ANEXOS LABORATORIO 8

Guamán Jhennifer, Lema Brianda, Mayorga Christopher

Universidad de las Fuerzas Armadas, Av. General Rumiñahui s/n Sangolquí-Ecuador
(jtguaman, blema, cdmayorga3)@espe.edu.es
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Laboratorio de Circuitos Eléctricos NRC: 8703
Instructor: Darwin Alulema

ANEXOS

1. FIGURA CON CAPACITORES

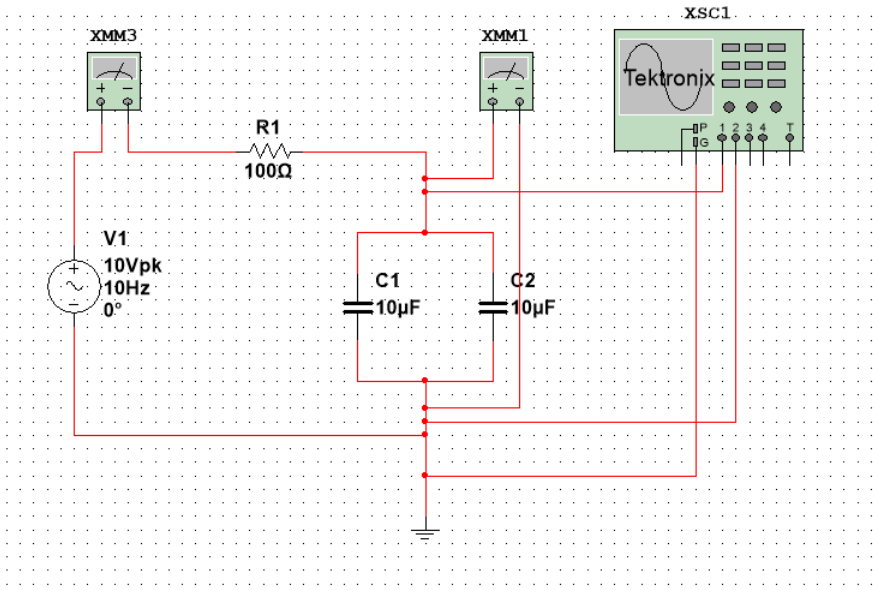

Figure 1. Circuito con capacitores

Frecuencia (Hz)	V_0 con osciloscopio(V)	V_0 con multimetro(V)	Intensidad (mA)
0	0	0	0
10	9.92	7.014	8.929
50	8.467	5.987	37.619
100	6.227	4.403	55.33
500	1.571	1.111	69.832
1000	0.793	0.5607	70.487

Análisis de resultados

$$C_{eq} = C_1 + C_2$$
$$C_{eq} = 10\mu F + 10\mu F$$
$$C_{eq} = 20\mu F = 20 \times 10^{-6} F$$

Frecuencia (Hz)	Reactancia $X = \frac{V_0}{I}$
0	0
10	0.7947
50	0.159
100	0.0795
500	0.0159
1000	0.00795

2. FIGURA CON INDUCTORES

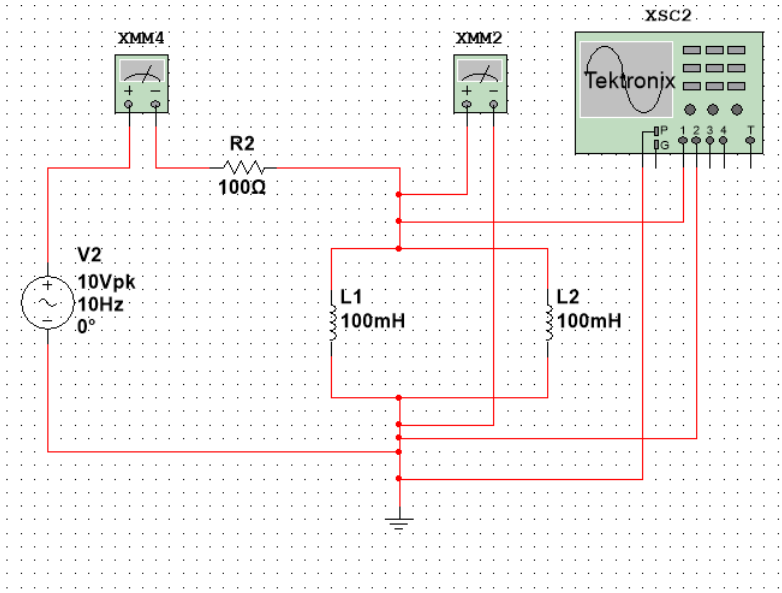

Figure 2. Circuito con inductores

Frecuencia (Hz)	V_0 con osciloscopio(V)	V_0 con multimetro(V)	Intensidad (mA)
0	0	0	70.7
10	0.314	0.2219	70.676
50	1.551	1.097	69.855
100	2.997	2.119	67.46
500	8.436	5.965	37.972
1000	9.529	6.738	21.441

Análisis de resultados

$$\frac{1}{L_{eq}} = \frac{1}{L_1} + \frac{1}{L_2}$$
$$\frac{1}{L_{eq}} = \frac{L_2 + L_1}{L_1 L_2}$$
$$L_{eq} = \frac{L_1 L_2}{L_2 + L_1}$$
$$L_{eq} = \frac{0.1 \times 0.1}{0.1 + 0.1}$$
$$L_{eq} = 0.05H$$

Frecuencia (Hz)	Reactancia $X = \frac{V_0}{I}$
0	0
10	∞
50	0.0157
100	0.0314
500	0.157
1000	0.314

3. CÁLCULO DE V_0 Y CORRIENTE EN LA FIGURA 1

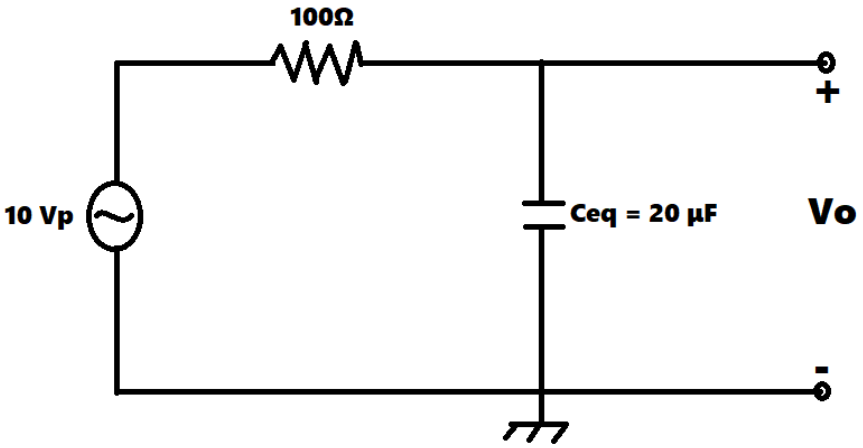

Figure 3. Circuito con capacitor equivalente.

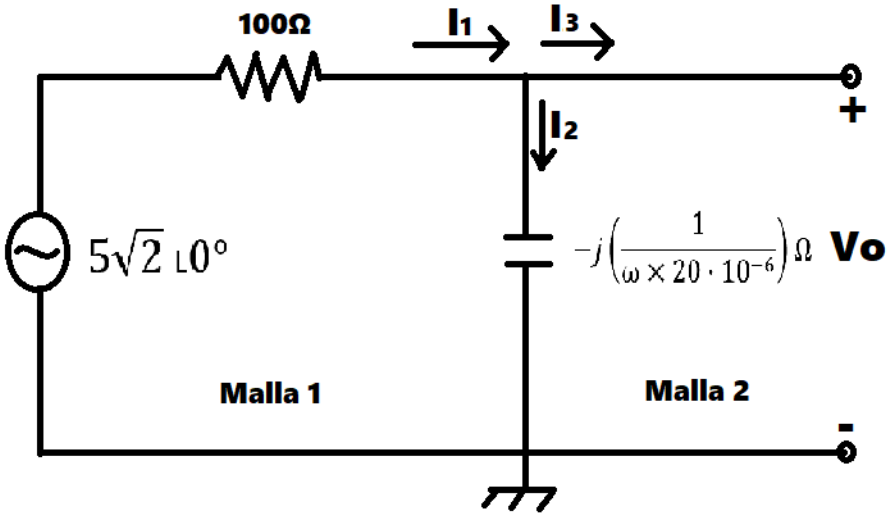

Figure 4. Circuito en el dominio de la frecuencia.

- Para $f = 0Hz$

$$\omega = 2\pi \cdot f$$
$$\omega = 2\pi \cdot 0$$
$$\omega = 0$$
$$C_{eq} = -\frac{1}{\omega \times 20 \cdot 10^{-6}}$$
$$C_{eq} = -\frac{1}{0 \times 20 \cdot 10^{-6}}$$
$$C_{eq} = \infty$$

- Para $f = 10Hz$

$$\omega = 2\pi \cdot f$$
$$\omega = 2\pi \cdot 10$$
$$\omega = 20\pi$$
$$C_{eq} = -\frac{1}{\omega \times 20 \cdot 10^{-6}}$$
$$C_{eq} = -\frac{1}{20\pi \times 20 \cdot 10^{-6}}$$
$$C_{eq} = -795.77\Omega$$

Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 - j795.77\overline{I}_2 = 0$$

Malla 2

$$V_0 - j795.77\overline{I}_2 = 0$$
$$V_0 = j795.77\overline{I}_2$$

Nodo

$$\overline{I}_1 - \overline{I}_2 - \overline{I}_3 = 0$$
$$\overline{I}_3 = 0$$
$$\overline{I}_1 = \overline{I}_2$$

En Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 - j795.77\overline{I}_1 = 0$$
$$(100 - j795.77)\overline{I}_1 = 5\sqrt{2}\angle 0^\circ$$
$$\overline{I}_1 = \frac{5\sqrt{2}\angle 0^\circ}{802.03\angle -82.84^\circ}$$
$$\overline{I}_1 = 8.816 \cdot 10^{-3}\angle 82.84^\circ$$
$$\overline{I}_2 = 8.816 \cdot 10^{-3}\angle 82.84^\circ$$

En Malla 2

$$V_0 = j795.77(8.816 \cdot 10^{-3}\angle 82.84^\circ)$$
$$V_0 = (795.77\angle 90^\circ)(8.816 \cdot 10^{-3}\angle 82.84^\circ)$$
$$V_0 = 7.015\angle 172.84^\circ V$$

- Para $f = 50Hz$

$$\omega = 2\pi \cdot f$$
$$\omega = 2\pi \cdot 50$$
$$\omega = 100\pi$$
$$C_{eq} = -\frac{1}{\omega \times 20 \cdot 10^{-6}}$$
$$C_{eq} = -\frac{1}{100\pi \times 20 \cdot 10^{-6}}$$
$$C_{eq} = -159.15\Omega$$

Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 - j159.15\overline{I}_2 = 0$$

Malla 2

$$V_0 - j159.15\overline{I}_2 = 0$$
$$V_0 = j159.15\overline{I}_2$$

Nodo

$$\overline{I}_1 - \overline{I}_2 - \overline{I}_3 = 0$$
$$\overline{I}_3 = 0$$
$$\overline{I}_1 = \overline{I}_2$$

En Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 - j159.15\overline{I}_1 = 0$$
$$(100 - j159.15)\overline{I}_1 = 5\sqrt{2}\angle 0^\circ$$
$$\overline{I}_1 = \frac{5\sqrt{2}\angle 0^\circ}{187.96\angle -57.86^\circ}$$
$$\overline{I}_1 = 0.0376\angle 57.86^\circ$$
$$\overline{I}_2 = 0.0376\angle 57.86^\circ$$

En Malla 2

$$V_0 = j159.15(0.0376\angle 57.86^\circ)$$
$$V_0 = (159.15\angle 90^\circ)(0.0376\angle 57.86^\circ)$$
$$V_0 = 5.984\angle 147.86^\circ V$$

- Para $f = 100Hz$

$$\omega = 2\pi \cdot f$$
$$\omega = 2\pi \cdot 100$$
$$\omega = 200\pi$$
$$C_{eq} = -\frac{1}{\omega \times 20 \cdot 10^{-6}}$$
$$C_{eq} = -\frac{1}{200\pi \times 20 \cdot 10^{-6}}$$
$$C_{eq} = -79.58\Omega$$

Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 - j79.58\overline{I}_2 = 0$$

Malla 2

$$V_0 - j79.58\overline{I}_2 = 0$$
$$V_0 = j79.58\overline{I}_2$$

Nodo

$$\overline{I}_1 - \overline{I}_2 - \overline{I}_3 = 0$$
$$\overline{I}_3 = 0$$
$$\overline{I}_1 = \overline{I}_2$$

En Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 - j79.58\overline{I}_1 = 0$$
$$(100 - j79.58)\overline{I}_1 = 5\sqrt{2}\angle 0^\circ$$
$$\overline{I}_1 = \frac{5\sqrt{2}\angle 0^\circ}{127.8\angle -38.51^\circ}$$
$$\overline{I}_1 = 0.055\angle 38.51^\circ$$
$$\overline{I}_2 = 0.055\angle 38.51^\circ$$

En Malla 2

$$V_0 = j79.58(0.055\angle 38.51^\circ)$$
$$V_0 = (79.58\angle 90^\circ)(0.055\angle 38.51^\circ)$$
$$V_0 = 4.377\angle 128.51^\circ V$$

- Para $f = 500Hz$

$$\omega = 2\pi \cdot f$$
$$\omega = 2\pi \cdot 500$$
$$\omega = 1000\pi$$
$$C_{eq} = -\frac{1}{\omega \times 20 \cdot 10^{-6}}$$
$$C_{eq} = -\frac{1}{1000\pi \times 20 \cdot 10^{-6}}$$
$$C_{eq} = -15.92\Omega$$

Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 - j15.92\overline{I}_2 = 0$$

Malla 2

$$V_0 - j15.92\overline{I}_2 = 0$$
$$V_0 = j15.92\overline{I}_2$$

Nodo

$$\overline{I}_1 - \overline{I}_2 - \overline{I}_3 = 0$$
$$\overline{I}_3 = 0$$
$$\overline{I}_1 = \overline{I}_2$$

En Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 - j15.92\overline{I}_1 = 0$$
$$(100 - j15.92)\overline{I}_1 = 5\sqrt{2}\angle 0^\circ$$
$$\overline{I}_1 = \frac{5\sqrt{2}\angle 0^\circ}{101.26\angle -9.04^\circ}$$
$$\overline{I}_1 = 0.0698\angle 9.04^\circ$$
$$\overline{I}_2 = 0.0698\angle 9.04^\circ$$

En Malla 2

$$V_0 = j15.92(0.0698\angle 9.04^\circ)$$
$$V_0 = (15.92\angle 90^\circ)(0.0698\angle 9.04^\circ)$$
$$V_0 = 1.111\angle 99.04^\circ V$$

- Para $f = 1000Hz$

$$\omega = 2\pi \cdot f$$
$$\omega = 2\pi \cdot 1000$$
$$\omega = 2000\pi$$
$$C_{eq} = -\frac{1}{\omega \times 20 \cdot 10^{-6}}$$
$$C_{eq} = -\frac{1}{2000\pi \times 20 \cdot 10^{-6}}$$
$$C_{eq} = -7.96\Omega$$

Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 - j7.96\overline{I}_2 = 0$$

Malla 2

$$V_0 - j7.96\overline{I}_2 = 0$$
$$V_0 = j7.96\overline{I}_2$$

Nodo

$$\overline{I}_1 - \overline{I}_2 - \overline{I}_3 = 0$$
$$\overline{I}_3 = 0$$
$$\overline{I}_1 = \overline{I}_2$$

En Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 - j7.96\overline{I}_1 = 0$$
$$(100 - j7.96)\overline{I}_1 = 5\sqrt{2}\angle 0^\circ$$
$$\overline{I}_1 = \frac{5\sqrt{2}\angle 0^\circ}{100.32\angle -4.55^\circ}$$
$$\overline{I}_1 = 0.0705\angle 4.55^\circ$$
$$\overline{I}_2 = 0.0705\angle 4.55^\circ$$

En Malla 2

$$V_0 = j7.96(0.0705\angle 4.55^\circ)$$
$$V_0 = (7.96\angle 90^\circ)(0.0705\angle 4.55^\circ)$$
$$V_0 = 0.561\angle 94.55^\circ V$$

Frecuencia (Hz)	V_0 (V)	Intensidad (mA)
0	-	0
10	7.015	8.816
50	5.984	37.6
100	4.377	55
500	1.111	69.8
1000	0.561	70.5

4. CÁLCULO DE V_0 Y CORRIENTE EN LA FIGURA 2

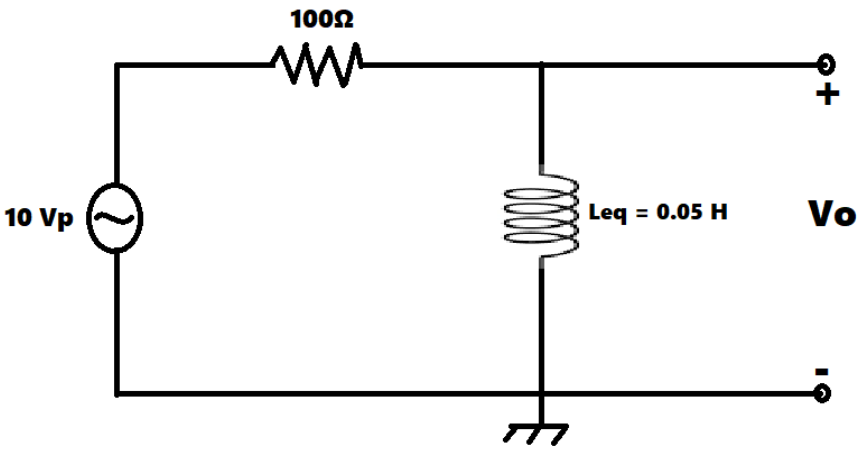

Figure 5. Circuito con inductor equivalente.

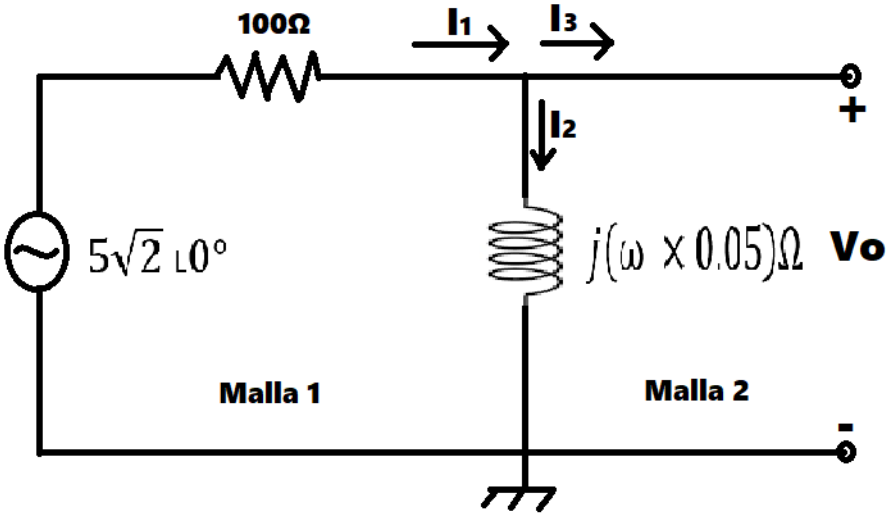

Figure 6. Circuito en el dominio de la frecuencia.

- Para $f = 0Hz$

$$\begin{aligned} \omega &= 2\pi \cdot f \\ \omega &= 2\pi \cdot 0 \\ \omega &= 0 \\ L_{eq} &= \omega \times 0.05 \\ L_{eq} &= 0 \times 0.05 \\ L_{eq} &= 0 \end{aligned}$$

Malla 1

$$\begin{aligned} -5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 &= 0 \\ 100\overline{I}_1 &= 5\sqrt{2}\angle 0^\circ \\ \overline{I}_1 &= \frac{5\sqrt{2}\angle 0^\circ}{100\angle 0^\circ} \\ \overline{I}_1 &= 0.0707\angle 0^\circ \end{aligned}$$

Malla 2

$$V_0 = 0$$

- Para $f = 10Hz$

$$\begin{aligned} \omega &= 2\pi \cdot f \\ \omega &= 2\pi \cdot 10 \\ \omega &= 20\pi \\ L_{eq} &= \omega \times 0.05 \\ L_{eq} &= 20\pi \times 0.05 \\ L_{eq} &= \pi\Omega \end{aligned}$$

Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 + j\pi\overline{I}_2 = 0$$

Malla 2

$$V_0 + j\pi\overline{I}_2 = 0$$
$$V_0 = -j\pi\overline{I}_2$$

Nodo

$$\overline{I}_1 - \overline{I}_2 - \overline{I}_3 = 0$$
$$\overline{I}_3 = 0$$
$$\overline{I}_1 = \overline{I}_2$$

En Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 + j\pi\overline{I}_1 = 0$$
$$(100 + j\pi)\overline{I}_1 = 5\sqrt{2}\angle 0^\circ$$
$$\overline{I}_1 = \frac{5\sqrt{2}\angle 0^\circ}{100.049\angle 1.8^\circ}$$
$$\overline{I}_1 = 0.0706\angle -1.8^\circ$$
$$\overline{I}_2 = 0.0706\angle -1.8^\circ$$

En Malla 2

$$V_0 = -j\pi(0.0706\angle -1.8^\circ)$$
$$V_0 = (\pi\angle -90^\circ)(0.0706\angle -1.8^\circ)$$
$$V_0 = 0.222\angle -91.8^\circ V$$

- Para $f = 50Hz$

$$\omega = 2\pi \cdot f$$
$$\omega = 2\pi \cdot 50$$
$$\omega = 100\pi$$
$$L_{eq} = \omega \times 0.05$$
$$L_{eq} = 100\pi \times 0.05$$
$$L_{eq} = 5\pi\Omega$$

Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 + j5\pi\overline{I}_2 = 0$$

Malla 2

$$V_0 + j5\pi\overline{I}_2 = 0$$
$$V_0 = -j5\pi\overline{I}_2$$

Nodo

$$\overline{I}_1 - \overline{I}_2 - \overline{I}_3 = 0$$
$$\overline{I}_3 = 0$$
$$\overline{I}_1 = \overline{I}_2$$

En Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 + j5\pi\overline{I}_1 = 0$$
$$(100 + j5\pi)\overline{I}_1 = 5\sqrt{2}\angle 0^\circ$$
$$\overline{I}_1 = \frac{5\sqrt{2}\angle 0^\circ}{101.23\angle 8.93^\circ}$$
$$\overline{I}_1 = 0.0698\angle -8.93^\circ$$
$$\overline{I}_2 = 0.0698\angle -8.93^\circ$$

En Malla 2

$$V_0 = -j5\pi(0.0698\angle -8.93^\circ)$$
$$V_0 = (5\pi\angle -90^\circ)(0.0698\angle -8.93^\circ)$$
$$V_0 = 1.096\angle -98.93^\circ V$$

- Para $f = 100Hz$

$$\omega = 2\pi \cdot f$$
$$\omega = 2\pi \cdot 100$$
$$\omega = 200\pi$$
$$L_{eq} = \omega \times 0.05$$
$$L_{eq} = 200\pi \times 0.05$$
$$L_{eq} = 10\pi\Omega$$

Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 + j10\pi\overline{I}_2 = 0$$

Malla 2

$$V_0 + j10\pi\overline{I}_2 = 0$$
$$V_0 = -j10\pi\overline{I}_2$$

Nodo

$$\overline{I}_1 - \overline{I}_2 - \overline{I}_3 = 0$$
$$\overline{I}_3 = 0$$
$$\overline{I}_1 = \overline{I}_2$$

En Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 + j10\pi\overline{I}_1 = 0$$
$$(100 + j10\pi)\overline{I}_1 = 5\sqrt{2}\angle 0^\circ$$
$$\overline{I}_1 = \frac{5\sqrt{2}\angle 0^\circ}{104.82\angle 17.44^\circ}$$
$$\overline{I}_1 = 0.0675\angle -17.44^\circ$$
$$\overline{I}_2 = 0.0675\angle -17.44^\circ$$

En Malla 2

$$V_0 = -j10\pi(0.0675\angle -17.44°)$$
$$V_0 = (10\pi\angle -90°)(0.0675\angle -17.44°)$$
$$V_0 = 2.12\angle -107.44°V$$

- Para $f = 500Hz$

$$\omega = 2\pi \cdot f$$
$$\omega = 2\pi \cdot 500$$
$$\omega = 1000\pi$$
$$L_{eq} = \omega \times 0.05$$
$$L_{eq} = 1000\pi \times 0.05$$
$$L_{eq} = 50\pi\Omega$$

Malla 1

$$-5\sqrt{2}\angle 0° + 100\overline{I}_1 + j50\pi\overline{I}_2 = 0$$

Malla 2

$$V_0 + j50\pi\overline{I}_2 = 0$$
$$V_0 = -j50\pi\overline{I}_2$$

Nodo

$$\overline{I}_1 - \overline{I}_2 - \overline{I}_3 = 0$$
$$\overline{I}_3 = 0$$
$$\overline{I}_1 = \overline{I}_2$$

En Malla 1

$$-5\sqrt{2}\angle 0° + 100\overline{I}_1 + j50\pi\overline{I}_1 = 0$$
$$(100 + j50\pi)\overline{I}_1 = 5\sqrt{2}\angle 0°$$
$$\overline{I}_1 = \frac{5\sqrt{2}\angle 0°}{186.21\angle 57.52°}$$
$$\overline{I}_1 = 0.03797\angle -57.52°$$
$$\overline{I}_2 = 0.03797\angle -57.52°$$

En Malla 2

$$V_0 = -j50\pi(0.03797\angle -57.52^\circ)$$
$$V_0 = (50\pi\angle -90^\circ)(0.03797\angle -57.52^\circ)$$
$$V_0 = 5.96\angle -147.52^\circ V$$

- Para $f = 1000Hz$

$$\omega = 2\pi \cdot f$$
$$\omega = 2\pi \cdot 1000$$
$$\omega = 2000\pi$$
$$L_{eq} = \omega \times 0.05$$
$$L_{eq} = 2000\pi \times 0.05$$
$$L_{eq} = 100\pi\Omega$$

Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 + j100\pi\overline{I}_2 = 0$$

Malla 2

$$V_0 + j100\pi\overline{I}_2 = 0$$
$$V_0 = -j100\pi\overline{I}_2$$

Nodo

$$\overline{I}_1 - \overline{I}_2 - \overline{I}_3 = 0$$
$$\overline{I}_3 = 0$$
$$\overline{I}_1 = \overline{I}_2$$

En Malla 1

$$-5\sqrt{2}\angle 0^\circ + 100\overline{I}_1 + j100\pi\overline{I}_1 = 0$$
$$(100 + j100\pi)\overline{I}_1 = 5\sqrt{2}\angle 0^\circ$$
$$\overline{I}_1 = \frac{5\sqrt{2}\angle 0^\circ}{329.69\angle 72.34^\circ}$$
$$\overline{I}_1 = 0.0214\angle -72.34^\circ$$
$$\overline{I}_2 = 0.0214\angle -72.34^\circ$$

En Malla 2

$$V_0 = -j100\pi(0.0214\angle -72.34^\circ)$$
$$V_0 = (100\pi\angle -90^\circ)(0.0214\angle -72.34^\circ)$$
$$V_0 = 6.72\angle -162.34^\circ V$$

Frecuencia (Hz)	V_0 (V)	Intensidad (mA)
0	0	70.7
10	0.222	70.6
50	1.096	69.8
100	2.12	67.5
500	5.96	37.97
1000	6.72	21.4