Solution Mid-Sem Exam

Sub: Network Theory Branch: 6th sem EC.

Solⁿ: 1. (i) $\mathcal{L} f(t) = \mathcal{L}(e^{-at} \cos \omega t) = \dfrac{s+a}{(s+a)^2 + \omega^2}$

(ii) In electrical or electronic ckt terminals are connecting point to connect with an external ckt. It is a point of entry or exit for electrical energy.

A port is a pair of terminals connecting an electrical network or ckt to an external circuit.

(iii) $$[Y] = [Z]^{-1} = \frac{1}{Z_{11}Z_{22} - Z_{12}Z_{21}} \begin{bmatrix} Z_{22} & -Z_{12} \\ -Z_{21} & Z_{11} \end{bmatrix}$$

$$\Rightarrow \quad Y_{22} = \frac{Z_{11}}{Z_{11}Z_{22} - Z_{12}Z_{21}} = \frac{0.9}{0.54 - 0.04}$$

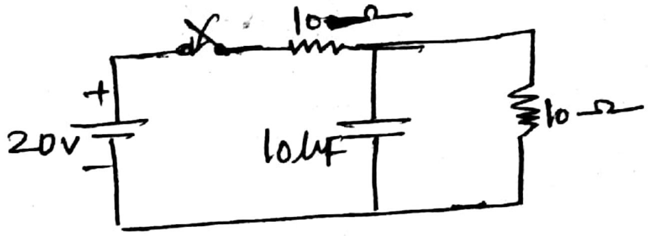
$$Y_{22} = \frac{0.9}{0.5} = 1.8 \text{ mho. Ans.}$$

(iv) $Z_{11} = \dfrac{h_{11}h_{22} - h_{12}h_{22}}{h_{22}}$; $Z_{12} = \dfrac{h_{12}}{h_{22}}$

$Z_{21} = \dfrac{-h_{21}}{h_{22}}$; $Z_{22} = \dfrac{1}{h_{22}}$

(v) At $t < 0^-$

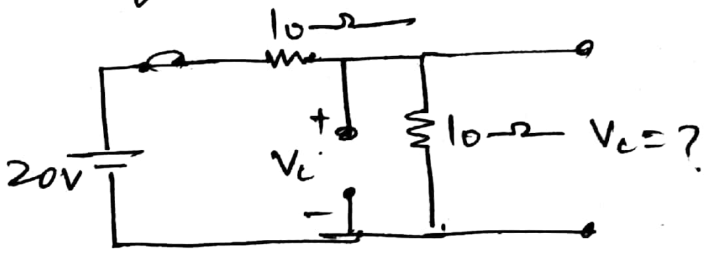
ckt is like



$V_c(0^-) = 0.$

At $t(\infty)$ i.e when steady state is reached

Ckt is like

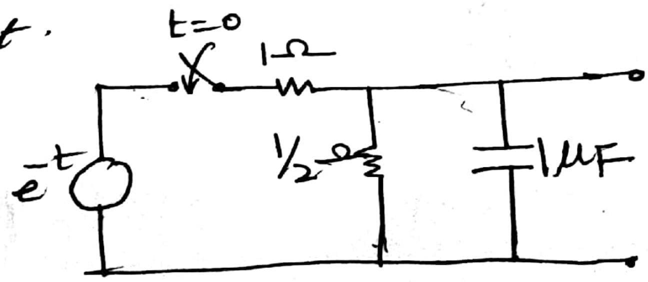


$V_c(\infty) = 10$ Volt.

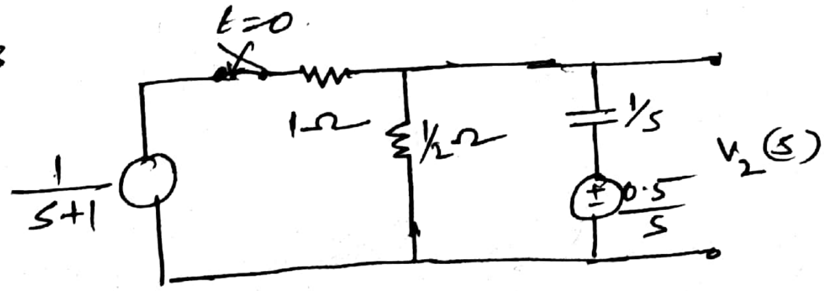
Ans: (2):

$V_c(0^-) = 0.5$ Volt.

Given ckt is like



The laplace equavalent ckt will be given as



Applying KCL
$$\frac{\frac{1}{s+1} - V_2(s)}{1} = \frac{V_2(s)}{\frac{1}{2}} + \frac{V_2(s) - \frac{0.5}{s}}{\frac{1}{s}}$$

or
$$\frac{1}{s+1} + 0.5 = (3+s)\,V_2(s)$$

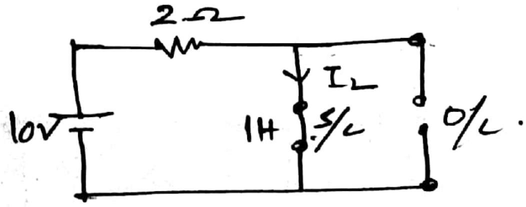
$$\Rightarrow \quad V_2(s) = \frac{1 + 0.5(s+1)}{(s+3)\ (s+1)} = \frac{0.5(s+3)}{(s+3)\ (s+1)}$$

$$V_2(s) = \frac{0.5}{s+1}$$

Taking inverse laplace

We get: $\boxed{V_2(t) = 0.5 \cdot e^{-t} \text{ Volt}}$ Ans

Ans: 3 At time time $t < 0$, ckt is in steady state condn.

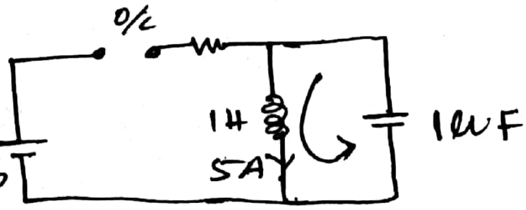


At $t < 0^{o}$

$$I_L(0^-) = \frac{10}{2} = 5 \text{ Amp.}$$

$$I_L(0^+) = I_L(0^-) = 5 \text{ Amp}$$

At $t > 0^+$; ckt will be like as below:



Applying KVL in the ckt.

$$L \frac{di_L(t)}{dt} + \frac{1}{C}\int i_L(t)\,dt = 0$$

Taking laplace transform, We have:

$$L\left[s I_L(s) - i_L(0^+)\right] + \frac{1}{C}\frac{I_L(s)}{s} = 0$$

$$\left(L \cdot s + \frac{1}{Cs}\right) I_L(s) = L \cdot \frac{V}{R}$$

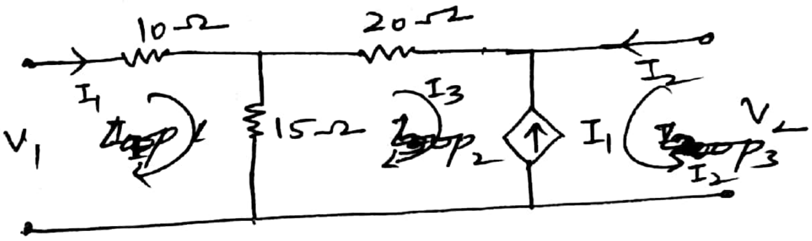
$$I_L(s) = \frac{LV}{R}\frac{Cs}{LCs^2+1} = \frac{V}{R}\frac{s}{s^2+\frac{1}{LC}} \quad \text{--- (1)}$$

Taking inverse laplace of eqn ①

We get $i_L(t) = \frac{V}{R} \cdot \cos \frac{1}{\sqrt{LC}} t$.

$\Rightarrow$ $\boxed{i_L(t) = 5 \cdot \cos 10^{-3} t.}$ Amp Ans.

Ans: (4)



Applying KVL in loop 1.

We get:

$$-V_1 + 10I_1 + 15(I_1 + I_1 + I_2) = 0$$

$$\Rightarrow V_1 = 10I_1 + 30I_1 + 15I_2$$

$$\Rightarrow V_1 = 40I_1 + 15I_2 \quad \text{———} ①$$

Again applying KVL in loop 2 & loop 3

We get $-V_2 + 20(I_1 + I_2) + 15(2I_1 + I_2) = 0$

$$\Rightarrow V_2 = 20I_1 + 20I_2 + 30I_1 + 15I_2$$

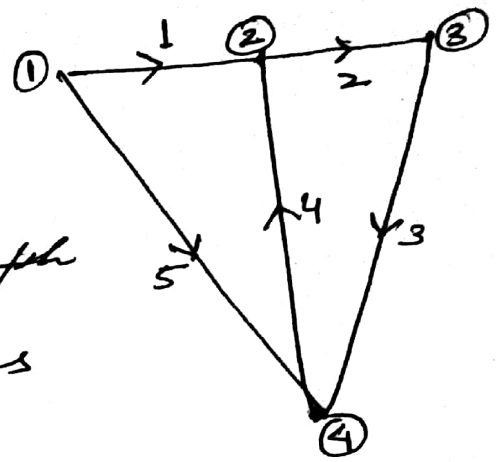
$$\Rightarrow V_2 = 50I_1 + 35I_2 \quad \text{———} ②$$

Equating eqn 1 & eqn 2 with standard Z-parameters

We get :

$$Z = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} = \begin{bmatrix} 40 & 15 \\ 50 & 35 \end{bmatrix}$$

Ans: (5) The given graph is as shown figure.



The incidence matrices of the graph may be shown as below.

No. of nodes = 4

No. of branches = 5

Nodes \ Branches	1	2	3	4	5
1	1	0	0	0	1
2	-1	1	0	-1	1
3	0	-1	1	0	0
4	0	0	-1	1	-1