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NRC: 4862

Tema: Inductor y Capacitor

Fecha: 23/02/2021

PRÁCTICA NO. 9. INDUCTOR Y CAPACITOR

Tema: Inductor y Capacitor

1.- Construya en el protoboard el circuito mostrado en la Figura 1.

- Utilice el osciloscopio para observar el voltaje V_{\square} variando la frecuencia entre los valores de 0, 10, 50, 100, 500, 1000 Hz. Anote los valores pico de las ondas observadas.
- Utilice un multímetro para medir el voltaje V_{\square} variando la frecuencia entre los valores de 0, 10, 50, 100, 500, 1000 Hz. Anote los resultados.
- Utilice un multímetro para medir la corriente que atraviesa la resistencia variando la frecuencia entre los valores 0, 10, 50, 100, 500, 1000 Hz. Anote los resultados.

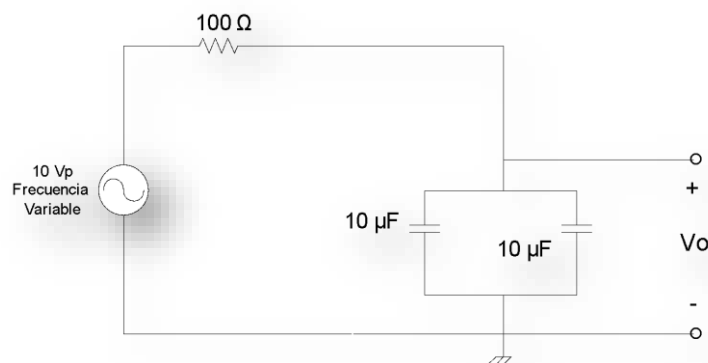


Figura 1.

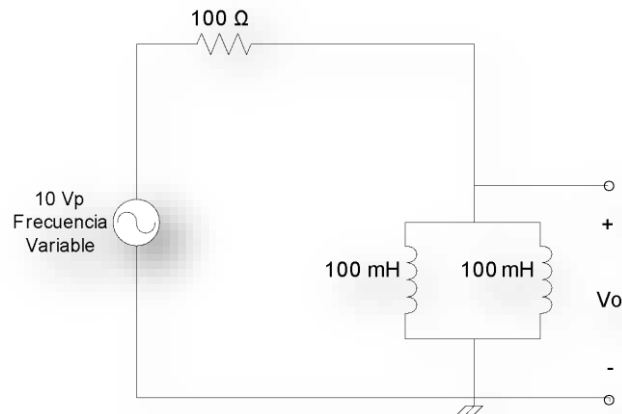


Figura 2.

✚ Formulas:

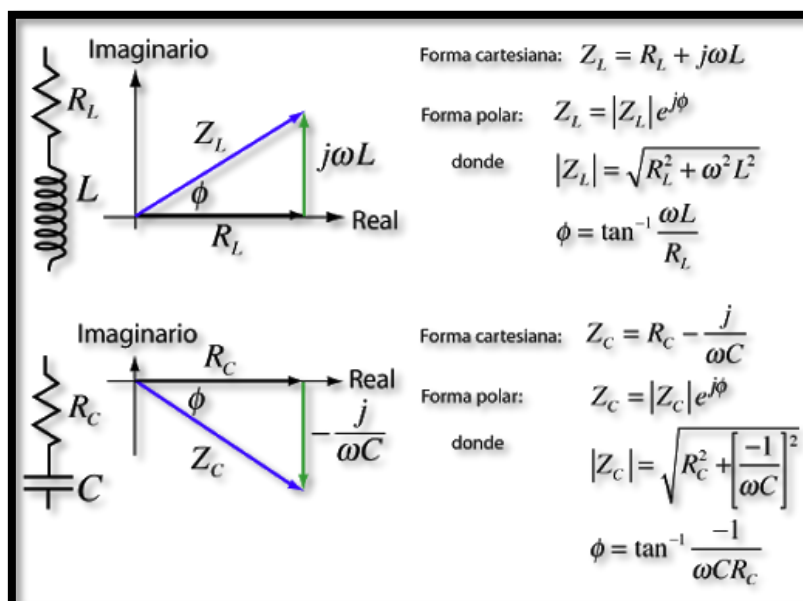
$$\bar{z}_c = \frac{1}{L * \omega} = \frac{1}{2\pi f c}$$

$$\bar{z}_L = L * \omega = 2\pi f L$$

Impedancia

$$I = \frac{V}{Z}$$

$$\phi = \tan^{-1} \left(\frac{co}{ca} \right)$$



- **Procedimiento**

$$V = 10 [V]$$

$$C_{eq} = 10 [\mu F] + 10 [\mu F] = 20 [\mu F]$$

$$L_{eq} = \frac{100 [mH] * 100 [mH]}{100 [mH] + 100 [mH]} = 50 [mH]$$

- ✚ **Cálculos para una resistencia de 100 ohm**

- **Primer circuito (Capacitancia) calcular**

- ✚ **Para $f = 0 \text{ Hz}$**

$$Z_c = \frac{-j}{2\pi f C}$$

$$Z_c = \frac{-j}{2\pi * 0 * 20 * 10^{-6}} = \infty$$

$$Z_c = \infty + 100 = \infty$$

- **Voltaje V_o**

$$V = I * Z$$

$$V = 0 * \infty = \textit{indeterminado}$$

- ✚ **Para $f = 10 \text{ Hz}$**

$$Z_c = \frac{-j}{2\pi f C}$$

$$Z_c = \frac{-j}{2\pi * 10 * 20 * 10^{-6}} = -j795.7747 [\Omega]$$

$$Z_c = -j 795.7747 [\Omega]$$

$$R = 100$$

$$Z_{eq} = R + Z_c = 802.033 < -82.84^\circ$$

- **Voltaje V_o**

$$V_p = 10 < 0$$

Aplico divisor de voltaje

$$V_c = \frac{Z_c}{R + Z_c} V_p$$

$$Z_c = 795.7747 < -90$$

$$V_c = \frac{795.7747 \angle -90}{802.033 \angle -82.84^\circ} 10 \angle 0 = 0.9922 \angle -7.16^\circ$$

$$V_c = 9.922 \angle -7.16^\circ$$

$$V_c = 9.845 - j1.2367$$

✚ Para $f = 50 \text{ Hz}$

$$Z_c = \frac{-j}{2\pi f C}$$

$$Z_c = \frac{-j}{2\pi * 50 * 20 \times 10^{-6}} = -j159.1549[\Omega]$$

$$Z_c = 795.7747 \angle -90$$

$$R = 100$$

$$Z_{eq} = R \pm X_c j$$

$$Z_{eq} = 100[\Omega] - j159.1549[\Omega]$$

$$Z_{eq} = 187.9635 \angle -57.86$$

• **Voltaje V_o**

$$V_p = 10 \angle 0$$

Aplico divisor de voltaje

$$V_c = \frac{Z_c}{R + Z_c} V_p$$

$$Z_c = 159.1549 \angle -90$$

$$V_c = \frac{159.1549 \angle -90}{187.9635 \angle -57.86} 10 \angle 0 = 0.8467 \angle -32.14^\circ$$

$$V_c = 8.467 \angle -32.14^\circ$$

$$V_c = 7.17 - j4.50$$

✚ Para $f = 100 \text{ Hz}$

$$Z_c = \frac{-j}{2\pi f C}$$

$$Z_c = \frac{-j}{2\pi * 100 * 20 \times 10^{-6}} = -j79.5775[\Omega]$$

$$Z_{eq} = R \pm Z_c j$$

$$Z_{eq} = 100[\Omega] - j79.5775[\Omega]$$

$$Z_{eq} = 127.789 \angle -38.512$$

- **Voltaje Vo**

$$V_p = 10 \angle 0$$

Aplico divisor de voltaje


$$V_c = \frac{Z_c}{R + Z_c} V_p$$

$$Z_c = 79.5775 \angle -90$$

$$V_c = \frac{79.5775 \angle -90}{127.789 \angle -38.512} 10 \angle 0 = 0.6227 \angle -51.488^\circ * 10 \angle 0 =$$

$$V_c = 6.227 \angle -51.488^\circ$$

$$V_c = 3.88 - j4.87$$

 Para f= 500 Hz

$$Z_c = \frac{-j}{2\pi fC}$$

$$X_c = \frac{-j}{2\pi * 500 * 20 \times 10^{-6}} = -j15.9155[\Omega]$$

$$Z_{eq} = R \pm Z_c j$$

$$Z_{eq} = 100[\Omega] - j15.9155[\Omega]$$

$$Z_{eq} = 101 \angle -9.043$$

- **Voltaje Vo**

$$V_p = 10 \angle 0$$

Aplico divisor de voltaje


$$V_c = \frac{Z_c}{R + Z_c} V_p$$

$$Z_c = 15.9155 \angle -90$$

$$V_c = \frac{15.9155 \angle -90}{101 \angle -9.043} 10 \angle 0 = 0.1576 \angle -80.957^\circ * 10 \angle 0 =$$

$$V_c = 1.576 \angle -80.957$$

$$V_c = 0.25 - j1.56$$

 Para f= 1000 Hz

$$Z_c = \frac{-j}{2\pi fC}$$

$$Z_c = \frac{-j}{2\pi * 1000 * 20 \times 10^{-6}} = -j7.9577[\Omega]$$

$$Z_{eq} = R \pm Z_c j$$

$$Z_{eq} = 100[\Omega] - j7.9577[\Omega]$$

$$Z_{eq} = 100\angle -4.5498$$

- **Voltaje Vo**

$$V_p = 10 < 0$$

Aplico divisor de voltaje

$$V_c = \frac{Z_c}{R + Z_c} V_p$$

$$Z_c = 7.9577 < -90$$

$$V_c = \frac{7.9577 < -90}{100\angle -4.5498} 10 < 0 = 0.079577 < -85.4502 * 10 < 0 =$$

$$V_c = 0.79577 < -85.4502^\circ$$

$$V_c = 0.063 - j0.79$$

- **Segundo Circuito (Inductancia)**

$$Z_L = L * \omega = 2\pi fL$$

✚ **Para f= 0 Hz**

$$X_L = 2\pi fC$$

$$Z_L = 2\pi * 0 * 50 \times 10^{-6} = 0[\Omega]$$

$$Z_{eq} = R + X_L j$$

$$Z_{eq} = 100[\Omega]$$

- **Voltaje Vo**

Aplico divisor de Voltaje

$$V_L = \frac{Z_L}{Z_{eq}} * V_p$$

$$V_L = \frac{0}{100} * 10 < 0$$

$$V_L = 0[V]$$

✚ Para $f = 10 \text{ Hz}$

$$X_L = 2\pi fC$$
$$Z_L = 2\pi * 10 * 50 \times 10^{-6} = 0.0031415[\Omega]$$

$$Z_{eq} = R + X_L j$$
$$Z_{eq} = 100[\Omega] + 0.0031415 j$$
$$Z_{eq} = 100 < 1.8$$

- **Voltaje V_o**

Aplico divisor de Voltaje

$$V_L = \frac{Z_L}{Z_{eq}} * V_p$$
$$V_L = \frac{0.0031415 < 90}{100 < 1.8} * 10 < 0$$
$$V_L = 0.000031415 < 88.2 * 10 < 0$$
$$V_L = 0.00031415 < 88.2 [V]$$
$$V_L = 9.87 * 10^{-6} + j3.14 * 10^{-4}$$

✚ Para $f = 50 \text{ Hz}$

$$X_L = 2\pi fC$$
$$X_L = 2\pi * 10 * 50 \times 10^{-6} = 0.01571[\Omega]$$

$$Z_{eq} = R + X_L j$$
$$Z_{eq} = 100[\Omega] + 0.01571 j$$
$$Z_{eq} = 100 < 9$$

- **Voltaje V_o**

Aplico divisor de Voltaje

$$V_L = \frac{Z_L}{Z_{eq}} * V_p$$

$$V_L = \frac{0.01571 \angle 90}{100 \angle 9} * 10 \angle 0$$

$$V_L = 0.0001571 \angle 81 * 10 \angle 0$$

$$V_L = 0.001571 \angle 81 [V]$$

$$V_L = 2.46 * 10^{-4} + j1.55 * 10^{-3}$$

✚ Para $f = 100 \text{ Hz}$

$$X_L = 2\pi fC$$

$$X_L = 2\pi * 100 * 50 \times 10^{-6} = 0.031415 [\Omega]$$

$$Z_{eq} = R + X_L j$$

$$Z_{eq} = 100 [\Omega] + 31.41 j$$

$$Z_{eq} = 100 \angle 0.02$$

- *Voltaje V_o*

Aplico divisor de Voltaje

$$V_L = \frac{Z_L}{Z_{eq}} * V_p$$

$$V_L = \frac{0.031415 \angle 90}{100 \angle 0.02} * 10 \angle 0$$

$$V_L = 0.00031415 \angle 89.98 * 10 \angle 0$$

$$V_L = 0.0031415 \angle 89.98 [V]$$

$$V_L = 1.096 * 10^{-6} + j3.14 * 10^{-3}$$

✚ Para $f = 500 \text{ Hz}$

$$X_L = 2\pi fC$$

$$X_L = 2\pi * 500 * 50 \times 10^{-6} = 0.157079 [\Omega]$$

$$Z_{eq} = R + X_L j$$

$$Z_{eq} = 100[\Omega] + 157.0796 j$$

$$Z_{eq} = 100 < 0.1$$

- **Voltaje Vo**

Aplico divisor de Voltaje


$$V_L = \frac{Z_L}{Z_{eq}} * V_p$$

$$V_L = \frac{0.157079 < 90}{100 < 0.1} * 10 < 0$$

$$V_L = 0.00157079 < 89.9 * 10 < 0$$

$$V_L = 0.0157079 < 89.9[V]$$

$$V_L = 2.74 * 10^{-5} + j0.16$$

 **Para f= 1000 Hz**

$$X_L = 2\pi fC$$

$$X_L = 2\pi * 1000 * 50 \times 10^{-6} = 0.3141592[\Omega]$$

$$Z_{eq} = R + X_L j$$

$$Z_{eq} = 100[\Omega] + 314.1592 j$$

$$Z_{eq} = 100 < 0.2$$

- **Voltaje Vo**

Aplico divisor de Voltaje

$$V_L = \frac{Z_L}{Z_{eq}} * V_p$$

$$V_L = \frac{0.3141592 < 90}{100 < 0.2} * 10 < 0$$

$$V_L = 0.003141592 < 89.8 * 10 < 0$$

$$V_L = 0.03141592 < 89.8[V]$$

$$V_L = 1.97 * 10^{-4} + j0.31$$

Bibliografía

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