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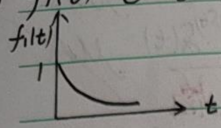
7-2

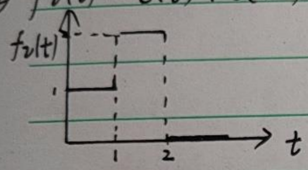
① $f_1(t) = e^{-t}\varepsilon(t)$



$$\frac{df_1(t)}{dt} = -e^{-t}\varepsilon(t) + e^{-t}\delta(t)$$

$$\int_{-\infty}^{t} e^{-t}\varepsilon(t)\,dt = \left(\int_0^t e^{-t}\,dt\right)\varepsilon(t) = (1-e^{-t})\varepsilon(t)$$

② $f_2(t) = \varepsilon(t) + \varepsilon(t-1) - 2\varepsilon(t-2)$

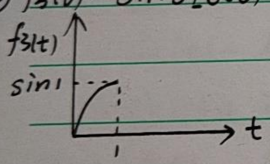


$$\frac{df_2(t)}{dt} = \delta(t) + \delta(t-1) - 2\delta(t-2)$$

$$\int_{-\infty}^{t} f_2(t)\,dt = \left(\int_0^t 1\,dt\right)\varepsilon(t) + \left(\int_1^t 1\,dt\right)\varepsilon(t-1) + \left(\int_2^t -2\,dt\right)\varepsilon(t-2)$$

$$= t\varepsilon(t) + (t-1)\varepsilon(t-1) - 2(t-2)\varepsilon(t-2)$$

③ $f_3(t) = \sin t\,[\varepsilon(t) - \varepsilon(t-1)]$

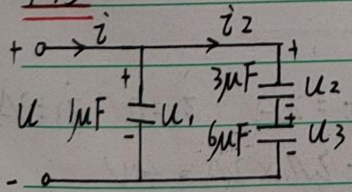


$$\frac{df_3(t)}{dt} = \cos t\,[\varepsilon(t) - \varepsilon(t-1)] + \sin t\,[\delta(t) - \delta(t-1)]$$

$$\int_{-\infty}^{t} f_3(t)\,dt = \left(\int_0^t \sin t\right)\varepsilon(t) - \left(\int_1^t \sin t\right)\varepsilon(t-1)$$

$$= (1-\cos t)\varepsilon(t) - (\cos 1 - \cos t)\varepsilon(t-1)$$

7-15



(1) $C_{eq} = \frac{1}{\frac{1}{3}+\frac{1}{6}} + 1 = 3\mu F$

(2) $u_1(t) = u_1(0_-) + u = 10(1-e^{-0.5t})\varepsilon(t)\,V$

$u_2(t) = u_2(0_-) + \frac{C_3}{C_2+C_3}u = 6.67(1-e^{-0.5t})\varepsilon(t)\ V$

$u_3(t) = u_3(0_-) + \frac{C_2}{C_2+C_3}u = 3.33(1-e^{-0.5t})\varepsilon(t)\ V$

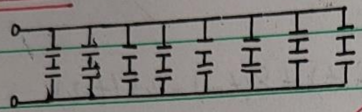
(3) $i(t)=C_{eq}\frac{du(t)}{dt}=15e^{-0.5t}\varepsilon(t)+30(1-e^{-0.5t})\delta(t)$ μA

$i_1(t)=C_1\frac{du_1(t)}{dt}=5e^{-0.5}\varepsilon(t)+10(1-e^{-0.5t})\delta(t)$ μA

$i_2(t)=C_2\frac{du_2(t)}{dt}=10e^{-0.5}\varepsilon(t)+20(1-e^{-0.5t})\delta(t)$ μA

可化简

7-16



7-24

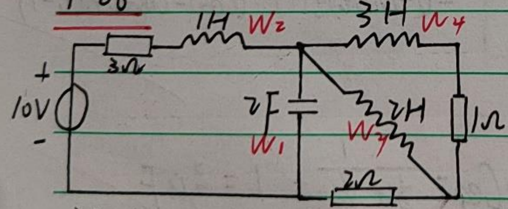
(1) $\Delta W=\frac{1}{2}L(i_1^2-i_2^2)$

$=0.192J$

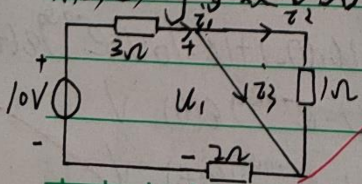
(2) $\frac{di}{dt}=-800$ A/s

$\therefore u=L\frac{di}{dt}=-320V$

7-26



稳态时等效电路



$i_1=\frac{10V}{3\Omega+2\Omega}=2A$ $i_2=0$ $i_3=2A$

$u_1=10V-3\Omega\times2A=4V$

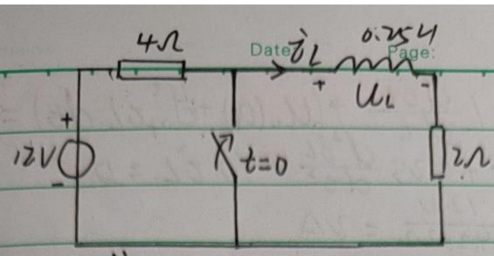
$W_1=\frac{1}{2}Cu_1^2=16J$

$W_2=\frac{1}{2}L_1i_1^2=2J$

$W_3=\frac{1}{2}L_2i_3^2=4J$

$W_4=0$

7-35



(1) 只含一个电感，为一阶电路

(2) $i_L(0)=\frac{12V}{4\Omega+2\Omega}=2A$

t>0后 $L\frac{di_L}{dt}+2i_L=0$

$\therefore \frac{di_L}{dt}+8i_L=0$

(3) $i_L(0+)=i_L(0-)=2A$

$u_L(0+)=-2\Omega\times i_L(0+)=-4V$

(4) $i_L(\infty)=0$

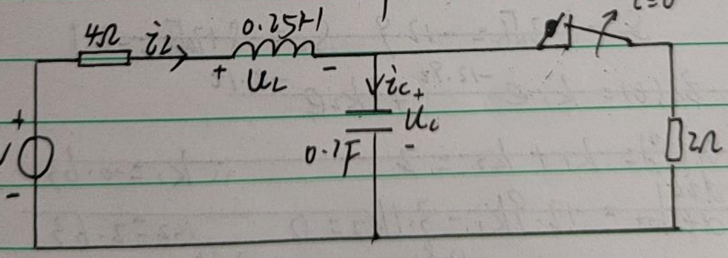
(5) $\frac{di_L}{dt}+8i_L=0$ 特征方程 $s+8=0$ $\therefore s=-8$

$\therefore i_L(t)=ke^{-8t}A$ 而 $i_L(0)=2A$ $\therefore k=2$

$\therefore i_L(t)=2e^{-8t}A$

(6) $t\to\infty$ $i_L(t)\to 0$ 即 $i_L(\infty)=0$

7-36



(1) 二阶电路

(2) $4i_L+u_L+u_C=12$

$\therefore 4C\frac{du_C}{dt}+L\frac{d(C\frac{du_C}{dt})}{dt}+u_C=12$

~~$\therefore 4C\frac{du_C}{}$~~ $0.4\frac{du_C}{dt}+0.025\frac{d^2u_C}{dt^2}+u_C=12$

同理：$4i_L + L\frac{di_L}{dt} + \left(u_c(0_+) + \frac{1}{C}\int_{0_+}^{t} i_L\,dt\right) = 12$

求导 $4\frac{di_L}{dt} + 0.25\frac{d^2 i_L}{dt^2} + 10 i_L = 0$

(3) $i_L(0_-) = \frac{12V}{4\Omega + 2\Omega} = 2A$

$u_C(0_-) = 2\Omega \times i_L(0_-) = 4V$

$\therefore i_L(0_+) = i_L(0_-) = 2A = i_C(0_+)$

$u_C(0_+) = u_C(0_-) = 4V$

$\therefore u_L(0_+) + 4i_L(0_+) + u_C(0_+) = 12$

$\therefore u_L(0_+) = 0$

(4) $\left.\frac{du_C}{dt}\right|_{0_+} = \frac{1}{C} i_L(0_+) = 20V/s$

$\left.\frac{di_L}{dt}\right|_{0_+} = \frac{1}{L} u_L(0_+) = 0$

(5) $i_L(\infty) = 0$ $u_C(\infty) = 12V$

~~(6) 由~~ $\cancel{4\frac{di_L}{dt} + 0.25\frac{d^2 i_L}{dt^2} + 10 i_L = 0}$

~~特征方程~~ $\cancel{s^2 + 16s + 40 = 0}$

$\cancel{s_1 = -8 - 2\sqrt{6} = -12.9}$ $\cancel{s_2 = -8 + 2\sqrt{6} = -3.1}$

$\cancel{\therefore i_L(t) = k_1 e^{-12.9t} + k_2 e^{-3.1t}}$

$\cancel{\begin{cases} i_L(0_+) = k_1 + k_2 = 2 & \therefore k_1 = -0.63 \\ \left.\frac{di_L}{dt}\right|_{0_+} = -12.9k_1 - 3.1k_2 = 0 & k_2 = 2.63 \end{cases}}$

$\cancel{\therefore i_L(t) = 0.63e^{-12.9t} - 2.63e^{-3.1t}}$

(6) $\frac{d^2u_C}{dt^2} + 16\frac{du_C}{dt} + 40u_C = 480$

$s^2 + 16s + 40 = 0$ $s_1 = -8 - 2\sqrt{6} = -12.9$ $s_2 = -8 + 2\sqrt{6} = -3.1$

特解为 $u_C = \frac{480}{40} = 12V$

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$\therefore u_c(t) = k_1 e^{-12.9t} + k_2 e^{-3.1t} + 12$

$$\begin{cases} u_c(0_+) = k_1 + k_2 + 12 = 4 \\ \left.\dfrac{du_c}{dt}\right|_{0_+} = -12.9k_1 - 3.1k_2 = 20 \end{cases}$$

$\therefore k_1 = 0.49 \quad k_2 = -8.49$

$\therefore u_c(t) = 0.49e^{-12.9t} - 8.49e^{-3.1t} + 12$

(7) $t \to \infty$ 时 $u_c \to 12V$ 即 $u_c(\infty) = 12V$

A+