LAB MANUAL

Programme (UG/PG) : UG
Semester : III

Abstract:

Electrical Network Analysis Laboratory (formerly known as Signal and Network Lab) is one of the important laboratories, useful for both 'Electrical Engineering' & 'Electronics & Communication Engineering' of under graduate students. The laboratory experiments in Electrical Network Analysis course are dedicated for practical understanding of signals and networks theory concepts. Linking the theory with practice, it is very important to motivate the students for learning theory and to encourage them to use this theoretical knowledge in practical activity. In this lab both hardware and simulation based experiments are conducted. Curriculum of the 'Electrical Network Analysis Laboratory' course in the Electrical Engineering department is designed to give a fundamental understanding in practical cases on two port networks, attenuator circuit, transient circuit analysis, signal generation and Laplace transform. This course is a one-semester course since 2009. Every week students have classes in the laboratory with three lecture periods. The credit point of this Lab is two. Students usually work in groups, but separate reports have to be prepared and presented to the instructor for individual assessment. Mostly digital type instruments are provided to meet the objectives of the laboratory. For simulation design, computers are provided. We use MATLAB based circuit simulation software. In the hardware lab, students can design different types of electrical circuits using different passive components like resistors, inductors and capacitors with DC power supply. They learn here how to use a multimeter, function generator, cathode ray oscilloscope or digital storage oscilloscopes. Apart from hardware design, by writing different programmes using MATLAB programming code, they can generate different signals, simulate Laplace transform methods, and analyze transient analysis. Also, they are encouraged to design their own hardware circuitry to apply their learning in practical model designing.

ELECTRICAL NETWORK ANALYSIS LABORATORY OBJECTIVES: The objective of Electrical Network Analysis laboratory is to impart hands on experience in circuit design, verification of result in different type of network analysis, study of circuit characteristics and simulation of different signals, Laplace and its inverse transform and transient response of R-C, R-L circuit. It also aims to introduce a circuit simulation software tool MATLAB. It enables the students to gain sufficient knowledge on the programming and simulation of Electrical circuits.

OUTCOMES: Upon the completion of Electrical Circuit and simulation practical course, the student will be able:

- **CO1:** To familiarize and verify the T, π and interconnected type two port network and circuit analysis techniques.
- **CO2:** To design and understand an attenuator circuit and its application.
- **CO3:** To study and calculate the value of resistance (R), inductance (L) and capacitance (C) of the R-L-C parallel circuit.

- **CO4:** To acquire skills for electrical circuit studies and different signal generation using MATLAB software.
- **CO5:** To determine the Laplace transform of time domain function and its inverse Laplace transform using MATLAB software.
- **CO6:** To analyze the transient response for R-L and R-C or combination of both type circuits for step input.
- **CO7:** To acquire knowledge to design different circuits in MATLAB SIMULINK
- **CO8:** To apply the knowledge of designing electrical circuit for a mini project work using waste material.

GUIDE LINES FOR THE EXPERIMENTS AND REPORT PREPARATION

1. **Preparation for the experiment:** Before conducting the experiment, the student is required to have read the experiment background and procedure from the experiment manual and studied the related theory. The lab instructor may, during the experiment, ask students questions pertaining to the procedure and theory.

2. **Laboratory teams:** The class will be divided in teams of five or six students. Each lab experiment requires a report. The lab report for the final experiment is due a week after the final lab classes. Each student has to submit one report per experiment. The grade of the report is given to 20 Marks. Late reports are penalized by taking 2 points off per each week past the due date of the report.

3. **Preparation of the report:** The report must contain the following sections: a) Index page: Include experiment number and title of the experiment, date the experiment was performed, the date of submission and teacher’s signature. b) Follow the lab manual. Do not copy or repeat the procedure description from the lab manual. Report the measurement and other experimental data. Tabulate measurements if necessary. Include title over tables. Conclusions: Summarize the experiment and the results. Discuss the factual knowledge gained.

List of Experiments

Hardware Based Experiments:

Experiment No	Title	Week/hours

1.	Evaluation of 'Z' parameter	3hrs
2.	Evaluation of 'Y' parameter	3hrs
3.	Evaluation of 'ABCD' parameter	3hrs
4.	Attenuator Network	3hrs
5.	Study of R-L-C Parallel Circuit	3hrs

Simulation Based Experiment:

Experiment No	Title	Week/hours
6.	Generation of signals using MATLAB in analogue and discrete form	4 hrs
7.	Determination of Laplace transform and Inverse Laplace Transform using MATLAB	3hrs
8.	Electrical Network Problems solving approach using MATLAB programming.	2hr.
9.	Electrical Series-Parallel circuit Problem using MATLAB SIMULNK	2hrs
10.	Simulink Diagram of the Reciprocity Theorem	2hrs
11.	Transient response of R-L and R-C network: simulation with MATLAB /Hardware Or Low Budget Project work: Choice based hardware design for each group	3hrs

Experiment No: 1

Title: Evaluation of 'Z' parameter

Objectives:

i. To evaluate 'Z' parameter of a T network
ii. To evaluate 'Z' parameter of a π network
iii. To evaluate 'Z' parameter of a network which have a 'T' network and 'π' network in series.

Theory:

Z-parameters are defined by these following two equations:

$$V_1 = Z_{11}I_1 + Z_{12}I_2$$
$$V_2 = Z_{21}I_1 + Z_{22}I_2$$

$Z_{11} = \frac{V_1}{I_1}$ Where $I_2 = 0$;(Driving input impedance)

$Z_{12} = \frac{V_1}{I_2}$ Where $I_1 = 0$;(Reverse transfer impedance)

$Z_{21} = \frac{V_2}{I_1}$ Where $I_2 = 0$;(Forward transfer impedance)

$Z_{22} = \frac{V_2}{I_2}$ Where $I_1 = 0$;(Driving Output impedance)

Circuit Diagrams:

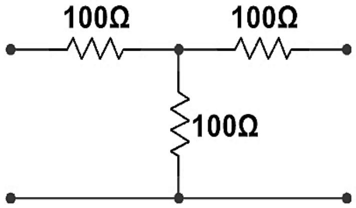

Fig-A

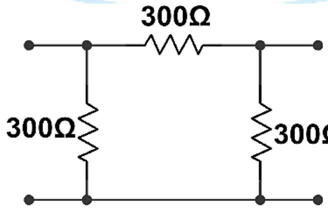

Fig-B

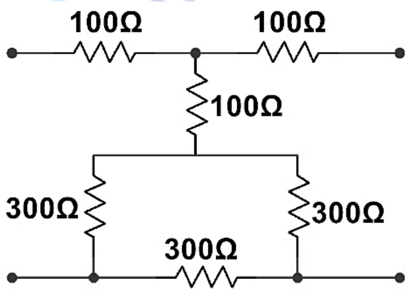

Fig-C

Procedure:

i. Make the circuit as shown in figure A, figure B, figure C.

ii. Apply 10volt from input side with output open circuited. Hence record I_1, V_2 by multimeter.

iii. Apply 10volt from output side with input open circuited. Hence record I_2, V_1 by multimeter.

Apparatus Table:

Sl. No.	Components Name	Range	Quantity	Type	Makers Name

Theoretical Calculation:

Data Table:-

Circuit No	V_1	V_2	I_1	I_2	$Z_{11} = \frac{V_1}{I_1}$	$Z_{21} = \frac{V_2}{I_1}$	$Z_{12} = \frac{V_1}{I_2}$	$Z_{22} = \frac{V_2}{I_2}$	'Z' Parameter
Figure A Theoretical	10V								
		10V							
Figure A Practical									
Figure B Theoretical									
Figure B Practical									
Figure C Theoretical									
Figure C Practical									

Conclusion:

Report:

What is the relationship between 'Z' parameters obtained in these three networks?

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Signature of Teacher with date

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Department:

Roll No. :

Experiment No: 2

Title: Evaluation of 'Y' parameter

Objective:

i. To evaluate 'Y' parameter of a T network
ii. To evaluate 'Y' parameter of a π network
iii. To evaluate 'Y' parameter of a network which have a 'T' network and 'π' network in parallel.

Theory: Y-parameters are defined by these following two equations:

$$I_1 = y_{11}V_1 + y_{12}V_2$$
$$I_2 = y_{21}V_1 + y_{22}V_2$$

$y_{11} = \frac{I_1}{V_1}$ Where V_2=0; (Driving input admittance)

$y_{12} = \frac{I_1}{V_2}$ Where V_1=0; (Forward transfer admittance)

$y_{21} = \frac{I_2}{V_1}$ Where V_2=0; (Reverse transfer admittance)

$y_{22} = \frac{I_2}{V_2}$ Where V_1=0; (Driving output admittance)

Circuit Diagram:

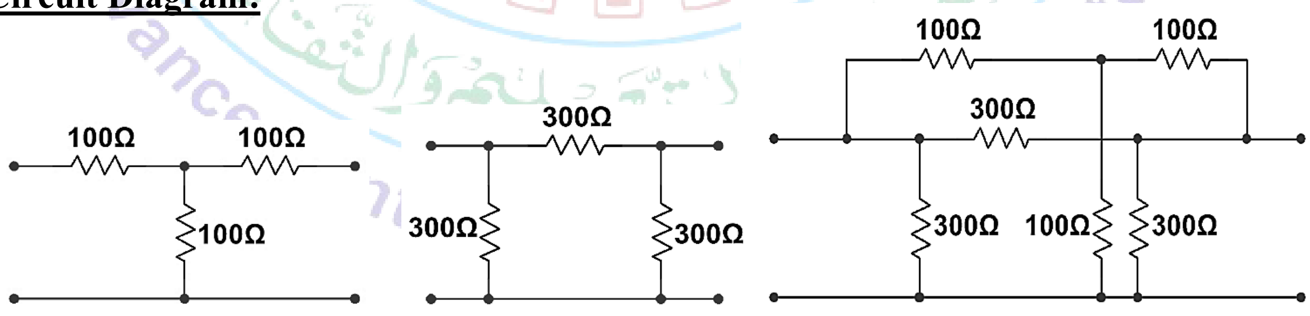

Fig-A Fig-B Fig-C

Procedure:

i. Make the circuit as shown in figure A, figure B, figure C.

ii. Apply 10volt from input side with output side short circuited. Hence record I_1, I_2 by multimeter.

iii. Apply 10volt from output side with input side short circuited. Hence record I_1, I_2 by multimeter.

Apparatus Table:

Sl. No.	Components Name	Range	Quantity	Type	Makers Name

Theoretical Calculation:

Data Table:-

Circuit No	V_1	V_2	I_1	I_2	$Y_{11} = \frac{I_1}{V_1}$	$Y_{21} = \frac{I_2}{V_1}$	$Y_{12} = \frac{I_1}{V_2}$	$I_{22} = \frac{I_2}{V_2}$	'Y' Parameter
Figure A Theoretical									
Figure A Practical									
Figure B Theoretical									
Figure B Practical									
Figure C Theoretical									
Figure C Practical									

Conclusion:

Report:

What is the relationship between 'Y' parameters obtained in these three networks?

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Signature of Teacher with date

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Department:

Roll No. :

Experiment No: 3

Title: Evaluation of ABCD parameter

Objective:

i. To evaluate ABCD parameter of a 'T' network
ii. To evaluate ABCD parameter of a 'π' network
iii. To evaluate ABCD parameter of a network which have a 'T' network and 'π' network connected in cascade.

Theory: ABCD-parameters are defined by these following two equations:

$$V_1 = AV_2 - BI_2$$
$$I_1 = CV_2 - DI_2$$

$A = \frac{V_1}{V_2}$ Where $I_2=0$; (The reverse voltage ratio with receiving end open)

$B = -\frac{V_1}{I_2}$ Where $V_2=0$; (The transfer impedance with receiving end short circuited)

$C = \frac{I_1}{V_2}$ Where $I_2=0$; (The transfer admittance with receiving end open)

$D = -\frac{I_1}{I_2}$ Where $V_2=0$; (The reverse current ratio with the receiving end short circuited)

Circuit Diagram:

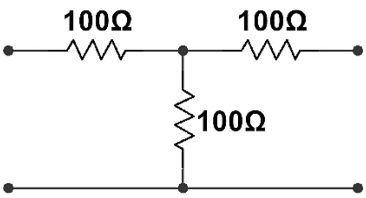

Fig-A

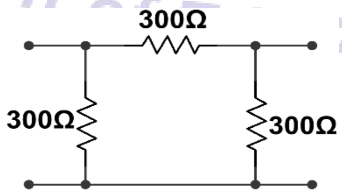

Fig-B

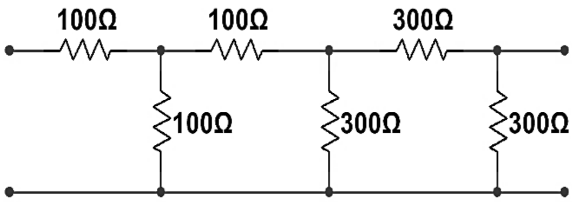

Fig-C

Procedure:-

i. Make the circuit as shown in figure A, figure B, figure C.

ii. Apply 10volt from input side with output side open circuited. Hence record I_1, V_2 by multimeter.

iii. Apply 10 volt from intput side with output side short circuited. Hence record I_1, I_2 by multimeter.

Apparatus Table:

Sl. No.	Components Name	Range	Quantity	Type	Makers Name

Theoretical Calculation:

Data Table:-

Circuit No	V_1	V_2	I_1	I_2	$A=\frac{V_1}{V_2}$	$C=\frac{I_1}{V_2}$	$B=\frac{V_1}{I_2}$	$D=\frac{I_1}{I_2}$	'ABCD' Parameter
Figure A Theoretical	10V								
	10V								
Figure A Practical									
Figure B Theoretical									
Figure B Practical									
Figure C Theoretical									
Figure C Practical									

Conclusion:

Report:-

What is the relationship between ABCD parameters obtained in these three networks?

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Experiment No: 4

Title: Attenuator Network

Objective: To attenuate the voltage using a resistive network.

Theory: An attenuator is to reduce, by known amounts, the voltage, current of power between its property terminated input and output ports. An attenuator is a two-port resistive network, and its propagation function is real. The attenuation is independent of frequency. Attenuation may be symmetrical or asymmetrical. An attenuator of constant attenuation is called 'pad'.

If the input and output image impedance or the ratio of voltage to current at the input port and output port are equal, then the magnitude ratios of the input to output currents or input to output voltages may be written as-

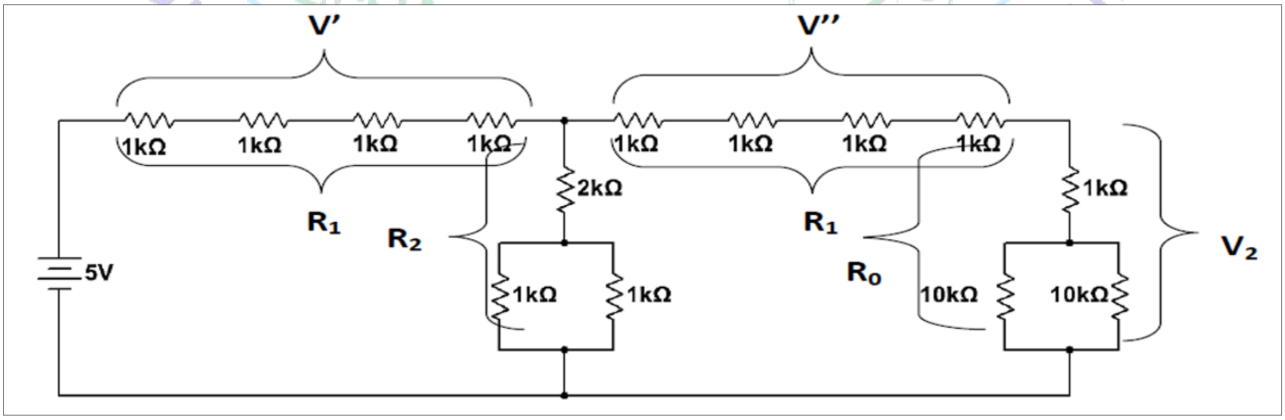
$$\frac{I_1}{I_2} = \frac{V_1}{V_2} = e^{\gamma} = N$$

Where, N is the attenuation and γ is called propagation constant and $\gamma = \alpha + i\beta$ where α = attenuation constant and β is known as phase constant. Here, I_1 is the current flowing through 4kΩ resistance and I_2 is the load current. Now, attenuation can be represented by two ways-

Attenuation in dB, $(\alpha_{dB}) = 20log_{10}\left(\frac{V_1}{V_2}\right) = 20log_{10}(\frac{I_1}{-I_2})$

Attenuation in Neper, $(\alpha_{nep} = ln\left(\frac{V_1}{V_2}\right) = ln(\frac{I_1}{-I_2})$

Circuit Diagram:



Procedure:-

i. Make the circuit as shown in figure.

ii. Apply 5volt in the input side and record I_1, I_2, and V_2 by multimeter.

Apparatus Table:

Sl. No.	Components Name	Range	Quantity	Type	Makers Name

Data Table:-

	V_1 (Volt)	V_2(Volt)	I_1(mA)	I_2(mA)	R_1(kΩ)	R_2(kΩ)	R_0(kΩ)	$\alpha_{nep}=\ln(V_1/V_2)$	$\alpha_{dB}=20\log(V_1/V_2)$
Theoretical									
Practical									

Conclusion:

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Signature of Teacher with date

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Signature of student with date
Department:
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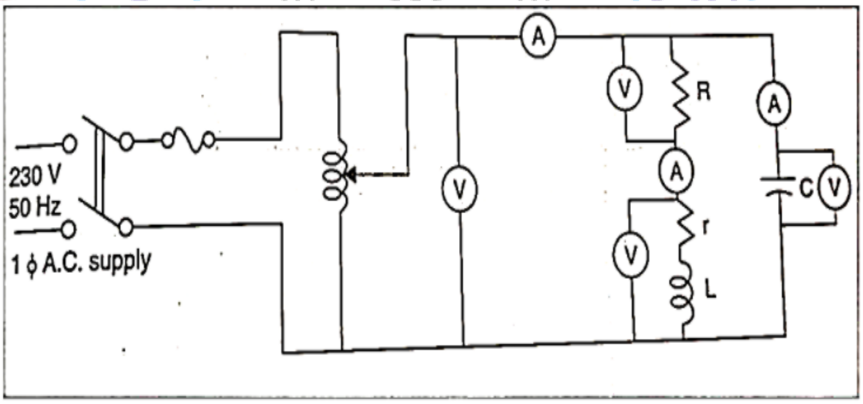
Experiment – 5

Title: Study of R-L-C Parallel Circuit

Objective: To study and measure the voltage, current, power, and power factor of an R-L-C parallel circuit.

Theory: A parallel circuit consists of a resistor (R) and an inductor (L) in one branch and a capacitor (C) in another branch across a voltage source. In a parallel circuit, the voltage across each branch remains the same and constant, while the total currents flowing through the circuit is divided into two branches. Therefore, for convenience, the voltage may be taken as a reference phasor, and all the currents, i.e., I, $I_{RL,}$ and I_C in Ampere, are drawn relative to this voltage vector V. The current through each element can be found using Kirchhoff's Current Law, which states that the sum of currents entering a junction or node equals the sum of currents leaving that node.

Circuit Diagram:



Procedure:-

i. Make the circuit as shown in the figure.

ii. Vary the supply voltage on the input side and record the currents from the ammeters.

Apparatus Table:

Sl. No.	Components Name	Range	Quantity	Type	Makers Name

Data Table:-

Let the total current flowing through the circuit be I Amp. The supply voltage is V Volt.

Sl. No	Supply Voltage V(Volt)	Total current I (A)	Voltage across resistor V_R(Volt)	Voltage across inductor V_{rL}(Volt)	Current through the resistor-inductor branch I_{R-rL}(A)	Current through the capacitor I_C(A)

Calculations:

Solve the two equations to find the **r** and $\boldsymbol{X_L}$**:**

$$\frac{V_{rL}}{I_{R-rL}} = \sqrt{r^2 + X_L^2} \quad (1)$$

$$\frac{V}{I_{R-rL}} = \sqrt{(R+r)^2 + X_L^2} \quad (2)$$

$$I = I_{R-rL} + I_C = V\left(\frac{1}{Z_1} + \frac{1}{Z_2}\right) \quad (3)$$
$$= V*Y$$

Find out the polar form of the total current and take the angle to find out the power factor (φ)

Sl. No	$R=\frac{V}{I_R}$	X_L	$X_c=\frac{V}{I_C}$	$L=\frac{X_L}{2\pi f}$	$C=\frac{1}{2\pi f X_c}$	r	Total admittance (Y)	Active Power P= V*I*Cosφ	Reactive Power Q= V*I*Sinφ

Phasor Diagram:

Conclusion:

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Experiment – 6

Experiment Title: Generation of signals using MATLAB in analog and discrete form.

Introduction to MATLAB:

MATLAB (short for Matrix Laboratory) is a software package which was designed initially for use as a tool for signal processing research. It was developed by John Little and Cleve Moler of MathWorks, Inc. MATLAB was originally written to provide easy access to the matrix computation software packages LINPACK and EISPACK. There is no compilation and linking as is done in high-level languages, such as C or FORTRAN. Computer solutions in MATLAB seem to be much quicker than those of a high-level language such as C or FORTRAN. It is numeric computation software for engineering and scientific calculations. It is also now one of the most popular tools for signal analysis in industry as well as research and education. It allows the user to manipulate signals using high level commands such as matrix multiply and convolution. The user is thus spared the tedious chore of writing low level C programs for these fundamental operations which everyone uses. MATLAB also has a series of extremely easy to use Graphical User Interface commands which allow images to be displayed, graphs to be plotted etc. Programs written in MATLAB are stored in files called MATLAB scripts and they contain MATLAB commands. MATLAB script files are recognized by having the extension .m after the filename. All computations are performed in complex-valued double precision arithmetic to guarantee high accuracy. MATLAB has a rich set of plotting capabilities. The graphics are integrated in MATLAB. Since MATLAB is also a programming environment, a user can extend the functional capabilities of MATLAB by writing new modules. It has a large collection of toolboxes in a variety of domains. Some examples of MATLAB toolboxes are control system, signal processing, neural network, image processing, and system identification. The toolboxes consist of functions that can be used to perform computations in a specific domain.

Procedure:

- Open the MATLAB command window by clicking on the MATLAB icon.
- Write down the programme on the edit window and save it.
- Run the file and see the output.

When MATLAB is invoked, the command window will display the prompt

>>. MATLAB

is then ready for entering data or executing commands.

To quit MATLAB, type the command exit or quit MATLAB has on-line help. To see the list of MATLAB's help facility, **type help**.

The help command followed by a function name is used to obtain information on a specific MATLAB function.

Some Basic MATLAB Commands

Command	Description
%	Comments. Everything appearing after % command is not executed.
demo	Access on-line demo programs
clear	Clears the variables or functions from workspace
clc	Clears the command window during a work session
clg	Clears graphic window
diary	Saves a session in a disk, possibly for printing at a later date
Linspace	Linearly evenly spaced vectors
logspace	Logarithmically evenly spaced vectors
.* , .\ , ./, .^	Element-by-element multiplication, left division, right division, and raising to the power respectively. [Array operations refer to element-by-element arithmetic operations. Preceding the linear algebraic matrix operations, * / \ ' , by a period (.) indicates an array or element-by-element operation.]
plot(x,y)	Plots vector 'y' verses vector 'x'
stem(n,y)	Plot the discrete signal.

Example:

- linspace(i_value, f_value, np)
- logspace(i_value, f_value, np)

where,i_value is the initial value ,f_value is the final value , np is the total number of elements in the vector.

- **Plot the straight-line using plot command y=mx+c, where m=0.5,c=-2 and the x coordinates are x=0,1.5,3,4.5.**

```
m=0.5;
c=-2;
x= [0 1.5 3 4.5];
y=m*x+c;
plot (x,y)
```

- **Generate a damped sinusoidal signal in analog and discrete form.**

```
x=0:0.1:5;
y=sin (x.^2).*exp(-x);
plot (x,y)
stem(x,y)
```

- **Generate unit step function in analog and discrete form.**

```
t=0:0.01:2;
y=stepfun (t,0);
plot (t,y)
axis ([0 2 0 2]);
t=0:0.1:2;
y=stepfun (t,0);
stem (t,y)
```

- **Generate unit impulse, step, ramp, parabolic, sinusoidal and triangular ramp signal.**

```
tmin=-5; dt=0.1; tmax=5;
t=tmin:dt:tmax
%.......Unit Impulse Signal…….
x1=1;
x2=0;
x=x1.*(t==0)+x2.*(t~=0);
subplot(3,2,1);
plot(t,x)
xlabel('time')
ylabel('x(t)')
title('Unit Impulse Signal')

%.......Unit Step Signal…….
x1=1;
x2=0;
x=x1.*(t>=0)+x2.*(t<0)
subplot(3,2,2);
plot(t,x)
xlabel('time')
ylabel('x(t)')
title('Unit Step Signal')

%.......Unit Ramp Signal…….
x1=t;
x2=0;
x=x1.*(t>=0)+x2.*(t<0)
subplot(3,2,3);
plot(t,x)
xlabel('time')
ylabel('x(t)')
title('Unit Ramp Signal')
```

```
%.......Unit Parabolic Signal…….
A=0.4;
x1=(A*(t.^2))/2;
x2=0;
x=x1.*(t>=0)+x2.*(t<0)
subplot(3,2,4);
plot(t,x)
xlabel('time')
ylabel('x(t)')
title('Unit Parabolic Signal')

%.......Sinusoidal Signal…….
T=2;
F=1/T;
x=sin(2*pi*F*t)
subplot(3,2,5);
plot(t,x)
xlabel('time')
ylabel('x(t)')
title('Sinusoidal Signal')

%.......Triangular Ramp Signal…….
a=2;
x1=1-abs(t)/a;
x2=0;
x=x1.*(abs(t)<=a)+x2.*(abs(t)>a)
subplot(3,2,6);
plot(t,x)
xlabel('time')
ylabel('x(t)')
title('Triangular Ramp Signal')
```

Conclusion:

Assignments:

1. Create a vector t with 10 elements 0 to 1 and plot the signals
   a) y=sin(t.^2)./(t.^2)

2. Generate a ramp signal of $\theta=30^0$;

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Roll No:

Experiment – 7

Experiment Title: Determination of Laplace transform and Inverse Laplace Transform using MATLAB.

Laplace Transform:

Laplace (F) is the Laplace transform of the scalar function F with default independent variable t.The default return is a function of S.

To determine the Laplace transform of a given function F(t), we first multiply f(t) by e^{-st} , 's' being a complex number $s = \sigma + j\omega$, then integrate this product w.r.t time with limits as zero to infinity.

Laplace transform of $f(t) = F(S) = \int_0^\infty f(t)e^{-st}dt$

Example:

syms a ω t;

laplace (a*cos(ω*t))

result:

a*s/(s^2+ω^2)

Inverse Laplace Transform

F=ilaplace(L) is the inverse Laplace transform of the scalar sym L with default independent variable 's'. The default return is a function of 't'.

Example:

syms s ;

ilaplace (1/(s-1))

Result: exp (t)

Procedure:

- Open the MATLAB Command Window by clicking on the MATLAB icon.
- Write down the program on edit window and save it.
- Run the file and see the output.

Assignments:

Find out the Laplace transform of the following functions;
Compare with the theoretical values.

1. e^{-at}
2. $e^{-at}\sin(\omega t)$
3. $\sin(\omega t)$
4. te^{-at}
5. $te^{-2t}+2t\sin(\omega t)$

Find out the Inverse Laplace transform of the following functions;
Compare with theoretical values.

1. $\frac{1}{s^2}$
2. $\frac{a}{s+b}$
3. $\frac{1}{s^2+4s+8}$
4. $\frac{s}{s^2+4^2}$
5. $\frac{s+3}{s^2+6s+18}$

Conclusion:

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Department:

Roll No:

Experiment – 8

Experiment Title:

Electrical Network Problems solving approach using MATLAB programming

Problem:

1. **If R = 10 Ohms and the current is increased from 0 to 10 A with increments of 2A, write a MATLAB program to generate a table of current, voltage and power dissipation.**

Objective: To evaluate the current, voltage and power dissipation using MATLAB programming

MATLAB Script

```
% Voltage and power calculation
R=10; % Resistance value
i=(0:2:10); % Generate current values
v=i.*R; % array multiplication to obtain voltage
p=(i.^2)*R; % power calculation
sol=[i v p] % current, voltage and power values are printed
```

2. **Simplify the complex number z and express it both in rectangular and polar form.**

$$Z=\frac{(3+j4)(5+j2)(2\angle 60^\circ)}{(3+j6)(1+j2)}$$

Objective: To evaluate the complex number, z, and express the result in polar notation and rectangular form.

MATLAB Script

```
% Evaluation of Z
% the complex numbers are entered
Z1 = 3+4*j;
Z2 = 5+2*j;
theta = (60/180)*pi; % angle in radians
Z3 = 2*exp(j*theta);
```

```
Z4 = 3+6*j;
Z5 = 1+2*j;
% Z_rect is complex number Z in rectangular form
disp('Z in rectangular form is'); % displays text inside brackets
Z_rect = Z1*Z2*Z3/(Z4+Z5);
Z_rect
Z_mag = abs (Z_rect); % magnitude of Z
Z_angle = angle(Z_rect)*(180/pi); % Angle in degrees
disp('complex number Z in polar form, mag, phase'); % displays text
%inside brackets
Z_polar = [Z_mag, Z_angle]
```

3. For the circuit shown below, find the nodal voltages V_1, V_2, and V_3.

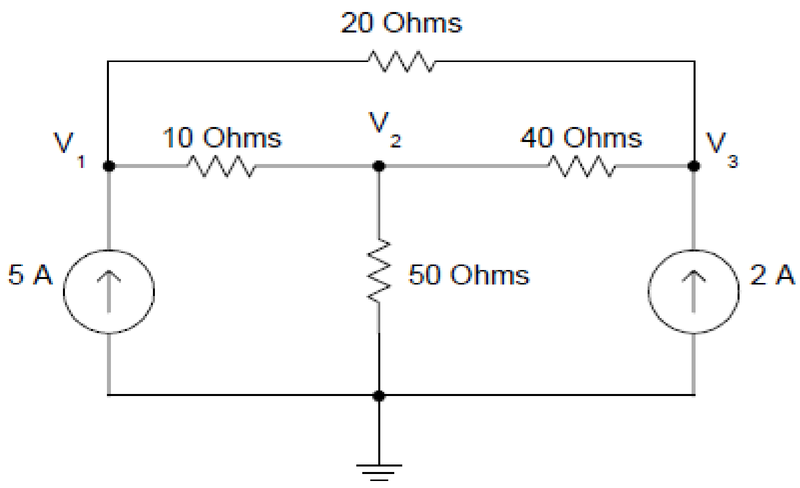


Fig. 1 Circuit with Nodal Voltages

Solution:

Solving the circuit, we are getting the matrix form

$$\begin{bmatrix} 0.15 & -0.1 & -0.05 \\ -0.1 & 0.145 & -0.025 \\ -0.05 & -0.025 & 0.075 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 5 \\ 0 \\ 2 \end{bmatrix}$$

Objective: To evaluate the nodal voltages V_1, V_2, and V_3.

MATLAB Script

```
% program computes the nodal voltages
% given the admittance matrix Y and current vector I
% Y is the admittance matrix and I is the current vector
% initialize matrix y and vector I using YV=I form
Y = [ 0.15 -0.1 -0.05;
-0.1 0.145 -0.025;
-0.05 -0.025 0.075];
I = [5; 0; 2];
% solve for the voltage
fprintf ('Nodal voltages V1, V2 and V3 are \n')
v = inv(Y)*I
```

Conclusion:

....

Signature of Teacher with date

Signature of student with date

Department:

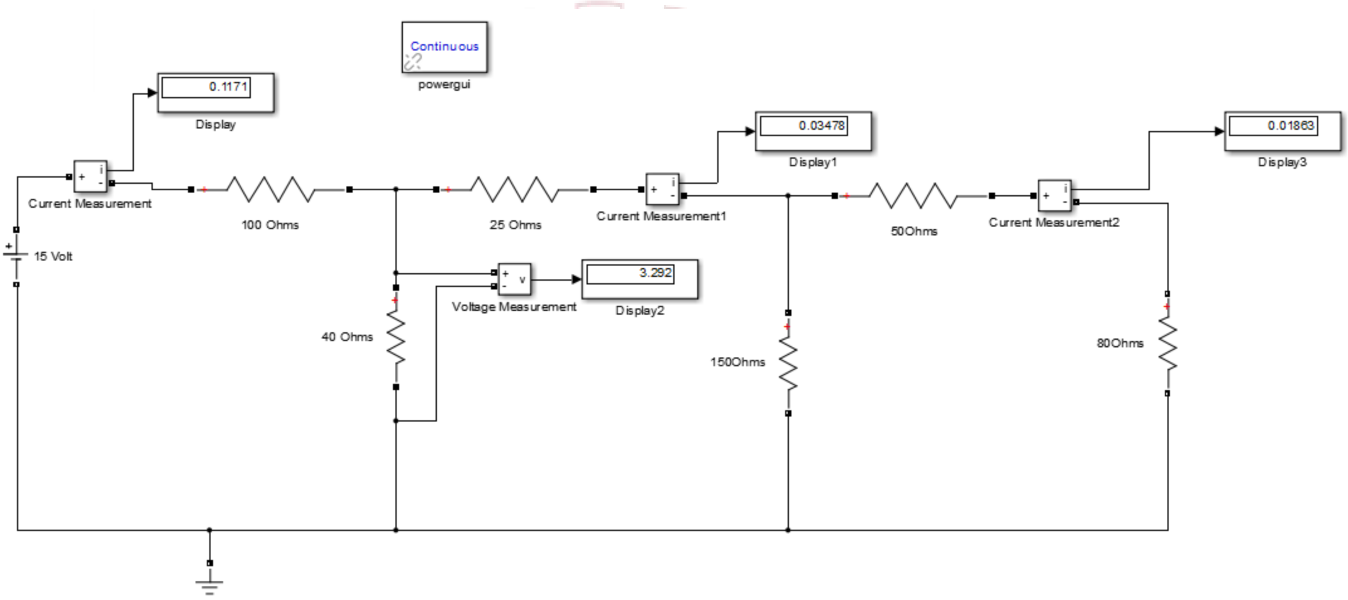
Roll No:

Experiment – 9

Experiment Title: Electrical Series-Parallel circuit Problem using MATLAB SIMULNK

Objective: To verify mesh and nodal analysis using MATLAB SIMULNK.

Simulation Diagram:



Procedure:

1. Make the connections as shown in the circuit diagram by using MATLAB Simulink. The steps are:

   Simscape⟹Simpower⟹Electric Sources⟹ DC Voltage Source

   Simscape⟹ Simpower ⟹ Element ⟹RLC series branch

   Simscape⟹ Simpower⟹ Measurement⟹ Current/Voltage Measurement

   Simscape⟹ Simpower Systems⟹ Powergui

   Simscape⟹ Simpower⟹ Element⟹ ground

   Simulink⟹Sink⟹Display

2. Measure voltage and current in each branch. Here, only one voltage measurement block is shown in Fig. Follow the same for other branches.

3. Verify the result using mesh analysis.

Calculation:

Data Table:-

Applied Voltage (V)	Loop current (I_1)		Loop current (I_2)		Loop current (I_3)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical
15volt						

Applied Voltage (V)	Node voltage(V1)		Node voltage (V2)		Node voltage (V3)	
	Theoretical	Practical	Theoretical	Practical	Theoretical	Practical
15volt						

Conclusion:

....

Signature of Teacher with date Signature of student with date

Department:

Roll No: