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MIT WORLD PEACE UNIVERSITY PUNE
TECHNOLOGY, RESEARCH, SOCIAL INNOVATION & PARTNERSHIPS

S. Y. B. Tech. (Electrical and Computer Engineering)

Semester: IV | **Subject: Electrical Circuit Analysis**

Name: Shreerang Mhatre | **Class:** B.Tech Elec & computer

Roll No: 29 | **Batch:** A2

Experiment No: 09

Name of the Experiment: Observing RLC series resonance using MATLAB.

Performed on: 15/11/2022

Submitted on: 22/11/2022

Marks	Teacher's Signature with Date
	22-11-22

Aim: To observe the RLC series resonance using MATLAB

Prerequisite: Knowledge of RLC circuits and MATLAB.

Theory:

A series RLC circuit is one in which resistor, inductor and capacitor are connected in series across a voltage supply. The resulting circuit is called series RLC circuit. Relationship between voltage and current in case of resistor, capacitor and inductor are different and explained below.
In case of resistor, the voltage and the current are in same phase, that is, the phase angle difference between voltage and current is zero.
In inductor, the voltage leads that of current by 90° and in capacitor, the voltage lags the current by 90^0.
The impedance Z of a series RLC circuit is defined as opposition to the flow of current, due to circuit resistance R, inductive reactance X_L and capacitive reactance X_C.

Inductive reactance $X_L = 2\pi fL$ means, inductive reactance is directly proportional to frequency and capacitive reactance $X_C = 1 / 2\pi fC$ is inversely proportional to frequency. As reactance is frequency phenomena, when the inductive and capacitive reactance becomes equal, it is called as resonance condition and the frequency at which these two reactance become equal, is called resonant frequency, f_r.

At resonance,

$X_L = X_C$

$$X_L = 2\pi fL \text{ and } X_C = \frac{1}{2\pi fC}$$

$$2\pi fL = \frac{1}{2\pi fC}$$

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$$2\pi fL = \frac{1}{2\pi fC}$$

At resonance $f = f_r$ and on solving above equation we get,

$$\frac{1}{2\pi\sqrt{LC}} = f_r \ H_Z$$

Procedure:

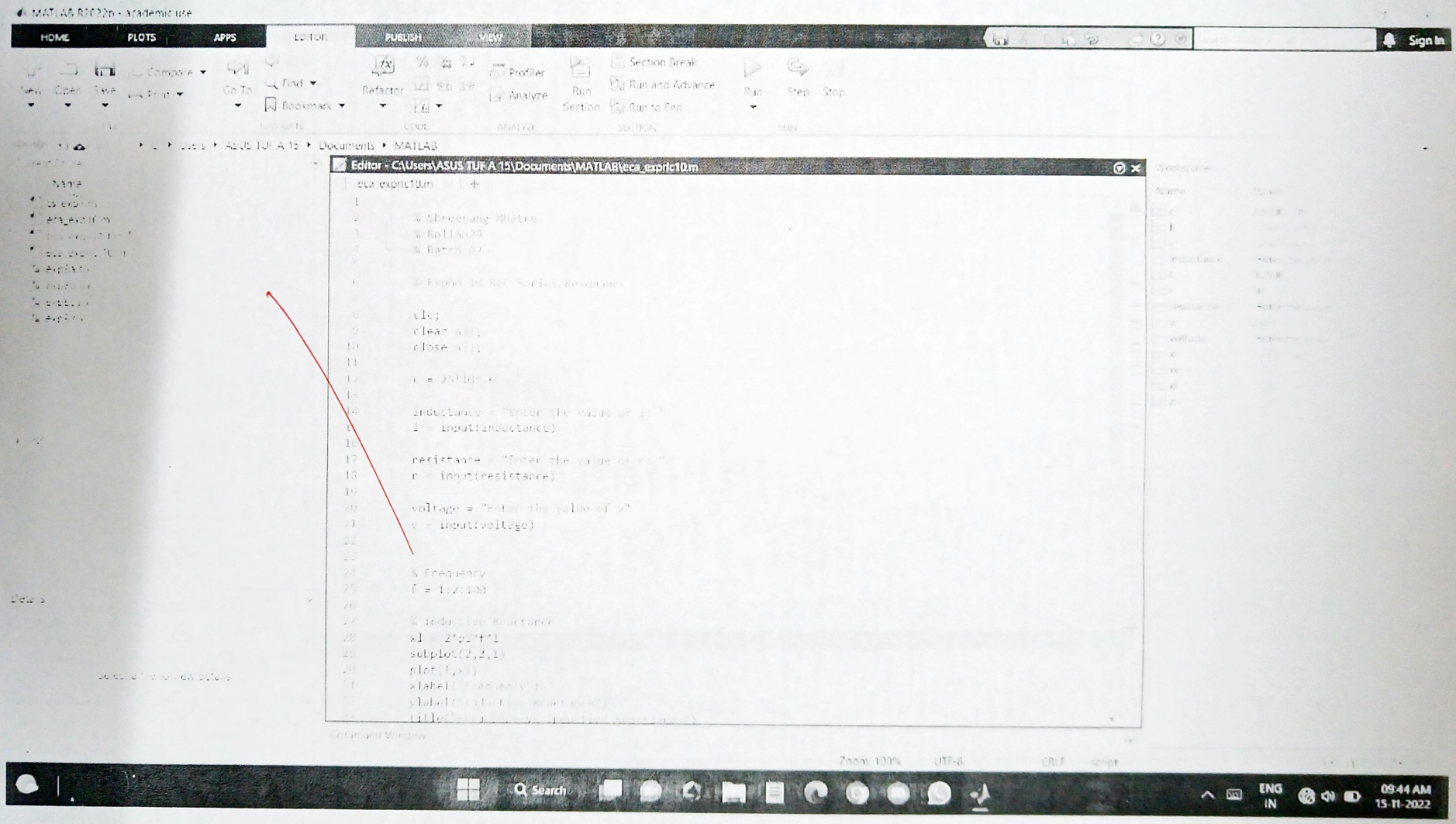
1. Start MATLAB.
2. Open a new file.
3. Write code to accept values of R, L, C and V from the user.
4. Using the code calculate inductive reactance, capacitive reactance, impedance and current for predetermined range of frequencies.
5. Plot the graph of all the above quantities against frequency axis.
6. Determine resonant frequency from the current waveform.

Activity:

Attach screenshots of code and output.

Post Lab Questions:

1. What is meant by resonance in RLC series circuit
2. Derive formula for resonant frequency.
3. Calculate theoretical value of resonant frequency for the same R, L, and C used in the code.


MATLAB R2022b - academic use
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eca exp1c10.m
% Shreerang Bhatre
% Roll no39
% Batch A2
% Expno 10 RLC Series Resonance
clc;
clear all;
close all;
inductance = "Enter the value of L"
l = input(inductance)
resistance = "Enter the value of R"
r = input(resistance)
voltage = "Enter the value of V"
v = input(voltage)
% Frequency
f = 10:100
% Inductive Reactance
xl = 2*pi*f*l
subplot(2,2,1)
plot(f,xl)
xlabel("Frequency")
ylabel("Inductive Reactance")
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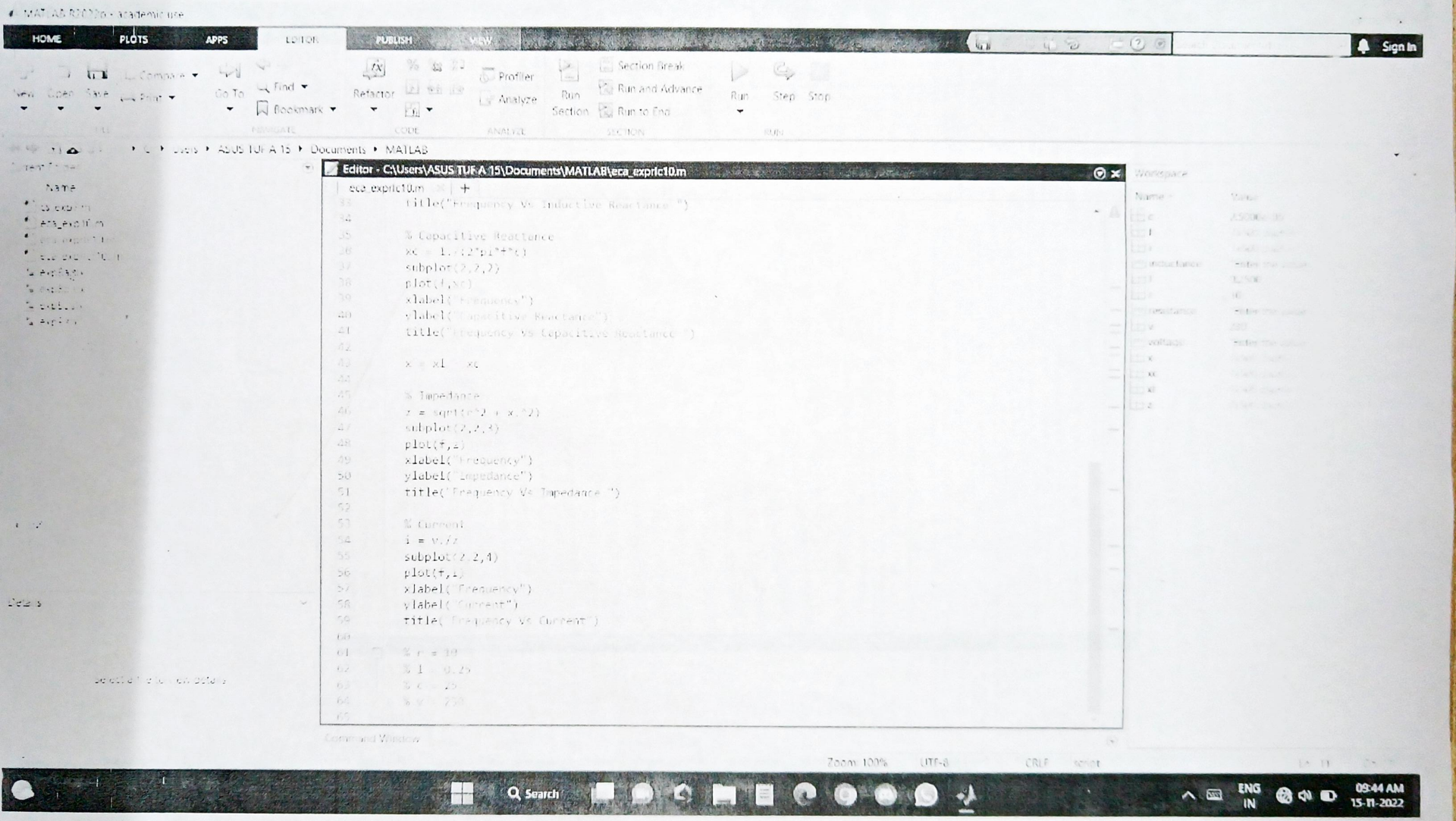
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Section Break
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Run
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ASUS TUF A 15 ▸ Documents ▸ MATLAB
Editor - C:\Users\ASUS TUF A 15\Documents\MATLAB\eca_exp4c10.m
eca_exp4c10.m
title("Frequency Vs Inductive Reactance ")
% Capacitive Reactance
xc = 1./(2*pi*f*c);
subplot(2,2,2)
plot(f,xc)
xlabel("Frequency")
ylabel("Capacitive Reactance")
title("Frequency Vs Capacitive Reactance ")
x = xl - xc
% Impedance
z = sqrt(r^2 + x.^2)
subplot(2,2,3)
plot(f,z)
xlabel("Frequency")
ylabel("Impedance")
title("Frequency Vs Impedance ")
% Current
i = v./z
subplot(2,2,4)
plot(f,i)
xlabel("Frequency")
ylabel("Current")
title("Frequency Vs Current")
% r = 10
% l = 0.25
% c = .5
% v = 230
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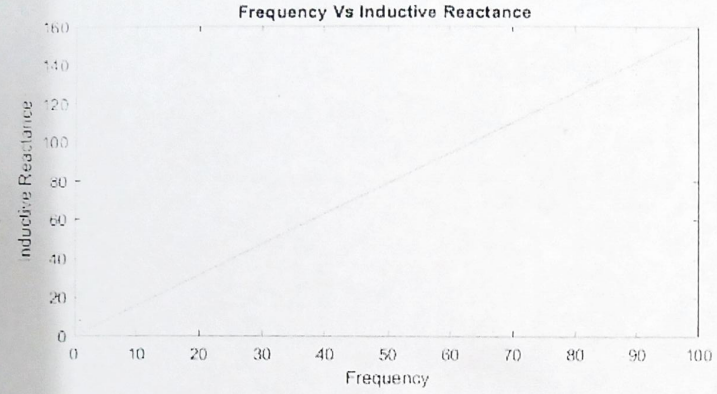
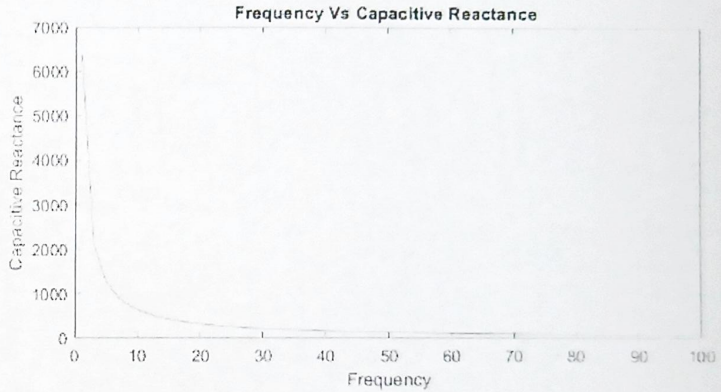
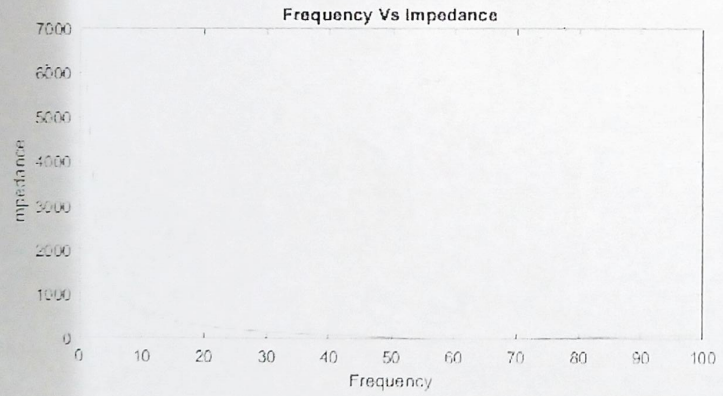
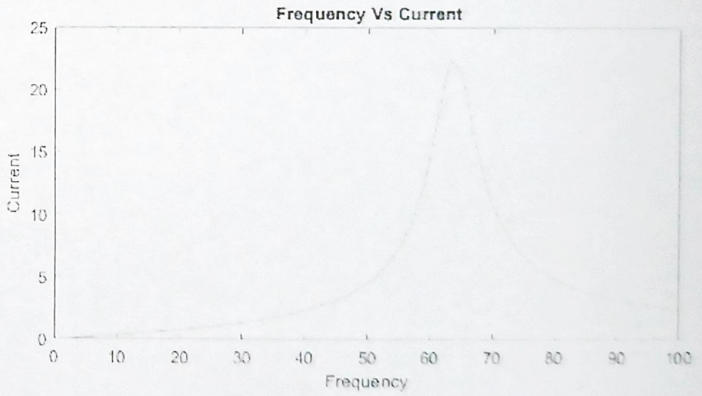
15-11-2022









* Post Lab Questions:

Q 1) what is meant by resonance in RLC series circuit.

→ The resonance of a series RLC circuit occurs when the inductive and capacitive reactances are equal in magnitude but cancel each other because they are 180 degrees apart in phase. The sharp minimum in impedance which occurs is useful in tuning applications.

Q 2) Derive formula for resonant frequency.

→ At resonance, $X_L = X_C$

$$X_L = 2\pi f L \text{ and } X_C = \frac{1}{2\pi f C}$$

$$2\pi f L = 1/2\pi f C$$

$$X_L = 2\pi f L \text{ and } X_C = 1/2\pi f C$$

$$2\pi f L = 1/2\pi f C$$

At resonance $f = fr$ on solving above equation we get,

$$\frac{1}{2\pi\sqrt{LC}} = fr \text{ Hz}$$