Department of Electrical Engineering
Assignment
Date: 13/04/2020

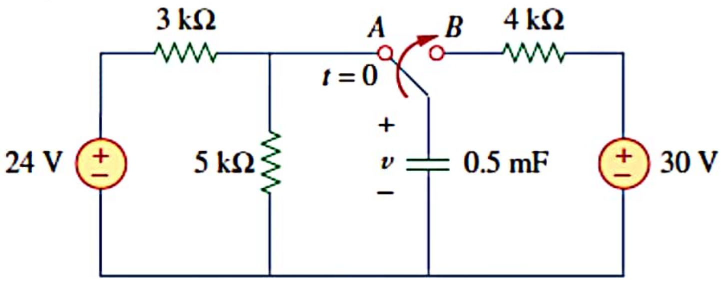
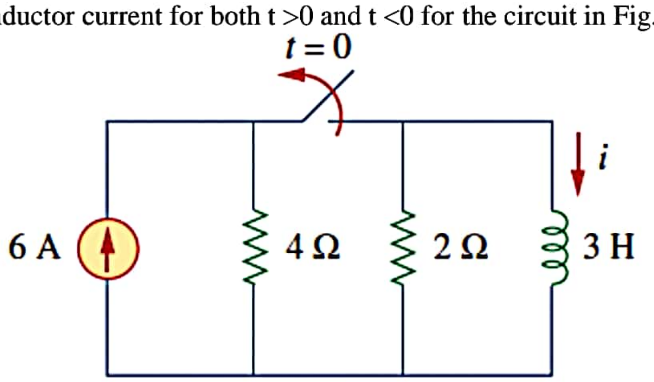
Course Details

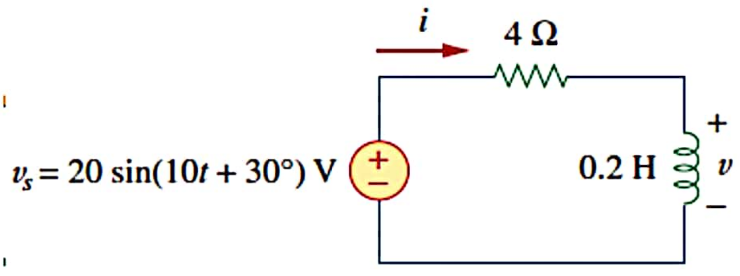
Course Title: Electrical Network Analysis **Module:** 4th
Instructor: ____________ **Total Marks:** 30

Student Details

Name: ____________ **Student ID:** ____________

Student Signature: ____________

Q1.		The switch in Fig. 1 has been in position *A* for a long time. At t = 0 the switch moves to *B*. Determine v(t) for t > 0 and calculate its value at *t* = 2s and 8s.  **Figure 1**	Marks 06 CLO 01
Q2.		Determine the inductor current for both t >0 and t <0 for the circuit in Fig. 2.  **Figure 2**	Marks 06 CLO 01
Q3.		A series RLC circuit is described by $L\frac{d^2i}{dt^2} + R\frac{di}{dt} + \frac{i}{C} = 10$ Find the response when L = 0.5 H , R = 4 Ω and C = 0.2 F. Let $i(0) = 1$, $di(0)/dt = 0$	Marks 06 CLO 01

Q4.		A series RLC circuit has R = 100Ω, L = 240 H and C = 10mF. If the input voltage is v(t) = 10cos 2t, find the current flowing through the circuit.	Marks 06 CLO 03
Q5.		Find v(t) and i(t) in the circuit shown in figure 3.  **Figure 3**	Marks 06 CLO 03

① :

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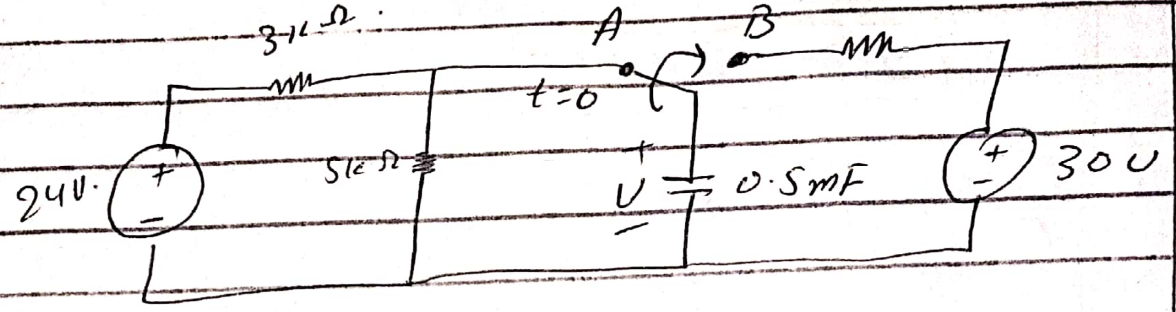
Q NO 1 :→



Solution :→ for $t<0$

$$v(0^-) = \frac{5}{5+3}(24) = 15V$$

As it is DC so

$$v(0) = v(0^-) = v(0^+) = 15V$$

for $t>0$,

$$R_{Th} = 4k\Omega$$

so

$$\tau = R_{Th}C = 4\times10^{3}\times0.5\times10^{-3} = 2sec$$

As capacitor acts like open ckt so

$$v(\infty) = 30V$$

so

$$v(t) = v(\infty) + [(v(0) - v(\infty))]e^{-t/\tau}$$

$$v(t) = 30 - 15e^{-0.5t}$$

P.T.O

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for $t = 2sec$.

$$V(2) = 30 - 15e^{-0.5(2)}$$

$$V(2) = 30 - 15e^{-1}.$$

$$V(2) = 30 - 5.517.$$

$$\boxed{V(2) = 24.48V}$$

for $t = 8sec$.

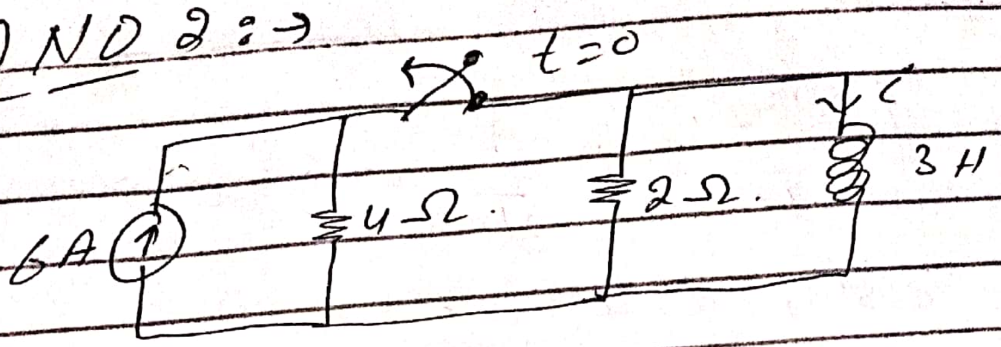
$$V(8) = 30 - 15e^{-0.5(8)}.$$

$$V(8) = 30 - 15e^{-4}.$$

$$V(8) = 30 - 15(0.018)$$

$$\boxed{V(8) = 29.73V}$$

Q NO 2 :→



Solution:-

for $t<0$.

Switch is closed & inductor acts like short circuit so

$$\boxed{i = 6A}$$

for $t>0$.

Switch is open and

$\tau = L/R$

$\tau = 3/2$.

So

$$\boxed{i(t) = 6e^{t/\tau}}$$

Q NO 3 :→

$$L\frac{d^2t}{dt^2} + R\frac{di}{dt} + i/c = 10$$

$L = 0.5H$, $R = 4\Omega$, $c = 0.2F$

Solution :→

$\Rightarrow$

$$\frac{d^2t}{dt^2} + \frac{R}{L}\,di/dt + \frac{1}{LC}\,i = \frac{10}{L}$$

~~let c=0.2F~~

$$\frac{d^2i}{dt^2} + \frac{R}{L}\cdot\frac{di}{dt} + \frac{i}{LC} = \frac{2}{LC}$$

$$\Rightarrow \frac{d^2i}{dt^2} + 8\frac{di}{dt} + 10i = 20 \quad (1)$$

$$\Rightarrow \frac{d^2i}{dt^2} + \frac{R\,di}{L\,dt} + \frac{1}{LC}\,i = \frac{I_s}{LC} \quad (2)$$

Now

$$\alpha = \frac{R}{2L} = 8/2 = 4 \text{ rad/sec}$$

$$w_0 = \sqrt{1/LC}$$

$$w_0 = \sqrt{10} \text{ rad/sec}$$

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$\alpha > \omega_0$

So

$s_{1} = -\alpha \pm \sqrt{\alpha^2 - \omega_0^2}$

$s_{1} = -4 \pm \sqrt{4^2 - (\sqrt{10})^2}$

$s = -4 \pm \sqrt{6}$ rad/sec

So

$I_s = 20 \times LC \Rightarrow I_s = 20 \times 0.8 = 9A.$

Now

$i(t) = i_s + A_1 e^{s_1 t} + A_2 e^{s_2 t}$ —— (3)

$t = 0$

$i(0) = I_s + A_1 + A_2$

$\Rightarrow A_1 + A_2 = -1 \quad \because$ As $I_s = 1A.$

Now $\dfrac{di(t)}{dt} = A_1 s_1 e^{s_1 t} + A_2 s_2 e^{s_2 t}.$

$\dfrac{di(0)}{dt} = A_1 s_1 + A_2 s_2.$

$\Rightarrow (-4 + \sqrt{6}) A_1 + (-4 - \sqrt{6}) A_2 = 0.$

$\Rightarrow A_1 = -1.316$

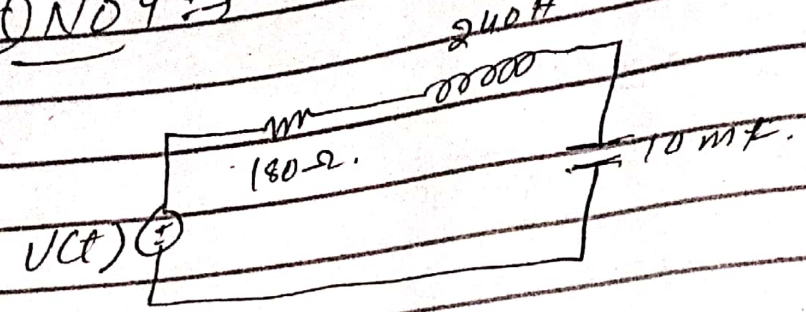
$A_2 = 0.316.$

(3) $\Rightarrow$ $\boxed{i(t) = 9 - 1.316 e^{(-4+\sqrt{6})t} + 0.316 e^{(-4-\sqrt{6})t}}$

Ans

⑥

Q NO 4 :-



Sol :-

$\Rightarrow$ $v(t) = 10\angle 0° V$

Now.

$X_L = \omega L.$

$X_L = 2 \times 240 \Rightarrow X_L = 480\ \Omega.$

$X_C = \frac{1}{\omega C}.$

$X_C = \frac{1}{2 \times 10}$

~~$X_C = 10mF$~~.

$X_C = 50\ \Omega.$

Now

$Z = R + JX_L + JX_C.$

$Z = 180 + J480 + J50.$

$Z = (180 + J430)\ \Omega$

$Z = 441.47\angle 79.90°\ \Omega.$

P.T.O

Now.

$$I = \frac{V(t)}{Z}.$$

$$I = \frac{10\angle 0}{441.47\angle 76.9}.$$

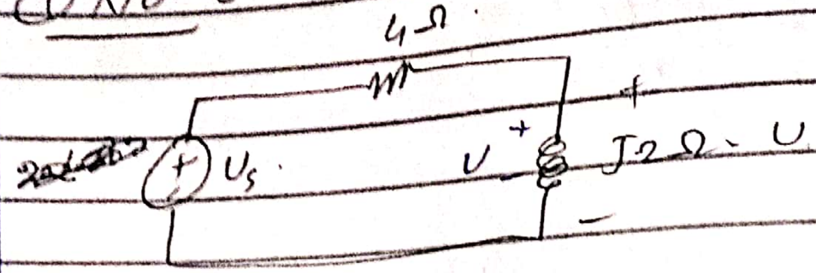
$$I = \frac{10}{441.47}\angle -76.9.$$

$$I = 22.6\times 10^{-3}\angle -76.9.$$

$$\boxed{I = 22.6\angle -76.9 \text{ mA}}$$

P.T.O.

Q NO 5.7



Sol:

$U_s = 20\sin(10t + 30^0)\,V$

$\Rightarrow U_s = 20\cos(10t + 30 - 90)$

$U_s = 20\cos(10t - 60)$

$U_s = 20\angle -60^\circ\, V$

$w = 10\ Rad/sec$

$X_L = Jwl$

$X_L = J \times 10 \times 0.2$

$X_L = J2\,\Omega$

$Z = (4 + J2)\,\Omega$

$Z = 2\sqrt{5}\angle 26.6^\circ$

$I = V/Z$

$I = \dfrac{20\angle -60^\circ}{2\sqrt{5}\angle 26.6^\circ}$

$I = \dfrac{20}{2\sqrt{5}}\angle -86.6^\circ$

$\boxed{I = 2\sqrt{5}\angle -86.6^\circ}\ A$

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$V = I X_L.$

$V = (2\sqrt{5} \angle -86.6)(2\angle 90^\circ)$

$\boxed{V = 4\sqrt{5} \angle 3.4^\circ \, V}$ Ans