Department of Electrical Engineering
Assignment
Date: 20/08/2020
Course Details

Course Title: Electrical Network Analysis **Module:** B-tech
Instructor: **Total Marks:** 30

Student Details

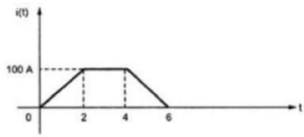
Name: **Student ID:** Rafaqat
14107

Q1 (a) For the circuit shown below, calculate the voltage V, the conductance G, and the power P. Marks 05

(b) A resistor absorbs an instantaneous power of when connected to a voltage source . Find I and R? Marks 05

Q2 (a) The current in a 4H inductor raises at a rate of 4A/s .Find the voltage across the inductor the energy stored in the magnetic field at after 2sec. Marks 04

(b) A current waveform flowing through an inductor of 1mH is shown in the figure. Obtain and sketch the waveform of voltage across the inductor.



Marks 06

Q3 (a) A series RLC circuit containing a resistance of 12Ω, an inductance of 0.15H and a capacitor of 100uF are connected in series across a 100V, 50Hz supply. Calculate the total circuit impedance, the circuits current, power factor and draw the voltage phasor diagram. Marks 07

R=12 Ohms,L=0.15H,C=100 micro Farad,Vs=100V,50HZ

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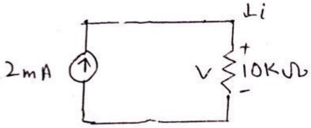
(1)

Name Rafaqatullah Khan

ID 14107

Question #01

(a) For the Circuit show below, Calculate the Voltage V, Conductance G, and the power P.



Solution:

$$V = IR$$

$$V = (2\times10^{-3})(10\times10^{3})$$

$$V = 2\times10 \times 10^{-3+3}$$

$$V = 20V$$

As we know that Capacitance is a Reciprocal of Resistance

So,

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

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(2)

$$\frac{1}{C} = \frac{V}{I}$$

$$\Rightarrow C = \frac{I}{V}$$

$$C = \frac{2\times10^{-3}}{20}$$

$$C = 0.0001$$

$$\boxed{C = 1mF}$$

Now

$$\text{Power} = V \times I$$

$$= 20 \times 2\times10^{-3}$$

$$= 40\times10^{-3}$$

$$\boxed{P = 40mW}$$

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Question # 01

(b) A Resistor absorbs an instantaneous Power of $20\cos^2(t)$ mW when Connected to a Voltage source $V = 10\cos(t)$ V. Find I & R ?

Solution:

Given a resistor absorbs an instantaneous power of $20\cos^2(t)$ mW

$$P = 20\cos^2(t) \text{ mW}$$

given Voltage source is

$$V = 10\cos(t) \text{ V}$$

$$I = \frac{P}{V}$$

$$I = \frac{20\cos^2(t) \times 10^{-3}}{10\cos(t)}$$

$$I = 2\cos(t) \times 10^{-3} \text{ A}$$

$$I = 2\cos(t) \text{ mA}$$

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(4)

$V = IR$

$R = \frac{V}{I}$

$R = \frac{10 \cos(t)}{2 \cos(t) \times 10^{-3}}$

$R = 5 \times 10^{3} \Omega$

$R = 5 K\Omega$

Question# 02

(a) The current in a 4H inductor raises at a rate of 4 A/s. Find the voltage across the inductor the energy stored in the magnetic field at after 2 sec?

Solution:

$L = 4 H$

$\frac{di}{dt} = 4 A/s$

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So

$$Voltage = L\frac{di}{dt}$$

$$= 4 \times 4$$

$$= 16V$$

$$W = \frac{1}{2}Li^2$$

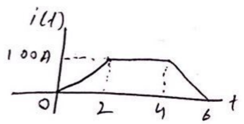
$$= \frac{1}{2}4(4)^2$$

$$= \frac{1}{2}4^2 \times 16$$

$$W = 32j$$

Question# 02

(b) A Current waveform flowing through an inductor of 1mH is shown in the figure. obtain a Sketch the waveform of Voltage across the inductor



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(6)

Solution:

From the given wave form:

For $0 < t < 2$:-

$i(t)$ is a straight line of slope $= \frac{100}{2} = 50$

Therefore,

$i(t) = 50t$ and $\frac{di(t)}{dt} = 50$

For $2 < t < 4$:-

$i(t) = 100$ and $\frac{di(t)}{dt} = 0$

For $4 < t < 6$,

$i(t)$ is a staight line of slope $= -\frac{100}{2} = -50$

Therfore,

$i(t) = -50t$ & $\frac{di(t)}{dt} = -50$.

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Now,

$$V_L(t) = L \frac{di(t)}{dt}$$

$= 1 \times 10^{-3} \times 50$

$= 0.05\ V \qquad , \qquad 0<t<2$

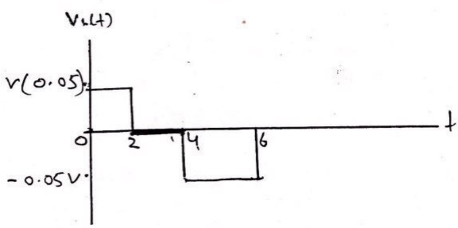
$= 1 \times 10^{-3} \times 0$

$= 0V \qquad , \qquad 2<t<4$

$= 1 \times 10^{-3} \times (-50)$

$= -0.05V \qquad 4<t<6.$

The voltage waveform is shown in following figure.



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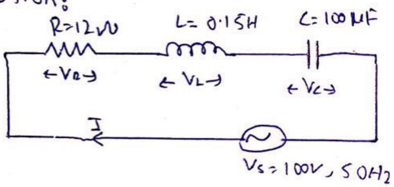
Question# 03

(a) A Series RLC Circuit Containing a Resistance of 12Ω. an inductance of 0.15H and a capacitor of 100μF are Connected in Series across a 200V. 50Hz Supply. Calculate the total circuit impedance & Current =? power factor =? & Voltage phasor diagram?

Solution:



Inductive Reactance,

$X_L = 2\pi f L$

$= 2\pi \times 50 \times 0.15$

$= 47.13\ \Omega$

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Capacitive Reactance

$$X_c = \frac{1}{2\pi f C}$$

$$= \frac{1}{2 \times 3.14 \times 50 \times 100 \times 10^{-6}}$$

$$= 31.83\,\Omega$$

Circuit Impedance:

$$Z = \sqrt{R^2 + (X_L - X_c)^2}$$

$$= \sqrt{(12)^2 + (47.13 - 31.83)^2}$$

$$= \sqrt{144 + 234}$$

$$= 19.4\,\Omega$$

Circuit Current:

$$I = \frac{V_s}{Z} = \frac{100}{19.4}$$

$$= 5.14 \text{ Amps.}$$

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(10)

Voltage across the Series RLC Circuit.

V_R, V_L V_C = ?

$V_R = I \times R$

$= 5.14 \times 12$

$= 61.7$ V

$V_L = I \times X_L$

$= 5.14 \times 47.13$

$= 242.2$ V

$V_C = I \times X_C$

$= 5.14 \times 31.8$

$= 163.5$ V

Circuit Power factor & Phase angle

$$\cos\phi = \frac{R}{Z} = \frac{12}{19.4} = 0.619$$

$\therefore \cos^{-1} 0.619 = 51.8^\circ$ degree.

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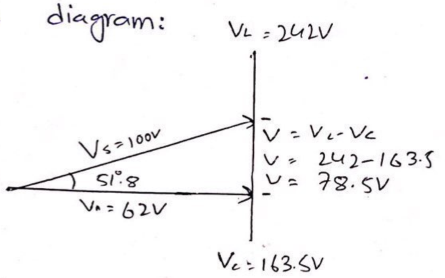
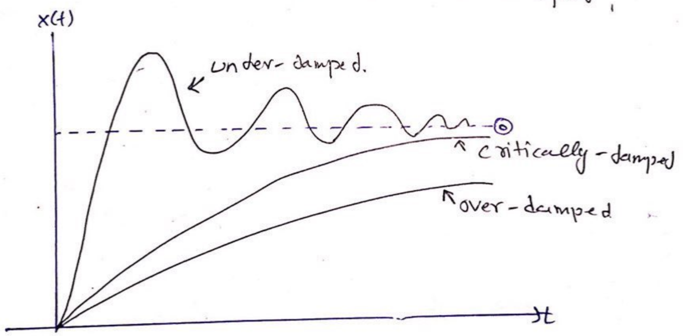
Phase diagram:



Question #03

(b) Write a short note on under damped, over damped & critical damped;

Sol:



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(12)

Under-Damped:

A System is called under-damped, If damping ratio (denoted by Zeta) is less than 1. Here the System Oscillates with a gradual decrements to zero. i-e automatic door or Window Closer is Under damped it will close with Considerable Velocity or the door will swing too or fro before closing at its normal Position.

Over-Damped:

A System is called over-damped, If the damping ratio is greater than one ($Z>1$) here System show tendencies to achieve equilibrium without Oscillating.

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(B)

Critically-Damped:

A System is called Critically damped if damping ratio for the System is exactly one. ($Z=1$). here System shows the tendencies to come to ecuuilibrium as quickly as possible without damping. Like automatic door & window closer mechanisms. they promptly come to original position without showing any further oscillation.

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