DATE
PAGE

Experiment – 2

Aim

To Study and demonstration of household ~~wiring~~ wiring System.

Apparatus Required

Name of the equipment	Range / Type
1. AC Power Supply	230v
2. Electrical Board	..
3. Bulb	100 w
4. Switches	(6A & 16A)
5. Connecting wire	14 SWG / 16 SWG

Theory

Basic Concepts Of Household wiring

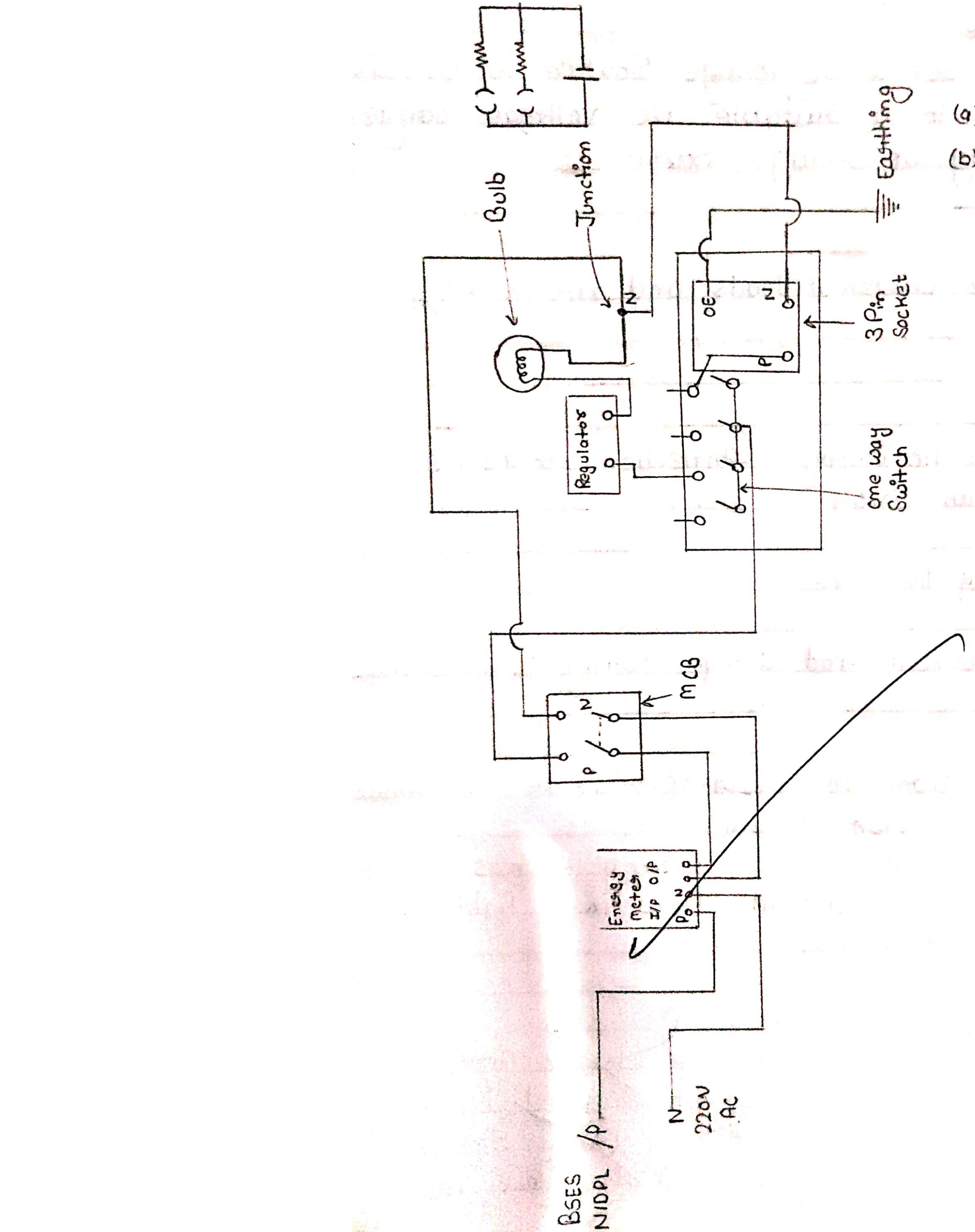
There are basically 4 Components involved in the whole procedure

1. Power (main voltage)
2. load
3. Conductor
4. The Switch

Connection of a lamp by a

(a) Single way Switch method

(b) Two way Switch method



Normally, our domestic mains Power includes 2 Paths, the incoming phase & outgoing phase through the neutral. Other than these 2 the third Conduction Path in electrical wiring is the 'earth' The top pin in a wall Shocket is where the earth Connection is given

How to do House wiring:

- wiring a lamp and a Switch
The diagram Shows a very Simple Configuration which Can be used for Powering a lamp and the Switching arrangement is also Povided in the form of a Switch.

- writing up a Plug Socket.
Here the load Points are Just Replaced with Socket terminals for receiving the phase and neutrals potentials through a Series Switch Placed in line with Phase.

- wiring up Heavier loads
External loads like irons, geysers, mixes etc normally have a Plug & requires a Socket to be Plugged into However the Socket / switch assembly and wires used must all be appropriately rated

DATE
PAGE

Procedure

Step 1:- make Connection as Shown in the diagram. Keep all the Switches in off position.

Step2:- Connect, Phase terminals at upper end of Switch 1.

Step3. Connect the lower end of Switch 1 to the one end of lamp.

Step4. Now Connect neutral terminal to the other terminal of lamp.

Step5. Turn on the Supply, Check Connection by using SPDT Switches.

Step6. Repeat above Procedure for other home appliances

Result

we Study about the house wiring and made the Connections for lamp wiring.

Precautions

1. For Configurations the Switch must always Come in
2. line with Phase and Before the load
2. Before ~~Switching~~ on the Ac Supply Connection Should be Checked Properly.
3. Do not touch any live wire, do not keep any Joint open.

12/12/25

Significance

1. Proper house wiring is imp. to present hazards such as are flash and other.
2. Wiring device provids proper control and connections in your electrical devices and wiring.

Application

1. The Exp. help in designing household wiring system which is used for domestic purpose.
2. The exp. gives us idea how house wiring system is to be done

DATE
PAGE

Experiment : 3

Aim

To writing for a lamp to be Controlled from 2 different position (Two way Switch method)

Apparatus Required

S.No.	Name of equipment	Range/Type	Quantity
1.	1-Ph Ac Power Supply	230V	01
2.	Two way Switch	SPDT, 6A	02
3.	lamp	60w/100w	01
4.	lamp Holder	6A, 230V	01
5.	Connecting leads/wire	14 SWG/16 SWG	As Req.

Theory

Staircase wiring is a Special type of wiring which is different from ordinary wiring due to field of application. In staircase wiring, lamp used for lighting the Staire Can be Switched ON or OFF from either side UPSTAIRS or DOWNSTAIRS

A two way Switch Probably refers to three way Connections, where a Single Common terminal

DATE
PAGE

Can make or Break Contacts with 2 possible Contact pts. A three Switch allows for a device el. to be Controlled independenlty from 2 locations regarding the position of the other Switch

This System works as XOR GATE

Procedure

Step 1. make the Connection as Shown in the Connection diagram. keep all devices in off position

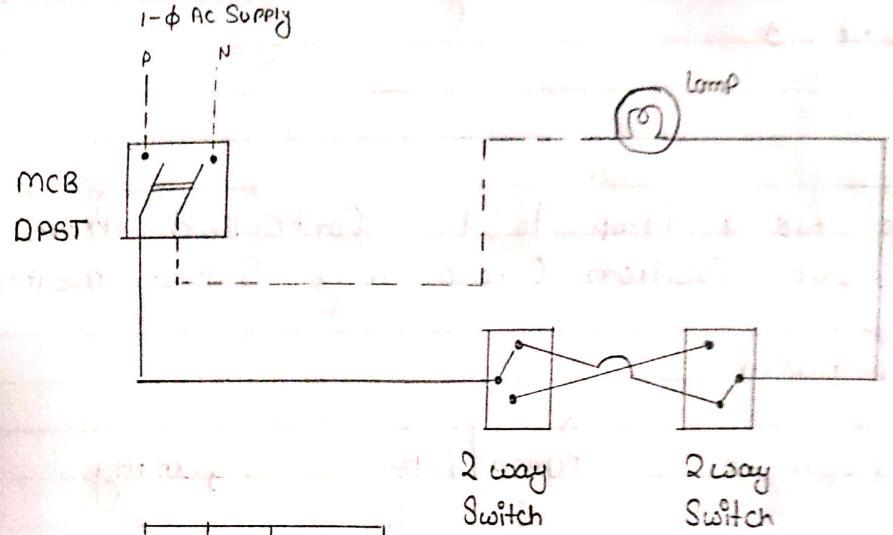
Step 2. Connect Phase terminal at middle terminal of Switch 1.

Step 3. The upper and lower terminals of Switch 1 Should be Connected with opp. terminal of Switch.

Step 4. Connect the middle terminal of Switch 2 to the one End of lamp

Step 5. Now Connect netural terminal to other terminal of lamp.

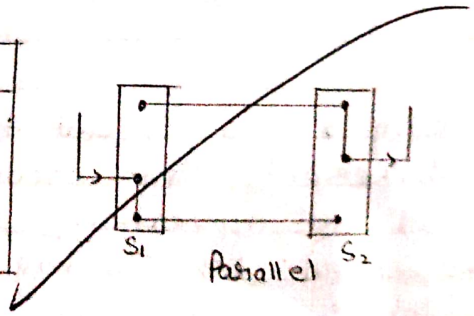
Step 6. Turn ON the Supply (MCB), checked Connections by using the SPDT Switches



Series / Cross:

S_1	S_2	Lamp
UP	UP	OFF
Down	Down	OFF
UP	Down	ON
Down	UP	ON

S_1	S_2	Lamp
UP	UP	ON
Down	Down	ON
UP	Down	OFF
Down	UP	OFF



Step 7. After note down the observations, switch OFF the Power Supply.

Result

We Study about the house wiring and made the Connections for Staircase wiring

Precautions

→ Before Switching on the Ac Supply, Connections. Should be checked by the lab Staff

→ Do not touch any live wire

→ use only Proper Current & voltage rating equipment.

Significance

In today's world we use there way Connecting is wiring so it is necessary to understand how Connection are made so we Can Stop hazardous impact of 3 circuit failures and Protect ourselves

Application

1. The Exp. help in designing household wiring System which is used for domestic Purpose
2. The Exp. gives us idea how house wiring System is to be done

DATE
PAGE

Experiment-4

Aim

To verify Thevenin's Theorem and Calculate Thevenin voltage (V_{Th}) and Thevenin resistance (R_{Th})

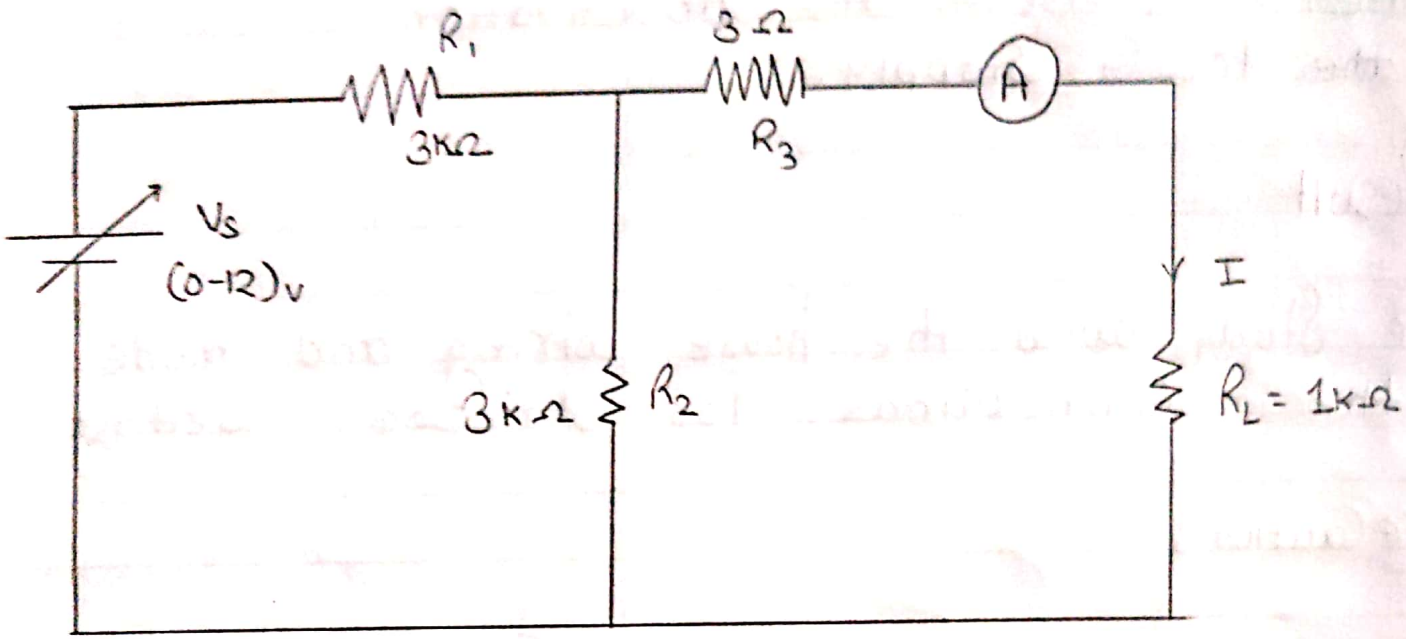
Apparatus Required

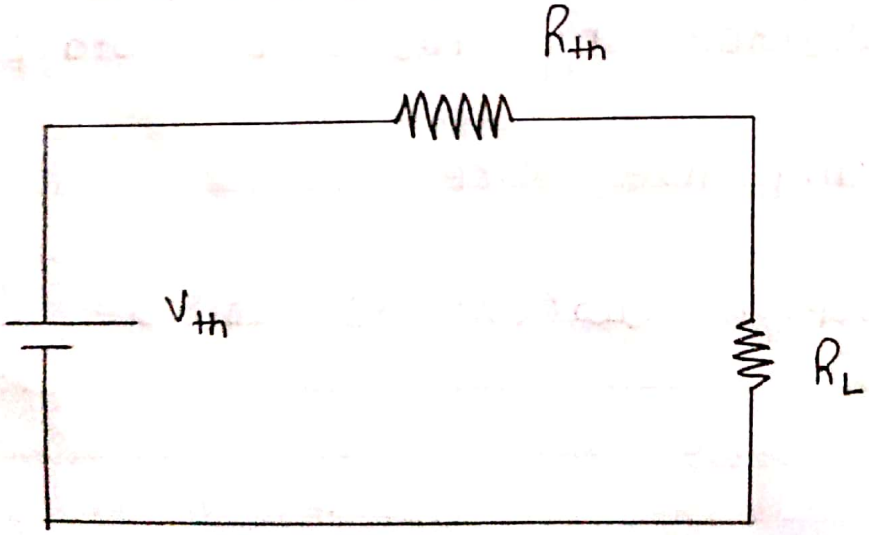
S.No.	Name of equipment	Range/Type	Quantity
1.	Dc Power Supply	0-12	01
2.	Bread Board		01
3.	voltmeter (DC)/DMM	0-20	02
4.	Ammeter (DC)/DMM	0-20mA	01
5.	Resistor	2.2KΩ & 1KΩ	03 each
6	Potentiometer	0.5KΩ	01
7	Key	1A	01
8	Connecting wires	14 SWG/16 SWG	As required

Theory

The Thevenis theorem provides a mathematics technique for solving the linear circuits.

Any linear electrical network with Voltage and Current Sources and resistance can be replaced by Thevenin's equi circuit elements at terminals A-B by equ. Voltage Source. V_{Th} in Series Connection with an equi resistance R_{Th}.





This equi voltage, $V_{TH} = V_{oc}$ is the voltage obtained at terminals A-B of the network with terminals A-B open circuit.

This equi resistance R_{TH} is resistance obtained at terminals A-B of the network with all its independent Current Source open circuited and all its independent voltage Source Short circuit.

1. Measure the values of Thevenis's resistance, R_{TH} at A-B after replace the voltage Source by Short circuit and load resistance R_L with the help of Ohmmeter / Omm
2. Switch on the Supply set the certain value of source voltage, Vsc with the help of Pot
3. Record the values of Vsc, I_L Source voltage
4. open the Switch and take the reading of open circuit voltage Blw terminal A-B and gives the Thevenin's Eq
5. For another Set of Reading Put another value of Source voltage Vsc with the help of Pot Repeat the Step 5-6.

6. Switch off the Supply
7. make the Connection for Thevenin's Eq. circuit, using R_{Th}, R_L and V_{Th}
8. Adjust the value of V_{Th} with the help of Pot and Record the value of load Current I_L.
9. Repeat the above for all values of V_{Th}
10. Switch off the Supply, disconnect the circuit Safely.

Result

It is observed that actual value of load Current, I_2 is tallies with the Calculated value of the load Current I_2. Hence Thevenins theorem is verified with Some permissible error which is allowed in Practicas

Pre Cautions

1. Terminal of voltage Source of last Should not be Short circuit only circuit on the Bread Board Should be Short Circuit.
2. Current in the ammeter is in mA not MA
3. Connection Should be tight and Correct
4. Terminals of rheostate Should be Connected properly

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DATE
PAGE

Experiment – 5

Aim

To verify the Norton's theorem and Calculate Norton Current, I_N and Norton resistance, R_N.

Theory

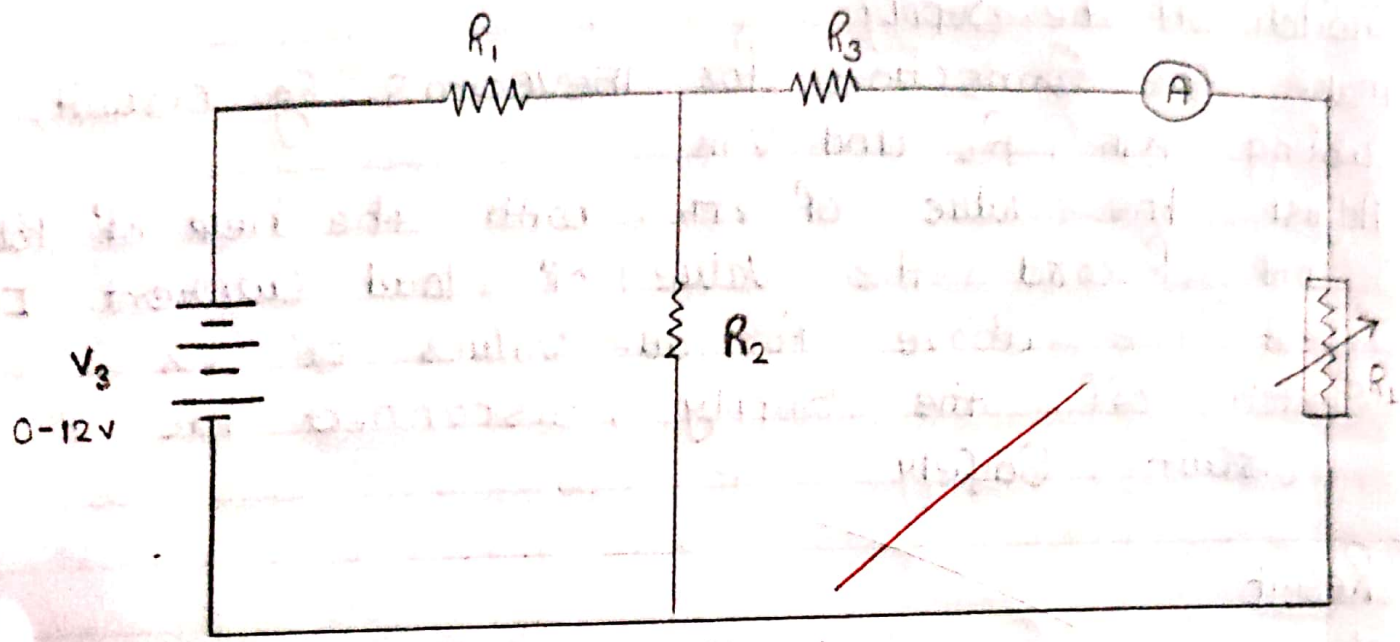
Any linear Passive, electrical circuit can be replaced by Norton's Equi circuit, by replacing an equi, Current Source, I_N in Parallel with an equi resistance R_N.

Apparatus Required

S.No.	Name of the equipment	Range	Quantity
1.	Dc Power Supply	12V	01
2.	Bread Board		01
3.	Voltmeter	0-20V	02
4.	Ammeter	0-20V	01
5	Resistor	2.2kΩ & 1kΩ	03 each
6.	Rheostat	1 kΩ	01
7	Key	1A	01
8.	Connecting leads/wire	SWG	As required

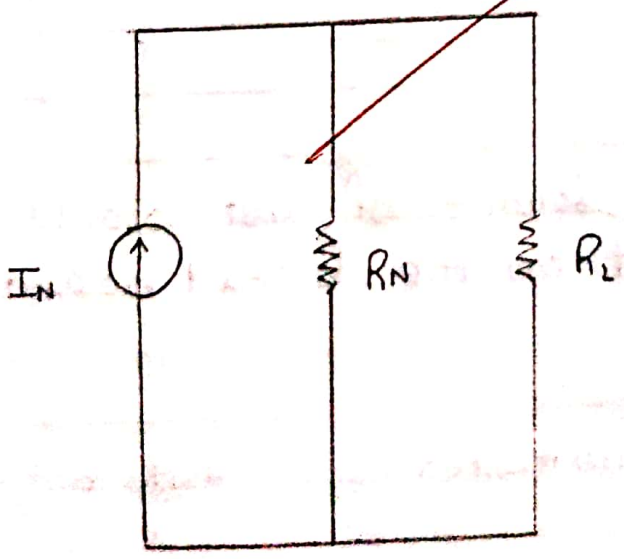
Procedure

1. measure the values of Norton's resistance R_N at A-B after replaced the V Source by short circuit and load Resistance, R_L with the help of ohmmeter.



$R_1 = R_2 = R_3 = R_L = 1\ K\Omega$

Norton's Equivalent circuit



DATE
PAGE

2. Keep the pot at max value to keep the Source voltage at its lowest volume

3. Switch on the Supply, set the certain value of Source voltage, V_{sc}

4. Record the reading

5. Open the Switch and take the reading of Short circuit Current I_{sc}.

6. Switch off the Supply

7. Adjust the value of I_N with the help of Pot and record the value of load Current I_L.

8. Repeat the above for all value of I_N, recorder earlier.

9. Switch of the Supply, disconnect the circuit Safely.

Precautions

1. Terminals of voltage Source should not be Short Circuit only circuit on board should be Short Circuit

2. Connections Should be tight and Correct

observation

S. No.	Load Resistance R_L (KΩ)	Norton's Resistance R_N (KΩ)	Source voltage V_S (V)	Load Current I_L (mA)	Norton's Current I_N (mA)	Load Current by Norton's (I'_L)	Error $\frac{I_L - I'_L}{I_L}$
1.	1KΩ	1.45KΩ	12	2.20	3.8mA	2.14	2.7
2.	1KΩ	1.45KΩ	09	1.79	2.94mA	1.74	2.6

formula :- $I_L' = \left(\frac{I_N \times R_N}{R_N + R_L} \right)$

3. Terminal of Rheostat Should be Connected Properly

4. Current in ammeter is in mille amperes not in amperes.

Significance

1. It is used to represent any network of linear Source
2. Norton's theorem is widely used for circuit.
3. analysis Simplification. it reduces a Complex circuit into a Simple circuit.
3. it is used for circuit where load resistance varies.

Applications

1. used for Simplifying Complex circuits for easy Calculation.

2. it Can be used interchangeably with thevenin's theorem through proper Source transformation

DATE
PAGE

Experiment-6

Aim

To determine the Parameter of Series RLC circuit

Apparatus Required.

S.No.	Name of Equipment	Range	Quantity
1.	Power Supply	220V, Ac	01
2.	RLC Series circuit Kit		01
3.	Voltmeter / Dmm	0-20V, MC type	04
4.	Ammeter / Dmm	0-2A, MC type	01
5.	Resistors, inductors and Capacitor		01 each
6.	Potentiometer	5 KΩ	01
7.	Key (Switch)	1 A, Dc	01
8.	Connecting wire	SWG	As Req'd.

Theory

~~circuit diagram Containing R ohm~~

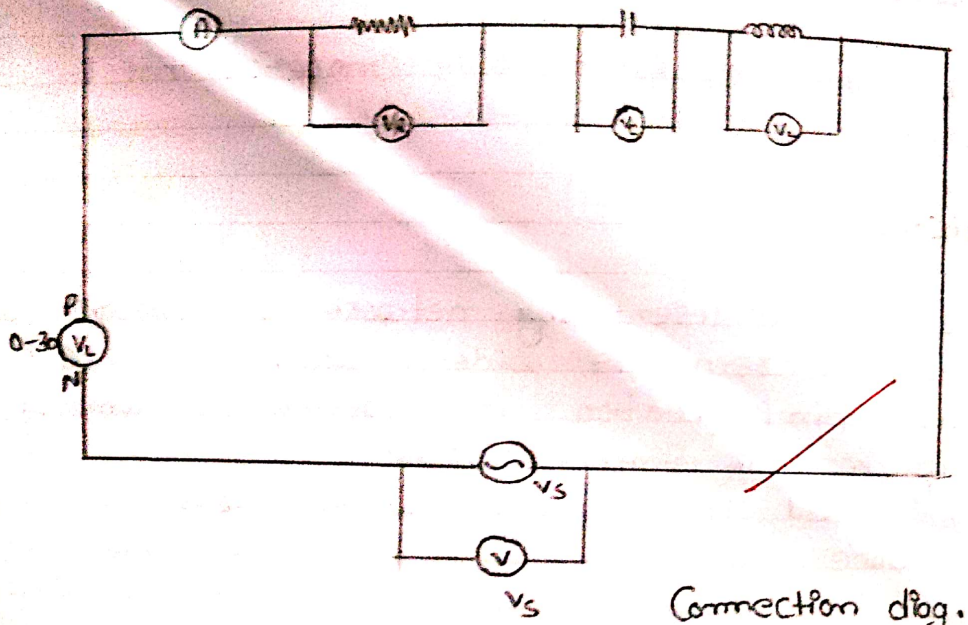
circuit diagram Containing R ohm, L and C farads Connected in wire

let the Current flowing through circuit to be of 1A and Supply freq. f (Hz)

Voltage drop across $V_R = IR$ in Phase with I

Voltage drop across $V_L = I\omega l$ leading I by $\pi/2$ rad.

voltage drop across $V_c = \frac{I}{\omega c}$ lagging behind I by $\frac{\pi}{2}$ rad.



Connection diag.

OBSERVATION

S.No.	V_S	I	V_L	V_C	V_R
1	20.42	6.74	1.2	19.8	6.7
2	23.9	6.8	1.2	23.4	6.8
3	25.5	7.2	0.9	25	7.2
4	25.1	7.4	0.9	25.1	7.4
5	25.4	7.1	0.9	24.6	7.1
6	26.5	7.1	0.9	24.6	7.4

The applied voltage V, being equal to Phasor Sum of V_R, V_L & V_C is magnitude by

$$V = \sqrt{(V_R)^2 + (V_L - V_C)^2}$$

$$V = \sqrt{(IR)^2 + (IX_L - IX_C)^2}$$

$$V = I\sqrt{(R)^2 + (X_L - X_C)^2}$$

The term $\sqrt{(R)^2 + (X_L - X_C)^2}$ is known as impedance represented by Z. Unit is ohms

Phase angle ϕ Blw V & I is given by

$$\phi = \tan^{-1}\left(\frac{V_L - V_C}{V_R}\right)$$

$$\phi = \tan^{-1}\left(\frac{IX_L - IX_C}{IR}\right)$$

$$\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$$

$$\phi = \tan^{-1}\left(\frac{X}{R}\right)$$

ϕ will be (+)ve i.e. applied V will lead I if $X_L > X_C$

Power factor is given by

$$\cos\phi = \frac{R}{Z} = \frac{R}{\sqrt{R^2 + (X_L - X_C)^2}}$$

Power Consumed in, circuit $P = I^2R$ or $V' \cos\phi$

Procedure

Step 1. make the Comection Keep Potentiometer at their max. value to Keep Source V at its lowest value

Connect ammeter and voltmeters as of their polarities

Step 2. Switch on the Supply, set the certain values of V with the help of Potentiometer.

Step 3 Note reading from ammeter and voltmeter.

Step 4. for another set of reading, Charge voltage at source with the help of Potentiometer and repeat Step 4

Step 5: Switch off the Supply. disconnect circuit safely

Result

From the table it is observed that the different parameter of series R-L-C circuit. are found. The diff. values of Power factor are almost same for each set of observation.

Precaution

1. Check all the resistances, inductors and capacitors properly.
2. Connections Should be tight and Correct
3. use Correct range the instrument only. for letter result.
4. Before Connecting the Ac Supply the zero reading of ammeter and voltmeter Should be checked

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DATE
PAGE

Experiment :- 07

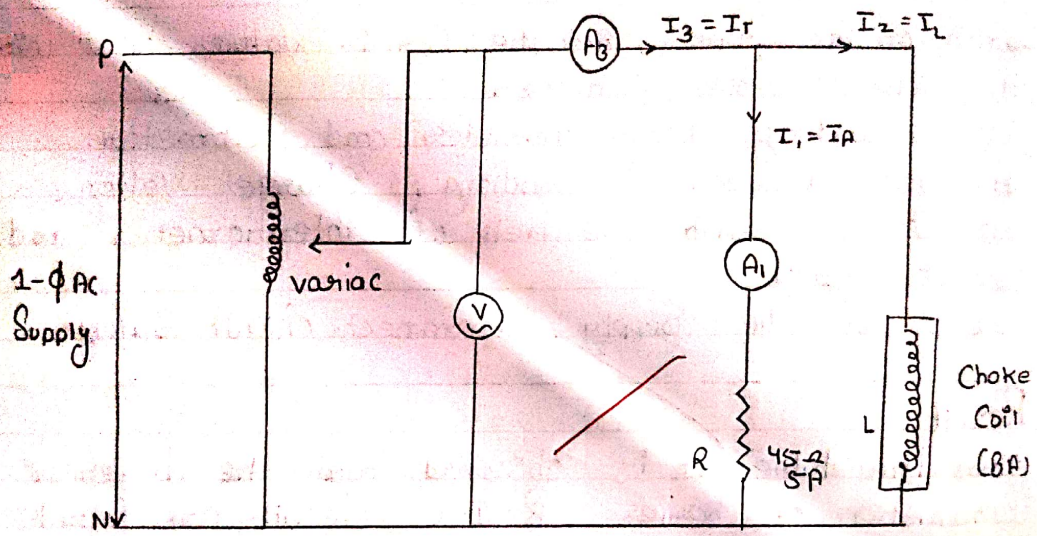
Aim :- Measurement of Power and Power factor of Single Phase using 3 ammeter method

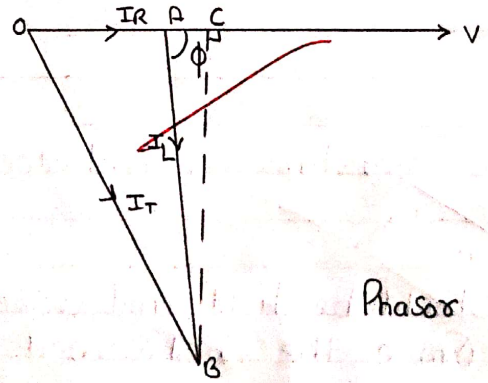
Apparatus Required

S.No	Name of the equipment	Range type	Quantity
1.	Single phase Ac Supply	230V, 6A, 50Hz	01
2.	MCB	32A / DPST	01
3.	Autotransformer	0-260V, 20A	01
4.	Rheostat	45Ω, 5A	01
5.	Choke coil	230V, 3A/6A	01
6.	Voltmeter	0-300V	01
7.	Ammeter	30A / 10A	01+02
8.	Connecting Leads	SWG	As reqd.

Theory

Parallel circuits are more often used because multiple system of transmission and distribution are extensively used nowdays. The total line current supplied to the circuit is equal to the phasor sum of branch currents. the total line current supplied to a parallel circuit may be determined by determining the currents in each branch and adding them taking into account their phase relation or by determining equi impedance





Phasor Diagram

DATE
PAGE

The Power Cos Consumed by the inductive load is

$$P = V I \cos\phi = V I_L \cos\phi \quad \text{—— (i)}$$

Therefore, unlike for a Dc circuit it is not Possible to find Power in Ac Circuit. However it is Possible to measure Power in an Ac Circuit by using 3- Ammeter

Phasor diagram for Ac Circuit Shows that the Current I_R through the Rheostat is in phase with the applied voltage V, the Current I_L through inductive load lags the voltage by angle ϕ,

$$I_T^2 = I_R^2 + I_L^2 + 2 I_R I_L \cos\phi \quad \text{—— (ii)}$$

Therefore Power, $PF = \cos\phi = \left(\frac{I_T^2 - (I_R^2 + I_L^2)}{2 I_R I_L} \right)$ —— (iii)

From eq (i) $I_L \cos\phi = \frac{P}{V}$ —— (iv)

Putting the value of $I_L \cos\phi$ in eq (ii)

$$I_T^2 = I_R^2 + I_L^2 + \left(\frac{2 I_R P}{V} \right)$$

Thus Power Consumed

$$P = [I_T^2 - (I_R^2 + I_L^2)] \times \frac{V}{2 I_R}$$

Procedure

1. Connections Should be Checked by the lab faculty Before Switch on.

S.NO.	Resistance Value (R)	App. Voltage	Current Drawon By circuit (I_T)	Current Drawon By Resistive (I_R)	Current load By Inductive load (I_L)
1.	45	50	1.5	1	0.8
2.	45	100	2.9	2.2	1.6
3.	45	150	4.8	3.4	2.4

S.NO.	Power factor $\cos\phi = \theta$ $\left[\frac{I_T^2 - (I_R^2 + I_L^2)}{2 I_R I_L}\right]$	Power Consumed $P = \omega$ $\left[I_T^2 - (I_R^2 + I_L^2) \times \frac{V}{2 I_R}\right]$
1.	0.388	15.29
2.	0.14	22.95
3.	0.35	126.17

1 Power factor $= \frac{(1.5)^2 - (1^2 + 0.8^2)}{2(1)(0.8)} = \frac{0.61}{1.6} = 0.38$

Power Consumed $= 1.5^2 - (1^2 + 0.8^2) \times \frac{50}{2 \times 1} = 15.25\ \omega$

2. Power factor $= \frac{2.9^2 - (2.2^2 + 1.6^2)}{2(2.2)(1.6)} = \frac{1.01}{7.04} = 0.14$

Power Consumed $= 2.9^2 - (2.2^2 + 1.6)^2 \times \frac{100}{2 \times 2.2}$

$= \frac{101}{4.4} = 22.95\ \omega$

DATE
PAGE

2. Set the Variac at 0 voltage output and Switch on the Ac Supply
3. Change the Supply voltage with the help of variacs. So that Some observation Readings are obtained.
4. Note down Readings
5. Change the position of Variac and Repeat the Step for Diff. Set of Reading
6. Switch off the Supply, disconnect the circuit Safely.

Result

On Changing the Power Supply voltage the Power Consumed By the induction load also Changes But, for all Sets of Readings, the values of Power factor have minor Changes.

Precaution

1. while taking the diff. Readings Care Should be taken that Current Recorded By the ammeters Does not Exceed 5A, the Current Rating of Rheostat
2. Before Switching on the Readings of voltmeter and ammeter Should be Checked

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DATE
PAGE

Experiment

Aim

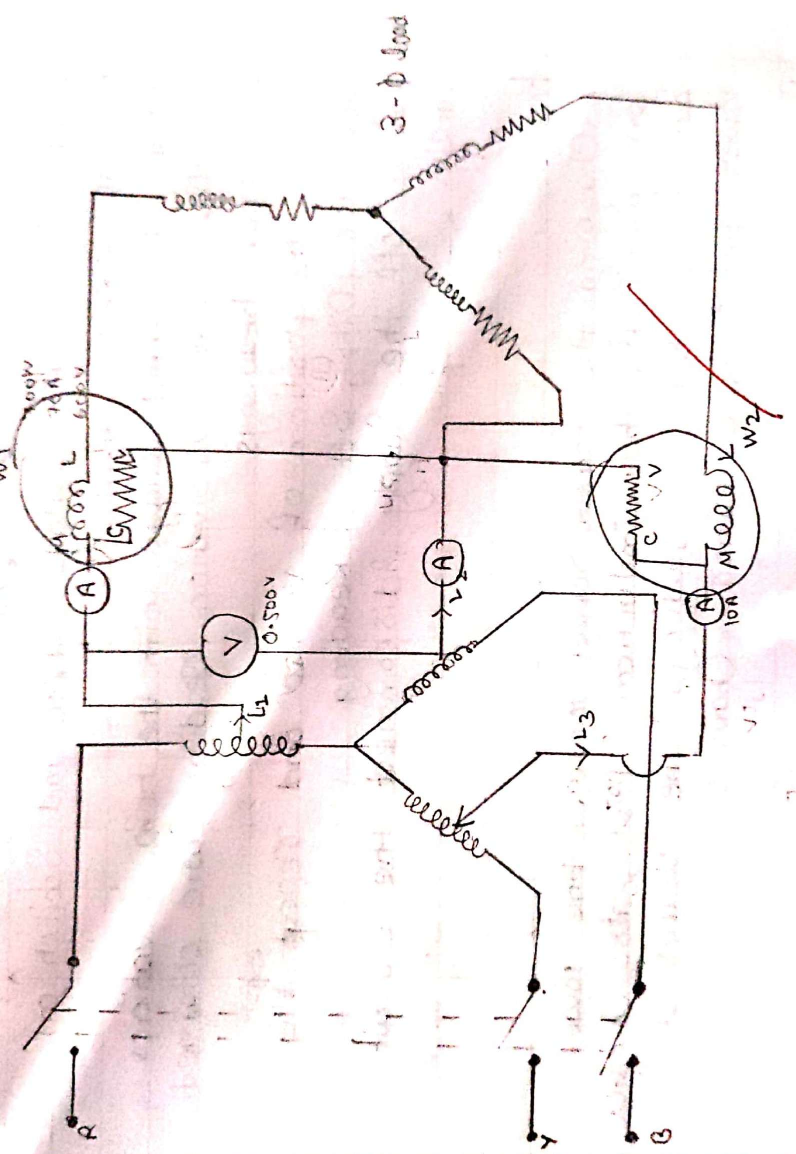
To measure Power and Power factor in a Balanced 3-Phase circuit using 2 Single-Phase wattmeter (2-wattmeter method)

Apparatus Required

S.No.	Name of the Equipment	Range/Type	Quantity
1.	Three-Phase AC Supply	415V	01
2.	MCB	63A/TPN	01
3.	Three-Phase Autotransformer	0-470V	01
4.	Three-phase Resistive load	5KW, 415V, 7A	01
5.	Three-Phase Inductive load	6A, 230V	01
6.	Voltmeter	0-600V	01
7.	Ammeter	10A-20A	01
8.	wattmeter	7000, 600V, 10A	02
9.	Connecting loads	S.W.G	As Req'd.

Theory

Surprisingly, only Single-Phase wattmeters are sufficient to measure the Power factor and total Power in Balanced 3-Phase load. the Current Coils of wattmeters are Connected in Series with Any 2-Phase Say R and Y the voltage Coils of 2



DATE
PAGE

Wattmeter are Connected Blw that phases and third line. if ω_1 and ω_2 are reading the total Consumed by the 3-phase loads is

$$P = \omega_1 + \omega_2$$

The phase Single angle of the load Can be Calculated

$$\tan\phi = \sqrt{3}\left\{\frac{(\omega_1 - \omega_2)}{(\omega_1 + \omega_2)}\right\}$$

$$\text{or } \phi = \tan^{-1}\sqrt{3}\left\{\frac{(\omega_1 - \omega_2)}{(\omega_1 + \omega_2)}\right\}$$

Then Power factor is given as

$$PF = \cos\phi$$

if V_L & I_L are the line voltage and Current for Balanced load the total Power is given as

$$P = V_L I_L \cos\phi$$

Procedure

1. Make the Connections as Shown Connect wattmeter Ammeter and voltmeter Correctly as of their Polarities and properly Choose the Current and Voltage Range of wattmeter.
2. Keep the 3-ϕ variac at 0 voltage with the output and Switch on the 3ϕ AC Supply.
3. Graadudly increase the Ac voltage with the help of 3ϕ variac till the meters give enough deflection (415 V)

OBSERVATION

S.no	Line Voltage (V_L)	Line Current (I_L)	Power through RY $W_1 \times 8$	Power through YB $W_2 \times 8$	Load	P(W_1+W_2) Total
1	418	0.7	45×8	46×8	$1 \times \frac{3.75}{6}$	728
2	418	1.7	87×8	90×8	$2 \times \frac{3.75}{6}$	1416
3	418	2.7	135×8	125×8	$3 \times \frac{3.75}{6}$	2080
4	418	3.6	178×8	165×8	$4 \times \frac{3.75}{6}$	2704
5	418	4.5	225×8	207×8	$5 \times \frac{3.75}{6}$	3456
6	418	5.75	275×8	250×8	$6 \times \frac{3.75}{6}$	4200

Calculations

S.No	$\phi = \tan^{-1}\sqrt{3}\left[\frac{(W_1-W_2)}{(W_1+W_2)}\right]$ Phase angle	Power factor $\cos\phi$	Power $P = \sqrt{3} V_L I_L \cos\phi$
1	1.09	0.99	501.71
2	1.66	0.99	1218.45
3	3.81	0.99	1935.18
4	3.75	0.99	2580.25
5	4.13	0.99	3225.31

4. Put Some Value of load with inductive Coil
5. Note the Reading of voltmeter, ammeter and 2 ammeter
6. Increase the value of inductive load By Change the position of Switch on inductive load.
7. Switch off the Supply and Disconnect the circuit

Result

The Power and Power factor of 3-Phase circuit has Been Calculated By 2-wattmeter method And total Power Calculated By 2-wattmeters method and V-I method is approx Same

Precautions

1. The Reading in ammeter Should not exceed the Current Ratings of wattmeter and load used.
2. Before Switching on Ac Supply the zero Reading of voltmeter and ammeter Should be Checked.
3. Connections Should be tight and Correct
4. meter of Proper Range and type Should be Selected

DDD

DATE
PAGE

Experiment

Aim

To study and Perform Starting and Reversing of the three Phase Induction motor

Apparatus Required

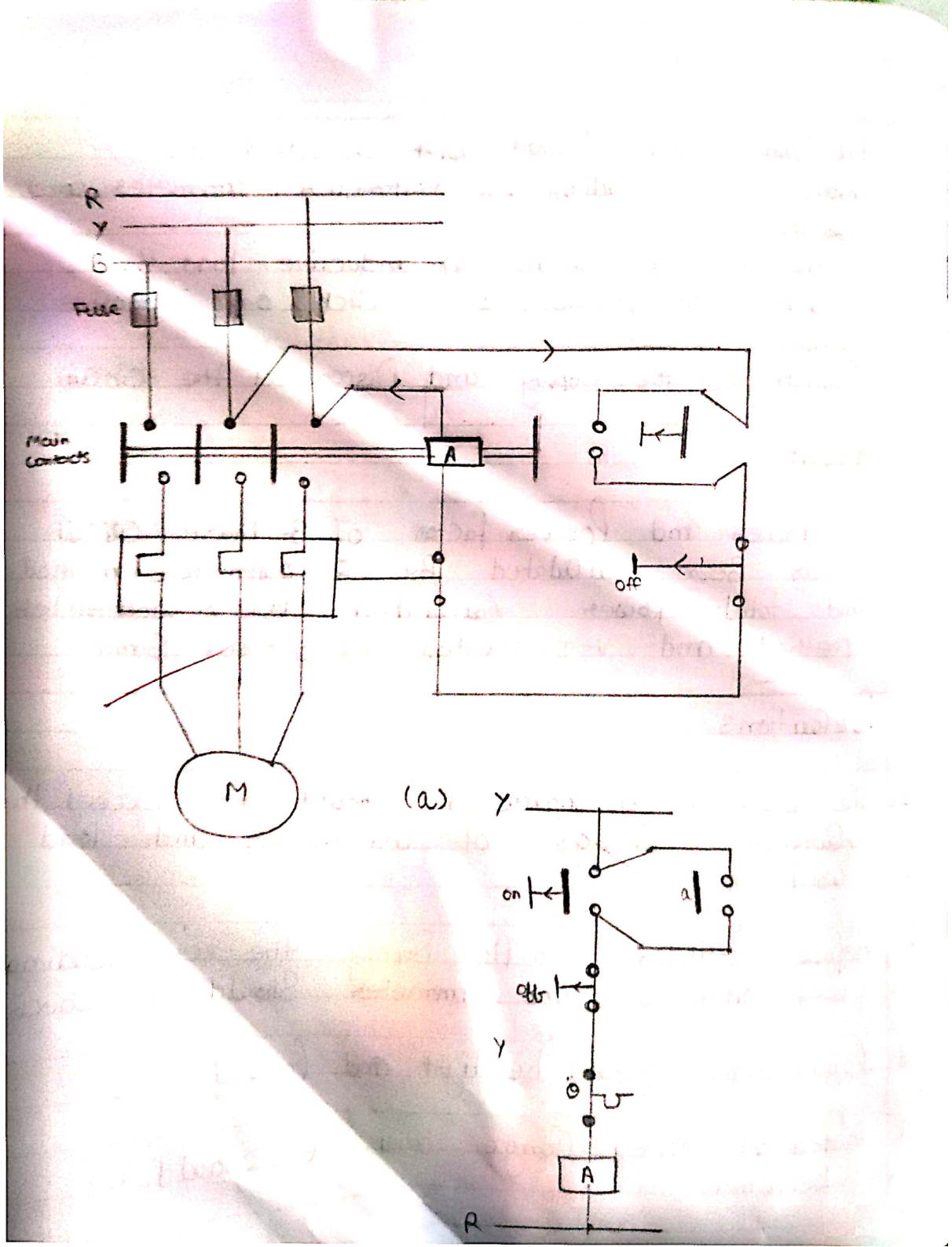
S.No.	Name of the equipment	Range/type	Quantity
1.	3-ϕ Induction Motor	1.5KW, 415V, 3.8A	01
2.	3-ϕ AC Supply	415V	01
3.	Ammeter	0-5A	01
4.	Voltmeter	0-500V	01
5.	Direct-on-line Starter		01
6.	Phase Sequence indicator	25-60HZ, 50-600V	01
7.	LT Control Switch	16-A, 415V	01
8.	Digital tacho meter		01
9.	MCB	63A, TPN	01
10.	Connecting wire	S.W.G	As Read.

Theory

Two Major problems in starting an induction motor:

i) Low starting torque
ii) Heavy starting current for a short duration.

As Induction motor having a low-resistance rotor, such as the usual type of squirrel-cage rotor,



DATE
PAGE

the starting torque is small compared to max. torque available. However, if the bars of cage rotor were made sufficiently high resistance to give a high starting torque.

First, the I^2R loss in rotor would be high causing excessive heating & reduced efficiency of the motor.

Second, the variation of speed with load would be quite large.

Procedure

1. Make the connection as shown.
2. Check the connection of DOL starter, phase sequence indicator & over current relay.
3. Switch on the 3-phase supply (415V)
4. Increase the value of 3ϕ ac supply by 3ϕ variac & fix it at 415V.
5. Start the motor with the help of DOL starter.
6. Note readings of rotor, terminal V, current and speed of the motor.
7. For diff. readings, change the value of 3ϕ ac voltage by 3ϕ ac variac.
8. Now turn off the motor to stop the rotor.
9. Interchange any of the 2 phases.
10. Switch off the 3-phase supply & disconnect the circuit safely.

Observation

Power Drawn = 2hp
Speed = 1420rpm
Voltage = 415 V
Current Drawn = 3.8A
Load = 1.5 Kloh
Frequency = 50 Hz
Efficiency = 77%
Connection = Star (Y)

S. No	Direction of motion of rotor	Source Voltage	Current drawn	Speed (N) rpm
1.	Clockwise	425V	2.5A	1482 rpm
2.	Anti-clockwise	425V	2.5A	1482 rpm

DATE
PAGE

Result

We learnt the diff. methods of starting of 3 phase induction motor & how it runs in reverse direction as we interchange the any of 2 phases connected with the motor. Speed control of 3 phases induction motor by varying the source voltage.

Precautions

1. The readings in ammeter shouldn't exceed the current reading of induction motor.
2. Record the values of speed by tachometer carefully,
3. Special care should be taken abt. the sign of phase sequence indicator.