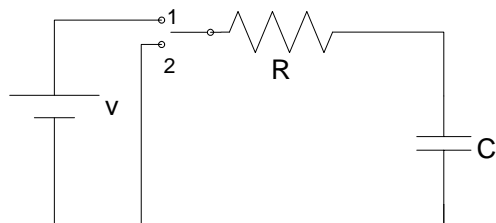


مختصری از تئوری آزمایش:

RC :RC

$$Q = C.v \Rightarrow i = \frac{dQ}{dt} = C \cdot \frac{dv}{dt} \quad (.)$$

$$(V) \quad \quad \quad KVL$$

$$V = v_R + v_c \Rightarrow V = iR + v_c \Rightarrow$$

$$R \frac{di}{dt} + \frac{dv_c}{dt} = 0, i = C \frac{dv_c}{dt} \Rightarrow i + RC \frac{di}{dt} = 0$$

$$i(0) = \frac{V}{R}$$

$$i(t) = \frac{V}{R} e^{-\frac{t}{RC}} \quad (.)$$

(.)

$$v_C = v_0 + \frac{1}{C} \int_0^t i(t') dt', v_0 = 0 \Rightarrow$$

$$v_C = V \left(1 - e^{-\frac{t}{RC}} \right) \quad (.)$$

KVL

 v_0

$$v_C + v_R = 0 \Rightarrow Ri + v_C = 0 \Rightarrow R \frac{di}{dt} + \frac{dv_C}{dt} = 0$$

$$i = C \frac{dv_C}{dt} \Rightarrow i + RC \frac{di}{dt} = 0$$

$$i(0) = \frac{v_0}{R}$$

$$i = \frac{-v_0}{R} e^{-\frac{t}{RC}} \quad (.)$$

$$v_C = v_0 + \frac{1}{C} \int_0^t i(t') dt' \Rightarrow$$

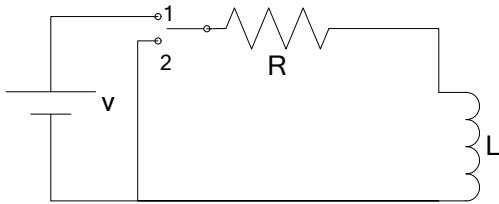
$$v_C = v_0 e^{-\frac{t}{RC}} \quad (.)$$

 τ

RC

//

RL



$$\phi = Li, v_L = \frac{d\phi}{dt} = L \frac{di}{dt} \quad (.)$$

KVL

$$V = v_L + Ri \Rightarrow L \frac{di}{dt} + Ri = V$$

$$\Rightarrow i + \frac{L}{R} \frac{di}{dt} = \frac{V}{R}$$

$$i = \frac{V}{R} \left(1 - e^{-\frac{R}{L}t} \right) \quad (.)$$

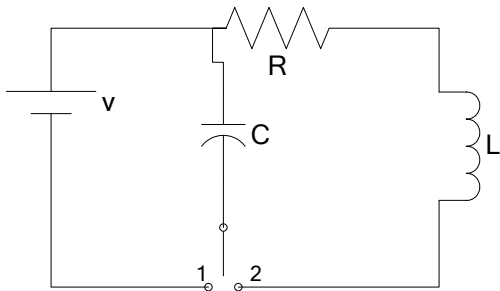
$$\frac{V}{R} \quad \tau = \frac{L}{R}$$

$$Ri + v_L = 0 \Rightarrow i + \frac{L}{R} \frac{di}{dt} = 0$$

$$i_0 = \frac{V}{R}$$

$$i = \frac{V}{R} e^{-\frac{R}{L}t} \quad (.)$$

RLC



$$v_C + v_L + v_R = 0 \Rightarrow v_C + L \frac{di}{dt} + Ri = 0$$

$$\Rightarrow \frac{dv_C}{dt} + L \frac{d^2i}{dt^2} + R \frac{di}{dt} = 0 \Rightarrow \frac{d^2i}{dt^2} + \frac{R}{L} \frac{di}{dt} + \frac{1}{LC} i = 0$$

$$\frac{di}{dt}(0) = \frac{-v_0}{L} \quad i(0) = 0$$

$$s^2 + \frac{R}{L}s + \frac{1}{LC} = 0$$

$$s = \pm j \sqrt{\frac{1}{LC}}$$

$$i = I_{\max} \cos(\omega t + \varphi), \omega = \frac{1}{\sqrt{LC}} \quad (.)$$

$$R < \sqrt{\frac{4L}{C}} \quad (.)$$

$$s = \frac{-R}{2L} \pm j\sqrt{\frac{R^2}{4L^2} - \frac{1}{LC}}$$

$$i = I_{\max} e^{\frac{-R}{2L}t} \cos(\omega_d t + \varphi) \quad (.)$$

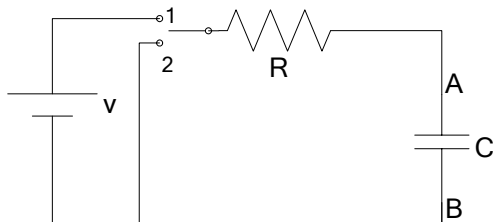
$$\omega_d = \sqrt{\frac{R^2}{4L^2} - \frac{1}{LC}}$$

$$\left(\frac{di}{dt}(0) = \frac{-v_0}{L} \quad i(0) = 0\right)$$

$$i(0) = I_{\max} \cos(\varphi) = 0 \Rightarrow \varphi = \frac{\pi}{2}$$

$$\frac{di}{dt}(0) = -\frac{1}{2}I_{\max} \frac{R \cos(\varphi) + 2\omega_d L \sin(\varphi)}{L} = -\frac{v_0}{L} \Rightarrow I_{\max} = \frac{v_0}{L \cdot \omega_d}$$

$$R \geq \sqrt{\frac{4L}{C}}$$



آزمایش اول - مدار RC : RC

$$R = 100k\Omega \quad C = 40\mu F$$

CASSY CASSY

(DC)

B A
()
(.)

CASSY

CASSY ((.))

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$$t = \tau \quad (.)$$

$$v_C = v_{\max} (1 - e^{-1}) \approx 0.63 v_{\max}$$

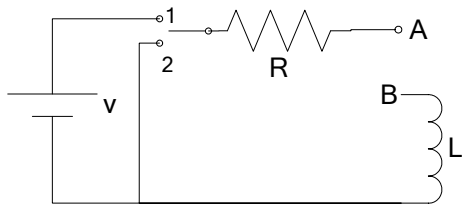
$$0.63 \times 5V = 3.161V$$

CASSY

$$\left. \begin{aligned} t = 4.2 \text{ sec} &\Rightarrow v = 6.27V \\ t = 4.3 \text{ sec} &\Rightarrow v = 6.36V \end{aligned} \right\} \Rightarrow \frac{\tau - 4.2}{4.3 - 4.2} = \frac{6.3 - 6.27}{6.36 - 6.27} \Rightarrow$$

$$\tau_C = 4.233 \text{ sec}$$

$$\tau_C = RC = 100k\Omega \times 40\mu F = 4 \text{ sec}$$



آزمایش دوم - مدار **RL** : **RL**

$L = 500H$

CASSY

$R = 2 \times 150\Omega = 300\Omega$

(DC)

B A

()

CASSY ((.))

(.)

(. CASSY)

: $t = \tau$ (.)

$$i_L = \frac{V}{R}(1 - e^{-1}) \approx 0.63 \frac{V}{R}$$

$$0.63 \times \frac{5V}{300\Omega} = 0.011A$$

: CASSY

$t = 1.7 \text{ sec} \Rightarrow i = 0.021A$

$\tau_L = 1.7 \text{ sec}$

$\tau_L = \frac{L}{R} = \frac{500}{300} = 1.667$

آزمایش سوم - مدار **RLC** : **RLC**

CASSY

$C = 40\mu F$ $L = 500H$ $R = 300\Omega$

()

ω_d

$t_1 = 1.4 \text{ sec}$ $t_2 = 2.4 \text{ sec}$ $t_3 = 3.3 \text{ sec}$ $t_4 = 4.2 \text{ sec}$ $t_5 = 5 \text{ sec}$

$$T = \frac{5 \text{ sec} - 1.4 \text{ sec}}{4} = 0.9 \text{ sec} \Rightarrow \omega_d = \frac{2\pi}{T} \approx 7 \text{ rad/sec}$$

: (.)

$$\omega_d = \sqrt{\frac{1}{LC} - \left(\frac{R}{2L}\right)^2} = \sqrt{\frac{1}{500H \times 40\mu F} - \left(\frac{300\Omega}{2 \times 500H}\right)^2} = 7.065 \text{ rad/sec}$$

:

$$\omega_d = \sqrt{\frac{1}{500H \times 40\mu F} - \left(\frac{R}{2 \times 500H}\right)^2} = 7 \text{ rad/sec} \Rightarrow$$

$$\left(\frac{R}{2 \times 500H}\right)^2 = 1(\text{rad/sec})^2 \Rightarrow \frac{R}{1000H} = 1 \text{ rad/sec} \Rightarrow$$

$$\boxed{R = 1000\Omega}$$

RLC

آزمایش چهارم - مدار *RLC* با ترانزیستور :

()

() .

RLC

()

(feedback)

(/)