

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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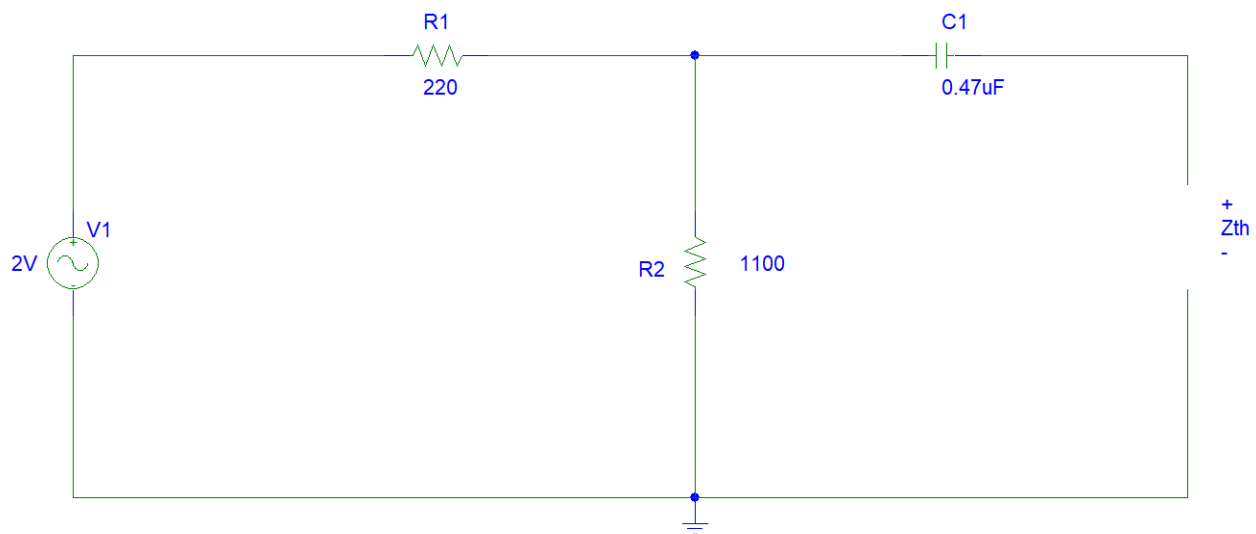
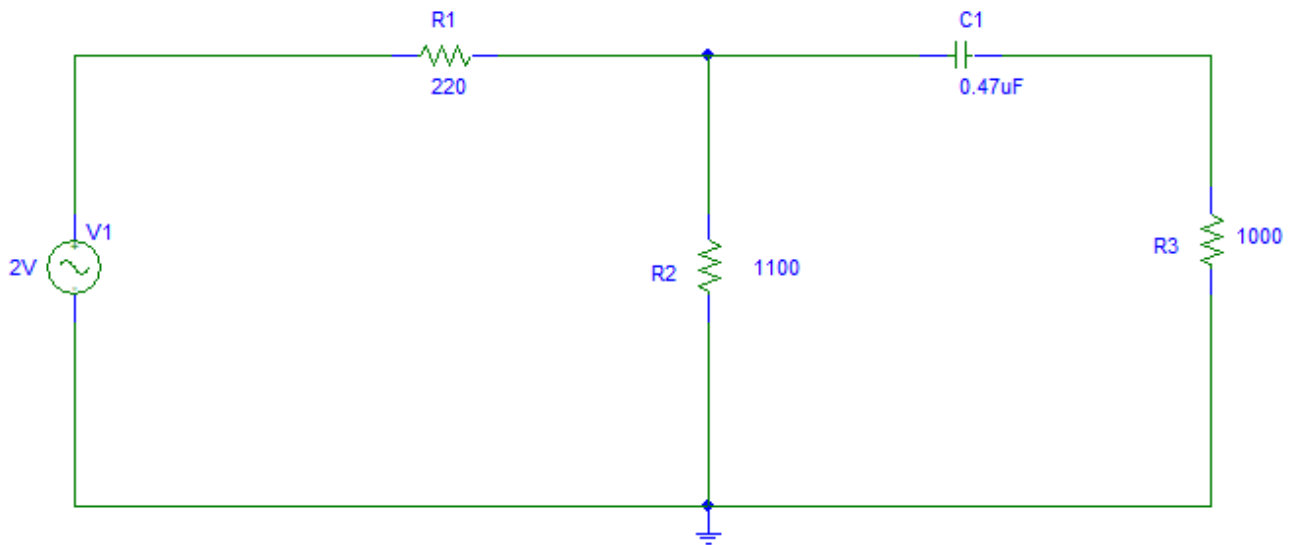
Group Number: 02

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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, **$Z_{th} = 183 - 338.6j$**

$$V_{th} = 1.67 \angle 0$$

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

Or, **$C = 0.47 \mu F$**

From the formula of resonance frequency, **$f_r = 1/2\pi\sqrt{LC}$**

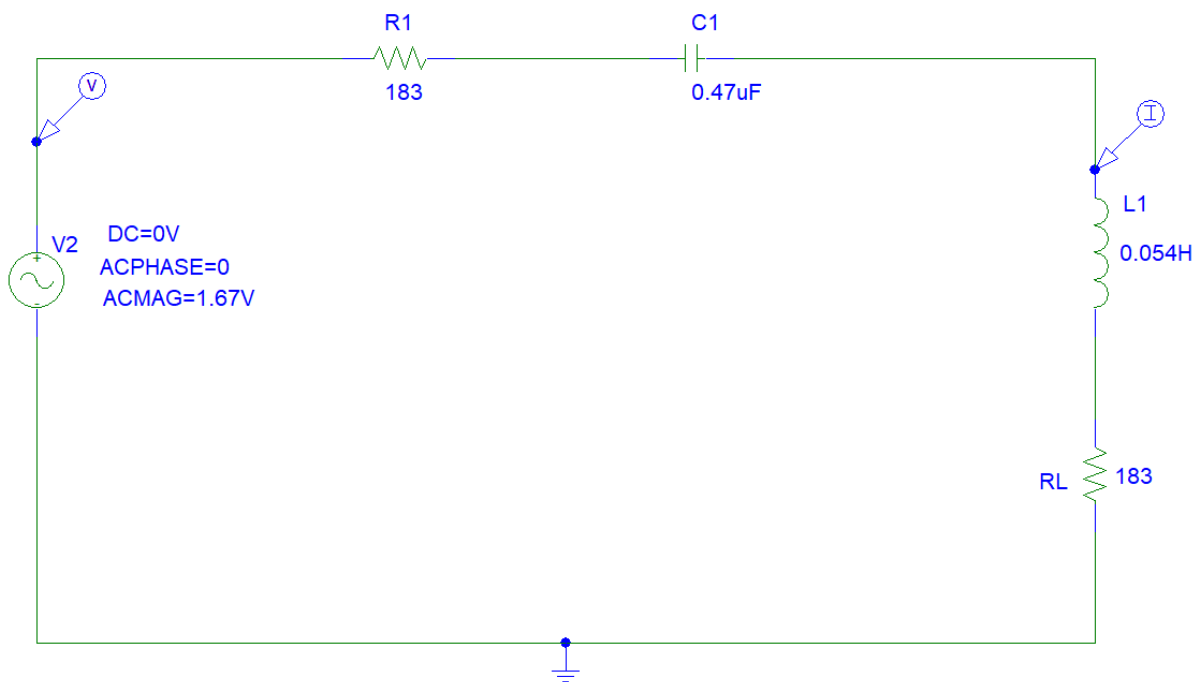
We get **$L = 0.054 H$** , here **$f = 1 kHz$**

Again for **load resistance**,

Load resistance, **$r_L = \sqrt{(183)^2 + (339.29 - 338.6)^2}$**

$r_L = 183 \Omega$

Simplified RLC circuit:



Setup Analysis:

Analysis Setup

Enabled

☒ AC Sweep...

☐ Load Bias Point...

☐ Save Bias Point...

☐ DC Sweep...

☐ Monte Carlo/Worst Case...

☐ Bias Point Detail

☐ Digital Setup...

Enabled

☐ Options...

☐ Parametric...

☐ Sensitivity...

☐ Temperature...

☐ Transfer Function...

☒ Transient...

Close

AC Sweep and Noise Analysis

AC Sweep Type

☒ Linear

☐ Octave

☐ Decade

Sweep Parameters

Total Pts.: 4991

Start Freq.: 10

End Freq.: 5.00K

Noise Analysis

☐ Noise Enabled

Output Voltage:

I/V

Interval:

OK

Cancel

V2 PartName: VAC

Name

Value

REFDES = V2

* REFDES=V2

* TEMPLATE=V^@REFDES %+ %- ?DC|DC @DC| #ACMAG|

DC=0V

* SIMULATIONONLY=

* PART=VAC

ACMAG=1.67V

ACPHASE=0

Save Attr

Change Display

Delete

OK

Cancel

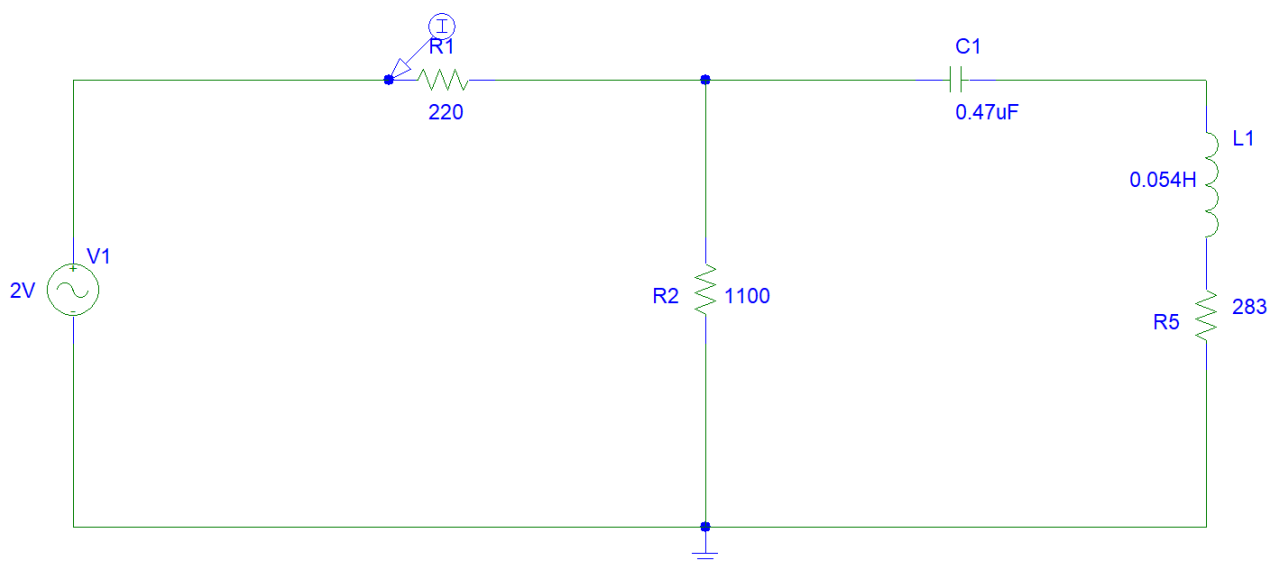
☒ Include Non-changeable Attributes

☒ Include System-defined Attributes

Frequency Response Graph:



Reconstructing the circuit:



Graph we get :



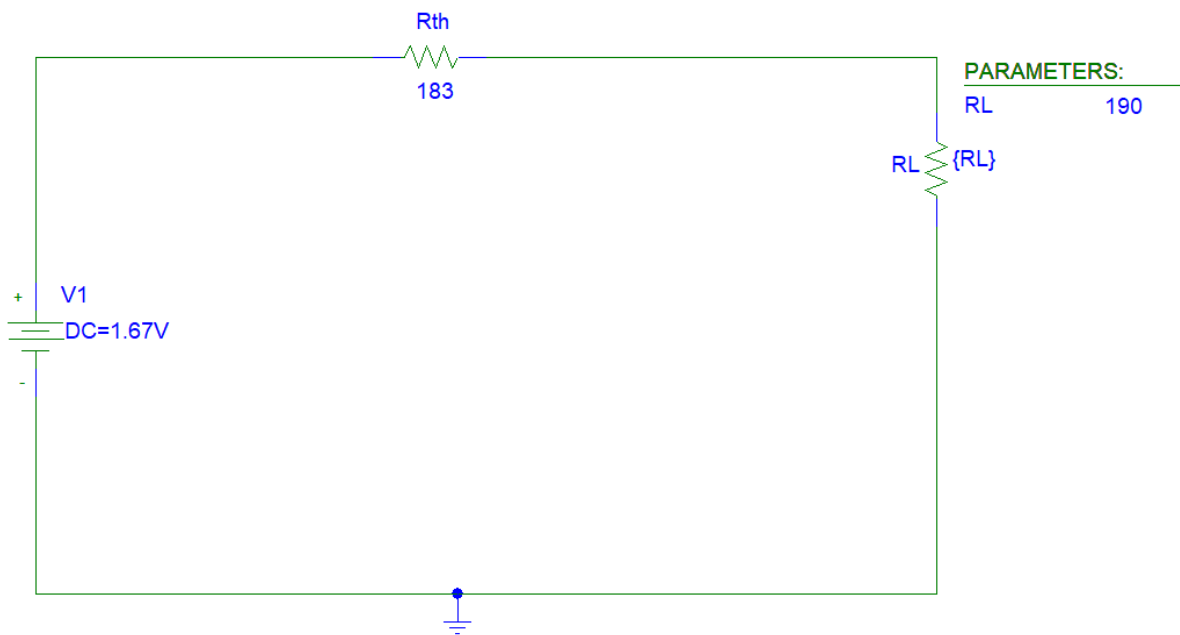
Maximum Power Transfer:

For maximum power transfer, the formula is

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

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:

Part Name:

Description:

Description Search:
Create New Part List

Library:

Close Place Place & Close Help Libraries... << Basic

Full List

PARAMETERS:

RL PartName: r

Name	Value
TEMPLATE	= R^@REFDES %1 %2 ?TOLERANCEIR^@F
* TEMPLATE=R^@REFDES %1 %2 ?TOLERANCEIR^@REF	
* REFDES=RL	
VALUE={RL}	
* PART=r	
TOLERANCE=	
PKGTYPE=RC05	
GATE=	

☒ Include Non-changeable Attributes ☒ Include System-defined Attributes

Save Attr Change Display Delete OK Cancel

PM2 PartName: PARAM

Name	Value
REFDES	= PM2
* REFDES=PM2	
TEMPLATE=PARAM @NAME1=@VALUE1 #NAME2/@N	
NAME1=RL	
NAME2=	
NAME3=	
VALUE1=190	
VAL11F2=	

Save Attr Change Display Delete

DC Sweep

Swept Var. Type

☐ Voltage Source
☐ Temperature
☐ Current Source
☐ Model Parameter
☒ Global Parameter

Name:

Model Type:
Model Name:
Param. Name:

Sweep Type

☒ Linear
☐ Octave
☐ Decade
☐ Value List

Start Value:
End Value:
Increment:
Values:

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

$$\text{Then, } P_{\max} = \frac{V_{Th}^2}{(R_{Th} + R_L)^2} R_L$$

$$\mathbf{P_{\max} = 3.7928 \text{ mW}}$$

Again, Let, R_L = 200 Ω

$$\text{Then, } \mathbf{P_{\max} = 3.8024 \text{ mW}}$$

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

Graph:



