Department of Electrical Engineering

Assignment

Course Title:: Electrical Network Analysis

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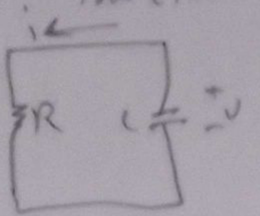
Q1:- For the circuit in Fig (1)

if $v = 10e^{-4t}$ & $i = 0.2e^{-4t}$ $t > 0$

a) Find R & C, b) ..., c) ..., d) ...,

50% of the initial energy.



step1

a) $\tau = RC = \frac{1}{4}$

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

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

$C = 5mF$

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

step 2:

b) $\tau = RC = \frac{1}{4} = 0.250$

step 3:

c) $W_C(0) = \frac{1}{2}Cv^2$

$\Rightarrow \frac{1}{2}(5\times10^{-3})(100)$

$\Rightarrow$ 250 mJ

Step 4

d) $w_R = \frac{1}{2} \times \frac{1}{2} C v_0^2$

$\Rightarrow \frac{1}{2} C v_0^2 (1 - e^{-8t_0})$

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

OR

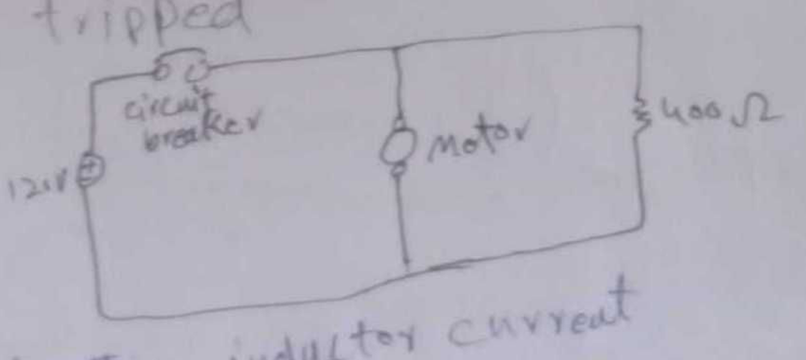
$e^{8t_0} = 2$

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

$\Rightarrow 86.6\,ms$

Q) :-

A 12-V dc generator energize a motor whose coil the breaker is tripped



Let the inductor current

For $t < 0$

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

$\Rightarrow 0.15 = 1.2\,A$

For $t > 0$ we have an RL circuit

$\tau = \frac{L}{R} = \frac{5.0}{100+400} \Rightarrow \frac{5.0}{500} = 0.1$

$i(\infty) = 0$

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

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

At $t = 100\,ms = 0.1s$

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

Q3 :- The Responce of RLC series RLC circuit the ~~value of~~ Determine the value of R, L, C

Series RLC circuit

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

$v(t) = v_0 + A_1 e^{s_1 t} + A_2 e^{s_2 t}$ $[\alpha > \alpha_0]$

comparing these eq.... we get

$v_s = 30$

$A_1 = -10$; $A_2 = 30$;

$s_1 = -20$; $s_2 = -10$ — (a)

$A_1 = 40$; $A_2 = -60$

$s_1' = -20$; $s_2' = -10$ — (b)

step 2

now eq a & b

$s_1 = -\alpha + \sqrt{\alpha^2 + \alpha_0^2}$ And $s_2 = -\alpha - \sqrt{\alpha^2 + \alpha_0^2}$

$s_1+s_2 = -2\alpha$ & $s_1 s_2 = \omega_0^2$

[where $\alpha = \frac{R}{2L}$; $\omega_0 = \frac{1}{\sqrt{LC}}$]

$\Rightarrow -30 = -2\alpha$

$\Rightarrow \alpha = 15$

$\Rightarrow \frac{R}{2L} = 15$ — d

$200 = \omega_0^2$, $\Rightarrow \frac{1}{LC} = 200$ — a

step 5

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

$(A_1' e^{s_1 t} + A_2' e^{s_2 t}) \times 10^{-3} A = C\{[200e^{-20t} - 300e^{-30t}] u\}$

OR

$[s_1 = s_1' , s_2 = s_2']$

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

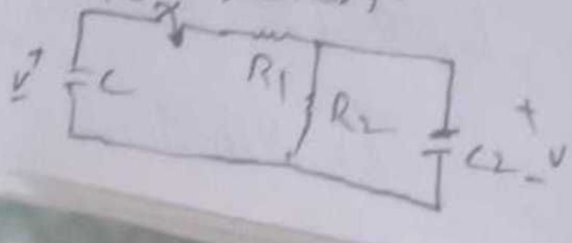
$\Rightarrow C = 200 \times 10^{-6} F \Rightarrow C = 200 \mu F$

using eq 4 c & d

$L = \frac{1}{200C} F = \frac{1}{200 \times 200 \times 10^{-6}} = L = 25 H$

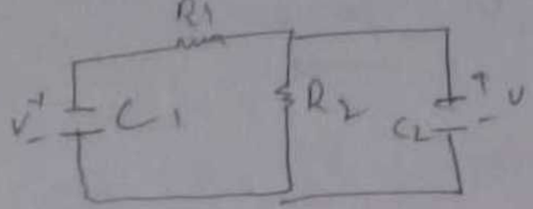
& $R = 30L = 30 \times 25 = 750 \Omega$

Q4:- The circuit in Fig 3 is the electrical analog to body function



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

For $t>0$ the circuit is shown below



$$v_0 - v/R_1 = (v/R_2) + C_2\, dv/dt$$

$$v_0 = v(1 + R_1/R_2) + R_1 C_2 \frac{dv}{dt}$$

$$60 = (1 + 5/2.5) + (5\times10^{6} \times 5\times10^{-6})\frac{dv}{dt}$$

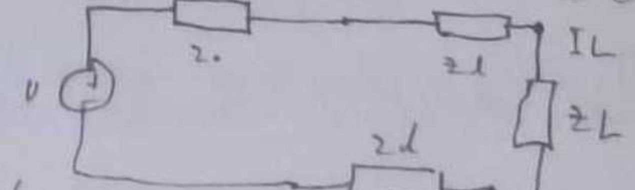
$$60 = 3v + 25\, dv/dt$$

$$v(t) = v_s + \{A e^{-3t/25}\}$$

where

$3v_s = 60$ yields $v_s = 20$

Q5:- A power transmission system is modeled as shown. . . Find the load current I_L



$Z = Z_0 + 2Z + Z_0$

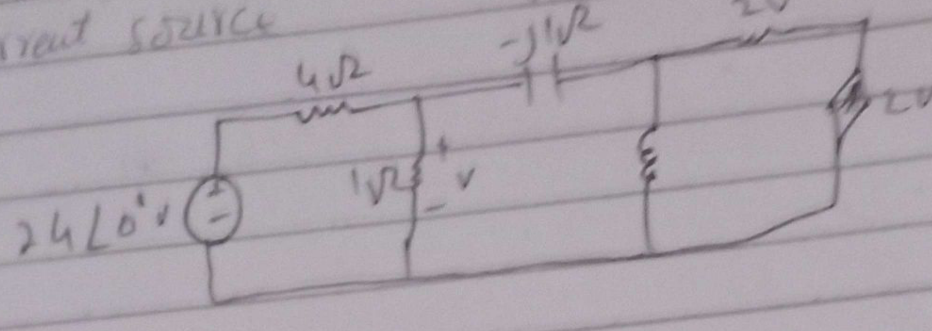
$= (1+0.8+23.2) + j(0.5+0.6+18.9)$

$Z = 25 + j20$

$$I = \frac{V_1}{Z} = \frac{115\angle 0}{32.02\angle 38.66^\circ}$$

$I_L = 3.592\angle -38.66\ A$

- For the circuit in Fig 5
Find the average, reactive and complex power delivered by the dependent current source



At node 0,

$$\frac{24 - v_0}{4} = \frac{v_0}{1} + \frac{v_0 - v_1}{-j}$$

$$24 = (5 + j4) v_0 - j4 v_1 \quad \text{— (1)}$$

At node 1,

$$\frac{v_0 - v_1}{-j} + 2 v_0 = \frac{v_1}{j2}$$

$$v_1 = (2 - j4) v_0 \quad \text{— (2)}$$

Subtracting 2 into (1)

$$24 = (5 + j4 - j8 - 16) v_0$$

$$v_0 = \frac{-24}{11 + j4}, \quad v_1 = \frac{(-24)(2 - j4)}{11 + j4}$$

The voltage across the depent source

$$v_2 = v_1 (2)(2 v_0) = v_1 + 4 v_0$$

$$v_2 = \frac{-24}{11 + j4} (2 - j4 + 4) = \frac{(-24)(6 - j4)}{11 + j4}$$

$$S = V_2 \bar{I} = V_2 (2 V_0')$$

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

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