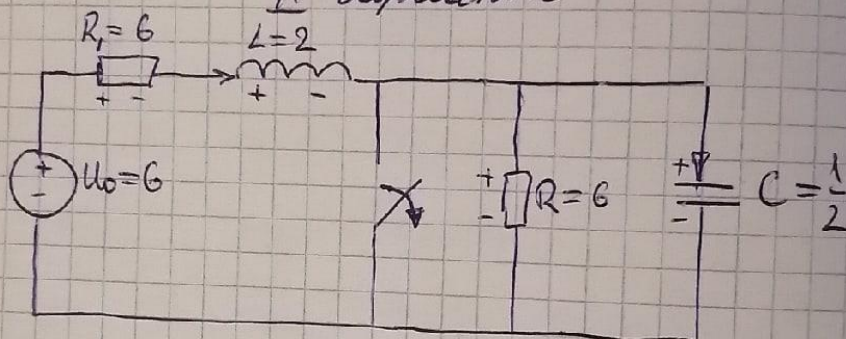


Контрольная работа №2 РЗР2, Мирончик Павел

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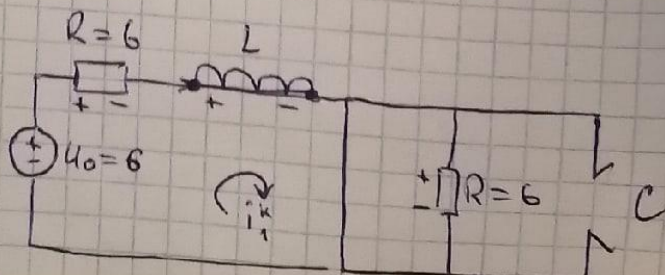
$$D=6 \quad M=6 \quad \Gamma=2$$

II вариант



| $f_{nc}(t)$ | $f_{nc}(0^+)$ | $f'_{nc}(0^+)$ | $f_{nc \text{ ст.}}$ | $P_{1,2}$ |
|-------------|---------------|----------------|----------------------|---|
| $u_c(t)$ | 0 | 2 | 6 | $-\frac{2}{3} \pm i\sqrt{\frac{14}{9}}$ |
| $i_L(t)$ | 1 | 3 | 1 | |

1. $t=0^-$



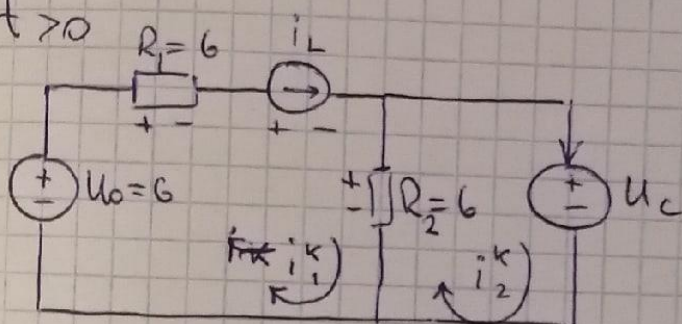
$$i_1^k: R i_1^k = U_0$$

$$i_1^k = 1$$

$$i_L(0^-) = i_1^k = 1$$

$$u_C(0^-) = \cancel{2} + \cancel{2} = 0$$

2. $t > 0$



$$\begin{cases} U_{R_1} + U_L + U_{R_2} = U_0 \\ U_{R_2} = U_C \\ i_L = i_{R_2} + i_C \end{cases}$$

$$U_L = R i_L - U_C + U_0$$

$$i_C = i_L - \frac{U_C}{R}$$

$$\begin{cases} U_C'(t) = \frac{i_C(t)}{C} = 2 \cdot i_L(t) - 2 \cdot \frac{U_C(t)}{6} = 2 i_L(t) - \frac{U_C(t)}{3} \\ i_L'(t) = \frac{U_L(t)}{L} = -6 \frac{i_L(t)}{2} - \frac{U_C(t)}{2} + 6 = -3 i_L(t) - \frac{U_C(t)}{2} + 6 \end{cases}$$

$$\begin{pmatrix} u'_L(t) \\ i'_L(t) \end{pmatrix} = [A] \begin{pmatrix} u_L \\ i_L \end{pmatrix} + B$$

$$[A] = \begin{pmatrix} -\frac{1}{3} & 2 \\ -\frac{1}{2} & -3 \end{pmatrix} \quad B = \begin{pmatrix} 0 \\ 6 \end{pmatrix}$$

3.

$$\det(A - pE) = \begin{vmatrix} -\frac{1}{3} - p & 2 \\ -\frac{1}{2} & -3 - p \end{vmatrix} =$$

$$= \left(\frac{1}{3} + p\right)(3 + p) + 1 = 1 + \frac{1}{3}p + 3p + p^2 + 1 =$$

$$= p^2 + \frac{4}{3}p + 2 = 0$$

$$3p^2 + 4p + 6 = 0$$

$$D = 16 - 72 = -56$$

$$p_{1,2} = \frac{-4 \pm \sqrt{-56}}{6} = -\frac{4}{6} \pm \sqrt{-\frac{56}{36}} = -\frac{2}{3} \pm i\sqrt{\frac{14}{9}}$$

$$\begin{cases} u_{Lcl}(t) = A_1 e^{-\frac{2}{3}t} \cos\left(\sqrt{\frac{14}{9}}t\right) + A_2 e^{-\frac{2}{3}t} \sin\left(\sqrt{\frac{14}{9}}t\right) \\ i_{Lcl}(t) = B_1 e^{-\frac{2}{3}t} \cos\left(\sqrt{\frac{14}{9}}t\right) + B_2 e^{-\frac{2}{3}t} \sin\left(\sqrt{\frac{14}{9}}t\right) \end{cases}$$

$$4. \quad u_c' = 0 \quad i_L' = 0$$

$$\begin{cases} 0 = 2i_{L\text{bun}} - \frac{u_{c\text{bun}}}{3} \\ 0 = -3i_{L\text{bun}} - \frac{u_{c\text{bun}}}{2} + 6 \end{cases} \quad \begin{cases} u_{c\text{bun}} = 6i_{L\text{bun}} \\ i_{L\text{bun}} = 1 \end{cases}$$

$$i_{L\text{bun}} = 1 \quad u_{c\text{bun}} = 6$$

$$5. \quad u_c'(0^+), i_L'(0^+)$$

$$u_c(0^+) = u_c(0^-) = 0 \quad i_L(0^+) = 1$$

$$\begin{cases} u_c'(0^+) = 2 \\ i_L'(0^+) = 3 \end{cases}$$

$$6. \quad A_1, A_2, B_1, B_2$$

$$\begin{cases} u_c(t) = u_{c\text{bun}} + A_1 e^{-\frac{2}{3}t} \cos(\sqrt{\frac{14}{9}}t) + A_2 e^{-\frac{2}{3}t} \sin(\sqrt{\frac{14}{9}}t) \\ u_c'(t) = -\frac{2}{3}A_1 e^{-\frac{2}{3}t} \cos(\sqrt{\frac{14}{9}}t) - \sqrt{\frac{14}{9}}A_1 e^{-\frac{2}{3}t} \sin(\sqrt{\frac{14}{9}}t) - \frac{2}{3}A_2 e^{-\frac{2}{3}t} \sin(\sqrt{\frac{14}{9}}t) + \sqrt{\frac{14}{9}}A_2 e^{-\frac{2}{3}t} \cos(\sqrt{\frac{14}{9}}t) \end{cases}$$

$$t=0^+$$

$$\begin{cases} 0 = 6 + A_1 \\ 2 = -\frac{2}{3}A_1 + \sqrt{\frac{14}{9}}A_2 \end{cases} \quad \begin{cases} A_1 = -6 \\ A_2 = -\frac{12}{\sqrt{14}} \end{cases}$$

$$\begin{cases} i_L(t) = i_{L\text{стат}} + B_1 e^{-\frac{2}{3}t} \cos(\sqrt{\frac{14}{9}}t) + B_2 e^{-\frac{2}{3}t} \sin(\sqrt{\frac{14}{9}}t) \\ i_L'(t) = -\frac{2}{3}B_1 e^{-\frac{2}{3}t} \cos(\sqrt{\frac{14}{9}}t) - \sqrt{\frac{14}{9}}B_1 e^{-\frac{2}{3}t} \sin(\sqrt{\frac{14}{9}}t) - \\ - \frac{2}{3}B_2 e^{-\frac{2}{3}t} \sin(\sqrt{\frac{14}{9}}t) + \sqrt{\frac{14}{9}}B_2 e^{-\frac{2}{3}t} \cos(\sqrt{\frac{14}{9}}t) \end{cases}$$

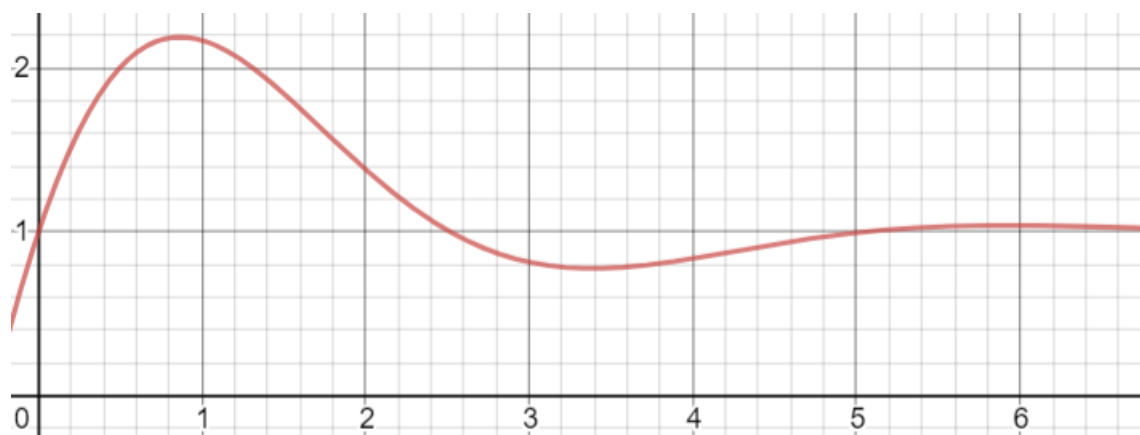
$t=0+$

$$\begin{cases} 1 = 1 + B_1 \rightarrow B_1 = 0 \\ 3 = \sqrt{\frac{14}{9}} B_2 \rightarrow B_2 = \frac{9}{\sqrt{14}} \end{cases}$$

\Rightarrow

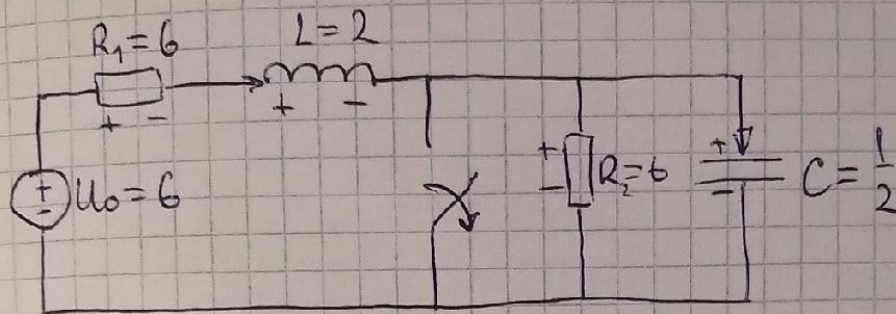
$$\begin{aligned} u_L(t) &= -6e^{-\frac{2}{3}t} \cos(\sqrt{\frac{14}{9}}t) - \frac{12}{\sqrt{14}} \sin(\sqrt{\frac{14}{9}}t) e^{-\frac{2}{3}t} + 6 \\ i_L(t) &= \frac{9}{\sqrt{14}} e^{-\frac{2}{3}t} \sin(\sqrt{\frac{14}{9}}t) + 1 \end{aligned}$$

и график для $i_L(t)$: (для части больше нуля, я забыл, как ограничивать графики в десмосе)



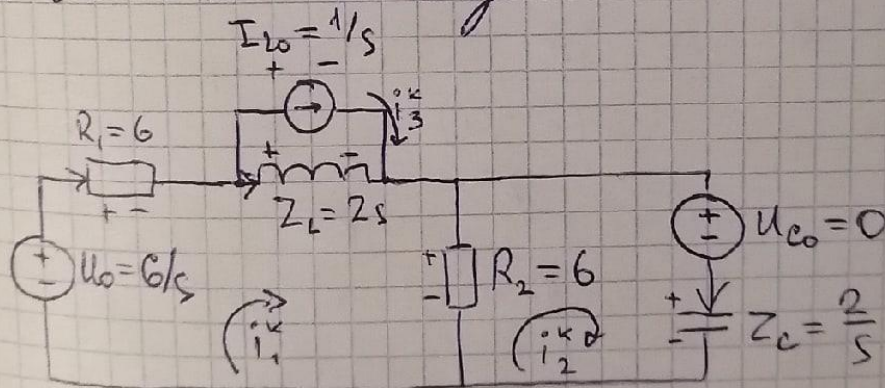
(там дальше есть скрины)

Операторный метод



$$i_L(0^-) = 1 \quad u_C(0^-) = 0$$

1. $t > 0$: no замык



$$\begin{cases} (12 + 2s)i_2 - 6i_3 - 2si_1 = \frac{6}{s} \\ -6i_1 + (\frac{2}{s} + 6)i_2 = 0 \\ i_3 = \frac{1}{s} \end{cases}$$

$$\begin{cases} i_3^k = 1/s \\ -6i_1^k + \left(\frac{2}{s} + 6\right)i_2^k = 0 \\ (12+2s)i_1^k - 6i_2^k - 2 = \frac{6}{s} \end{cases}$$

$$\begin{cases} i_3^k = 1/s \\ (12+2s)i_1^k = \frac{6si_2^k + 2s + 6}{s} \\ -6i_1^k + \left(\frac{2}{s} + 6\right)i_2^k = 0 \end{cases}$$

$$\begin{cases} i_3^k = 1/s \\ i_1^k = \frac{6si_2^k + 2s + 6}{s(2s+12)} \\ \frac{-36si_2^k - 12s - 36}{s(2s+12)} + \left(\frac{2}{s} + 6\right)i_2^k = 0 \end{cases}$$

$$-18si_2^k - 6s - 18 + s\left(\frac{2}{s} + 6\right)(s+6)i_2^k = 0$$

$$-9si_2^k - 3s - 9 + (3s+1)(s+6)i_2^k = 0$$

$$i_2^k(3s^2 + 19s + 6 - 9s) = 3s + 9$$

$$\begin{cases} i_2^k = \frac{3s+9}{s(3s^2+10s+6)} \\ i_1^k = \frac{6(3s+9)}{s(3s^2+10s+6)(2s+12)} + \frac{2s+6}{s(2s+12)} \\ i_3^k = 1/s \end{cases}$$

$$i_L(s) = i_1^k - i_3^k = \frac{6(3s+9)}{s(3s^2+10s+8)(2s+12)} + \frac{2s+6}{s(2s+12)} - \frac{1}{s}$$

$$u_c(s) = i_2^k \cdot Z_c = \frac{2(3s+9)}{s^2(3s^2+10s+8)}$$

→ ~~мы~~ разбиваем на простейшие дроби и переводим к оригиналам. Также можно сразу поискать ошибку, ~~т.к.~~ т.к. корни (знаменатели) будут не комплексные