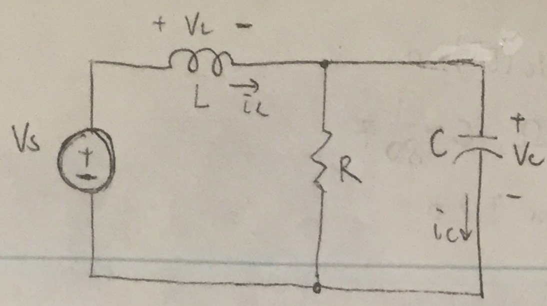


$V_s(t) = 20u(t)$ V

$L = 2H$, $R = 5\Omega$, and $C = \frac{1}{50}$ F

Find i_L for $t > 0$

(i) Find α, W_0, and $S_{1,2}$

$$\alpha = \frac{1}{2RC} = 5, \quad W_0 = \frac{1}{\sqrt{LC}} = 5, \quad S_{1,2} = -\alpha \pm \sqrt{\alpha^2 - W_0^2} = -5$$

(ii) Check $\alpha^2 - W_0^2$

$\alpha^2 - W_0^2 = 0 \Rightarrow$ critically damped

(iii) Equation

$$i_L = I_L + D_1 t e^{st} + D_2 e^{st} = I_L + D_1 t e^{-5t} + D_2 e^{-5t}$$

(iv) Use initial value and first-order derivative to find the coefficients.

$I_L = i_L(\infty) = \frac{V_s}{R} = 4$ A (steady state)

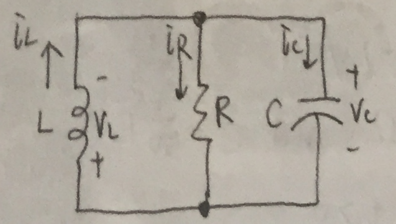
$i_L(0^+) = i_L(0^-) = 0 = 4 + D_2 \Rightarrow D_2 = -4$

$V_L(0^+) = V_s(0^+) - V_c(0^+) = V_s(0^+) - V_c(0^-) = 20 - 0 = 20$

$$= L \frac{di_L(0^+)}{dt} = 2 \cdot \left[-5D_1 t e^{-5t} + D_1 e^{-5t} - 5D_2 e^{-5t} \right]\Big|_{t=0^+}$$

$$= 2 \cdot (D_1 + 20) \Rightarrow D_1 = -10$$

$\therefore i_L = 4 - 4e^{-5t} - 10te^{-5t}$, $t > 0$



$i_L(0^-) = 3A$, $V_c(0^-) = 0$

$L = 5H$, $R = 8\Omega$, $C = \frac{1}{80}F$

Find $V_c(t)$ for $t > 0$

(i) Find α and W_0

$$\alpha = \frac{1}{2RC} = 5, \quad W_0 = \frac{1}{\sqrt{LC}} = 4$$

(ii) Check $\alpha^2 - W_0^2$

$$\alpha^2 - W_0^2 = 25 - 16 = 9 > 0 \Rightarrow \text{overdamped}$$

$$S_{1,2} = -5 \pm \sqrt{9} \Rightarrow S_1 = -2, S_2 = -8$$

(iii) Equation

$$V_c(t) = A_1 e^{S_1 t} + A_2 e^{S_2 t} = A_1 e^{-2t} + A_2 e^{-8t}$$

(iv) Initial value and first-order derivative

$$V_c(0^+) = V_c(0^-) = 0 = A_1 + A_2$$

$$i_c(0^+) = i_L(0^+) - i_R(0^+) = i_L(0^-) - \frac{V_c(0^+)}{R} = 3$$

$$= C\frac{dV_c(0^+)}{dt} = \frac{1}{80} \cdot \left[-2A_1 e^{-2t} - 8A_2 e^{-8t}\right]\Big|_{t=0^+} = \frac{1}{80}(-2A_1 - 8A_2)$$

$$\therefore \begin{cases} A_1 + A_2 = 0 \\ A_1 + 4A_2 = -120 \end{cases} \Rightarrow A_1 = 40, A_2 = -40$$

$$\therefore V_c(t) = 40e^{-2t} - 40e^{-8t}, \quad t > 0$$