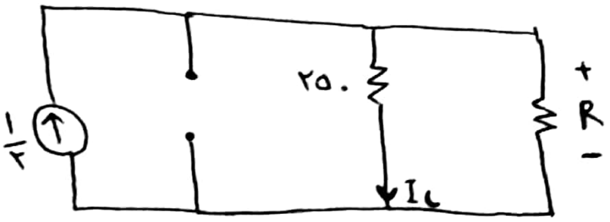
فرهاد امان ۹۹۳۱۰۶

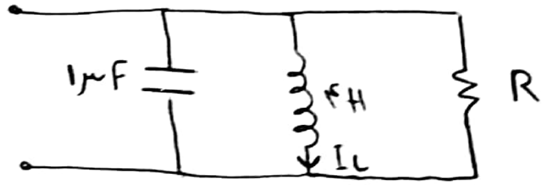
۲ـ $t<0$



تقسیم جریان: $I_L(0^+) = I_L(0^-) = I_L = \frac{R}{500+2R}$ A

$V_L(0^-) = 0$ V $\quad$ $I_C(0^-) = 0$ A $\quad$ $V_C(0^+) = V_C(0^-) = \frac{250R}{500+2R}$ V

$t>0$



یک مدار بدون منبع RLC داریم.

$\alpha = \frac{1}{2RC} = \frac{5\times10^5}{R}$

$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{2\times10^{-3}} = 500$

برای ⇒ $\frac{5\times10^5}{R} = 500 \Rightarrow R = 1000\,\Omega$

$KVL_1: 4I_L' + \frac{1}{10^{-6}}\int i_1 = 0 \Rightarrow 4I_L'' = -10^6 i_1$

$KVL_2: 4I_L' + 1000 I_L - 1000 i_1 = 0 \Rightarrow$

$\frac{4}{1000} I_L'' + 4I_L' + 1000 I_L = 0$

$I_L'' + 10^3 I_L' + 2.5\times10^5 I_L = 0 \Rightarrow s^2 + 10^3 s + 2.5\times10^5 = 0$

$s = -500$ $\quad$ $e^{-500t}(A_1 t + A_2) = I_L(t)$

$A_2 = 0.4$

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ادامه ۲

$$I_L'(0^+) = 25 \Leftarrow 4I_{L(0^+)}' = v_C(0^+)$$

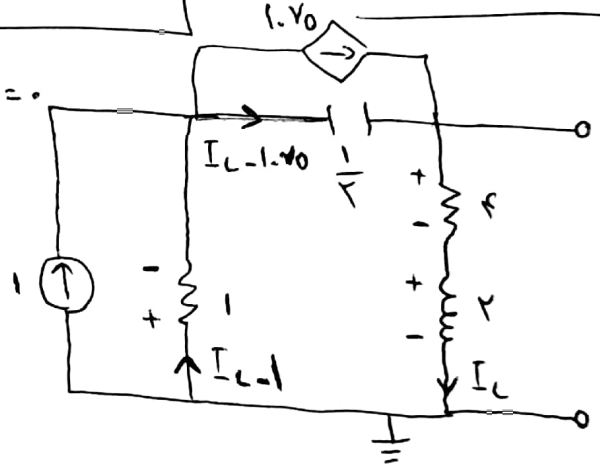
$$\left(e^{-500t}(A_1 t + 0.4)\right)' = -500e^{-500t}(A_1 t + 0.4) + e^{-500t}A_1 = 25$$

$$A_1 - 200 = 25 \Rightarrow A_1 = 225$$

$$e^{-500t}(225t + 0.4)$$

۳ -

$$v_C(0^-) = v_C(0^+) = 0\ V \qquad I_L(0^+) = I_L(0^-) = 0\ A$$



$$-4I_L - 2I_L' - I_L + 1 - 2\{I_L - 1.v_0 = 0$$

$$\Rightarrow 2I_L'' + 5I_L' + 2I_L = -2.v_0$$

$$v_0 = 2I_L' + 4I_L$$

$$2I_L'' + 13I_L' + 12I_L = 0$$

$$2s^2 + 13s + 12 = 0 \begin{cases} s = -2 \\ s = -\frac{13}{2} \end{cases} \qquad Ae^{-2t} + Be^{-\frac{13}{2}t} = I_L$$

$$I_L(0^+) = 0 \Rightarrow A + B = 0$$

$$-2A - \frac{13}{2}B = I_L'(0^+) = \frac{25}{2}A \qquad I_L''(0^+) = \frac{-1950}{4}A$$

$$v_0(0^+) = 2I_L'(0^+)$$

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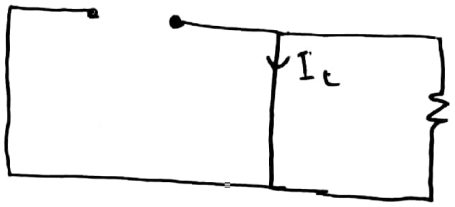
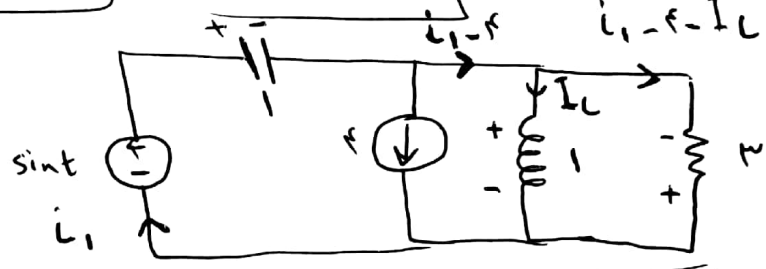
۴- $t<0$



$v_c(0^-) = v_c(0^+) = 2V$ $\quad I_L(0^+) = I_L(0^-) = 3A$

$I_c(0^-) = 0$ $\quad v_L(0^-) = 0$

$t>0$



$KVL_1: \sin t - \int i_1 - I_L' = 0 \Rightarrow \cos t - i_1 - I_L'' = 0$ ①

$KVL_2: -3(I_L + 4 - i_1) - I_L' = 0$

$\Rightarrow I_L' + 3I_L = 3i_1 - 12$ ②

①② $\Rightarrow 3I_L'' + I_L' + 3I_L = 3\cos t - 12$

$3s^2 + s + 3 = 0 \Rightarrow$ برای مقیز $\quad \alpha = \frac{1}{6} \quad w_d = \sqrt{\frac{35}{36}}$

$e^{-\frac{1}{6}t}\left(B_1 \cos\sqrt{\frac{35}{36}}\,t + B_2 \sin\sqrt{\frac{35}{36}}\,t\right) = I_L$

$B_1 = I_L(0^+) = 3$ $\quad v_L(0^+) = -2 = I_L'(0^+)$

$B_2\sqrt{\frac{35}{36}} = -\frac{w}{2} \Rightarrow B_2 = \frac{-9}{\sqrt{35}}$ $\quad I_L''(0^+) = \frac{21}{6}$

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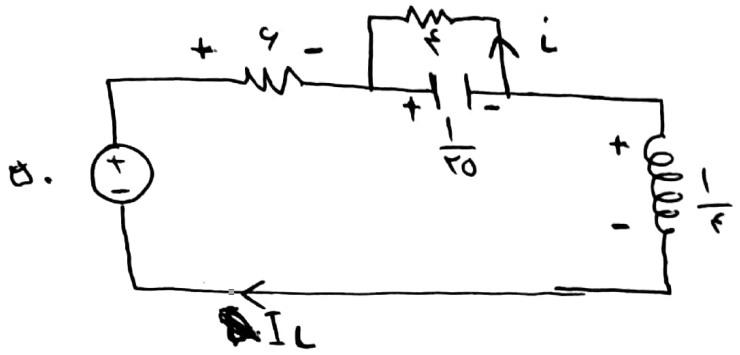
$t<0^-$ چون منبعی نداریم همه چیز ۰ است.

$v_C(0^-)=v_C(0^+)=0$ V $I_L(0^-)=I_L(0^+)=0$ A $v_L(0^-)=0$ V $I_C(0^-)=0$ A

$t>0$



KVL I_L: $50 - 6I_L - 25\int I_L + i - \frac{1}{4}I_L' = 0$

$I_L'' + 24I_L' + 100I_L = 100i$

KVL i: $4i + 25\int I_L + i = 0 \Rightarrow 4i' + 25i + 25I_L = 0$

$I_L'' + 24I_L' = 200i + 19i'$

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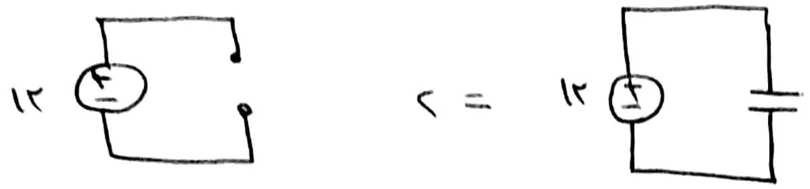
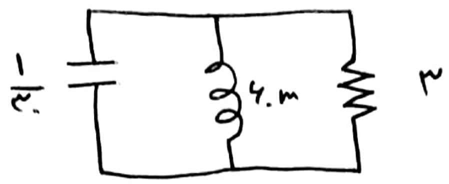
۶ - $t<0$



$I_L(0^+) = I_L(0^-) = 0A$ $\qquad$ $V_C(0^+) = V_C(0^-) = 12V$

$t>0$

$\alpha = \frac{1}{2RC} = 5$



$\omega_0 = \frac{1}{\sqrt{LC}} = \sqrt{500}$

برای ضعیف

$5\sqrt{19} = \omega_d = \sqrt{\omega_0^2 - \alpha^2}$

$e^{-5t}(B_1\cos 5\sqrt{19}t + B_2\sin 5\sqrt{19}t) = V_C = V_R$

$B_1 = 12$ $\quad$ (0^+)

$\left.\begin{array}{l} I_L(0^+) = 0 \\ V_C(0^+) = 12 \end{array}\right\} = I_C(0^+) = 4A$

$I_C(0^+) = \frac{1}{30} V_C'(0^+) \Rightarrow V_C'(0^+) = 120$

$5\sqrt{19}B_2 - 48 = 120 \Rightarrow B_2 = \frac{168}{5\sqrt{19}}$

اولین پیک اولین باری است که مشتق صفر می‌شود

$-5e^{-5t}\left(12\cos 5\sqrt{19}t + \frac{168}{5\sqrt{19}}\sin 5\sqrt{19}t\right) + e^{-5t}\left(168\cos 5\sqrt{19}t - 60\sqrt{19}\sin 5\sqrt{19}t\right)$

$= 108e^{-5t}\cos 5\sqrt{19}t - \frac{1308\sqrt{19}}{19}e^{-5t}\sin 5\sqrt{19}t = 0$