

RLC Steady State Analysis Project

This project aims to analyze a RLC electrical circuit driven by a sinusoidal source in steady state. You will choose a RLC circuit, reduce it to an equivalent impedance, apply Kirchhoff's Laws to form a linear system of phasor equations, compute the resulting current(s), and build an Excel file that evaluates the current magnitude(s) and phase(s) over a range of frequencies. You will present your Excel file and be able to explain and modify it on the spot.

Number of group members: 1-2

Presentation: week 14

Worth 10% of final grade

Choose a RLC circuit

Pick a simple RLC circuit (containing 2-3 loops).

Examples:

microphone, speaker, ...

filter (low-pass, band-pass, high-pass RLC networks)

Determine the equivalent impedance

Replace each circuit element with its impedance.

Combine impedances using series and parallel rules.

Apply Kirchhoff's Laws and Ohm's Law:

KVL (sum of voltages in a loop = 0)

KCL (sum of currents at a node = 0)

Ohm's Law in phasor form

Set up your phasor equations for the unknown current(s)

This will produce a linear system.

Solve for the complex steady-state current(s).

Excel Implementation

Build a Excel file that computes the phasor solution over a range of frequencies.

Your sheet must include:

Parameter section (clearly labeled)

Frequency column (both omega and frequency values)

Impedance column(s):

Compute individual, and total equivalent impedance

Current phasor column

Compute real part, imaginary part, magnitude, and phase.

Required Plots (from Excel):

Magnitude (Current) Response

Plot I [dB] versus frequency [Hz]

Include units and labels.

Phase Response

Plot ϕ_I [degrees] versus frequency [Hz]

Include units and labels.

Marking Scheme

Correctness (math & physics) 2 mark(s)

Correct impedance combinations

Correct use of KVL/KCL and Ohm's Law

Magnitude response plot 2 mark(s)

Correct data, labels, meaningful behaviour

Phase response plot 2 mark(s)

Correct data, labels, meaningful behaviour

Presentation & understanding 2 mark(s)

Ability to explain your model

Effect of parameter changes

Formatting and clarity 2 mark(s)

Clearly labeled parameters, units, and variables

Clean, readable Excel layout

Total 10 mark(s)