Electri... ...ineering Department
Network Analysis 1 – ENEE2301
Midterm Exam
November 7th , 2017
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ID: Section:

Student Name:

Important Notes:

- Turn off your cell phones
- Provide only one solution to each question using the specified method.
- Solve each question on a separate sheet .
- Write question number, Section # and ID on each sheet

Question 1 (25 points) (to assess "a" ABET SO)
Find Vo in Figure 1 using Nodal Analysis Method and Calculate the power absorbed/delivered by the dependent source 2Vy

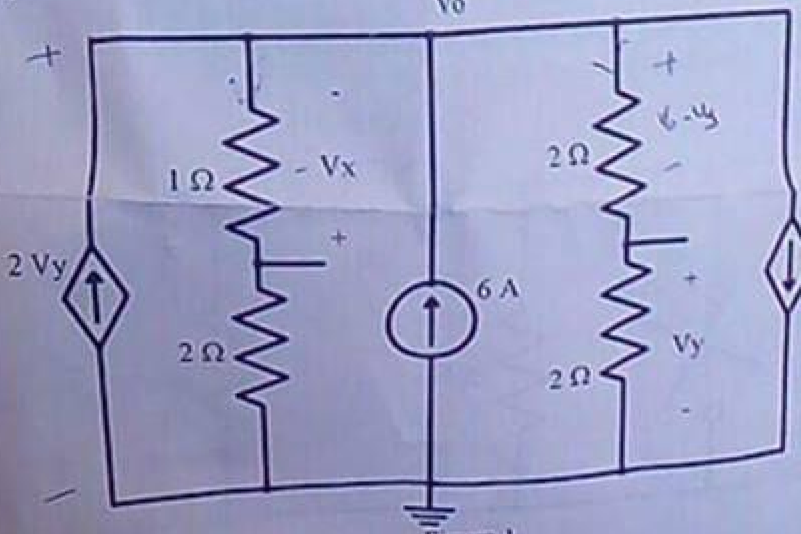


Figure 1

Question 2 (25 points) (to assess "a" ABET SO)
Find the value of RL in Figure 2 for maximum power transfer, and then calculate the amount of maximum power absorbed by RL.

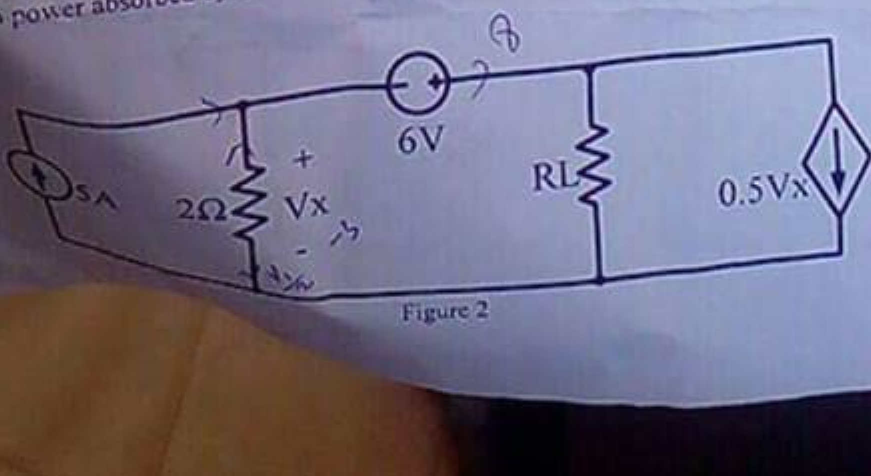


Figure 2

Question 3 (25 points) (to assess "a" ABET SO)

The switch in the circuit shown in Figure 3 has been open for a long time before Closing it at $t = 0$. Find $V_o(t)$ for for $t > 0$.

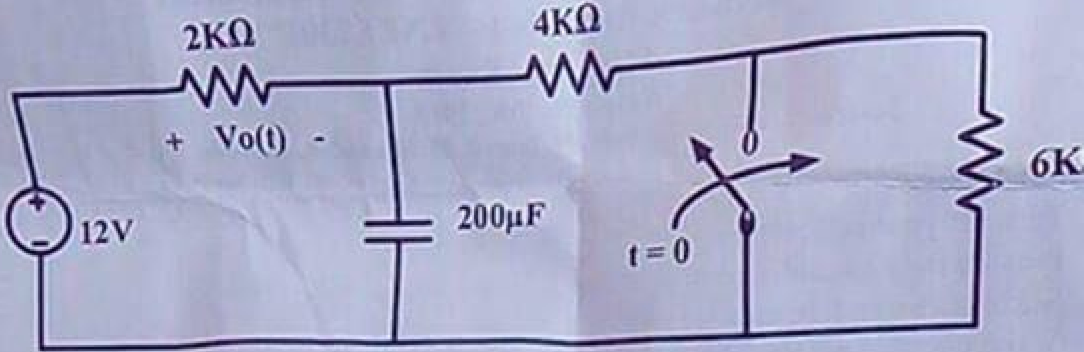


Figure 3

Question 4 (25 points) (to assess "e" ABET SO)

The switch in the circuit shown in Figure 4 has been open for a long time before Closing it at $t = 0$. Find the expression for $i(t)$ for $t > 0$

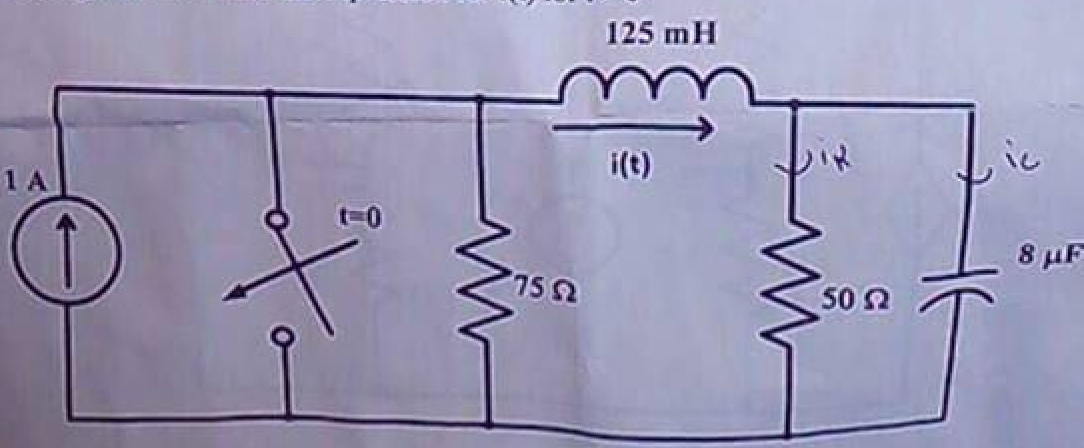
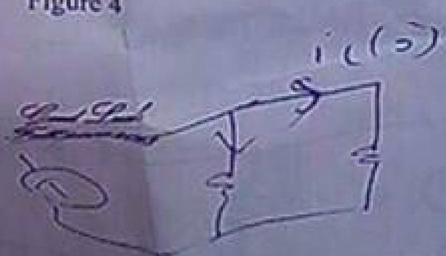
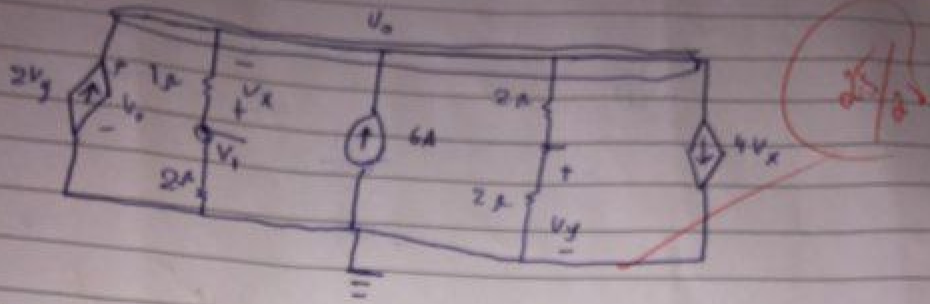


Figure 4





KCL at v_0

$$\frac{V_y - V_0}{2} + \frac{V_y}{2} = 0 \quad \text{---} (1$$

$$-2V_y + \frac{V_0}{3} - 6 + \frac{V_0}{4} + 4V_x = 0 \text{ -- } (2$$

$$V_1 - V_0 = V_x$$

$$V_0 + V_x$$

$$\frac{V_x}{2} + \frac{V_x}{1} = 0 \quad \ldots (3$$

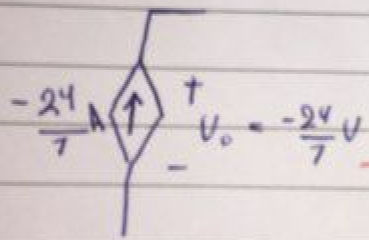
$V_y = \frac{-12}{7} V$, $V_x = \frac{8}{7} V$, $V_0 = \frac{-24}{7} V$ by calculation

$v_1 - v_0 = v_x$

$v_0 + v_x$

$\frac{v_x}{2} + \frac{v_x}{1} = 0 \quad \ldots (3$

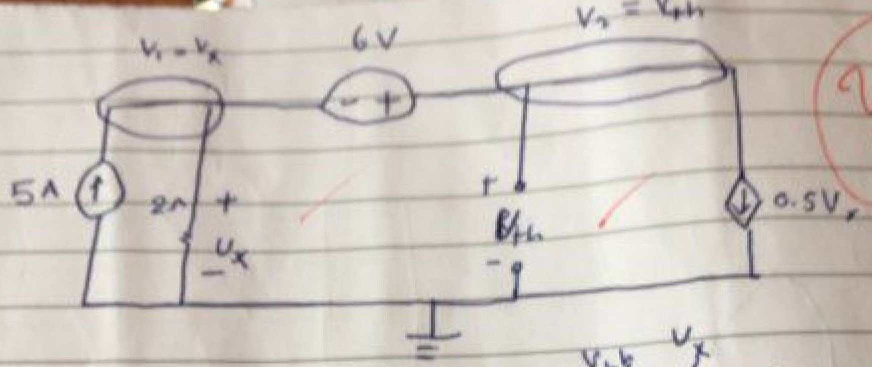
$v_y = \frac{-12}{7}V, \; v_x = \frac{8}{7}V \quad , \quad v_0 = \frac{-24}{7}V$ by calculation



$P = -I v_0 = -\left(\frac{-24}{7}\right) \cdot \left(\frac{-24}{7}\right) = \frac{-576}{49} = -11.755W$

(supplied)

Q2



KCL at $(V_2, V_1) \Rightarrow$ super node

$\cancel{V_2} - \cancel{V_1} = 6V$ (V_{th}, V_x)

$V_2 = V_{th}$

$V_1 = V_x$

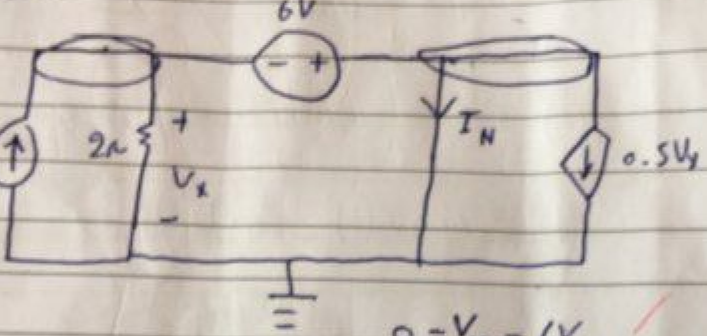
$$-5 + \frac{V_x}{2} + 0.5V_x = 0$$

$$1V_x = 5V$$

$$V_{th} - 5 = 6 \Rightarrow V_{th} = 11V$$

10/10

$V_{th} - 5 = 6 \Rightarrow V_{th} = 11\,V$



$0 - V_x = 6V$

$\Rightarrow V_x = -6V$

$-5 + \frac{V_x}{2} + I_N + 0.5V_x = 0$

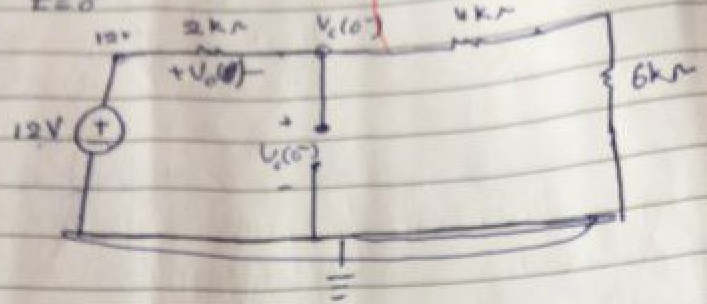
$I_N = 11\,A$

$R_L = R_{th} = \frac{V_{th}}{I_N} = \frac{11V}{11A} = 1\Omega$

$P_{max} = \frac{V_{th}^2}{4R_L} = \frac{11^2}{4} = 30.25\,W$

Q: 8

at $t = 0^-$



$\frac{24}{27}$

$$12 - V_c(0^-) = V_o(0^-)$$

$$\frac{V_c(0^-) - 12V}{2k} + \frac{V_c(0^-)}{10k} = 0$$

$$\frac{3}{5} V_c(0^-) = 6$$

$$V_c(0^-) = 10V$$

$$V_o(0^-) = 2V$$

$12 - V_c(0^-) = V_o(0^-)$

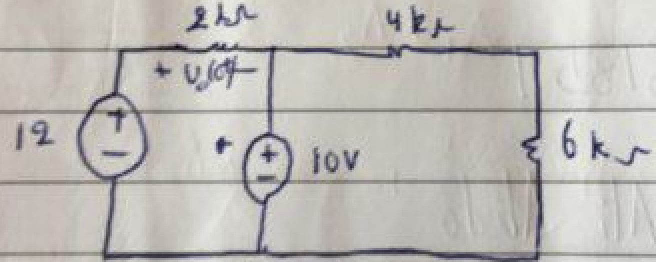
$$\frac{V_c(0^-) - 12V}{2k} + \frac{V_c(0^-)}{10k} = 0$$

$$\frac{3}{5} V_c(0^-) = 6$$

$$V_c(0^-) = 10V$$

$$V_o(0^-) = 2V$$

at $t = 0^+$

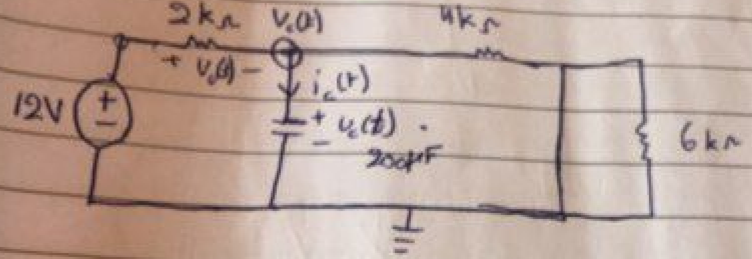


$V_o(0^+) = 2V$

Q3

at $t>0$

$\frac{24}{25}$



$$v_c(t) = v_c(0) + \frac{1}{C}\int_0^t i_c(t)\,dt$$

$$12 - V_a(t) = V_a(t)$$

$$i_c(t) = C\frac{dV_c(t)}{dt}$$

KCL at $V_c(t)$

$$\frac{V_c(t) - 12}{2k\Omega} + \frac{C\,dv_c(t)}{dt} + \frac{V_c(t)}{4K} = 0$$

$$200\times10^{-6}\frac{dV_c(t)}{dt} + \frac{3}{4K}V_c(t) = 6$$

(-1)

$$\frac{dt}{} \quad \frac{}{4K}$$

$$200\times10^{-6}\frac{dV_c(t)}{dt}+\frac{3}{4K}V_c(t)=6$$

$$V_c'(t)+\frac{3}{4\times200\times10^{-6}}V_c(t)=\frac{6}{200\times10^{-6}}$$

4000

$$\Rightarrow V_c'(t)+3750V_c(t)=3\times10^{4}$$

by solving $\mu(t)=e^{\int 3750\,dt}$

$$V_c(t)=e^{-3750t}\left[\frac{3\times10^{4}}{3750}e^{3750t}+A_1\right]$$

$$V_c(t)=8+A_1e^{-3750t}$$

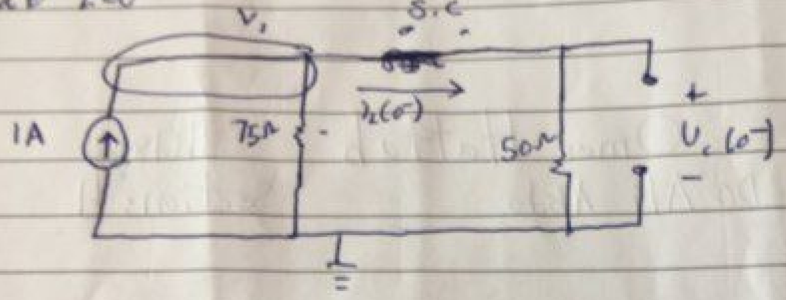
$$V_c(0)=8+A_1=10\Rightarrow A_1=2V$$

$$V_c(t)=8+2e^{-3750t}\ (V)$$

$$12-\left(8+2e^{-3750t}\right)=V_o(t)$$

$$\therefore\Rightarrow V_o(t)=4-2e^{-3750t}\ (V)\ \text{for}\ t>0$$

at $t=0^-$



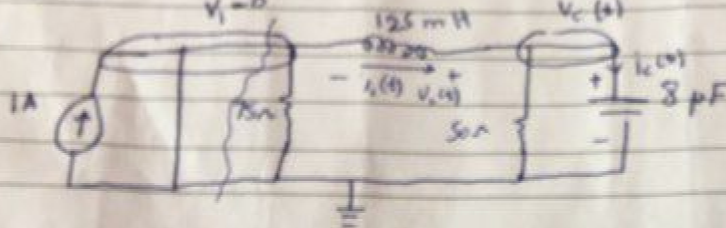
$$-1 + \frac{V_1}{75} + \frac{V_1}{50} = 0$$

$V_1 = 30\,V$ $\qquad$ $i_L(0^-) = \frac{30}{50} = 0.6\,A$

$V_c(0^-) = 30\,V$

$\boxed{\frac{6}{6}}$

For $t>0$



$$V_c(t) - 0 = V_L(t) \Rightarrow V_c(t) = V_L(t)$$

$$i_L(t) = i_L(0^-) - \frac{1}{L}\int_0^t V(t)\,dt$$

KCL at $V_c(t)$

$$-i_L(t) + \frac{V_c(t)}{50} + i_c(t) = 0$$

$$V_c(t) = V_c(0^-) + \frac{1}{C}\int_0^t i_c(t)\,dt$$

$$i_c(t) = C\frac{dV(t)}{dt}$$

$$\Rightarrow i_c(t) = C\left(-L\frac{d^2 i_L(t)}{dt^2}\right)$$

$$\Rightarrow \frac{di_L(t)}{dt} = -\frac{1}{L}V(t)$$

$$V_c(t) = V_L(t) = -L\frac{di_L(t)}{dt}$$

$$\frac{d^2 i_L(t)}{} = -\frac{1}{L}\frac{dV(t)}{}$$

$$\therefore \quad i_L(t) + \frac{CL\, d^2 i_L(t)}{dt^2} + \frac{L\, di_L(t)}{50\, dt} = 0$$

$$\frac{d^2 i_L}{dt^2} + \frac{di_L(t)}{50C\, dt} + \frac{1}{LC} i_L(t) = 0$$

$$s^2 + \frac{1}{50 \times 8 \times 10^{-6}} s + \frac{1}{}$$

$$\downarrow$$

$$s^2 + 2500 s + 100 \times 10^4 = 0$$

$$s_1 = -500 \qquad s_2 = -2000$$

overdamped response.

$\boxed{\frac{12}{12}}$

response.

$$i_L(t) = A_1 e^{-500t} + A_2 e^{-2000t}$$

$$i_L(0^-) = i_L(0^+) = 0.6 = A_1 + A_2$$

$$\frac{di_L(t)}{dt} = -500A_1 e^{-500t} + -2000A_2 e^{-2000t}$$

6/7

$$\frac{di_L(0^+)}{dt} = +240 = +500A_1 + 2000A_2$$

$A_1 = 0.64$ $A_2 = -0.04$

$$\frac{di_L(t)}{dt} = -\frac{1}{L}V_L(t) = \frac{-1}{L}v(t)$$

$$\frac{di_L(0^+)}{dt} = \frac{-1}{L}v\overset{30}{\cancel{(0^+)}} = +240$$

ok

for $t > 0$

$$\therefore i_L(t) = 0.64e^{-500t} - 0.04e^{-2000t}$$