Department of Electrical Engineering

Assignment

Course Detail

Course title:- Electrical Network Analysis

Module: 4th

Total Marks :- 20

Instructor :- Dr Engr Shehryar Shafique

Student detail

Name:- Maaz Khan

Student ID:- 14569

Student Sign:- M

Question NO 7

ANS:-

(a) $|V_{ab}| = \sqrt{3} V_p = 240$

Here Now

$$V_p = \frac{240}{\sqrt{3}} = 138.56$$

$$V_{ab} = V_p < -30^\circ$$

$$Pf = 0.5 = \cos\theta$$

$$\theta = 60^\circ$$

$$P = S\cos\theta$$

$$S = \frac{P}{\cos\theta}$$

$$= \frac{5}{0.5}$$

$$= 10 \text{ KVA}$$

$$Q = S\sin\theta$$

$$= 10 \sin 60$$

$$= 8.66$$

$$S_p = 5 + j\,8.66 \text{ KVA}$$

But

$$S_p = \frac{V_p^2}{Z_p}$$

$$Z_p = \frac{V_p^2}{S_p}$$

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

$$Z_p = 0.96 - j1.663$$

$$Z_p = 0.96 + j1.663\ \Omega$$

(b)

$$I_a = \frac{V_{ab}}{Z_Y} = \frac{138.56\angle -30}{0.96+j1.6627}$$

$$I_a = 72.17\angle -90^\circ\ A$$

$$I_b = I_a \angle -120^\circ$$

$$I_b = 72.17\angle -210^\circ\ A$$

$$I_c = I_a \angle +120^\circ$$

$$I_c = 72.17\angle 30^\circ\ A$$

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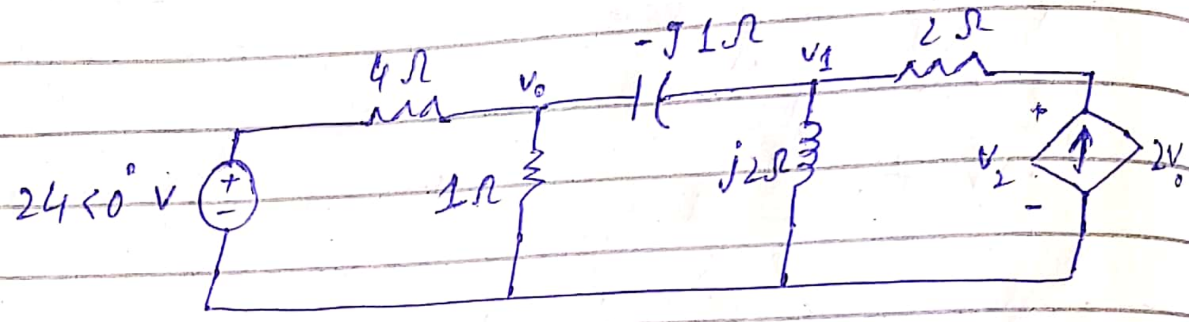
Question No 6

ANS :- The given circuit is,



At Node 0,

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

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

At Node 1,

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

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

Now Substituting (2) into (1),

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

$$V_o = \frac{-24}{11 + j4}, \quad V_1 = \frac{(-24)(6 - j4)}{11 + j4}$$

P. No 5

The voltage across the dependent source is:

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

$$= V_1 + 4V_0$$

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

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

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

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

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

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

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Question No 5

ANS:-

Given data:

source voltage = $V_S = 115 \angle 0^\circ V$

Source Impedance = $Z_s = 1 + j0.5\,\Omega$

Line Impedance = $Z_\ell = 0.4 + j0.3\,\Omega$

Load Impedance = $Z_L = 23.2 + j18.9\,\Omega$

Find the load current I_L.

So

$$Z = Z_a + 2Z_o + Z_b$$

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

$$Z = 25 + j20$$

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

$$I_L = 3.592 \angle -38.66^\circ\ A.$$

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Question No 3

Solution:

Given that $s_1 = -10$ and $s_2 = -20$, we recall that

$$s_{1,2} = -\alpha \pm \sqrt{\alpha^2 - \omega_0^2} = -10, -20$$

Clearly,

$$s_1 + s_2 = -2\alpha = -30 \quad \text{or}$$

$$\alpha = 15 = R/(2L) \quad \text{or}$$

$$R = 60L \rightarrow (1)$$

$$s_1 = -15 + \sqrt{15^2 - \omega_0^2} = -10$$

which lead to

$$15^2 - \omega_0^2 = 25 \quad \text{or}$$

$$\omega_0 = \sqrt{225 - 25}$$

$$= \sqrt{200} = 1/\sqrt{LC},$$

thus $LC = 1/200 \rightarrow (2)$

Since we have a series RLC circuit, $i_L = i_C = C\,dv_C/dt$

which gives,

$i_L / C = dv_C / dt = [200 e^{-20t} - 300 e^{-30t}]$

or $i_L = 100C [2e^{-20t} - 3e^{-30t}]$

But,

i is also $= 20\{[2e^{-20t} - 3e^{-30t}] \times 10^{-3}\}$

$= 100C [2e^{-20t} - 3e^{-30t}]$

therefore,

$C = (0.02 / 10^2)$

$= 200\ \mu F$

$L = 1 / (200C)$

$= 25\ H$

$R = 30L$

$= 750$ ohms

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Question No 1

Solution:

(a)

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

$$\Rightarrow -1 = C\frac{dv}{dt}$$

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

$$\Rightarrow C = 5\,mF$$

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

(b)

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

(c)

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

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

$$\Rightarrow 250\ mJ.$$

(d)

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

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

$$0.5 = 1 \cdot e^{-8t}$$

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

OR

$$e^{8t_0} = 2$$

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

$$= 86.6 \text{ ms}$$

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Question NO 2

Solution:

Step 1

Let the inductor current,

for $t < 0$

$$i(0) = \frac{120}{100} = \frac{12^6}{10^5} = 1.2 \text{ A}$$

For $t > 0$ we have an RL circuit

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

$$= \frac{50}{500} = \frac{1}{10} = 0.1$$

$i(\infty) = 0$

$$i(t) = i(\infty) + [i(0) - i(\infty)]e^{-10t}$$

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

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

$$i(0.1) = 1.2e^{-1}$$

$$= 0.441\,A$$

which is the same as the current through the resistor

Step 2

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

An integrator

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

$T_{min} = 6\,\mu s.$

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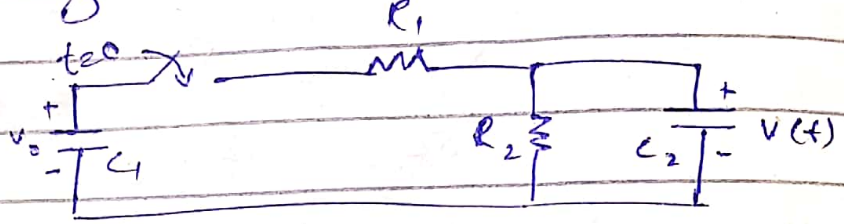
Question NO 4

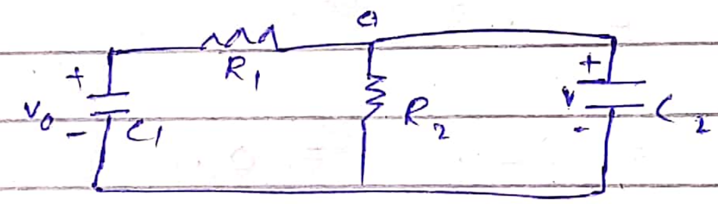
Solution:

The given circuit is:



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

For $t>0$ the circuit is:



$$\frac{V_0 - v}{R_1} = \left(\frac{v}{R_2}\right) + C_2 \frac{dv}{dt}$$

$$V_0 = v\left(1 + \frac{R_1}{R_2}\right) + R_1 C_2 \frac{dv}{dt}$$

$$60 = \left(1 + \frac{5}{2.5}\right) + \left(5\times 10^{6} \times 5 \times 10^{-6}\right)\frac{dv}{dt}$$

$$60 = 3v + 25 \frac{dv}{dt}$$

$$v(t) = V_s + \left[A e^{-3t/25}\right]$$

Where

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

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

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