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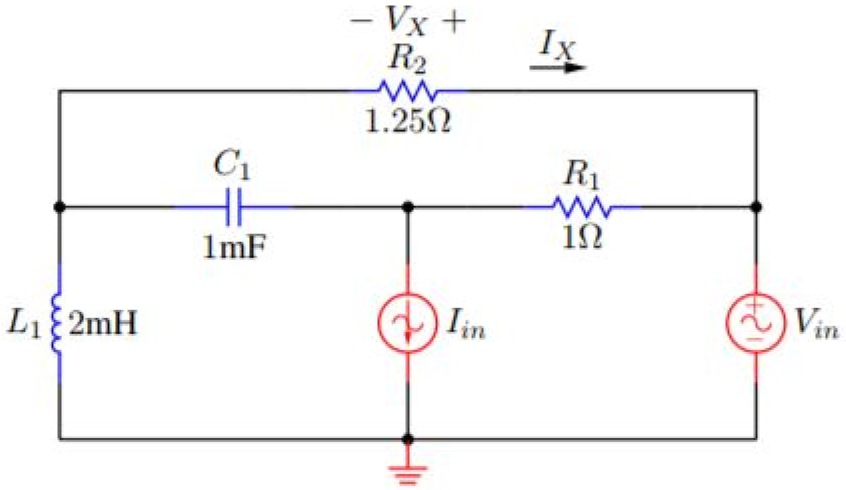
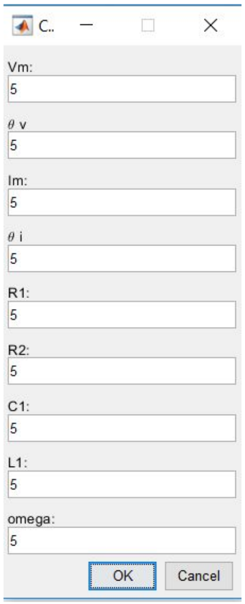
A01197044 - BCR
Electrical Circuits 2

It was commanded to us to generate a Matlab program to take some values as input which represent resistors, capacitors, voltages and currents. These values go according the following circuit.



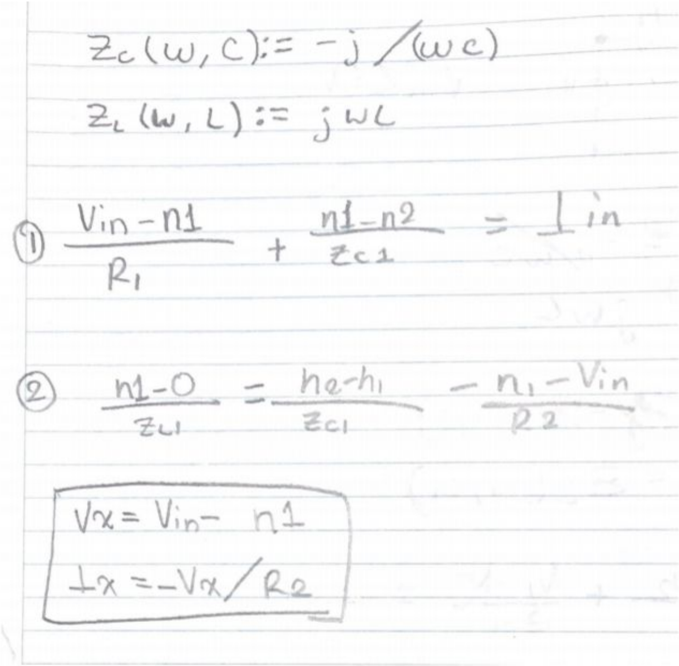
The first step for solving this circuit was to leave everything represented as variables and generating functions to be solved by the program.

A basic GUI was coded with Matlab in order to ease the input of values for the user.



Vm: 5
θ v 5
Im: 5
θ i 5
R1: 5
R2: 5
C1: 5
L1: 5
omega: 5

The functions used for solving the circuit are the following.



$$Z_c(\omega, c) := -j/(\omega c)$$

$$Z_L(\omega, L) := j\omega L$$

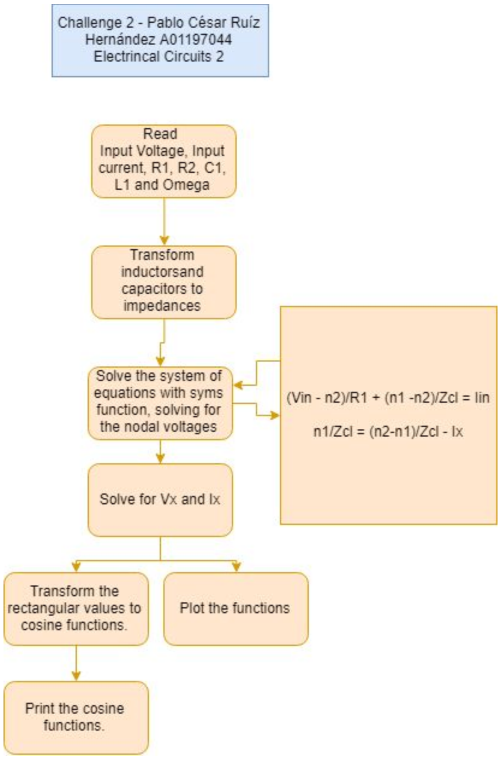
$$(1)\quad \frac{V_{in} - n1}{R_1} + \frac{n1 - n2}{Z_{c1}} = I_{in}$$

$$(2)\quad \frac{n1 - 0}{Z_{L1}} = \frac{n_2 - n_1}{Z_{c1}} - \frac{n_1 - V_{in}}{R2}$$

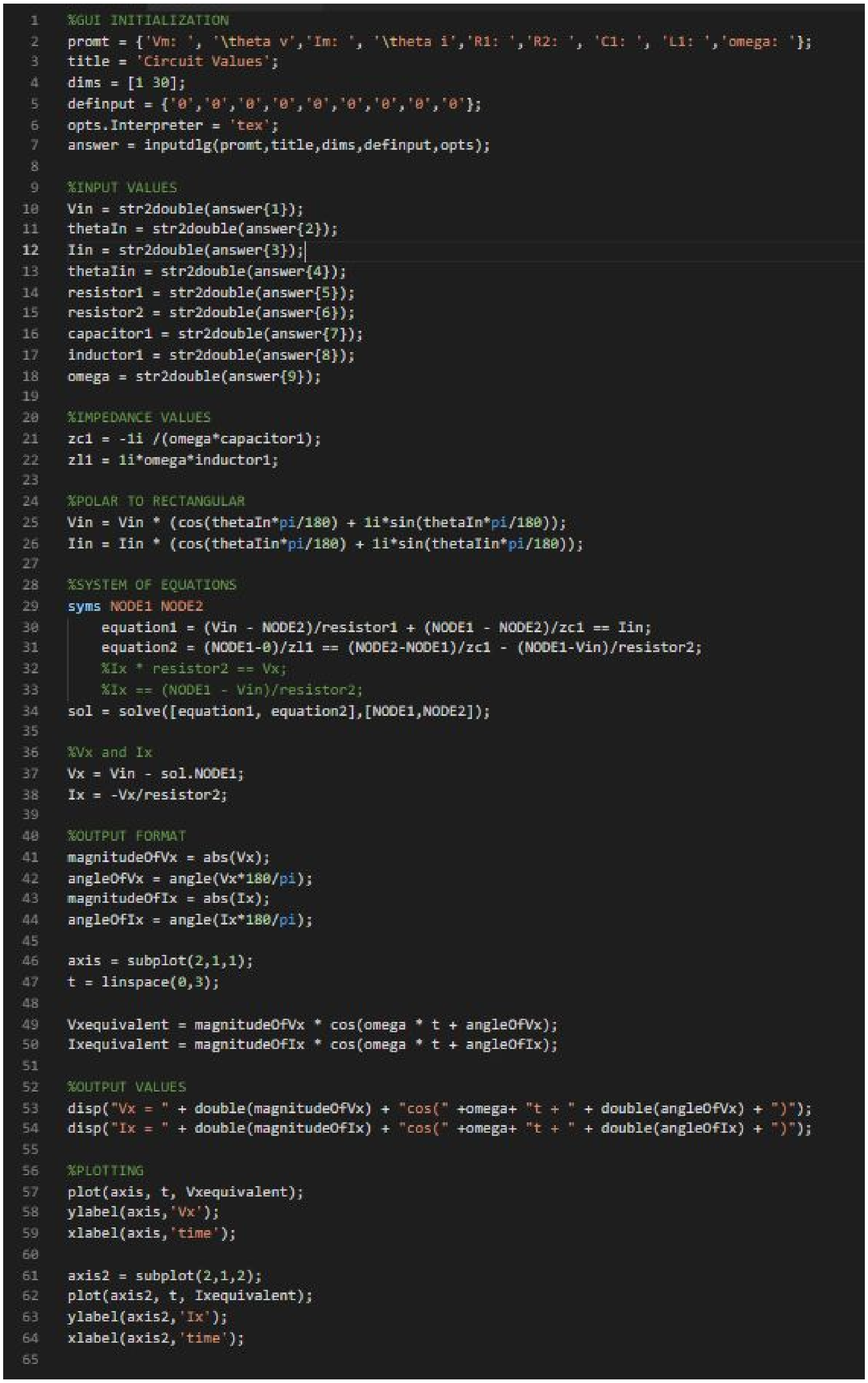
$$\boxed{\begin{array}{l} V_x = V_{in} - n1 \\ I_x = -V_x/R2 \end{array}}$$

(1) and (2) are the functions implemented at line 29. Please refer to the code to see how the syms function is used for solving this system of equations.

The following flow diagram was used to solve the problem behind the GUI.

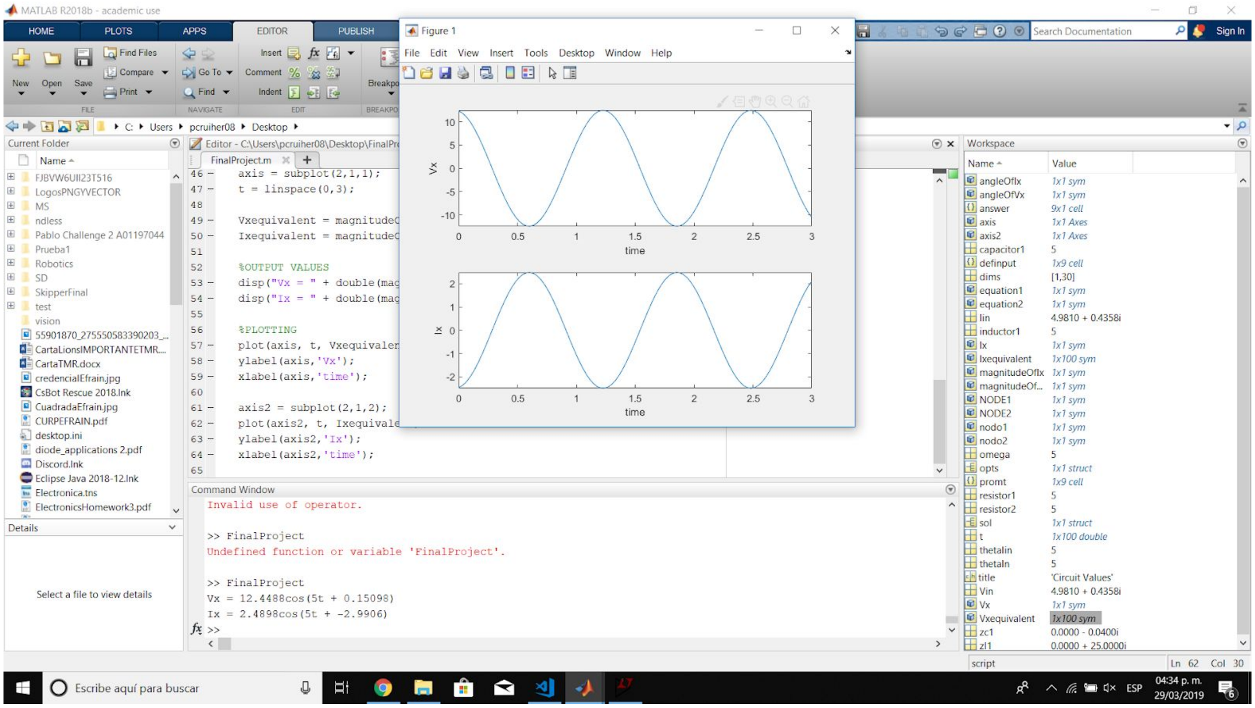

Challenge 2 - Pablo César Ruíz Hernández A01197044 Electrincal Circuits 2
Read Input Voltage, Input current, R1, R2, C1, L1 and Omega
Transform inductorsand capacitors to impedances
Solve the system of equations with syms function, solving for the nodal voltages
(Vin - n2)/R1 + (n1 -n2)/Zcl = Iin
n1/Zcl = (n2-n1)/Zcl - Ix
Solve for Vx and Ix
Transform the rectangular values to cosine functions.
Plot the functions
Print the cosine functions.

Code was edited with VSCode and compiled using Matlab 2018b.



```matlab
%GUI INITIALIZATION
promt = {'Vm: ', '\theta v','Im: ', '\theta i','R1: ','R2: ', 'C1: ', 'L1: ','omega: '};
title = 'Circuit Values';
dims = [1 30];
definput = {'0','0','0','0','0','0','0','0','0'};
opts.Interpreter = 'tex';
answer = inputdlg(promt,title,dims,definput,opts);

%INPUT VALUES
Vin = str2double(answer{1});
thetaIn = str2double(answer{2});
Iin = str2double(answer{3});
thetaIin = str2double(answer{4});
resistor1 = str2double(answer{5});
resistor2 = str2double(answer{6});
capacitor1 = str2double(answer{7});
inductor1 = str2double(answer{8});
omega = str2double(answer{9});

%IMPEDANCE VALUES
zc1 = -1i /(omega*capacitor1);
zl1 = 1i*omega*inductor1;

%POLAR TO RECTANGULAR
Vin = Vin * (cos(thetaIn*pi/180) + 1i*sin(thetaIn*pi/180));
Iin = Iin * (cos(thetaIin*pi/180) + 1i*sin(thetaIin*pi/180));

%SYSTEM OF EQUATIONS
syms NODE1 NODE2
    equation1 = (Vin - NODE2)/resistor1 + (NODE1 - NODE2)/zc1 == Iin;
    equation2 = (NODE1-0)/zl1 == (NODE2-NODE1)/zc1 - (NODE1-Vin)/resistor2;
    %Ix * resistor2 == Vx;
    %Ix == (NODE1 - Vin)/resistor2;
sol = solve([equation1, equation2],[NODE1,NODE2]);

%Vx and Ix
Vx = Vin - sol.NODE1;
Ix = -Vx/resistor2;

%OUTPUT FORMAT
magnitudeOfVx = abs(Vx);
angleOfVx = angle(Vx*180/pi);
magnitudeOfIx = abs(Ix);
angleOfIx = angle(Ix*180/pi);

axis = subplot(2,1,1);
t = linspace(0,3);

Vxequivalent = magnitudeOfVx * cos(omega * t + angleOfVx);
Ixequivalent = magnitudeOfIx * cos(omega * t + angleOfIx);

%OUTPUT VALUES
disp("Vx = " + double(magnitudeOfVx) + "cos(" +omega+ "t + " + double(angleOfVx) + ")");
disp("Ix = " + double(magnitudeOfIx) + "cos(" +omega+ "t + " + double(angleOfIx) + ")");

%PLOTTING
plot(axis, t, Vxequivalent);
ylabel(axis,'Vx');
xlabel(axis,'time');

axis2 = subplot(2,1,2);
plot(axis2, t, Ixequivalent);
ylabel(axis2,'Ix');
xlabel(axis2,'time');
```

Matlab outputs

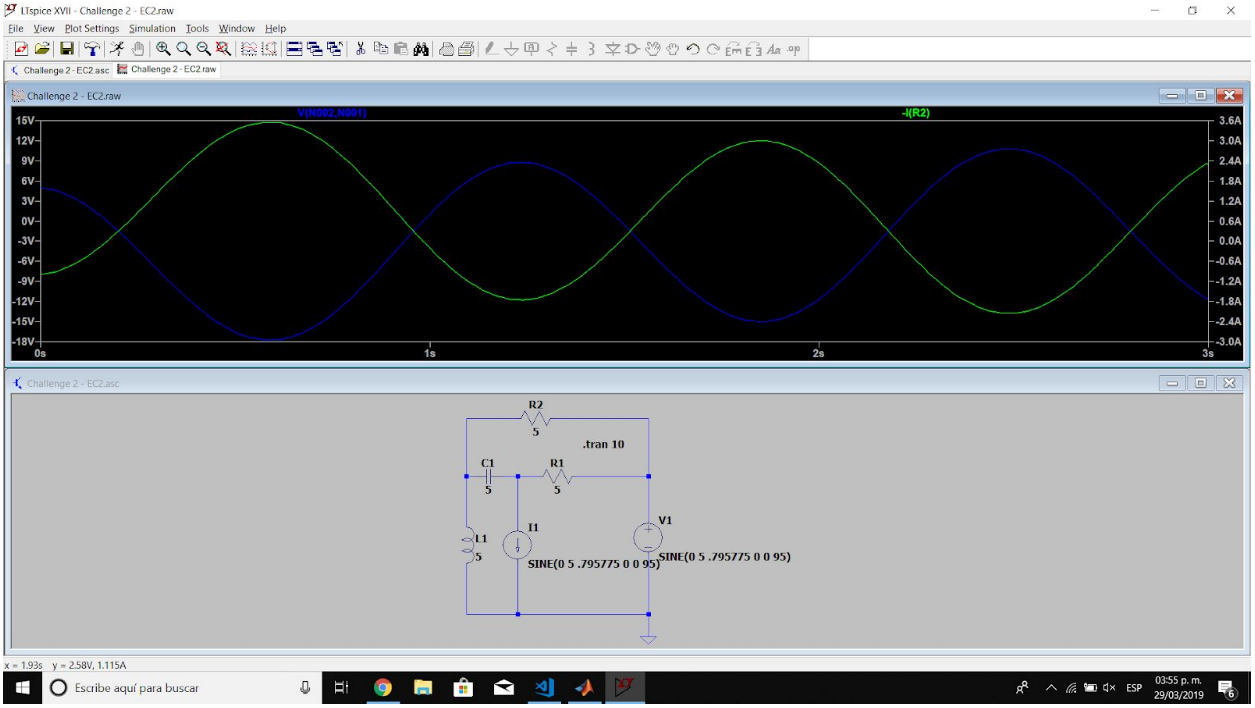


```
    axis = subplot(2,1,1);
    t = linspace(0,3);

    Vxequivalent = magnitudeC
    Ixequivalent = magnitudeC

    %OUTPUT VALUES
    disp("Vx = " + double(mag
    disp("Ix = " + double(mag

    %PLOTTING
    plot(axis, t, Vxequivalen
    ylabel(axis,'Vx');
    xlabel(axis,'time');

    axis2 = subplot(2,1,2);
    plot(axis2, t, Ixequivale
    ylabel(axis2,'Ix');
    xlabel(axis2,'time');
```

```
Invalid use of operator.

>> FinalProject
Undefined function or variable 'FinalProject'.

>> FinalProject
Vx = 12.4488cos(5t + 0.15098)
Ix = 2.4898cos(5t + -2.9906)
>>
```

Name	Value
angleOfIx	1x1 sym
angleOfVx	1x1 sym
answer	9x1 cell
axis	1x1 Axes
axis2	1x1 Axes
capacitor1	5
definput	1x9 cell
dims	[1,30]
equation1	1x1 sym
equation2	1x1 sym
Iin	4.9810 + 0.4358i
inductor1	5
Ix	1x1 sym
Ixequivalent	1x100 sym
magnitudeOfIx	1x1 sym
magnitudeOf...	1x1 sym
NODE1	1x1 sym
NODE2	1x1 sym
nodo1	1x1 sym
nodo2	1x1 sym
omega	5
opts	1x1 struct
promt	1x9 cell
resistor1	5
resistor2	5
sol	1x1 struct
t	1x100 double
thetaIin	5
thetaIn	5
title	'Circuit Values'
Vin	4.9810 + 0.4358i
Vx	1x1 sym
Vxequivalent	1x100 sym
zc1	0.0000 - 0.0400i
zl1	0.0000 + 25.0000i

LTSpice Circuit Simulation with all input values of 5, graphs are the same as shown in Matlab. Both outputs are totally related.



I1: SINE(0 5 .795775 0 0 95)

V1: SINE(0 5 .795775 0 0 95)

Personal experiences:

The challenge was alright, I liked that it forced us to learn a little more about Matlab. Such an important tool will be really important for our further engineering life. The time race that I experienced by starting and finishing this challenge all in two hours before its due time was amazing. Although, I wouldn't recommend my fellow classmates to try these risky practices. It would have been way better if I had done this project earlier.