Subject :

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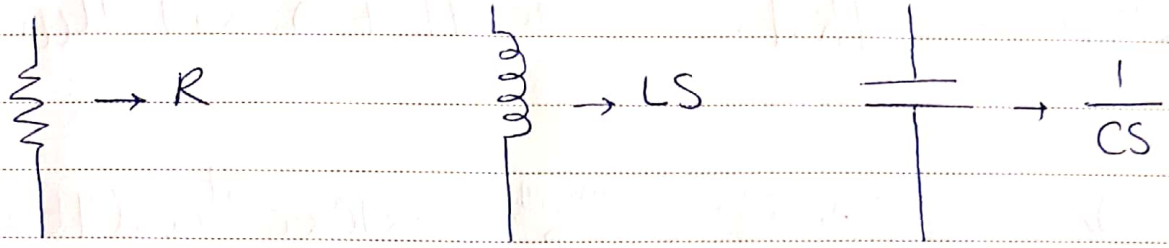
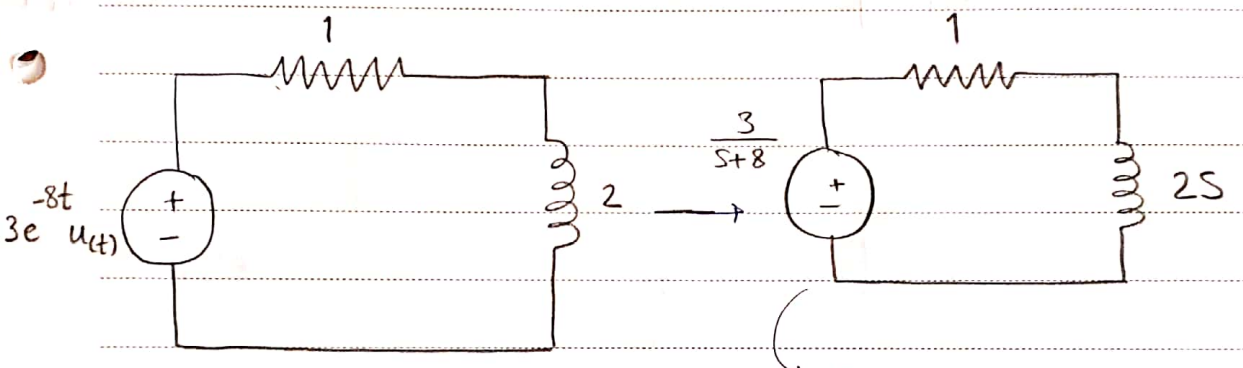
مبانی مدارهای الکتریکی و الکترونیکی

جلسه 18ام



مثال :



$$\frac{3}{S+8} = I_{(S)}(1) + I_{(S)}.2S$$

$$\rightarrow I_{(S)} = \frac{3}{(2S+1)(S+8)}$$

$$\rightarrow I_{(S)} = \frac{1.5}{(S+\frac{1}{2})(S+8)} = \frac{A}{S+\frac{1}{2}} + \frac{B}{S+8}$$

$$\rightarrow A = I_{(S)}(S+\tfrac{1}{2})\Big]_{S=-\frac{1}{2}} \quad , \quad B = I_{(S)}(S+8)\Big]_{S=-8}$$

$$\rightarrow A = \frac{1.5}{S+8}\Big]_{S=-\frac{1}{2}} = 0.2 \quad , \quad B = \frac{1.5}{S+\frac{1}{2}}\Big]_{S=-8} = -0.2$$

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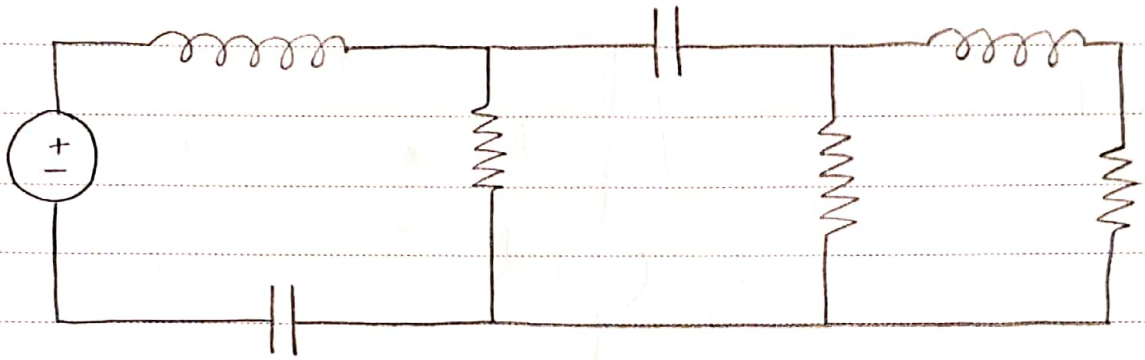
$$i_{(t)} = \frac{1}{5} \underbrace{e^{-t/2}}_{e^{-t/\tau}} u_{(t)} + \left(-\frac{1}{5}\right) e^{-8t} u_{(t)}$$

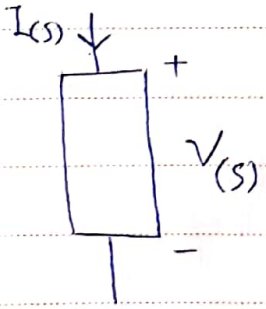
$$\tau = \frac{L}{R} = 2$$

مثال:

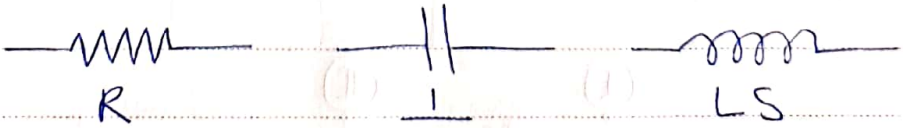


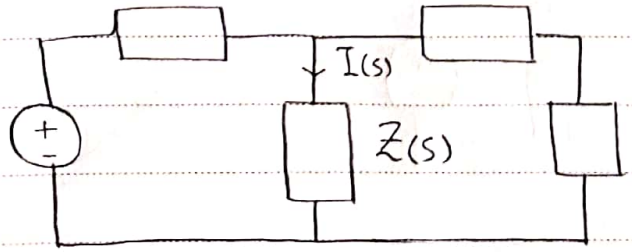
$$V_{(t)} = L \frac{di_{(t)}}{dt} \qquad I_{(s)} = CS\, V_{(s)}$$

$$\rightarrow V_{(s)} = LS\, I_{(s)}$$

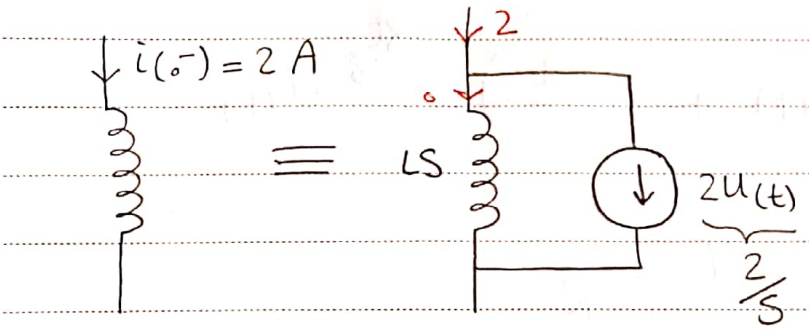


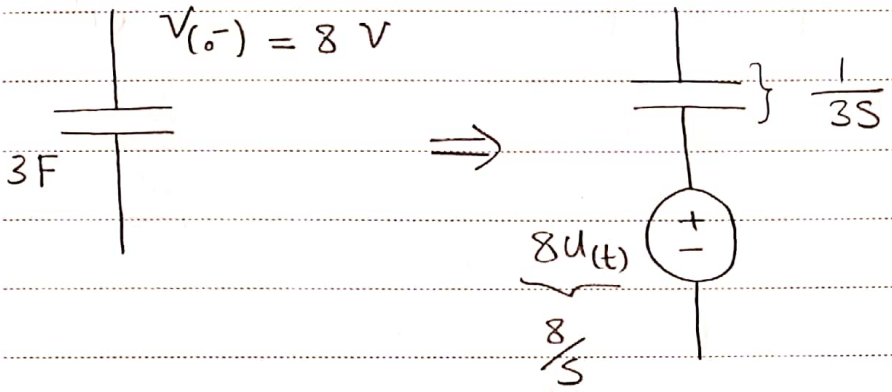
$$\frac{V_{(s)}}{I_{(s)}} = Z_{(s)}$$ امپدانس



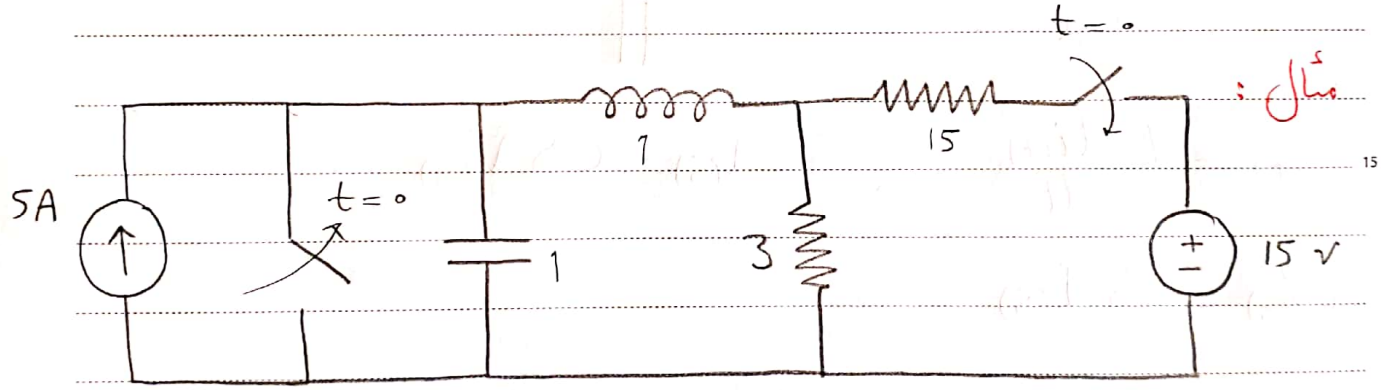


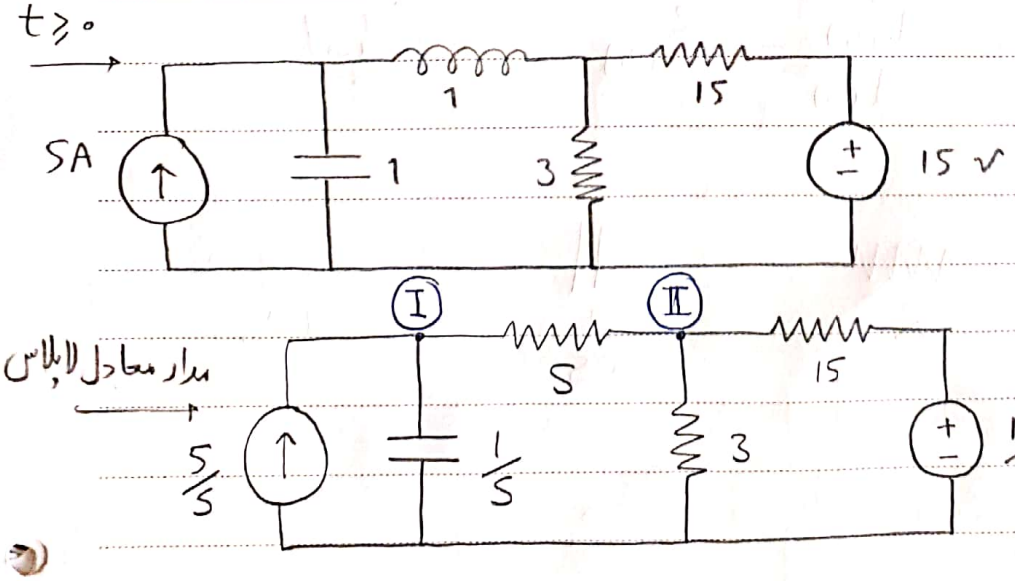
$$\rightarrow I_{(s)} = \frac{V_{(s)}}{Z_{(s)}}$$





مثال :





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(I) $\rightarrow -\frac{5}{S} + \frac{V_1}{\frac{1}{5}} + \frac{V_1 - V_2}{S} = 0$

$I_{(S)} = \frac{V_{(S)}}{Z_{(S)}}$

(II) $\rightarrow \frac{V_2 - V_1}{S} + \frac{V_2}{3} + \frac{V_2 - \frac{15}{S}}{15} = 0$

$\Rightarrow V_1 = \frac{5(S+3)}{S(S+2)(S+\frac{1}{2})}$, $V_2 = \frac{(2.5)(S^2+6)}{S(S+2)(S+\frac{1}{2})}$

$\rightarrow V_1 = \frac{A}{S} + \frac{B}{S+2} + \frac{C}{S+\frac{1}{2}}$, $V_2 = \frac{A'}{S} + \frac{B'}{S+2} + \frac{C'}{S+\frac{1}{2}}$

$\rightarrow A = \ldots$, $B = \ldots$, $C = \ldots$ - - - - - -

$\rightarrow A = 15$, $B = \frac{5}{3}$, $C = -\frac{50}{3}$, $A' = 15$, $B' = \frac{25}{3}$, $C' = -\frac{125}{6}$

$\Rightarrow V_1(t) = 15u(t) + \frac{5}{3}e^{-2t}u(t) - \frac{50}{3}e^{-\frac{t}{2}}u(t)$

, $V_2(t) = 15u(t) + \frac{25}{3}e^{-2t}u(t) - \frac{125}{6}e^{-\frac{t}{2}}u(t)$

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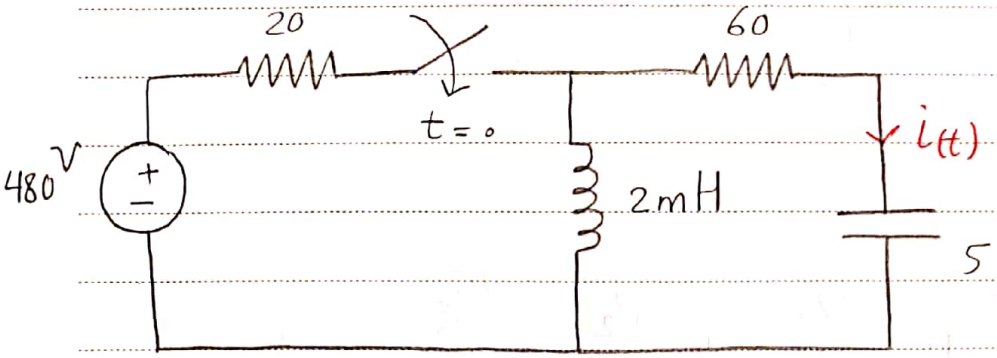
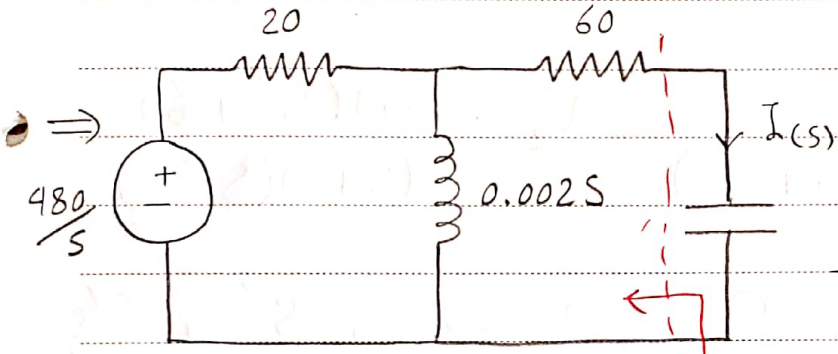
مثال: معادله جریان خازن را می‌خواهیم بدست آوریم:





$$\frac{1}{5\times10^{-6}\,S} = \frac{2\times10^{5}}{S}$$

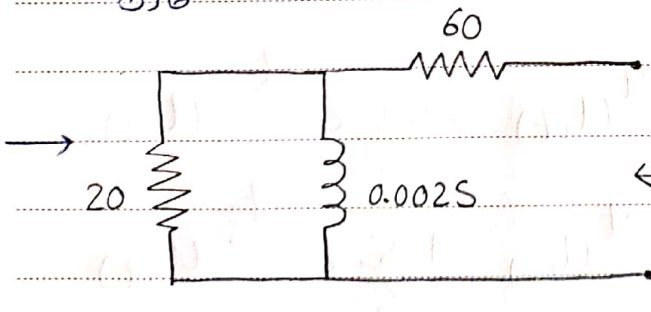
$V_{(S)} = Z_{(S)}\, I_{(S)}$

مدار معادل تونن در حوزهٔ لاپلاس

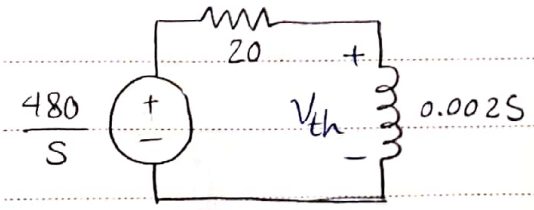
R — مقاومت

$\frac{1}{CS}$ — خازن

LS — سلف



$$Z_{th} = 60 + \frac{20(0.002S)}{20 + 0.002S}$$



ولتاژ مدار باز در حوزهٔ لاپلاس

$$V_{th} = \frac{480}{S} \times \frac{0.002S}{20 + 0.002S}$$

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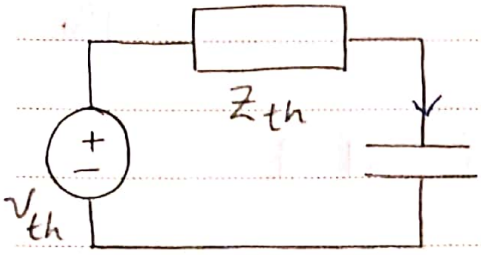


مدار معادل تونن در حوزهٔ لاپلاس:

$$\rightarrow I_{(S)} = \frac{V_{th(S)}}{Z_{th} + \frac{2\times10^5}{S}} = \frac{6S}{(S+5000)^2}$$

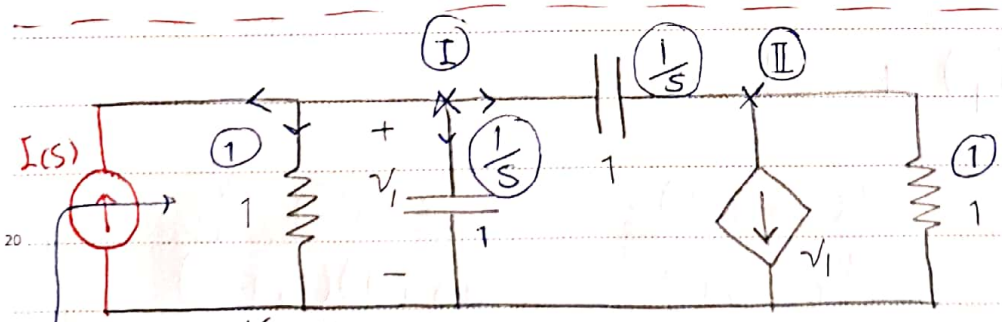
$$\rightarrow I_{(S)} = \frac{A}{(S+5000)^2} + \frac{B}{S+5000}$$

$$\rightarrow A = -30000 \quad , B = 6$$

لاپلاس معکوس $\rightarrow$ $i_{(t)} = -30000\, e^{-5000t} u_{(t)} + 6(-t)\, e^{-5000t} u_{(t)}$

امپدانس $\leftarrow$ نسبت ولتاژ به جریان، در حوزهٔ فرکانس

مثال:



به منابع وابسته کاری نمی‌کنیم! $\leftarrow$ مشابه مدار معادل تونن، باید منبع مستقل بگذاریم

$$\text{(I)} \rightarrow -I_{(S)} + \frac{V_1}{1} + \frac{V_1}{\frac{1}{S}} + \frac{V_1 - V_2}{\frac{1}{S}} = 0$$

$$\frac{V_2 - V_1}{\frac{1}{S}} + \frac{V_2}{1} + V_1 = 0 \rightarrow \frac{V_1}{I_{(S)}} = \frac{S+1}{(1+S)^2 + 2S}$$

اشتباه است اگر از Z_{th}، لاپلاس معکوس ($\mathcal{L}^{-1}$) بگیریم!

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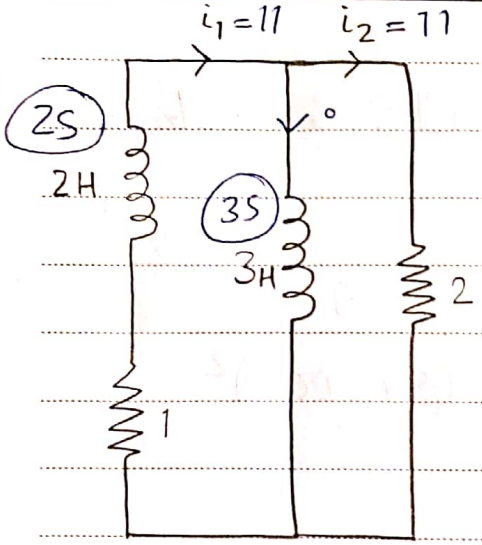
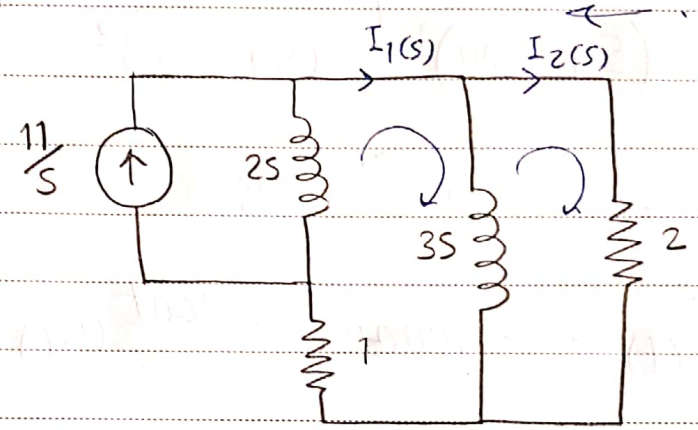
مثال :



$t = 0^-$

$i_1(0^-) = i_2(0^-) = 11\ A$

$i_1(t) = ?$



(I) $I_1(s)(1) + 2S(I_1 - \frac{11}{s}) + 3S(I_1 - I_2) = 0$

(II) $3S(I_2 - I_1) + 2I_2 = 0$

$$\longrightarrow I_1(s) = \frac{22(3S+2)}{6S^2+13S+2} = \frac{22(3S+2)}{(6S+1)(S+2)}$$

$$\rightarrow I_1(s) = \frac{A}{S+\frac{1}{6}} + \frac{B}{S+2} = Ae^{-\frac{t}{6}}u(t) + Be^{-2t}u(t)$$