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Tema: Inductor y Capacitor

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PRÁCTICA NO. 9. INDUCTOR Y CAPACITOR

Tema: Inductor y Capacitor

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

    a. Utilice el osciloscopio para observar el voltaje V☐ variando la frecuencia entre los valores de 0, 10, 50, 100, 500, 1000 Hz. Anote los valores pico de las ondas observadas.

    b. Utilice un multímetro para medir el voltaje V☐ variando la frecuencia entre los valores de 0, 10, 50, 100, 500, 1000 Hz. Anote los resultados.

    c. 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.
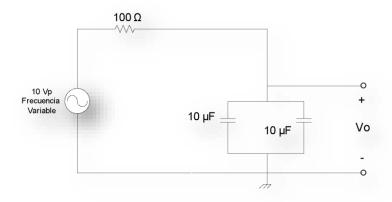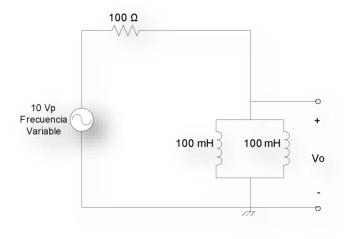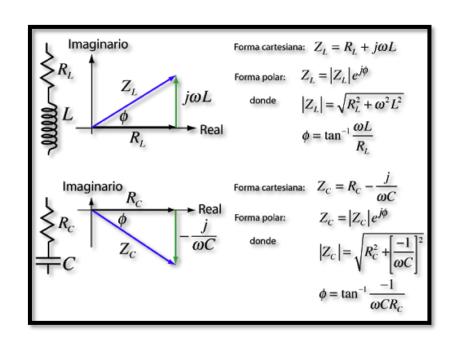

Figura 1.

Figura 2.

Formulas:

$$\bar{z}_c = \frac{1}{L * \omega} = \frac{1}{2\Pi fc}$$

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

Impedancia

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

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

- *Procedimiento*

$$V = 10 \ [V]$$
$$C_{eq} = 10 \ [\mu F] + 10 \ [\mu F] = 20 \ [\mu F]$$
$$L_{eq} = \frac{100 \ [mH] * 100 [mH]}{100 \ [mH] + 100 [mH]} = 50 \ [mH]$$

+ <u>*Cálculos para una resistencia de 100 ohm*</u>

- **Primer circuito (Capacitancia) calcular**

+ <u>*Para f = 0 Hz*</u>

$$Z_C = \frac{-j}{2 \Pi f C}$$
$$Z_C = \frac{-j}{2 \Pi * 0 * 20 * 10^{-6}} = \infty$$
$$Z_C = \infty + 100 = \infty$$

- *Voltaje Vo*

$$V = I * Z$$

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

+ <u>*Para f= 10 Hz*</u>

$$Z_C = \frac{-J}{2 \Pi f C}$$

$$Z_C = \frac{-J}{2 \Pi * 10 * 20x10^{-6}} = -j795.7747 [\Omega]$$

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

$$R = 100$$

$$Z_{eq} = R + Z_c = \textbf{802.033} < -\textbf{82.84°}$$

- *Voltaje Vo*

$$\textbf{\textit{Vp}} = \textbf{10} < \ \textbf{0}$$

Aplico divisor de voltaje

$$V_C = \frac{Z_c}{R + Z_C} V_p$$

$$Z_c = 795.7747 < -\textbf{90}$$

$$V_c = \frac{795.7747 < -90}{802.033 < -82.84°} 10 < 0 = 0.9922 < -7.16 * 10 < 0$$

$$V_c = \boldsymbol{9.922 < -7.16}°$$

Para f= 50 Hz

$$Z_C = \frac{-j}{2\Pi f C}$$

$$Z_C = \frac{-j}{2\Pi * 50 * 20x10^{-6}} = -j159.1549[\Omega]$$

$$Z_c = 795.7747 < -\boldsymbol{90}$$

$$R = 100$$

$$\boldsymbol{Z_{eq} = R \pm X_C j}$$
$$Z_{eq} = 100[\Omega] - j\ 159.1549[\Omega]$$
$$Z_{eq} = 187.9635 < -57.86$$

- **Voltaje Vo**

$$\boldsymbol{Vp = 10 < 0}$$

Aplico divisor de voltaje

$$\boldsymbol{V_C = \frac{Z_c}{R + Z_C} V_p}$$

$$Z_c = 159.1549 < -90$$

$$V_c = \frac{159.1549 < -90}{187.9635 < -57.86} 10 < 0 = 0.8467 < -32.14 * 10 < 0$$

$$V_c = \boldsymbol{8.467 < -32.14}°$$

Para f= 100 Hz

$$Z_C = \frac{-J}{2\Pi f C}$$

$$Z_C = \frac{-j}{2\Pi * 100 * 20x10^{-6}} = -j79.5775[\Omega]$$
$$\boldsymbol{Z_{eq} = R \pm Z_C j}$$
$$Z_{eq} = 100[\Omega] - j79.5775[\Omega]$$

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

- **Voltaje Vo**

$$\boldsymbol{Vp = 10 < 0}$$

Aplico divisor de voltaje

$$V_C = \frac{Z_c}{R + Z_C} V_p$$

$$Z_c = 79.5775 < -90$$

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

$$\boldsymbol{V_c = 6.227 < -51.488°}$$

⬥ *Para f= 500 Hz*

$$Z_C = \frac{-j}{2\Pi f C}$$

$$X_C = \frac{-j}{2\Pi * 500 * 20x10^{-6}} = -j15.9155[\Omega]$$

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

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

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

- *Voltaje Vo*

$$\boldsymbol{Vp = 10 < 0}$$

Aplico divisor de voltaje

$$V_C = \frac{Z_c}{R + Z_C} V_p$$

$$Z_c = 15.9155 < -90$$

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

$$\boldsymbol{V_c = 1.576 < -80.957}$$

⬥ *Para f= 1000 Hz*

$$Z_C = \frac{-j}{2\Pi f C}$$

$$Z_C = \frac{-j}{2\Pi * 1000 * 20x10^{-6}} = -j7.9577[\Omega]$$

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

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

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

- *Voltaje Vo*

$$\boldsymbol{Vp = 10 < 0}$$

Aplico divisor de voltaje

$$V_C = \frac{Z_c}{R + Z_C} V_p$$

$Z_c = 7.9577 < -90$

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

$$\boldsymbol{V_c = 0.79577 < -85.4502\,°}$$

- **_Segundo Circuito (Inductancia)_**

$$z_L = L * \omega = 2\pi f L$$

Para f= 0 Hz

$$X_l = 2\Pi f C$$
$$Z_L = 2\Pi * 0 * 50x10^{-6} = 0 [\Omega]$$

$$\boldsymbol{Z_{eq} = R + X_L j}$$
$$Z_{eq} = \boldsymbol{100} [\Omega]$$

- **Voltaje Vo**

Aplico divisor de Voltaje

$$V_L = \frac{ZL}{Zeq} * Vp$$

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

$$\boldsymbol{V_L = 0 [V]}$$

Para f= 10 Hz

$$X_l = 2\Pi f C$$
$$Z_L = 2\Pi * 10 * 50x10^{-6} = 0.0031415 [\Omega]$$

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

- *Voltaje Vo*

Aplico divisor de Voltaje

$$V_L = \frac{ZL}{Zeq} * Vp$$

$$V_L = \frac{0.0031415 < 90}{100 < 1.8} * 10 < 0$$

$$V_L = 0.000031415 < 88.2 * 10 < 0$$

$$V_L = 0.00031415 < 88.2 \, [V]$$

➕ *Para f= 50 Hz*

$$X_l = 2\Pi f C$$
$$X_L = 2\Pi * 10 * 50x10^{-6} = 0.01571 [\Omega]$$

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

- *Voltaje Vo*

Aplico divisor de Voltaje

$$V_L = \frac{ZL}{Zeq} * Vp$$

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

$$V_L = 0.0001571 < 81 * 10 < 0$$

$$V_L = 0.001571 < 81 \, [V]$$

➕ *Para f= 100 Hz*

$$X_l = 2\Pi f C$$
$$X_L = 2\Pi * 100 * 50x10^{-6} = 0.031415 [\Omega]$$

$$Z_{eq} = R + X_L\, j$$
$$Z_{eq} = 100[\Omega] + 31.41\, j$$
$$Z_{eq} = 100 < 0.02$$

- *Voltaje Vo*

Aplico divisor de Voltaje

$$V_L = \frac{ZL}{Zeq} * Vp$$

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

$$V_L = 0.00031415 < 89.98 * 10 < 0$$

$$\boldsymbol{V_L = 0.0031415 < 89.98[V]}$$

Para f= 500 Hz

$$X_l = 2\Pi f C$$
$$X_L = 2\Pi * 500 * 50x10^{-6} = 0.157079[\Omega]$$

$$Z_{eq} = R + X_L\, j$$
$$Z_{eq} = 100[\Omega] + 157.0796\, j$$
$$Z_{eq} = 100 < 0.1$$

- *Voltaje Vo*

Aplico divisor de Voltaje

$$V_L = \frac{ZL}{Zeq} * Vp$$

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

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

$$\boldsymbol{V_L = 0.0157079 < 89.9[V]}$$

+ *__Para f= 1000 Hz__*

$$X_l = 2\Pi f C$$
$$X_L = 2\Pi * 1000 * 50x10^{-6} = 0.3141592 [\Omega]$$

$$\boldsymbol{Z_{eq} = R + X_L j}$$
$$\boldsymbol{Z_{eq} = 100[\Omega] + 314.1592 j}$$
$$\boldsymbol{Z_{eq} = 100 < 0.2}$$

- *__Voltaje Vo__*

$$Aplico\ divisor\ de\ Voltaje$$

$$V_L = \frac{ZL}{Zeq} * Vp$$

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

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

$$\boldsymbol{V_L = 0.03141592 < 89.8 [V]}$$

+ **Bibliografía**

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