# LABORATORY MANUAL

**Of**

# ELECTRICAL SIMULATION TOOLS LABORATORY (R22A0285)

**II B. Tech I – SEM (EEE)**

**Prepared by:**

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**Mr. K.ARAVINDA SWAMY, Assistant Professor**

**DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING**

**MALLA REDDY COLLEGE ENGINEERING & TECHNOLOGY**

**(Autonomous Institution – UGC, Govt. of India)**

**(Affiliated to JNTU, Hyderabad, Approved by AICTE - - ISO 9001:2015 Certified)**

**Accredited by NBA & NAAC – 'A' Grade**

**NIRF India Ranking 2018, Accepted by MHRD, Govt. of India**

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## CERTIFICATE

*Department of Electrical and Electronics Engineering certified that in the bonafide Record of the work done by Mr./Miss.---------------------------------------------------------------------------------------------- Reg.No--------------------------------of B-Tech EEE-----------YEAR---------------semester for the Academic year 20------- to 20------------- in --------------------------------- ------------------- Laboratory.*

***Date:*** **Staff In charge** **HOD**

# LIST OF EXPERIMENTS

**Course Objectives:**

- To understand basic block sets of different simulation platform used in electrical/electronic circuit design.
- To understand use and coding in different software tools used in electrical/ electronic circuit design.
- To understand the simulation of electric machines/circuits for performance analysis.

Any **ten experiments** need to be performed from the following experiments from various subject domains

1. Introduction to basic matrix operations.
2. Generation of standard test signals using suitable simulation tools.
3. Measurement of Voltage, Current and Power in DC circuits.
4. Verification of different network theorems Thevenin's & Norton’s with independent sources using suitable simulation tools.
5. Verification of performance characteristics of basic Electronic Devices using suitable simulation tools.
6. Analysis of series and parallel resonance circuits using suitable simulation tools
7. Obtain the response of R-L circuit with standard test signals using suitable simulation tools.
8. Modeling and Analysis of Low pass and High pass Filters using suitable simulation tools
9. Performance analysis of DC motor using suitable simulation tools
10. Modeling of transformer using suitable simulation tools.
11. Analysis of single-phase bridge rectifier with and without filter using suitable Simulation tools.
12. Modeling and Verification of Voltage Regulator using suitable simulation tools.
13. Modeling of transmission line using simulation tools.
14. Performance analysis of Solar PV model using suitable simulation tools

**Course Outcomes:** At the end of this course, students will demonstrate the ability to

- Develop knowledge of software packages to model and program electrical and electronics systems.
- Model different electrical and electronic systems and analyze the results.
- Articulate importance of software packages used for simulation in laboratory experimentation by analyzing the simulation results.

# INDEX

| S.NO | DATE | NAME OF THE EXPERIMENT | GRADE | SIG OF THE FACULTY |
|---|---|---|---|---|
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# LIST OF EXPERIMENTS

**Course Objectives:**

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- To understand use and coding in different software tools used in electrical/ electronic circuit design.
- To understand the simulation of electric machines/circuits for performance analysis.

Any **ten experiments** need to be performed from the following experiments from various subject domains

1. Introduction to basic block sets of simulation platforms. Basic matrix operations.
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# EXPERIMENT NO-1

# BASIC OPERATIONS ON MATRICES

**AIM**: Generate a matrix and perform basic operation on matrices using MATLAB software.

**Software Required:** MATLAB software.

**COMMANDS:**

1. eye - identity matrix
2. zeros - matrix of zeros
3. ones - matrix of ones
4. diag - extract diagonal of a matrix or create diagonal matrices
5. triu - upper triangular part of a matrix
6. tril - lower triangular part of a matrix
7. rand - ran
8. size- size of a matrix
9. det -determinant matrix
10. inv- inverse of a matrix
11. rank- rank of a matrix

**PROGRAM**

```
%%%% % creating a column vector
>> a= [1; 2; 3]
a =1
2
3

%%%% Creating a row vector
>> b= [1 2 3]
b=
1 2 3
% creating a matrix
>> m= [1 2 3; 4 6 9; 2 6 9]

m= 1    2    3
       4    6    9
       2    6    9
```

```
% creating zeros matrix
>>
D=zeros(3,3)
D =

     0     0     0
     0     0     0
     0     0     0
% creating identity matrix
>>
F=eye(3,3)
F =

     1     0     0
     0     1     0
     0     0     1
% creating one's matrix
>>
k=ones(5,5)
k =

     1     1     1     1     1
     1     1     1     1     1
     1     1     1     1     1
     1     1     1     1     1
     1     1     1     1     1
% Create a diagonal matrix
>>
diag(k)
ans =

     1
     1
     1
     1
     1
% Create a upper diagonal matrix
>>
triu(k)
ans =

     1     1     1     1     1
     0     1     1     1     1
     0     0     1     1     1
     0     0     0     1     1
     0     0     0     0     1
```

```
% Create a lower diagonal matrix
>> tril(k)
ans =

     1     0     0     0     0
     1     1     0     0     0
     1     1     1     0     0
     1     1     1     1     0
     1     1     1     1     1
% Size of a matrix
>> Size(k)
ans =

     5     5
%  det of a matrix
>> det(k)
ans =

     0
% Rank of a matrix
>> rank(k)
ans =

     1
%  inv of a matrix
>> inv(k)
ans =

   Inf   Inf   Inf   Inf   Inf
   Inf   Inf   Inf   Inf   Inf
   Inf   Inf   Inf   Inf   Inf
   Inf   Inf   Inf   Inf   Inf
   Inf   Inf   Inf   Inf   Inf

%   matrix multiplication
>> l=a*b
l =

     1     2     3
     2     4     6
     3     6     9
```

Result:

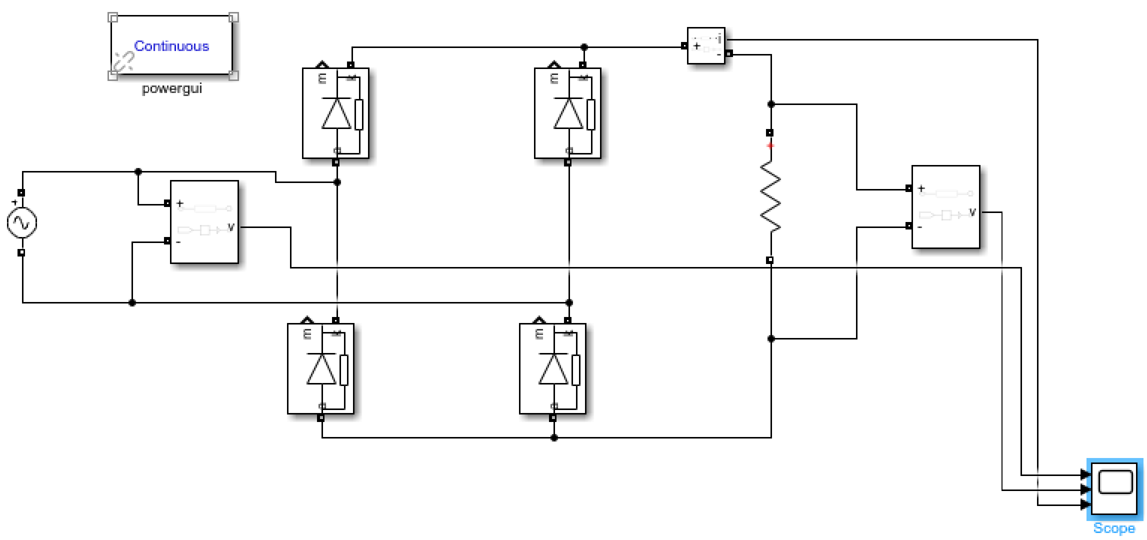
# EXPERIMENT NO-2

## Single Phase Bridge Rectifier with and without filter

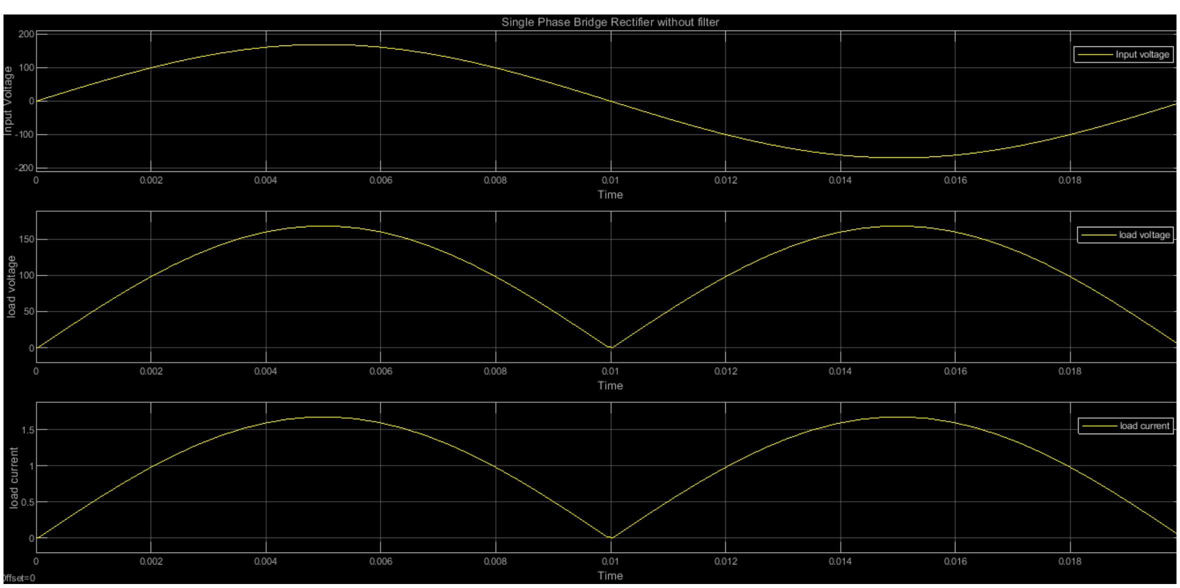
**AIM**: To analyze the rectifier output with and without C-type filter.

**Software Required:** MATLAB software.

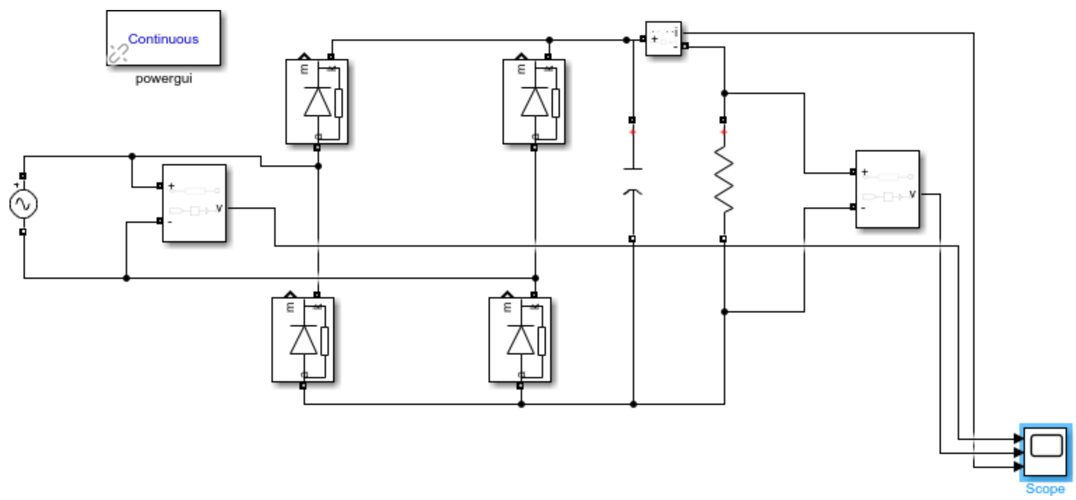
### Simulation Diagram without Filter:



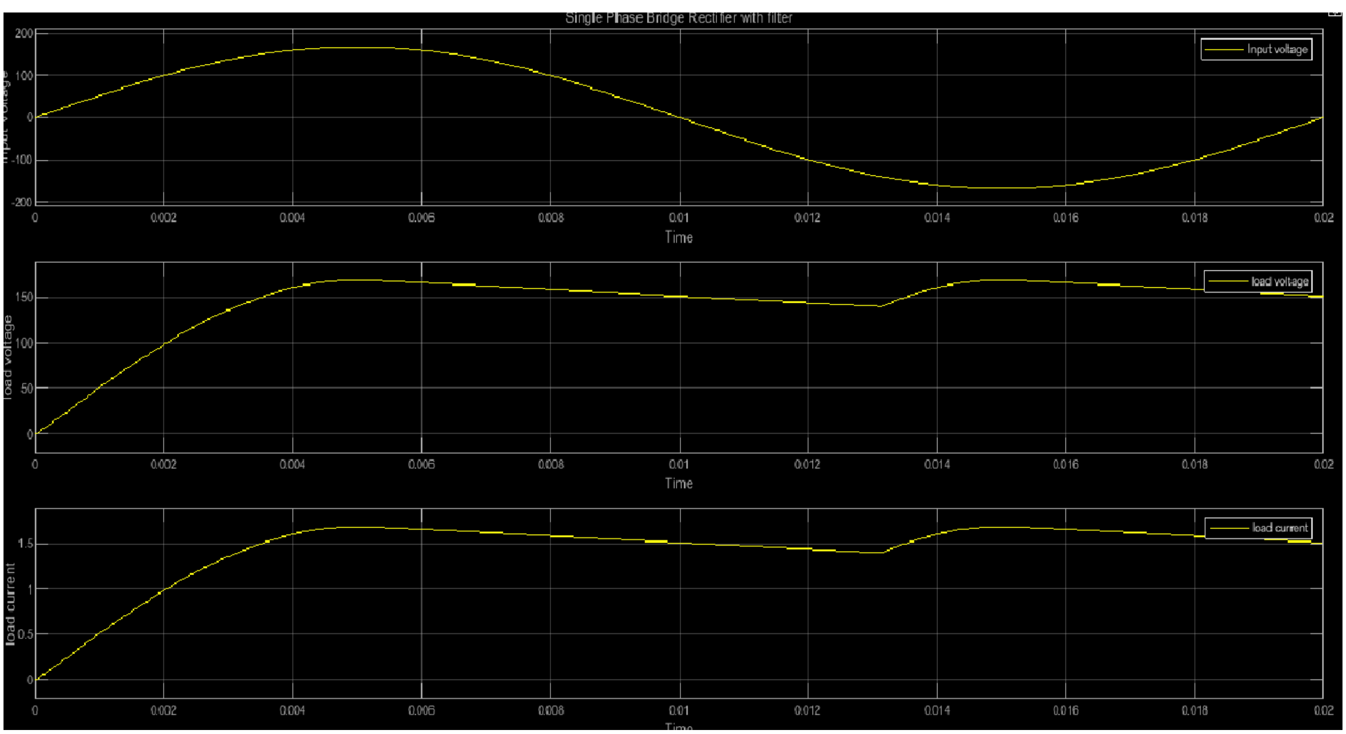

### Simulation output without Filter:



## Simulation Diagram with Filter:




## Simulation output with Filter:



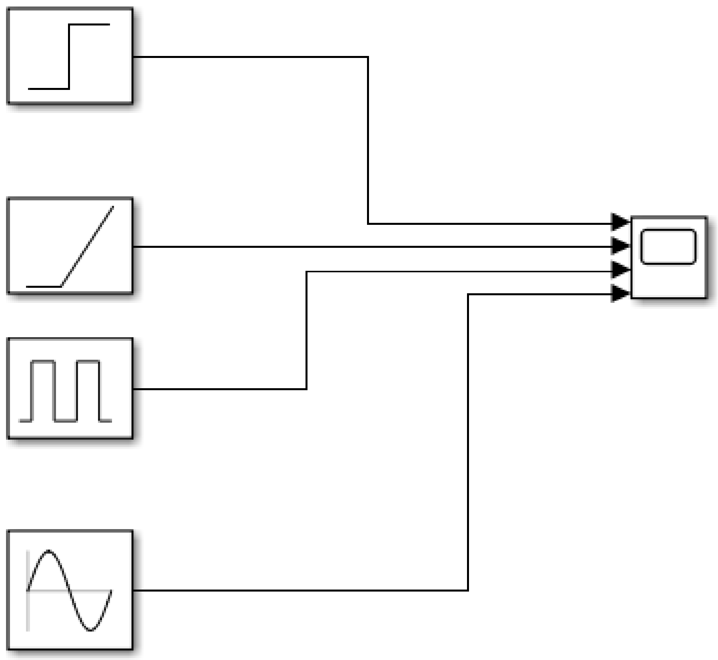

Result:

# EXPERIMENT NO-3
## GENERATION OF STANDARD SIGNALS

**AIM**: Generate various signals such as Unit Step, Unit Ramp, Unit impulse and Sinusoidal signals.

**Software Required:** MATLAB software.

**Simulation Diagram:**



1. **Unit Step Signal:**

$$\mathbf{r(t) = 1 \text{ for } t \geq 0, 0 \text{ for } t < 0}$$

2. **Unit Ramp Signal:**

$$\mathbf{r(t) = t \text{ for } t \geq 0, 0 \text{ for } t < 0}$$

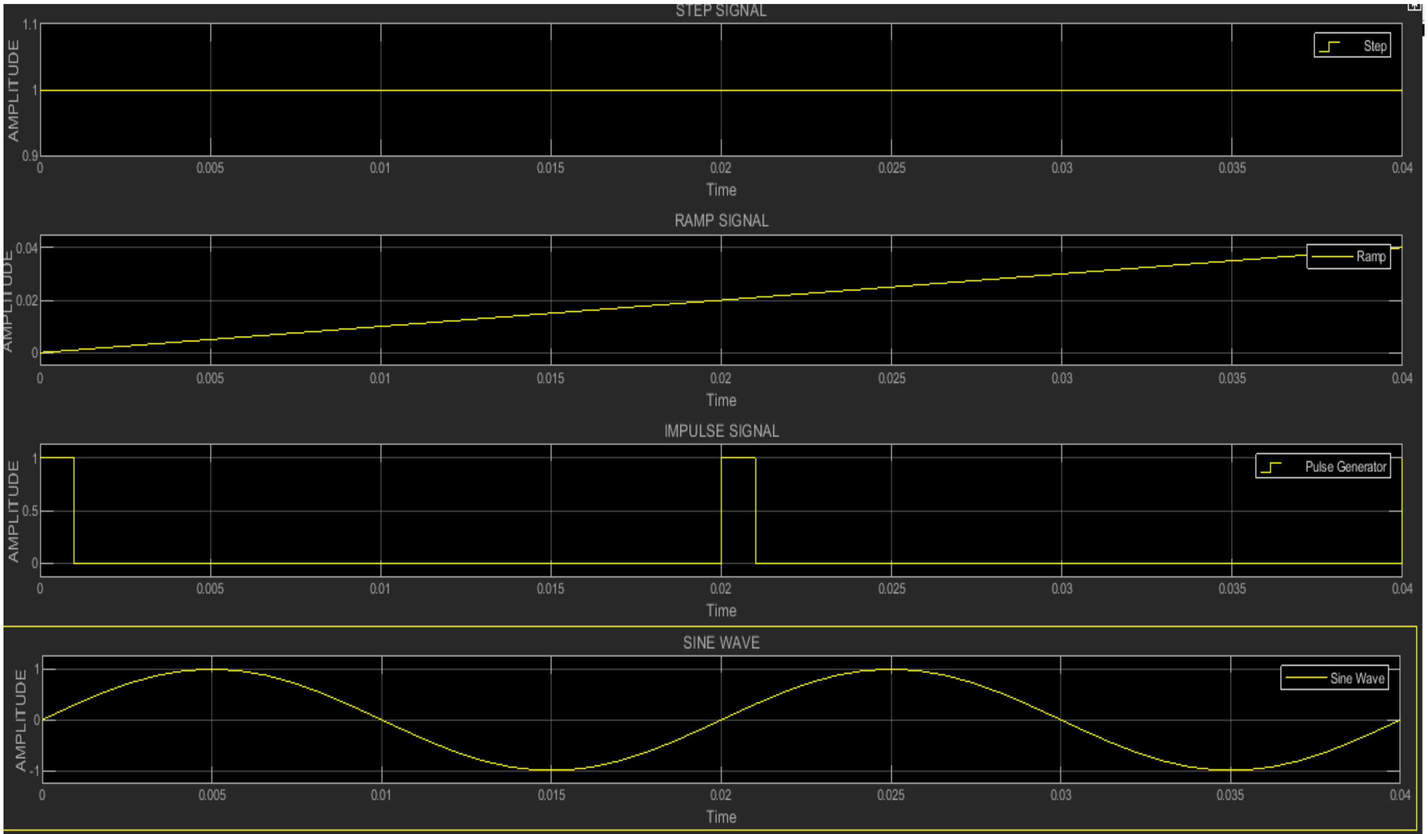
3. **Unit Impulse Signal:**

$$\mathbf{\delta(t) = 1 \text{ for } t = 0, 0 \text{ for } t \neq 0}$$

4. **Sinusoidal Signal**

$$\boldsymbol{x(t) = ASin(2\pi F \pm \phi)}$$

## Simulation Output:




Result:

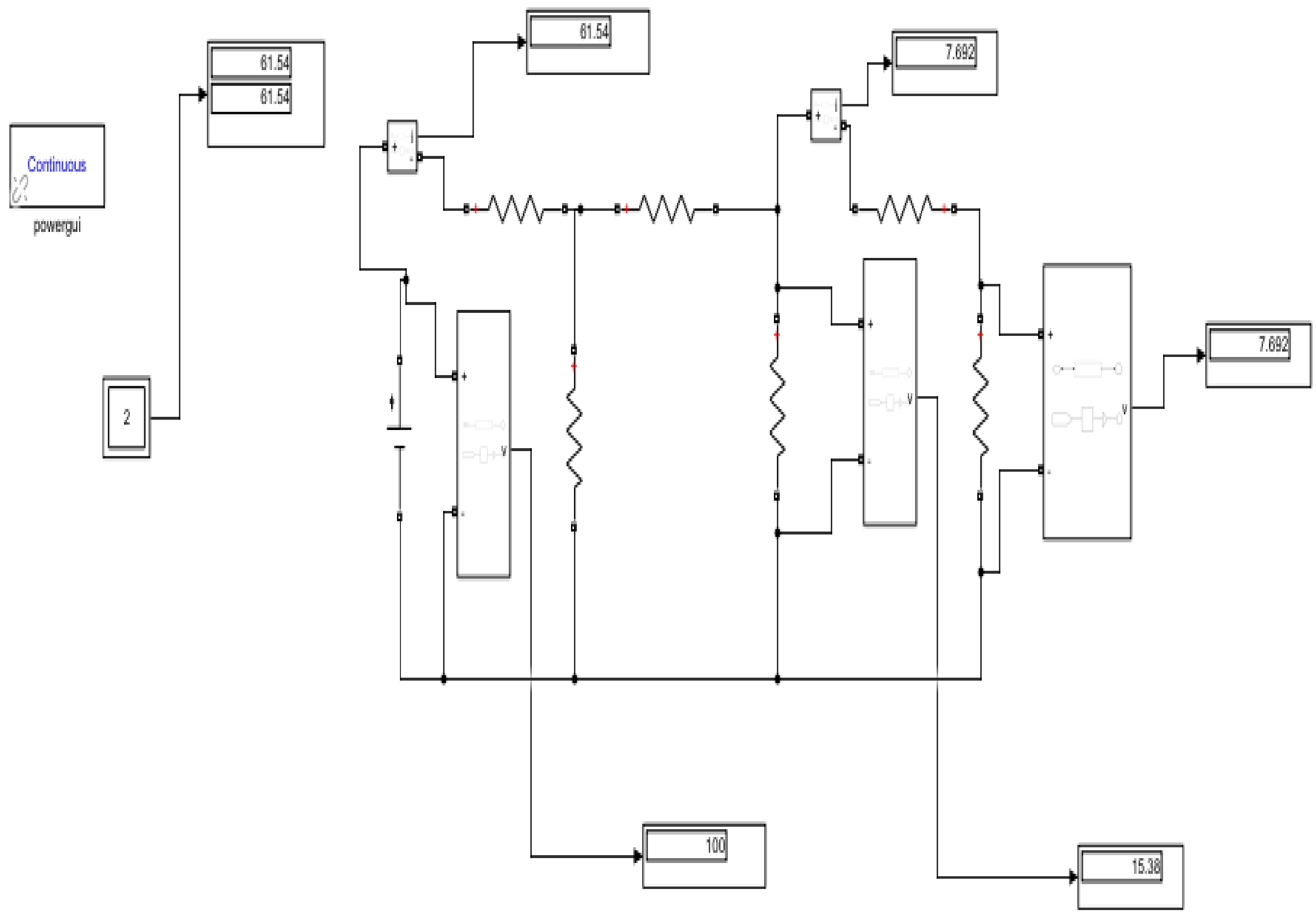
# EXPERIMENT NO-4

## MEASUREMENT OF VOLTAGE, CURRENT IN DC CIRCUITS

**AIM**: To measure Voltage and current in Dc circuits using MATLAB Simulation.

**Software Required:** MATLAB software.

## Simulation Diagram:




**Result:**

# EXPERIMENT NO-5

## SERIES AND PARALLEL RESONANCE

### SERIES RESONANCE:

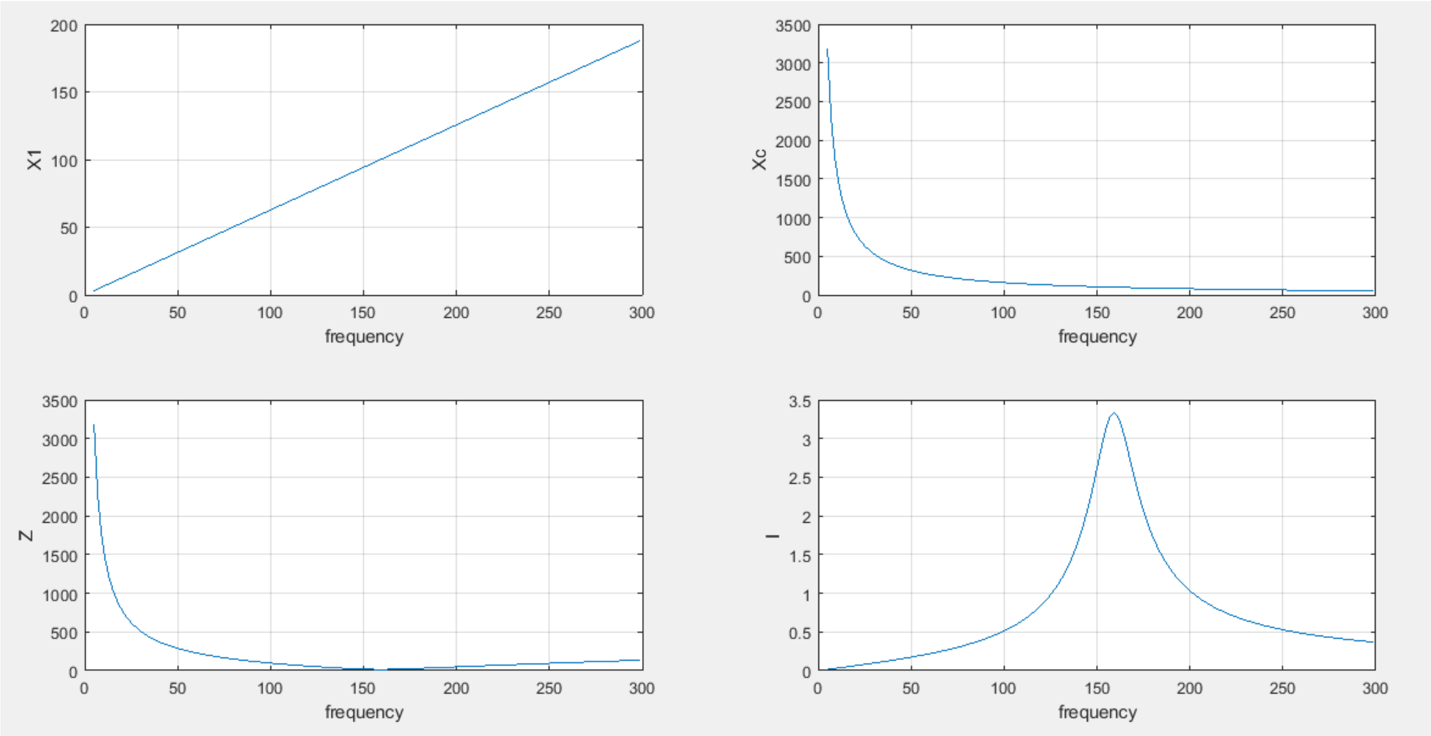
Aim: - To obtain the plot of frequency versus $X_L$, frequency versus $X_C$, frequency impedance and frequency vs. current for the given series RLC circuit and determine the resonant frequency and check by theoretical calculations.

R = 15Ω, C = 10 μ F, L = 0.1 H, V = 50V vary frequency in steps of 1 Hz using MATLAB.

```
clc;
clear all;
close all;
r=input('enter the resistance value----->');
l=input('enter the inductance value------>');
c=input('enter the capacitance value ---- >');
v=input('enter the input voltage------->');
f=5:2:300;
xl=2*pi*f*l;
xc=(1./(2*pi*f*c));
x=xl-xc;
z=sqrt((r^2)+(x.^2));
i=v./z;
%plotting the graph
subplot(2,2,1);
plot(f,xl);
grid;
xlabel('frequency');
ylabel('X1');
subplot(2,2,2);
plot(f,xc);
grid;
xlabel('frequency');
ylabel('Xc');
subplot(2,2,3);
plot(f,z);
grid;
xlabel('frequency');
ylabel('Z');
subplot(2,2,4);
plot(f,i);
```

```
grid;
xlabel('frequency');
ylabel('I');
```

PROGRAM RESULT:
enter the resistance value ---->15
enter the inductance value ----- >0.1
enter the capacitance value----->10*10^-6
enter the input voltage------->50




**Result:**

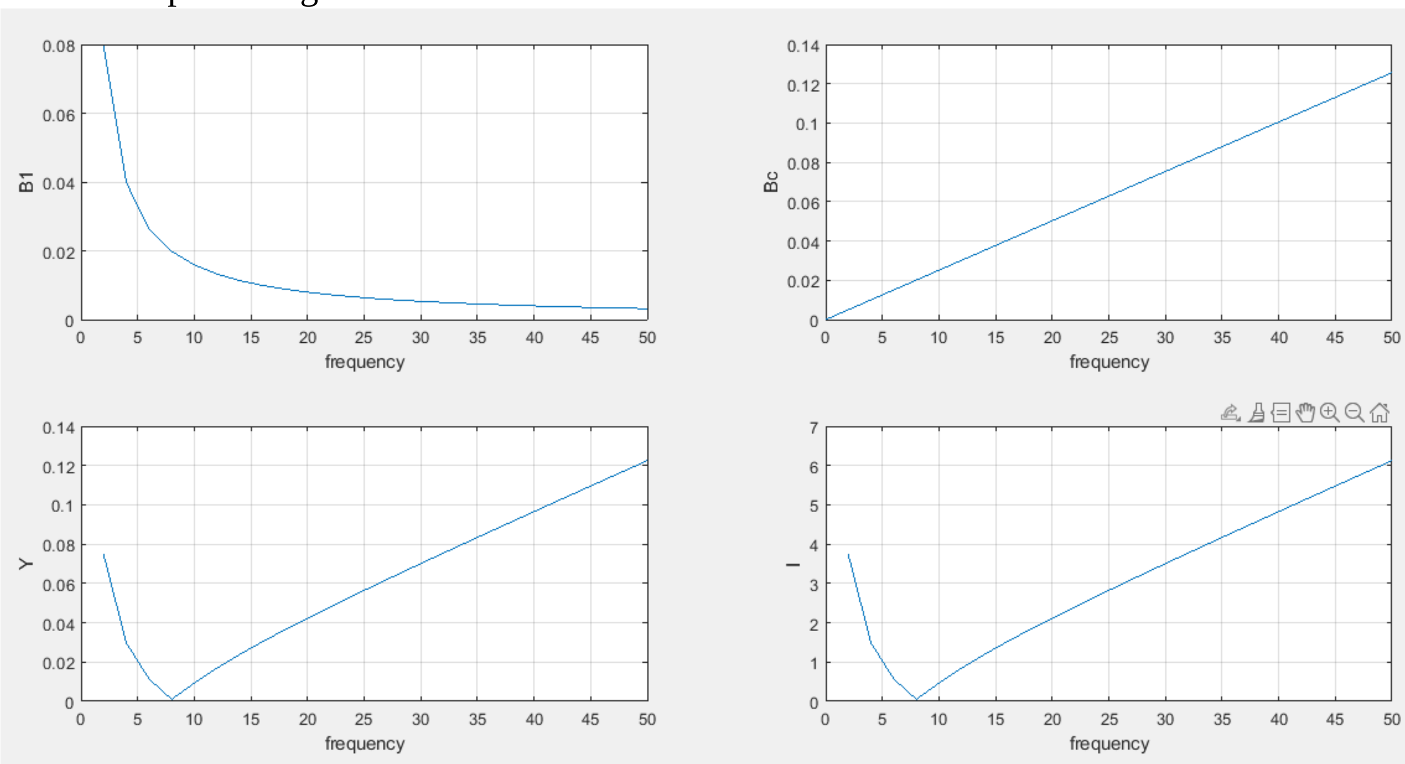
**PARALLEL RESONANCE: -**

To obtain the graphs of frequency vs. BL, frequency vs. BC, frequency vs. admittance and frequency vs. current vary frequency in steps for the given circuit and find the resonant frequency and check by theoretical calculations.
R = 1000Ω , C = 400 μ F, L = 1 H, V = 50V vary frequency in steps of 1 Hz using MATLAB.

```
clc;
clear all;
close all;
r=input('enter the resistance value---- >');
l=input('enter the inductance value----- >');
c=input('enter the capacitance value---- >');
v=input('enter the input voltage------ >');
f=0:2:50;
xl=2*pi*f*l;
xc=(1./(2*pi*f*c));
b1=1./xl;
bc=1./xc;
b=b1-bc;
g=1/r;
y=sqrt((g^2)+(b.^2));
i=v*y;
%plotting the graph
subplot(2,2,1);
plot(f,b1);
grid;
xlabel('frequency');
ylabel('B1');
subplot(2,2,2);
plot(f,bc);
grid;
xlabel('frequency');
ylabel('Bc');
subplot(2,2,3);
plot(f,y);
grid;
xlabel('frequency');
ylabel('Y');
subplot(2,2,4);
plot(f,i);
grid;
```

```
xlabel('frequency');
ylabel('I');
```

PROGRAM RESULT:
enter the resistance value ---->1000
enter the inductance value ----- >1
enter the capacitance value----->400*10^-6
enter the input voltage------->50




**Result:**

# EXPERIMENT NO-6

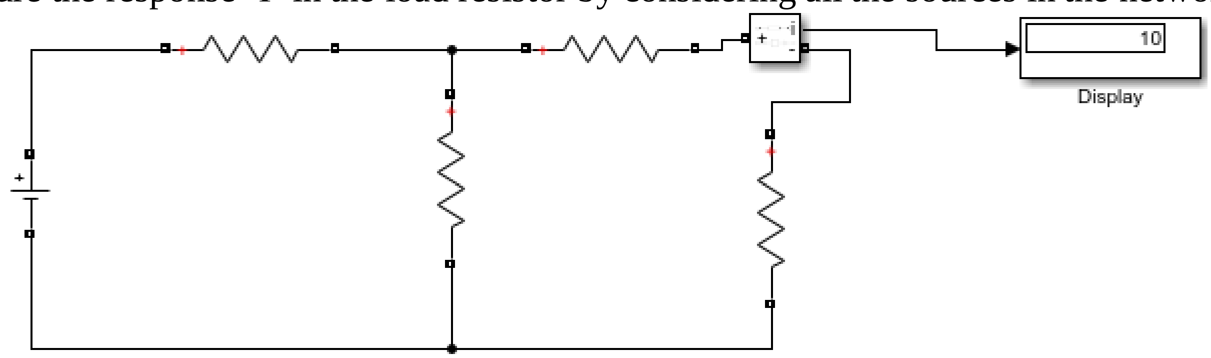
## VERIFICATION OF NETWORK THEOREMS

AIM: To verify Thevenin's theorem, Norton's theorem.

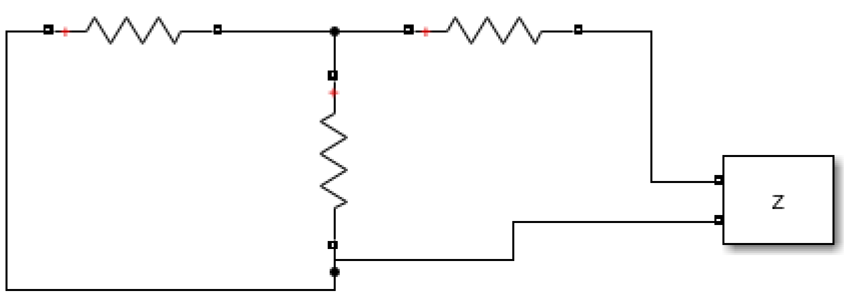
SOFTWARE USED: MATLAB Simulink

THEVENIN'S THEOREM:
Procedure:

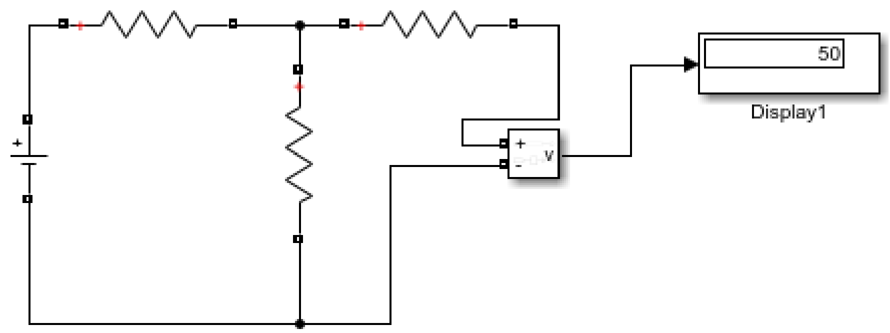
Step 1:
1. Measure the response 'I' in the load resistor by considering all the sources in the network.




Step 2:
Finding Thevenin's Resistance ($R_{th}$)
1. Open the load terminals and replace all the sources with their internal impedances.
2. Measure the impedance across the open circuited terminal which is known as Thevenin's Resistance.



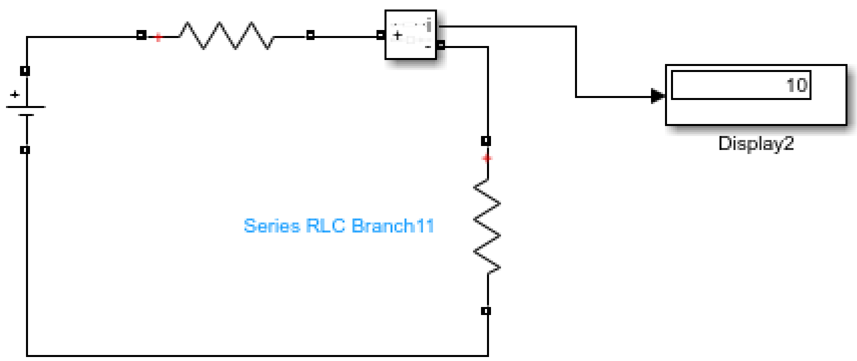

Step 3: Finding Thevenin's Voltage ($V_{th}$)
1. Open the load terminals and measure the voltage across the open circuited terminals.
2. Measured voltage will be known as Thevenin's Voltage.




Step 4: Thevenin's Equivalent Circuit

1. $V_{th}$ and $R_{th}$ are connected in series with the load.
2. Measure the current through the load resistor

$$I_L = \frac{V_{th}}{R_{th}+R_L}$$

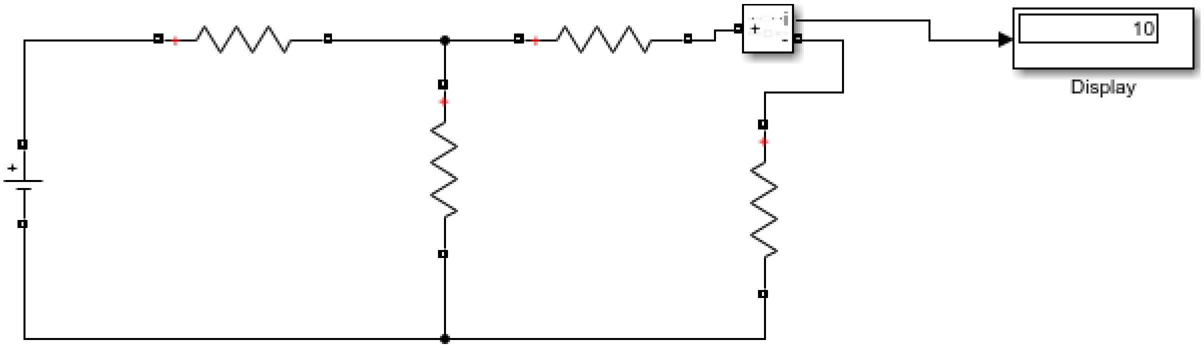



**Result:**

# NORTON'S THEOREM:

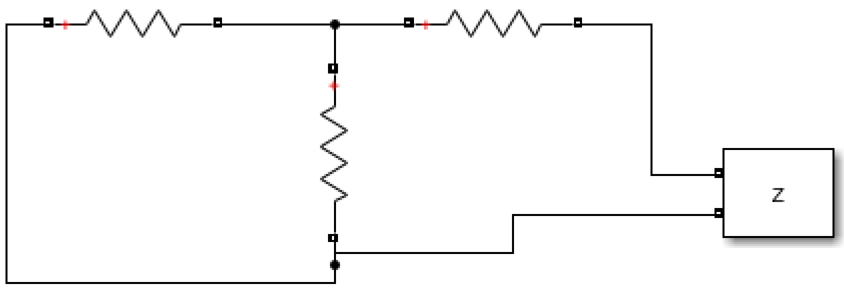
**Procedure:**

Step 1: Measure the response 'I' in the load resistor by considering all the sources in the network.




Step 2: Finding Norton's Resistance ($R_N$)

1. Open the load terminals and replace all the sources with their internal impedances.
2. Measure the impedance across the open circuited terminal which is known as Norton's Resistance.



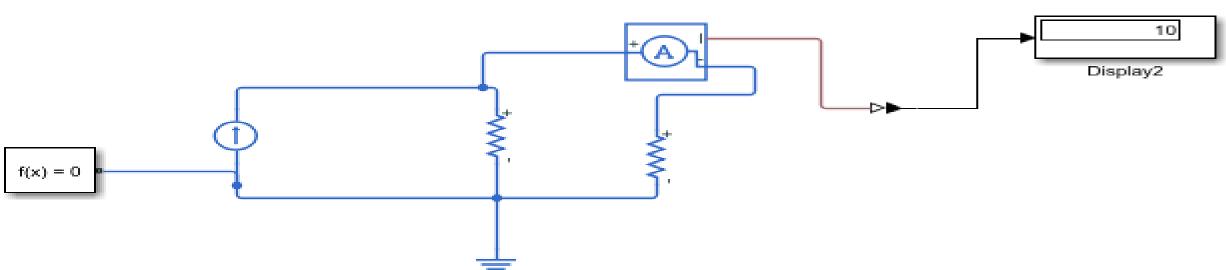

Step 3: Finding Norton's Current ($I_N$)

1. Short the load terminals and measure the current through the short-circuited terminals.
2. Measured current is be known as Norton's Current.

Step 4: Norton's Equivalent Circuit

1. $R_N$ and $I_N$ are connected in parallel to the load.
2. Measure the current through the load resistor

$$I_L = \frac{I_{N*}R_N}{R_N + R_{th}}$$



Result:

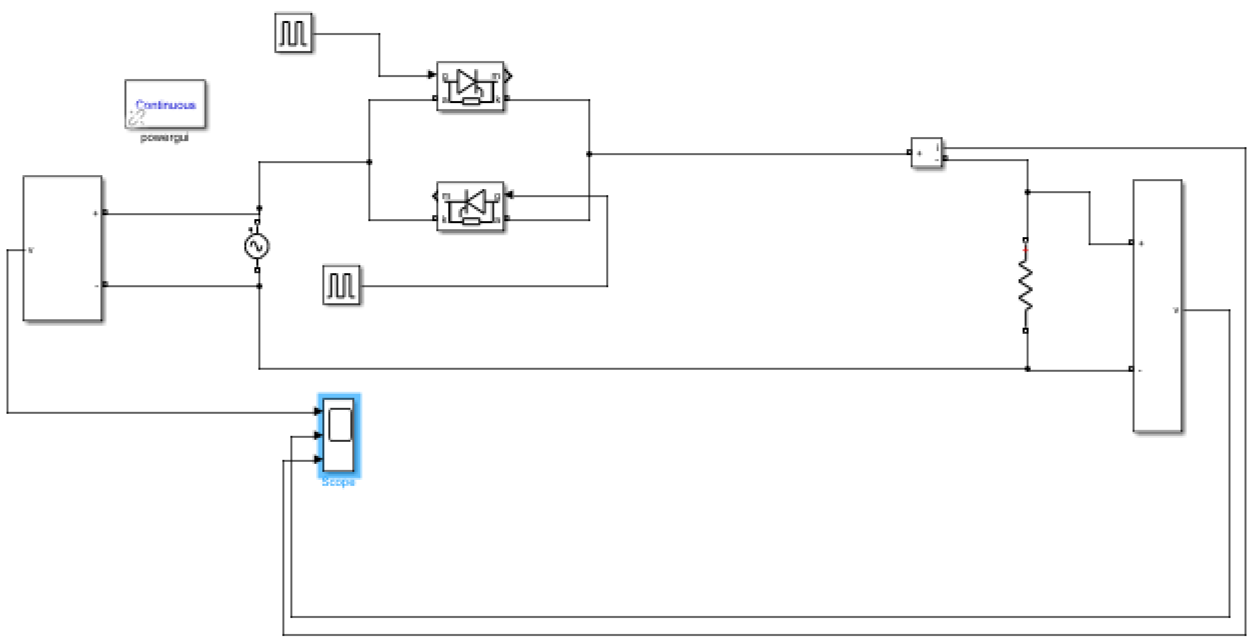
# EXPERIMENT NO-7

# VOLTAGE REGULATOR

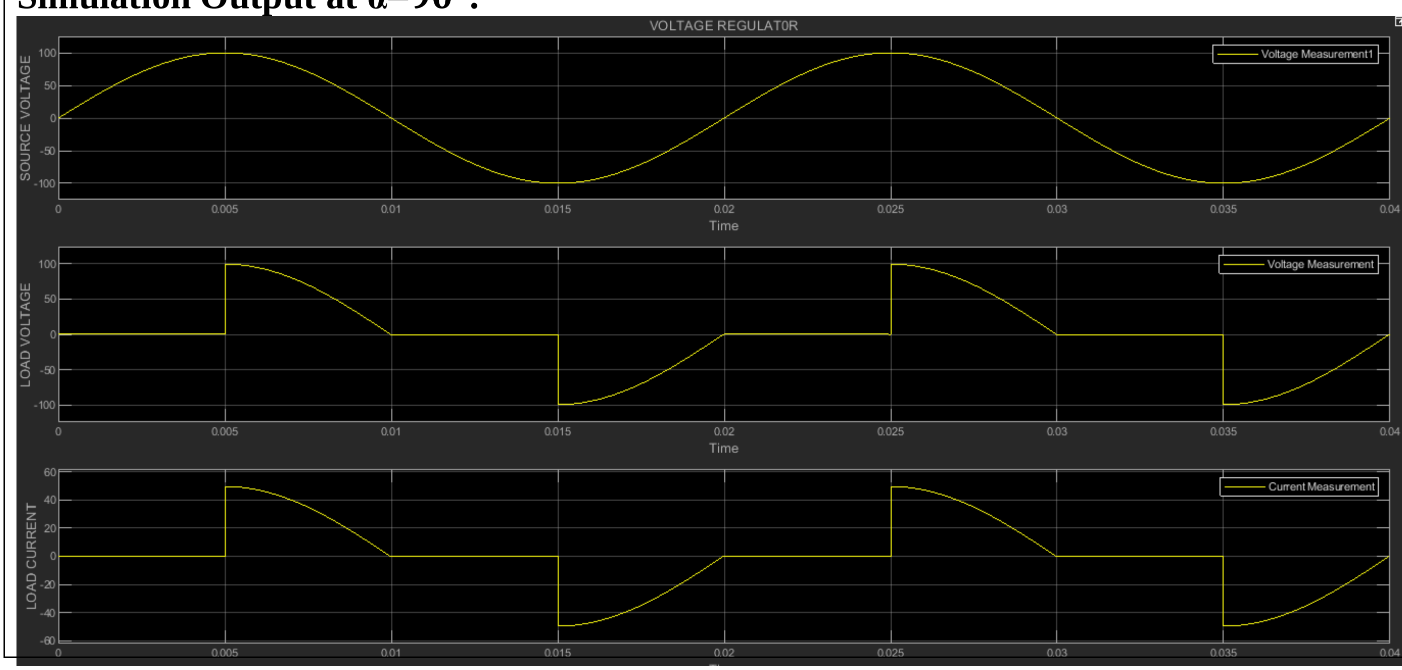
**AIM**: To analyze the voltage regulator output with R-LOAD.

**Software Required:** MATLAB software.

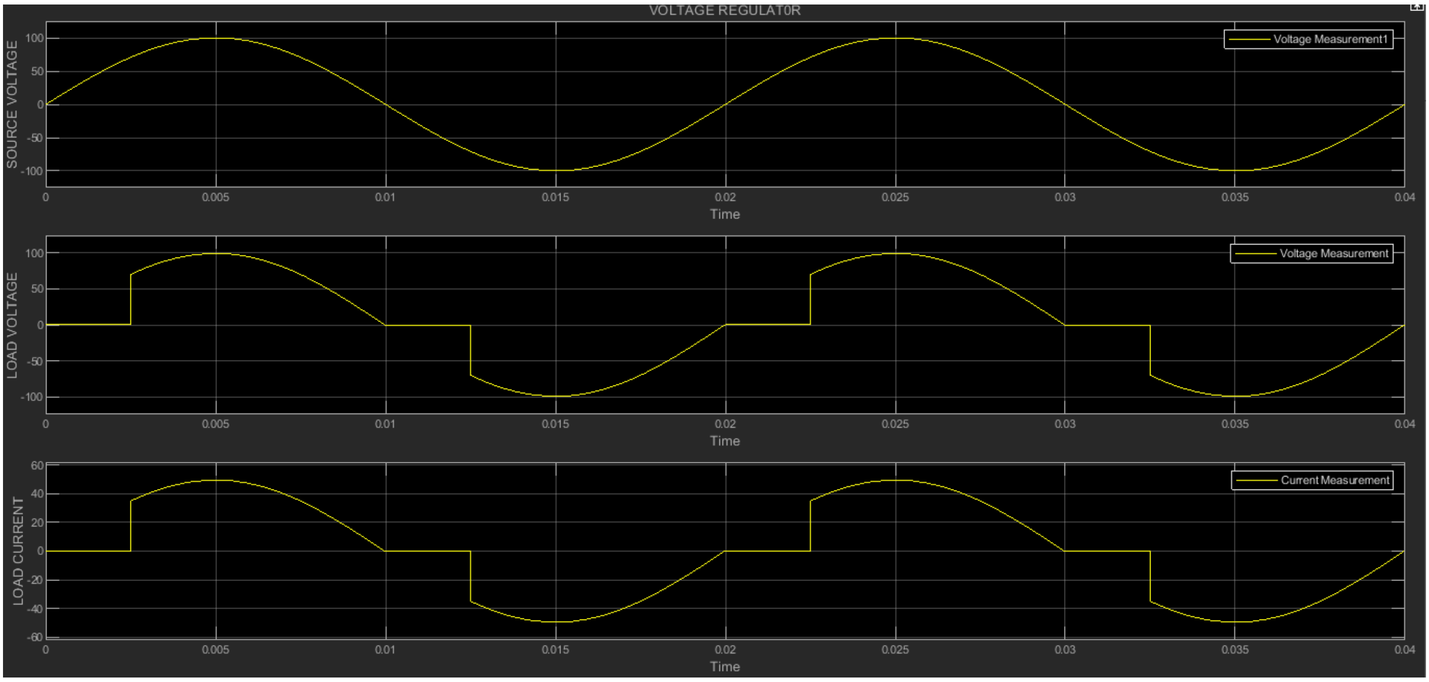
## Simulation Diagram:




## Simulation Output at $\alpha=90^0$:



## Simulation Output at $\alpha = 45^0$:




## Result:

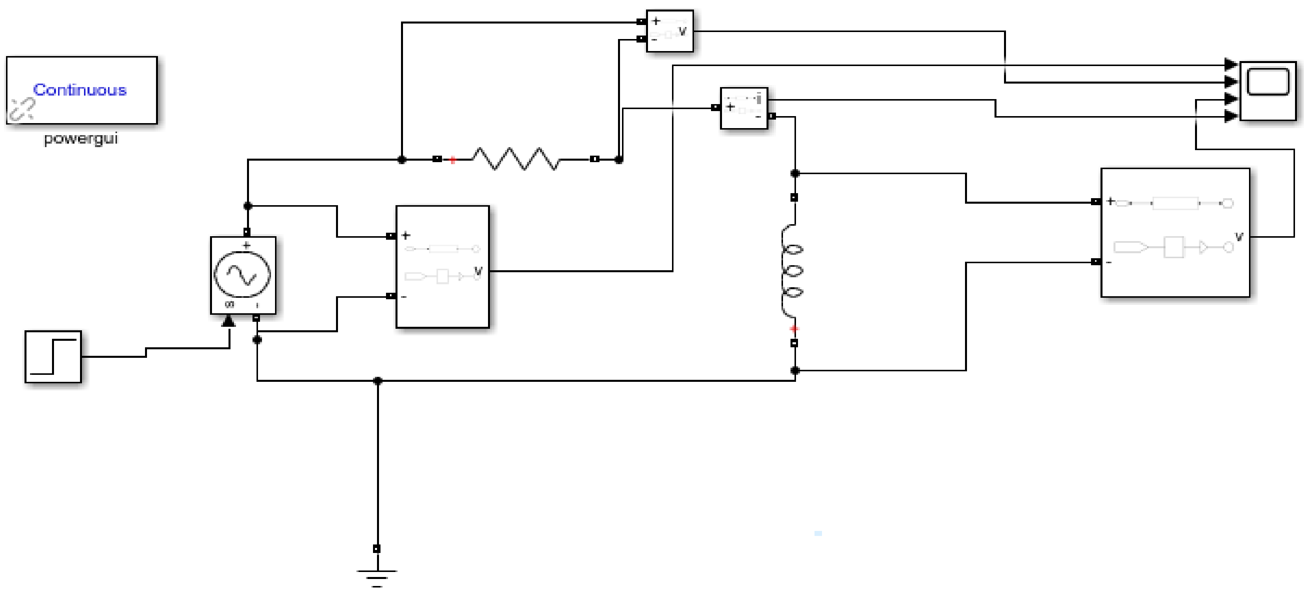
# EXPERIMENT NO - 8

## RESPONSE OF RL CIRCUIT WITH STEP SIGNAL

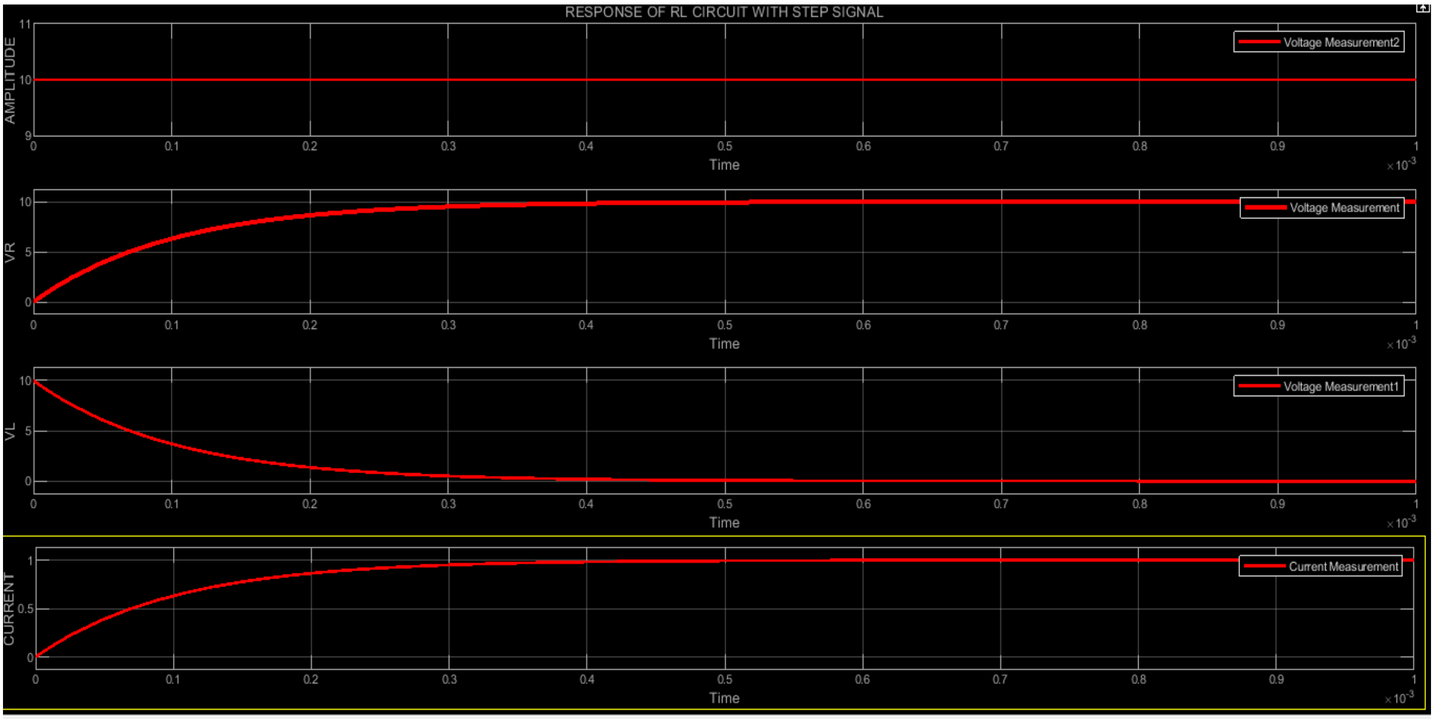
**AIM**: To Obtain the response of RL circuit with Step Signal.

**Software Required:** MATLAB software.

### Simulation Diagram:




### Simulation Output:




### Result:

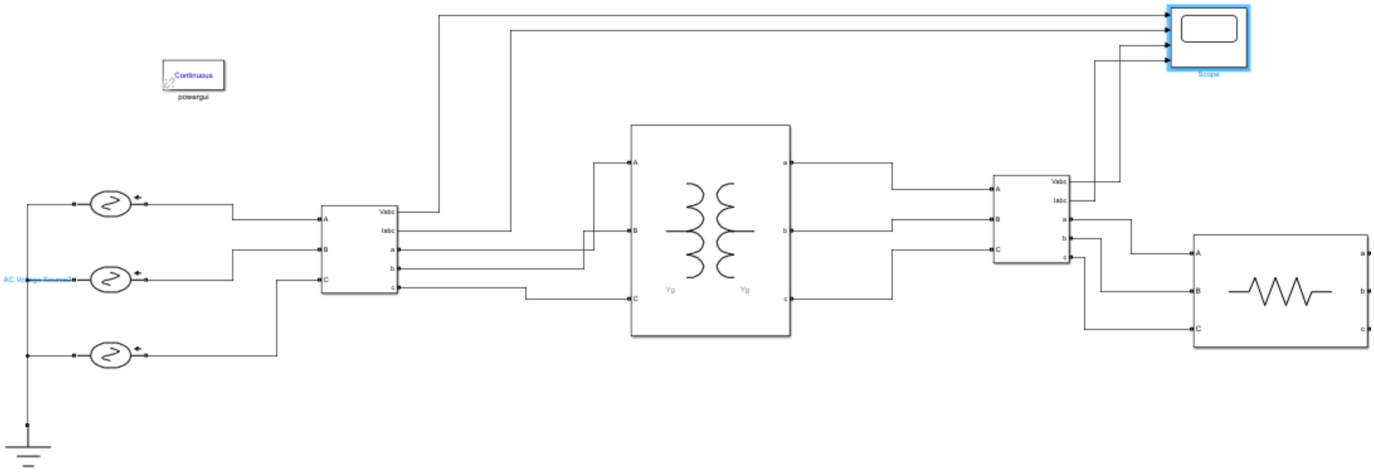
# EXPERIMENT NO -9

# MODELLING OF TRANSFORMER USING MATLAB

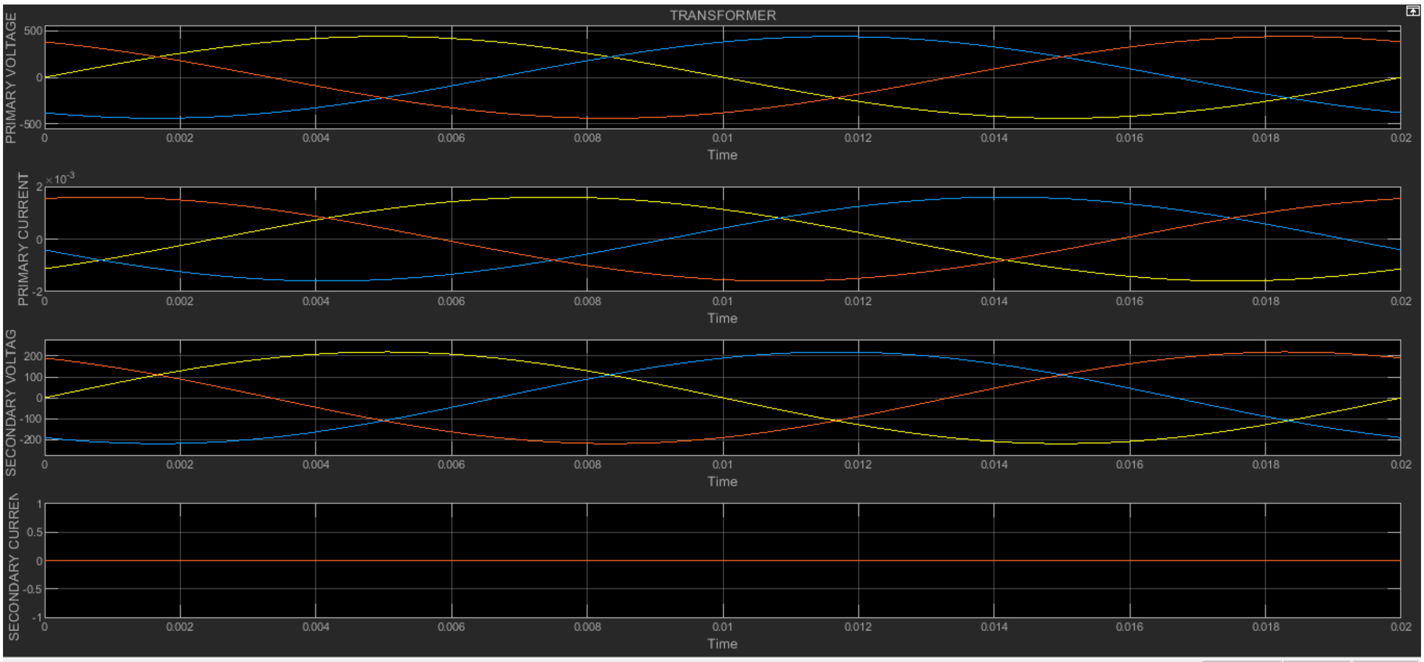
**AIM**: Analyze of Step-down transformer with MATLAB software.

**Software Required:** MATLAB software.

## SIMULATION DIAGRAM:



## Simulation output:




## Result:

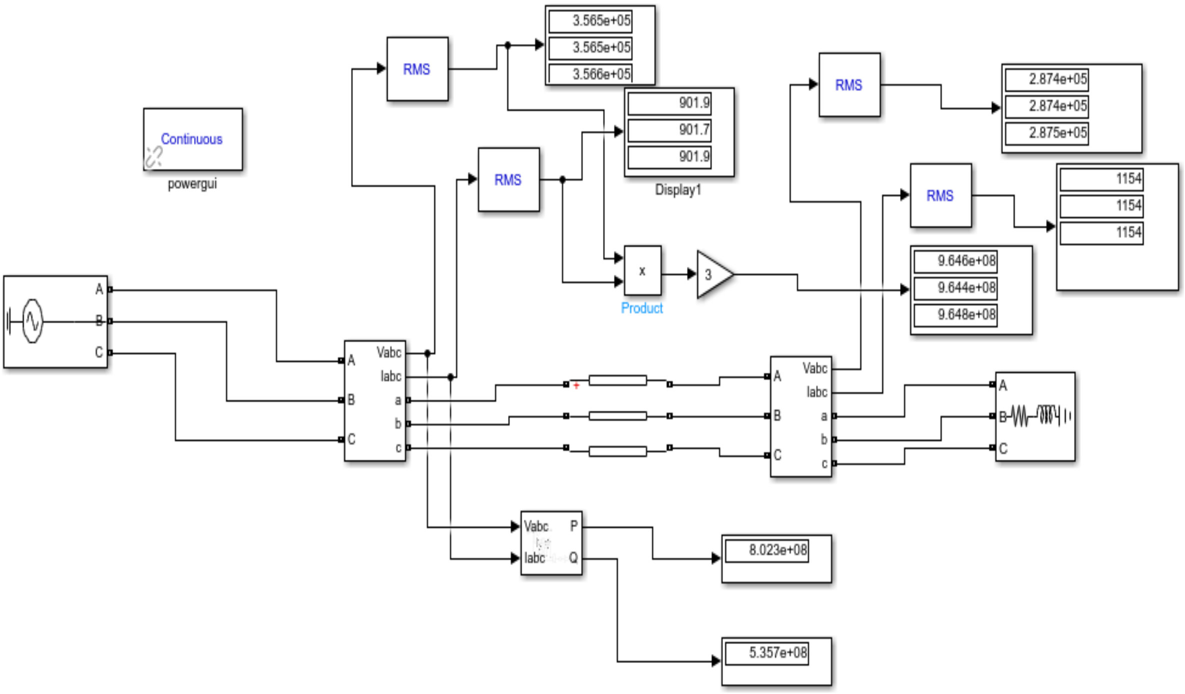
## EXPERIMENT NO -10

## MODELLING OF TRANSMISSION LINE USING MATLAB

**AIM**: A three phase, 60Hz, 500 KV transmission line is 300 km long. The line inductance is0.97mh/km per phase and its capacitance is 0.0115 µf/km per phase. Assume a lossless line.

**Software Required:** MATLAB software.

**SIMULATION DIAGRAM:**




Result: