FUNDAMENTALS OF ELECTRICAL CIRCUITS LAB (20A02101P)

LAB MANUAL

I – BTECH

Prepared by

C.Dastagiri

Department of Electrical & Electronics Engineering

VEMU INSTITUTE OF TECHNOLOGY

(Approved by AICTE, New Delhi and Affiliated to JNTUA, Ananthapuramu)
Accredited by NAAC, NBA (EEE , ECE & CSE) & ISO 9001-2015 Certified Institution
Near Pakala. P. Kothakota, Chittoor-Tirupati Highway
Chittoor, Andhra Pradesh -517112
Website: *www.vemu.org*

Course Code	Fundamentals of Electric Circuits Lab	L	T	P	C
20A05202P		0	0	2	1.5

Course Objectives

- Remember, understand and apply various theorems and verify practically.
- Understand and analyze active, reactive power measurements in three phase balanced & un balanced circuits.

Course outcomes (CO) : After completion of the course, the student can able to

CO-1: Apply various theorems and verify practically

CO-2: Analyse active, reactive power measurements in balanced star connected circuits

CO-3: Analyse active, reactive power measurements in balanced delta connected circuits

CO-4: Analyse active, reactive power measurements in three phase un balanced circuits

CO-5: Apply the Magnetic circuit parameters and verify practically

LIST OF EXPERIMENTS

1. Verification of Thevenin's and Norton's Theorems
2. Verification of Superposition Theorem for average and rms values
3. Maximum Power Transfer Theorem for DC and AC circuits
4. Verification of Compensation Theorem for DC circuits
5. Verification of Reciprocity, Millmann's Theorems for DC circuits
6. Determination of Self, Mutual Inductances and Coefficient of Coupling
7. Measurement of Active Power for Star Connected Balanced Loads
8. Measurement of Reactive Power for Star Connected Balanced Loads
9. Measurement of 3-Phase Power by Two Wattmeter Method for Unbalanced Loads
10. Measurement of Active Power for Delta Connected Balanced Loads
11. Measurement of Reactive Power for Delta Connected Balanced Loads
12. Analysis of RL and RC Series circuits for AC Excitation
13. Apply Mesh & Nodal Analysis techniques for solving electrical circuits

FUNDAMENTALS OF ELECTRICAL CIRCUITS LAB

I B.Tech-I SEMESTER

STUDENT OBSERVATION RECORD

DEPARTMENT
OF
ELECTRICAL AND ELECTRONICS ENGINEERING

VEMU INSTITUTE OF TECHNOLOGY::P.KOTHAKOTA

NEAR PAKALA, CHITTOOR-517112

(Approved by AICTE, New Delhi & Affiliated to JNTUA, Anantapuramu)

VEMU INSTITUTE OF TECHNOLOGY

DEPT.OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION OF THE INSTITUTE

- To be a premier institute for professional education producing dynamic and vibrant force of technocrats with competent skills, innovative ideas and leadership qualities to serve the society with ethical and benevolent approach.

MISSION OF THE INSTITUTE

- To create a learning environment with state-of-the art infrastructure, well equipped laboratories, research facilities and qualified senior faculty to impart high quality technical education.
- To facilitate the learners to foster innovative ideas, inculcate competent research and consultancy skills through Industry-Institute Interaction.
- To develop hard work, honesty, leadership qualities and sense of direction in rural youth by providing value based education.

VISION OF THE DEPARTMENT

- To produce professionally deft and intellectually adept Electrical and Electronics Engineers and equip them with the latest technological skills, research & consultancy competencies along with social responsibility, ethics, Lifelong Learning and leadership qualities.

MISSION OF THE DEPARTMENT

- To produce competent Electrical and Electronics Engineers with strong core knowledge, design experience & exposure to research by providing quality teaching and learning environment.
- To train the students in emerging technologies through state - of - the art laboratories and thus bridge the gap between Industry and academia.
- To inculcate learners with interpersonal skills, team work, social values, leadership qualities and professional ethics for a holistic engineering professional practice through value based education.

PROGRAM EDUCATIONAL OBJECTIVES(PEOs)

Programme Educational Objectives (PEOs) of B.Tech (Electrical and Electronics Engineering) **program are:**

Within few years of graduation, the graduates will

PEO 1: Provide sound foundation in mathematics, science and engineering fundamentals to analyze, formulate and solve complex engineering problems.

PEO 2: Have multi-disciplinary Knowledge and innovative skills to design and develop Electrical & Electronics products and allied systems.

PEO 3: Acquire the latest technological skills and motivation to pursue higher studies leading to research.

PEO 4: Possess good communication skills, team spirit, ethics, modern tools usage and the life-long learning needed for a successful professional career.

PROGRAM OUTCOMES (POs)

PO-1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO-2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO-3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO-4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO-5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO-6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO-7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO-8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO-9	**Individual and team work:** Function effectively as an individual, and as a member or leader

	in diverse teams, and in multidisciplinary settings.
PO-10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO-11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO-12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

On completion of the B.Tech. (Electrical and Electronics Engineering) degree, the graduates will be able to

PSO-1: Higher Education: Apply the fundamental knowledge of Mathematics, Science, Electrical and Electronics Engineering to pursue higher education in the areas of Electrical Circuits, Electrical Machines, Electrical Drives, Power Electronics, Control Systems and Power Systems.

PSO-2: Employment: Get employed in Public/Private sectors by applying the knowledge in the domains of design and operation of Electronic Systems, Microprocessor based control systems, Power systems, Energy auditing etc.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

I B.Tech. I-Sem (EEE)

FUNDAMENTALS OF ELECTRICAL CIRCUITS LABORATORY(20A02101P)

COURSE OUTCOMES

C119.1	Apply various theorems and verify practically
C119.2	Analyze active, reactive power measurements in balanced star connected circuits
C119.3	Analyze active, reactive power measurements in balanced delta connected circuits
C119.4	Analyze active, reactive power measurements in three phase un balanced circuits
C119.5	Apply the Magnetic circuit parameters and verify practically

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Quality Education for Bright Future
P. KOTHA KOTA
ESTD:2008

Name: ______________________________

H.T.No: ______________________________

Year/Semester: ______________________________

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B. Tech I-I Sem. (EEE) **L T P C**
0 0 2 1.5

(20A02101P) FUNDAMENTALS OF ELECTRICAL CIRCUITS LABORATORY

The following experiments are required to be conducted as compulsory experiments:

1. Verification of Thevenin's and Norton's Theorems
2. Verification of Superposition Theorem for average and rms values
3. Maximum Power Transfer Theorem for DC and AC circuits
4. Verification of Compensation Theorem for DC circuits
5. Verification of Reciprocity, Millmann's Theorems for DC circuits
6. Determination of Self, Mutual Inductances and Coefficient of Coupling
7. Measurement of Active Power for Star Connected Balanced Loads
8. Measurement of Reactive Power for Star Connected Balanced Loads
9. Measurement of 3-Phase Power by Two Wattmeter Method for Unbalanced Loads
10. Measurement of Active Power for Delta Connected Balanced Loads
11. Measurement of Reactive Power for Delta Connected Balanced Loads

ADDITIONAL EXPERIENTS

12. Analysis of RL and RC Series circuits for AC Excitation
13. Apply Mesh & Nodal Analysis techniques for solving electrical circuits

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NEAR PAKALA, CHITTOOR-517112

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List of Experiments to be conducted

FUNDAMENTALS OF ELECTRICAL CIRCUITS LABORATORY

S.NO.	NAME OF THE EXPERIMENT
1	Verification of Thevenin's and Norton's Theorems
2	Verification of Superposition Theorem for average and rms values
3	Maximum Power Transfer Theorem for DC and AC circuits
4	Verification of Compensation Theorem for DC circuits
5	Verification of Reciprocity, Millmann's Theorems for DC circuits
6	Determination of Self, Mutual Inductances and Coefficient of Coupling
7	Measurement of Active Power for Star Connected Balanced Loads
8	Measurement of Reactive Power for Star Connected Balanced Loads
9	Measurement of 3-Phase Power by Two Wattmeter Method for Unbalanced Loads
10	Measurement of Active Power for Delta Connected Balanced Loads
11	Measurement of Reactive Power for Delta Connected Balanced Loads
Additional Experiments	
12	Analysis of RL and RC Series circuits for AC Excitation
13	Apply Mesh & Nodal Analysis techniques for solving electrical circuits

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List of Experiments to be conducted

CONTENTS

FUNDAMENTALS OF ELECTRICAL CIRCUITS LABORATORY

GENERAL INSTRUCTIONS FOR LABORATORY CLASSES

DO'S

1. Without Prior permission do not enter into the Laboratory.
2. While entering into the LAB students should wear their ID cards.
3. The Students should come with proper uniform.
4. Students should sign in the LOGIN REGISTER before entering into the laboratory.
5. Students should come with observation and record note book to the laboratory.
6. Students should maintain silence inside the laboratory.
7. Circuit connections must be checked by the lab-in charge before switching the supply

DONT'S

8. Students bringing the bags inside the laboratory..
9. Students wearing slippers/shoes insides the laboratory.
10. Students scribbling on the desk and mishandling the chairs.
11. Students using mobile phones inside the laboratory.
12. Students making noise inside the laboratory.
13. Students mishandle the devices.
14. Students write anything on the devices

FUNDAMENTALS OF ELECTRICAL CIRCUITS LABORATORY

SCHEME OF EVALUATION

S.No	Experiment Name	Date	Marks Awarded				Total 30(M)
			Record (10M)	Observation (10M)	Viva Voce (5M)	Attendance (5M)	
1	Verification of Thevenin's and Norton's Theorems						
2	Verification of Superposition Theorem for average and rms values						
3	Maximum Power Transfer Theorem for DC and AC circuits						
4	Verification of Compensation Theorem for DC circuits						
5	Verification of Reciprocity, Millmann's Theorems for DC circuits						
6	Determination of Self, Mutual Inductances and Coefficient of Coupling						
7	Measurement of Active Power for Star Connected Balanced Loads						
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9	Measurement of 3-Phase Power by Two Wattmeter Method for Unbalanced Loads						
10	Measurement of Active Power for Delta Connected Balanced Loads						
11	Measurement of Reactive Power for Delta Connected Balanced Loads						
ADDITIONAL EXPERIENTS							
12	Analysis of RL and RC Series circuits for AC Excitation						
13	Apply Mesh & Nodal Analysis techniques for solving electrical circuits						

Signature of Lab In-charge

EXP.NO:01 DATE

01(A).VERIFICATION OF THEVENIN'S THEOREM

AIM: To verify Thevenin's theorem for the given circuit.

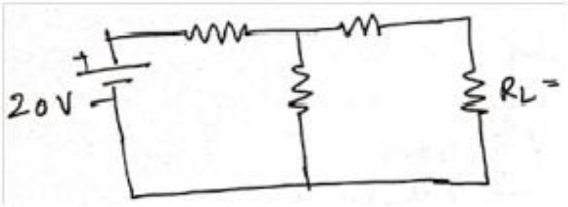
STATEMENTS:

Thevenin's theorem: It states that "Any linear**,** active network and bilateral network consists of no.of voltage sources, current sources and resistances can be replaced by an equivalent circuit consisting of single voltage source (Thevenin's equivalent voltage source Vth) in series with Resistance (Thevenin's equivalent resistance $R_{th.}$) Where V_{th} is the open circuit voltage across the two terminals and R_{th} is the resistance seen from the same two terminals.

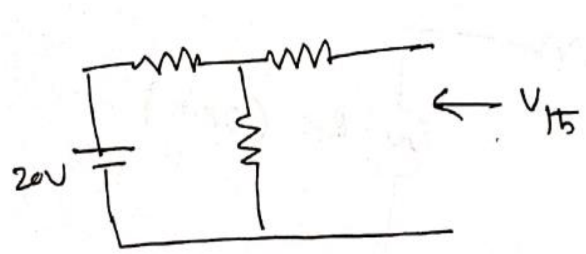
APPARATUS:

S. No	Name of the apparatus	Range	Type	Quantity
1	Dual channel Regulated power supply	(0 – 30)V	-	1
2	Voltmeter	(0-10)V	MC	1
3	Ammeter	(0-10m)A	MC	1
4	Decade resistance box	(0-111.11K)Ω	-	1
5	Resistors	1k Ω 2.2 KΩ 680Ω 470Ω	Carbon Composition	3 1 1
6	Bread board	-	-	1
7	Current Source	(0-10m)A		1
8	Connecting wires	-	-	Required number

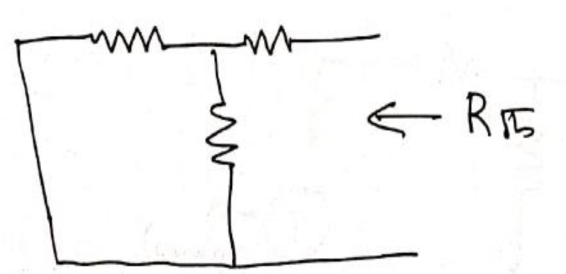
GIVEN CIRCUIT (Theoretical)



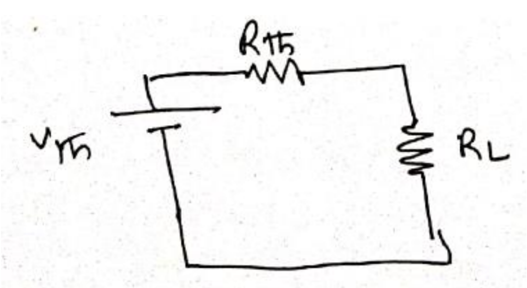
a) To find Thevenin's Voltage (Vth):



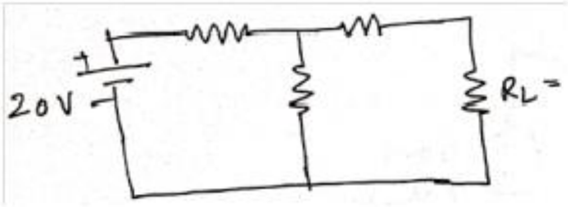
b) To find R_{th}

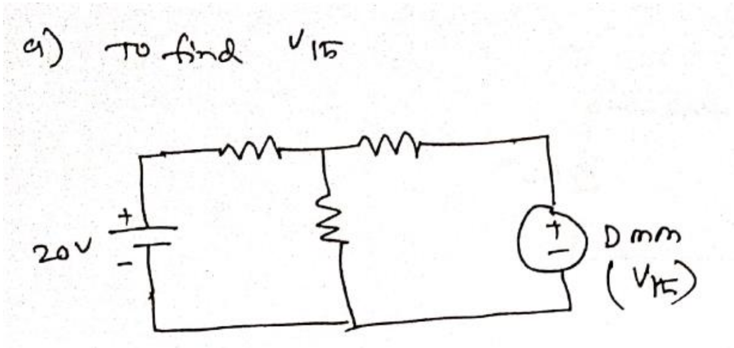


c) To find I_L



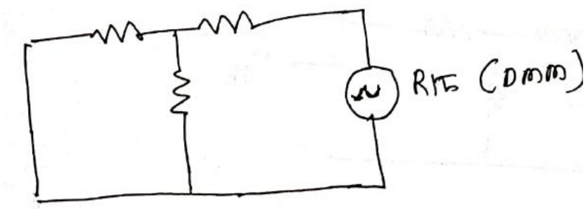
GIVEN CIRCUIT (Practical)





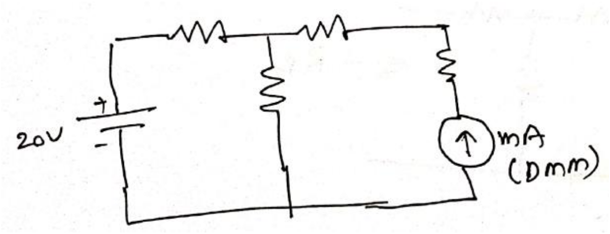
Voltage	V_{th}	
	Theoretical	Practical
20V		

b) To find Rth



Voltage	R_{th}	
	Theoretical	Practical
20V		

c) To find Load Current (I_L)



Voltage	I_L (mA)	
	Theoretical	Practical
20V		

PRECAUTIONS:

1. Initially keep the RPS voltage knob in zero volt position.
2. Set the ammeter pointer at zero position.
3. Take the readings without parallax error.
4. Avoid loose connections.
5. Do not short-circuit the output terminals of the R.P.S.

PROCEDURE:

Thevenin's Theorem

1. Connect the circuit as per the circuit diagram (4.1)
2. Set the R.P.S output voltage to 10V.
3. Note down the current I_L through the load terminals AB (Ammeter Reading)
4. Disconnect the circuit and connect as per the fig (4.2).
5. Set the R.P.S output voltage to 10V.
6. Note down the voltage across the load terminals AB (Voltmeter Reading) that gives V_{th}.
7. Disconnect the circuit and connect as per the fig (4.3).
8. Set the R.P.S output voltage to say V=5V.
9. Note down the current (I) supplied by the source (Ammeter Reading).
10. The ratio of V and I gives the R_{th}.
11. Connect the circuit as per the circuit diagram (4.4).

12. Set the R.P.S output voltage to 6.96V.
13. Note down the current I_L^1 through the load terminals AB (Ammeter Reading).
14. Disconnect the circuit and verify the $I_L=I_L^1$.

RESULT:

Since $\mathbf{I_L=I_L^1}$ Thevenin's theorems are verified and practical values are compared with theoretical values.

S.No	Parameter	Thevenin's theorem	
		Theoretical Values	Practical Values
1	V_{th}		
2	R_{th}		
3	Load current		

EXP.NO:01 DATE

01(B).VERIFICATION OF NORTON'S THEOREM

AIM: To verify Norton's theorem for the given circuit.

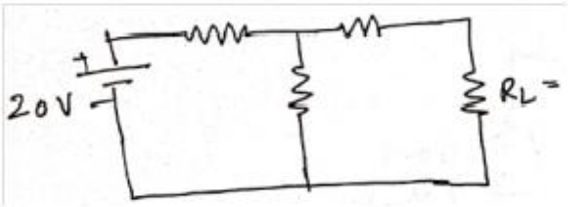
STATEMENTS:

Norton's theorem: It states that "Any linear, active network and bilateral network consists of no.of voltage sources, current sources and resistances can be replaced by an equivalent circuit consisting of single current source (Norton's equivalent current source I_N) in Parallel with Resistance (Norton's equivalent resistance R_N) Where I_N is the Short circuit Current and R_N is the resistance seen from the same two terminals.

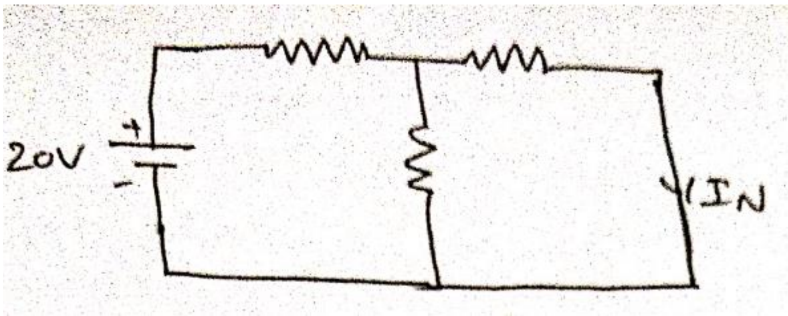
APPARATUS:

S. No	Name of the apparatus	Range	Type	Quantity
1	Dual channel Regulated power supply	(0 – 30)V	-	1
2	Voltmeter	(0-10)V	MC	1
3	Ammeter	(0-10m)A	MC	1
4	Decade resistance box	(0-111.11K)Ω	-	1
5	Resistors	1k Ω 2.2 KΩ 680Ω 470Ω	Carbon Composition	3 1 1
6	Bread board	-	-	1
7	Current Source	(0-10m)A		1
8	Connecting wires	-	-	Required number

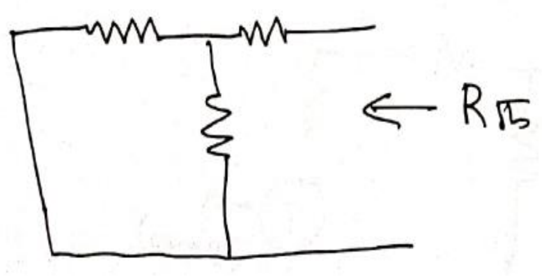
GIVEN CIRCUIT (Theoretical)



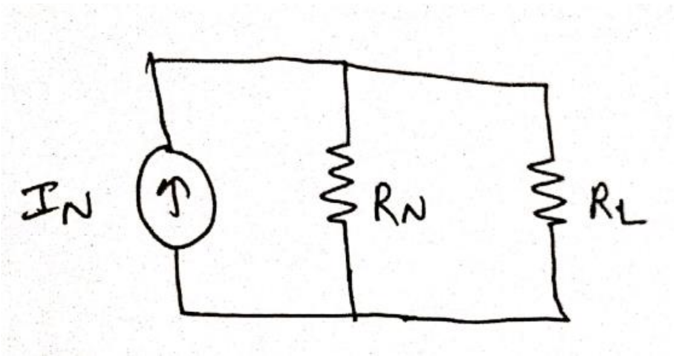
a) To find Norton's Current (I_N):



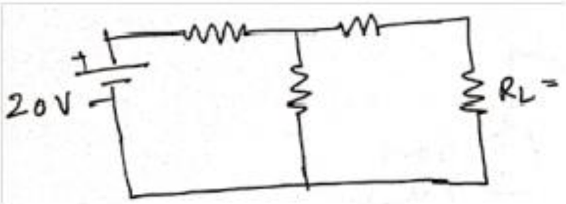
b) To find R_N and R_{th}



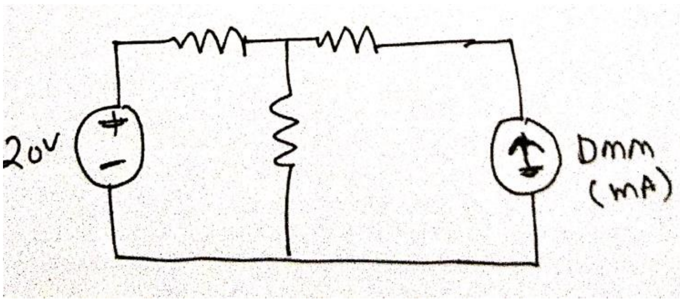
c) To find I_L



GIVEN CIRCUIT (Practical)

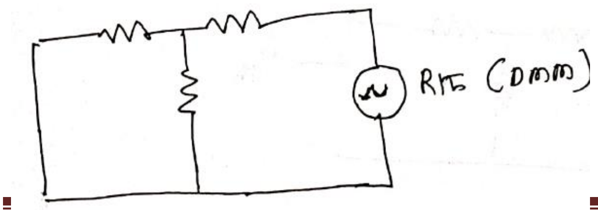


a) To find Norton's Current(I_N)



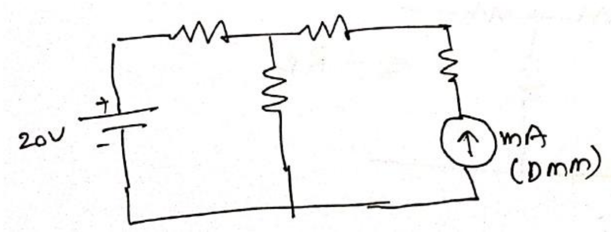
Voltage	I_N	
	Theoretical	Practical
20V		

b) To find R_N or R_{th}



Voltage	R_N or R_{th}	
	Theoretical	Practical
20V		

c) To find Load Current (I_L)



Voltage	I_L (mA)	
	Theoretical	Practical
20V		

PRECAUTIONS:

1. Initially keep the RPS voltage knob in zero volt position.
2. Set the ammeter pointer at zero position.
3. Take the readings without parallax error.
4. Avoid loose connections.
5. Do not short-circuit the output terminals of the R.P.S.

PROCEDURE:

Norton's Theorem

1. Connect the circuit as per the circuit diagram (4.5)
2. Set the R.P.S output voltage to 10V.
3. Note down the current I_L through the load terminals AB (Ammeter Reading)
4. Disconnect the circuit and connect as per the fig (4.6).
5. Set the R.P.S output voltage to 10V.
6. Note down the current through the load terminals AB (ammeter Reading) that gives I_N.
7. Disconnect the circuit and connect as per the fig .
8. Set the R.P.S output voltage to say V=20V.
9. Note down the current supplied by the source I (Ammeter Reading).
10. The ratio of V and I gives the R_N.
11. Connect the circuit as per the circuit diagram .
12. Set the current source to required mA
13. Note down the current I_L^1 through the load terminals AB (Ammeter Reading).
14. Disconnect the circuit and verify the $I_L=I_L^1$.

RESULT:

Since $\mathbf{I_L=I_L^1}$ Norton's theorems are verified and practical values are compared with theoretical values.

S.No	Parameter	Norton's theorem	
		Theoretical Values	Practical Values
1	I_N		
2	R_N		
3	Load current		

EXP.NO:02 **DATE**

VERIFICATION OF SUPERPOSITION THEOREM

AIM: To verify superposition theorems for the given circuit.

STATEMENT:

Super position theorem

In any linear, bilateral, multi source network the response in any element is equal to the algebraic sum of the responses obtained by each source acting separately while all other sources are set equal to zero.

APPARATUS:

S. No	Name of the apparatus	Range	Type	Quantity
1	Dual channel regulated power supply	(0 – 30V)	-	1No
2	Ammeter	(0 – 10) mA	MC	1No
3	Resistors		Carbon Composition	1No 1No 1No
4	Bread board	-	-	1No
5	Connecting wires	-	-	Required number

PROCEDURE:

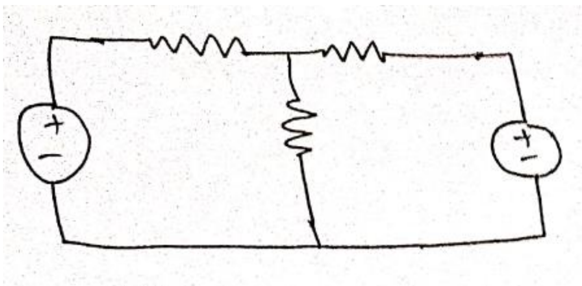
Super position theorem:

Connect the circuit as per the fig

1. Adjust the output voltage of sources X and Y to 20V and 5V respectively (RPS output).
2. Note down the response (current, I_L) through the branch of interest (AB) (ammeter reading).
3. Now set the 5V source (Y) to 0V.
4. Note down the current through the branch AB (I_L^{I}) (ammeter reading).
5. Now set the 20V source (X) to 0V and source Y to 5V.
6. Note down the response (current, I_L^{II}) through the branch AB (ammeter reading).
7. Disconnect the circuit

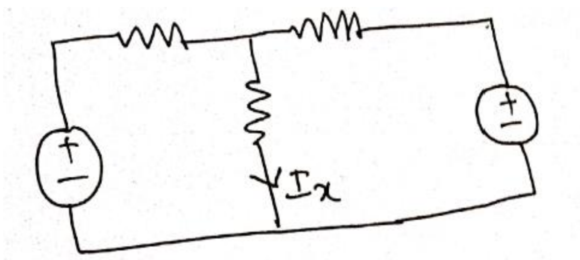
VERIFICATION OF SUPERPOSITION THEOREM

GIVEN CIRCUIT:



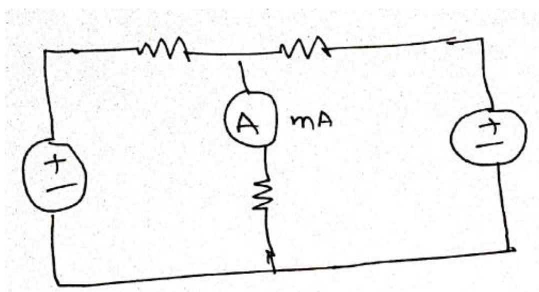
Theoretical circuit diagrams:

a) When both the sources are acting:



Practical circuit diagrams:

a) When both the sources are acting:

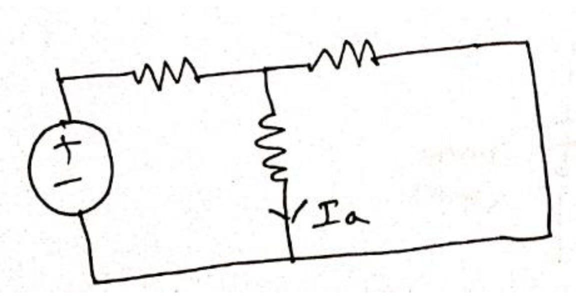


Tabular Column:

S.No	Applied Voltage		Current
	V_1 (Volts)	V_2 (Volts)	I_L (mA)

Theoretical circuit diagrams:

b. When 20V source alone is acting;



Practical circuit diagrams:

b) When 20V source alone is acting;

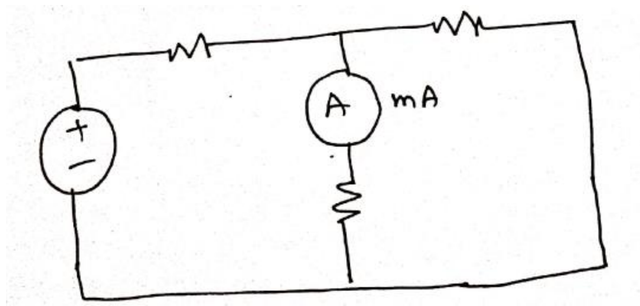
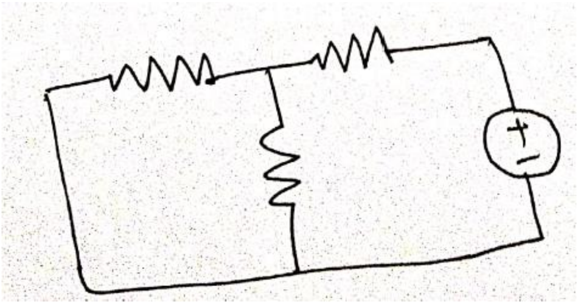


Fig (3.2)

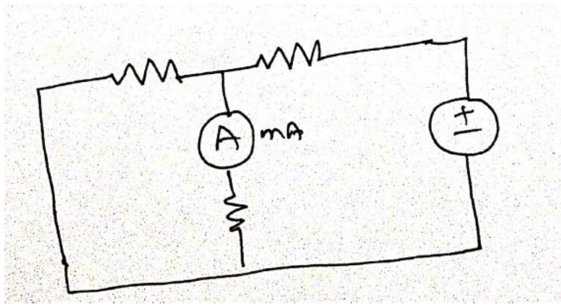
Tabular Column:

S. No	Applied voltage (V_1) Volt	Current I_L(mA)	
		T	P

C) When 5V source alone is acting;



C)When 5V source alone is acting:



S. No	Applied voltage (V2) Volt	Current I_L(mA)	
		T	P

Result:

1. Since $I_L = I_L^1 + I_L^{11}$ superposition theorem is verified on the given circuit and practical values are compared with theoretical values.

S.No	**Load current**	**Theoretical Values**	**Practical Values**
1	When Both sources are acting, I_L		
2	When only source X is acting, I_L^1		
3	When only source Y is acting, I_L^{11}		

CONCLUSION:

EXP.NO:03 **DATE:**

MAXIMUM POWER TRANSFER THEOREM

AIM: To verify maximum power transfer theorem theoretically and practically.

APPARATUS:

S.No.	Name of the equipment	Range	Type	Quantity
1.	RPS	(0-30)V	..	1
2	Bread Board	..	..	1
3	Resistors			
4	Ammeter	(0-500)mA	MC	1
5	Voltmeter	(0-30)V	MC	1
6	DRB	(0-1)M ohm	..	1
7	Connecting Wires	..	..	..

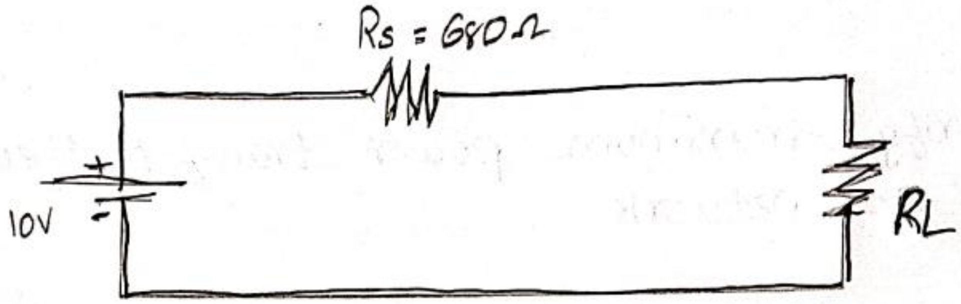
Statement for maximum power transfer theorem:

It states that the maximum power is transferred from the source to the load, when the load resistance is equal to the source resistance.

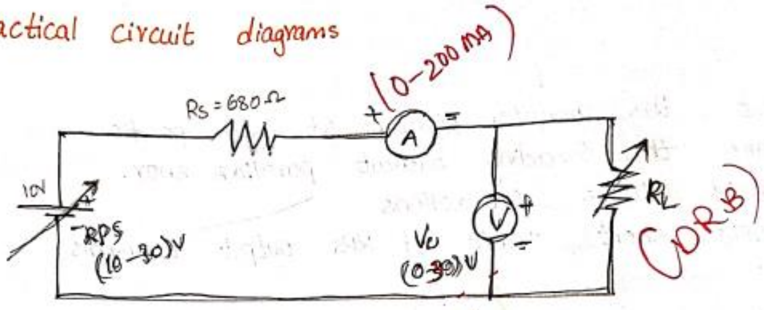
PROCEDURE:

1. Make the connections as shown in fig 1.
2. By varying RL in steps, note down the reading of ammeter IL in each step.
3. Connect the circuit as shown in fig (2), measure the effective resistance R_{th}.with the help of digital multi meter.
4. Calculate power delivered to load PL in each step.
5. Draw a graph PL Vs RL and find the RL corresponding to maximum power from it.
6. Verify that RL corresponding to maximum power from the graph is equal to the R_{th}(which is nothing but source resistance RS).

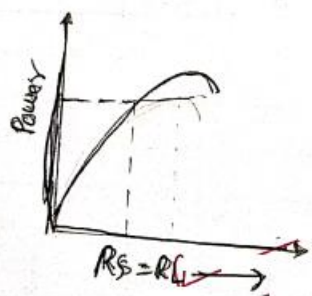
Theoretical circuit diagram



Practical circuit diagrams



Model Graph



Tabular Column

Source Resistance R_S =

S.No.	**V_S(V)**	**V_L(V)**	**I_L(A)**	**$R_L = V_L / I_L$ (Ω)**	**$P = V_L I_L$ (W)**

Theoretical Calculations:

Result:

VIVA QUESTIONS:-

1) What is the Statement of Maximum Power Transfer theorem?

2) What is a non linear network?

3) What is a unilateral network?

4) What are the applications of the above theorem?

5) What are the advantages & disadvantages of the above theorem?

6) State the maximum power transfer theorem for AC network?

EXP.NO:04 **DATE:**

VERIFICATION OF COMPENSATION THEOREM

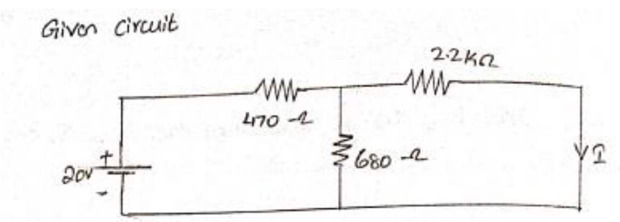
Aim: To Verify Compensation Theorem Theoretically and Practically.

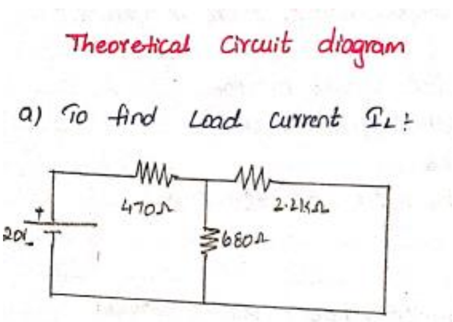
APPARATUS:

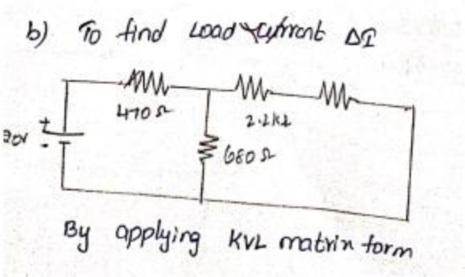
S.No.	Name of the equipment	Range	Type	Quantity
1.	RPS	(0-30)V	..	1
2	Bread Board	..	..	1
3	Resistors			
4	Ammeter	(0-500)mA	MC	1
5	Voltmeter	(0-30)V	MC	1
6	DRB	(0-1)M ohm	..	1
7	Connecting Wires	..	..	..

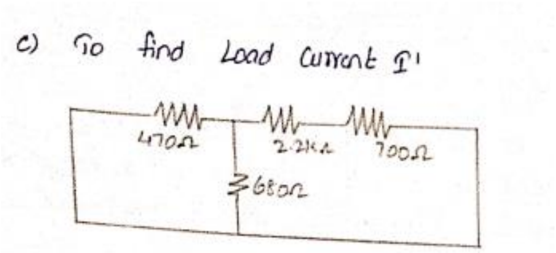
Statement:

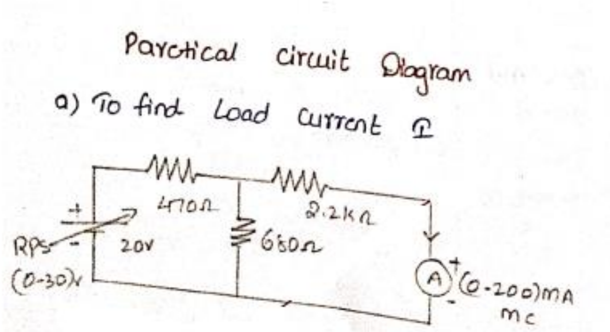
Circuit Diagram:



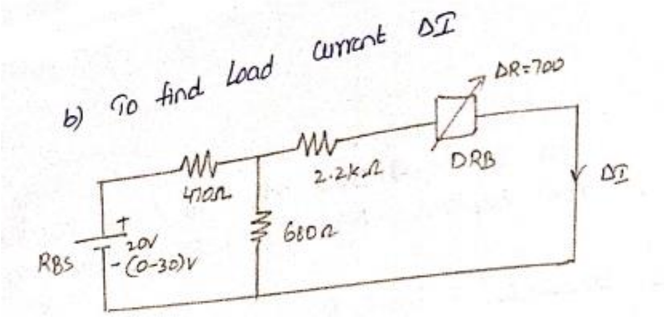




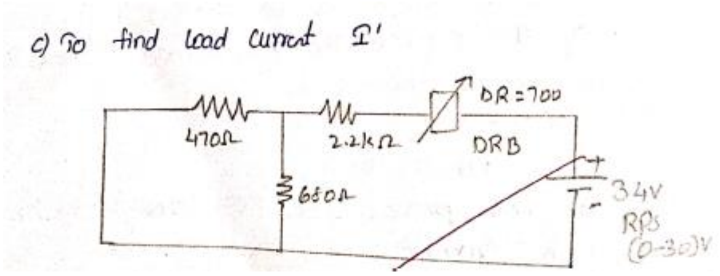




S.No	Voltage (V)	Current



S.No	Voltage (V)	Current



S.No	Voltage (V)	Current

Procedure:

PROCEDURE :

1)Connect the circuit as shown in fig, Note down the values of I1 and I2 using milli Ammeters.

2) Connect the circuit as shown in fig-2, Note down the value of I2l .

3) Connect the circuit as shown in fig-3, where VC(Compensating voltage)=(I2l - I2).

4)Note down the reading of ammeter as I.

5) If I = I2 l - I2 , Compensating Theorem is verified.

Tabular Column:

I_1 (mA)	I_2 (mA)	I'_1 (mA)	I'_2 (mA)	Vc Volts	Calculated I(mA)	Measured I (mA)

Result:

Conclusion:

EXP.NO: 05 **DATE:**

A.VERIFICATION OF RECIPROCITY THEOREM

AIM: To verify reciprocity theorems for the given circuit.

STATEMENT:

Reciprocity theorem:

In any linear, bilateral, single source network, the ratio of excitation to the response is same even though the positions of excitation and response are interchanged

APPARATUS:

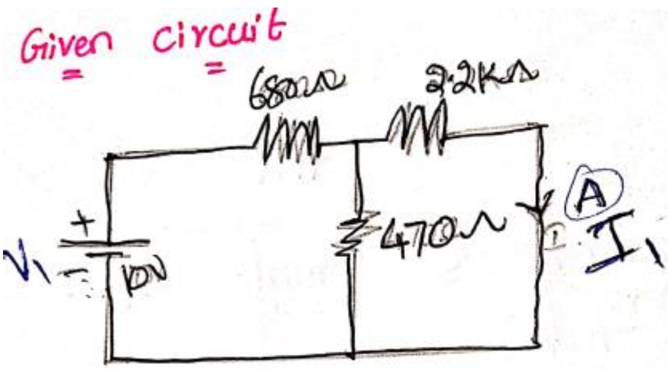
S. No	**Name of the apparatus**	**Range**	**Type**	**Quantity**
1	Dual channel regulated power supply	(0 – 30V)	-	1No
2	Ammeter	(0 – 10) mA	MC	1No
3	Resistors		Carbon Composition	1No 1No 1No
4	Bread board	-	-	1No

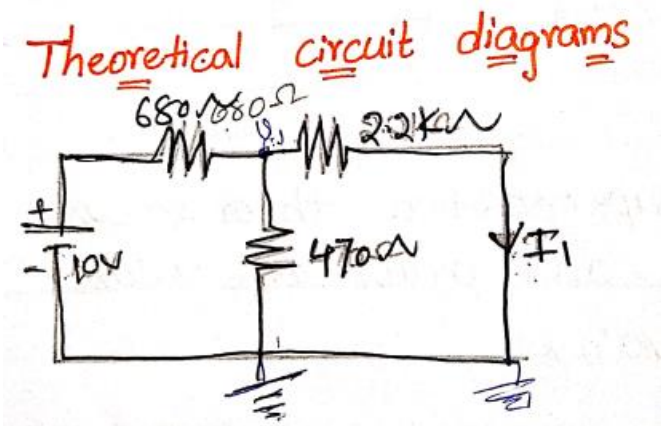
5	Connecting wires	-	-	Required number

PROCEDURE:

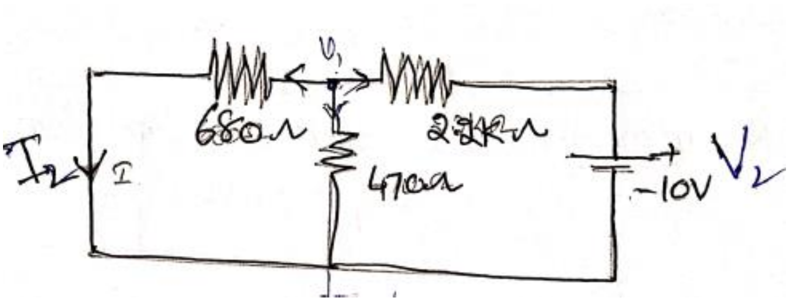
Reciprocity theorem

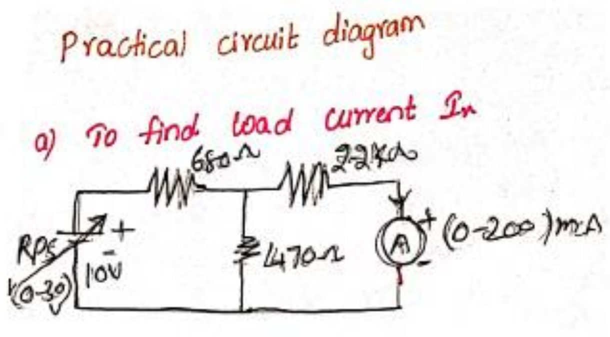
1. Connect the circuit as per the fig (4.4).
2. Set the R.P.S output voltage to 10V.
3. Note down the response (current through 1.8KΩ resistor)(ammeter reading).
4. Disconnect the circuit.
5. Connect the circuit as per the fig (4.5).
6. Note down the response (current through 2.2KΩ resistor)(ammeter reading).
7. Disconnect the circuit.



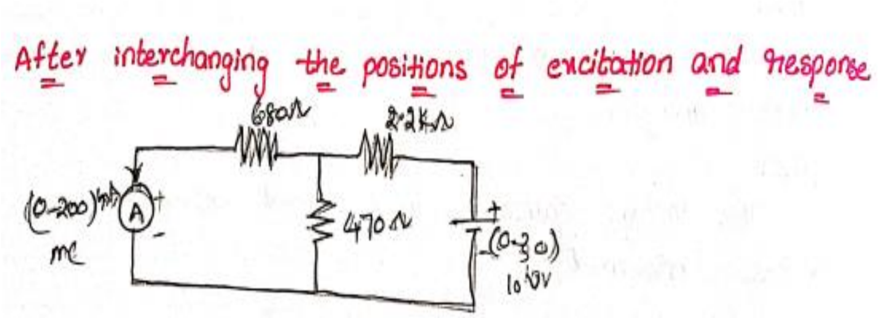


After interchanging their positions of excitation and Response





S.No	Applied Voltage (V1)Volts	Current mA	
		T	P



S.No	Applied Voltage (V1)Volts	Current mA	
		T	P

Precautions:

1. Initially keep the RPS voltage knob in zero volt position.
2. Set the ammeter pointer at zero position.
3. Take the readings without parallax error.
4. Avoid loose connections.
5. Do not short-circuit the output terminals of the R.P.S.

Result:

Conclusion:

EXP.NO: 05 **DATE:**

B.VERIFICATION OF MILLMAN's THEOREM

Aim: To verify the Millman's Theorem.

APPARATUS :

	NAME	RANGE	QUANTITY
1.	Bread Board.		
2.	Resistors	1.8KΩ	3No.s
3.	Voltmeter	(0-20)V	1 No.

Statement:

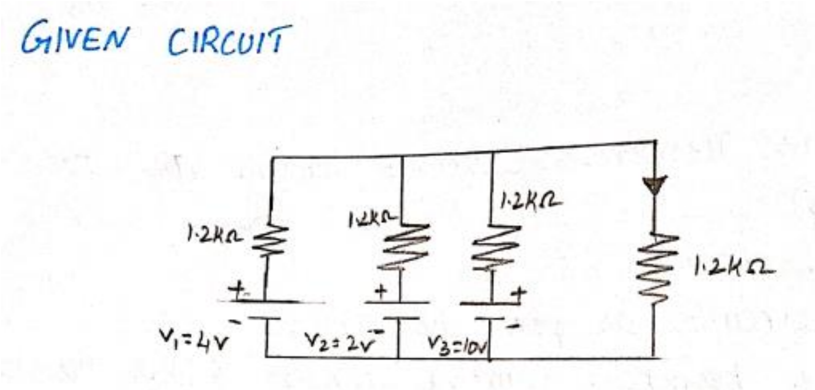
Millman's theorem states that in any network, if the voltage sources V_1, V_2, ... V_n in series with internal resistances R_1, R_2,.... R_n respectively are in parallel, then these sources may be replaced by a single voltage source V_{eq} in series with R' where value of the voltage source V_{eq} can be given by

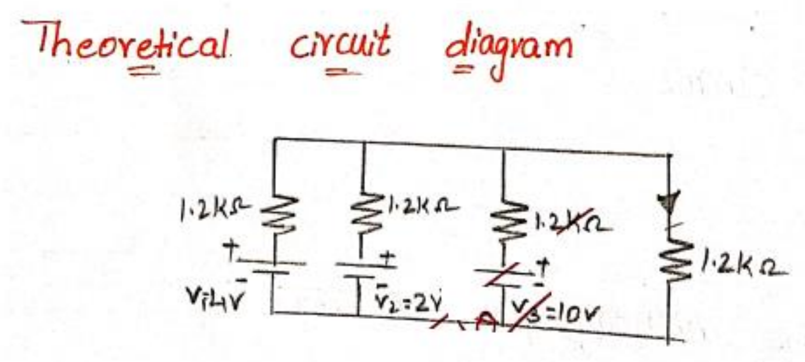
$$V_{eq} = \frac{V_1 G_1 + V_2 G_2 + ... V_n G_n}{G_1 + G_2 + ... G_n}$$

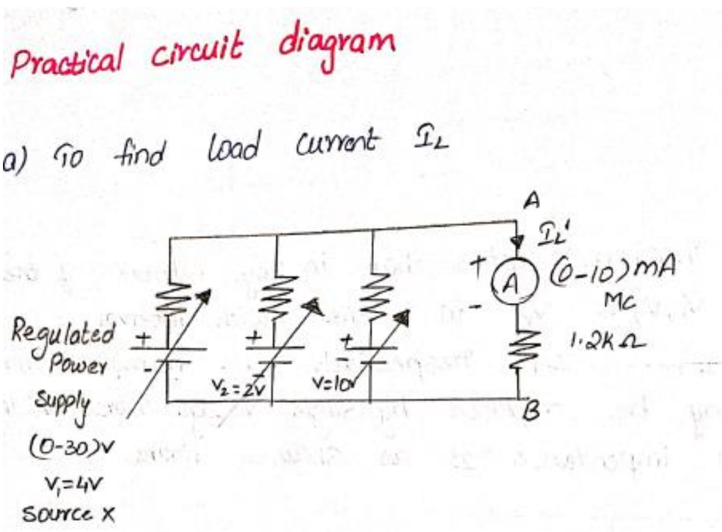
Where Gn is the conductance of the nth branch,

And $R' = 1 / (G_1 + G_2 + ... + G_n)$

Circuit Diagram:







S.No	Voltage (V) Volts			Load Current mA	
	V_1	V_2	V_3	T	P

PROCEDURE:

PROCEDURE :

1. Connect the circuit as shown in CIRCUIT-1 and Note down the reading of voltmeter as V_{L1}.
2. Connect the equivalent circuit as shown in CIRCUIT-2 , by calculating
3. $V_{eq}=(V_1G_1 + V_2G_2)/ (G_1 + G_2)$ and $R_{eq}= 1/ (G_1+G_2)$
4. Note down the reading of the voltmeter as V_{L2}.
5. If $V_{L1} = V_{L2}$, the Milliman's Theorem is verified.

PRECAUTIONS:

1. Initially keep the RPS voltage knob in zero volt position.

2. Set the ammeter pointer at zero position.

3. Take the readings without parallax error.

4. Avoid loose connections.

5. Do not short-circuit the output terminals of the R.P.S.

Result:

Conclusion:

EXP.NO:06 **DATE:**

SELF INDUCTANCE AND MUTUAL INDUCTANCE

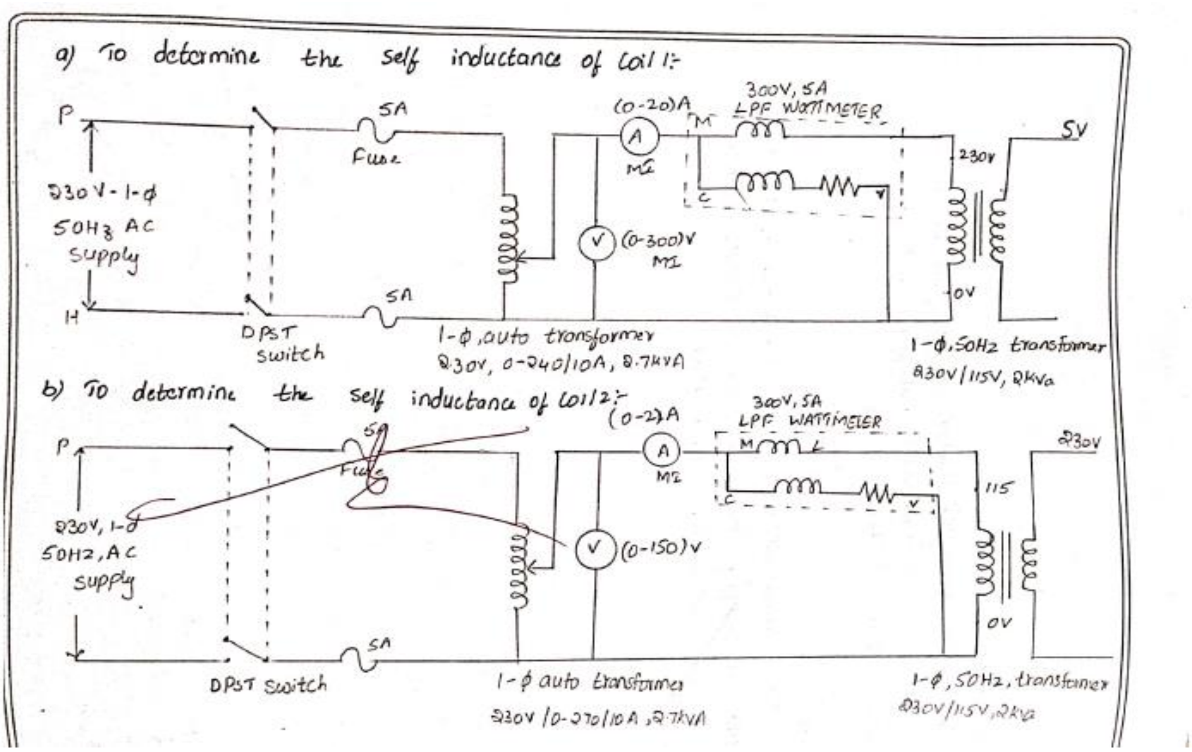
AIM:

To determine self and mutual inductance and coefficient of coupling of magnetically coupled circuit.

APPARATUS:

S. No	Apparatus	Type	Range	Quantity
1	Voltmeter	MI	(0-300)v	1
2	Ammeter	MI	(0-2)A	1
3	Wattmeter	L.P.F	300V ,2 A	1
4	Auto transformer	_	230/(0-270)v	1

Circuit Diagram



Procedure:

Tabular Column

A) To determine the self inductance of coil 1

S.No	V_1	I_1	W_1	V_2

A) To determine the self inductance of coil 2

S.No	V_1	I_1	W_1	V_2

PRECAUTIONS:

1. Initially keep the RPS voltage knob in zero volt position.

2. Set the ammeter pointer at zero position.

3. Take the readings without parallax error.

4. Avoid loose connections.

5. Do not short-circuit the output terminals of the R.P.S.

Result:

Conclusion:

EXP.NO:07 **DATE:**

MEASUREMENT OF ACTIVE POWER FOR STAR CONNECTED BALANCED LOADS

AIM:

To measure the active power in a three phase circuit using 1-Φ wattmeter method with star connected loads.

EQUIPMENTS REQUIRED:

S. No.	Equipment / Component	Specification	Quantity
1	Autotransformer	3- Ø, 440/(0-470) V	1
2	Voltmeter	(0 – 600) V MI	1
	Ammeter	(0 – 10) A MI	1
3	Wattmeter	600 V, 10 A, UPF	1
4	Load (Variable)	3- Ø, 4400 V, 10 A, Inductive	1
5	Connecting wire	-	As per requirement

CIRCUIT DIAGRAM:

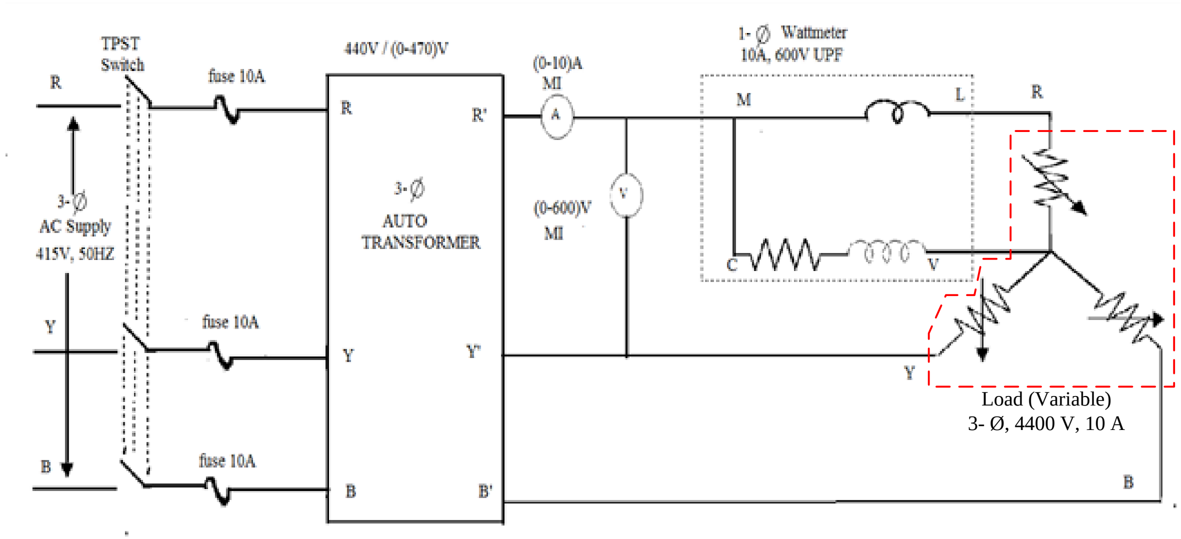


Fig. 7.1: Experimental circuit connection for calculating the active power consumption by the Y-connected 3-ph load

PROCEDURE:

1. Connect the circuit as per the circuit diagram presented in Fig. .
2. Ensure the autotransformer output and applied load is zero before switching ON the supply.
3. Verify the circuit connection and switch ON the supply.
4. Supply the rated voltage to the load by varying the output position of autotransformer.
5. Apply a particular load by using switches of the connected load box.
6. Note down the corresponding ammeter, voltmeter and wattmeter readings in Table. for the particular load connected.
7. Theoretically, calculate the active power consumption by the load applied. (**Note:** Follow the calculation process described in Page)
8. Repeat the Step-5 to Step-7 for another four different input voltages.
9. Keep the load and autotransformer output zero
10. Switch OFF the supply.

OBSERVATION:

TABLE : Experimental readings describing active power consumption by Y-connected 3-ph load

S.No.	**Ammeter Reading, A (A)**	**Voltmeter Reading, V (V)**	**Wattmeter Reading, (W)**	**Active Power, W (W)**	**Pf** $= \cos\emptyset = \frac{W}{V \times A}$	**Phase Angle, ∅ (°)**
1						
2						
3						
4						

CALCULATION:

Wattmeter reading, $W =$ W

Power factor, $pf = \cos\emptyset = \frac{Wattmeter\ reading}{Voltmeter\ reading \times Ammeter\ reading} =$

∴ Phase angle, $\emptyset = cos^{-1}(\quad) =$

PRECAUTIONS:

1) Readings should be taken without parallax error.

2) Loose connections are avoided.

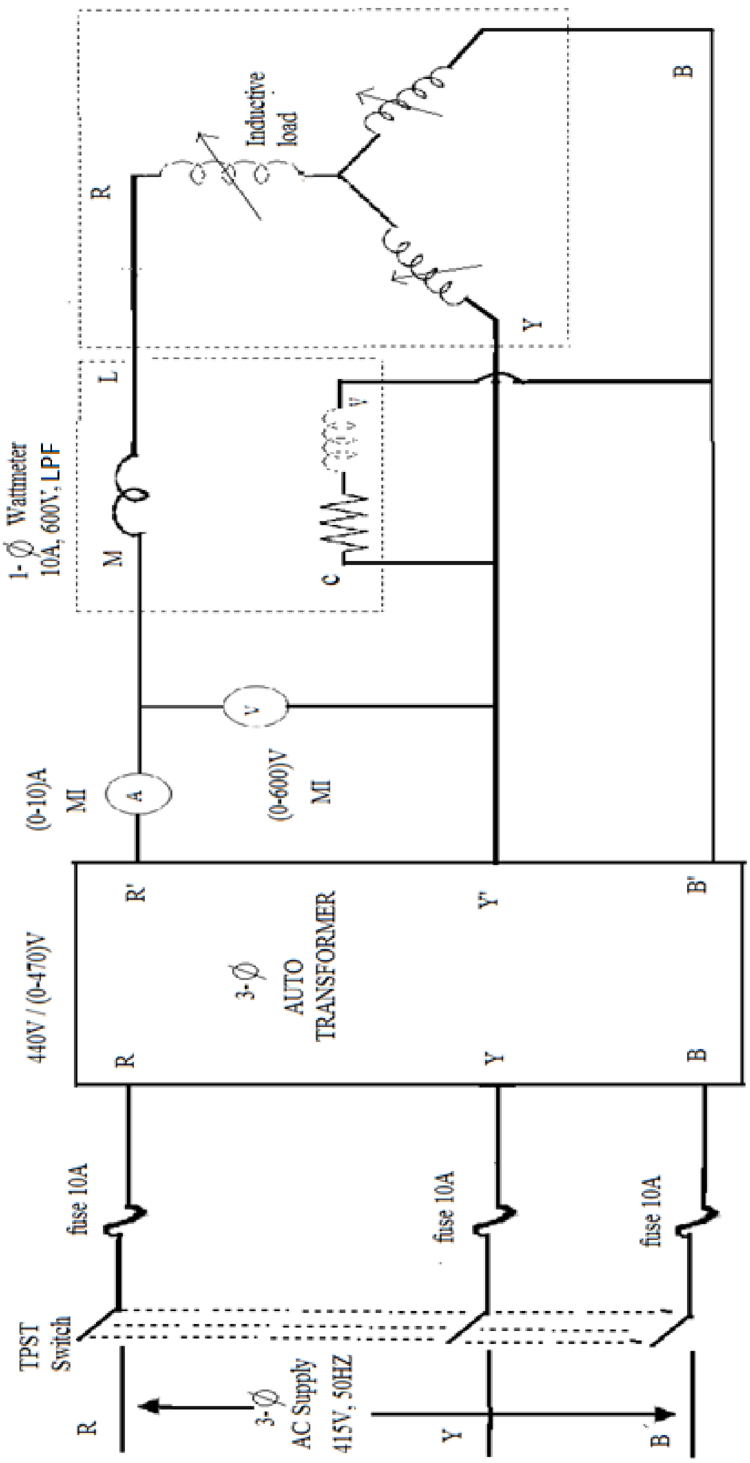
RESULT:

Active power consumed by the given Y-connected load is measured with the help of single wattmeter.

VI VA-VOCE Questions

1) What is the Active Power in a three phase circuit?
2) What is Apparent Power in a three phase circuit?
3) Why one wattmeter is preferable?

CIRCUIT DIAGRAM:-



Measurment of Reactive Power For Star Connected Balanced Load

EXPT. NO:08 **DATE:**

MEASUREMENT OF REACTIVE POWER FOR STAR CONNECTED BALANCED LOAD

AIM:

To measure the reactive power for star connected balanced load.

APPARATUS:

S. No.	Equipment	Type	Range	Quantity
1	Autotransformer	3-Ø	440/(0-470)v	01
2	Wattmeter	LPF	600v/10A	01
3	Ammeter	MI	(0-10)A	01
4	Voltmeter	MI	(0-600)v	01
5	Inductive load	3-Ø	440v/10A	01

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Keeping 3-Ø auto transformer in ZERO output position.
3. Switch on the supply and apply the rated voltage to the circuit by varying auto transformer.
4. Apply the load note down the readings of wattmeter, ammeter and voltmeter.
5. Repeat the same procedure at different loads.
6. Measure the reactive power consumed by the load by using the formula

TABULAR COLUMN FOR STAR CONNECTION: -

S. No.	Ammeter reading (I)	Voltmeter reading (v)	Wattmeter reading (w)	Reactive power	Phase angle Ø	Power factor
1						
2						
3						
4						
5						
6						

FORMULAE:

Wattmeter reading, $W = VI\sin\emptyset$

Reactive power$=\sqrt{3}\ VI\sin\emptyset$

Reactive power$=\sqrt{3}\ W$

$\emptyset=\sin^{-1}(\frac{W}{VI})$.

Power factor=cos $\emptyset$

CALCULATIONS:

Supply voltage = 415V

Line current =

Reading of wattmeter =

Reactive power consumed by the load = √3VIsinØ =

phase angle $\emptyset$=sin$^{-1}(\frac{W}{VI})$ =

power factor=cos $\emptyset$ =

multiplication factor=$\frac{VI\ COS\emptyset}{full\ scale\ deflection}$ =

PRECAUTIONS:

1) Readings should be taken without parallax error.

2) Loose connections are avoided.

RESULT:

Reactive power consumed by the given load is measured with the help of single wattmeter.

VIVA QUESTIONS:

1.what is reactive power?

2.what are the methods for measurement of reactive power in single phase circuits?

3.what is the unit of reactive power?

4.what are the errors present in wattmeter?

EXP.NO:09 **DATE:**

MEASUREMENT OF 3-PHASE POWER BY TWO WATTMETER METHOD FOR UNBALANCED LOADS

AIM:

To Measure the 3-Phase Power by Two Wattmeter Method for Unbalanced Loads.

Apparatus:

S.No	Name of the apparatus	Type	Range	Quantity
1	Voltmeter	MI	0-600V	1
2	Ammeter	MI	0-10A	1
3	1-phase wattmeter	MI		1
4	3-phase inductive load			

Procedure:

1. Give the circuit as per the circuit diagram

2. Check the connection as per the circuit

3. the current coil of the Wattmeter is connected in series with the load and Pressure coil is connected in parallel with the load.

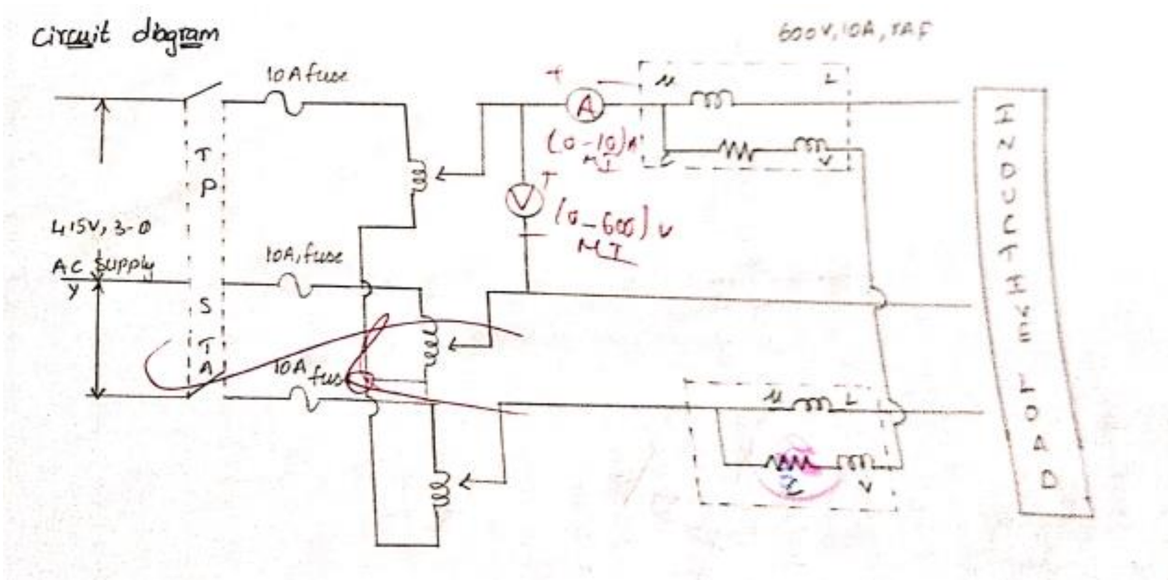
4. Give the supply to the circuit by closing the TPST Switch

5. At different voltages, By varying 3-phase load, the reading of the ammeter and Wattmeter are noted.

6. If any one of the wattmeter define to deflects backward, the connection of either current coil or Pressure coil should be interchanged but not both.

7. Take the readings from meter without parallax error.

CIRCUIT DAIGRA



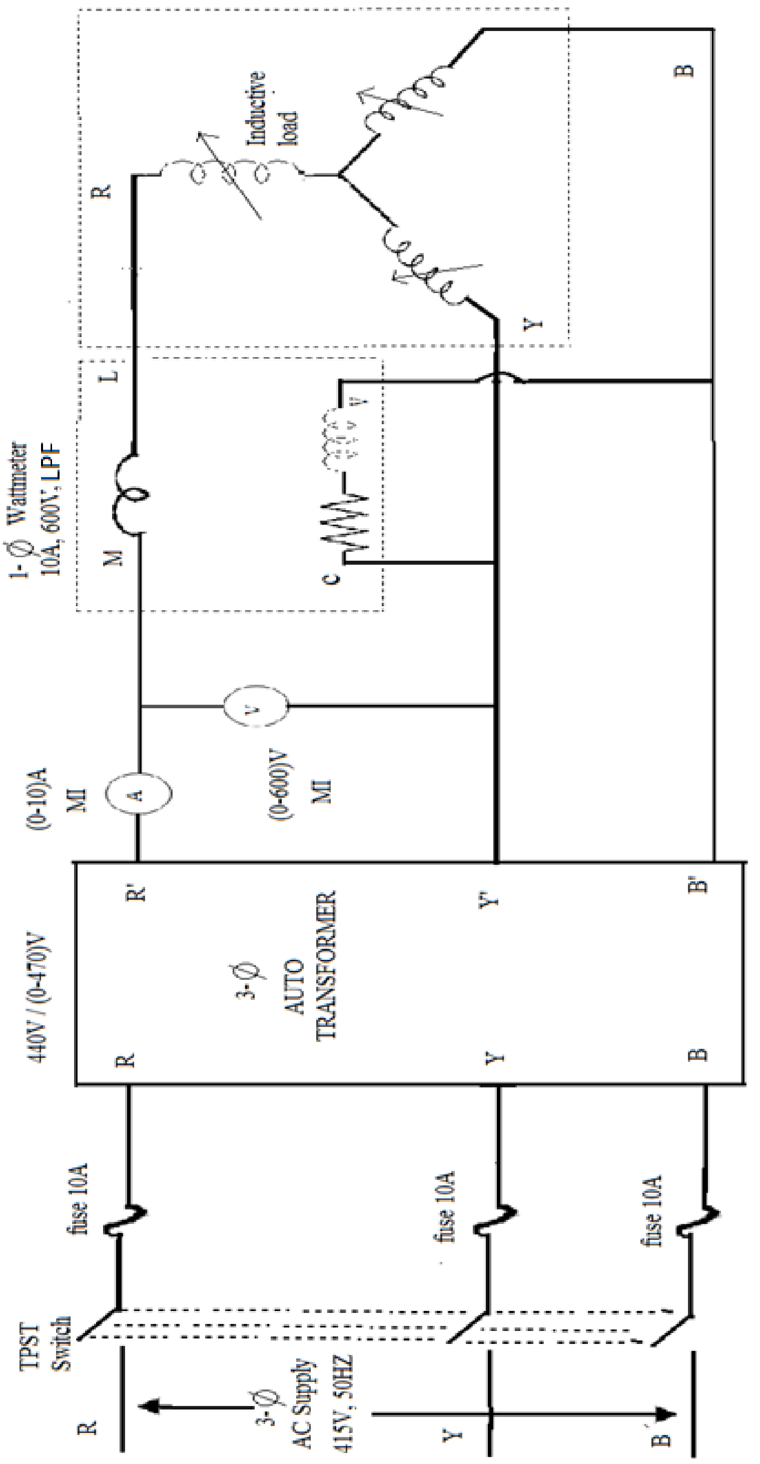
Tabular Column:

S.No	Voltmeter (V)	Ammeter (A)	Wattmeter (W1)	Wattmeter (W2)	Total Power W1+W2	Cosφ=	P

THEORETICAL CALCULATIONS:

RESULT:

CIRCUIT DIAGRAM:-



Measurment of Reactive Power For Star Connected Balanced Load

EXPT NO:10 DATE:

MEASUREMENT OF REACTIVE POWER FOR STAR CONNECTED BALANCED LOAD

AIM:

To measure the reactive power for star connected balanced load.

APPARATUS:

S. No.	Equipment	Type	Range	Quantity
1	Autotransformer	3-Ø	440/(0-470)v	01
2	Wattmeter	LPF	600v/10A	01
3	Ammeter	MI	(0-10)A	01
4	Voltmeter	MI	(0-600)v	01
5	Inductive load	3-Ø	440v/10A	01

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Keeping 3-Ø auto transformer in ZERO output position.
3. Switch on the supply and apply the rated voltage to the circuit by varying auto transformer.
4. Apply the load note down the readings of wattmeter, ammeter and voltmeter.
5. Repeat the same procedure at different loads.
6. Measure the reactive power consumed by the load by using the formula

TABULAR COLUMN FOR STAR CONNECTION: -

S. No.	Ammeter reading (I)	Voltmeter reading (v)	Wattmeter reading (w)	Reactive power	Phase angle Ø	Power factor
1						
2						
3						
4						
5						
6						

FORMULAE:

Wattmeter reading, W = VIsin $\emptyset$

Reactive power= $\sqrt{3}$ VI sin $\emptyset$

Reactive power= $\sqrt{3}$ W

$\emptyset=\sin^{-1}(\frac{W}{VI})$.

Power factor=cos $\emptyset$

CALCULATIONS:

Supply voltage = 415V

Line current =

Reading of wattmeter =

Reactive power consumed by the load = √3VIsinØ =

phase angle $\emptyset$=$\sin^{-1}(\frac{W}{VI})$ =

power factor=cos $\emptyset$ =

multiplication factor=$\frac{VI\ COS\emptyset}{full\ scale\ deflection}$ = 4

PRECAUTIONS:

1) Readings should be taken without parallax error.

2) Loose connections are avoided.

RESULT:

Reactive power consumed by the given load is measured with the help of single wattmeter.

VIVA QUESTIONS:

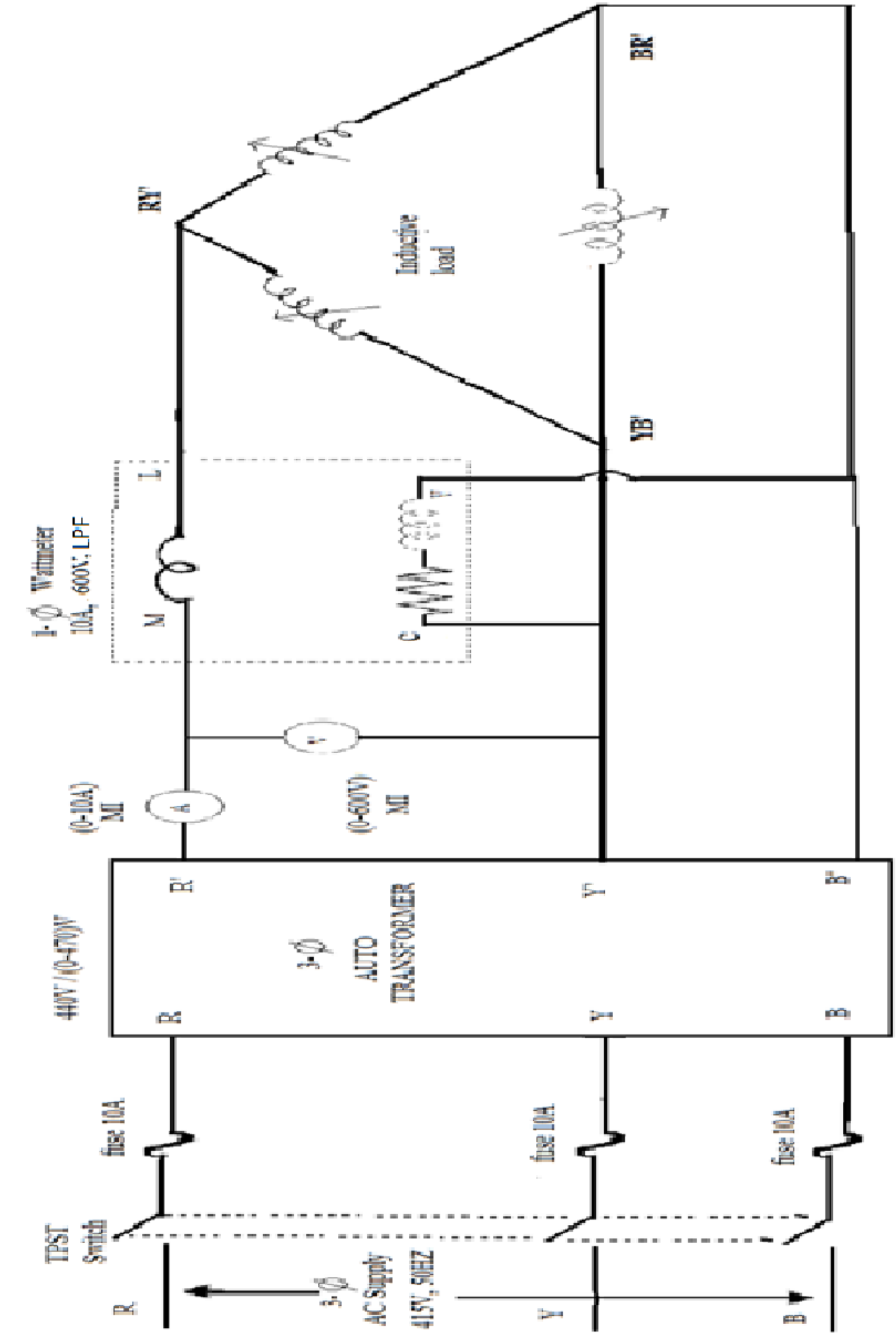
1.what is reactive power?

2.what are the methods for measurement of reactive power in single phase circuits?

3.what is the unit of reactive power?

4.what are the errors present in wattmeter?

CIRCUIT DIAGRAM:-



Measurment of Reactive Power For Delta Connected Balanced Load

EXPT. NO:11 **DATE:**

MEASUREMENT OF REACTIVE POWER FOR DELTA CONNECTED BALANCED LOAD

AIM:

To measure the reactive power for delta connected balanced load.

APPARATUS:

S. No.	Equipment	Type	Range	Quantity
1	Autotransformer	3-Ø	440/(0-470)v	01
2	Wattmeter	LPF	600v/10A	01
3	Ammeter	MI	(0-10)A	01
4	Voltmeter	MI	(0-600)v	01
5	Inductive load	3-Ø	440v/10A	01

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Keeping 3-Ø auto transformer in ZERO output position.
3. Switch on the supply and apply the rated voltage to the circuit by varying auto transformer.
4. Apply the load note down the readings of wattmeter, ammeter and voltmeter.
5. Repeat the same procedure at different loads.
6. Measure the reactive power consumed by the load by using the formula

TABULAR COLUMN FOR DELTA CONNECTION: -

S. No.	Ammeter reading (I)	Voltmeter reading (v)	Wattmeter reading (w)	Reactive power	Phase angle Ø	Power factor
1						
2						
3						
4						
5						
6						

FORMULAE:

Wattmeter reading, $W = VI\sin\emptyset$

Reactive power=$\sqrt{3}$ VI $\sin\emptyset$

Reactive power=$\sqrt{3}$ W

$\emptyset=\sin^{-1}(\frac{W}{VI})$.

Power factor=cos $\emptyset$

CALCULATIONS:

Supply voltage = 415V

Line current =

Reading of wattmeter =

Reactive power consumed by the load = √3VIsinØ =

phase angle $\emptyset$=$\sin^{-1}(\frac{W}{VI})$ =

power factor=cos $\emptyset$ =

multiplication factor=$\frac{VI\ COS\emptyset}{full\ scale\ deflection}$ =

PRECAUTIONS:

1) Readings should be taken without parallax error.

2) Loose connections are avoided.

RESULT:

Reactive power consumed by the given load is measured with the help of single wattmeter.

VIVA QUESTIONS:

1.what is reactive power?
2.what are the methods for measurement of reactive power in single phase circuits?
3.what is the unit of reactive power?
4.what are the errors present in wattmeter?

ADDITIONAL EXPERIENTS

EXPT.NO:12 DATE

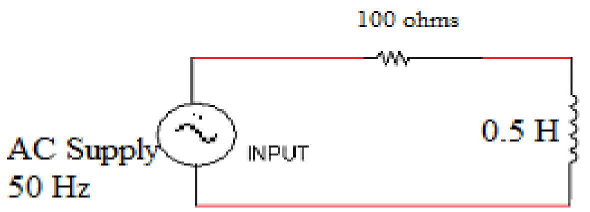
ANALYSIS OF RL AND RC SERIES CIRCUITS FOR AC EXCITATION

AIM: To find out the unknown resistance and maximum power for dc circuits.

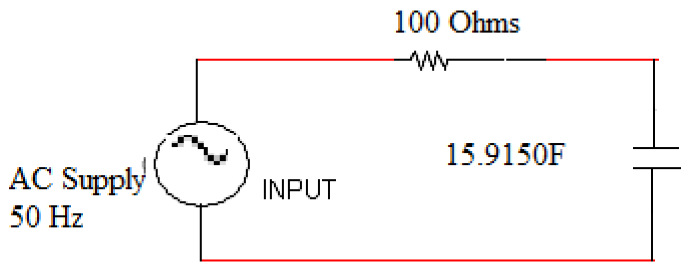
SOFTWARE REQUIRED: PSPICE – Personal Computer Simulated Program with Integrated Circuit Emphasis.

CIRCUIT DIAGRAM:

A) RL series circuit



B) RC Series Circuit



PROCEDURE:

1. Open PSPICE A/D windows.
2. Create a new circuit file.
3. Enter the program representing the nodal interconnections of various components.
4. Run the program.
5. Observe the response through all the elements in the output file.
6. Observe the voltage, current graph of any in probe window.

PROGRAM:

```
** RL SERIES**
VS   1   0 AC 100V
R1   1   2   100
L1    2   0    0.5
.AC  LIN  1 50 100
.PRINT AC IM (R1)
.PRINT AC  VM (R1)  VM (L1)  VP (L1)
.PROBE
.END
** RC SERIES**
VS   1   0 AC 50V
R1   1   2   100
C1    2   0    15.915U
.AC LIN   1   50   100
.PRINT AC IM (R1)
.PRINT AC VM (R1) VM (L1) VP (L1)
.PROBE
.END
```

<u>THEORETICAL CALCULATIONS:</u>

RESULT:

VIVA QUESTIONS:

1. Define time constant of capacitor circuit
2. Define power factor
3. Define reactive power
4. Which parameter is leading in parallel RC circuit
5. What happens to Z when it attains selectivity
6. Which part of impendence produce heat
7. Which part produce magnetic energy

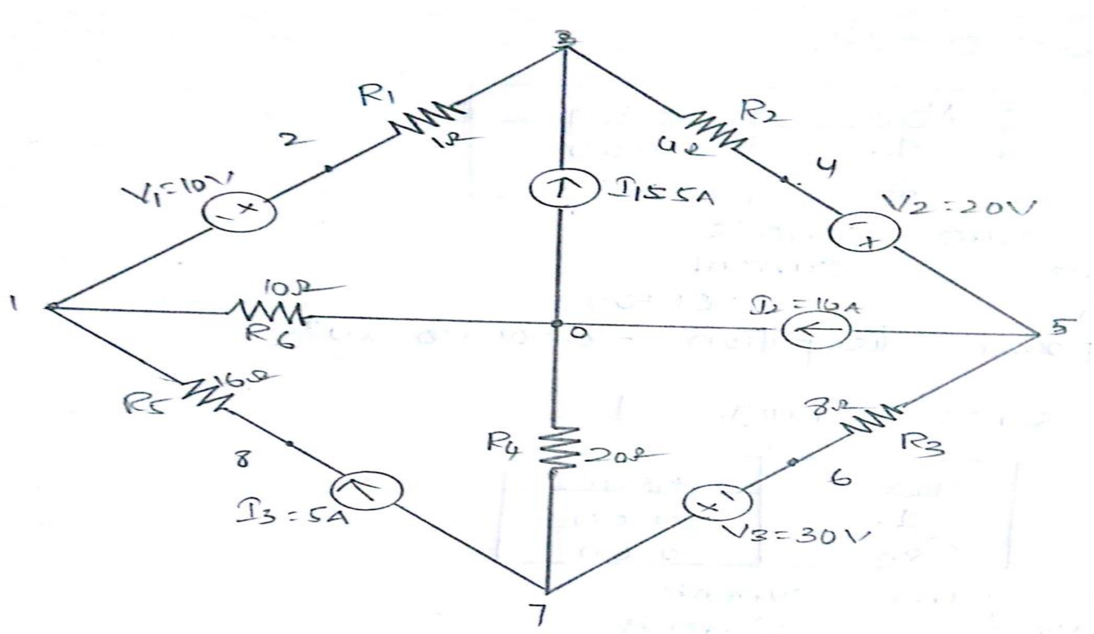
EXPT.NO:13 A DATE

MESH ANALYSIS

AIM: To determine currents for the given DC circuit by mesh analysis.

SOFTWARE REQUIRED: PSPICE – Personal Computer Simulated Program with Integrated Circuit Emphasis.

CIRCUIT DIAGRAM:



PROCEDURE:

1. Open PSpice A/D windows
2. Create a new circuit file.
3. Enter the program representing the nodal interconnections of various components
4. Run the program
5. Observe the response through all the elements in the output file.
6. Observe the voltage, current graph of any in probe window.

PROGRAM

```
V1   2  1 dc 10v
V2   5  4 dc 20v
V3   7  6 dc 30v
I1     0  3 5a
I2    5  0 10a
I3     7  8 15a
R1   2   3  1
R2   3   4  4
R3   5   6  8
R4   7   0  20
R5   8   1  16
R6   1   0  10
.dc lin V1  10  10  1
.print dc I(R1) I(R2) I(R3) I(R5)
.end
```

THEORETICAL CALCULATIONS:

RESULT:

VIVA QUESITIONS:

1. What are internal resistance of an ideal voltage source and an ideal current source?

2. What are active elements and passive elements?

3. What are non linear elements and give examples?

4. what is meant by super mesh

5. Write the formulae to convert a current source into voltage source?

6.Write the formulae to convert a voltage source into current source?

7. Define KVL and KCL?

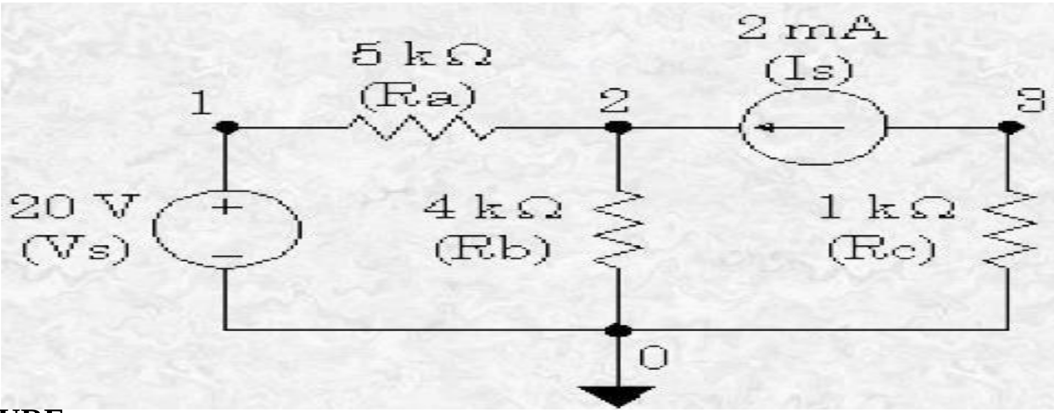
Exp. No.: 13 B **Date:**

NODAL ANALYSIS

AIM: To Simulate the DC Circuit for determining the all node voltages using PSPICE.

SOFTWARE REQUIRED: **PSPICE – P**ersonal Computer **S**imulated **P**rogram **with I**ntegrated **C**ircuit **E**mphasis.

C IRCUIT DIAGRAM:



PROCEDURE:

1. Open PSPICE A/D windows.
2. Create a new circuit file.
3. Enter the program representing the nodal interconnections of various components
4. Run the program.
5. Observe the response through all the elements in the output file.
6. Observe the voltage, current graph of any in probe window.

PROGRAM

V_s 1 0 DC 20.0V
R_a 1 2 5.0k
R_b 2 0 4.0k
R_c 3 0 1.0k
Is 3 2 DC 2.0ma
.END

THEORETICAL CALCULATIONS:

RESULT:

VIVA QUESITIONS:

1.Define Node
2.What are the advantages of nodal analysis over mesh analysis?
3.which law is applicable for nodal analysis?
4. what is the difference between nodal analysis and super node analysis?
5.Give any two comparison between nodal analysis and mesh analysis?