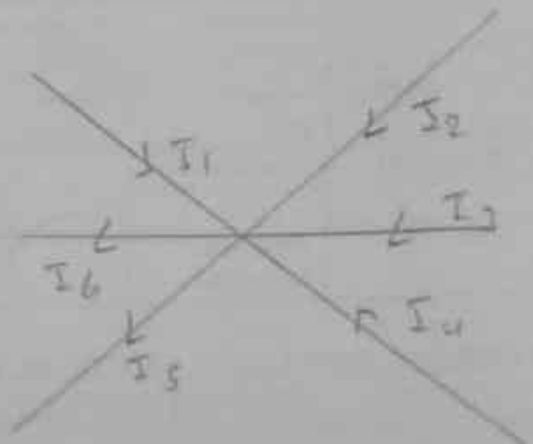
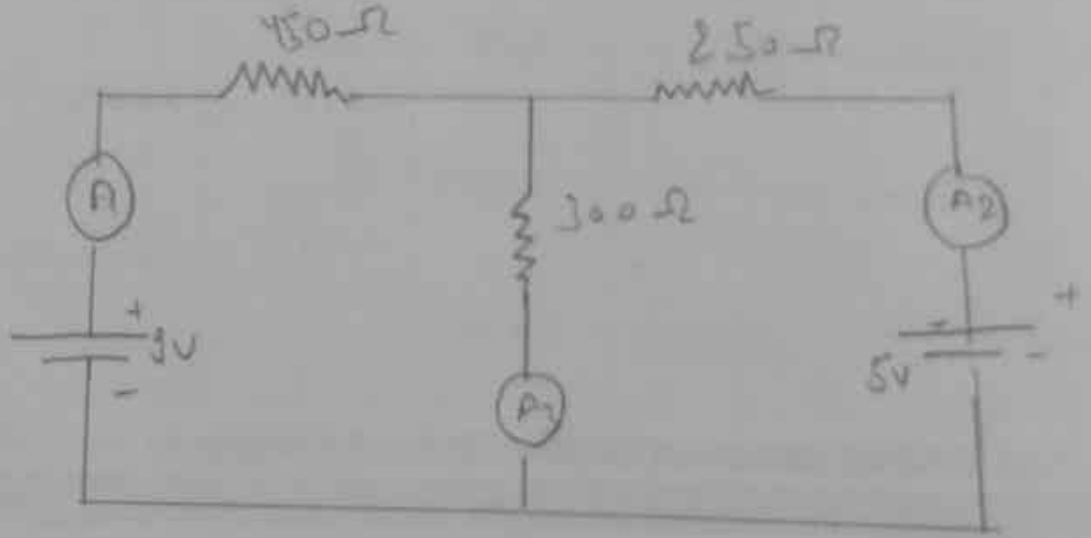
Topic _____ Date _____

S.No.	Experiment Discription	Experiment Date	Submission Date	Remarks Signature
1.	To prepare a job for facing, Turning, Knurling, Tapper, Grooving and Threading as per drawing.	15-04-2021		
2.	To prepare a T-Shape and U-shape workpiece by filling, Sawing, Drilling, grinding, in fitting shop.	22-04-2021		
3.	To Cast a Component using a single piece pattern in foundry shop.	29-04-2021		
4.	To study the G-M Codes for CNC machine and to perform different machining operations including facing, turning, grooving, etc, on CNC lathe	06-05-2021		
5.	To cut a slot on CNC milling machine as per given drawing.	27-05-2021		
6.	To make a hole given diameter on CNC drilling machine.	3-06-2021		

Topic _____ Date _____

S.No.	Experiment Discription	Experiment Date	Submission Date	Remarks / Signature
7.	To study the Construction and working of FDM 3D printing machine.	17-06-2021		
8.	To study construction and working of SLA 3D printing machine.	24-06-2021		
9.	To study the development of drawing using 3D scanner.	01-07-2021		
10.	To study plastic processing with injection moulding method.	08-08-2021		


I1
I2
I3
I4
I5
I6


450Ω
250Ω
300Ω
A
A1
A2
9V
5V
+
-

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Experiment No: 1

Objective:- Verification of Kirchoff's Law.

Apparatus required:

No.	Apparatus	Type	Specification/Range	QTY
-	Experimental Board			1
-	Power Supply	DC	3V 15V	1
	Voltmeter.	DC	0-15V	1
-	Ammeter.	DC	0-100mA	1
	Connecting wires.			

Theory:

- Kirchoff's current Law:
In State that the total algebraic sum of current not meeting at the junction is zero. This law is based on the principle of conservation of charges.

KCL at junction "O"

$I_1 + I_2 + I_3 + I_4 - I_5 - I_6 = 0$

Teacher's Signature .....

S.No.	I_1 (mA) Paractically	I_2 (mA) Practically	I_3 (mA) Practically	I_3 (mA) calculated	$I_3 = I_2 + I_1$
1-	10 mA	3 mA	13 mA	13.65 mA	13 mA.

calculations:

$450 I_1 + 300 I_3 = 9$ — (1)

$250 I_1 - 550 I_2 = -5$ — (2)

$I_1 = 10.6$ mA

$I_2 = -3.125$ mA

$I_3 = 13.85$ mA

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i.e. $I_1 + I_2 + I_3 + I_4 = I_5 + I_6$

Procedure :-

(i) Connect the circuit as shown in circuit diagram.
(ii) Switch on the power supply.
(iii) Note the reading of ammeters.

Calculation of current I_3

$I_3 = I_2 + I_1$

Precautions :-

(i) All the connections should be tight.
(ii) Before connecting the instruments check their zero reading.
(iii) The terminal of resistance should be properly connected.

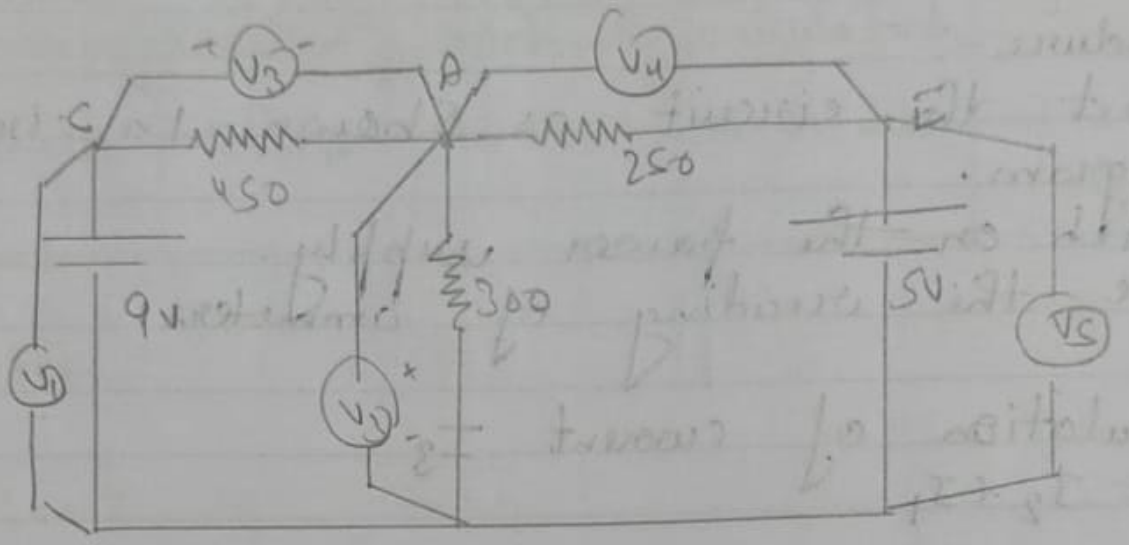
Result :-

Add the reading of Ammeter 1 (A_1) and Ammeter 2 (A_2) and it will be equal to reading of ammeter 3 (A_3).

$I_3 = I_2 + I_1$

KCL is verified.

Teacher's Signature .....


C
A
E
V3
V4
450
250
300
9V
5V
V5
V2
V1

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Kirchoff's voltage Law :-

It States that the algebraic sum of voltage thorough a closed loop is zero. This law is based on the principle of conservation of energy.

$$\sum_{i=1}^{k} v_i = 0$$

$$\sum_{i=1}^{k} v_i + \sum IR = 0$$

Procedure :-

(i) Connect the circuit as shown in the circuit diagram.
(ii) Switch on the power supply.
(iii) Note the reading of voltmeter V_1, V_2, V_3, V_4, V_5 (with both polarity).

Precautions :-

(i) All connections should be tight
(ii) Before connecting the instruments check their zero reading.
(iii) The terminals of resistance should be properly connected.

Teacher's Signature .....

S.No.	V_1 (Volt) practically	V_2 (Volt) Practically	V_3 (Volt) Practically	$V_3 + V_2 + V_1$
1.	9V	-4.8V	-4.2V	-4.2 -4.8 +9 = 0
2.	V_3 (Volt) -4.1V	V_4 (Volt) -0.8	V_5 (Volt) 5V	$V_3 + V_4 - V_5$ -0.1

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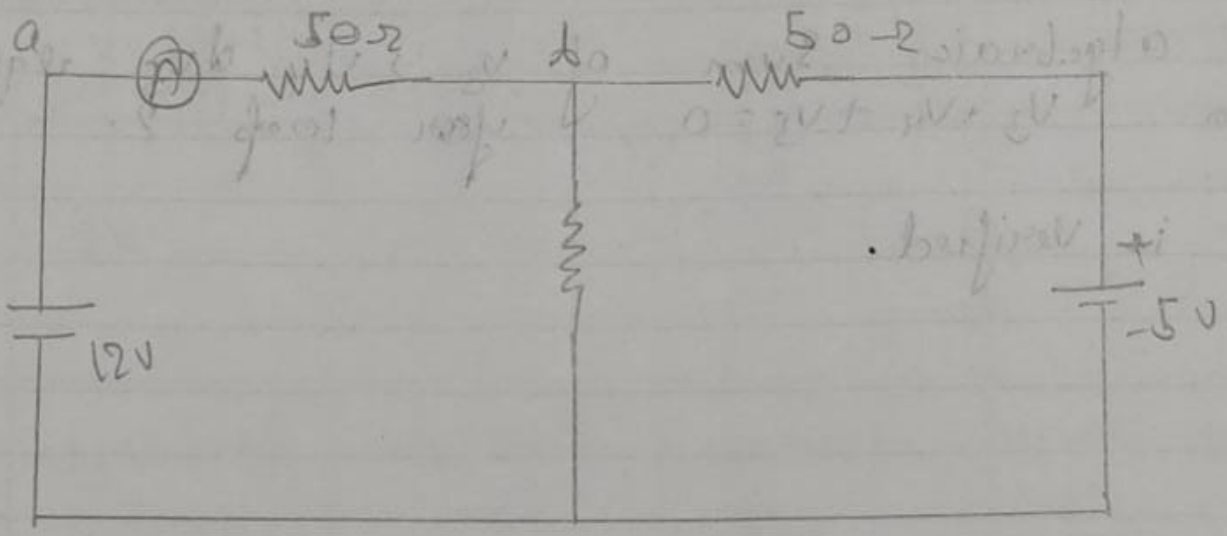
Result :-

The algebraic sum of V_1, V_2, V_3 equals to zero $V_3 + V_2 + V_1 = 0$ for loop 1.

The algebraic sum of V_3, V_4 & V_5 equals to zero $V_3 + V_4 + V_5 = 0$ for loop 2.

KVL is verified.

Teacher's Signature .....


a
A
50Ω
b
50Ω
12V
-5V

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Experiment No. 2

Objective :- Verification of Superposition theorem.

Apparatus required:

S.No.	Instruments	Type	Range/specification	Qty.
1-	Supply	DC	0-12V	1
2-	Experimental board			1
3-	Voltmeter	MC	0-15V	1
4-	Ammeter	MC	0-10mA	1
5-	Resistance	CFR/MFR	50Ω	2
6-	Resistance	CFR/MFR	50Ω	1
7-	Connecting leads.		As required.	

Theory :-

This theorem states that in a linear bilateral network containing several sources the overall response at any point in the network equal the sum of the responses of each individual sources considered

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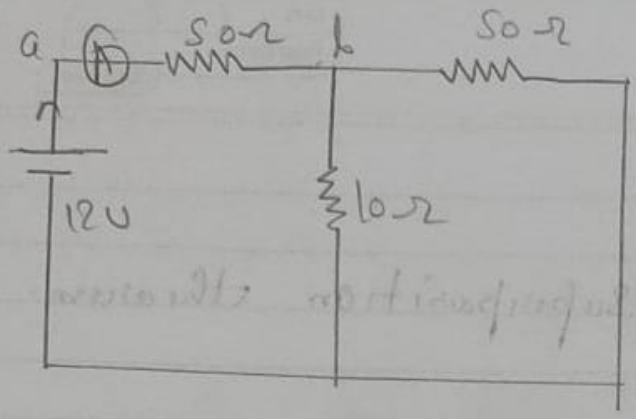

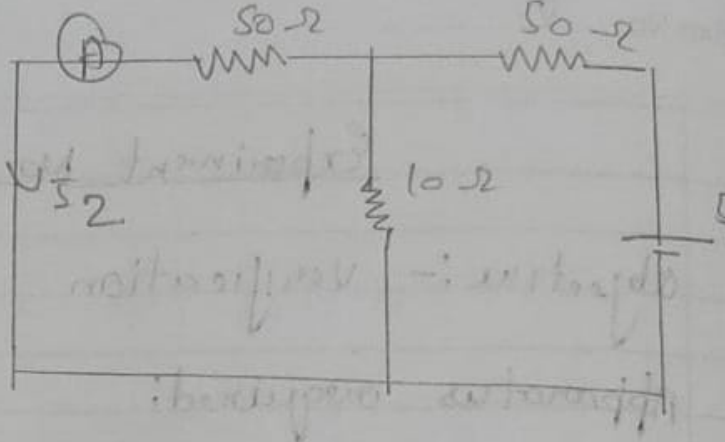

S.No	Current 'I' (mA) practically C.K.T diagram	current I_1 (mA) Branch	Current I_2 (mA) practically	$I = I_1 + I_2$ (Loop Eqn)
1	170 mA	180 mA	-10 mA	180 - 10 = 170 mA

calculations:

$60I_1 - 10I_2 = 12$ — (i) and $60I_2 + 5 = 10I_1$ — (ii)

$I_1 = 0.190\ A = 190\ mA$

$60I_1' - 10I_2' = 12$ — (i)

$I_1' = 0.205\ A$

$I_1' = 205\ mA$

$I_1' = 6I_2'$

$I_2 = -14\ mA$

$I_1 = I_1' + I_2'$

$191\ mA = 205\ mA - 14\ mA$

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Separately with all other sources made inoperative i.e replaced by resistances equal to their internal resistance.

Procedure :-
Short circuit the terminals
Connect the 12V supply with terminal
Connect the ammeter V in series with branch
observe the reading of ammeter " I_1 ".
Again short circuit the terminals having an ammeter in series.
Connect 5V supply with terminal
Observe the reading of ammeter " I_2 ".

Precaution :-
Do not make interconnection on the board with mains switched ON.
As soon as mains is ON the reading in the meters must be zero. If the reading in the meter is not zero check the meter.

Result :-
The net current I is the algebraic sum of I_1 & I_2 due to individual voltage source taking one at a time $I = I_1 + I_2$

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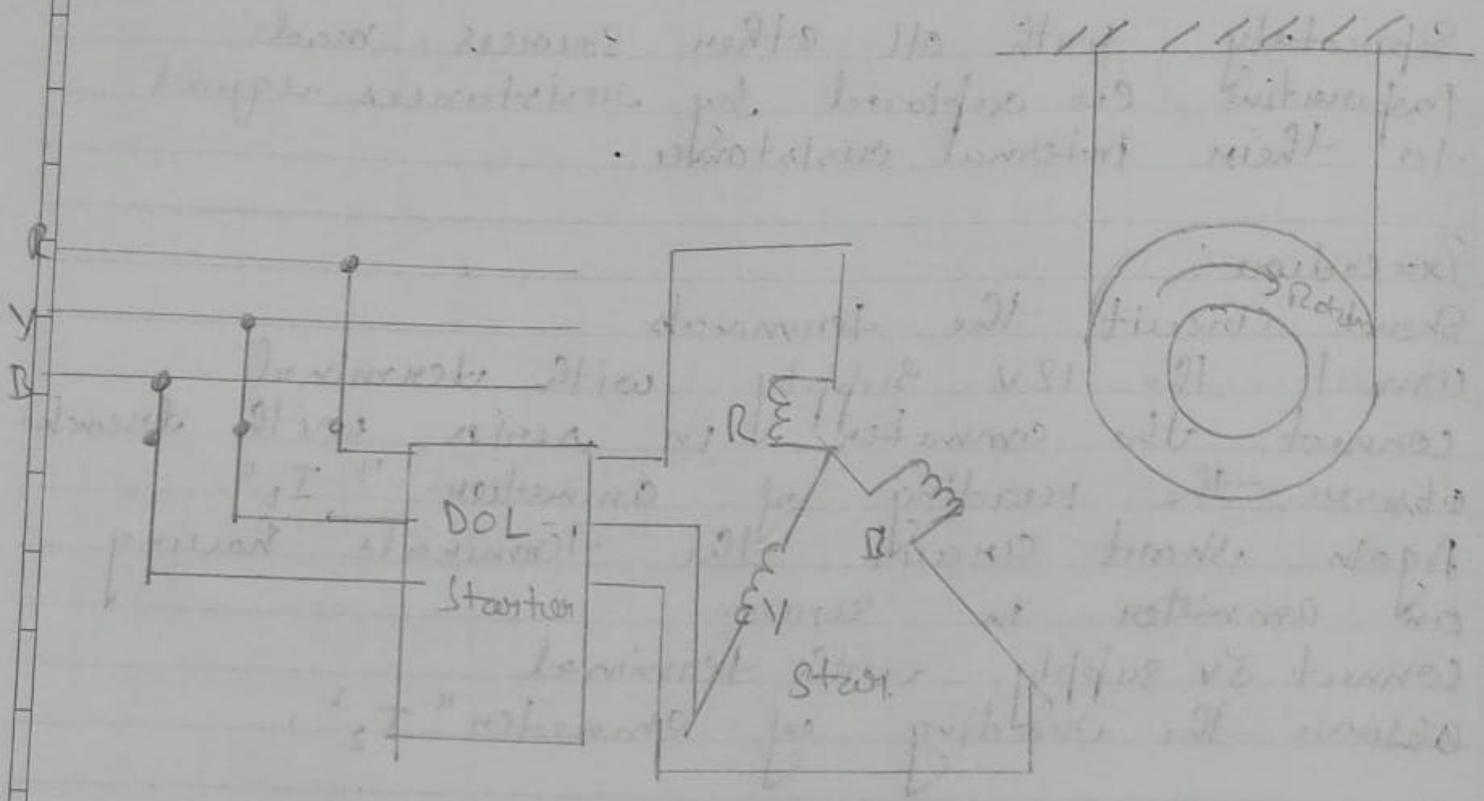

Circuit diagram for running of Induction motor.

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Experiment - 3

Objective :- To study the running and speed reversal of a three - phase induction motor and record speed in both direction.

Apparatus used :-

S.No	Equipment	Type	Signification	Qty.
1-	3-phase induction motor.	Squirrel cage	3-phase, 415V 1440 r.p.m.	1
2-	DOL starter			1
3-	Tachometer.	Digital	(0-10000) r.p.m.	1

Theary :-

Three phase Induction motor :-

A machine that converts 3-phase a.c. electrical power into mechanical power by using an electromagnetic induction phenomenon is called as three phase induction motor.

The 3-phase IM are usually built in small size. They are most common used a.c. motor used in industery because they have simple & rugged construction, low cost, high efficiency, reasonably good power factor, self-starting and

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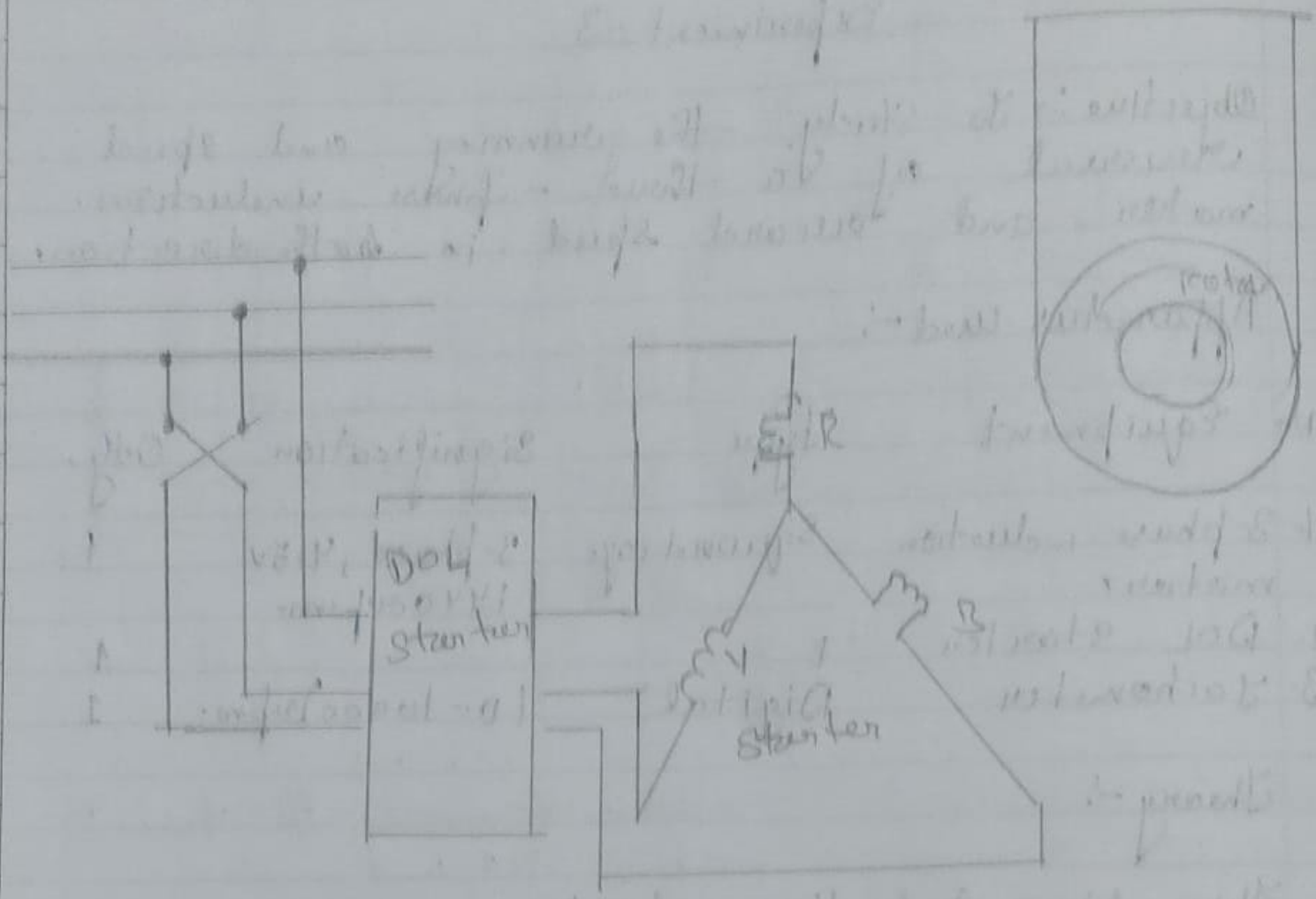

Circuit Diagram for Reversing the Direction of Induction motor.

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low maintenance. Almost 90% of mechanical power used in industry is provided by 3-phase induction motor.

Working Principle:-
At starting stationary rotor conductor cuts across the revolving magnetic field produced by the stator & an e.m.f. is induced in them by electromagnetic induction phenomenon. Current flows through the rotor conductors as they are short circuited and produce rotor field. By the interaction of rotor & stator magnetic field torque develops & rotor start rotating in the direction of applied field.

Type of Induction Motor:
According to the construction of the rotor, there are two types of induction motors namely:
Squirrel Cage Induction motor.
Slip ring or wound rotor type Induction Motor.

Starter:
A device used the limit the in rush flow of current at start is known as starter. In this experiment we are going the use

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S.No.	Voltage (V)	Current (AMP)	R.P.M	Remarks
1.	400 V	2.3A	1501	F/O - Clockwise
2.	400 V	2.4A	1501	F/O - Anti clockwise

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In this experiment we are going to use "Direct on line starter" to start the three phase I M.

Starting of Three - Phase Induction Motors:
At starting 3 phase Induction motor takes 5-7 times of full load current & starting torque being 1.5 to 2.5 times of full load torque. Due to this high current the winding of motor & instruments may burn. A starter is used to keep current with in reasonable limits of three phase induction motor, otherwise large starting current may cause undesirable voltage dip in the supply.

Direct on line starter:
A DOL starter essentially consists of a contactor having four normally open (N.O) contacts and a conteactor coil also known as no-volt coil. There are two push buttons ON and OFF which are used to start and stop the motor. To protect motor against over load, thermal or magnetic over load coils are connected in each phase.
To start the motor, the ON push button is pressed which energizes the no-volt coil pulls it plunger in such a direction

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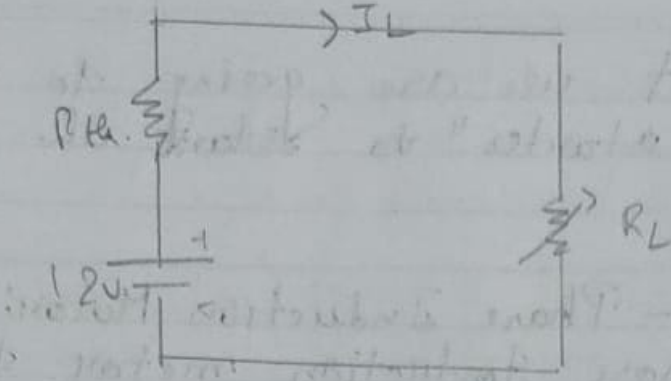
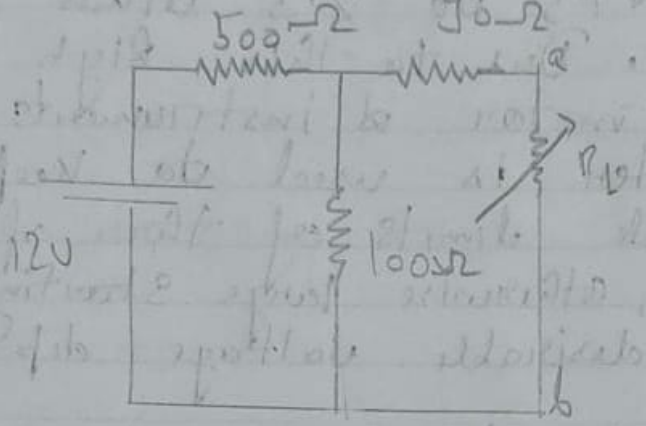
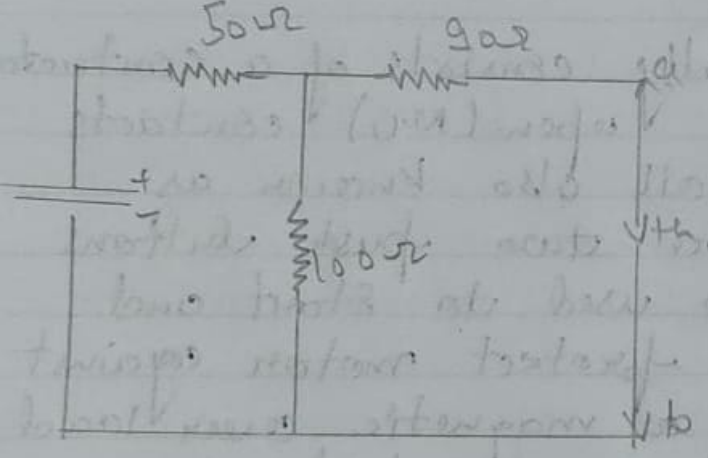
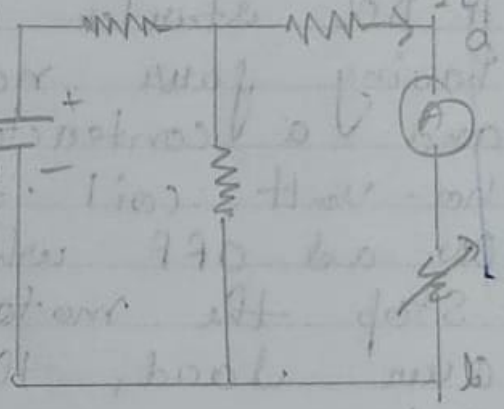


Circuit diagram







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that all the normally open (N.O.) contacts are closed and the motor is connected across supply through three contact which keeps the no volt coil circuit even after the ON push button is released. To stop the motor, OFF push button is pressed momentarily which de-energizes the no-volt coil opening the main contacts.

When the motor is over loaded, the thermal overload relay contact, connected in control circuit opens thus disconnecting the no-volt relay from the supply. Overload protection is achived by thermal element overload relay. This starter is used only for under 5 H.P. motor.

Reversal of direction of rotation of induction motor:

The direction of rotation of Induction motor can be changed by changing the phase sequence of the supply to the stator as by changing the phase sequence, I.M torque is reversed due to reversal of phase sequence rotating in opposite direction. The phase sequence can be changed by interchanging any two supply wires i.e. R-Y-B is changed to R-B-Y. is changed

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to R-B-Y.

Procedure:

(i) Connect the circuit as shown in the circuit diagram.
(ii) First see put the starter to start position when it gains approx 80% to 90% of their rated speed throw it to the run position.
(iii) Load the machine by tightening the belt till this rated current start flowing.
(iv) Interchange the connection of any two phase & then repeat the above procedure.

Precautions:

(i) All the connections should be tight.
(ii) Never touch the live terminal during experiment.
(iii) Before changing the connection, switch off supply properly.
(iv) Increase the load carefully.
(v) Always use the starter of proper rating.
(vi) Always wear shoes when working in lab.
(vii) Make proper contact when measuring the speed with Tachometer.

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Result:

(i) The induction Motor starting using DOL starter is carried out.

(ii) It also found that when any two of the phases of three phase supply is interchanged, then the direction of rotation is reversed but magnitude remains the same.

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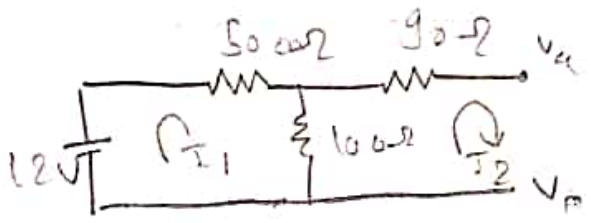
S.NO	V_{AB} - Practical	V_{th} theoretical	R_{th} computed	R_L	I_L measured	$I_L = \frac{V_{th}}{R_{th}+R_L}$
1.	2V	2V	173.3Ω	25Ω	9.75mA	10mA
2.	2V	2V	173.3Ω	50Ω	8mA	8mA
3.	2V	2V	173.3Ω	100Ω	6.2mA	6.3mA

Calculation

$$R_{th} = \frac{500 \times 100}{600} = 173.3\Omega.$$



$$V_a - 90 I_2 - 100(I_2 - I_1) = V_b$$

$$\Rightarrow V_{th} = V_a - V_b = 2V$$

$$I = \frac{V_{th}}{R_{th} + R_L} = \frac{2}{173.2 + 25} = 0.01$$

when $R_L = 50\Omega$

$$I = \frac{2}{173.3 + 50} = 0.008A$$

when $R_L = 100\Omega$

$$I = \frac{2}{173.3 + 100} = \frac{2}{273.3} = 0.007A$$

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Experiment No-4

Objective:- Verification of Thevinin's Theorem.

Appparatus Required:

SNo.	Instrument	Type	Range	Qnty
	Supply	DC	0-12V	1
	Experimental board			1
	Voltmeter	MC	0-15V	1
	Ammeter	MC	0-10mA	1
	Resistance	CFR/MFR	50Ω	2
	Resistance	CFR/MFR	10Ω	1
	Connecting Leads			As required.

Theary:

This theary provides a mathematical technique for replacing a two-terminal network by voltage source and resistance R_{th}. According to Thevenins theorem "Any linear network containing energy source and resistance can be replaced by an equivalent circuit consisting of voltage source V_{TH} in series with R_{TH}. The value of V_{TH} is the open circuit voltage between the terminals of network and R_{th} is resistance measured as a short ckt. While current

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Source treated as open ckt.
current across load resistance (R_L) is given by Eqn. $I_L = V_{th} / R_{th} + R_L$

where, V_{th} = open ckt voltage across the terminals
R_{th} = Eqn resistance across terminals
R_L = load resistance.

Procedure:-
(i) Connect the ckt according to fig (a); observe V_{AB}.
(ii) Connect the ckt according to fig (b); observe I_1

Precautions:
Do not make interconnection on board with main switched ON.
As soon as mains is ON, the reading in meter must be zero. If the reading is not zero, check the meter again.

We find that calculated value of load current "I_1" is equal to measured = "I_1".
I_1 (calculated) = I_1 (measured).

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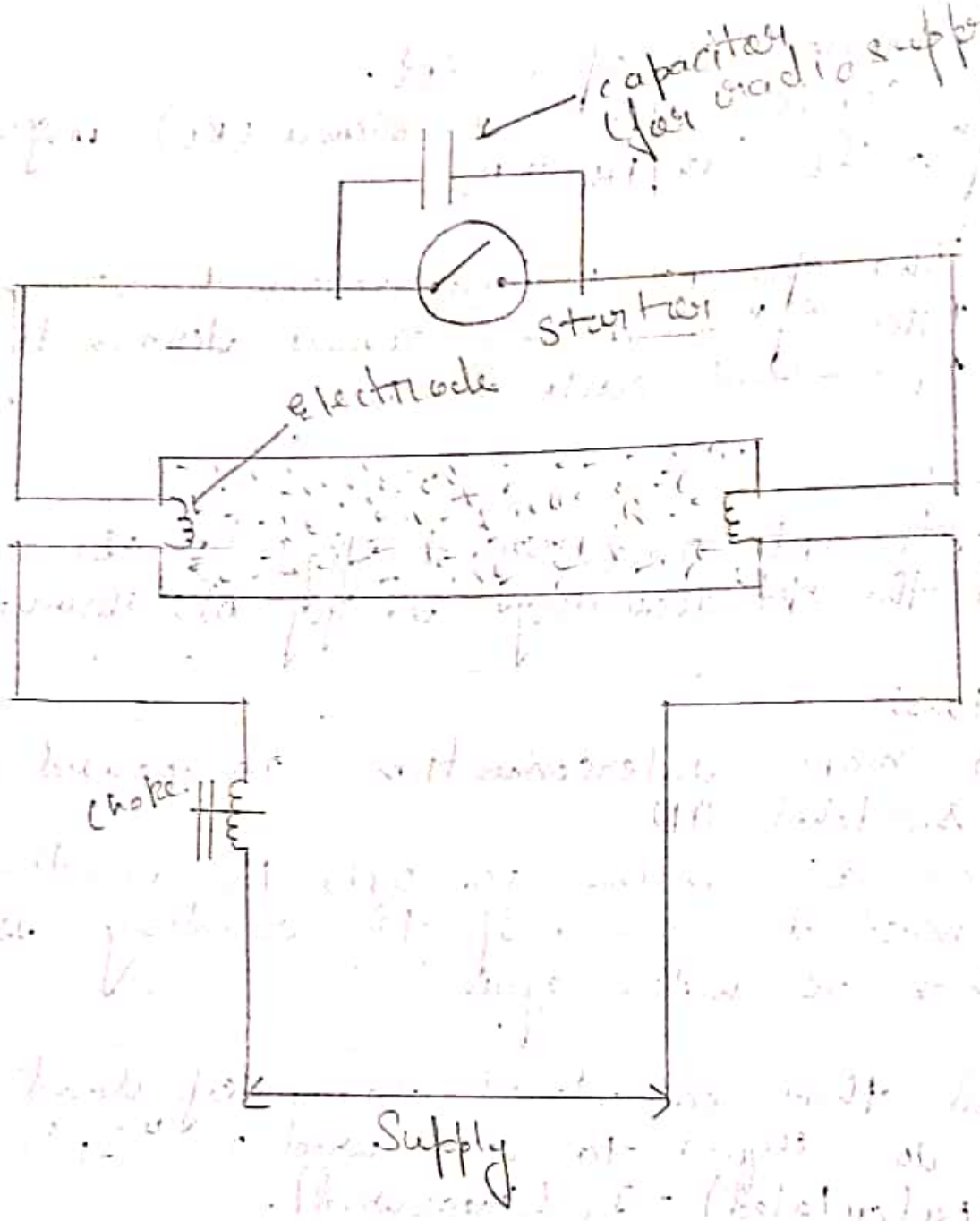

FLUORESCENT LAMP CIRCUIT

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electrodes is required for ionisation of gas and is caused by combined action of choke coil and starter. The arrangement of fluorescent lamp circuit is shown in the fig. 6

When fluorescent lamp is switched ON the starter makes and breaks the circuit rapidly resulting in high rate of change of current through choke and starter. The voltage across the choke is given as $e = L \frac{di}{dt}$ high rate of change of current through coil causes high voltage across choke and gas discharge starts. The resistance of ionized gaseous medium rapidly drops by it has negative resistance characteristics. The lamp tends to draw dangerously high current, but prevented by choke coil.

Result:

The working and operation of F.L. is studied. Power factor of FL is also measured, the choke coil in series with FL have very low power factor which is undesirable.

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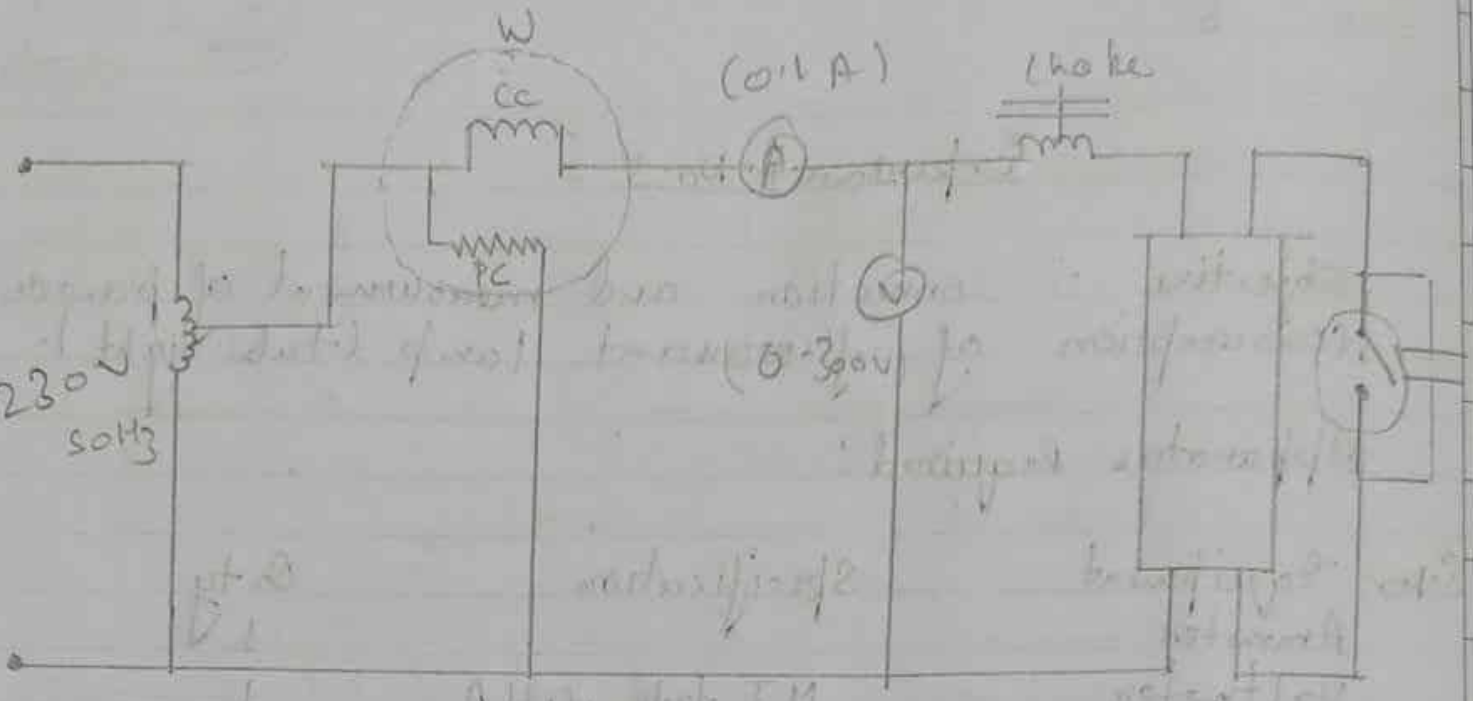

Circuit diagram for determine of Power factor of fluorescent lamp.

Power factor = $\cos\phi = \frac{P}{VI} = \frac{W}{V \times A}$

Voltage across FL (V)	Current Drawn By FL (A)	Power consumed	P.f = $\frac{W}{V \times A}$
220V	0.66 A	80W	$\frac{80}{220 \times 0.66} = 0.54$

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Experiment – 6

Objective :- Measurement of Power and power factor in a Single phase AC series inductive circuit and Study improvement of power factor using capacitor.

Apparatus required :

S.No	Equipment	Specification	Qty
1-	Ammeter	MI type, 0-1A	1
	voltmeter	MI type, 0-250V	1
	wattmeter	50w, 0-250V, 1A	1
	Fluorescent lamp with starter & choke coil.	40w, 230V, 50Hz	1
	Auto transformer	1-ph, 30V, 8A	1
	Capacitor	0.5μF, 2.5μF, 3.5μF each 500V	1

Theory :- The fluorescent lamp (FL) is commonly used in houses for lighting. It is discharge lamp in form of tube 3.5 cm in diameter and 0.5 m to 1.5 m long with an electrode at each end which are in form of coiled filaments coated with electron emitting material. The inside of tube is coated with fluorescent powder as operating temp

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p.f without c W / VA (Switch open)	Value of c	p.f with Parallel W / VA (Switch close)
80 / 220 x 066 = 0·55	10 μF	80 / 220 x = 0·75

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of tube is around 50°C, no auxiliary is required.

A relatively high voltage b/w electrodes is required for ionization of gas and initial starting. This high voltage is caused by combined action of choke coil and starter. The arrangement of CFL circuit is shown in fig below.

When fluorescent lamp is switched ON the starter makes and breaks the circuit rapidly resulting in high rate of change of current through coil choke and starter. The voltage across the choke is given as $e = L\frac{di}{dt}$ High rate of change of current through coil causes high voltage across the choke and gas discharge starts. The resistance of ionized gaseous medium rapidly drops because it has negative resistance characteristics. The lamp tends to draw dangerously high current, but prevented by the choke coil. The choke coil is in series with fluorescent lamp has very low value of power factor.

Result :- Power factor is improve.

(i) From 0.24 to 0.174 by connecting C = 10μF

(ii) From 0.24 to 0.174 by connecting C = 10μF

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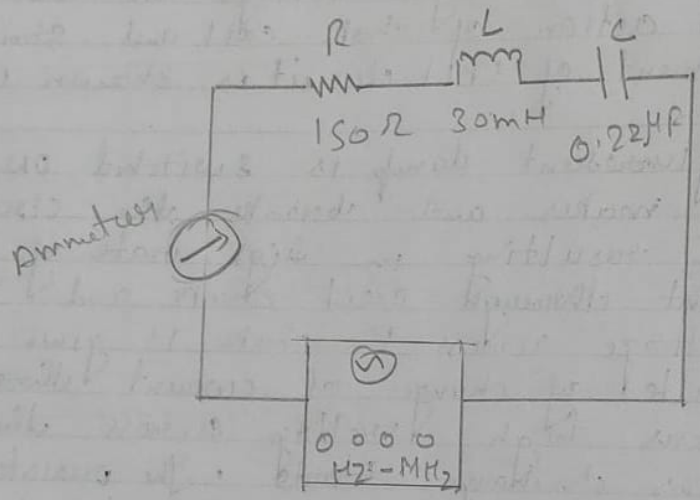

Single Generator.

S.No	Reading of Signal generator frequency in [kHz]	Ammeter reading I (mA)	Frequency corresponding to max. current	$f_r = 1/2\pi\sqrt{LC}$
1.	1.15	13		
2.	1.37	15.5	1.97 kHz	1.96 kHz
3.	1.60	18.5		
4	1.97	20		
5.	2.28	18.5		
6	2.48	1.7		
7	2.68	15.6		
8	2.86	14		

2- Percentage error in Resonance frequency

$$\text{error \%} = \frac{f_r(\text{measured}) - f_r(\text{calculated})}{f_r(\text{measured})}$$

$$= \frac{1.97 - 1.96}{1.97} \times 100$$

$$= \frac{0.01}{1.97} \times 100$$

$$0.50\ \%$$

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Experiment No.-7

Objective:- Study the phenomenon of Resonance in RLC series circuit & obtain the Resonance Frequency.

Apparatus:-

SNo.	Equipments	Type	Specification	Qty.
	Single phase AC	AC	230V, 50Hz	1
	variable frequency Signal Generator	AC	1Hz - MHz, (0-10)V Sine wave	1
	AC Ammeter	MI	(0-10) mA	1
	Inductor		10, 20, 30 mH	1
	Capacitor		10, 20, 30 nf	1
	Resistor		100 Ω	1
	Connecting wires		PVC Insulated	As per CKt requirement

Theory - In a consisting of reactive components of opposite nature i.e. L & C if we change the variable f, L or C there comes a situation when over all impedance (or Admittance) of the circuit becomes purely resistive (or conductive (r)). Such a condition is called "Resonance" of the electri

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electrical circuit.

In resonance condition, output decreases much larger than the excitation. Let us consider the circuit shown in fig.

Applying KVL we get;

$V = V_R + V_L + V_C$

$= IR + j(IX_L - IX_C)$

$= IZ$

where, $Z = R + j(X_L - X_C)$

$|Z| = \sqrt{R^2 + (X_L - X_C)^2}$ and the magnitude of current.

$I = V/Z$

Now, at resonance we have;

$X_L = X_C$

$2\pi f_r L = \frac{1}{2\pi f_r C}$

Hence, $f_r = \frac{1}{2\pi\sqrt{LC}}$

Since, $|Z| = \sqrt{R^2 + (X_L - X_C)^2}$

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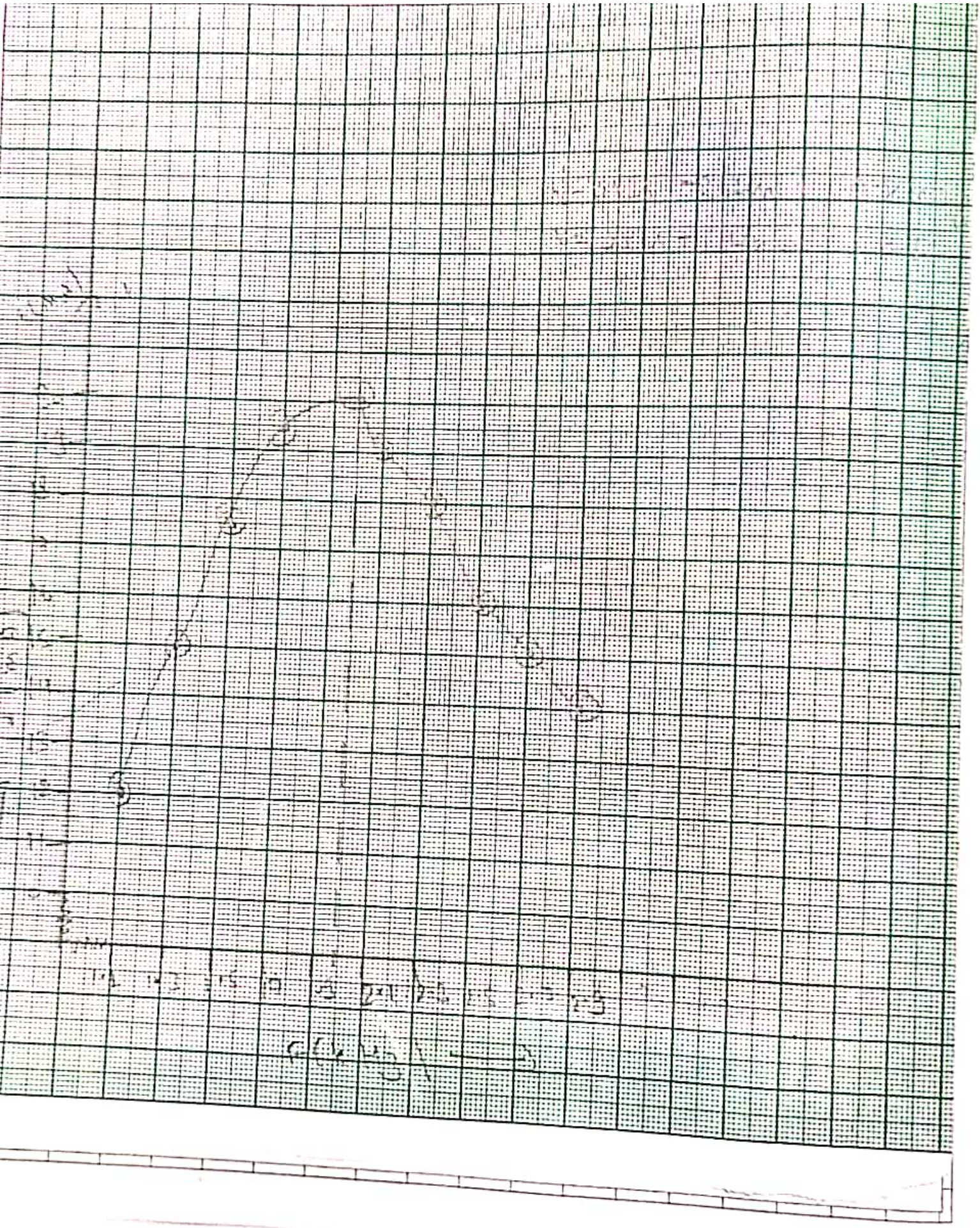

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Now, $Z = R$, $(as\ X_L = X_C)$

$\therefore I = \frac{V}{R}$

Variations of current w.r.t. frequency as shown in fig 2. When current is maximum, the circuit is said to be in resonance. So, In resonance condition Z should be minimum. Thus, in this condition current is in phase with voltage, power factor become unity & $\therefore Z = R$.

Procedure:
Make the connection as per ckt diagram
Switch on the supply keeping search freq of signal generator at zero.
Take the value of frequency & current as per observation table.
Increase the value of frequency & take the readings upto maximum frequency range of available source.
Take atleast 10-12 reading to cover complete range of variation of current around mark. Value
Now draw graph between current & frequency.

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Observation:
Value given: R = 150 ohms, L = 30 mH, C = 0.22 nF. Applied voltage = 3 volts, Frequency = 1.96 KHz.

Result:-
Resonance phenomenon is studied successfully and resonance curve is drawn. The resonance frequency is found to be 1.96 KHz.

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Experiment No.: 8

Objective:- Study and calibration of single phase energy meter.

Apparatus Required:

S.No	Name	Range	Qty
1-	Wattmeter	0-750 W	1
2-	Voltmeter	0-300 A	1
3-	Ammeter	0-10 A	1
4-	Lamp Load bank	1 KW	1
5.	Single phase Energy meter.	600 R/KWH$_2$ 50 Hz.	

Theory:- The total power consumed by load during an interval of time is ENERGY.

$E = P \times T$

where E = Energy, P = Power, T = Time.

If the voltage & currents are not constant & have n-values over time t, then.

$$E = \sum_{i=1}^{n} P_i \cdot t_i \rightarrow \sum_{i=1}^{n} V_i I_i T_i$$

It can also be expressed as continuous integral of Power i.e.

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$$E = \int_0^t P\,dt = \int_0^t VI\,dt$$

The unit of energy is watt second or joule. But its commercial unit is kilowatt - hours or kwh which is defined as energy consumed by load of 1000 w over a period of one hour.

Energy Meter:- The Induction type energy meters are most commonly form of the ac kwh meter used to measure the energy consumed in any ac circuit in a prescribed period when supply voltage & frequency are constant, in day to day life & in industrial installation. Energy meter is an integrating instrument which measure the total quantity of electrical energy supplied to the circuit in given period.

Principle:- The Basic principle of induction type energy meter is electromagnetic induction. When an alternating current flows through two suitably located coils (current coil & potential coil) produced rotating magnetic field which is cut by metallic disc suspended near to coils, thus an emf is induced in this

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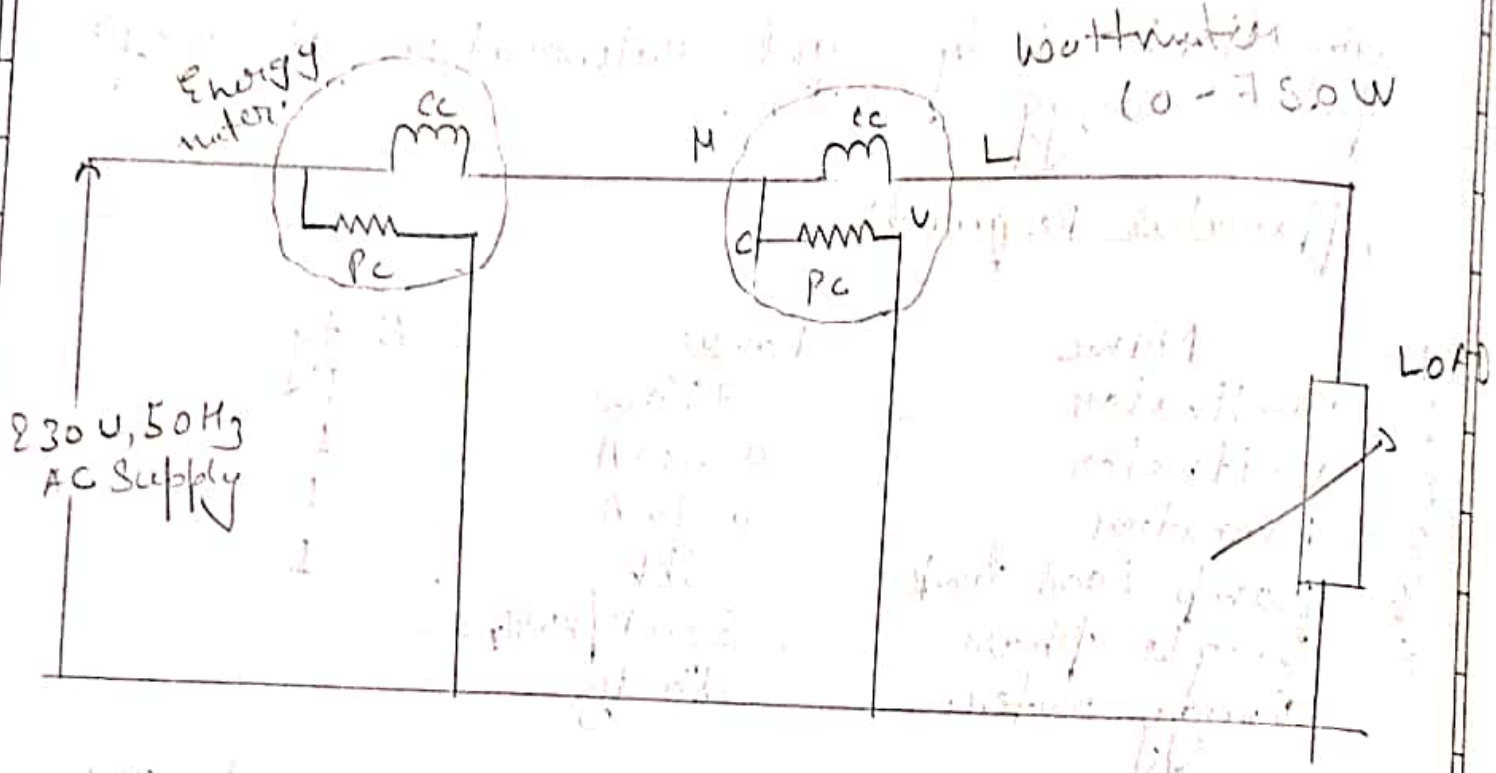
Energy meter
CC
PC
M
CC
L
C
V
PC
Wattmeter
(0 - 750 W
LOAD
230 V, 50 Hz
AC Supply

K = 600
↳ meter constant

S.No	Power kw	Time (sec)	No. of revolution	$E_r = n/k$	$E_t = \frac{kw\,t}{3600}$	% error = $\frac{E_t - E_r}{E_t} \times 100$
1	0.4	33.9	2	0.0033	0.0037	10.81
2	0.6	21.56	2	0.0033	0.0025	5.71
3	0.8	23.62	3	0.005	0.0052	3.84

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Aluminium disc which circulates eddy current in it.

Construction:- An induction type single phase energy meter, has following main parts of operating mechanism:

1)- Driving System
2) Moving System
3)- Breaking System
4)- Registering System.

1)- Driving System → Develops torque to rotate the moving system. It consists of two electro magnetic one is formed by current coil & other one is by voltage coil or pressure coil.

2- Moving System:- Essentially consists of aluminium mounted on spindle which is supported by Pivot - jewel Bearing System.

3- Breaking System → consist of permanent magnet of C shape covering a part of rotating disk to provide torque.

4 Registering system → keeps record of energy consumed by load through worm wheel or pinion gear mounted with spindle of moving disc.

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Working - When energy meter is connected in circuit, the current coil carries the load current and pressure coil carries the current the supply voltage.
The reading of energy meter is $\Rightarrow E_t = R/K$

Let kw = Power in kw from wattmeter reading
R = No. of revolution made by disc per sec
K = revolution / kwh.
Energy recorded by meter under test / Recorded value $(E_r) = \frac{R}{K}$ kwh.
Let wattmeter reading the kw or watts of energy calculated by wattmeter.

Energy consumed by wattmeter / True value (E_t)
$E_t = kw \times \frac{kw \times t}{3600}$

% error $= \left[\frac{E_t - E_r}{E_t}\right] \times 100$
=

Procedure :->
1) Make connection as per circuit diagram.
2) Decide the no. of revolution to take reading It should neigh neither be too small nor be too large. keep it b/w 4-6 revolutions.

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3. Keep load at minimum & switch on power Supply.
4. Take reading of E_t, W_t from energy meter, wattmeter & stop watch resp. Calc. E_2 & % error
5. Increase load in 5-10 steps upto rated value of energy meter & take reading. Switch off supply.

observation :-

1) When Supply is on there is no load i.e when loads practical nature of its is called 'creep error'.
2) If at very high loads, it reads less it is called as "Frictional error".
3) If at very high load meter reading is less, it may due to "Dynamic breaking torque" required over load compensation.
4)

Precaution :-

1) Make sure connections carefully & get checked by your instructor before you switch on supply.
2) Take reading carefully, especially energy meter reading & stop watch operation must be simultaneous.
3) Don't touch live wires.
4) Do not use energy meter beyond its rating.
5) The input voltage must be kept constant with help of variac autotransformer.

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Result :-
The given 1-phase induction type energy meter is calibrated with help of standard wattmeter & stopwatch. It is found that % error does not remain constant rather it varies in magnitude from no load to full load.

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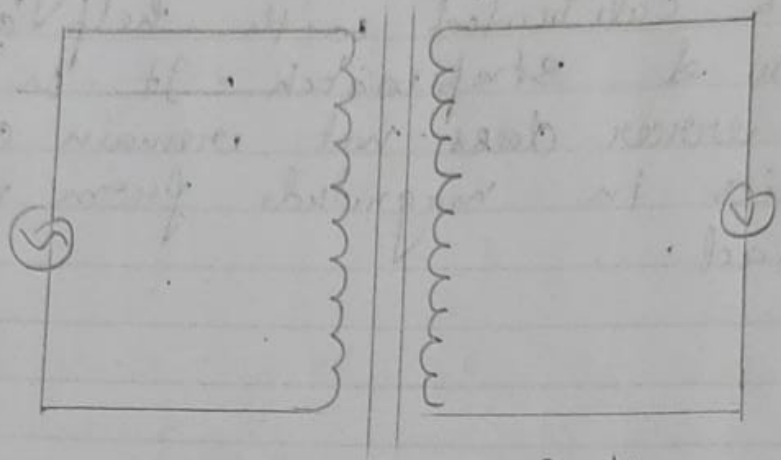
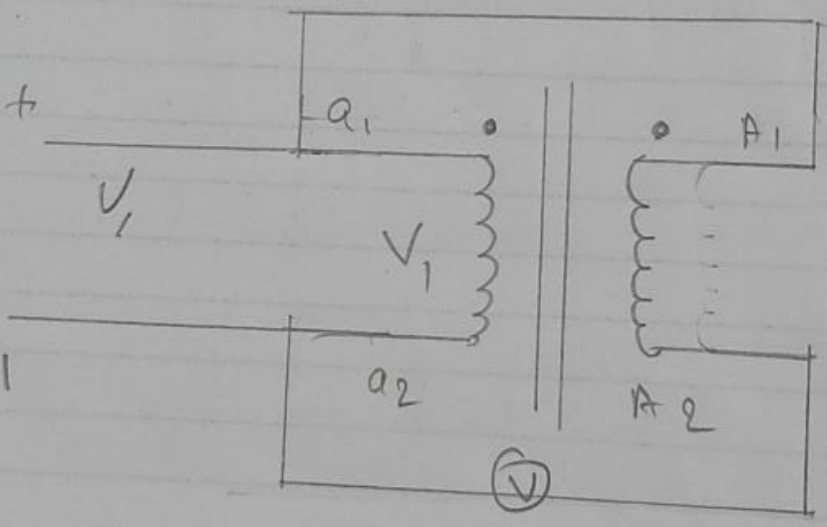


Circuit Diagram for voltage Ratio Determination



Circuit diagram for polarity test of 2-winding Transformer.

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Experiment No:- 9

Objective:- Determination of (a) voltage ratio (b) polarity test (c) efficiency by load test of single phase transformer.

Apparatus required:

S.No.	Equipments	Type	specification	Qty.
1.	Single phase Transformer		1kVA, 230V/230V	1
2.	Wattmeter	Dynamometer	(0-300V), 5/10A 150/300/600V	1
3.	Ammeter	MI	(0-5-10) A, AC	1
4.	Voltmeter	MI	(0-150-300) V, AC	1
5.	Lamp Bank load.	Resistive	Resistive 1kW, 230V	1

Theory:-

The Transformer is device which transfers energy from one electrical circuit to another electrical circuit to another electrical circuit through magnetic field as coupling medium. In this process it does not change frequency of voltage or current. It works on basic principle of electromagnetic induction (mutually induced emf). Being static device it have very high efficiency as compared to rating machine of same rating as losses are less.

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Procedure :-

1) Make connections as per circuit diagram.
2) Keep switch S on secondary side open so that load is zero to measure no load voltage.
3) Now increase voltage through auto-transformer until voltage in voltmeter V_2 reads rated value of secondary winding & read no load voltage E_2.
4) Switch on certain lamps in lamp in bank load such that secondary winding ~~load~~ current the approx 10% of rated current of secondary side.
5) Take reading from WH W_2, VH V_2 & Amm I_2.
6) Increase load current in step of 10% of rated value switching on few more lamps & take readings of wattmeter, Ammeter & voltmeter till it reaches 120 - 125 of rate value.
7) Reduce load to zero by switching of lamps one by one.
8) Switch off AC-supply.

Precautions :-

1) Instruments used should be of appropriate ranges
2) All connections should be tight.

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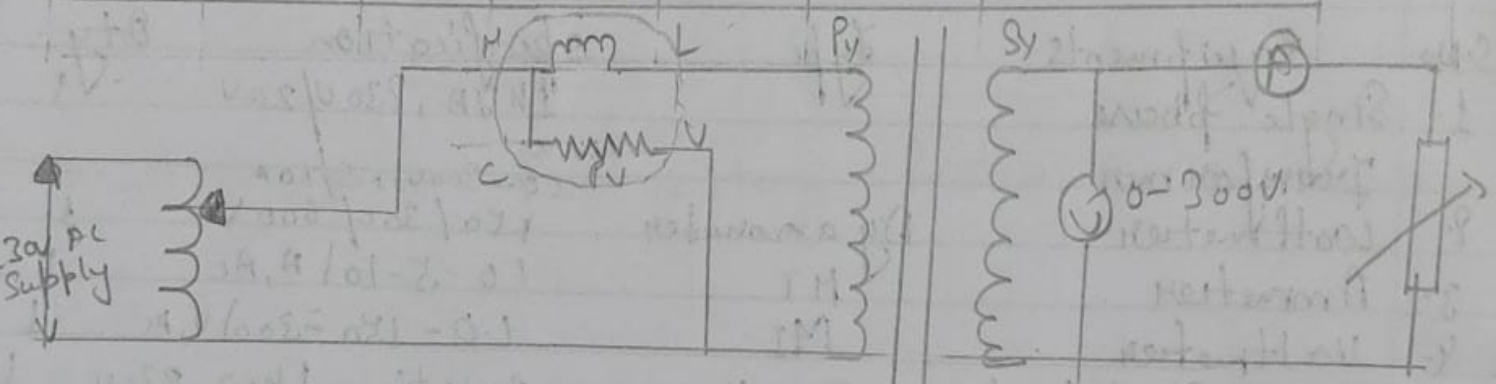
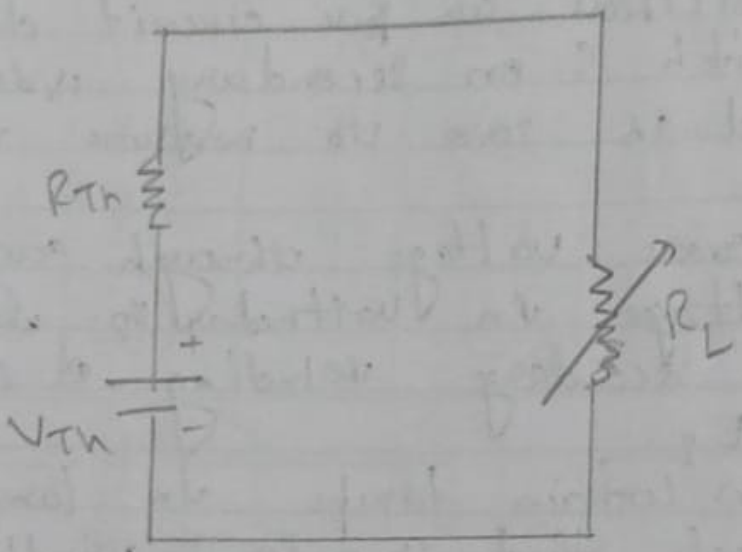
No. of bulbs	W_1 (W)	E_2 (V)	V_2 (V)	I_2 (A)	$P_2 = V_2 I_2$ (W)	$\eta = P_2/W_1 \times 100$
4	125×2	230	214	1.5	321	86.75
6	275×2	230	208	2.4	499.2	90.76
8	360×2	230	204	3.75	765	106.25
10	440×2	230	198	3.9	773.2	87.75



Circuit diagram for 1-ϕ Transformer



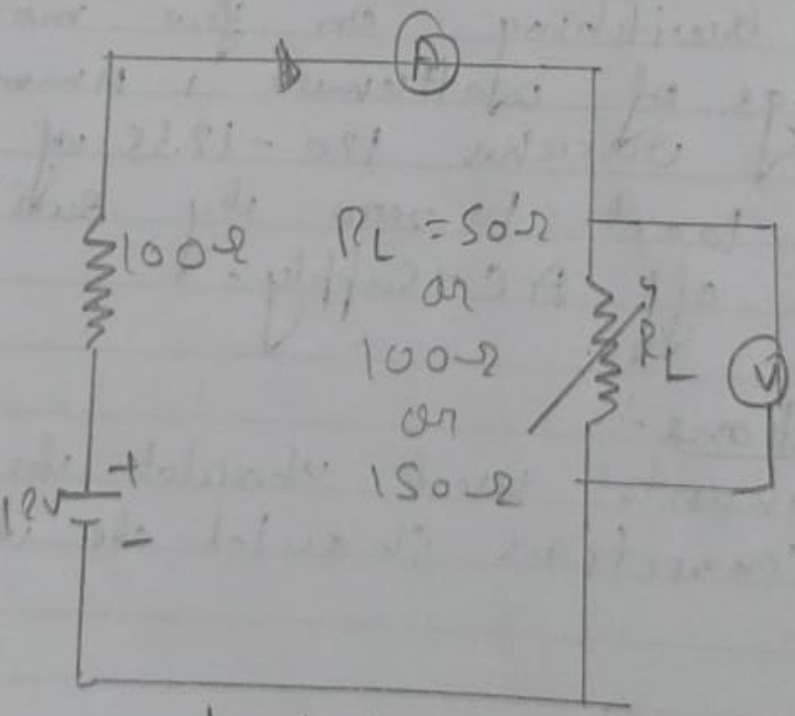


fig :- 1

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Experiment No: 10

Objective:- Verification of maximum power transfer theorem (MPT)

Apparatus used:-

S.No.	Instrument	Type	Range	Qty.
1.	Supply	DC	0-12 V	1
2.	Experimental Board		0-5 V	
3.	Voltmeter	MC	0-5 V	1
4.	Ammeter	MC	0-10 mA	1
5	Resistance	CFR/MFR	2.5Ω/50Ω/10Ω 100Ω/500Ω	1
6.	Connecting leads.		As required.	

Theory:- This theorem states that in a DC network, a resistance load unit will abstract maximum power from a network when the load resistance is equal to the resistance of the network as viewed from the output terminals with all energy sources replaced by their internal resistance.

$P_0 = P_{max}$ when $R_L = R_T = R_{TH}$

$$P_{max} = \frac{V_{th}^2}{4R_L}$$

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Calculation

(i) $V_{TH} = 12V$, $R_{TH} = 100\Omega$

$P_{max} = \frac{V_{TH}^2}{4R_{TH}} = \frac{12 \times 12}{4 \times 100} = 0.36W$

(ii) 50Ω $I = 75mA$ or $0.75A$ $V = 4V$

$P = VI = 300 = 0.3W$

$P_{max} = \frac{V_{TH}}{4R_L} = 12 \times 12 / 4 \times 50 = 0.72W$

(iii) 100Ω $I = 60mA$ or $0.6A$ $V = 6V$

$P = VI = 360W = 0.36W$

$P_{max} = \frac{V_{TH}^2}{4R_L} = \frac{12 \times 12}{4 \times 160} = 0.36W$

(iv) 150Ω $I = 45mA$ or $V = 7.5V$

$P = VI = 337.5 = 0.3375$

$P_{max} = \frac{V_{TH}^2}{4R_L} = \frac{12 \times 12}{4 \times 150} = 0.24W$

P_{max} Average $= \frac{0.72 + 0.36 + 0.34}{3}$

$\Rightarrow \frac{1.32}{3} = 0.44W$

Observation Table

S.No	R_L (Ω)	I (mA)	V Volts	$R = V/I$	R_{Th} (Ω)	V_{Th} Volts	$P_{max} = V_{Th}^2/4R$
1	50 Ω	75 mA	4 Volt	0.3 W			0.72 W
2	100 Ω	60 mA	6 Volts	0.36 W	100 Ω	12 V	0.36 W
3	150 Ω	45 mA	7.5 Volts	0.3375 Volts			0.24 W

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Procedure:

(i) Connect the circuit. Acc. to the fig 1.
(ii) Select the different value of R_L (Ω) viz — 50, 80, 100, 120, R_L (Ω)
(iii) Note down the reading of voltmeter to find V (volts)
(iv) Note down the reading of ammeter to find I (mA).

Precaution:-

Do not make interconnection on the board with mains switch ON.
As soon as mains is ON. The reading in the meter must be zero. If the reading in the meters is not zero, check meters.

Result:-

From the observation table, we can observe that power delivered is maximum when the load resistance is equal to int. resistance and the max value of Power is — $P_{max} = 0.44W$

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