Brac University

Department of Electrical & Electronic Engineering

Semester: Summer 2024

Course Number : EEE203L

Course Title: Electrical Circuits II Laboratory

Section: 1

Project

Ensuring maximum power transfer to a load at resonant frequency.

Prepared by:

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Group Number: 02

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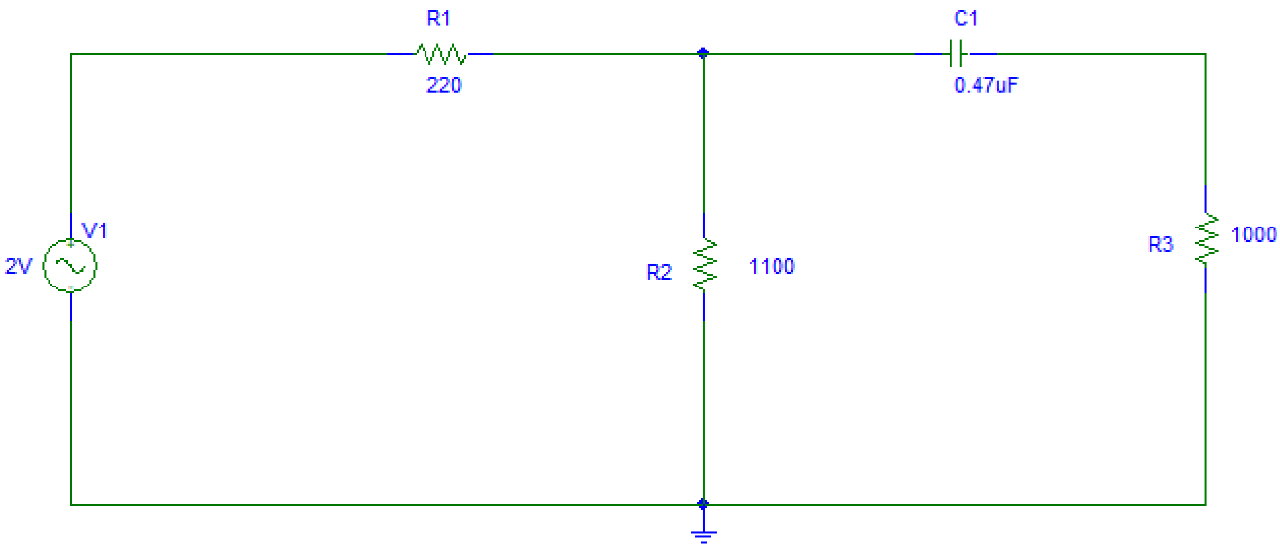
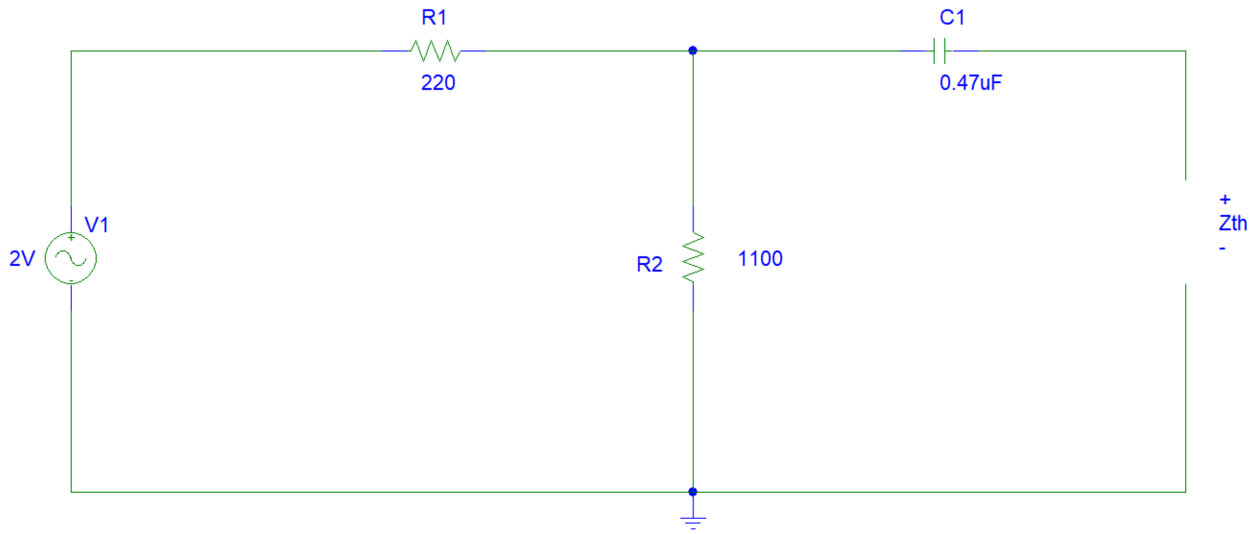
Objective: We need to find a load component which will consume maximum average power in a circuit and also, we need to ensure there will be resonance for an input frequency of 1kHz.

Circuit Diagram:





From Calculations, **Z_{th}= 183-338.6j**

V_{th}= 1.67∠0

From Zth (Z_{th}= 183-338.6j), we can get the value of Capacitor, as -338.6j

Or , **C= 0.47uF**

From the formula of resonance frequency, **fr= 1/2π√LC**

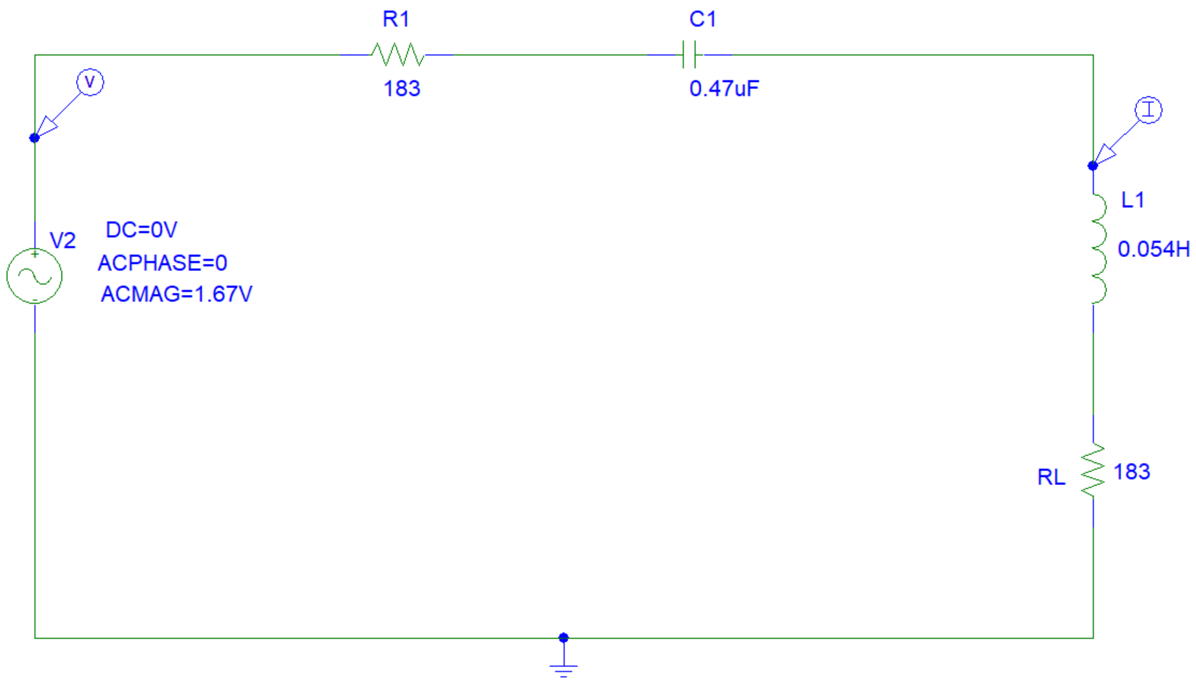
We get **L= 0.054H**, here **f=1kHz**

Again for **load resistance**,

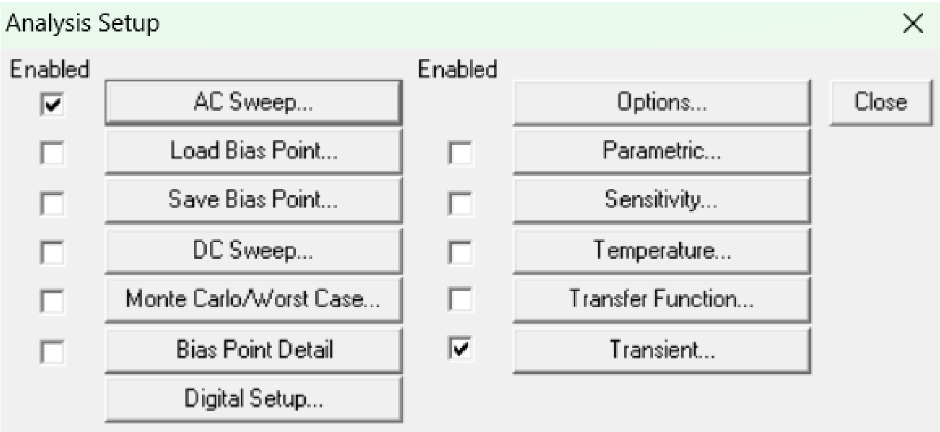
Load resistance, **rL**= √((183)^2+(339.29-338.6)^2)

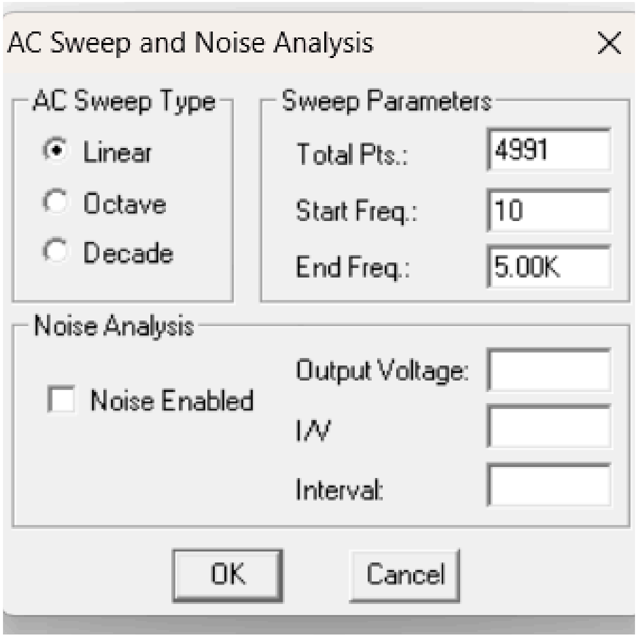
rL= 183Ω

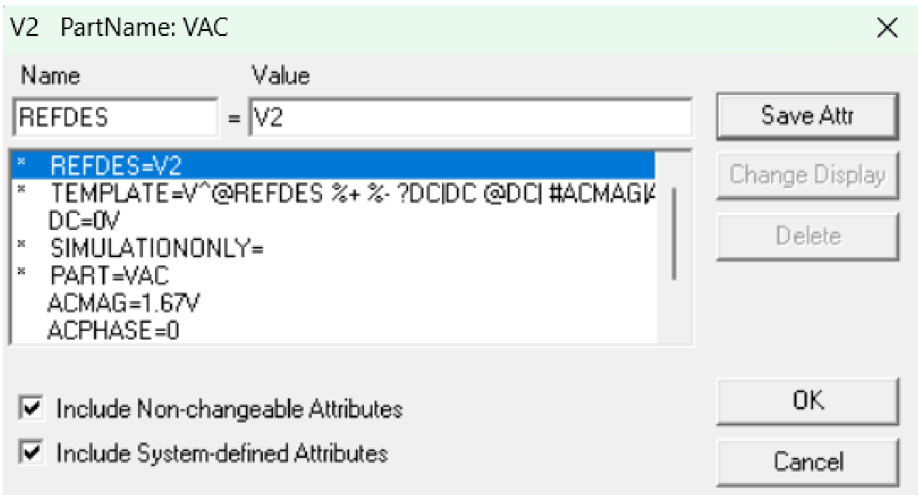
Simplified RLC circuit:



Setup Analysis:

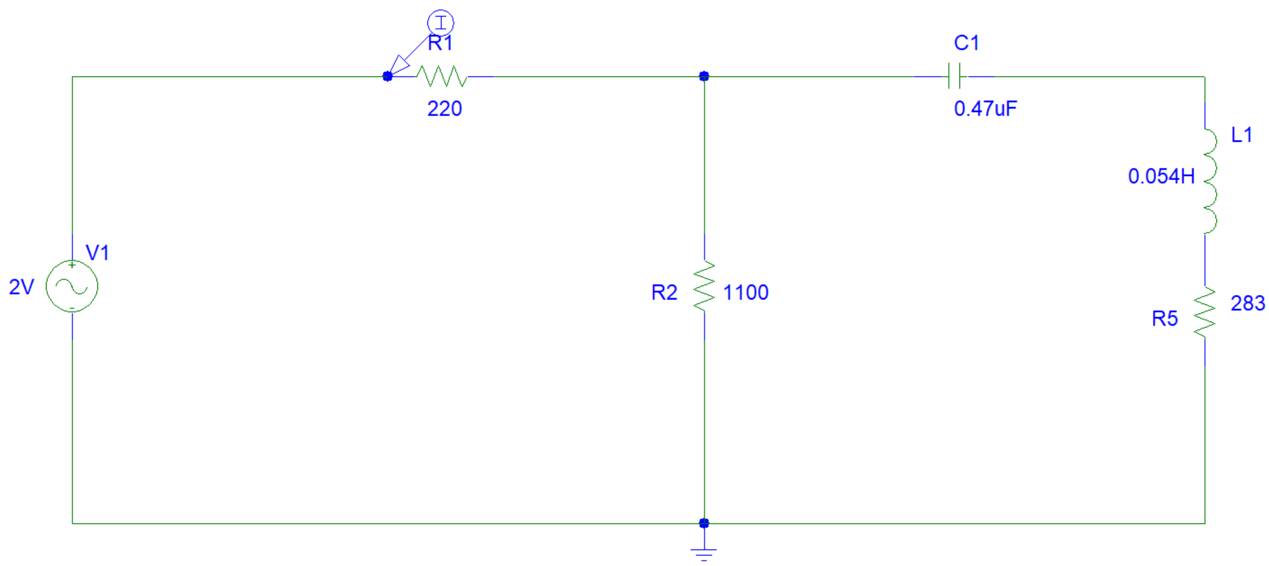






Frequency Response Graph:

Reconstructing the circuit:



Graph we get :

* C:\Users\hp\Downloads\pth.sch
Date/Time run: 09/21/24 01:15:20
Temperature: 27.0
(A) pth (active)
5.0mA
4.0mA
3.0mA
2.0mA
1.0mA
(1.0080K,4.4931m)
0Hz
1.0KHz
2.0KHz
3.0KHz
4.0KHz
5.0KHz
6.0KHz
I(R1)
Frequency
A1:(1.0080K,4.4931m) A2:(10.000,1.5163m) DIFF(A):(0.9980K,2.9769m)
Date: September 21, 2024
Page 1
Time: 01:16:23

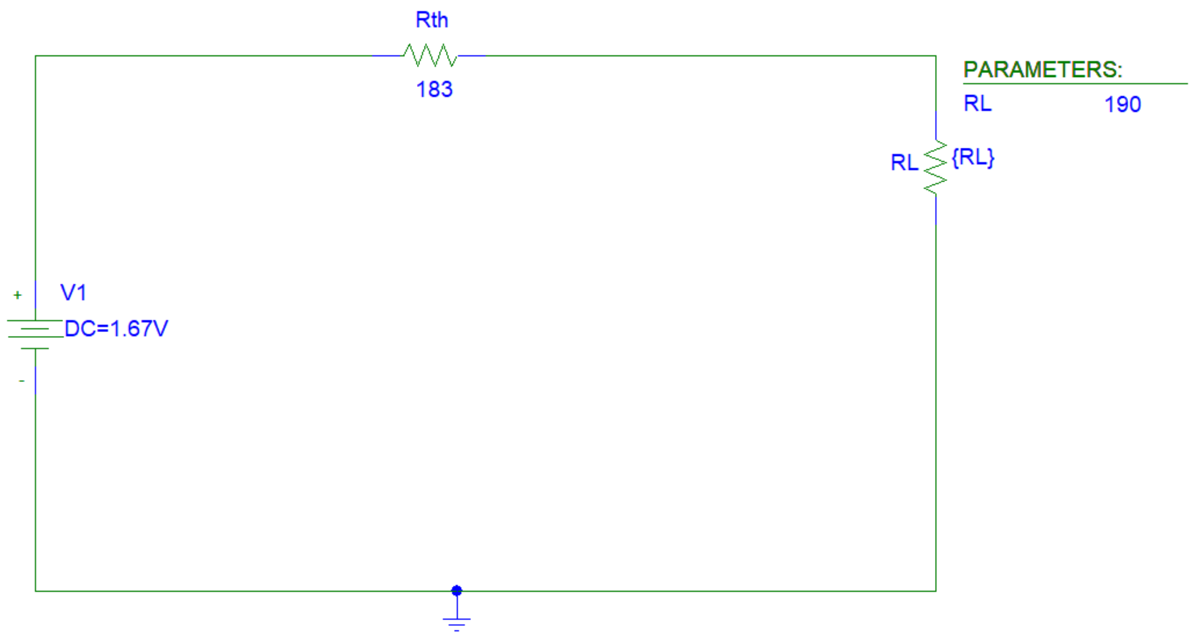
Maximum Power Transfer:

For maximum power transfer, the formula is

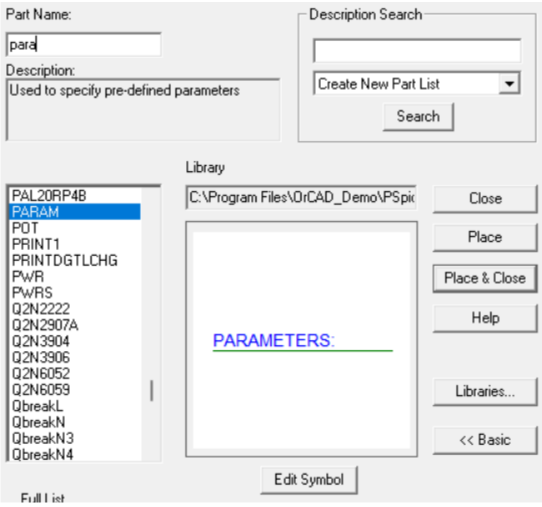
$P_{max} = V_{Th}^2/4R_{Th}$

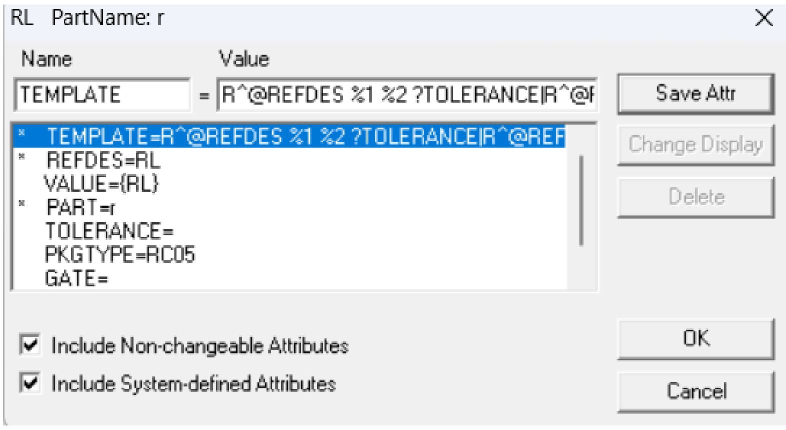
Here only the magnitude of V_{Th} and R_{Th} matters. So, we can construct a DC circuit to find the R which will consume maximum power ignoring the capacitive and inductive components as their reactance in AC was zero.

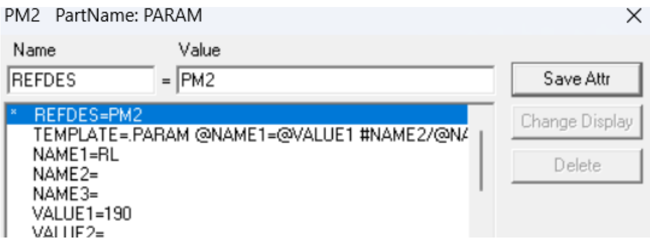
Circuit Diagram:

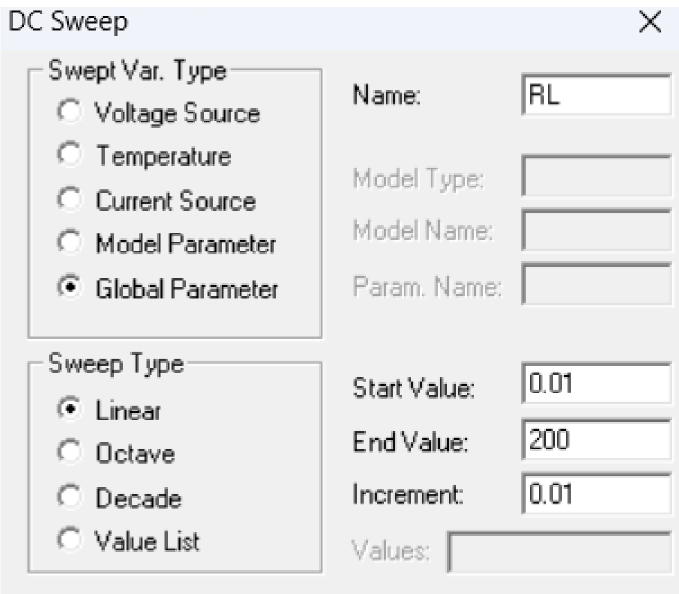


Setup analysis:









Data Table:

R (kΩ)	P_{max} (mW)	P_{avg}= P_{max}/2 (mW)
183Ω	3.8099 mW	1.90495

Calculation: According to the formula of P_{max} , **we get P_{max}=3.8099 mW** which is the same as the simulation result.(R_{th}=183 ohm).

By analyzing the graph we get that power becomes maximum when load resistance is **181.980** (182) ohm .

Now, let's take a lower value of R_L to calculate the power,

Let, R_L= 160Ω

Then, P_{max}= $\frac{VTh^2}{(RTh+RL)^2}RL$

P_{max}= 3.7928 mW

Again, Let, R_L = 200 Ω

Then, **P_{max}= 3.8024 mW**

In both cases, the power is lesser than the simulation result. Which means our calculation is right.

Graph:

* C:\Users\hp\Downloads\pr 203L(2).sch
Date/Time run: 09/20/24 02:22:00
Temperature: 27.0
(A) pr 203L(2) (active)
4.0m
3.0m
2.0m
1.0m
0
(181.980,3.8099
0
50
100
150
200
I(RL) * I(RL) * RL
RL
A1:(181.980,3.8099m) A2:(10.000m,832.690n) DIFF(A):(181.970,3.8091m)
Date: September 20, 2024
Page 1
Time: 02:23:01