LABORATORY DEMONSTRATION

ON

FUNDAMENTALS OF ELECTRICAL CIRCUITS (20A02101P)

By

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Assistant Professor

Department of EEE

VEMU IT ,CHITTOOR

Vision of the Institute

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

Mission of the Institute

Mission_1: 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.

Mission_2: To facilitate the learners to foster innovative ideas, inculcate competent research and consultancy skills through Industry-Institute Interaction.

Mission_3: 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

Mission_1: To produce competent Electrical and Electronics Engineers with strong core knowledge, design experience & exposure to research by providing quality teaching and learning environment..

Mission_2: To train the students in emerging technologies through state - of - the art laboratories and thus bridge the gap between Industry and academia.

Mission_3: 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

Programme Educational Objectives (PEOs)

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.

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.

Programme Specific Outcome(PSOs)

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.

VEMU INSTITUTE OF TECHNOLOGY::P.KOTHAKOTA

I B.Tech I Semester (ECE)

Fundamentals of Electrical Circuits Lab (20A02101P)

Course Outcomes:

CO1. Apply various theorems and verify practically.

CO2. Analyze active, reactive power measurements in balanced star connected circuits

CO3. Analyze active, reactive power measurements in three phase un balanced circuits

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

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I B.Tech I Semester ECE)

Fundamentals of Electrical Circuits Lab (20A02101P)

List of Experiments (Continued)

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

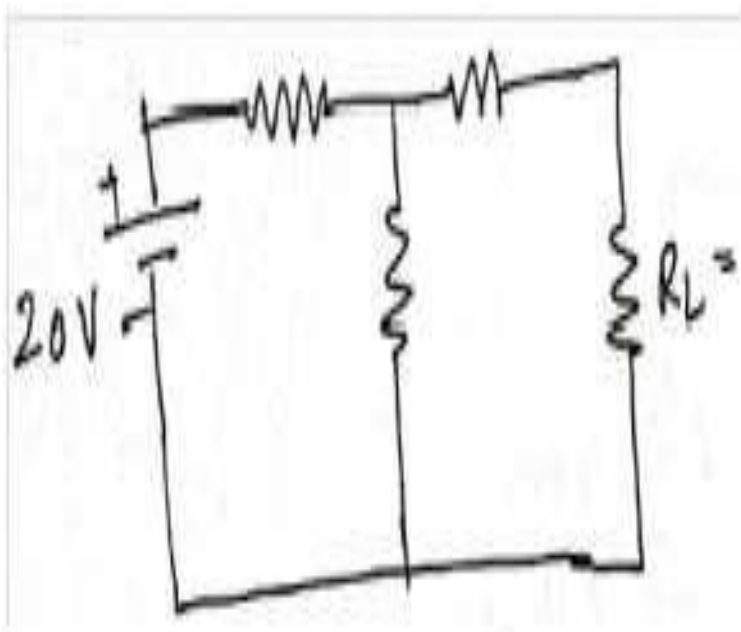
10. Measurement of Active Power for Delta Connected Balanced Loads

11. Measurement of Reactive Power for Delta Connected Balanced Loads

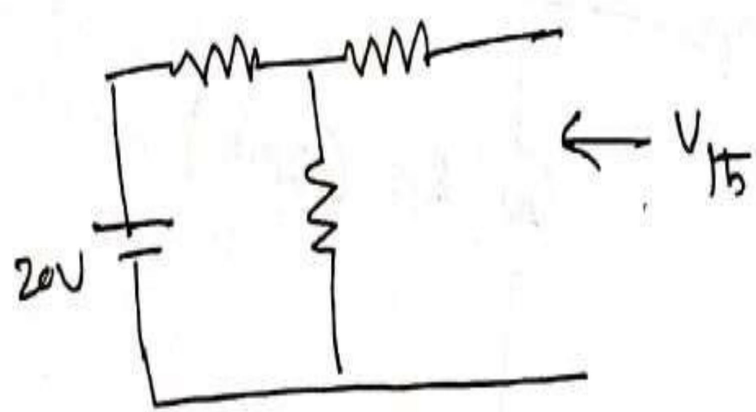
1.0 VERIFICATION OF THEVENIN'S THEOREM

STATEMENTS:

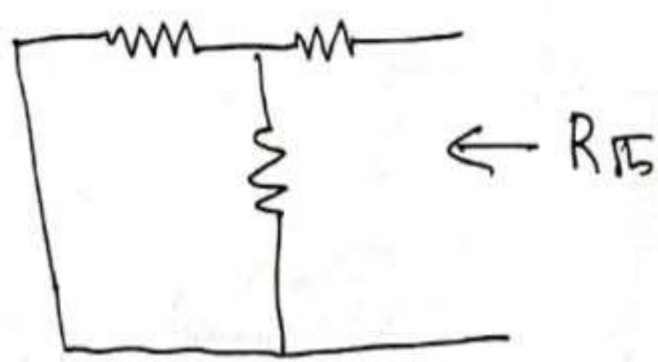
Thevenin's theorem: It states that "Any linear**,** active network and bilateral network consists of no.of voltage sources, current sources and resistances can be replaced by an equivalent circuit consisting of single voltage source (Thevenin's equivalent voltage source Vth) in series with Resistance (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.



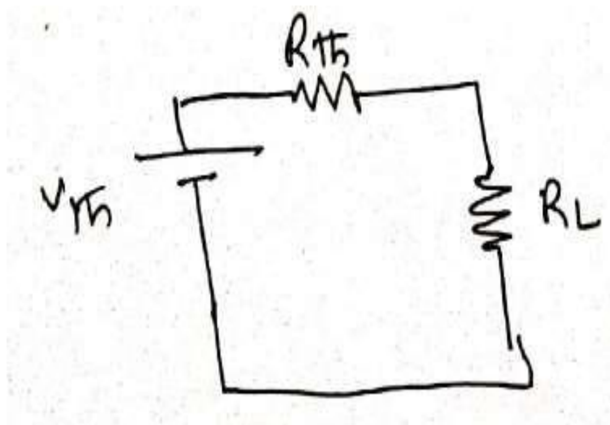
To find Thevenin's Voltage (V_{th}):



To find Thevenin' Resistance (R_{th}):



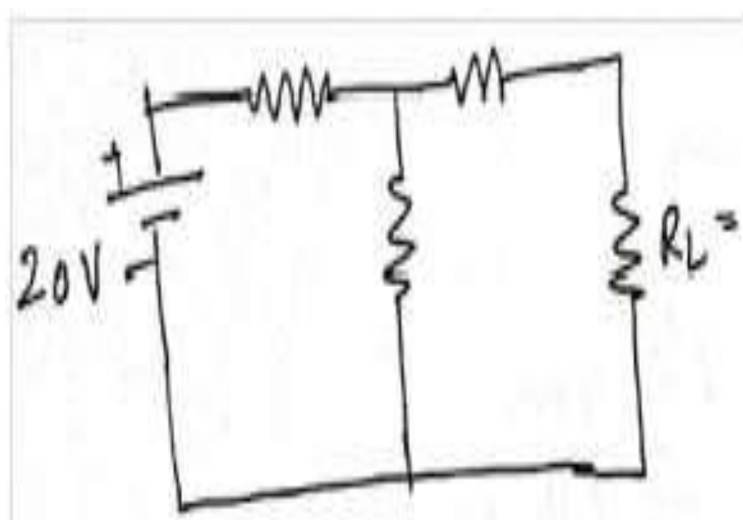
c) To find I_L



VERIFICATION OF NORTON'S THEOREM

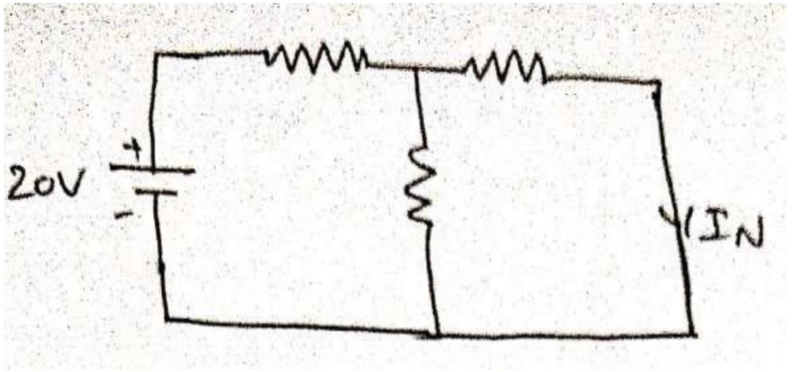
STATEMENTS:

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.

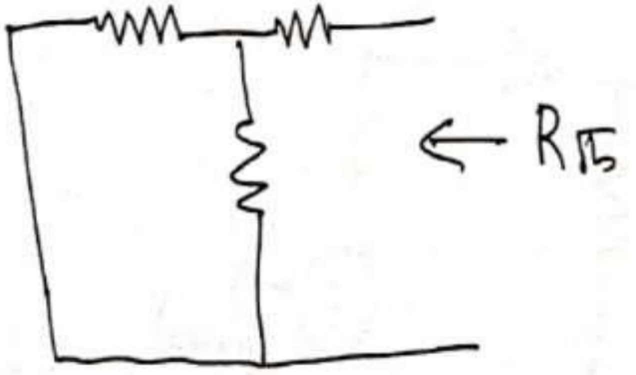


a) To find Norton's Current (I_N):

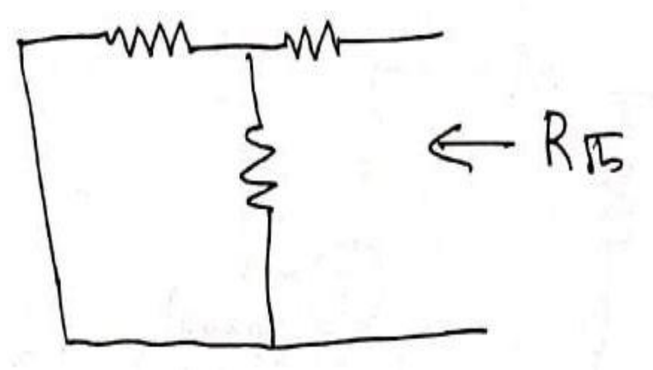
a) To find Norton's Current (I_N):



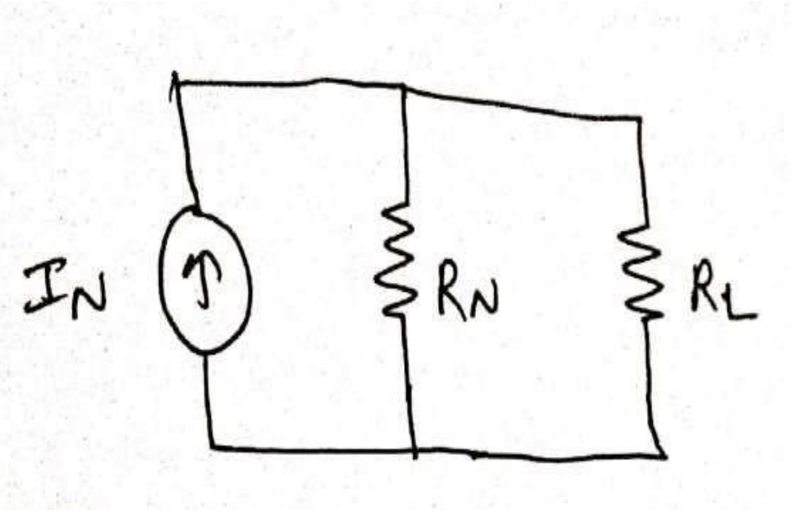
b) To find Norton's Resistancde (R_N):



b) To find R_N and R_{th}



c) To find I_L

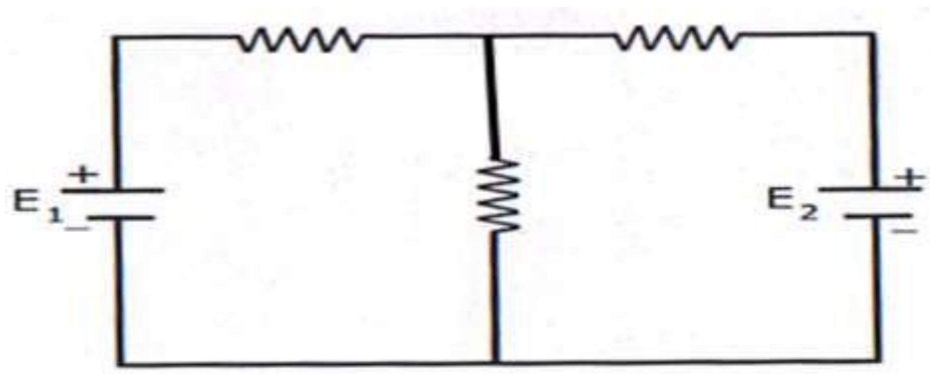


<u>**2.0 VERIFICATION OF SUPERPOSITION THEOREM**</u>

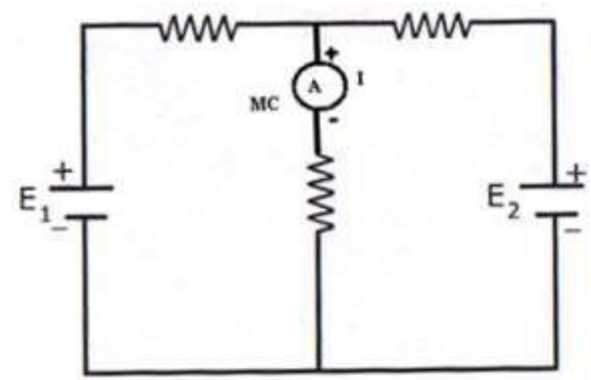
STATEMENT:

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.



a) When both the sources are acting:



b. When 20V source alone is acting and 5v Source is acting alone

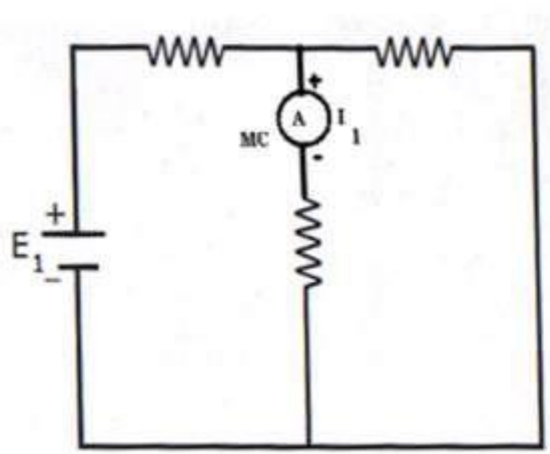


Figure 1

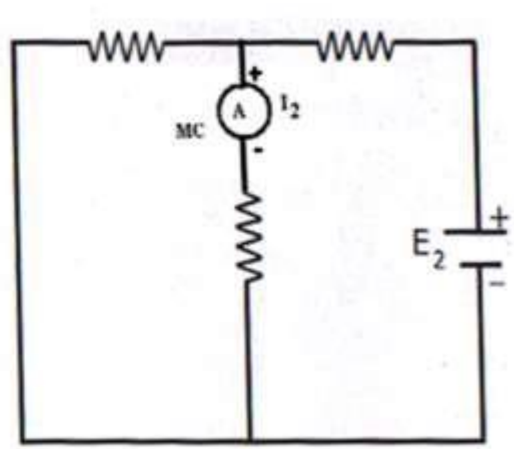
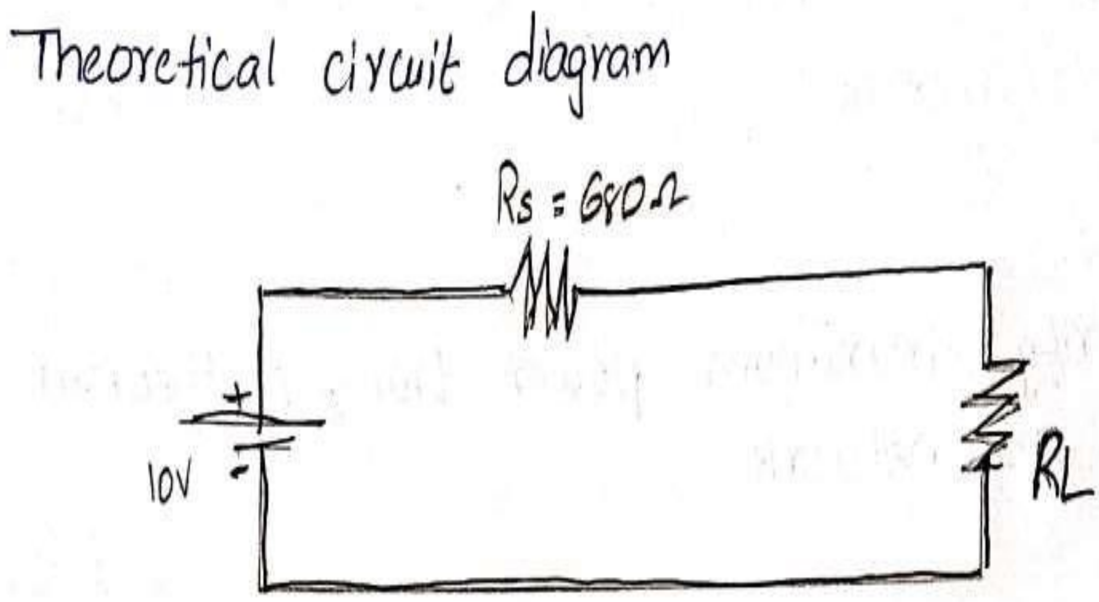


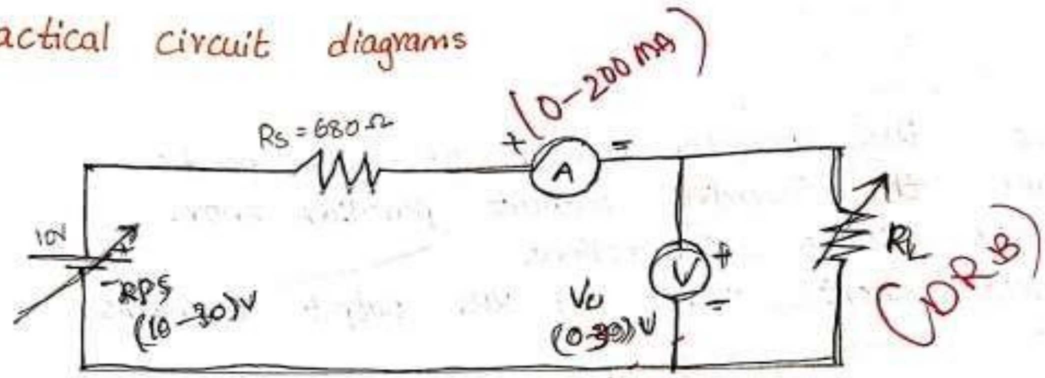
Figure 2

Statement for maximum power transfer theorem:

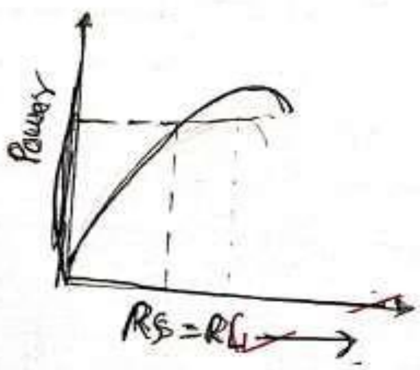
It states that the maximum power is transferred from the source to the load, when the load resistance is equal to the source resistance



Practical circuit diagrams

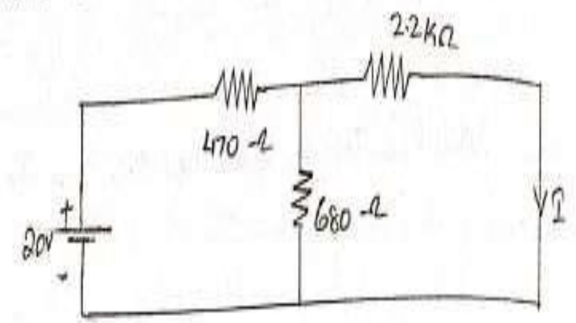


Model Graph



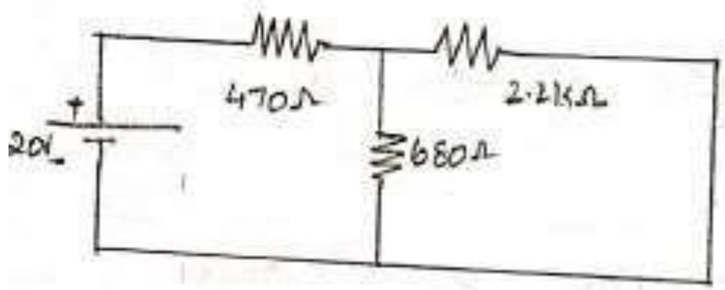
4.0 VERIFICATION OF COMPENSATION THEOREM

Given circuit

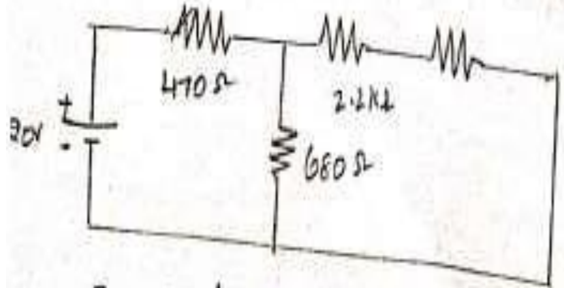


Theoretical circuit diagram

a) To find Load current I_L:

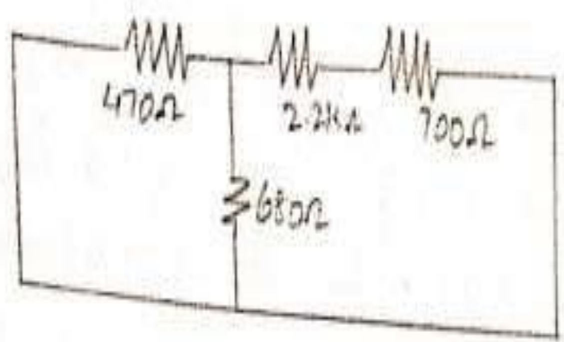


b) To find Load current ΔI



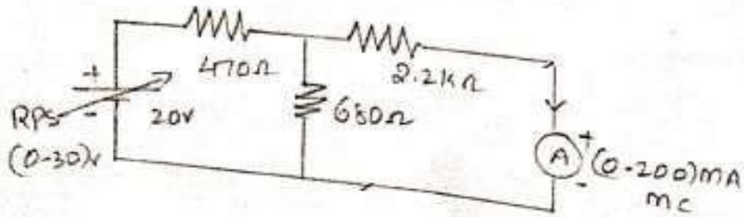
By applying KVL matrix form

c) To find Load current I'

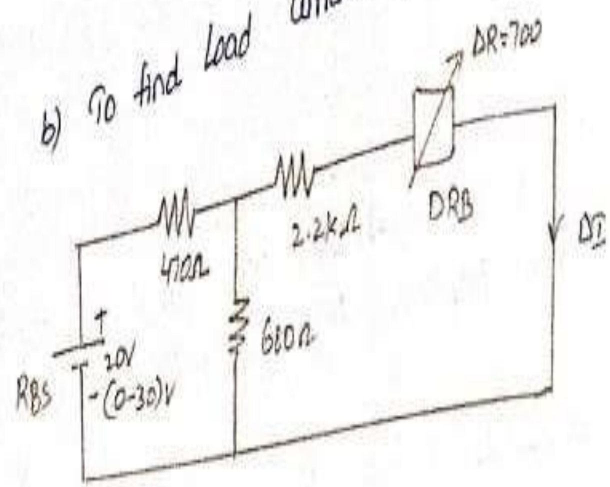


Parctical circuit Diagram

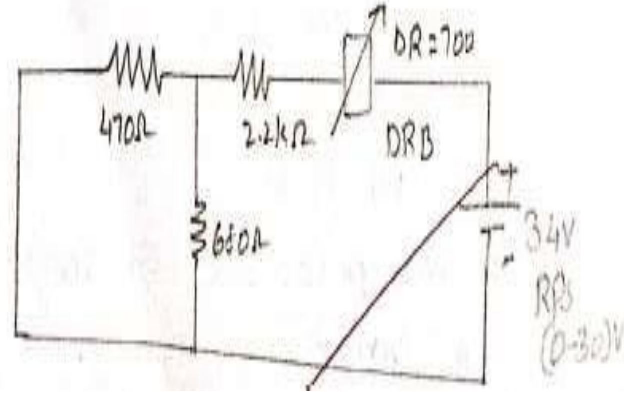
a) To find Load current I



b) To find Load current ΔI



c) To find load current I'

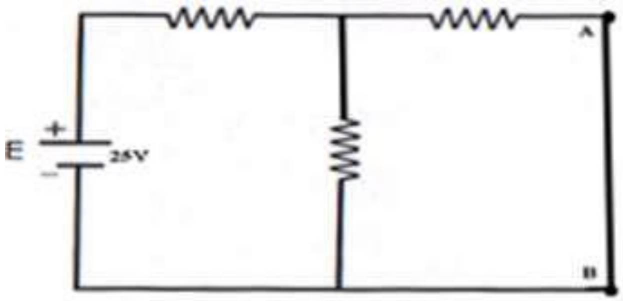


5.0 VERIFICATION OF RECIPROCITY THEOREM

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



After interchanging their positions of excitation and Response

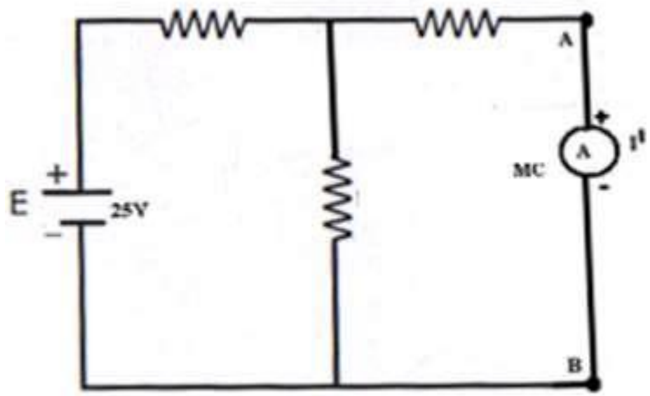


Figure 1

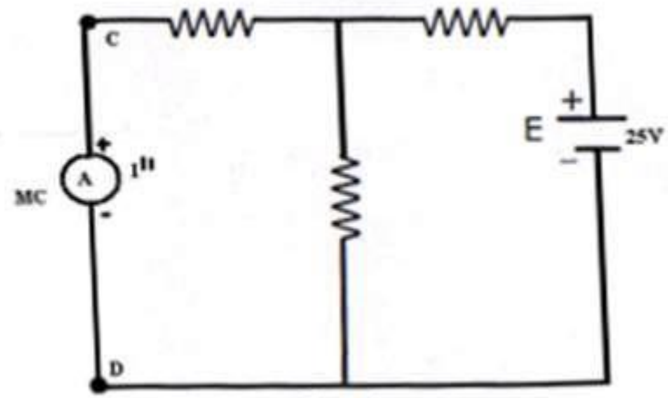


Figure 2

VERIFICATION OF MILLMAN's THEOREM

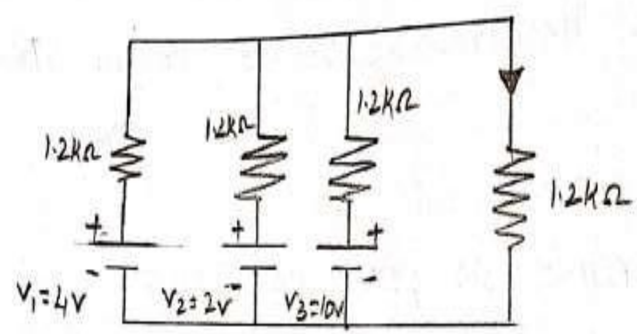
Millman's theorem states that in any network, if the voltage sources V_1, V_2, ... V_n in series with internal resistances R_1, R_2,.... R_n respectively are in parallel, then these sources may be replaced by a single voltage source V_{eq} in series with R' where value of the voltage source V_{eq} can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

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

Where Gn is the conductance of the nth branch,

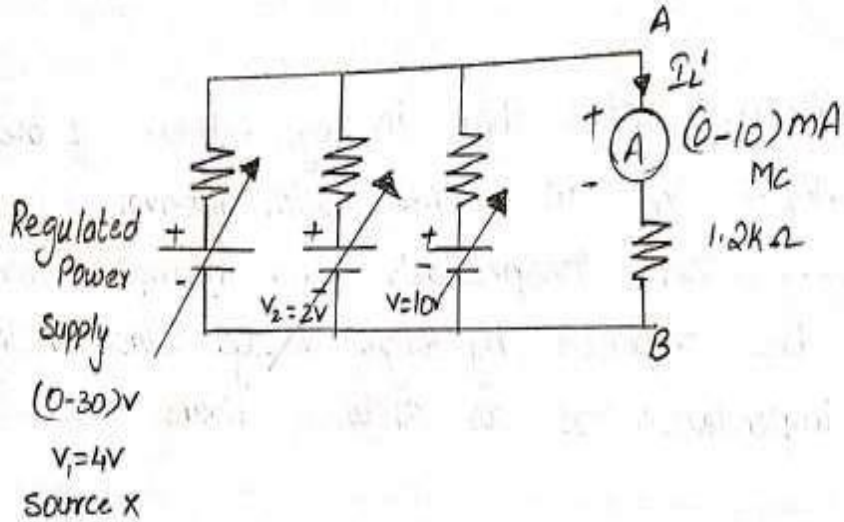
And $R' = 1/(G_1 + G_2 + \ldots\ldots + G_n)$

GIVEN CIRCUIT



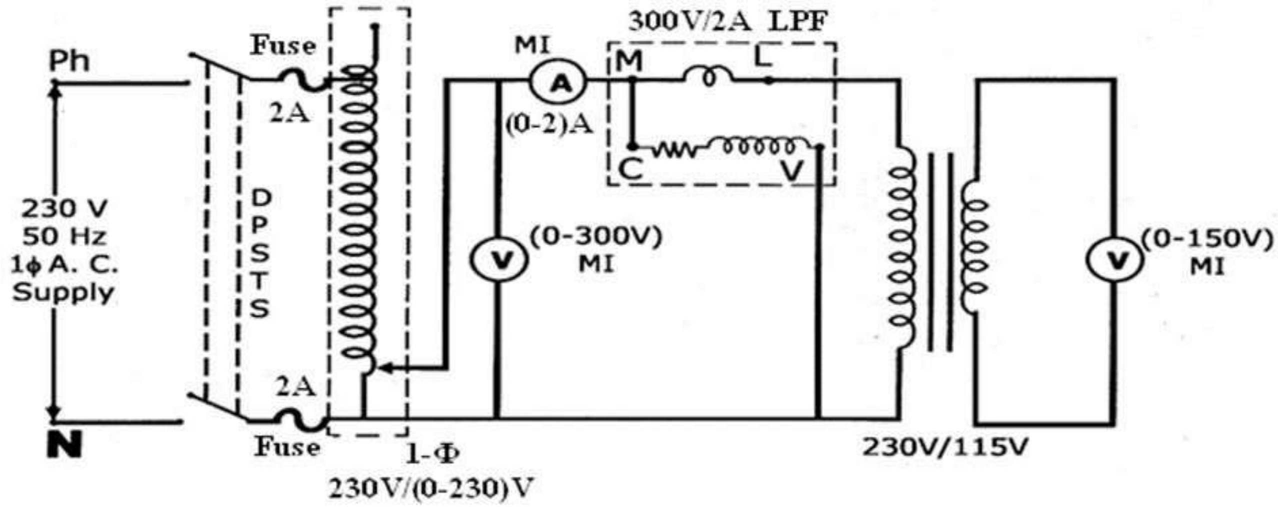
Practical circuit diagram

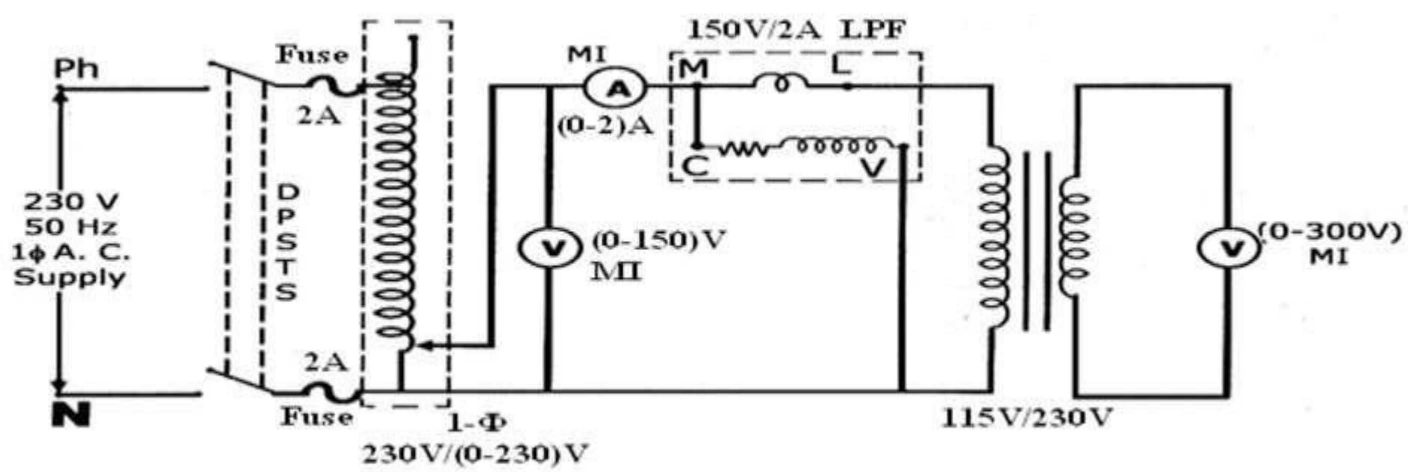
a) To find load current I_L



6.0 SELF INDUCTANCE AND MUTUAL INDUCTANCE

Aim: **To determine the values of L_1, L_2, M and coefficient of coupling, K for the given pair of coils.**





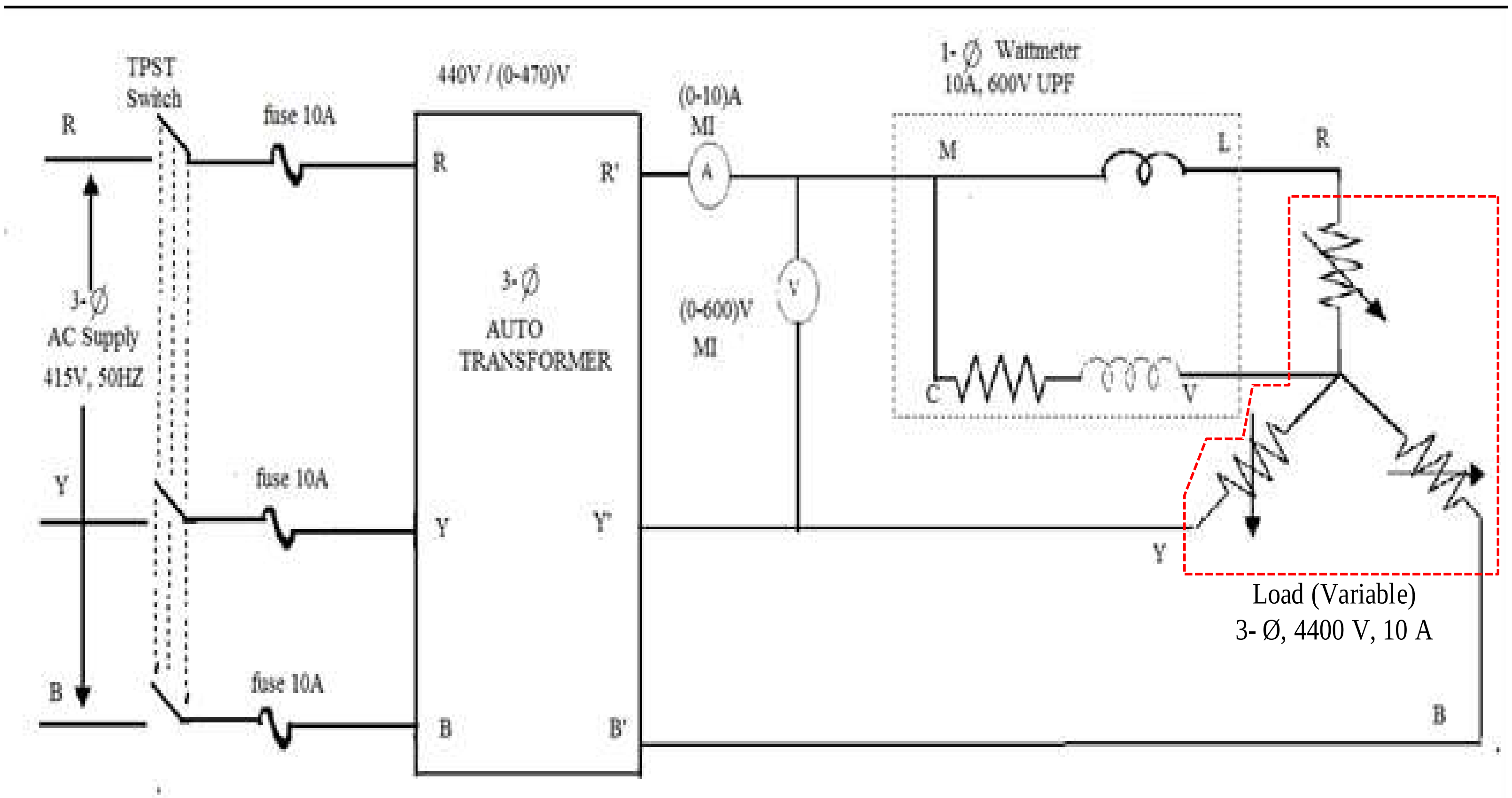
Tabular Column

I_1	V_1	W_1	V_1'	$Z_1 = \frac{V_1}{I_1}$	$R_1 = W_1/I_1^2$	$X_{L1} = \sqrt{Z_1^2 - R_1^2}$	$L_1 = X_{L1}/2\Pi f$	$X_{M1} = V_1/I_1$

Tabular Column2:

I_2	V_2	W_2	V_2'	$Z_2 = \frac{V_2}{I_2}$	$R_2 = W_2/I_2^2$	$X_{L2} = \sqrt{Z_{2}^{2} - R_{2}^{2}}$	$L_2 = X_{L2}/2\Pi f$	$X_{M2} = V_2/I_2$

7. MEASUREMENT OF ACTIVE POWER FOR STAR CONNECTED BALANCED LOADS

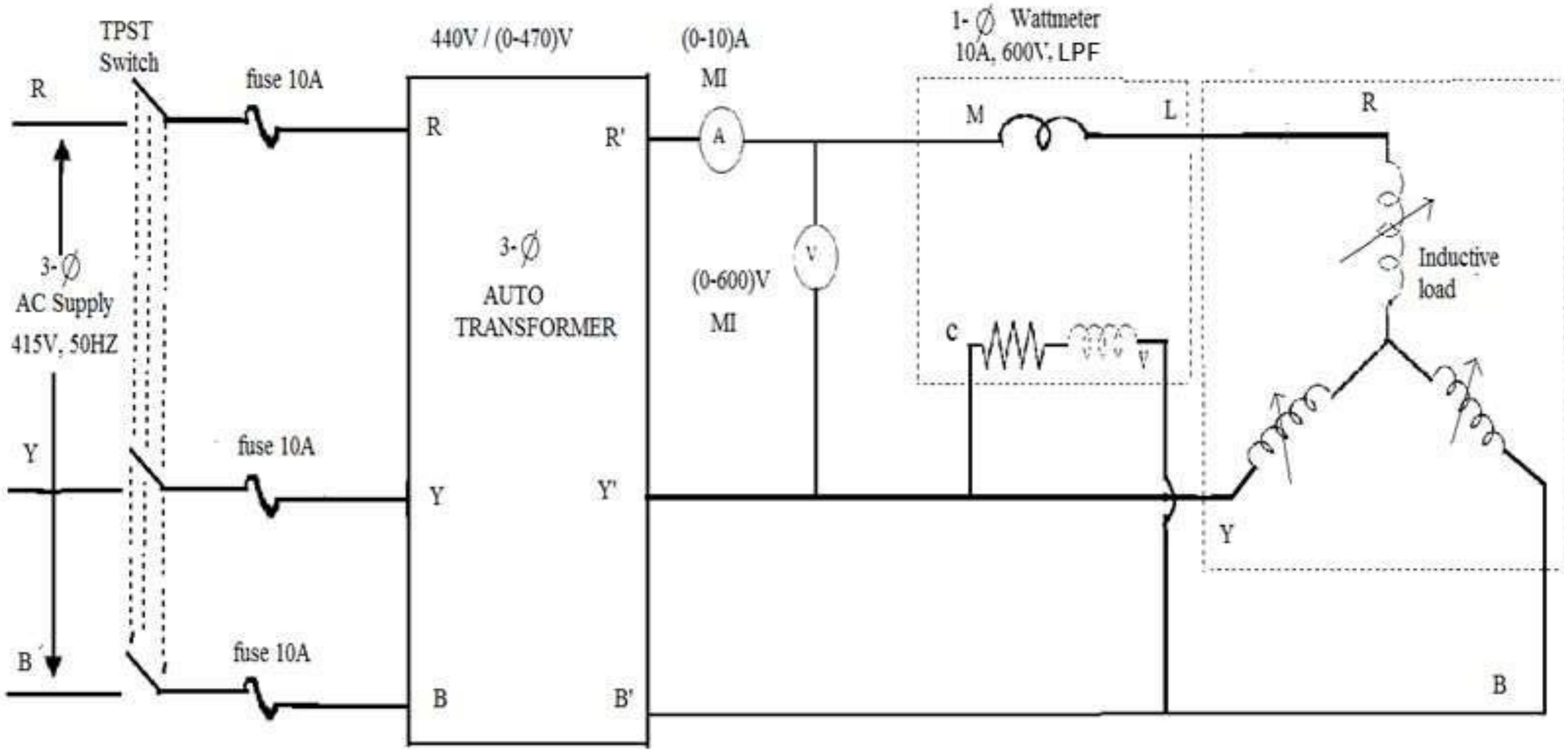


$\emptyset$

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

8. MEASUREMENT OF REACTIVE POWER FOR STAR CONNECTED BALANCED LOAD

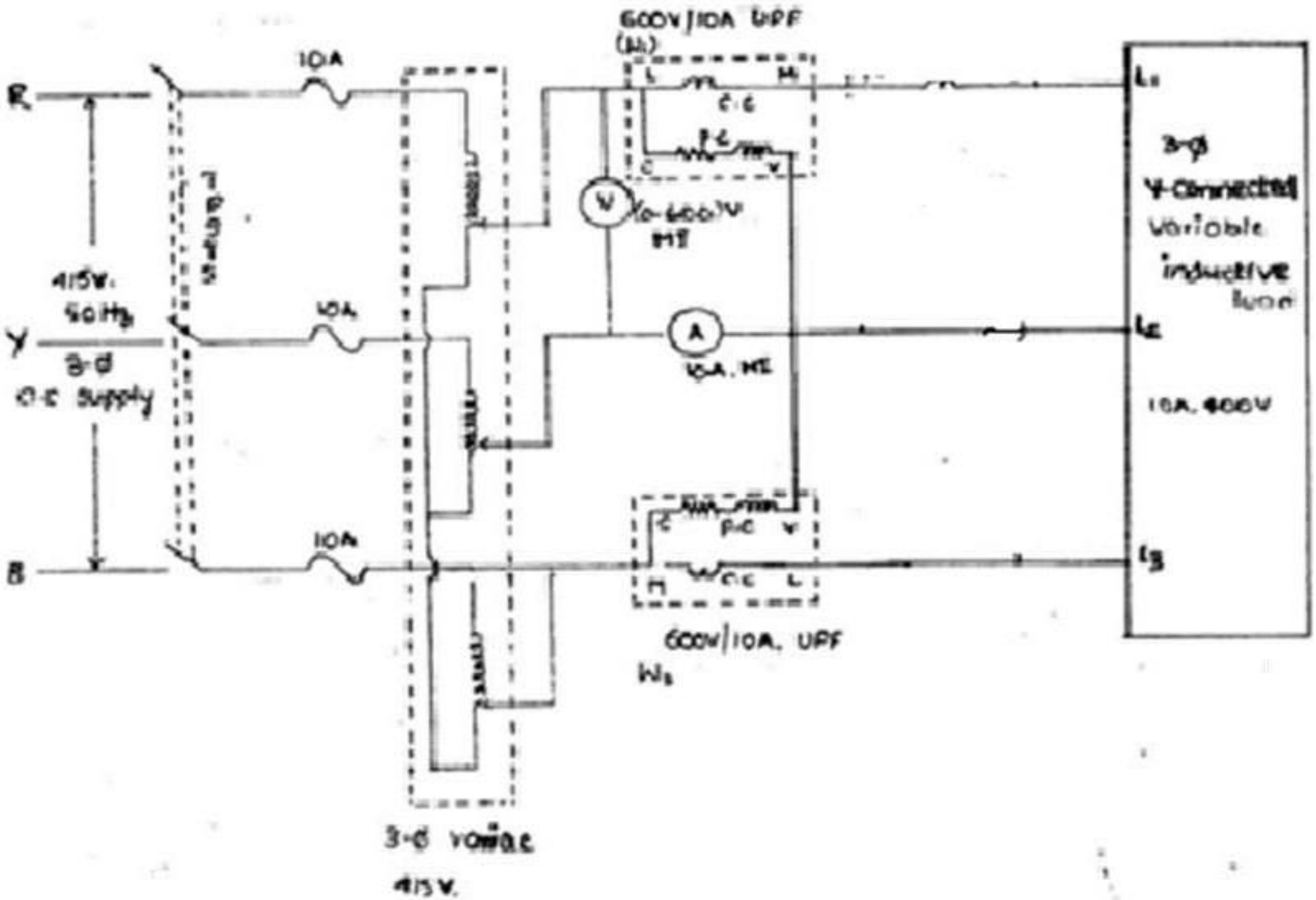
CIRCUIT DIAGRAM:-



Measurment of Reactive Power For Star Connected Balanced Load

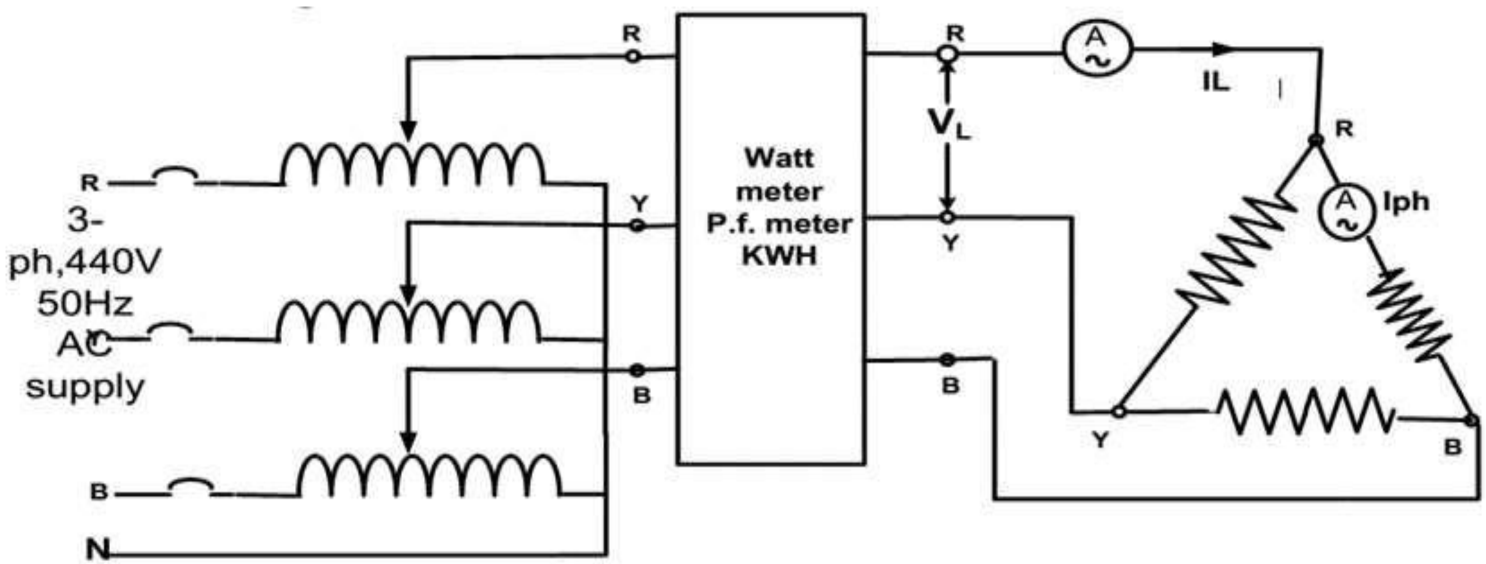
S. No.	Ammeter reading (I)	Voltmeter reading (v)	Wattmeter reading (w)	Reactive power=1.732 *W	Phase angle Ø	Power factor= CosØ
1						
2						
3						
4						
5						
6						

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



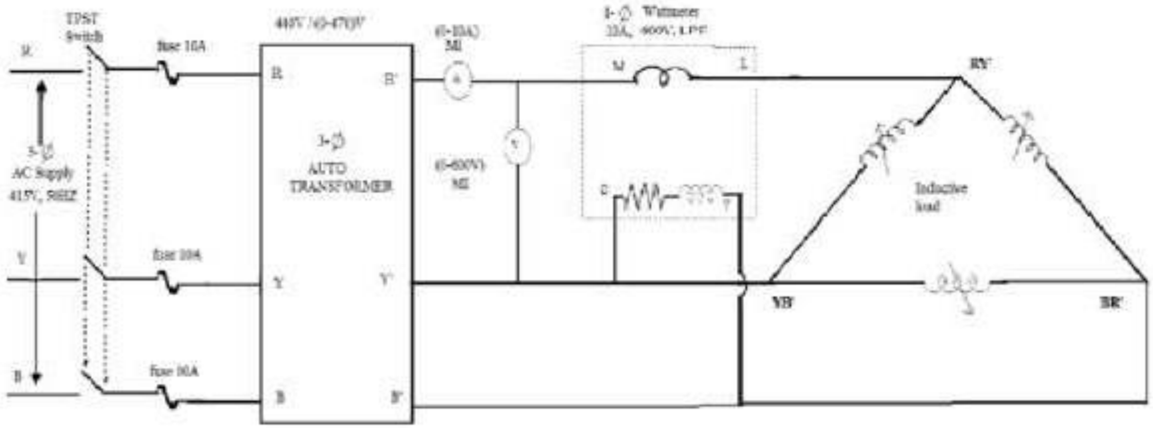
S.No	Voltmeter (V)	Ammeter (A)	Wattmeter (W1)	Wattmeter (W2)	Total Power W1+W2	Cosφ	P

10. MEASUREMENT OF ACTIVE POWER FOR DELTA CONNECTED BALANCED LOAD



11. MEASUREMENT OF REACTIVE POWER FOR DELTA CONNECTED BALANCED LOAD

CIRCUIT DIAGRAM:-

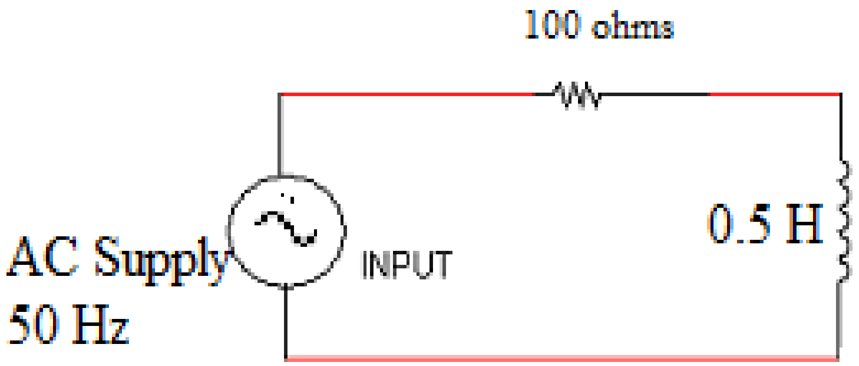


Measurment of Reactive Power For Delta Connected Balanced Load

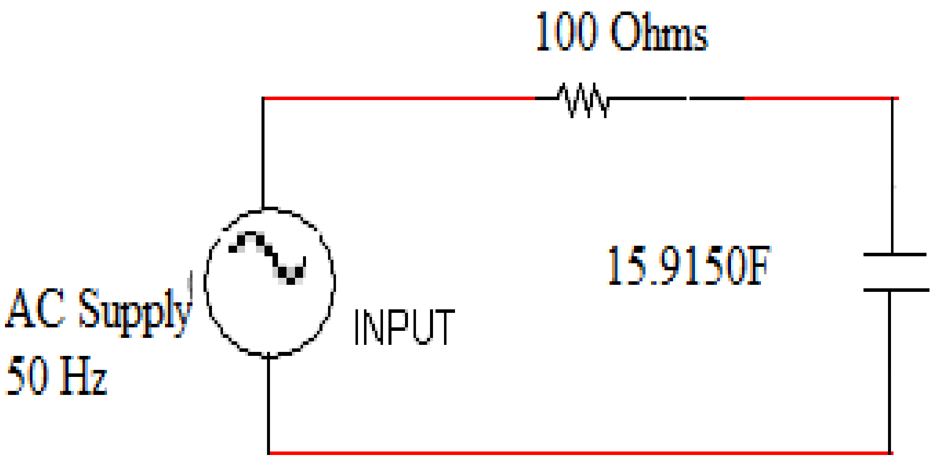
S. No.	Ammeter reading (I)	Voltmeter reading (v)	Wattmeter reading (w)	Reactive power	Phase angle Ø	Power factor
1						
2						
3						
4						
5						
6						

ANALYSIS OF RL AND RC SERIES CIRCUITS FOR AC EXCITATION

RL Series Circuit



RC Series Circuit



PROGRAM:

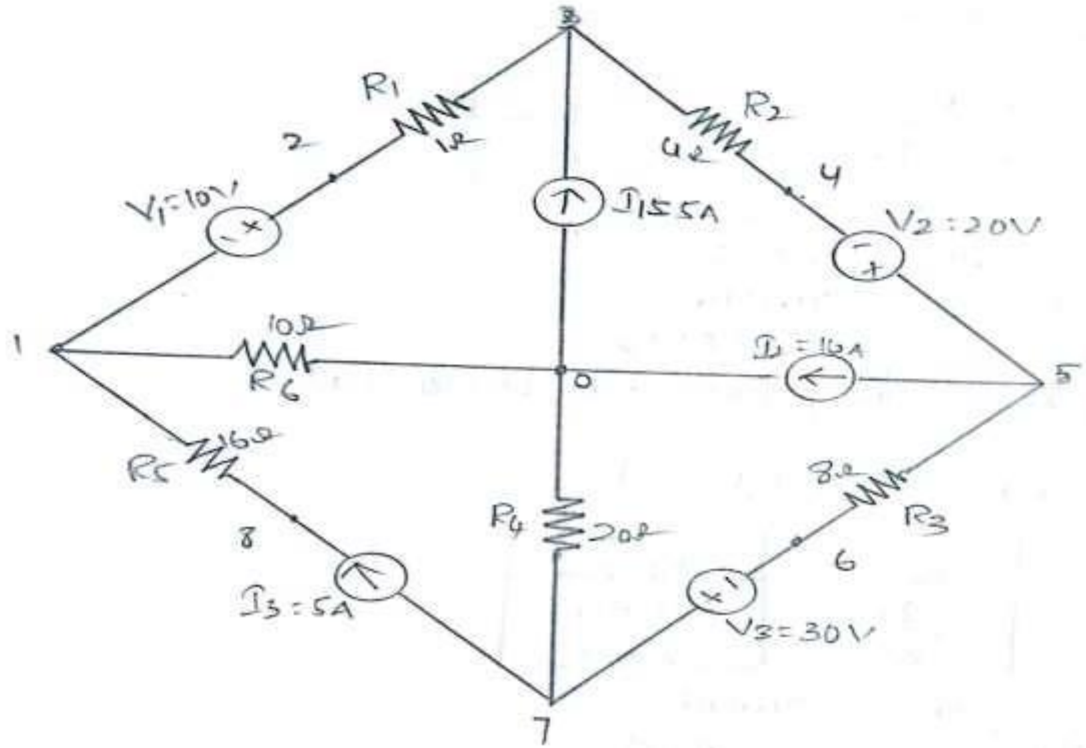
**** RL SERIES****

```
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
```

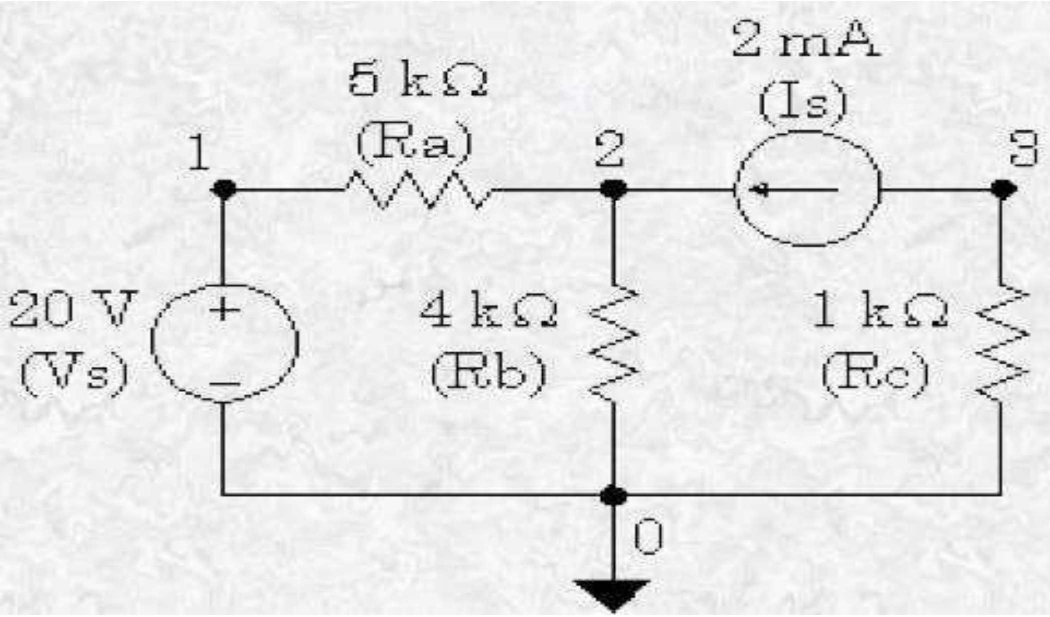
MESH ANALYSIS



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
```

NODAL ANALYSIS



PROGRAM

```
Vs   1  0   DC 20.0V
Ra   1  2   5.0k
Rb   2  0   4.0k
Rc   3  0   1.0k
Is   3  2   DC 2.0ma
.END
```

GENERAL INSTRUCTIONS

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

Safety Precautions

- Equipped with Fire Extinguishers.
- Students and Faculty are instructed to follow Safety Instructions in Laboratories.
- The Lab is under CC Camera surveillance.
- Keep all the equipment's in proper places
- Switch on the Miniature Circuit Breaker's (MCB's) after verifying the connections by the faculty member
- Don't switch on the supply during th connections of wires
- Students should not attempt to repair, open, tamper or interfere with any of the equipment in the laboratory.
- Do not disturb the equipment's.
- Switch of the supply after completion of Lab.

Fire Extinguishers

First Aid Box

Miniature Circuit Breaker's (MCB's).

CC Camera surveillance

Table 6.4.2 Safety Measures in the Laboratories

THANK YOU