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

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Student Signature:			

<table>
<tr><td rowspan="2">Q1.</td><td rowspan="2"></td><td rowspan="2">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.

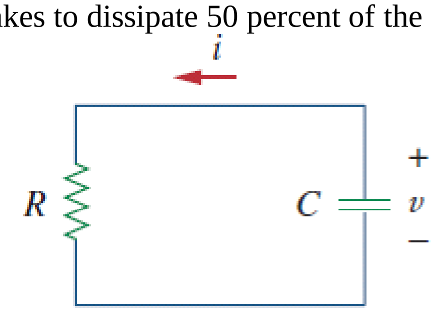



Figure 1</td><td>Marks 02</td></tr>
<tr><td>CLO 01</td></tr>
<tr><td rowspan="2">Q2.</td><td rowspan="2"></td><td rowspan="2">A 120-V dc generator energizes a motor whose coil has an inductance of 50 H and a resistance of 100 Ω. A field discharge resistor 400 Ω of is connected in parallel with the motor 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.

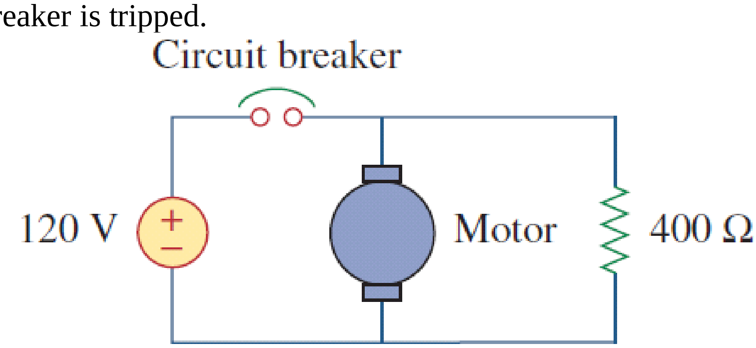
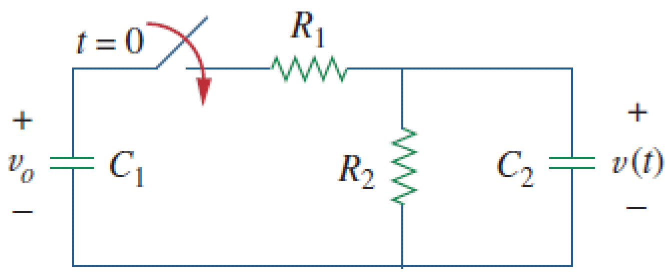
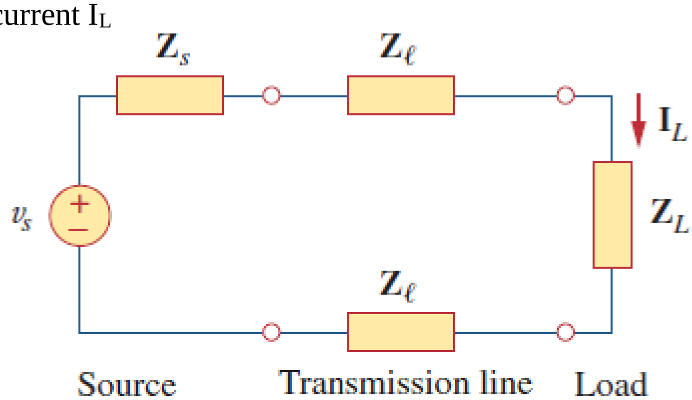
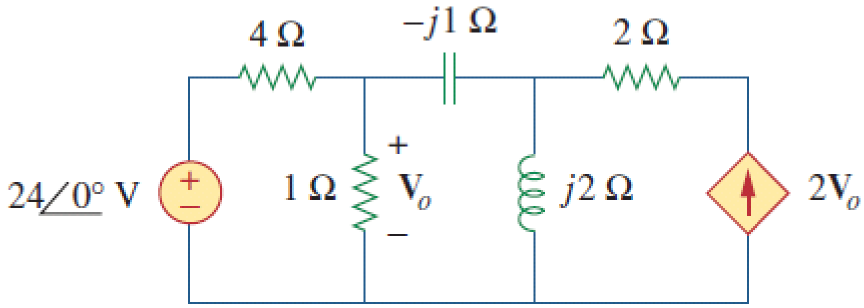



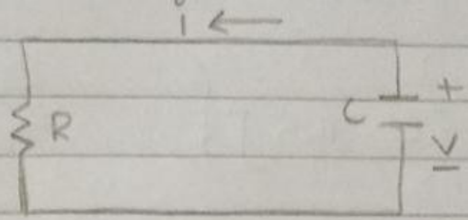
Figure 2</td><td>Marks 03</td></tr>
<tr><td>CLO 03</td></tr>
</table>

Q3.		The responses of a series *RLC* circuit are $v_c(t) = 30-10e^{-20t}+30e^{-10t}$ V $i_L(t) = 40e^{-20t}-60e^{-10t}$ 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 ∠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

Q1: 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)

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

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

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

$$\Rightarrow C = 5mF$$

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

STEP # 2:

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

STEP #3:

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

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

$$\boxed{\Rightarrow 250\ mJ}$$

STEP #4:

(B) $W_R = \frac{1}{2} \times \frac{1}{2} C V_0^2$

$$\Rightarrow \frac{1}{2} C V_0^2 (1 - e^{-2t})$$

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

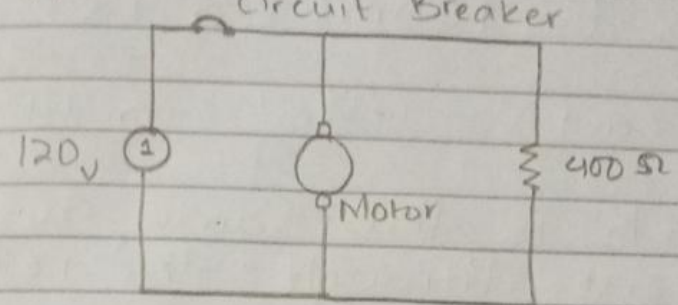
OR

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

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

$$\boxed{\Rightarrow 86.6\ ms}$$

Q2 A 120-v dc generator energize a motor coil ______ ______ the breaker is tripped ?.



STEP # 1.

Let the instructor current. for $t < 0$

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

$$\Rightarrow 6/5 = 1.25A$$

For $t > 0$ we have an RL circuit

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

$$= \frac{5\emptyset}{50\emptyset} = 5/50$$

$$\Rightarrow 1/10 = 0.1$$

$$i(\alpha) = 0$$

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

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

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

(B)

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

An integrator

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

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

x ——————————————— x

QUESTION # 3.

The response of Series RLC circuit the value of R, L, C

STEP # 1:

Series RLC circuit.

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

$$v(t) = V_0 + A_1 e^{s_1 t} + A_2 e^{s_2} \; [\alpha > \omega]$$

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

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

Comparing these eq.... we get

$V_s = 30$

$A_1 = -10$; $A_2 = 30$;
$S_1 = -20$; $S_2 = -10 \rightarrow (a)$
$A'_1 = 40$; $A'_2 = -60$;
$S'_1 = -20$; $S'_2 = -10 \rightarrow (b)$

STEP # 2
Now eq (a) & (b)

$S_1 = -\alpha + \sqrt{\alpha^2 + \alpha_0^2}$ And $S_2 = -\alpha - \sqrt{\alpha^2 - \alpha_0^2}$
$S_1 + S_2 = -2\alpha$ & $S_1 S_2 = \alpha_0^2$

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

$\Rightarrow -30 = -2\alpha$

$\Rightarrow \alpha = 15$

$200 = \omega_0^2 \Rightarrow 1/LC = 200 \rightarrow (d)$

STEP #3

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

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

OR

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

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

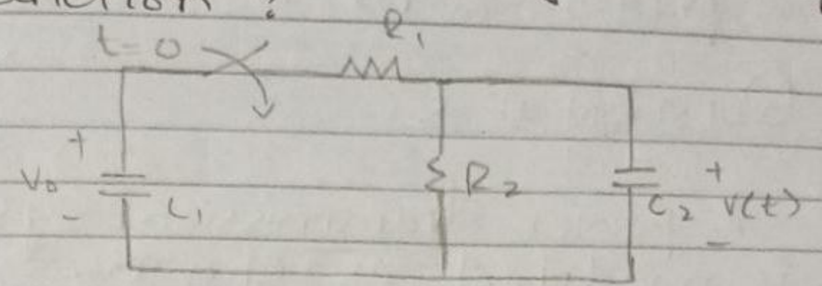
$\Rightarrow C = 200 \times 10^{-6} F \Rightarrow C = \boxed{200 \mu F}$

Using eq (c) & (d)

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

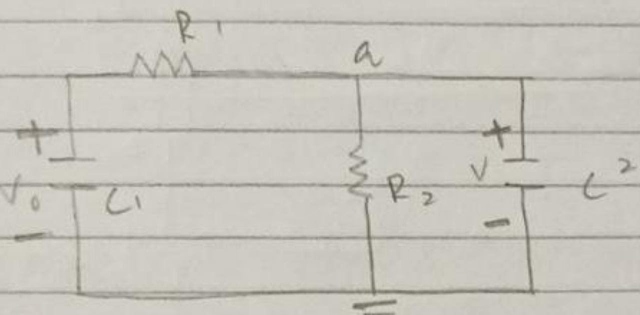
& $R = 30L = 30 \times 25 = \boxed{750 \Omega}$

1. 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.



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

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

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

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

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

$3V_s = 60$ yields $V_s = 20$.

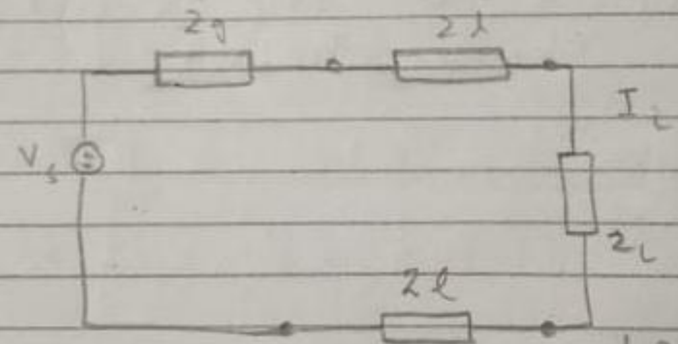
$v(0) = 0 = 20 + A$ or $A = -20$

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

x——————x

QUESTION # 5.

A power transmission system is modeled as shown ------- find the load current I_L.



$Z = Z_g + 2Z_l + Z_L$

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

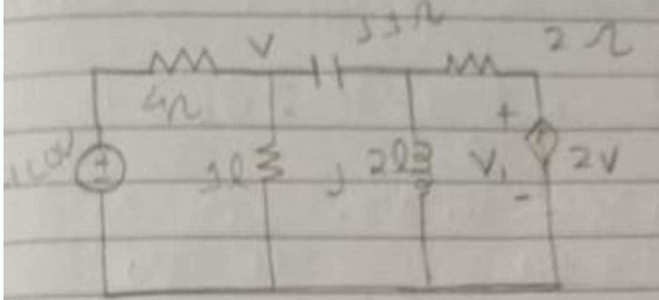
$Z = 25 + j20$

$I_L = V_s / Z = \dfrac{115\angle 0}{32.02\angle 38.66°}$

$$\boxed{I_L = 3.592\angle -38.66°}$$ ANSWER

x——————x

For the circuit in fig #5
Find the ave ----
dependent current source?



Consider the circuit as shown
At node o

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

$$24 = (5 + j4) V_o - j4 V_1 \rightarrow (1).$$

At node 1.

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

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

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

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

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

$$S = \frac{1}{2} V_2 I = \frac{1}{2} V_2 (2V_o)$$

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

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

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

x ———————————————— x

QUESTION # 7.

A balance Y_load to a 60Hz three Phase ---- Phase draw 5KW.

(a) determine the load independence Z

(b) Find I_a I_b 2_p I_c

(a) STEP # 1.

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

$$V = V_p \angle -30^\circ$$

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

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

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

$$S_p = 5 + j8.66\,KVA.$$

But

$$S_p = \frac{V_p^2}{Z_p} \rightarrow Z_p = \frac{V^2 P}{SP} = \frac{138.56^2}{(5+j8.66)\times10^3}$$

(B) STEP 2 :

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

$$I_b = I_o \angle -120^\circ = 72.17\angle -210^\circ A$$

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

x ———————————— x