EXPERIMENT 1a

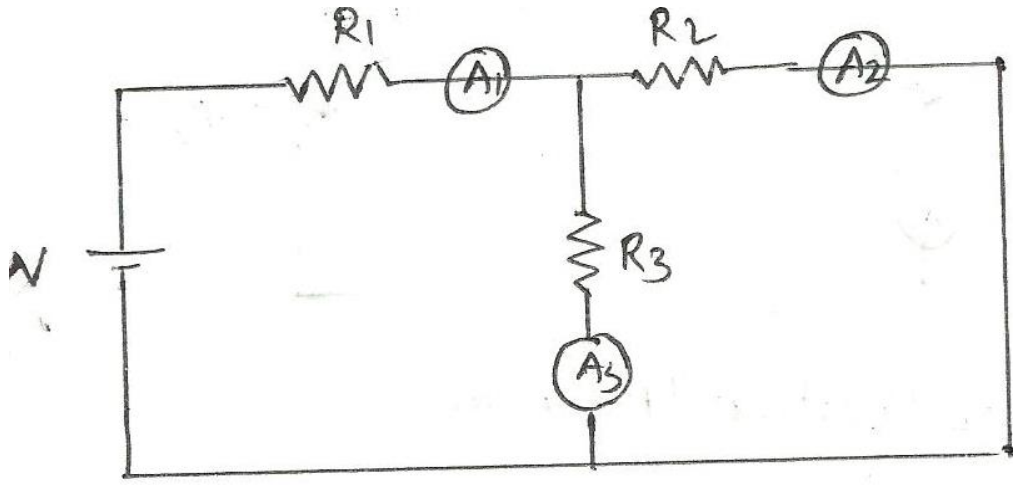
1. OBJECTIVE: VERIFICATION OF KIRCHHOFF'S CURRENT LAW.

2. APPARATUS REQUIRED:

Serial No.	Equipment	Specification	Quantity	Remark
1	Regulated power supply or Battery	0-24 V or 24V	1	
2	PMMC ammeter	0 – 1A	3	
3	Rheostats	10 Ω, 1A	3	
4	Connecting wires			

3.BRIEF THEORY: According to Kirchhoff's current law, in any network of wires carrying currents, the algebraic sum of all currents meeting at a junction (or node) is zero or the sum of incoming currents towards any junction (or node) is equal to the sum of outgoing currents away from that junction.

4. CIRCUIT DIAGRAM:



5. PROCEDURE: Three rheostats R_1, R_2 and R_3 and ammeters A_1, A_2 and A_3 are connected to 24 V battery or regulated power supply as shown in figure. The three rheostats are set their maximum values, supply is switched on and the reading of the ammeter A_1, A_2 and A_3 are noted. The process may be repeated by varying either of rheostats R_1, R_2 and R_3.

6. OBSERVATIONS:

Sr. no	Reading of ammeter A_1 (I_1)	Reading of ammeter A_2 (I_2)	Reading of ammeter A_3 (I_3)	I_2+ I_3
1				
2				
3				
4				
5				

7. CALCULATION:

8. RESULT AND DISCUSSION: It is found that current I_1 is equal to the sum of currents I_2 and I_3.Hence kirchhoff's current law is verified.

9. Precautions:

1. All connections should be tight.
2. All steps should be followed carefully.
3. Readings and calculation should be taken carefully.
4. Don't touch the live terminals.

10. PRE EXPERIMENT QUESTIONS:

1. What is KCL?

2. What is ohm's law?

11. POST EXPERIMENT QUESTIONS:

1. What is difference between emf and potential difference?

2. Why ammeters are connected in series to measure current?

3. If the length of a wire of resistance R is uniformly stretched to n times its original value, what will be its new resistance?

EXPERIMENT 1b

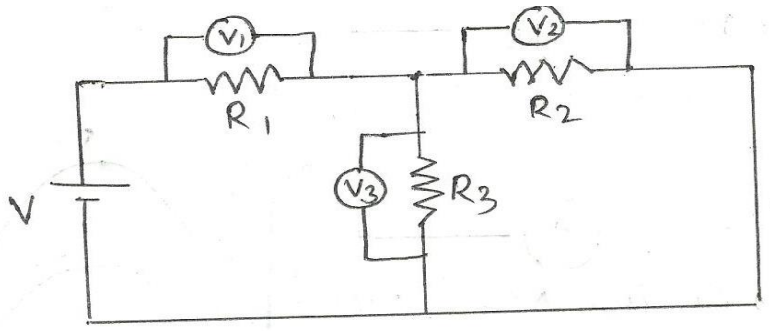
1. OBJECTIVE: VERIFICATION OF KIRCHHOFF'S VOLTAGE LAW.

2. APPARATUS REQUIRED:

Serial No.	Equipment	Specification	Quantity	Remark
1	Regulated power supply or Battery	0-24 V or 24V	1	
2	PMMC voltmeter	0 –24V	3	
3	Rheostats	10 Ω, 2.5A	2	
4	Connecting wires			

3. BRIEF THEORY: According to Kirchhoff's voltage law, in any closed circuit or mesh, the algebraic sum of emfs acting in the circuit or mesh is equal to the algebraic sum of the products of the currents and resistances of each part of the circuit or mesh.

4. CIRCUIT DIAGRAM:



5. PROCEDURE: Two rheostats R_1 , R_2 , R_3 and three voltmeters V_1 , V_2 and V_3 are connected to 24V battery or regulated power supply as shown in figure. Three rheostats are set their maximum values, supply is switched on and the reading of the voltmeters V_1 , V_2 and V_3 are noted. The process may be repeated by varying either of rheostats R_1 , R_2 or R_3.

6. OBSERVATIONS:

Sr. no	Reading of Voltmeter V_1 in Volts	Reading of Voltmeter V_2 in Volts	Reading of Voltmeter V_3 in Volts
1			
2			
3			

4			
5			

7. CALCULATION:

8. RESULT AND DISCUSSION: It is found that, in first loop, voltage V is equal to the sum of voltages V_1 and V_3 and in second loop $V_2 = V_3$ .Hence Kirchhoff's voltage law is verified.

9. PRECAUTION:

1. All connections should be tight.
2. All steps should be followed carefully.
3. Readings and calculation should be taken carefully.
4. Don't touch the live terminals.

10. PRE EXPERIMENT QUESTIONS:

1. What is KVL?

11. POST EXPERIMENT QUESTIONS:

1. Why voltmeters are connected in parallel to rheostats to measure voltage?

2. How does the resistance of a homogeneous material having constant length vary with the changing cross sectional area.

3. What is Fleming's left hand rule?

4. What is Fleming's right hand rule?

5. Define junction and node.

6. Define Mesh and loop.

EXPERIMENT 2a

1. OBJECTIVE: VERIFICATION OF SUPERPOSITION THEOREM.

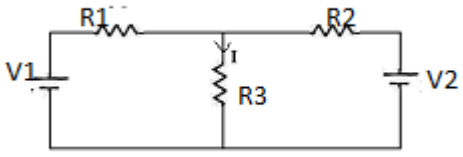
2. APPARATUS REQUIRED:

Serial No.	Equipment	Specification	Quantity	Remark
1	Two Batteries	12V and 6 V	1	
2	PMMC ammeters	0 –2A	3	
3	Rheostats	10 Ω, 2.5A	3	
4	Keys		02	
5	Connecting Wires			

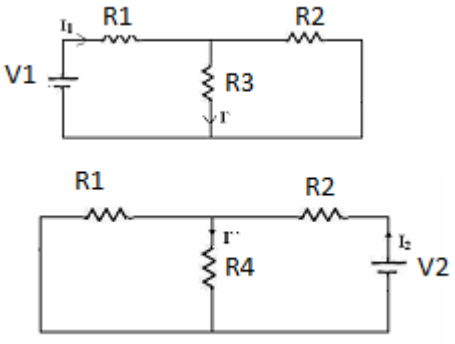
3. THEORY:

Statement of superposition theorem: In a linear resistive network containing two or more voltage sources, the current through any element may be determined by adding together algebraically the currents produced by each source acting alone, when all others voltage sources are replaced by their internal resistances. If a voltage source has no internal resistance, the terminal to which it was connected is joined together. If there are current sources present they are removed and the network terminals to which they are connected are left open.

4. CIRCUIT DIAGRAM:



Circuit 1.



Circuit 2 & 3.

5. PROCEDURE:

(i) Make the connections as shown in the circuit diagram.
(ii) Connect the ammeter in the appropriate branch of the circuit.

(iii) Switch on the power supply.
(iv) Measure the currents I_1, I_2, and I by using ammeter.
(v) Tabulate the readings.

Now repeat the above procedure for circuit diagram 2 and circuit diagram 3.

6. OBSERVATIONS:

Practical Values								
I_1	I_2	I	I_1'	I_2'	I'	I_1''	I_2''	I''

7. CALCULATION:

8. RESULT AND DISCUSSIONS:

It is found that

$I_1 = I_1' + I_1''$
$I_2 = I_2' + I_2''$
$I = I' + I''$
So superposition theorem is verified.

9. PRECAUTION:

5. All connections should be tight.
6. All steps should be followed carefully.
7. Readings and calculation should be taken carefully.
8. Don't touch the live terminals.

10. PRE EXPERIMENT QUESTIONS:

1. Describe Linear & Non-linear circuits?

2. Describe Active & Passive elements?

3. What are energy sources?

11. POST EXPERIMENT QUESTION:

1. State the superposition theorem.

2. What are the limitations of superposition theorem?

3. What is the utility of superposition theorem?

EXPERIMENT 2b

1. OBJECTIVE: VERIFICATION OF THEVENIN'S THEOREM.

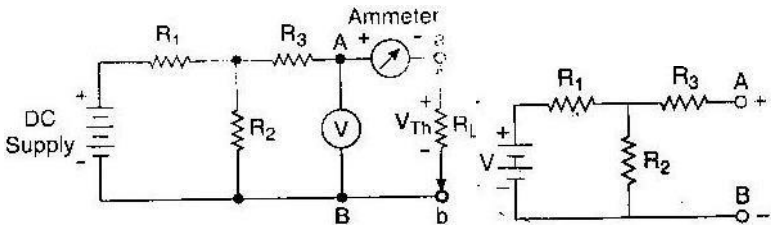
2. APPARATUS REQUIRED:

Serial No.	Equipment	Specification	Quantity	Remark
1	Two Batteries	12V and 6 V	1	
2	PMMC ammeters	0 –5A	1	
3	PMMC voltmeter	0-10V	1	
3	Rheostats	10 Ω, 2.5A	3	
4	Resistor	10 Ω	1	
5	Keys		04	
6	Connecting Wires			

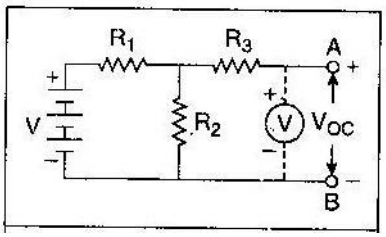
3. THEORY: According to this theorem if a resistor of R_L ohms be connected between any two terminals of a linear bilateral network, then the resulting current through resistor will be equal to $\frac{V_{TH}}{R_L + R_{TH}}$ where V_{TH} is the potential difference across these two points and R_{TH} is the resistance of network measured between these two points.

V_{Th} is the open circuit voltage across the terminals, R_{Th} is the equivalent resistance across the terminals , R_L is the load resistance .

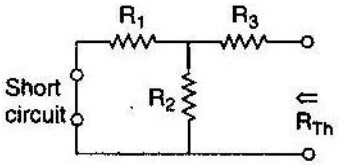
4. CIRCUIT DIAGRAM:



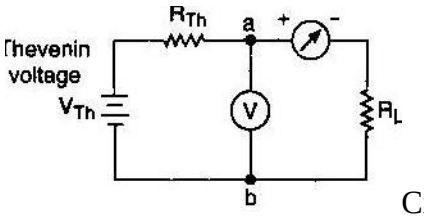
Circuit 1. Circuit 2.



Circuit 3.



Circuit 4.



Circuit 5.

5. PROCEDURE:

1. Remove the resistance (called Load Resistance R_L).
2. Find the open circuit voltage V_{OC} which appears across the two terminals from where resistance is removed. It is also called Thevenin's voltage V_{Th}
3. Compute the resistance of the whole network as looked into from these two terminals after all sources of e.m.f. are treated as short circuited while all the current sources are treated as open circuited
4. Connect R_L back to its terminals from where previously it was removed and measure the current flowing through R_L.
5. Finally, calculate the current flowing through R_L using the equation

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

6. OBSERVATION TABLE:

Open circuit voltage across terminals A& B (V_{OC})	**Equivalent resistance across the terminals A&B, R_{Th}**	**Load current** $I_L = \frac{V_{TH}}{R_L + R_{TH}}$	**Measured I_L**

7. CALCULATION:

The load current $I_L = \frac{V_{TH}}{R_L + R_{TH}}$

I_L = …… amp.

8. RESULT AND DISCUSSIONS:

The value of open circuit voltage (V_{OC}) is …..volts.
The value of Thevenin's resistance is …..ohms.
The value of current across load is ……amps.

It will be found that measured value of current flowing through the load I_L are the same as determined by Thevenin's theorem.

9. PRECAUTIONS:

1. All connections should be tight.
2. All steps should be followed carefully.
3. Readings and calculation should be taken carefully.
4. Don't touch the live terminals.

10. PRE EXPERIMENT QUESTIONS:

1. What do you mean by bilateral and unilateral circuits?

2. What is voltage source?

11. POST EXPERIMENT QUESTION:

1. State of Thevenin's theorem.

2. What is the utility of Thevenin's theorem?

EXPERIMENT 2c

1. OBJECT: TO VERIFY THE MAXIMUM POWER TRANSFER THEOREM.

2. APPARATUS REQUIRED:

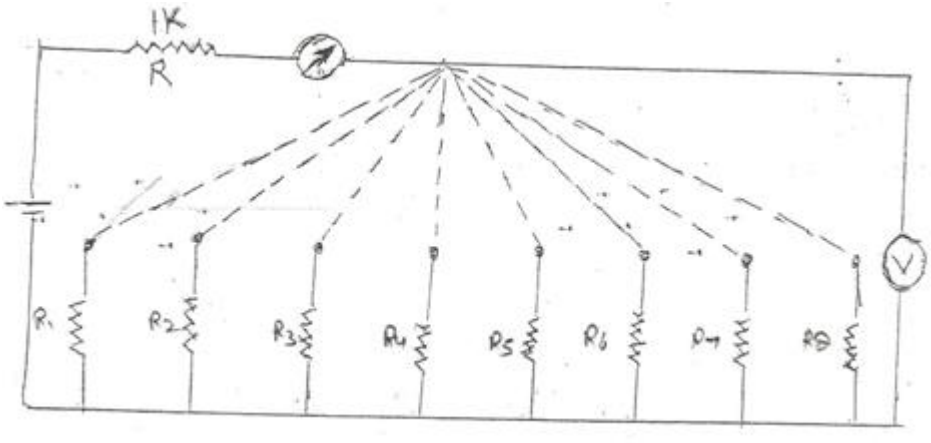
Serial No.	Equipment	Specification	Quantity	Remark
1	Battery	12V	1	
2	PMMC ammeters	0 –5A	1	
3	PMMC voltmeter	0-10V	1	
3	Resistance Box		1	
4	Rheostat	10 Ω, 2.5A	1	
5	Connecting Wires			

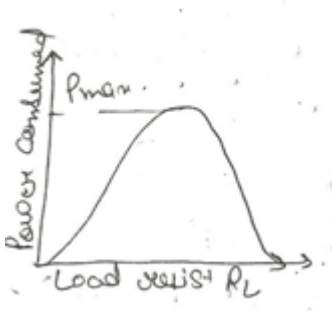
3. THEORY:

According to maximum power transfer theorem a resistive load will abstract maximum power from a network when the load resistance is equal to the resistance of network as viewed from the output terminal, with all the energy sources replaced by their internal resistances.

4. CIRCUIT DIAGRAM:

The circuit diagram is shown below.





5. PROCEDURE:

1. Connect 12V DC power supply at the terminals provided for the same at the lower left hand corner near the mains On/OFF switch.
2. Connect 0 – 20 mA DC current meter and 0 – 15V DC voltmeter at the appropriate positions as shown in the circuit diagram.
3. Connect resistor R1 in the circuit with the help of jumper link.
4. Observe and record the current meter reading I and voltmeter reading V.
5. Calculate the power transferred to the load .
6. Similarily calculate the power for all different load resistor from R 1 and R8 and find out at which load resistor maximum power is transferred. Compare its value with the source resistor R.

6. OBSERVATION TABLE:

Load Resistor R_L	**Load Current I (mA)**	**Load Voltage (Volts)**	**Power Transferred P = VI (Watts)**

7. CALCULATION:

Calculate the value of load resistor at which maximum power is transferred and also calculate the maximum power.
Compare it with value practically obtained

8. RESULT AND DISCUSSION:

Maximum power is obtained at resistance:_____
As practical value is same as theoretical value maximum transfer theorem is verified.

9. PRECAUTIONS:

1. All connections should be tight.
2. All steps should be followed carefully.
3. Readings and calculation should be taken carefully.
4. Don't touch the live terminals.

10. PRE EXPERIMENT QUESTIONS:

1. Statement of Maximum power transfer theorem.

11. POST EXPERIMENT QUESTION:

1. What is the condition for maximum power transfer?

2. What is the efficiency under maximum power transfer condition?

3. What are the applications for Maximum power transfer theorem?