

مختصری از تئوری آزمایش:

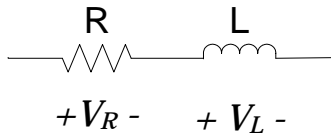
$$e = -L \frac{dI}{dt} \quad (.)$$

$$I = I_m \sin(\omega t) \quad (.)$$

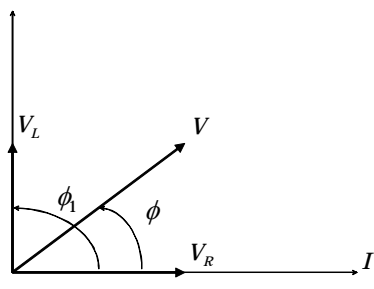
$$V = L \frac{dI}{dt} = L \frac{d}{dt}(I_m \sin \omega t) = LI_m \omega \cos \omega t \quad (.)$$

$$V = V_m \cos \omega t = V_m \sin\left(\omega t + \frac{\pi}{2}\right) \quad (.)$$

$$X_L = L\omega$$



$$V_L \quad I \quad V_R \quad I$$



$$V^2 = V_L^2 + V_R^2 - 2V_L V_R \cos \phi_1$$

$$\phi_1 = \frac{\pi}{2} \Rightarrow V^2 = V_L^2 + V_R^2 \Rightarrow$$

$$V = \sqrt{V_L^2 + V_R^2} = \sqrt{(RI)^2 + (X_L I)^2} \Rightarrow$$

$$V = I \sqrt{R^2 + X_L^2} \quad (.)$$

$$Z = \sqrt{R^2 + X_L^2}$$

$$\left. \begin{matrix} V_L = X_L I \\ V_R = RI \end{matrix} \right\} \Rightarrow \tan \phi = \frac{L\omega}{R} \Rightarrow$$

$$\phi = \tan^{-1} \frac{L\omega}{R} \quad (.)$$

$$I \quad V$$

$$\left. \begin{matrix} Q = C \cdot V \\ I = \frac{dQ}{dt} \end{matrix} \right\} \Rightarrow I = C \frac{dV}{dt} \quad (.)$$

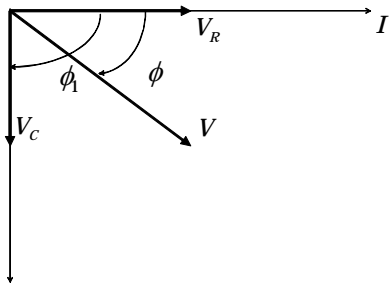
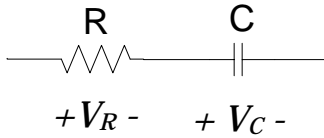
$$(V = V_m \sin(\omega t))$$

$$I = C \frac{dV}{dt} = C \frac{d}{dt}(V_m \sin(\omega t)) = CV_m \omega \cos(\omega t) \quad (.)$$

$$I = I_m \cos(\omega t) = I_m \sin\left(\omega t + \frac{\pi}{2}\right) \quad (.)$$

$$X_C = \frac{1}{C\omega}$$

$$V_m = X_C I_m \quad (.)$$



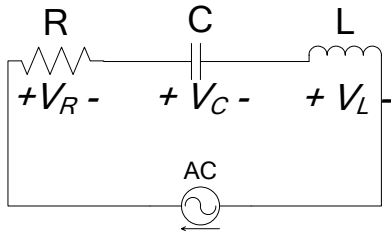
$$V^2 = V_C^2 + V_R^2 \Rightarrow$$

$$V = \sqrt{V_R^2 + V_C^2} = \sqrt{(RI)^2 + (X_C I)^2} \Rightarrow$$

$$V = I\sqrt{R^2 + X_C^2} \quad (.)$$

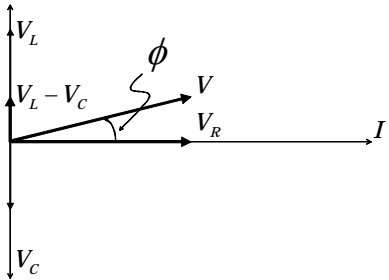
$$Z = \sqrt{R^2 + X_C^2} \quad (.)$$

RLC :



$$V^2 = V_R^2 + (V_L - V_C)^2 = I^2 R^2 + (I \cdot X_L - I \cdot X_C)^2 \Rightarrow$$

$$V^2 = I^2 [R^2 + (X_L - X_C)^2] \quad (.)$$



$$\tan \phi = \frac{V_L - V_C}{V_R} = \frac{IX_L - IX_C}{IR} = \frac{L\omega - 1/C\omega}{R} \Rightarrow$$

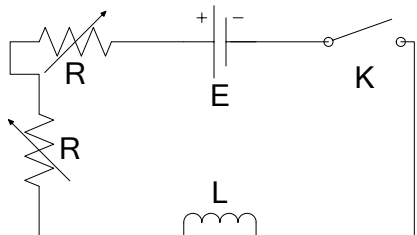
$$\phi = \tan^{-1} \frac{L\omega - 1/C\omega}{R} \quad (.)$$

(.)

$$X_L = X_C \Rightarrow L\omega = \frac{1}{C\omega} \Rightarrow$$

$$\omega = \frac{1}{\sqrt{LC}} \quad (.)$$

آزمایش اول - اندازه‌گیری مقاومت سیم‌پیچ :



(R_1)

(R_2)

DC

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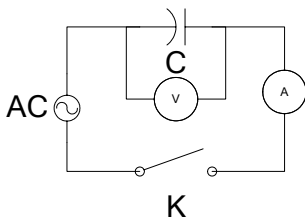
(40mA)

$$R = R_2 - R_1 = 90.1\Omega - 72.6\Omega = 17.5\Omega$$

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$$R = R_2 - R_1 = 89.3\Omega - 88.6\Omega = 0.7\Omega$$

آزمایش دوم - اثر خازن در مدار:



$$C = \frac{I_e}{V_e}$$

$$C\omega = \frac{1}{Z} = \frac{I_e}{V_e}$$

$C(\mu F)$	$I_e(mA)$	$V_e(volts)$	I_e/V_e	d
4	5.1	4.2	1.214	-0.03
6	7.7	4.2	1.816	-0.03
8	10.0	4.2	2.358	0.02
10	12.0	4.2	2.830	0.14
12	15.0	4.2	3.571	-0.01
14	17.0	4.2	4.048	0.11
16	20.0	4.2	4.762	-0.01
18	23.0	4.2	5.476	-0.13
20	25.0	4.2	5.952	-0.01

$$\left. \begin{array}{l} [XX] = 1536 \\ [XY] = 456.256 \\ [YY] = 135.578 \end{array} \right\} \Rightarrow \left\{ \begin{array}{l} \omega = \frac{[XY]}{[XX]} = 0.297 \times 10^3 \text{ rad/sec} \\ r^2 = \frac{[XY]^2}{[XX][YY]} = 0.997 \end{array} \right.$$

$$[X] = 108, N = 9, \Delta = \begin{vmatrix} [XX] & [X] \\ [X] & N \end{vmatrix} = 2160$$

$$\alpha^2 = \frac{[dd]}{N-2} = \frac{0.0511}{7} = 0.0073$$

$$\alpha_a^2 = \frac{N \cdot \alpha^2}{\Delta} = \frac{9 \times 0.0073}{2160} = 3.04 \times 10^{-5}$$

$$y = (0.297 \pm 3.04 \times 10^{-5}) x$$

$$\omega = 0.297 \times 10^3 \pm 3.04 \times 10^{-2} \text{ rad/sec}$$

$$\frac{\Delta\omega}{\omega} = \frac{3.04 \times 10^{-2}}{297} = 1.024 \times 10^{-4} = 0.01024\%$$

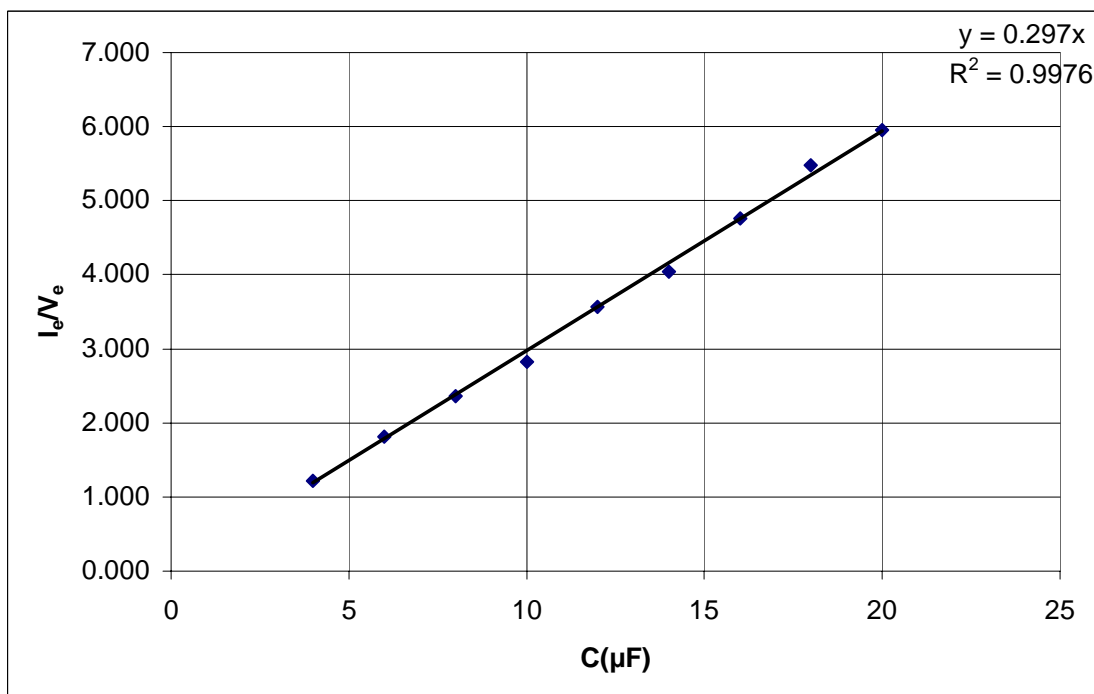
$$\omega = 2\pi \cdot f \Rightarrow f = 47.269 \text{ Hz}$$

$$\Delta f = \frac{\Delta\omega}{2\pi} = \frac{3.04 \times 10^{-2}}{2\pi} = 4.838 \times 10^{-3}$$

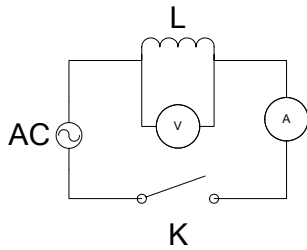
$$f = 47.269 \pm 4.838 \times 10^{-3} \text{ Hz}$$

$$\frac{\Delta f}{f} = 0.01024\%$$

: C $\frac{I_e}{V_e}$



آزمایش سوم - اندازه‌گیری مقاومت ظاهری سلف:



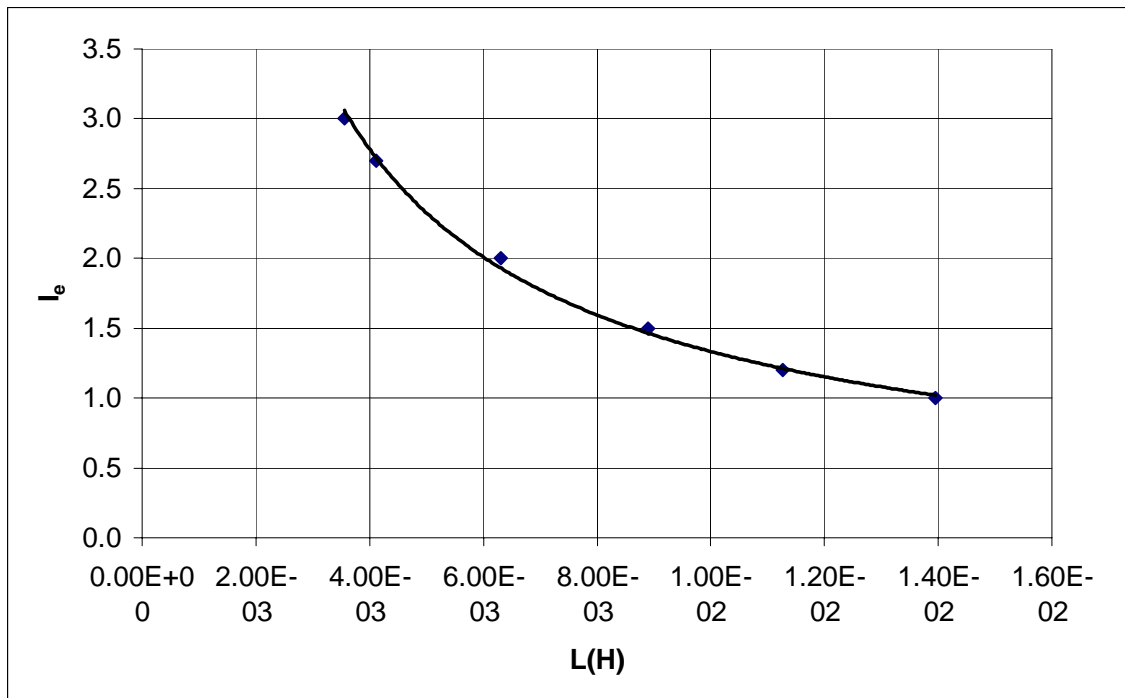
$$Z = \sqrt{R^2 + L^2 \omega^2}$$

$$Z = \frac{V_e}{I_e}$$

$$L = \frac{\sqrt{Z^2 - R^2}}{\omega}$$

$R = 0.7 \Omega$ $\omega = 297 \text{ rad/sec}$:

$l(\text{cm})$	$I_e(\text{mA})$	$V_e(\text{volts})$	$Z = V_e/I_e$	$L(\text{H})$
25	1.0	4.2	4.200	1.39E-02
20	1.2	4.1	3.417	1.13E-02
15	1.5	4.1	2.733	8.90E-03
10	2.0	4.0	2.000	6.31E-03
5	2.7	3.8	1.407	4.11E-03
0	3.0	3.8	1.267	3.55E-03

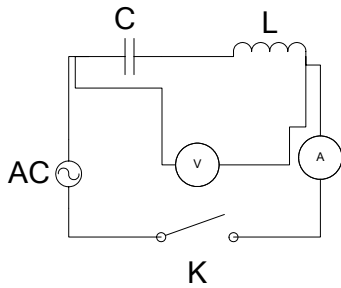


آزمایش چهارم - اثر سلف و خازن بر روی هم:

$30 \mu F$ $10 \mu F$

Z

//



Z

C

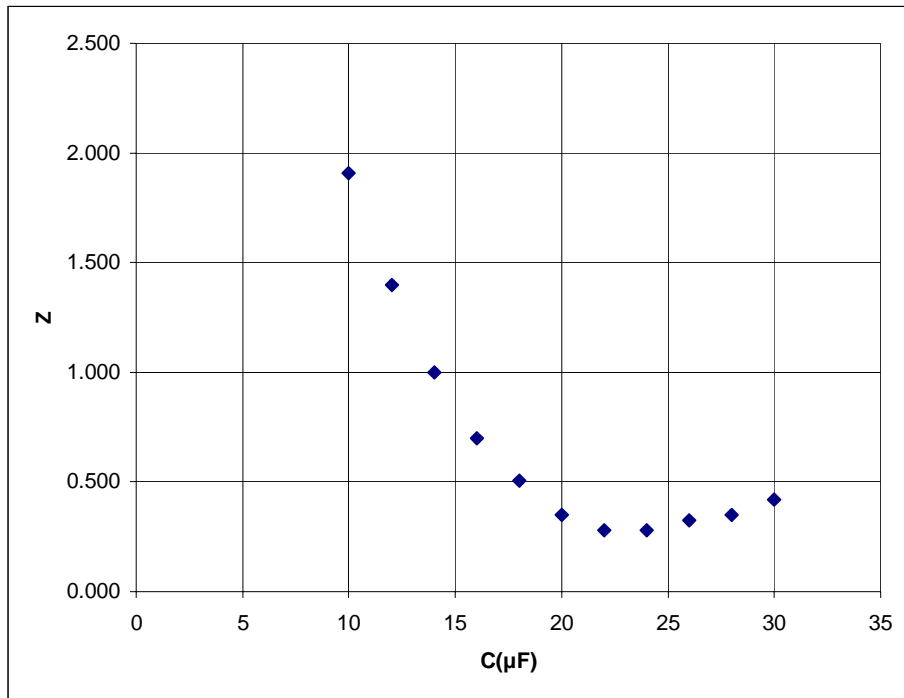
Z

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C

$C(\mu F)$	$I_e(mA)$	$V_e(volts)$	$Z=V_e/I_e$
10	2.2	4.2	1.909
12	3.0	4.2	1.400
14	4.2	4.2	1.000
16	6.0	4.2	0.700
18	8.3	4.2	0.506
20	12.0	4.2	0.350
22	15.0	4.2	0.280
24	15.0	4.2	0.280
26	13.0	4.2	0.323
28	12.0	4.2	0.350
30	10.0	4.2	0.420



$Z \quad C = 23 \mu F$

$$L = \frac{1}{C\omega^2} = \frac{1}{23 \mu F \times (297 \text{ rad/sec})^2} = 0.493 H$$