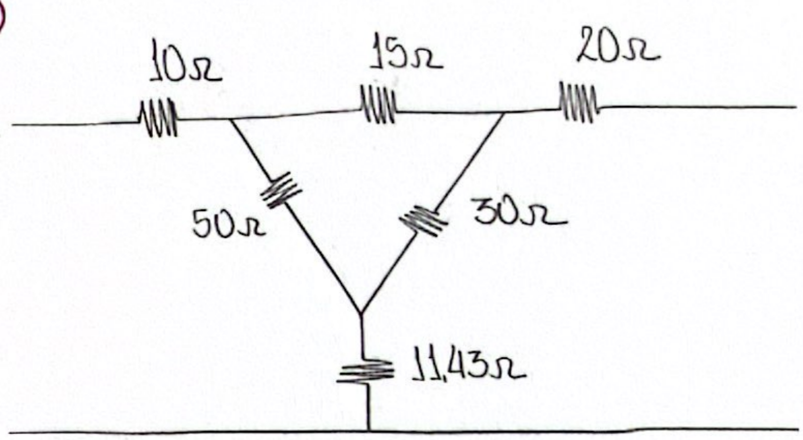
$V_1 = 20 \cdot i_x = 0{,}8V$ $I_2 = 0{,}09$

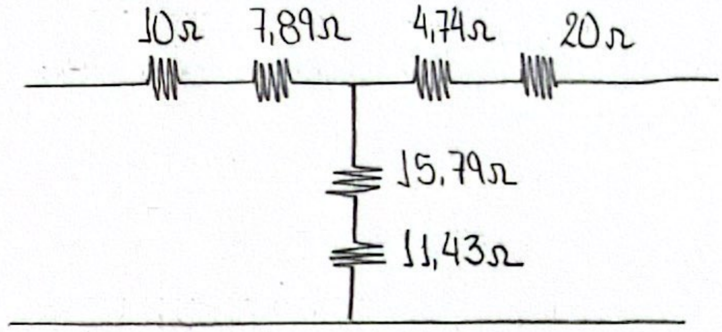
$h_{12} = 0{,}08$; $h_{22} = 0{,}09S$

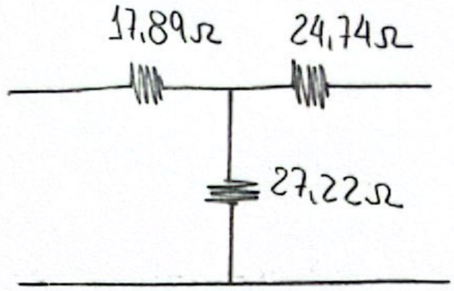
b) $\boxed{[h] = \begin{bmatrix} 12{,}5\Omega & 0{,}8 \\ -0{,}63 & 0{,}09S \end{bmatrix}}$

a) $\boxed{[a] = \begin{bmatrix} 2{,}63 & 20\Omega \\ 0{,}14S & 1{,}6 \end{bmatrix}}$

4

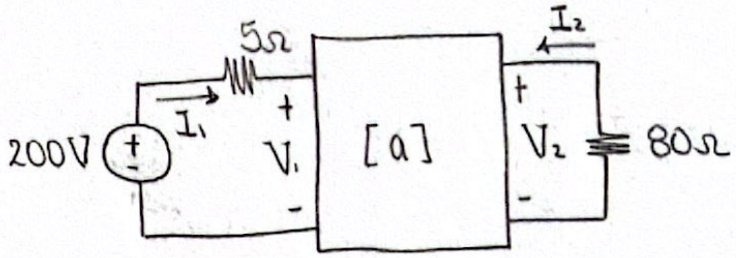






$$[z'] = \begin{bmatrix} 45,11\Omega & 27,22\Omega \\ 27,22\Omega & 51,95\Omega \end{bmatrix} \qquad [a'] = \begin{bmatrix} 1,66 & 58,9\Omega \\ 0,04S & 1,91 \end{bmatrix}$$

$$[a''] = \begin{bmatrix} 1,6 & 4\Omega \\ 0,04S & 0,4 \end{bmatrix} \qquad [a] = [a'][a''] \qquad [a] = \begin{bmatrix} 5,01 & 30,19\Omega \\ 0,14S & 0,91 \end{bmatrix}$$



$$-200 + 5I_1 + V_1 = 0$$
$$V_1 = 5,01V_2 - 30,19I_2$$
$$I_1 = 0,14V_2 - 0,91I_2$$
$$-V_2 - 80I_2 = 0$$

$$\begin{bmatrix} 1 & 5 & 0 & 0 \\ 1 & 0 & -5,01 & 30,19 \\ 0 & 1 & -0,14 & 0,91 \\ 0 & 0 & 1 & 80 \end{bmatrix} \begin{bmatrix} V_1 \\ I_1 \\ V_2 \\ I_2 \end{bmatrix} = \begin{bmatrix} 200 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

P_f? P_R?

$I_1 = 4,93A$; $I_2 = 0,41A$

$P_f = 200 \cdot I_1$ $\qquad \boxed{P_f = 986\ W}$

$P_R = 80 I_2^2$ $\qquad \boxed{P_R = 13,45\ W}$