EE23BTECH11047 - Deepakreddy P

44 The switch S_1 was closed and S_2 was open for a long time. At t=0,switch S_1 is opened and S_2 is closed,simultaneously. The value of $i_c(0^+)$, in amperes, is (GATE EC 44)

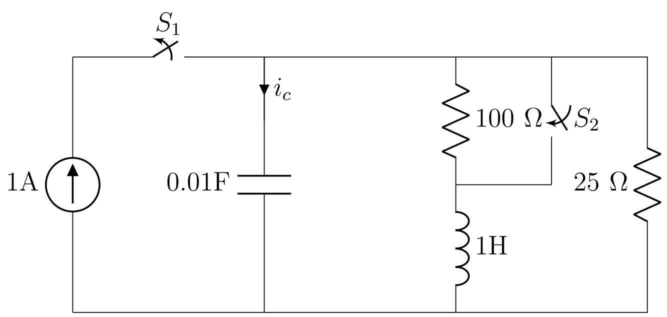

Fig. 1. Circuit 1

Solution:

1) Switch S_1 was closed and S_2 was open

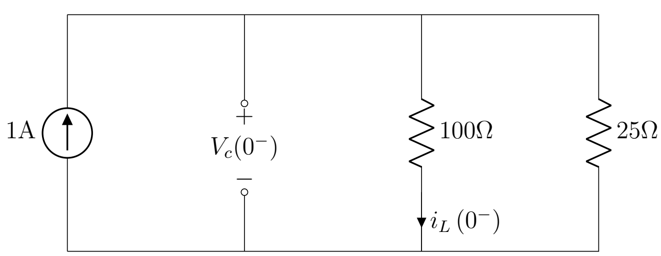

Fig. 2. S_1 is closed and S_2 is open

$$R_{eff} = \frac{25\,(100)}{(25+100)}\Omega \tag{1}$$

$$R_{eff} = 20\Omega \tag{2}$$

$$V_c\left(0^-\right) = 1\,(R_{eff}) \tag{3}$$

$$V_c\left(0^-\right) = 20V \tag{4}$$

2) Switch S_1 is open and S_2 was closed

At $t = 0^+$ The capacitor is charged. Thus, it acts as a voltage source.The inductor acts as the current source.

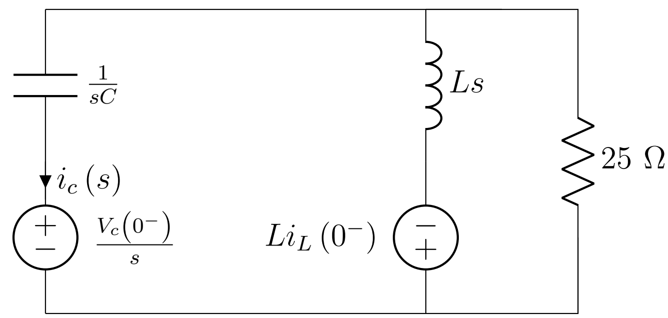

Fig. 3. S_1 is open and S_2 is closed

By Superposition Theorem
Case (i):

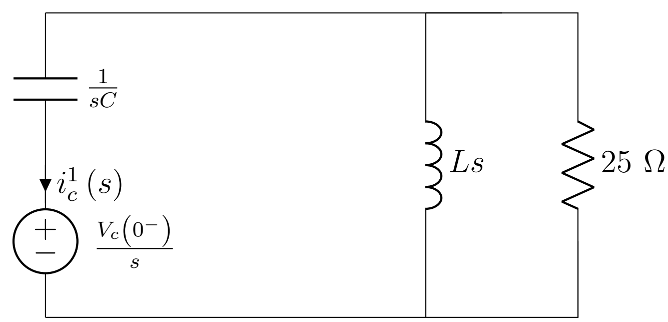

Fig. 4. Circuit 4

$$\left(\frac{25\,(Ls)}{25+Ls} + \frac{1}{sC}\right) i_c^1\,(s) + \frac{V_c\,(0^-)}{s} = 0 \tag{5}$$

$$i_c^1\,(s) = -\frac{V_c\,(0^-)}{s}\left(\frac{25sC + LCs^2}{25LCs^2 + Ls + 25}\right) \tag{6}$$

$$i_c^1\,(s) = -\left(\frac{5+0.2s}{0.25s^2 + s + 25}\right) \tag{7}$$

Case (ii):

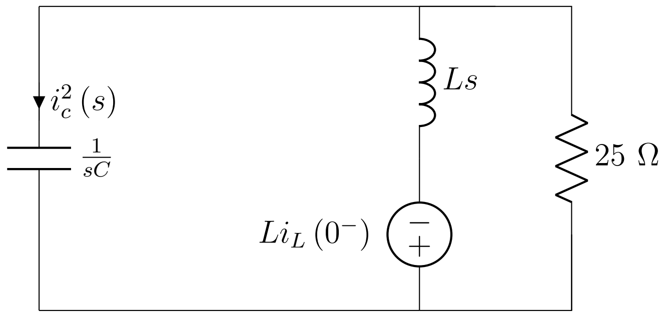

Fig. 5. Circuit 4

$$Li_L\left(0^-\right) + \left(\frac{25}{25sC+1} + Ls\right) i_c^2(s) = 0 \quad (8)$$

$$0.2 = -\left(\frac{25LCs^2 + Ls + 25}{25sC+1}\right) i_c^2(s) \quad (9)$$

$$i_c^2(s) = -\left(\frac{0.05s + 0.2}{0.25s^2 + s + 25}\right) \quad (10)$$

From eq (7) and eq (10)

$$i_c(s) = i_c^1(s) + i_c^2(s) \quad (11)$$

$$i_c(s) = -\left(\frac{0.25s + 5.2}{0.25s^2 + s + 25}\right) \quad (12)$$

Using Inverse Laplace Transform
From eq (12)

$$i_c(t) = -e^{-2t}\left(\cos\left(4\sqrt{6}\,t\right) + \frac{18.8}{4\sqrt{6}}\sin\left(4\sqrt{6}\,t\right)\right) \quad (13)$$

$$i_c\left(0^+\right) = -1A \quad (14)$$

Parameter	Description	Remarks
$V_c(0^-)$	Voltage across capacitor when t<0	20V
$i_L(0^-)$	current across inductor when t<0	0.2
$i_L(0^+)$	current across inductor when t>0	0.2
C	Capacitance	0.01F
L	Inductance	1H

TABLE I
PARAMETERS

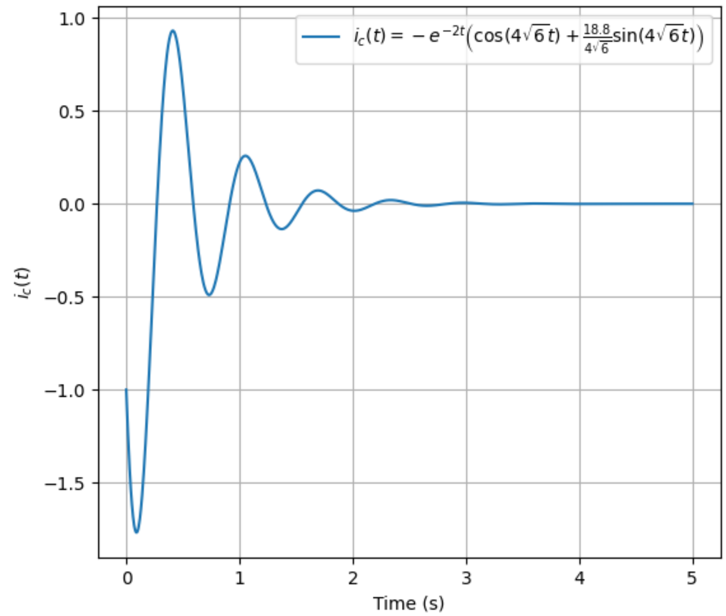

Fig. 6. Plot of $i_c(t)$ vs time

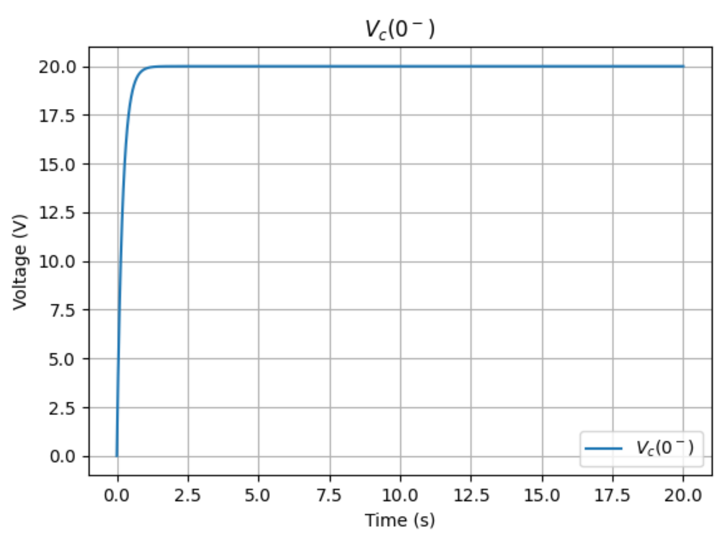

Fig. 7. Plot of $V_c(0^-)$ vs time