Topic: Experiment - 1 Date: 15/3/23

* **Aim:-** Introduction to MATLAB and its basic commands.

* **Software Used :**

* **Theory:-**

A MATLAB is a high performance language for technical computing. It integrates computation, visualization and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation.

The name MATLAB stands for matrix laboratory. MATLAB was orignally written to provide easy access to matrix.

* **Basic Commands**

- clear command :- Removes all the variables from workspace.
- clc command :- Clears the command window and homes the cursor.
- help command :- help <topic> displays help about the topic if it exist.
- quit :- Stops MATLAB
- disp :- Displays content of an array or a string.

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- format :- controls screen display format.
- input :- Displays the prompt and waits for input.
- cat :- concatenates the array.
- find :- finds the indices of non-zero elements.
- max :- Returns the largest element
- min :- Returns the smallest element.
- prod :- Product of each column
- rank :- computes rank of a matrix
- eye :- creates an identity matrix
- inv :- computes the inverse of a matrix
- axis :- sets axis limit
- grid : display grid lines

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- plot :- Generates xy plot
- figure :- Opens a new figure window.

Topic Experiment - 2 Date 5/4/23

*. Aim:- Plot unit step, unit impulse, unit ramp, exponential, parabolic functions and sinusoidal signals.

*. Software used :- MATLAB

*. Theory:-

Unit step function :- It is that type of standard signal which exists only for positive time and it is zero for negative time.

$$u(t) = \begin{cases} 0 & \text{if } t<0 \\ 1 & \text{if } t\geq 0 \end{cases}$$

Unit impulse function:- An unit impulse function that is zero everywhere but at the origin, where it is infinitely high.

$$\delta(t) = \begin{cases} 0 & \text{if } t\neq 0 \\ \infty & \text{if } t=0 \end{cases}$$

Unit ramp function:- It is a type of standard signal which starts at t=0 and increases linearly with time. The unit ramp function has unit slop.

$$r(t)= \begin{cases} t & \text{for } t\geq 0 \\ 0 & \text{for } t<0 \end{cases}$$

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Exponential function:- An exponential function is a function that literally represents an exponentially or decreasing series.

$$\boxed{x(t) = Ae^{\alpha t}}$$

Parabolic function:- When the signal gives the constant acceleration distinction of actual input signal, such a signal is known as Parabolic function. The unit parabolic signal starts at $t=0$.

$$P(t) = \begin{cases} t^2/2 & \text{for } t \geq 0 \\ 0 & \text{for } t < 0 \end{cases}$$ ↳ continuous time unit parabolic signal.

Also, $P(t) = \frac{t^2}{2} u(t)$

Sinusoidal function:- A sinusoidal function is a function that describes a smooth periodic oscillations.

$$\boxed{x(t) = A\sin(\omega t + \phi) = A\sin(2\pi f t + \phi)}$$

$$T = \frac{2\pi}{\omega} = \frac{1}{f}$$

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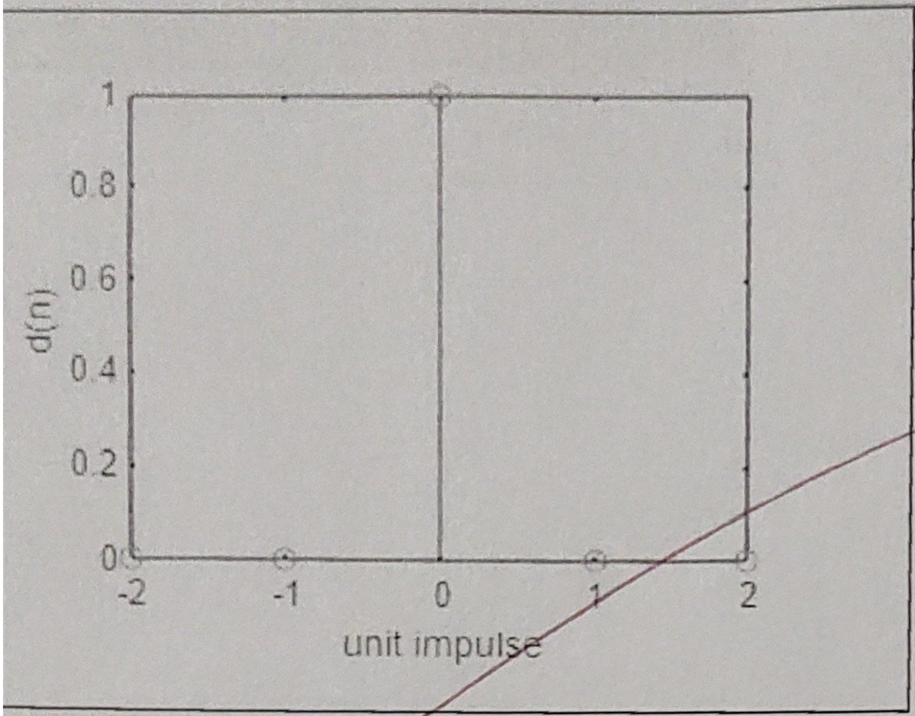
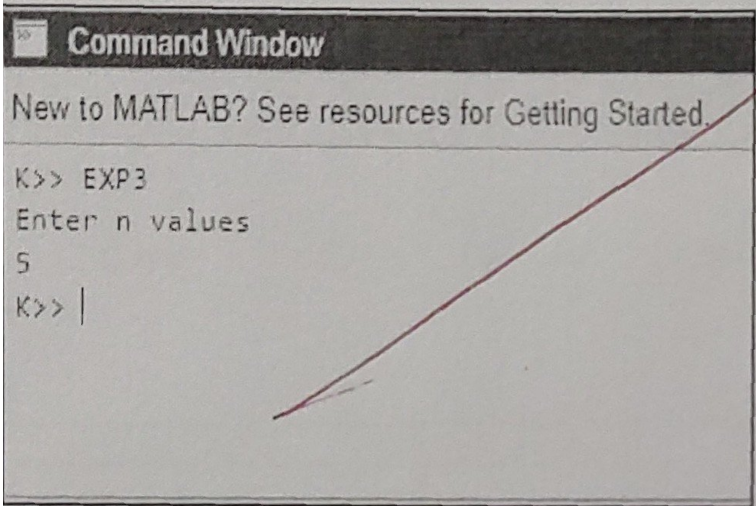
CODE

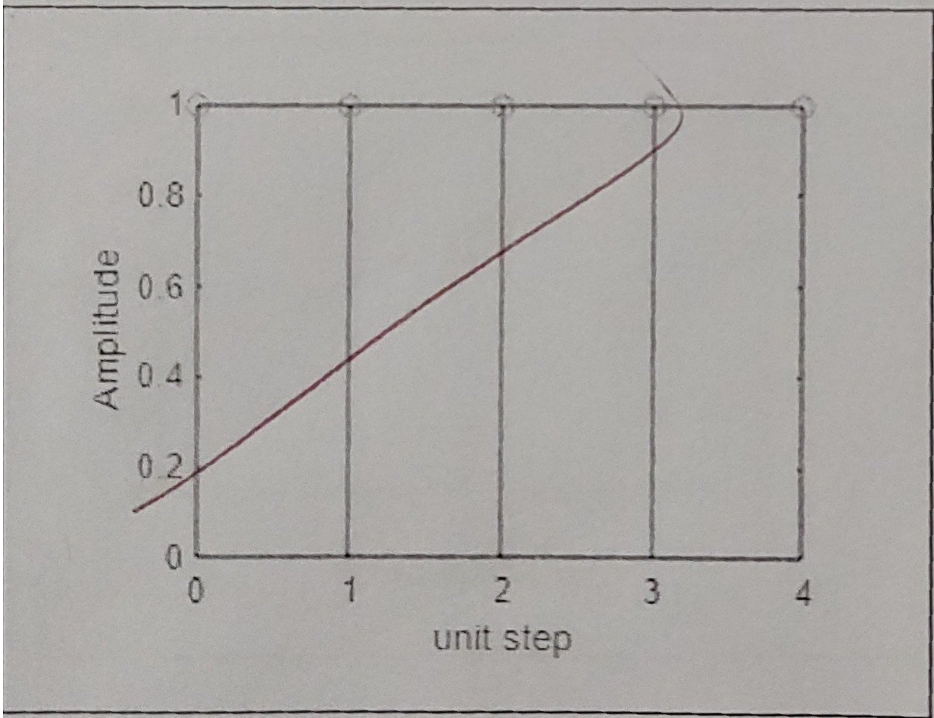
```
% PLOT UNIT STEP SIGNAL
 n = input("Enter n values");
 t = 0:1:n-1;
 y1 = ones(1,n);
 subplot (2,2,2);
 stem (t,y1);
 %line (t,y1);
 ylabel ('Amplitude');
 xlabel ('unit step');

% PLOT UNIT IMPULSE SIGNAL
 t = -2:1:2;
 y = [zeros (1,2), ones (1,1), zeros (1,2)];
 subplot (t,y);
 ylabel ('d(n)');
 xlabel ('unit impulse');

% PLOT UNIT RAMP SIGNAL
 n = input ('Enter n values');
 t = 0:1:n-1;
 subplot (2,2,3);
 stem (t,t);
 %line (t,t);
 ylabel ('Amplitude');
 xlabel ('unit ramp');
```

Unit Impulse Function



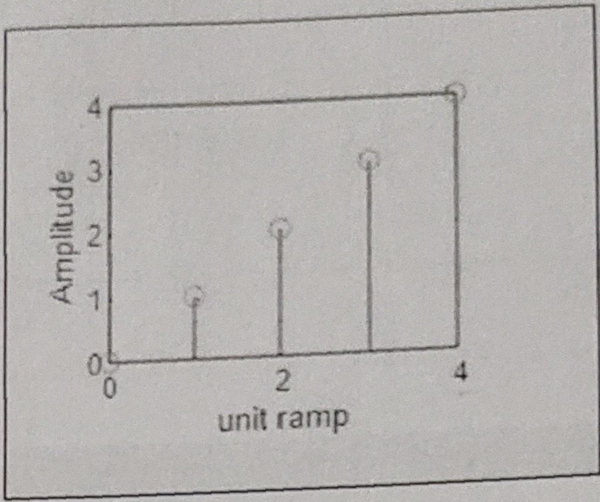
Unit Step Function





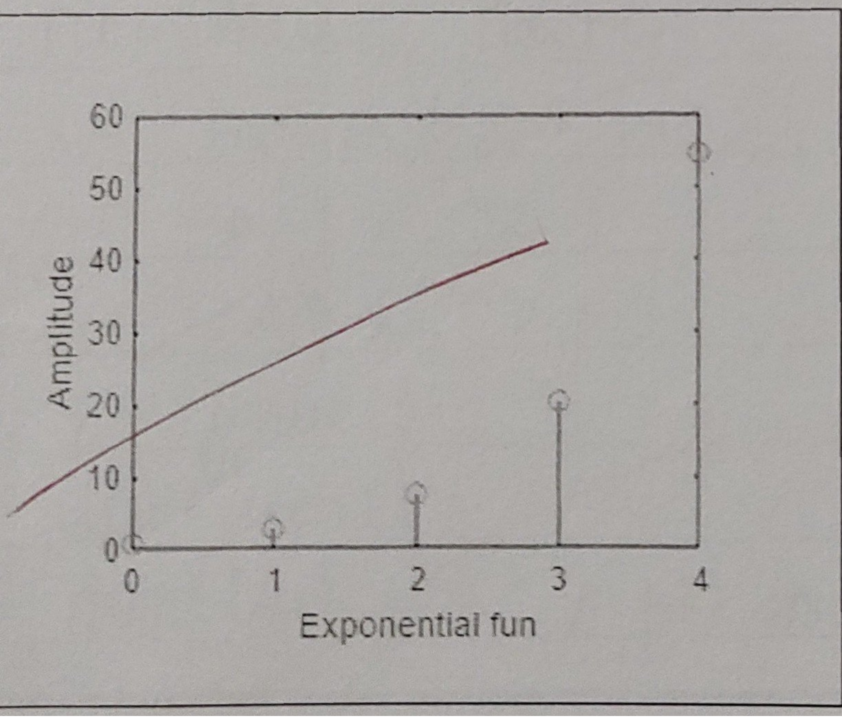
Unit Ramp Function

```
Command Window
Enter n values
5
```



Exponential Function

```
Command Window
Enter length of exponential seq
5
Enter a value
5

y2 =

    1.0000    2.7183    7.3891   20.0855   54.5982

K>>
```



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```
% PLOT EXPONENTIAL FUNCTION
n = input('Enter length of exponential seq');
t = 0:1:n-1 ;
a = input('Enter a value');
%y2 = exp(a*t);
y2 = exp(t);
y2
subplot(2,2,4);
stem(t, y2);
%line(t,y2);
xlabel('Exponential function');
ylabel('Amplitude');

% PLOT PARABOLIC FUNCTION
x = linspace(-5, 5, 100);
y1 = 0.5*x.^2 ;
y2 = 2*x.^2 ;
f = figure();
ax = axes();
hold(ax);        % plot multiple line on the axes.
plot(x,y1);
plot(x,y2);
```

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```
% PLOT SINUSOIDAL SIGNALS

t = [0 : 0.1 : 2*pi]
a = sin(t).
f = figure();
ax = axes();
hold (ax);
plot (t, ax);
```

Topic Experiment - 3 Date 12/4/23

* Aim :- Plot the linear convolution of two sequences

* Software used :- MATLAB

* Theory :-

Convolution is a formal mathematical operation that takes two signals and produce a third signal.
In linear systems, convolution is used to describe the relationship between three signals of interest : the input signal, the impulse response and the output signal.

In MATLAB, you can perform linear convolution using the "conv" function.

$\boxed{c = conv(A,B)}$ where A and B are input signals.

* CODE :-

```
x = input ('Enter the sequence 1 : ');
y = input ('Enter the sequence 2 : ');

c = conv (x,y);

subplot (3,1,1);
stem (x);
```

Topic

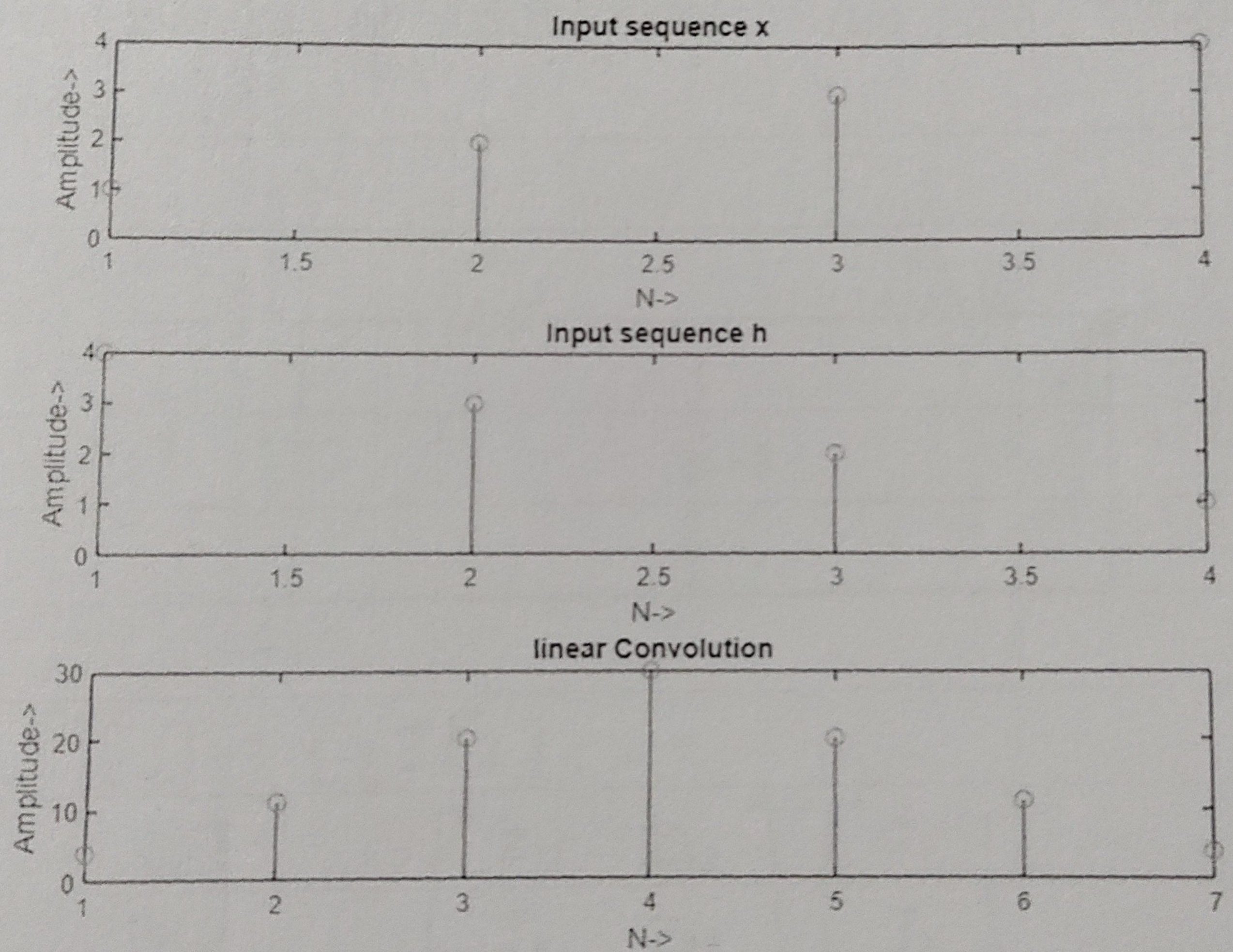
```
ylabel('Amplitude');
xlabel('N');
title('Input sequence x');

subplot(3,1,2);
stem(y);

ylabel('Amplitude');
xlabel('N');
subplot(3,1,3);

ylabel('Amplitude');
xlabel('N');
title('Linear convolution');
```

Command Window

New to MATLAB? See resources for Getting Started.

```
>> EXP3
Enter the sequence 1:
[1 2 3 4]
Enter the sequence 2:
[4 3 2 1]
>>
```

Figure 1

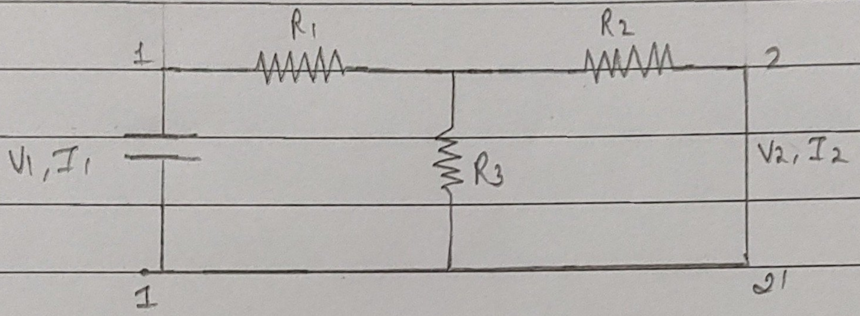


Topic: Experiment - 4 Date:

* **Aim:-** To determine Z and Y parameters of the given two port network.

* **Theory:-**

Two port network is a pair of two terminal electrical network in which, current enters through one terminal and leaves through another terminal of each point. Two port network representation is shown as:-



$$[V] = [Z][I]$$

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

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

Z-Parameter :-

$Z_{11} = \dfrac{V_1}{I_1}$ when $I_2 = 0$; $Z_{21} = \dfrac{V_2}{I_1}$ when $I_2 = 0$; $\dfrac{V_1}{I_2} = Z_{12}$ when $I_1 = 0$; $\dfrac{V_2}{I_2} = Z_{22}$ when $I_1 = 0$

Here, one pair of terminals, 1 & 1' represents one port which is called as port1 and the other pair of terminals 2 & 2'

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represents another port, which is called port 2.

Y-Parameter :-

The coefficient of independent variables, V_1 and V_2 are called as Y parameter.

The Y parameters are :-

$y_{11} = \frac{I_1}{V_1}$, where $V_2 = 0$ $y_{21} = \frac{I_2}{V_1}$ when $V_2 = 0$

$y_{21} = \frac{I_1}{V_2}$, when $V_1 = 0$ $y_{22} = \frac{I_2}{V_2}$, when $V_1 = 0$

Y parameters are called as Admittance parameters because these are simply, the ratio of currents and voltages.

Units of Y parameters are mho.

Calculations:-

For, Z Parameters

For given, Port 1 $z_{11} = \frac{V_1}{I_1}$; $z_{21} = \frac{V_2}{I_1}$

Now $V_1 = 100V$; $I_1 = 50A$

$V_2 = 50V$

$\boxed{z_{11} = \frac{100}{50} = 2}$ $\boxed{z_{21} = \frac{50}{50} = 1}$

For port 2, $V_1 = 100V$, $V_2 = 50$, $I_1 = 50$, $I_2 = 0$

$\boxed{z_{12} = \frac{V_1}{I_2} = \frac{100}{50} = 2}$ $\boxed{z_{22} = \frac{50}{50} = 1}$

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for Y parameters :-

$y_{11} = \left.\frac{I_1}{V_1}\right|_{V_2=0} = \frac{0.667}{100} = .0067$

$y_{12} = \left.\frac{I_1}{V_2}\right|_{V_1=0} = \frac{0.6667}{100} = .0067$

$y_{21} = \left.\frac{I_2}{V_1}\right|_{V_2=0} = \frac{0.3333}{100} = .0033$

$y_{22} = \left.\frac{I_2}{V_2}\right|_{V_1=0} = \frac{0.3333}{100} = .0033$

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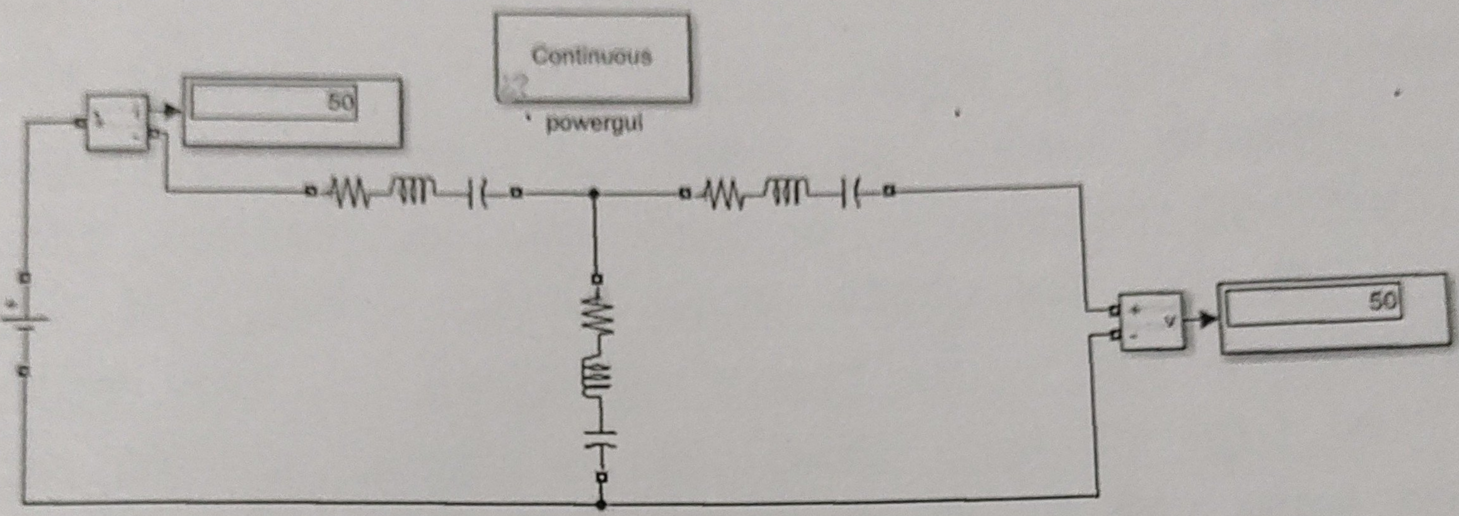
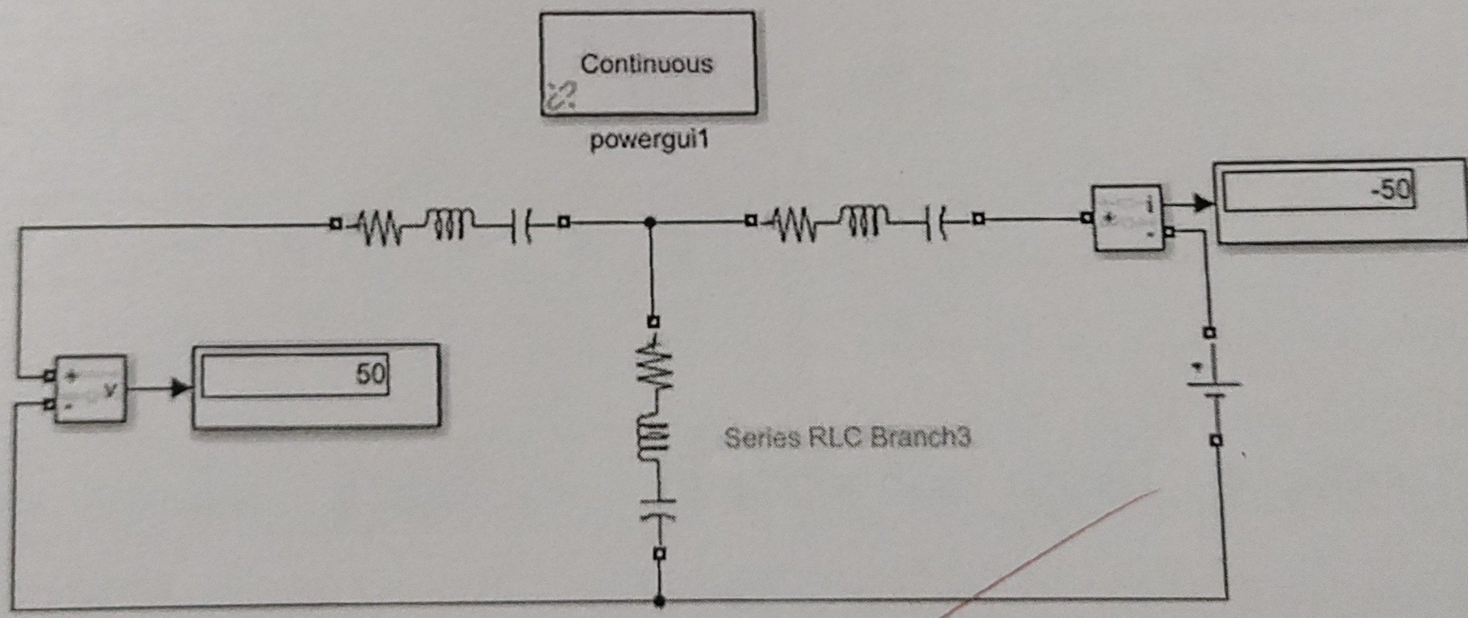
CNS LAB EXPERIMENT-4



Circuit - 1



Circuit - 2

Topic: Experiment -5 Date: 26/4/23

★ **Aim:-** To determine the ABCD parameters of the given two port network.

★ **Theory:-**

ABCD parameters are widely used in analysis of power transmission engineering where they are termed as "Circuit Parameters". ABCD parameters are also known as "Transmission parameters". The input port is referred as the sending end while the output port is referred as recieving end. These are obtained by expressing voltage V_1 and current I_1 at the input port in terms of voltage V_2 and current I_2 at the output port.

$$V_1 = AV_2 + B(-I_2)$$

$$I_1 = CV_2 + D(-I_2)$$

In matrix form above equation can be written as:-

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_2 \\ -I_2 \end{bmatrix}$$

The individual transmission parameters are defined as follows:-

$A = \left.\frac{V_1}{V_2}\right|_{I_2=0}$ - open circuit reverse voltage gain.

$C = \left.\frac{I_1}{V_2}\right|_{I_2=0}$ - open circuit transfer admittance

$B = \left.\frac{V_1}{-I_2}\right|_{V_2=0}$ - short circuit transfer impedance.

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$D = \left.\frac{I_1}{-I_2}\right|_{V_2=0}$ - short circuit reverse current gain.

* Calculations

$V_1 = 50V$

$V_2 = 25V$

$I_1 = 0.25A$

$I_2 = 0.1667A$

$A = \frac{V_1}{V_2} = \frac{50}{25} = 2$

$B = \frac{V_1}{I_2} = \frac{50}{0.1667} = 299.94$

$C = \frac{I_1}{V_2} = \frac{0.25}{25} = 0.01$

$D = \frac{I_1}{I_2} = \frac{0.333}{0.1667} = 1.499$

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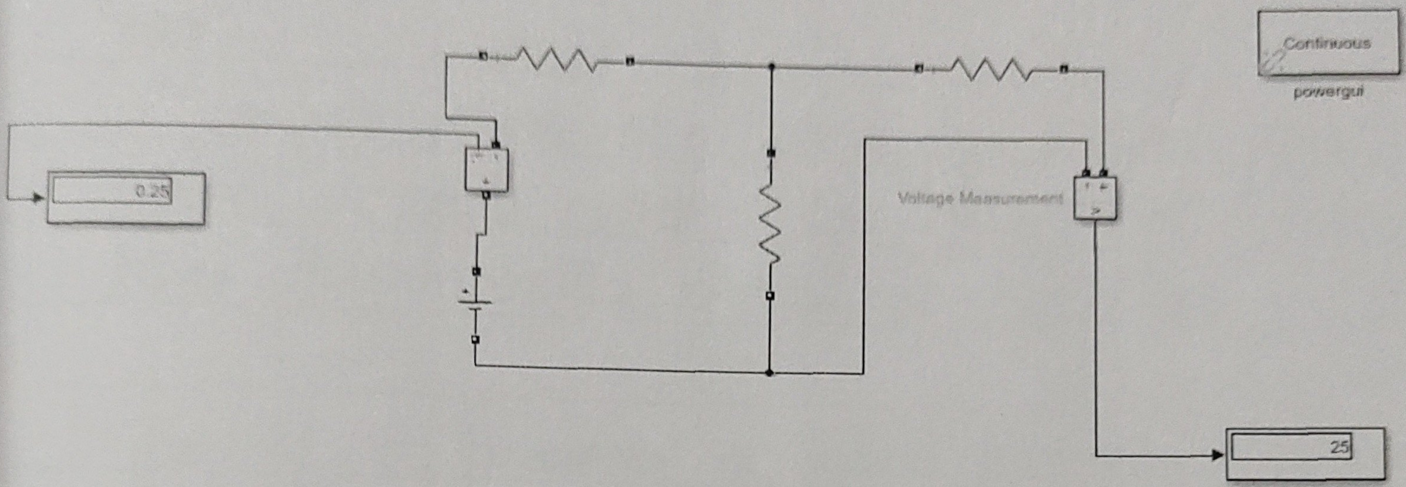
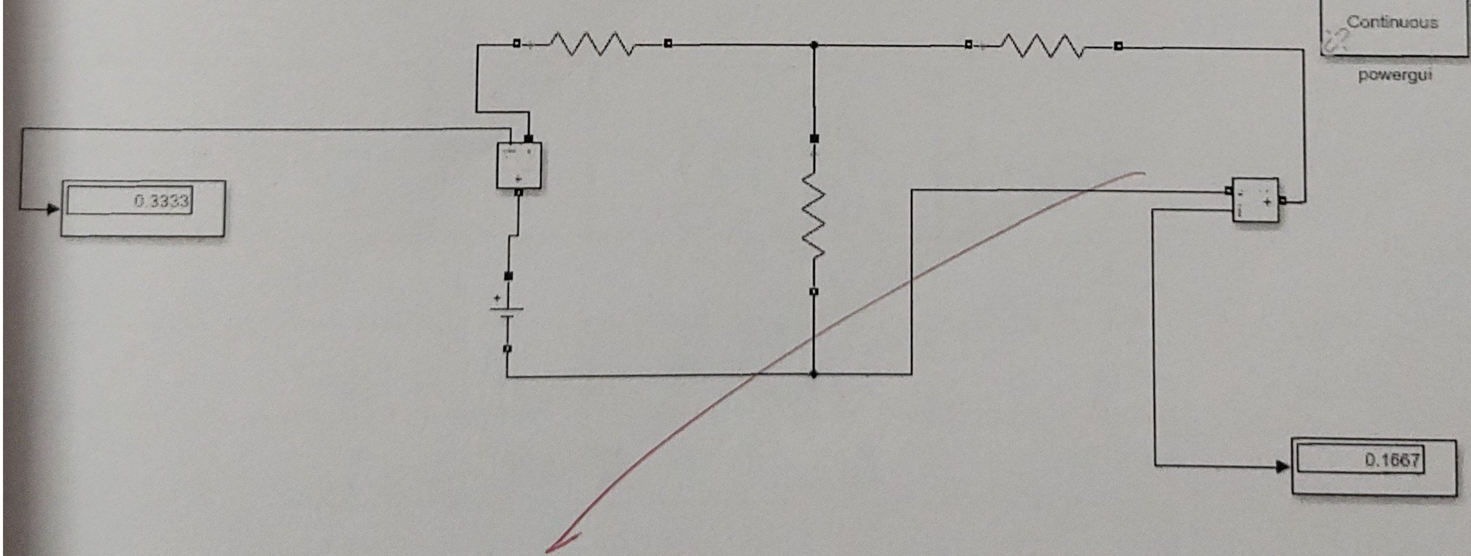
EXPERIMENT 5





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* **Aim:** To determine Hybrid parameters of the given two port network.

* **Theory:**

The two port network is a pair of two terminals in an electrical network in which current enters through one terminal and leaves through another terminal of each port.

In case of H parameter or hybrid parameter, voltage of the input port and the current of the output port are expressed in the terms of current of input port and the voltage of the output port. Due to this reason, these parameters are called as "Hybrid parameters".

i.e.

$$(V_1, I_2) = f(I_1, V_2)$$

$$\begin{bmatrix} V_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ V_2 \end{bmatrix}$$

i.e. $V_1 = h_{11} I_1 + h_{12} V_2$

$I_2 = h_{21} I_1 + h_{22} V_2$

when output port short circuited $(V_2 = 0)$

$$h_{11} = \frac{V_1}{I_1} \quad ; \quad h_{21} = \frac{I_2}{I_1}$$

when input port open circuited $(I_1 = 0)$

$$h_{12} = \frac{V_1}{I_2} \quad ; \quad h_{22} = \frac{I_2}{V_2}$$

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Calculations :-

(i) When $V_2 = 0$

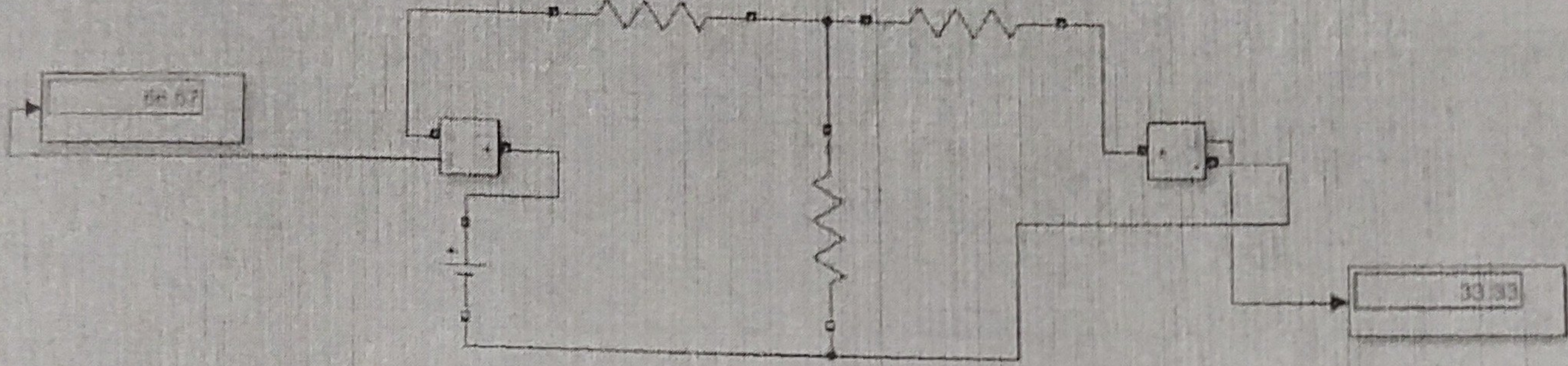
$$h_{11} = \frac{V_1}{I_1} = \frac{100}{66.67} = 1.49$$

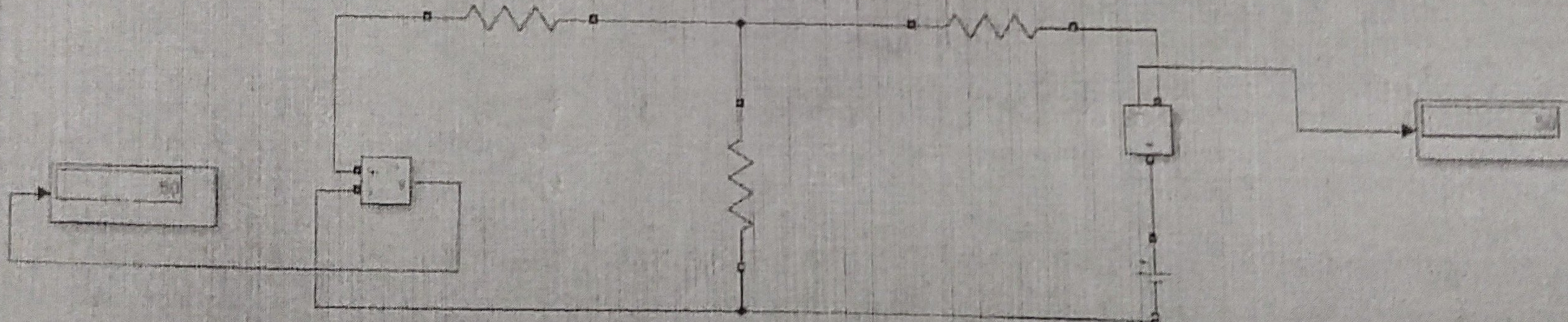
$$h_{21} = \frac{I_2}{I_1} = \frac{33.33}{66.67} = 0.499$$

(ii) When $I_1 = 0$

$$h_{12} = \frac{V_1}{V_2} = \frac{50}{100} = 0.5$$

$$h_{22} = \frac{I_2}{V_2} = \frac{5}{100} = 0.05$$


33.33


50
50

Topic: Experiment - 7 Date

* **Aim:-** To design Cascade connection and determine ABCD parameters of the given two port network.

* **Theory:-**

Cascade connection :- An arrangement of two or more components or circuits such that the output of one is the input of the next.

ABCD parameters :- ABCD parameters of Two port network are known as transmission parameters. These are generally used in the analysis of power transmission in which the input port is referred as the sending end while the output port is referred as Recieving end.

$$V_1 = AV_2 + B(-I_2)$$
$$I_1 = CV_2 + D(-I_2)$$

In matrix form :- $\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_2 \\ -I_2 \end{bmatrix}$

The individual transmission parameters are depend as follows :-

$A = \frac{V_1}{V_2}\Big|_{I_2 = 0}$ (open circuit - reverse voltage gain)

$B = \frac{V_1}{-I_2}\Big|_{V_2 = 0}$ (short circuit transfer impedance)

$$C = \left.\frac{I_1}{V_2}\right|_{I_2=0}$$ (open circuit transfer impedance)

$$D = \left.\frac{I_1}{-I_2}\right|_{V_2=0}$$ (short circuit reverse current gain)

The possible simplest interconnection of two port networks is cascade or tandem connection. The two port networks are said to be connected in cascade if the output port of first becomes the input port of second.

For Network Na :

$$\begin{bmatrix} V_{1a} \\ I_{1a} \end{bmatrix} = \begin{bmatrix} A_a & B_a \\ C_a & D_a \end{bmatrix} \begin{bmatrix} V_{2a} \\ -I_{2a} \end{bmatrix}$$

For Network Nb :

$$\begin{bmatrix} V_{1b} \\ I_{1b} \end{bmatrix} = \begin{bmatrix} A_b & B_b \\ C_b & D_b \end{bmatrix} \begin{bmatrix} V_{2b} \\ -I_{2b} \end{bmatrix}$$

So in matrix form the T-parameters of the cascade connected combined network can be written as

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_2 \\ -I_2 \end{bmatrix}$$

where $\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} A_a & B_a \\ C_a & D_a \end{bmatrix} \begin{bmatrix} A_b & B_b \\ C_b & D_b \end{bmatrix}$

in eq^n form :-
$A = A_a A_b + B_a C_b$
$B = A_a B_b + B_a D_b$
$C = C_a A_b + D_a C_b$
$D = C_a B_b + D_a D_b$

The overall T-parameter matrix for cascade connected two port network is simply the matrix product of T-parameter matrices of each individual two port network in cascade.

* Calculations :-

$A_a, A_b = \frac{V_1}{V_2} = \frac{50}{25} = 2$ $\quad$ $B_a, B_b = \frac{V_1}{I_1} = \frac{50}{1.667} = 299.94$

$C_a, C_b = \frac{I_1}{V_2} = \frac{0.25}{25} = 0.01$ $\quad$ $D_a, D_b = \frac{I_1}{I_2} = \frac{0.25}{0.1667} = 1.499$

Now,

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} A_a & B_a \\ C_a & D_a \end{bmatrix} \begin{bmatrix} A_b & B_b \\ C_b & D_b \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 299.94 \\ 0.01 & 1.499 \end{bmatrix} \begin{bmatrix} 2 & 299.94 \\ 0.01 & 1.499 \end{bmatrix}$$

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 6.9994 & 1049.59 \\ 0.034 & 5.24 \end{bmatrix}$$

Now,

$$A = \frac{V_1}{V_2} = \frac{100}{14.28} = 6.994$$

$$B = \frac{V_1}{I_1} = \frac{100}{0.0952} = 1049.49$$

$$C = \frac{I_1}{V_2} = \frac{0.0952}{14.28} = 0.034$$

$$D = \frac{I_1}{I_2} = \frac{0.0952}{0.1816} = 5.24$$

Hence,

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} A_a & B_a \\ C_a & D_a \end{bmatrix} \begin{bmatrix} A_b & B_b \\ C_b & D_b \end{bmatrix}$$

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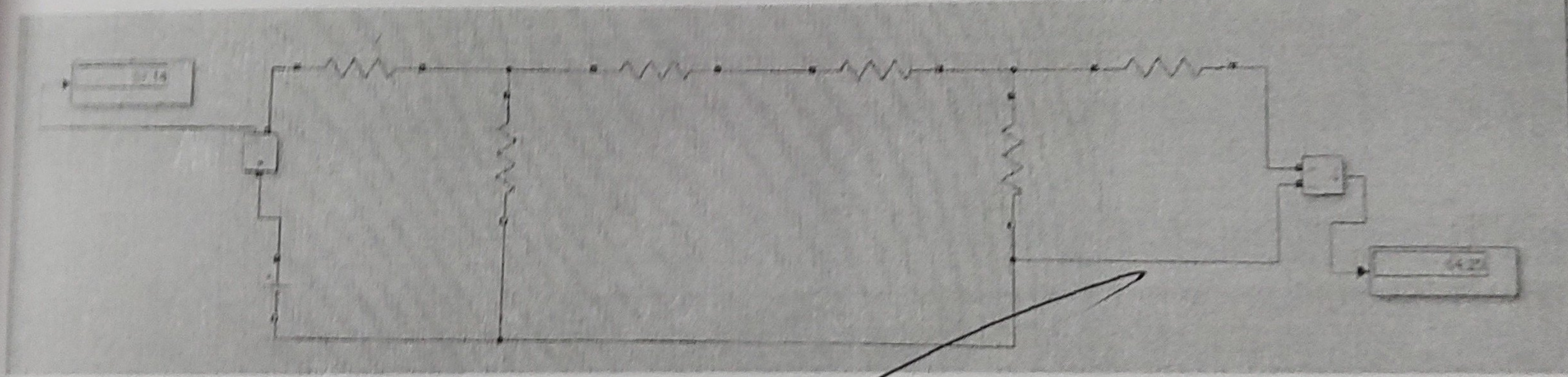

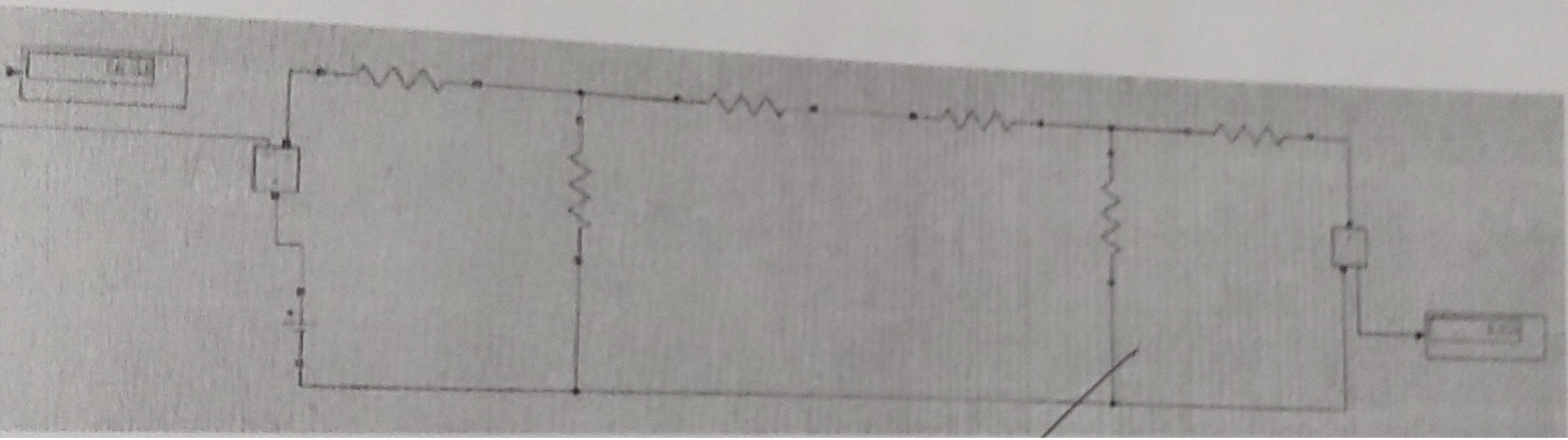

Topic: Experiment - 8 Date:

* Aim :- To design series - series connection and determine the z-parameters of the given two port network.

* Theory :-

Series Connection of Two Ports :-

Consider two network A and B are connected in series. When two ports are connected in series, we can add their z parameters to get overall z-parameters of the overall series connection.

Let the z-parameters of network A be z'_{11}, z'_{12}, z'_{21}, z'_{22}
Let the z-parameters of network B be z''_{11}, z''_{12}, z''_{21}, z''_{22}
Let the overall z-parameters of series connection be z_{11}, z_{12}, z_{21}, z_{22}.

For series connection, we have

$$V_1 = V_1' + V_1''$$
$$V_2 = V_1' + V_2''$$
$$I_1 = I_1' = I_1''$$
$$I_2 = I_2' = I_2''$$

For network A, z parameter eq^n:

$$V_1' = z'_{11} I_1' + z'_{12} I_2'$$
$$V_2' = z'_{21} I_1' + z'_{22} I_2'$$

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For network B, z parameters eq^n:

$$V_1'' = z_{11}'' I_1'' + z_{12}'' I_2''$$

$$V_2'' = z_{21}'' I_2'' + z_{22}'' I_2''$$

$$V_1 = (z_{11}' + z_{11}'') I_1 + (z_{12}' + z_{12}'') I_2$$

$$V_2 = (z_{21}' + z_{21}'') I_1 + (z_{22}' + z_{22}'') I_2$$

In matrix form:

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} (z_{11}' + z_{11}'') & (z_{12}' + z_{12}'') \\ (z_{21}' + z_{21}'') & (z_{22}' + z_{22}'') \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

Thus, overall z-parameter are:

$$[z] = \begin{bmatrix} z_{11}' + z_{11}'' & z_{12}' + z_{12}'' \\ z_{21}' + z_{21}'' & z_{22}' + z_{22}'' \end{bmatrix}$$

Hence, the z-parameters of the series connection are the sum of z-parameters of the individual network connected in series.

* Calculations:

$$[z_a] = [z_b] = \begin{bmatrix} 200 & 200 \\ 100 & 100 \end{bmatrix}$$

$$[z] = [z_a] + [z_b]$$

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$Z_{11} = \frac{100}{0.2857} = 347.8$

$Z_{12} = \frac{100}{0.2857} = 347.8$

$Z_{21} = \frac{71.43}{0.2857} = 250$

$Z_{22} = \frac{71.43}{0.2857} = 250$

Now,

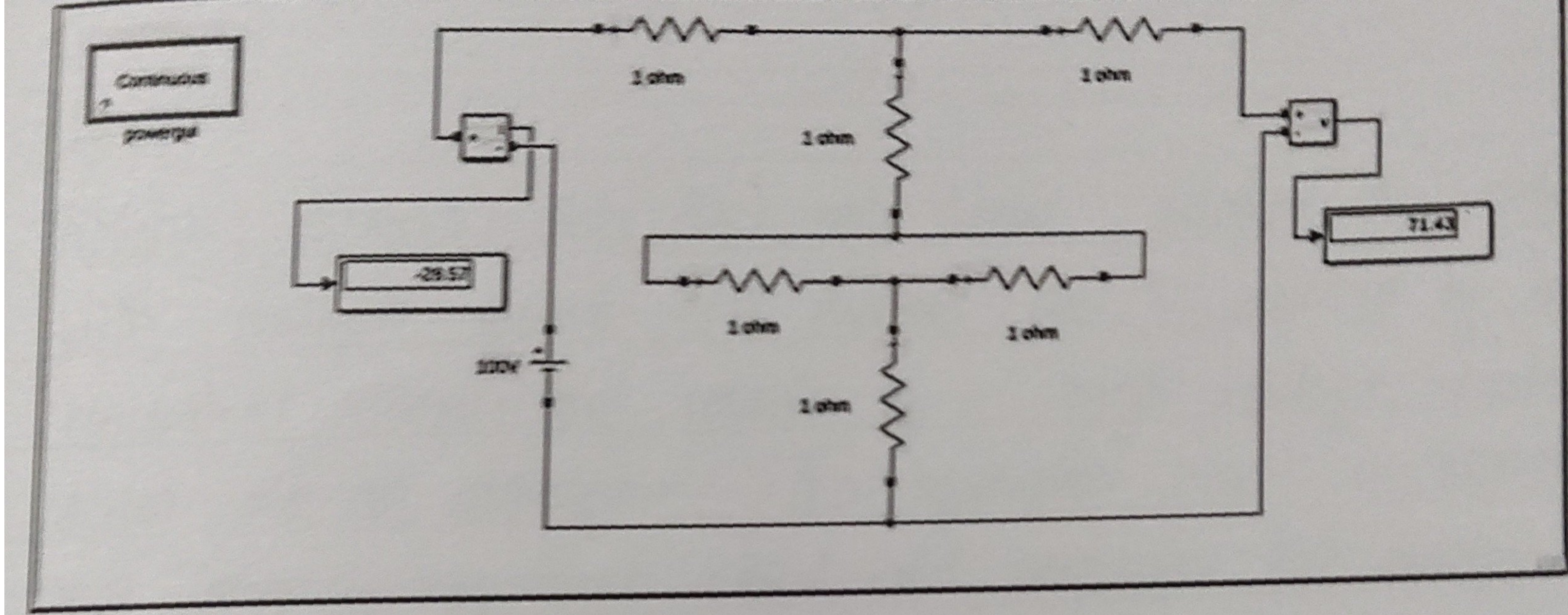
$LHS = [Z] = \begin{bmatrix} 347.8 & 347.8 \\ 250 & 250 \end{bmatrix}$

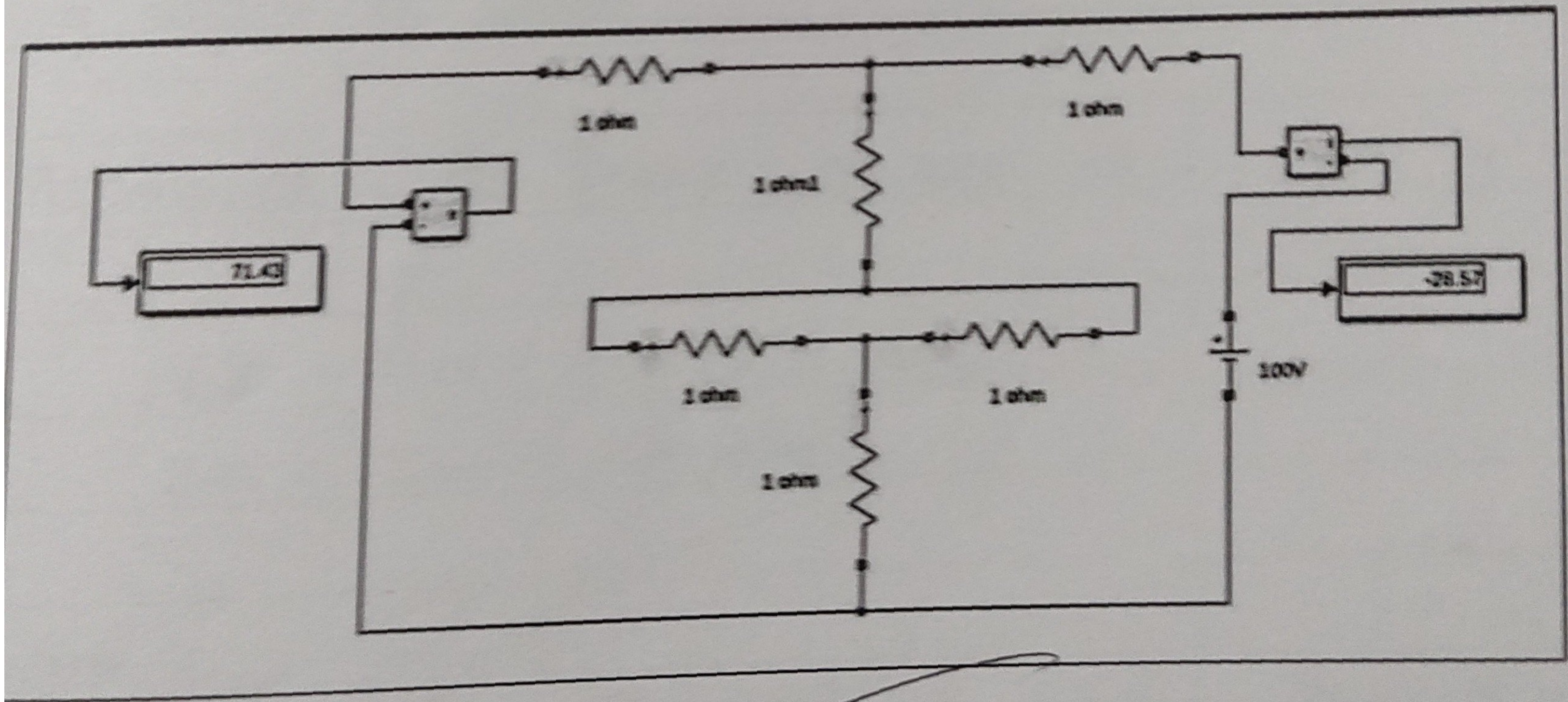
$RHS = [Z_a] + [Z_b]$

$= \begin{bmatrix} 400 & 400 \\ 200 & 200 \end{bmatrix}$

$LHS \approx RHS$

Hence Proved.


Continuous
powergui
1 ohm
1 ohm
1 ohm
-28.57
71.43
1 ohm
1 ohm
100V
1 ohm


1 ohm
1 ohm
1 ohm1
71.43
-28.57
1 ohm
1 ohm
100V
1 ohm