ELECTRIC NETWORK ANALYSIS

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15243

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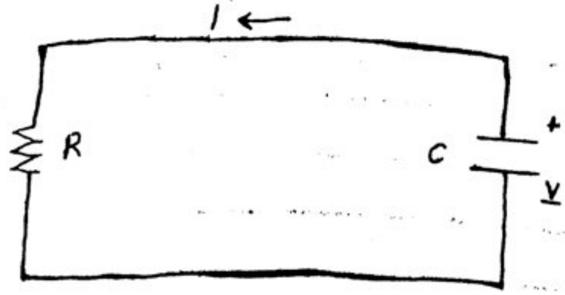
Q.1 For the Circuit in Fig 1. if $v = 10e^{-4t}$ and $0.2e^{-4t}$ $t > 0$
Find R and C (b) ..... (c) ... d ....
50% of the initial energy.



Step 1
(A) $\tau = RC = \frac{1}{4}$

$\Rightarrow -i = C\frac{dv}{dt}$

$\Rightarrow -0.2e^{-4t} = C(10)(-4)e^{-4t}$

$\Rightarrow C = 5mF$

$R = \frac{1}{4C} = 50\ \Omega$

Step 2
(B) $T = RC = \frac{1}{4} = 0.250$

Step 3
(C) $We(0) = \frac{1}{2}CV^2$

$\Rightarrow \frac{1}{2}(5\times 10^{-3})^2(100)$

$\Rightarrow 250\ mJ.$

Step : 4

(D) $W_R = \frac{1}{2} \times \frac{1}{2} CV_0^2$

$\Rightarrow \frac{1}{2} CV_0^2 (1 - e^{-2t_0})$

$0.5 = 1 - e^{-8t} \Rightarrow e^{-8t_0} = \frac{1}{2}$

OR

$e^{8t_0} = 2$

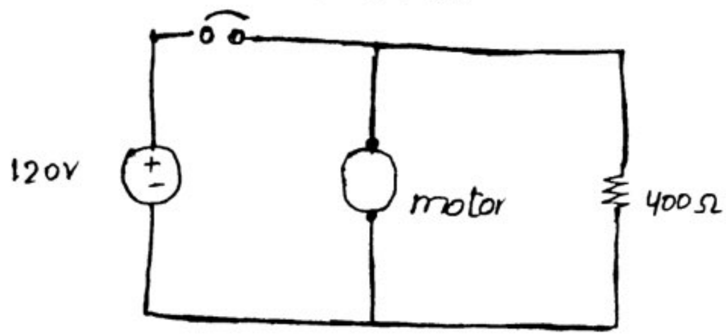
$t_0 = \frac{1}{8} \ln(2)$

$= 86.6 \text{ ms}$

Q-2

120 -V dc generator energize a motor whose coil The breaker is Tripped.

Circuit breaker




let the inductor current.

For $t < 0$

$$i(0) = \frac{120}{100} = \frac{12}{10}$$

$$\Rightarrow \frac{6}{5} = 1.2\ A$$

For $t > 0$ We have an RL Circuit

$$\tau = \frac{L}{R} = \frac{50}{100 + 400}$$

$$= \frac{50}{500} \Rightarrow \frac{5}{50} \Rightarrow \frac{1}{10} \Rightarrow \boxed{0.1}$$

$$i(\infty) = 0$$

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

$$i(t) = 1.2e^{-10t}$$

At $t = 100\ ms = 0.1\ S$

$i(0.1) = 1.2e^{-1} = 0.441\ A$.

Q=3 The Response of Series RLC Circuit the value of R,L,C

Series RLC Circuit

$V_1(t) = 30 - 10e^{-20t} + 30e^{-10t}\ V$

$V(t) = V_1 + A_1 e^{s_1 t} + A_2 e \quad [\alpha > \omega_0]$

$40e^{-20t} - 60e^{-30t}\ mA$

$\Leftarrow\!\!\Rightarrow \quad i(t) = A_1 e^{s_1 t} + A_2 e^{s_2 t} \quad [\alpha > \omega_0]$

Comparing these equation We get

$V_s = 30$

$A_1 = -10\ j \quad A_2 = 30j$

$S_1 = -20\ i \quad S_2 = -10$ —— (a)

$A_1' = 40\ j \quad A_2' = -60i$

$S_1' = -20\ i \quad S_2' = -10 \longrightarrow (b)$

Step 2:-

Now Equ (a) & (b)

$S_1 = -\alpha + \sqrt{\alpha^2 + \omega_0^2}$ And $S_2 = -\alpha - \sqrt{\alpha^2 - \omega_0^2}$

$$s_1 + s_2 = 2\alpha \quad \text{and} \quad s_1 s_2 = \omega_0^2$$

$$\left[\text{Where } \alpha = \frac{R}{2L} \; ; \; \omega_0 = \frac{1}{\sqrt{LC}}\right.$$

$$\Rightarrow -30 = -2\alpha$$
$$\Rightarrow \alpha = 15$$
$$\Rightarrow \frac{R}{2L} = 15 \longrightarrow (c)$$

$$200 = \omega_0^2 \Rightarrow \frac{1}{LC} = 200 \longrightarrow d)$$

Step 3 :-

$$i(t) = C \frac{dv}{dt}(t) = C\left[200e^{-20t} - 300e^{-30t}\right.$$

$$(A_1' e^{s_1 t} + A_1' e^{s_2 t}) \times 10^{-3} \quad A = C\left\{\left[20e^{-20t} - 300e^{-30t}\right]V\right\}$$

OR

$$[s_1 = s_1' \quad s_2 = s_2'$$

$$\Rightarrow 200C = A_1' = 40 \times 10^{-3}$$

$$\Rightarrow 200C = A_1' = 40 \times 10^{-3}$$
$$\Rightarrow C = 200 \times 10^{-6} \, F \quad \Rightarrow C = 200 \, \mu F$$

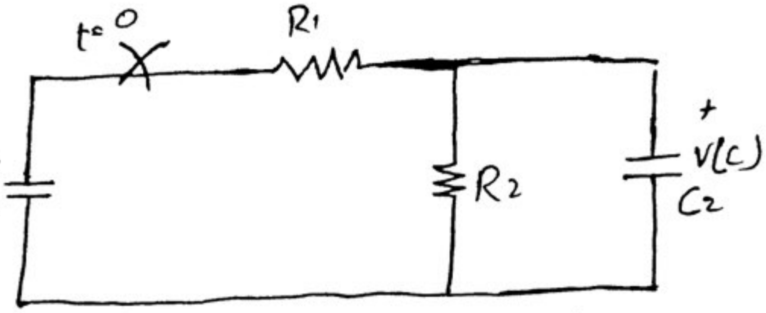
using eqn (C) and (d)

$$L = \frac{1}{200C} F = \frac{1}{200 \times 200 \times 10^{-6}} \Rightarrow L = 20H$$

$$\& \; R = 30L = 30 \times 25 = 750 \, \Omega.$$

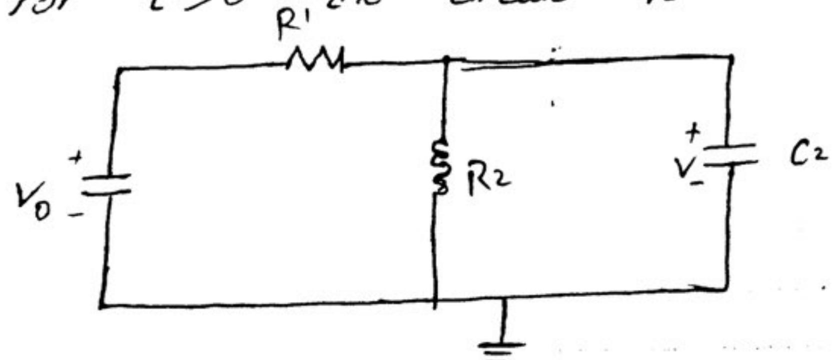
Q4 :-

The Circuit in Fig.3 is the electrical analog of body function




For $t = 0$ $v(0) = 0$

For $t > 0$ the Circuit is shown below




$$Vo - v/R_1 - (v/R_2) + C_2\, dv/dt)$$

$$Vo = v(1 + R_1/R_2) + R_1 C_2\, dv/dt$$

$$60 = (1+5/2.5) + (5 \times 10^6 \times 5 \times 10^{-6})\, dv/dt$$

$$60 = 3v + 25\; dv/dt$$

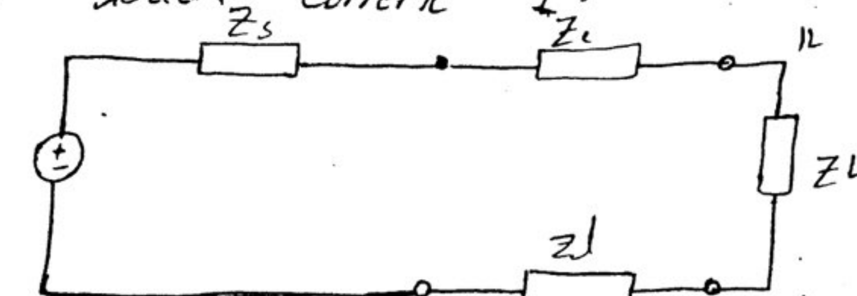
$$v(t) = vs + [Ae^{-3t/25}$$

Where

$$3V_s = 60 \text{ yields } V_s = 20$$

$$V(0) = 0 = 20 + A \text{ or } A = -20$$
$$V(t) = 20 \left(1 - e^{-3t/25}\right) V.$$

Q=5 A Power Transmission System is modeled a shown --- Find the load current $I_L$.




$$Z = Z_a + 2Z + Z_e$$

$$= (1 + 0.8 + 23.2) + j(0.5 + 0.6 + 18.9)$$

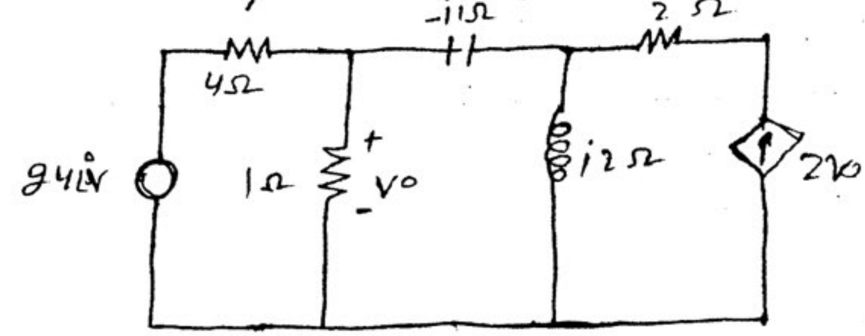
$$Z = 25 + j20$$

$$I_L = \frac{V_s}{Z} = \frac{115 \angle 0}{32.02 \angle 38.66^\circ}$$

$$I_2 = 3.5926 - 38.66^\circ A$$

Q = 6 :-

For the circuit in Fig. 5. Find the dependent current source.




Consider the circuit as shown

At node 0

$$\frac{24-V_0}{4} = \frac{V_0}{1} + \frac{V_0-V_1}{-j}$$

$$24 = (5+j4)V_0 - j4V_1 \quad \text{——} ①$$

At node 1

$$\frac{V_0-V_1}{-j} + 2V_0 = \frac{V_1}{j2}$$

$$V_1 = (2-j4)V_0 \longrightarrow 2)$$

Subsbracting (2) into (1)

$$24 = (5+j4-j8-16)V_0$$

$$V_0 = \frac{24}{11+j4}, \quad V = \frac{(-24)(2-j4)}{11+j4}$$

Voltage across the dependent Source is ?

$V_2 = V_1 + (2)(2V_0) = V_1 + 4V_0$

$V_2 = \frac{-24}{11+j4} - (2 - j4 + 4) = \frac{(-24)(6-j4)}{11+j4}$

$S = V_2 I' = V_2 (2V_0)$

$S = \frac{(-24)(6-j4)}{11+j4} - \frac{-48}{11-j4} = \left(\frac{1152}{137}\right)(6-j4)$

$S = (50.45 - j33.64)\ VA$