Course Details

Course Tittle — ENA

Instructor Name — Sir shahrayan

Student Details

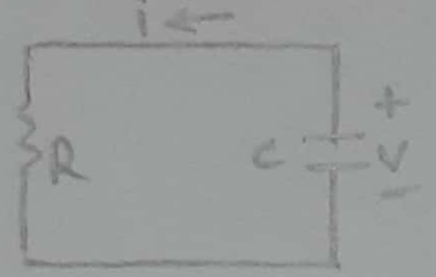
Name — Faiz-ur-Rehman

Modul — 4th

Student ID — 14623

Studend Sign — Faiz ur Rehman

Q_1: For the circuit in Fig 1,
if $V = 10e^{-4t}$ & $0.2e^{-4t}$ $t > 0$
(a) Find R & C (b) —— (c) —— (d) ——
50 % of the initial energy.



Step 1

(A)

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

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

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

$$\Rightarrow \quad C = 5mF$$

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

Step 2

(B)

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

Step 3

(C)

$$W_c(0) = \frac{1}{2}CV^2$$

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

$$\Rightarrow \quad 250 \text{ mJ}.$$

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

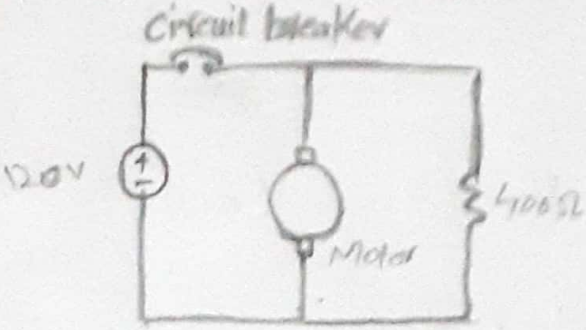
$e^{8t_0} = 2$

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

$\Rightarrow 88.6\,ms$

Q2

A 120-V dc generator energize a motor whose coil ________ ________ the Breaker is tripped.



Step 1

Let the inductor current.

For $t < 0$

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

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

For $t > 0$ We have an RL circuit

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

$$\Rightarrow \frac{5\cancel{0}}{50\cancel{0}} \Rightarrow \frac{5}{50}$$

$$\Rightarrow \frac{1}{10} = 0.1$$

$$i(\infty) = 0$$

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

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

At $t = 100\,mS = 0.1\,S$

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

Which is the same as the current through the resistor

Step 2

(B)

$\tau = R_C\, ms = 60\mu s$

An integrator

$T < 0.1 \ \tau = 6\mu s$

$\boxed{T_{Max} = 6\mu s}$

Q3 The Response of ~~RLC~~ series RLC circuit . Determine the value of R, L, C

Step 1 -

Series RLC Circuit

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

$V(t) = V_s + A_1 e^{s_1 t} + A_2 e^{s_2 t}$ $[\alpha > \omega_0]$

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

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

Camparing these equ... We get

$V_s = 30$

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

$S_1 = -20$; $S_2 = -10$ $\rightarrow$ (a)

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

$S_2' = -20$; $S_1' = -10$ $\rightarrow$ (b)

Step 2

Now Equ (a) & (b)

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

$S_1 + S_2 = -2\alpha$ & $S_1 S_2 = \omega_0^2$

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

$\Rightarrow$ $-30 = -2\alpha$

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$\Rightarrow \quad \alpha = 15$

$\Rightarrow \quad \dfrac{R}{2L} = 15 \rightarrow (c)$

$200 = \omega_0^2 \Rightarrow \dfrac{1}{LC} = 200 \rightarrow (d)$

Step 3//

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

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

OR

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

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

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

Using Equ (c) & (d)

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

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

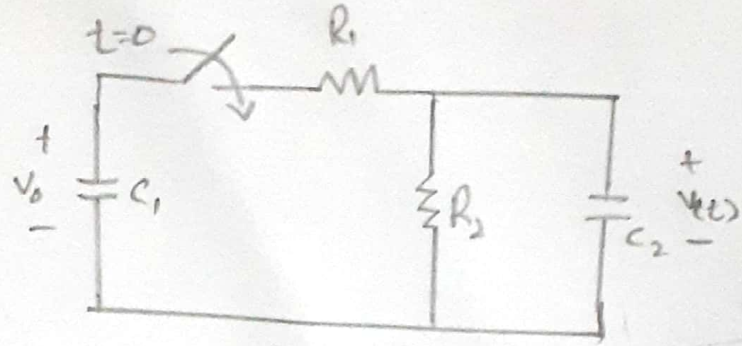
$C = 200 \mu F$

$L = 25 H$

$R = 750 \Omega$

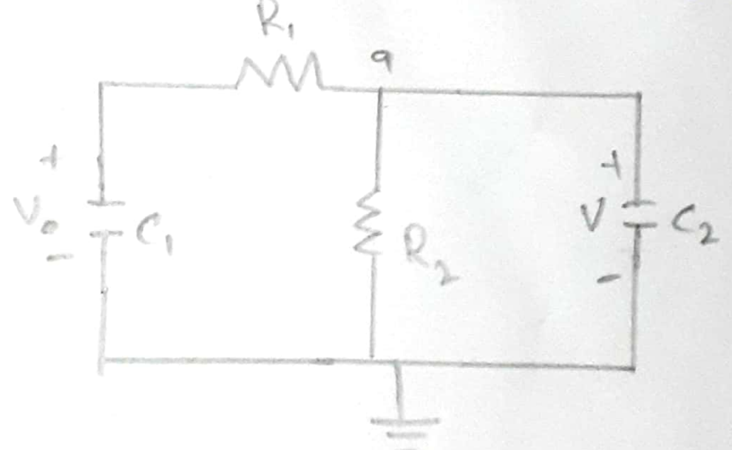
Answer.

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.



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

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

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

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

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

Where

$3V_s = 60$ Yields $V_s = 20$

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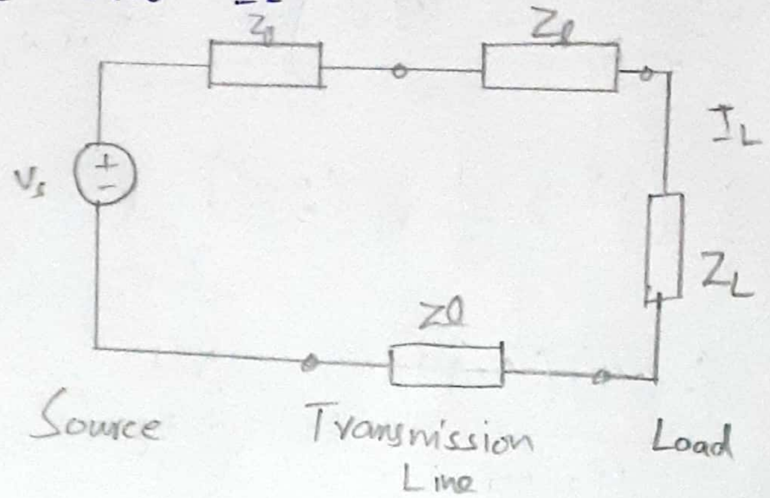
$$V(0) = 0 = 20 + A \text{ or } A = -20$$

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

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



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

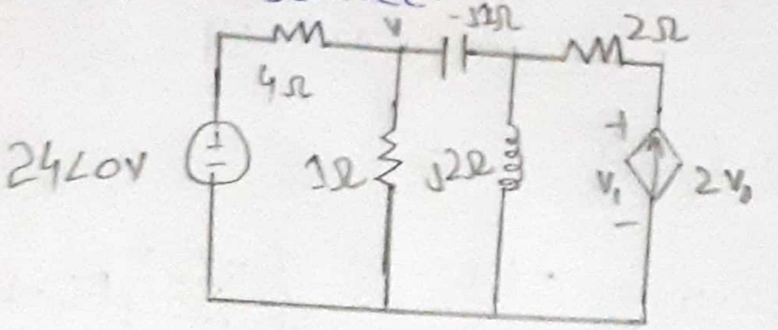
$$= (1+0.8+23.2)+j(0.5+0.6+18.9)$$

$$Z = 25 + j20$$

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

$$I_L = 3.592\angle -38.66^\circ \text{ A}$$

Q6) For the circuit in Fig. 5 find the
ave dependent
current source.



Consider the circuit as shown

At node 0

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

$$24 = (5+j4)V_o - j4V_1 \quad \rightarrow (1)$$

At node 1

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

$$V_1 = (2-j4)V_o \quad \rightarrow (2)$$

Substituting (2) into (1)

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

$$V_o = \frac{-24}{11+j4}, \quad V_1 = \frac{(-24)(2-j4)}{11+j4}$$

Voltage across the dependent Source is

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

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

$$S = \frac{1}{2} V_2 I^* = \frac{1}{2} V_2 (2V_0^*)$$

$$S = \frac{(-24)(6-j4)}{11+j4} \cdot \frac{-24}{11-j4}$$

$$= \left(\frac{576}{137}\right)(6-j4)$$

$$S = 25.23 - j16.82 \text{ VA.}$$

Q7 A balanced Y- load to a 60Hz three phase ———— Phase draw 5kW.

(a) Determine the load impendence Z

(b) Find I_a I_b & I_c.

(a) Step 1

$|V_{ab}| = \sqrt{3} V_p = 240 \rightarrow V_p = \frac{240}{\sqrt{3}} = 138.56$

$V_{an} = V_p \angle -30°$

$Pf = 0.5 = \cos\theta \rightarrow \theta = 60°$

$P = S\cos\theta \rightarrow S = \frac{P}{\cos\theta} = \frac{5}{0.5} = 10KVA$

$Q = S\sin\theta = 10\sin 60 = 8.66$

$S_p = 5 + j8.66KVA$

But

$S_p = \frac{V_p^2}{Z_e} \rightarrow Z_p^* = \frac{V_p^2}{S_p} = \frac{138.56^2}{(5+j8.66)\times 10^3}$

$= 0.96 - j1.663$

$Z_p = 0.96 + j1.6627\ \Omega$

(b) Step 2

$I_a = \frac{V}{Z_r} = \frac{138.56 \angle -30°}{0.96 + j1.6627} = 72.17 \angle -90° A$

$I_b = I_a \angle -120° = 72.17 \angle -210° A$

$I_c = I_a \angle +120 = 72.17 \angle 30° A.$

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