Department of Electrical Engineering
Assignment
Date: 07/05/2020

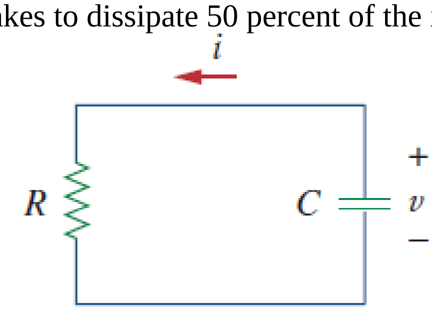
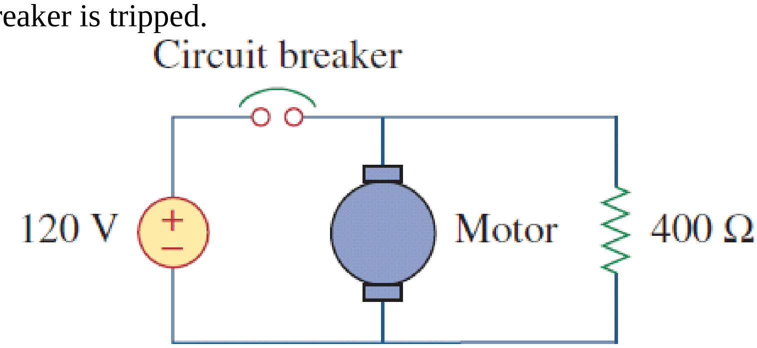
Course Details

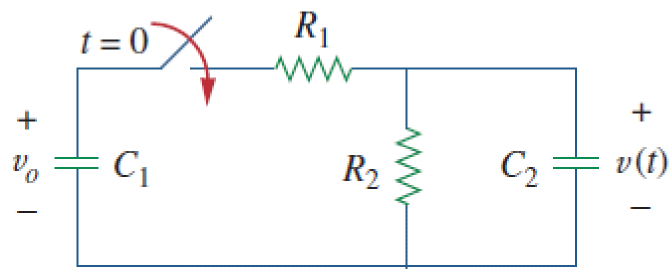
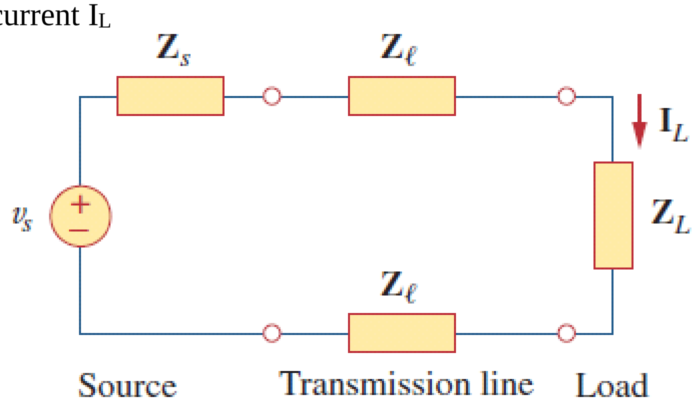
Course Title:	Electrical Network Analysis	**Module:**	4th
Instructor:		**Total Marks:**	20
Submission Deadline	05/06/2020		

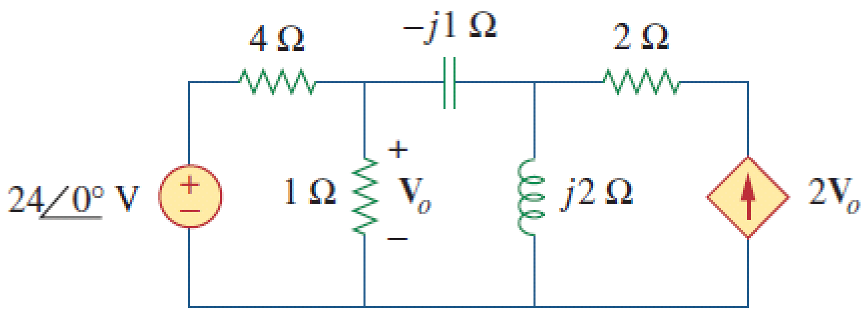
Student Details

Name: ______________________ **Student ID:** ______________

Student Signature: ______________________

Q1.		For the circuit in Fig. 1, if $v = 10e^{-4t}$ V and $I = 0.2e^{-4t}$, $t>0$ (a) Find *R* and *C*. (b) Determine the time constant. (c) Calculate the initial energy in the capacitor. (d) Obtain the time it takes to dissipate 50 percent of the initial energy.  Figure 1	Marks 02 CLO 01
Q2.		A 120-V dc generator energizes a motor whose coil has an inductance of 50 H and a resistance of 100 Ω. A field discharge resistor 400 Ω of is connected in parallel with the motor to avoid damage to the motor, as shown in Fig. 2. The system is at steady state. Find the current through the discharge resistor 100 ms after the breaker is tripped.  Figure 2	Marks 03 CLO 03

Q3.		The responses of a series *RLC* circuit are $v_c(t) = 30\text{-}10e^{-20t}+30e^{-10t}$ V $i_L(t) = 40e^{-20t}\text{-}60e^{-10t}$ mA where v_c and i_L are the capacitor voltage and inductor current respectively. Determine the values of R, L, C	Marks 02 CLO 01
Q4.		The circuit in Fig. 3 is the electrical analog of body functions used in medical schools to study convulsions. The analog is as follows: C_1 = Volume of fluid in a drug C_2 = Volume of blood stream in a specified region R_1 = Resistance in the passage of the drug from the input to the blood stream R_2 = Resistance of the excretion mechanism, such as kidney, etc. $v0$ = Initial concentration of the drug dosage $v(t)$ = Percentage of the drug in the blood stream Find v(t) for t>0 given that $C_1 = 0.5\mu F$, $C_2 = 5\mu F$, $R_1 = 5M\Omega$, $R_2 = 2.5\ M\Omega$ and $v_0 = 60u(t)$ V  Figure 3	Marks 03 CLO 03
Q5.		A power transmission system is modeled as shown in Fig. 4. Given the source voltage and circuit elements Source voltage $V_s = 115\angle 0$ V, Source impedance $Z_s = 1 + j0.5\ \Omega$, Line impedance $Z_l = 0.4 + j0.3\ \Omega$, Load impedance $Z_L = 23.2 + j18.9\ \Omega$, find the load current I_L  Figure 4	Marks 02 CLO 03

Q 6		For the circuit in Fig. 5, find the average, reactive, and complex power delivered by the dependent current source.  Figure 5	Marks 03 CLO 03
Q 7		A balanced Y-load is connected to a 60-Hz three-phase source with $V_{ab} = 240 \angle 0°$ V. The load has pf = 0.5 lagging and each phase draws 5 kW. (a) Determine the load impedance Z_Y . (b) Find I_a, I_b, and I_c.	Marks 5 CLO02

Department of Electrical Engineering

Course Title: Signal And System

Module: 4^{th} semester

Student Detail

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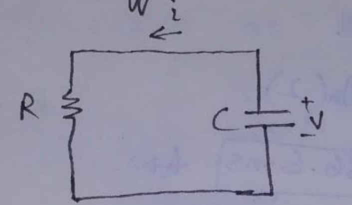
QNo1:- For the ckt in fig 1 if $v = 10e^{-4t}$ V and $i = 0.2e^{-4t}$ A, $t > 0$.

(a) Find R & C.

(b) Determine the Time Constant.

(c) Calculate the initial energy in the capacitor.

(d) Obtain the time it takes to dissipate 50 percent of the initial energy.



Solution

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

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

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

$\boxed{C = 5mF}$

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

$= \frac{1}{4(5mF)}$

$\boxed{R = 50\Omega}$.

(b) $\tau = RC = \frac{1}{4} = \boxed{0.25s}$

(c) $W_C(0) = \frac{1}{2}CV_0^2$

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

$= \boxed{250mJ}$

(1)

(d) $W_c(0) = \frac{1}{2} C V_0^2 (1 - e^{-2\tau_0 J})$

$= \frac{1}{2} (5\times10^{-3})(100)(1 - e^{-2\tau_0 J})$.

$0.5 = 1 - e^{-8\tau_0}$

$e^{-8\tau_0} = \frac{1}{2}$.

or $e^{8\tau_0} = 2$.

$\tau_0 = \frac{1}{8} \ln(2)$.

$= \boxed{86.6 ms}$ Ans.

Q No # 2

Solution:-

let the inductor current

for $t<0$

$i(0) = \frac{\cancel{120}}{\cancel{100}} = 1.2 A$

For $t>0$

we have an RL ckt.

$\tau = \frac{L}{R}$

$= \frac{50}{100+400} = \frac{\cancel{50}}{\cancel{500}}$ [1 / 10]

0.1

$i(\infty) = 0.$

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

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

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

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

$= 0.441 A$

Which is the same as the current (I) through the resistor.

$\tau = RC_{ms} = 60 \mu s.$

As An Integrator.

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

$T_{max} = 6 \mu s.$

QNo # 3

Solution:-

We have RLC ckt.

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

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

$i_{(L)}(t) = 40 e^{-20t} - 60 e^{-10t} mA.$

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

Comparing these Equation.

$V_s = 30$

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

$S_1 = -20 \; ; S_2 = -10 \rightarrow (1).$

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

$s_1' = -20$; $s_2' = -10 \rightarrow$ (2).

Now Equation (1) and (2).

. $S_1 = -\alpha\sqrt{\alpha^2 - \omega_0^2}$ & $S_2 = -\alpha - \sqrt{\alpha^2 - \omega_0^2}$.

$S_1 + S_2 = -2\alpha$

$S_1 \cdot S_2 = \omega_0^2$

Where $\alpha = \frac{R}{2L}$

$\omega_0 = \frac{1}{\sqrt{LC}}$

$-30 = 2\alpha$

$\alpha = 15$

$\frac{R}{2L} = 15 \rightarrow$ (3)

$200 = \omega_0^2$

$\frac{1}{LC} = 200 \rightarrow$ (4).

Also $i(t) = C\frac{dV(t)}{dt}$

$= C[200e^{-20t} - 300e^{10t}]$.

$[S_1 = S_2' , S_2 = S_2']$

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

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

$\boxed{C = 200 \mu F}$

And Hence by using Equation (3) and 4 we get. (4).

$$L = \frac{1}{200C}\ F$$

$$= \frac{1}{200 \times 200 \times 10^{-6}}$$

$$= \boxed{25H}$$

And $R = 30L$

$$= 30 \times 25$$

$$= \boxed{750\ \Omega}$$

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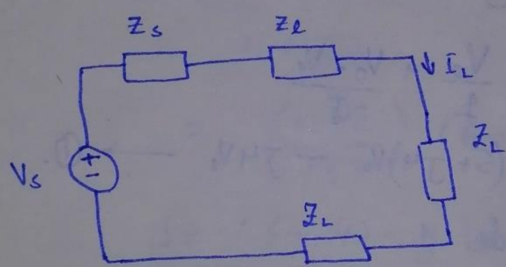
Q No#5

Solution:-



Transmission line load.

$$Z = Z_s + 2Z + Z_L$$

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

$$Z = 25 + j20.$$

$$I_L = \frac{V_s}{Z}$$

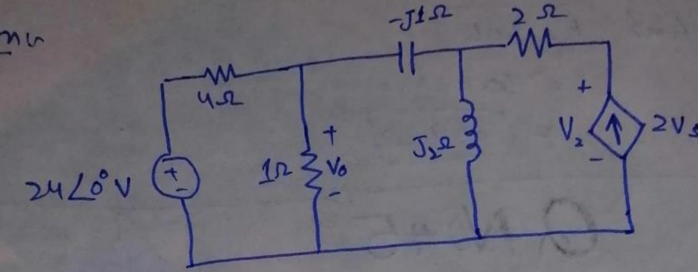
$$= \frac{115\angle 0^\circ}{32.02\angle 38.66^\circ}$$

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

(5).

Q No # 6

Solution:



Consider the ckt as shown.

At node 0

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

$$24 = (5+J4)V_0 - J4V_1 \longrightarrow (1).$$

At node 1.

$$\frac{V_0 - V_1}{-J} + 2V_0 = \frac{V_1}{J_2}.$$

$$V_1 = (2-J4)V_0 \rightarrow (2).$$

Substituting (2) into (1).

$$24 = (5+J4-J8-16)V_0.$$

$$V_0 = -\frac{24}{11+J4}$$

$$V_1 = \frac{(-24)(2-J4)}{11+J4}$$

The voltage across the dependent source

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

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

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

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

$$S = \frac{(-24)(6-j4)}{11+j4} \cdot \frac{-48}{11-j4}$$

$$= \left(\frac{1152}{137}\right)(6-j4).$$

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

Q No#7

Solution :-

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

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

$$V_{in} = V_p \angle -30^\circ.$$

$$pf = 0.5 = \cos\theta.$$

$$\theta = 60^\circ.$$

$P = S\cos\theta$.

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

$$= \frac{5}{0.5} = 10\ \text{KVA}.$$

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

$= 8.66$

$S_p = 5 + j8.66\ \text{KVA}$.

But

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

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

$$= \frac{(138.56)^2}{(5 + j8.66)\times 10^{-3}} = 0.96 - j1.663.$$

$$\boxed{Z_p = 0.96 + j1.663}\ \Omega.$$

$$I_a = \frac{V_{an}}{Z_p} = \frac{138.56\angle -30}{0.96 + j1.6627} = \boxed{72.17\angle -90^\circ\ A}$$

$$I_b = I_a\angle -120^\circ = \boxed{72.17\angle -210^\circ\ A}$$

$$I_c = I_a\angle +120 = \boxed{72.17\angle 30^\circ\ A}$$

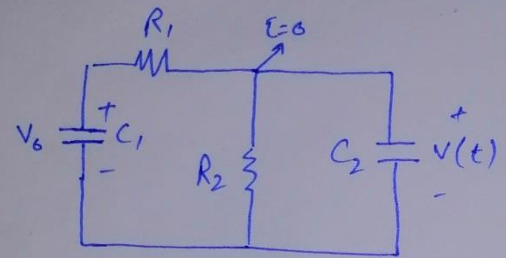
QNO # 4

Solution

for $t = 0^-$

$V(0) = 0$.

for $t > 0$,



At Node ⓐ

$$\frac{V_0 - V}{R_1} = \frac{V}{R_2} + C_2 \frac{dV}{dt}.$$

$$V_0 = V\left(1 + \frac{R_1}{R_2}\right) + R_2 C_2 \frac{dV}{dt}.$$

$$60 = \cancel{3V} \, V\left(1 + \frac{5}{2.5}\right) + \left(5\times10^6 \times 5\times10^{-6}\right)\frac{dV}{dt}$$

$$60 = 3V + 25\frac{dV}{dt}.$$

$$V(t) = V_s + \left(Ae^{\frac{-3t}{25}}\right).$$

$3V_s = 60$ yields

$V_s = 20$

$V(0) = 0 = 20 + A.$

$A = -20 \longrightarrow$ ⓐ.

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