MEERUT INSTITUTE OF ENGINEERING & TECHNOLOGY

EXPERIMENT NO: 1

Date:

Objective : To verify the Kirchoff's Voltage law.

Apparatus required :

S.No	Name of Apparatus	Range	Quantity
1.	Bread Board	-	1
2.	Resistors	1K, 2.2K, 1.5K	3
3.	Digital multimeter	-	1
4.	DC power supply	0.5 Amp	1
5.	Connecting wires	-	-

Theory :

This is the restatement of law of conservation of energy.
It states that in a closed loop/mesh at any instant the algebric sum of all voltage drop across resistance and all emf's is zero for a closed circuit having k elements.

$$\sum_{j=1}^{k} V_j = 0$$, V_j represent the voltage drop of the j^{th} element.

$$V_1 + V_2 + V_3 + \cdots V_k = 0$$

The algebric sum of voltages in a closed loop is equal to zero.

Calculation :-

In loop 1

$$+10 - 1000 I_1 - 1500 (I_1 - I_2) = 0$$

$$= -2500 I_1 + 1500 I_2 = -10 \quad — ①$$

In loop 2

$$-1500 (I_2 - I_1) - 2200 I_2 = 0$$

$$= 1500 I_1 - 3700 I_2 = 0 \quad — ②$$

from ① and ② we get

$$I_1 = 5.285 \times 10^{-7} A$$

$$I_2 = 2.142 \times 10^{-3} A$$

$$V_{R1} = IR =$$

$$\Rightarrow V_{1000} = I_1 R_{(1000)}$$

$$= 5.285 \times 1000 \times 10^{-3}$$

$$V_{R1} = 5.285 V$$

$$V_{R2} = [I_1 - I_2] R_2$$

$$= (5.285 \times 10^{-3} - 2.142 \times 10^{-3}) (1500)$$

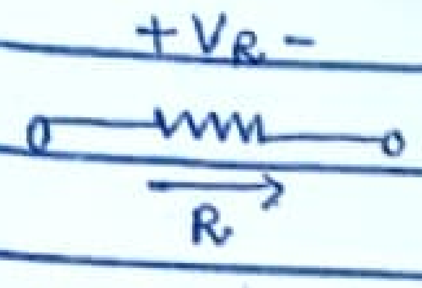
$$V_{R2} = 4.714 \Omega$$

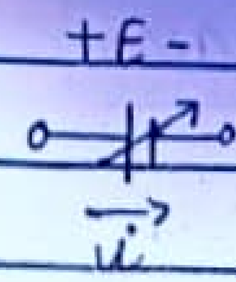
$$V_{R3} = I_2 R_3$$

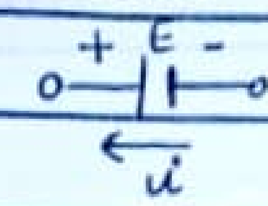
$$= 2.142 \times 10^{-3} \times 2200$$

$$V_{R3} = 4.712 \Omega$$

Date:







Resistor

Battery

Observation Table.

Voltage drop	Theoritical value (v)	Practical value (v)	% Error
V_{R1}	5.285 V	5.31 V	0.18 %
V_{R2}	4.714 V	4.72 V	0.21 %
V_{R3}	4.712 V	4.72 V	0.21 %
V $V_{R1}+V_{R2}$	9.9 V	10 V	01.01 %
Loop voltage	0.1 V ~ 0 V	0 V	0 %

Result

The sum of all voltages drop across resistance and emf's in each mesh/loop is zero hence KVL is verified.

Limitation only applicable in linear and bilateral elements.

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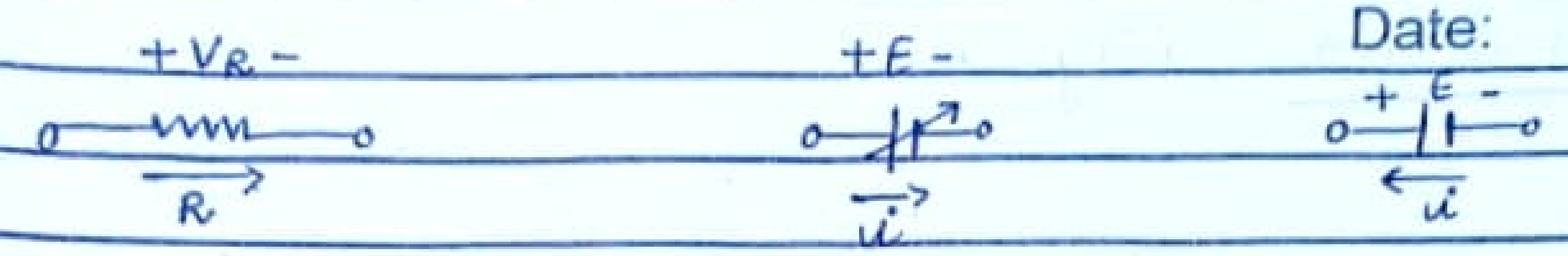
EXPERIMENT NO:.........................

Date:



Resistor Battery

Observation Table

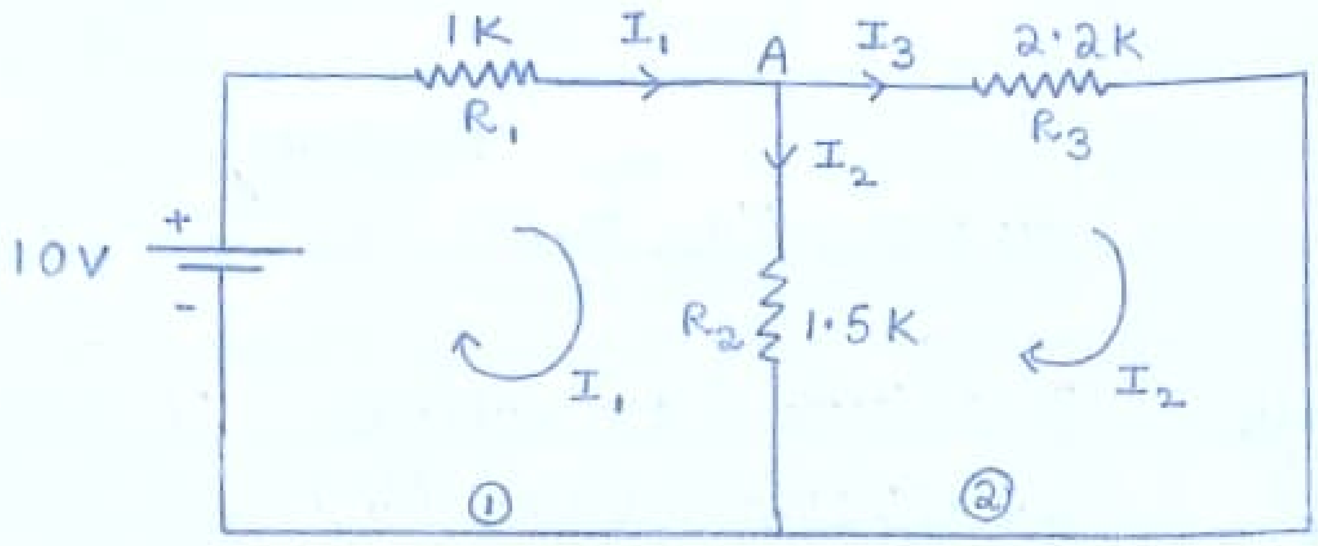
Voltage drop	Theoritical value (V)	Practical value (V)	% Error
V_{R1}	5.285V	5.31V	0.18%
V_{R2}	4.714V.	4.72V	0.21%
V_{R3}	4.712V	4.72V	0.21%
V $V_{R1}+V_{R2}$	9.9V	10 V	01.01%
Loop voltage	0.1V~0V	0V	0%

Result

The sum of all voltages drop across resistance and emf's in each mesh/loop is zero hence KVL is verified.

Limitation only applicable in linear and bilateral elements.

Connection diagram



Precautions

Do not touch the live wire.

Take all readings very carefully.

Always wear shoes.

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EXPERIMENT NO: 2

Date:

Objective : To verify the Kirchoff's current law.

Apparatus required :

S.NO	Name of Apparatus	Range	Quantity
1	Bread Board	-	1
2	Resistors	1K, 2.2K, 1.5K	3
3	Digital Multimeter	-	1
4	DC power supply	0.5 Amp	1
5.	Connecting wires	-	-

Theory

Kirchoff's current law is nothing more than a restatement of principal of conservation of charge.
It states that the algebric sum of currents meeting at a junction of conductors is zero.

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

Assuming current entering to be positive and current leaving to be negative.

$$\sum_{b=1}^{k} I_b = 0$$

Calculation

At node A

$$I_1 = I_2 + I_3$$

$$\frac{10 - V_A}{1000} = \frac{V_A}{1500} + \frac{V_A}{2200}$$

$$\frac{10 - V_A}{10} = \frac{22V_A + 15V_A}{330}$$

$$3300 - 330V_A = 370V_A$$

$$700V_A = 3300$$

$$V_A = 4.71$$

$$I_1 = \frac{10 - V_A}{1000} = \frac{10 - 4.71}{1000}$$

$$I_1 = 0.00529 = 5.29 \times 10^{-3} A$$

$$I_2 = \frac{V_A}{1500} = \frac{4.71}{1500}$$

$$I_2 = 3.14 \times 10^{-3} A$$

$$I_3 = \frac{V_A}{2200} = \frac{4.71}{2200}$$

$$I_3 = 2.14 \times 10^{-3} A$$

- $I_{R1} = 5.29 \times 10^{-3} A$
- $I_{R2} = 3.14 \times 10^{-3} A$
- $I_{R3} = 2.14 \times 10^{-3} A$

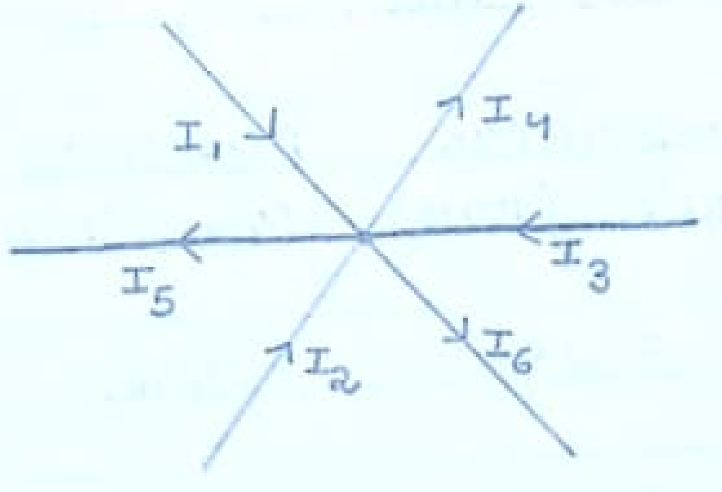
Observation Table.

Current in branches	Theoritical value (mA)	Practical value (mA)	% Error
I_{R1}	5·29	5·2	-1·70%
I_{R2}	3·14	3·05	-2·86%
I_{R3}	2·14	2·12	-0·93%
$I_{R1} = I_{R2} + I_{R3}$	5·28	5·17	-2·08%

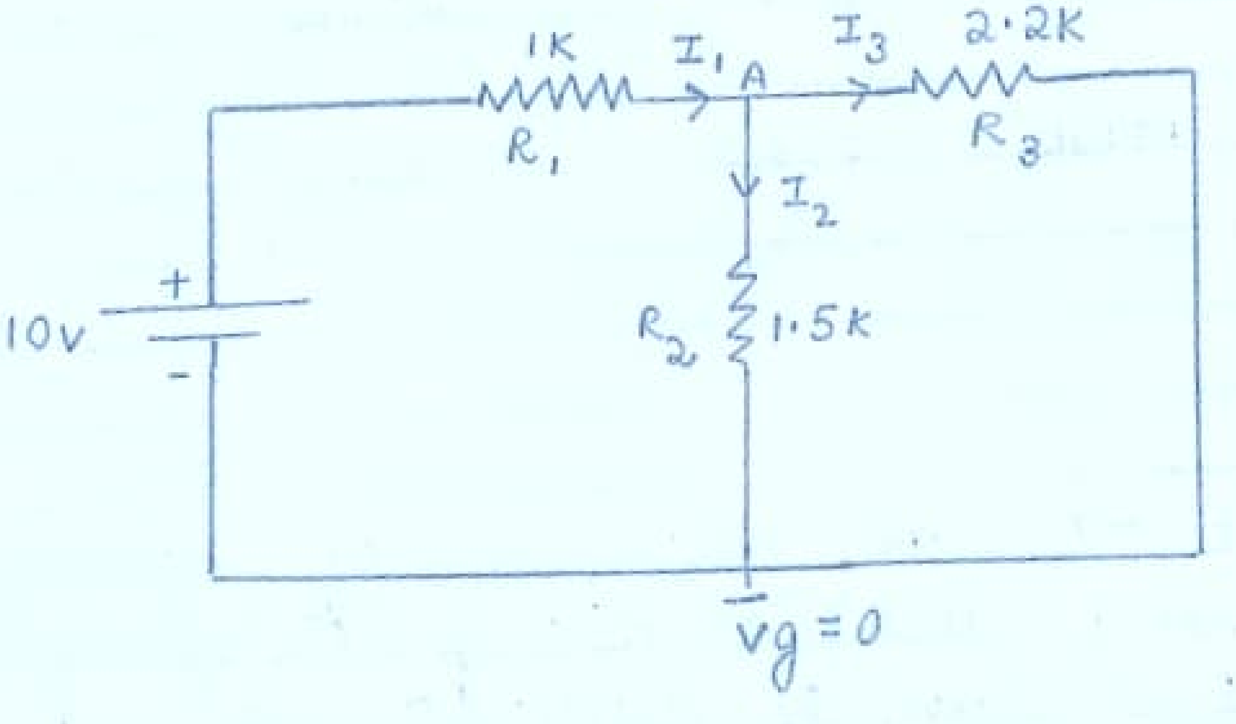
Result → As the sum of currents flowing towards the junction equal to the sum of currents flowing away from the junction hence KCL is verified.

Limitation →
Applicable only to the linear and bilateral elements.

Precautions →
Do not touch the live wire.
Take all reading very carefully
Always wear shoes.



Connection Diagram



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EXPERIMENT NO: 3

Date:

Objective : To determine parameter of AC single phase series RLC circuit.

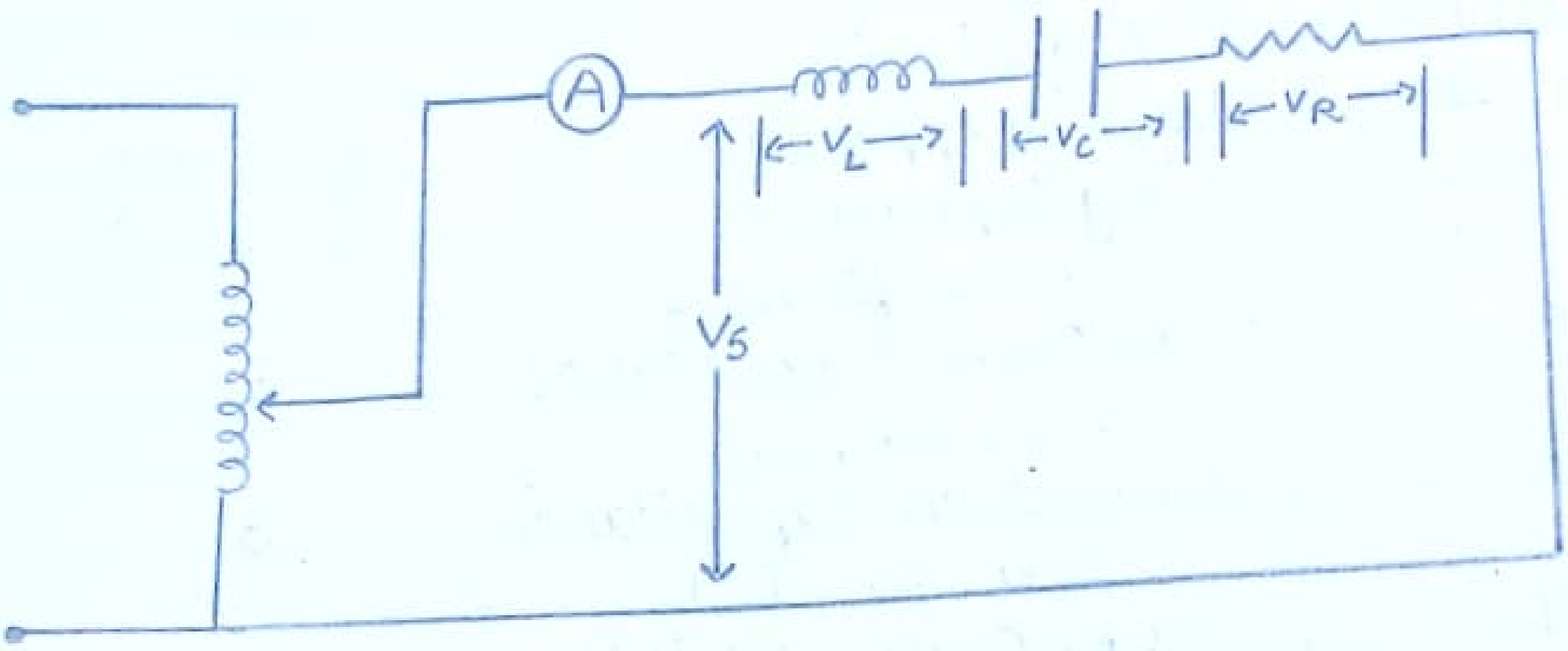
Apparatus Required.

S. NO	Name of Apparatus	Quantity
1	Single phase Transformer	1
2	unknown inductance (L_1, L_2, L_3)	3
3	unknown capacitance (C_1, C_2, C_3)	3
4	unknown resistance (R_1, R_2, R_3)	3
5	multimeter	1
6	Patch cords	

Theory

In the present circuit, Resistance (R), Inductance (L), Capacitance (C) are connected in series across a voltage (V). Thus the current in all elements of circuit is same where as voltage across each element would be different. Resultant applied voltage V_s is the phasor sum of all voltage across these elements. In such a series circuit, following basic relation hold good.

Circuit diagram



Calculations

i) $R = \frac{V_R}{I} \times 10^3 = \frac{5.08}{15.70} \times 10^3 = 0.32 \times 10^3 \Omega$

ii) $X_L = \frac{V_L}{Z} \times 10^3 = \frac{0.78}{15.70} \times 10^3 = 0.04 \times 10^3 \Omega$

$L = \frac{X_L}{2\pi f} \times 10^3 = \frac{0.04 \times 10^3 \times 10^3}{2 \times 3.14 \times 50}$

$L = 1.27 \times 10^2$

iii) $X_C = \frac{V_C}{I} \times 10^3 = \frac{25.67}{15.70} \times 10^3 = 1.63 \times 10^3 \Omega$

$C = \frac{1}{2\pi f C} \times 10^3 = \frac{1 \times 10^3}{2 \times 3.14 \times 50 \times 1.63 \times 10^3}$

$C = 1.95 \times 10^{-3} \mu F$

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

$= \sqrt{0.1024 + (1.59)^2}$

$Z = 1.621 \Omega$

v) $\cos\phi = \frac{R}{Z} = \frac{5.08}{1.621} = 3.134$

Power $P = V I \cos\phi$

$P = 1284.21 W$

Voltage across Resistance Date:

$V_R = IR$

Voltage across Inductance $V_L = IX_L$

Voltage across Capacitance $V_C = IX_C$

Voltage across circuit $V = IZ$

Power drawn by circuit $P = VI\cos\phi$

Power factor $\cos\phi = P/VI$

X_L = Inductive Reactance $\omega L = 2\pi f L \,\Omega$

$X_C = \dfrac{1}{2\pi f C}$ $Z = \sqrt{R^2 + (\omega L - 1/\omega C)^2}$

$$I = \frac{V}{\sqrt{R^2 + (\omega L - 1/\omega C)^2}}$$

Observations

i) All four Capacitor in parallel.
ii) Two inductors in series.
iii) Two Resistance in Parallel

Observation Table.

S.NO	Vs (Volts)	I (m.Amp)	Volts V_R	Volts V_L	V_C
01	26.1V	15.7mA	5.08V	0.78 V	25.67 V

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EXPERIMENT NO:........................

Date:

S.NO	$R = (V_R/I)10^3$ Ω	$X_L = (V_L/I)10^3$	$L = (I_L/2\pi f)10^3$	$X_C = (V_C/I)10^3$ Ω
01.	$0.32 \times 10^3 \Omega$	0.04×10^3 Ω	1.27×10^2 mH	$1.63 \times 10^3 \Omega$

$C = \{1/(2\pi f X_C)\}10^6$ (μF)
$1.95 \times 10^{-3} \mu F$

Result
$X_L = 0.04 \times 10^3 \Omega$
$X_C = 1.63 \times 10^3 \Omega$
$Z = 1.621 \Omega$
Power factor 3.134
Power = 1284.21W

Precautions
Do not touch line wire.
Take all reading carefully.
Always wear shoes.

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EXPERIMENT NO: 4

Date:

Objective: To study the starting and running of and reversing of three phase induction motor.

Apparatus Required:

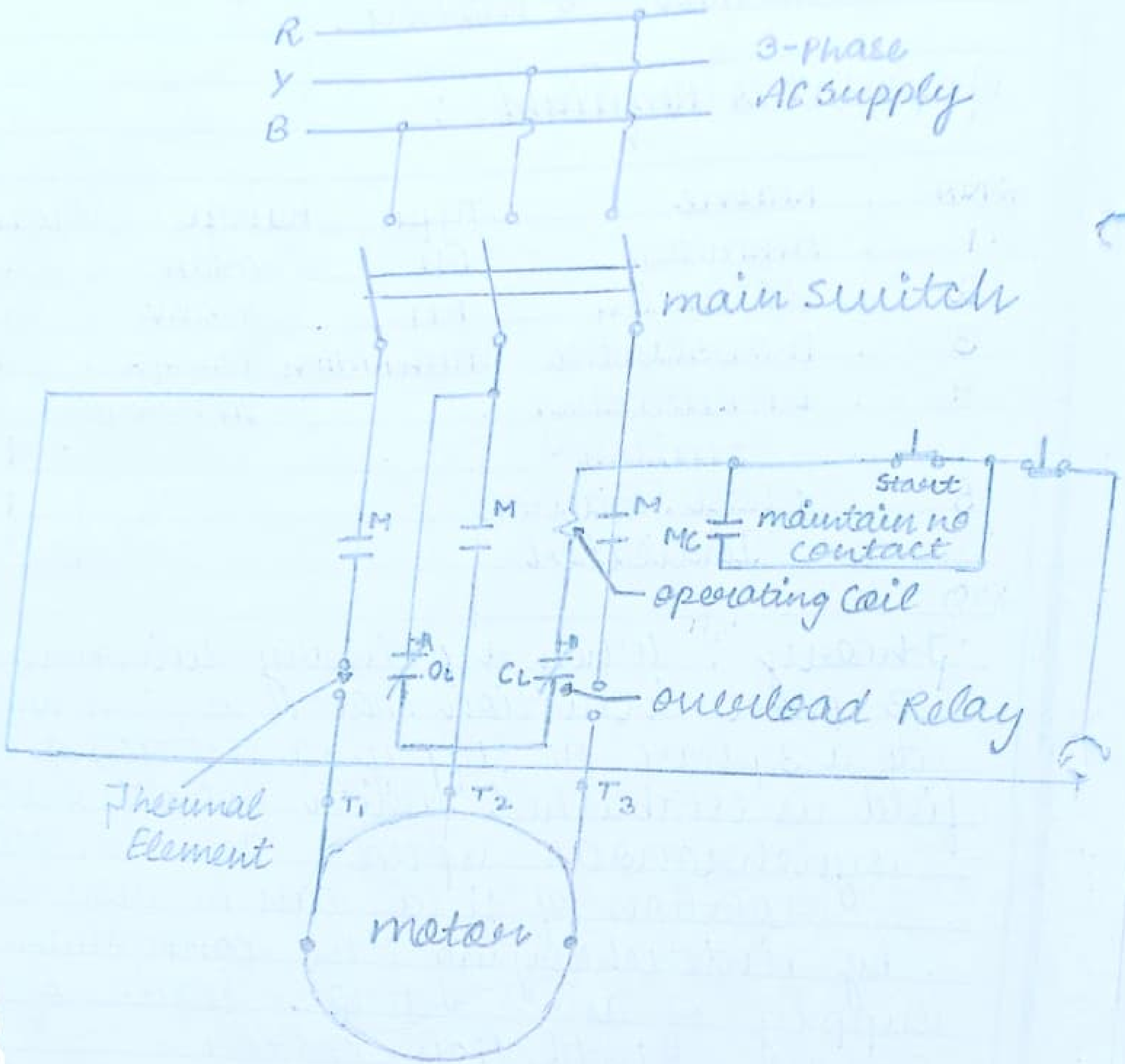
S.No	Name	Type	Range	Quantity
1	Ammeter	MI	0-10A	1
2	Voltmeter	MI	0-500V	1
3	D.O.L Starter	Push Button	For 2/3 HP Motors	1
4	DP Reversing switch			1
5	Phase Sequence Indicator			1

Theory: When a primary winding of a 3-phase induction motor is connected to a 3 phase AC supply a rotating magnetic field is established which rotates at synchronous speed. The direction of rotation of field can be reversed by interchanging the connection to the supply of any two leads of a 3phase induction motor.

The speed at which the field produced by primary currents will revolve is called synchronous speed.

$$N_s = \frac{120f}{P}$$

Connection Diagram.



So the speed of rotor magnetic field with respect to stator surface is equal to sum of actual speed of rotor N and rotor field speed sN_s w.r.t with respect to rotor surface.

$$N + sN_s = N_s(1-s) + sN_s = N_s \text{ rpm}$$

For clockwise direction

When Phase direction is R-Y-B Then acc. to theory stator flux rotates in R-Y-B-R direction. so rotor also moves in clockwise direction.

For anticlockwise direction

When phase direction is B-Y-R or Y-R-B or B-R-Y or R-B-Y which is done by interchanging any two leads of 3 ϕ supply to AC motor, which for safety purpose in our panel is done through a 3 ϕ switch called reversing switch

Observation Table:

S.NO	Forward Direction No Load		Reverse Direction No Load	
	Current	Speed	Current	Speed
1.	3amp	1496rpm	3amp	1496 rpm

Result :

When motor runs in both the directions following comparatively statement will be obtained :

Forward direction (no load) Speed =

Reversed direction (no load) Speed =

Precautions :

Do not press the switch of P.S.I for more than 5 seconds.

Immediately release the push button after checking the directions.

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EXPERIMENT NO: 5

Date:

Objective: To study the phenomenon of resonance in RLC series circuit and perform following operations.

ii) To study variation in current with change in frequency in RLC series circuit.

iii) To verify Resonance frequency $= 1/2\pi\sqrt{LC}$.

Apparatus Required:

S.NO	Name	Specifications	Quantity
1	Ammeter	10 A	1
2	Resistance	33.33 Ohm	1
3	Inductance	172 mH	1
4	Capacitor	24 nF	1
5	Variable frequency signal generator	1KHz - 5kHz	1

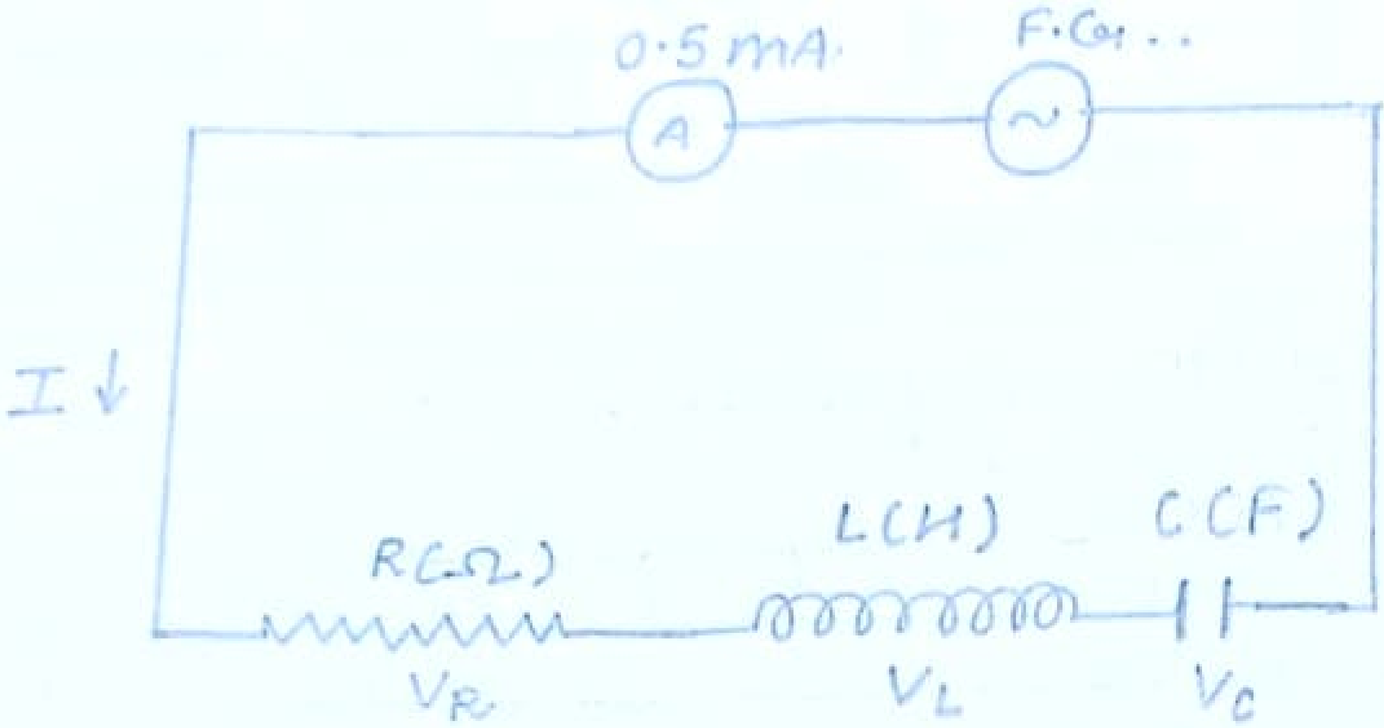
Theory: The impedance of RLC series is equal to:

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

where $X_L = \omega L = 2\pi f L \ \Omega$

$X_C = 1/\omega C = 1/2\pi f C \ \Omega$

Resonance is condition in a series R-L-C that at particular frequency the current is maximum and power factor is unity.



$R = 33.33\,\Omega$

$L = 98.77\,mH$

$C = 24\,nF$

Calculate value of resonance frequency $= 3.0\ KHz$

$X_L = X_C$ or $\omega_0 L = \dfrac{1}{\omega_0 C}$

$\therefore \omega_0 = \dfrac{1}{\sqrt{LC}}$ and $f_0 = \dfrac{1}{2\pi\sqrt{LC}}$ Hz.

If for some frequency of applied voltages $X_L = X_C$ then $Z = \sqrt{R^2+0} = R$.

i) Net reactance is zero.
ii) $V_L = V_C$ or $V_L - V_C = 0$
iii) net impedance resonance i.e $Z=R$
iv) line current is maximum and is equal to V/R.
v) Power factor is unity.
vi) Resonance frequency $f_0 = 1/2\pi\sqrt{LC}$ Hz

Observation Table:

f(KHz)	1	1.5	2	2.5	3	3.5	4	f_0 = 3KHz
I(mA)	0.9	1.6	2.2	2.7	2.8	2.5	2.2	max current = 2.8mA

Calculation:

$f_0 = \dfrac{1}{2\pi\sqrt{LC}}$ = KHz

Calculations :

$$f_0 = \frac{1}{2\pi\sqrt{LC}} \text{ KHz.}$$

Result :

measured Resonance f_0 (KHz)

=> 3KHz

Calculated Resonance f_0(KHz)

=> 3KHz

Precautions :

1) The connection should be tight and proper.
2) The instruments used should of proper range and error free.
3) Do not touch live wire and wear shoes for proper insulation
4) Do not change the connections without switching off the connections.

MEERUT INSTITUTE OF ENGINEERING & TECHNOLOGY

EXPERIMENT NO:........................

Date:

Objective: To study power measurement in a three phase load by two-watt meter method.

Apparatus Required: Wattmeter -> 2, 3-phase inductive load - 1, multimeter -> 1, connecting wires.

Theory: Three Phase power measurement by two wattmeter method star connected inductive load:

The voltage across the pressure coil of W_1 is (V_{RB}) and current is I_R.

whereas voltage across pressure coil of W_2 is (V_{YB}) and current is I_R.

whereas voltage across pressure coil.

Hence, instantaneous power is,

$$P = V_R I_R + V_R I_Y + V_B I_B$$

By Kirchoff's current law at neutral point of star connected load,

$$I_R + I_Y + I_B = 0$$

$$P = V_R I_R + V_R I_Y - V_B (I_R + I_Y)$$

$$\text{Power}(W) = W_1 + W_2$$

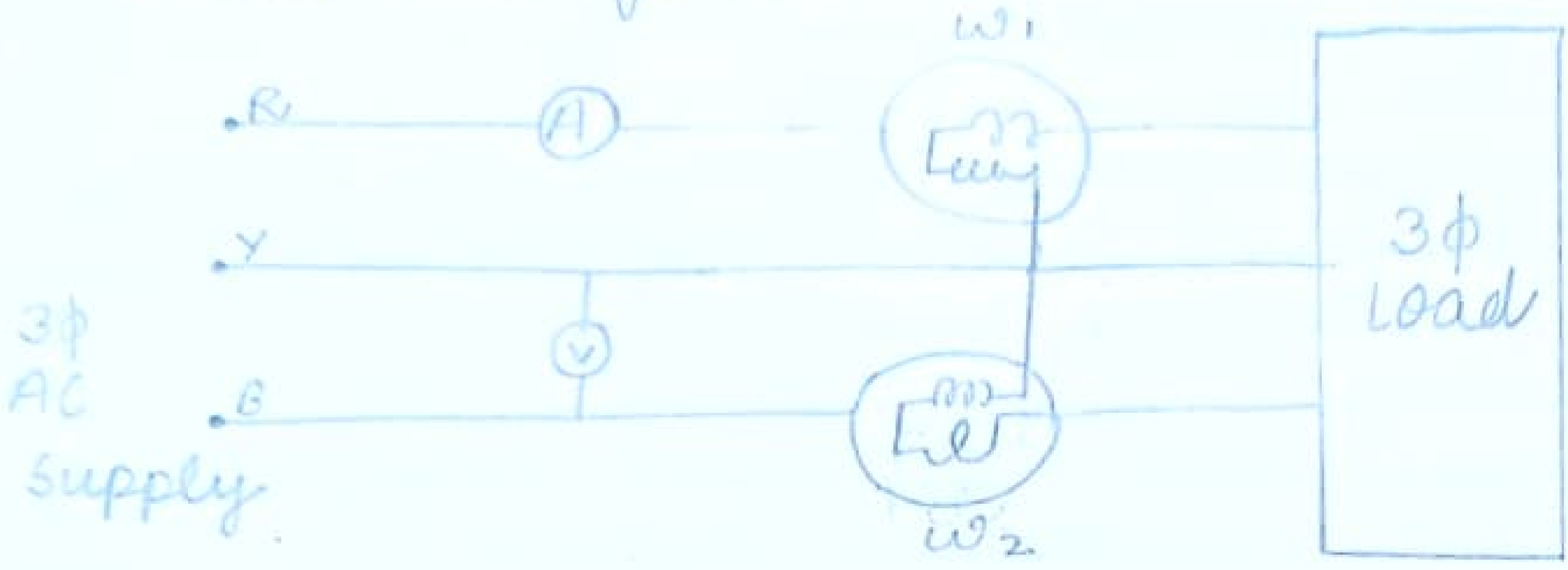
Now power measurement by two wattmeter method for star connected inductive load lagging powerfactor:-

Reading of first wattmeter is

$$W_1 = V_{RB} I_R \cos(I_R \wedge V_{RB}) \quad -(1)$$

$$W_2 = V_{RB} I_Y \cos(I_Y \wedge V_{RB}) - (2)$$

Connection Diagram :



Calculations :

$W_1 = 480$ watts
$W_2 = 320$ watts

$W_1 + W_2 = 800$ watts
$W_1 - W_2 = 160$ watts

$$\cos\phi = \cos\left[\tan^{-1}\sqrt{3}\left[\frac{160}{800}\right]\right]$$

$$\cos\left[\tan^{-1} 0.346\right]$$

$$= 0.945$$

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EXPERIMENT NO:.........................

Date:

Angle b/w $(I_R \wedge V_{RB}) = 30-\phi$

$(I_R \wedge V_{YB}) = 30+\phi$

By eq.^{n} ① and ②

$W_1 = V_{RB} I_R \cos(30-\phi)$

and $W_2 = V_{YB} I_Y \cos(30+\phi)$

Three phase power is

$W = W_1 + W_2$

$W = V_L I_L \cos(30-\phi) + V_L I_L (30+\phi)$

$W = \sqrt{3} V_L I_L \cos\phi$

$W = 3 V_{Ph} I_{Ph} \cos\phi$ which is three phase power in balanced load

Observation Table:

S.NO	Voltage (Volt)	Current (A)	Power W_1 Watts	Power W_2 Watts	Total Power (Watts)	Power factor $\cos\phi$
1.	417	1.7	480	320	800	0.945

Result: Net Power consumed (P) = 800 Watts

Power factor $\cos\phi = 0.945$

Precautions:

1) Before reversing the connection of current coil and Pressure coil, switch off the supply.
2) Do not touch the line wires and take all readings very carefully

MIET MEERUT INSTITUTE OF ENGINEERING & TECHNOLOGY

EXPERIMENT NO:........................

Date:

Objective : Determination of i) Polarity ii) Voltage Ratio iii) Efficiency by load test of single phase transformer

Apparatus Required :

S.NO	Equipments	Range	Quantity
1.	Single Phase Transformer	1KVA, 110/200V	1
2.	Wattmeter	5/10A, 150/300V	1
3.	Ammeter	0-5 Amp AC	1
4.	Voltmeter	0-300V, AC	1
5.	Lamp Bank Load	Resistive 1KW, 230V	1

Theory :

Polarity Test : Each of the terminals of primary as well as secondary winding of a transformer is alternatively positive and negative with each other.

i) When 2 single phase transformers are to be connected in parallel to share the total load on the system.

ii) For connecting 3φ transformer to from a 3φ bank with proper connections of primary and secondary windings.

Voltage Ratio : The induced emf per phase in a primary and secondary

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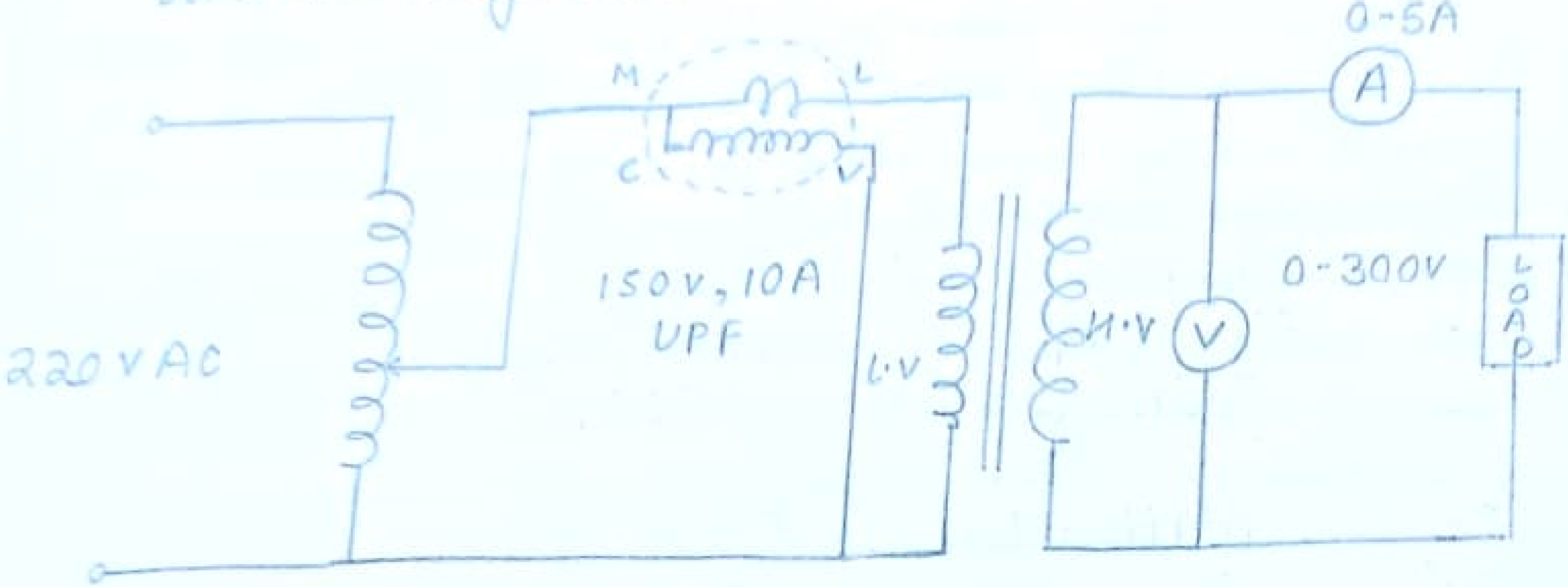
Circuit Diagram:



winding of transformer is given by
induced emf in primary $E_1 = 4.44 f \phi T_1$
induced emf in secondary $E_2 = 4.44 f \phi T_2$
voltage Ratio $= \frac{V_2}{V_1}$ $\frac{T_2}{T_2}$

Observation Table:

SNO	V_1	V_2	V_3	SNO	V_1	V_2	V_2/V_1
1.	100.5V	100.5V	0	1.	100.5V	100.5V	1
2.	100.5V	100.5V	200.10V	2.	100.5V	100.5V	1

Observations:
No Load Voltage across secondary $E_2 = 240V$

SNO	W(Watt)	E_2(V)	I_2(A)	$P = V_2 I_2$	V_2(V)	efficiency P/W×100%	% Regulation
1.	420	240	1.6	355.2	222	84.57%	0.07
2.	640	240	2.6	572	220	89.37%	0.08
3.	840	240	3.5	756	216	90%	0.10
4.	1040	240	4.4	941.6	214	90.53%	0.10

Result: Efficiency and % Regulation for different loadings have been presented and ploted.

Precautions:
1) The connection should be tight and proper
2) The Instrument used should be of proper range.
3) Do not touch live wire and wear shoes for proper insulation.
4) Do not change connections without switching off connections.

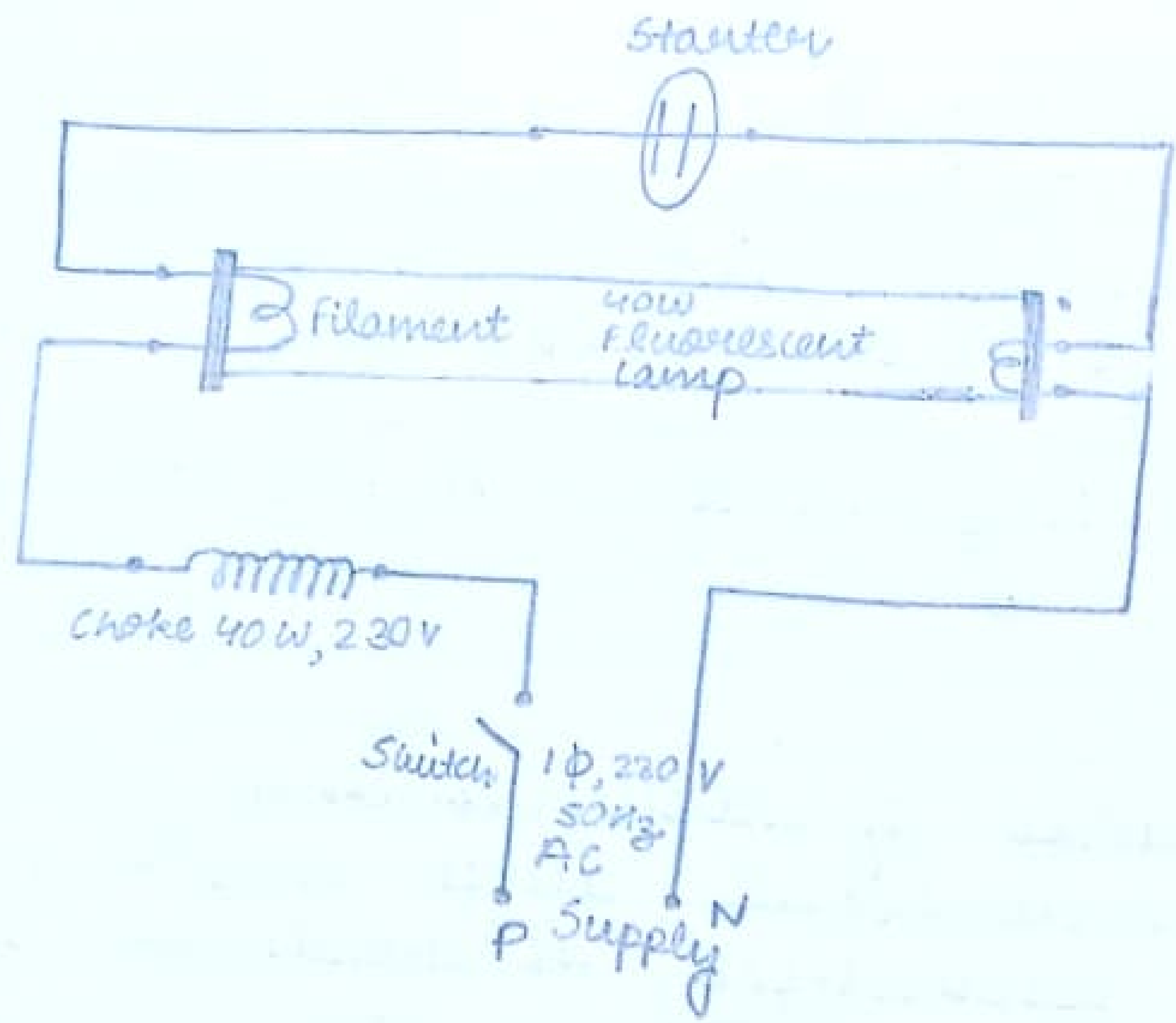
Objective: To make connections of a fluorescent lamp wiring and to measure power.

Apparatus Required:
1. Fluorescent lamp fixture 4ft - one
2. Fluorescent lamp 40W - one
3. Choke 40 W, 230V - one
4. Starter one
5. Connecting wires - As per required

Theory:

The electrode of starter which is enclosed in a gas bulb filled with argon gas, cause discharge in argon gas with consequent heating.
Due to heating, the bimetallic strip bends and causes in starter to close.
When sudden break in circuit occur due to moving apart of starter terminals this cause a high value of emf be induced in a choke.
The fluorescent lamp is a low pressure mercury lamp is a long evacuated tube.
A starter helps to start the tube and break the circuit. The choke coil is also called blast.

Circuit diagram :



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EXPERIMENT NO:.........................

Date:

The function of choke is to start increase voltage to almost 1000V at time of switching of tube and when tube starts working.

Observations

SNO	V	I	Power
1	230V	3·20 A	40V X 10 Hs =400 WHs

Result : Energy Consumption = 400 WHs
0·40 kWh (Unit)

Precautions :

Do not touch live wire.

Take all readings very carefully.

Always wear shoes.

MIET MEERUT INSTITUTE OF ENGINEERING & TECHNOLOGY

EXPERIMENT NO:.........................

Date:

Objective: To observe the B-H loop of a ferromagnetic material in CRO.

Apparatus Required.

SNO	Equipments	Quantity
1.	B-H Curve kit	1
2.	CRO	1

Theory:

The term magnetic materials are used to represent the substance which posses spontaneous magnetization below a critical temperature.

To obtain BH Curve. The step down transformer with different output voltage is used to adjust magnetizing current in the circuit.

This current is measured with an AC supply ammeter and voltage developed by it across a small resistance r is applied to X plates of the CRO. This is used to measure of (H) the output of pickup coil, eq is applied to an integrating circuit consisting of Resistance R and Capacitance C. of suitable time constant RC.

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EXPERIMENT NO:..........................

Date:

Precaution :

Do not touch live wires.
Take all readings very Carefully.
Always wear Shoes

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EXPERIMENT NO:........................

Date:

Objective – To measure power and power factor in a single phase ac series inductive circuit and improve power factor using capacitor.

Apparatus Required :

SNO	Name	Quantity
1	Digital Wattmeter	01
2	Digital Ammeter	01
3	Digital Voltmeter	01
4	Variable Resistance	01
5	Inductive Coil	01
6	Capacitive	01
7	Patch Cords	–

Theory: The ratio between real power and apparent power is called power factor. $\cos\phi = \frac{\text{Active Power}}{\text{Apparent Power}}$ or $\frac{R}{Z}$

Also, $I \propto \frac{1}{\cos\phi}$

If p.f is low, then I is high or vice versa.

Active power $P = VI\cos\phi$ (W)

Reactive Power $Q = VI\sin\phi$ (VAR)

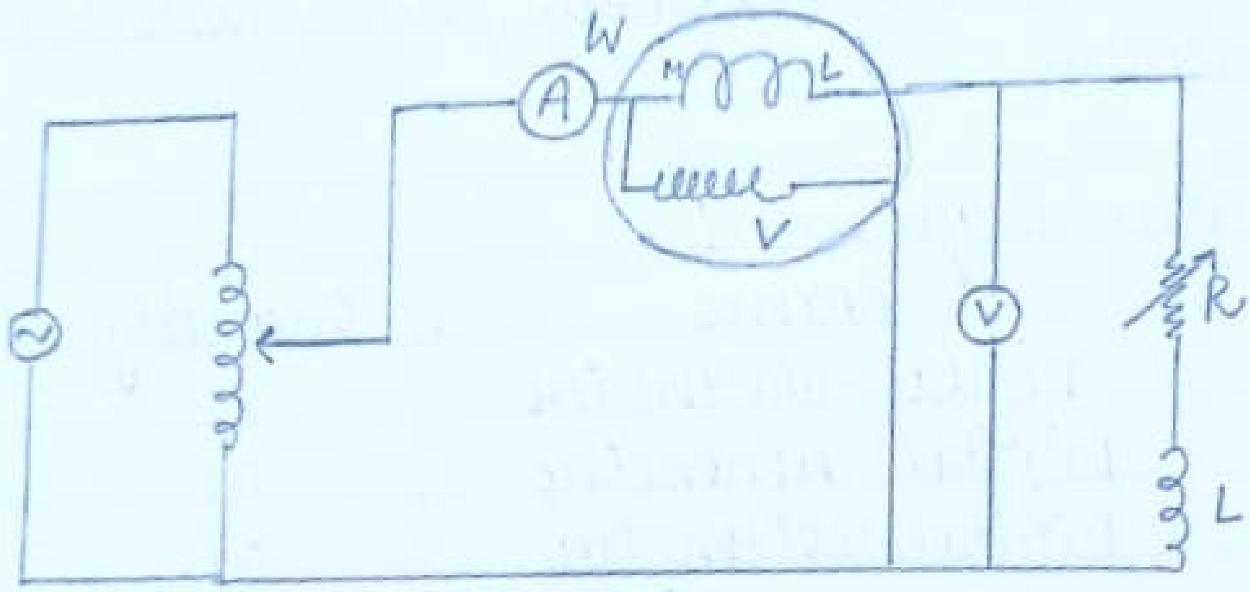
Apparatus Power $S = VI$ (VA)

$\sqrt{P^2+Q^2}$

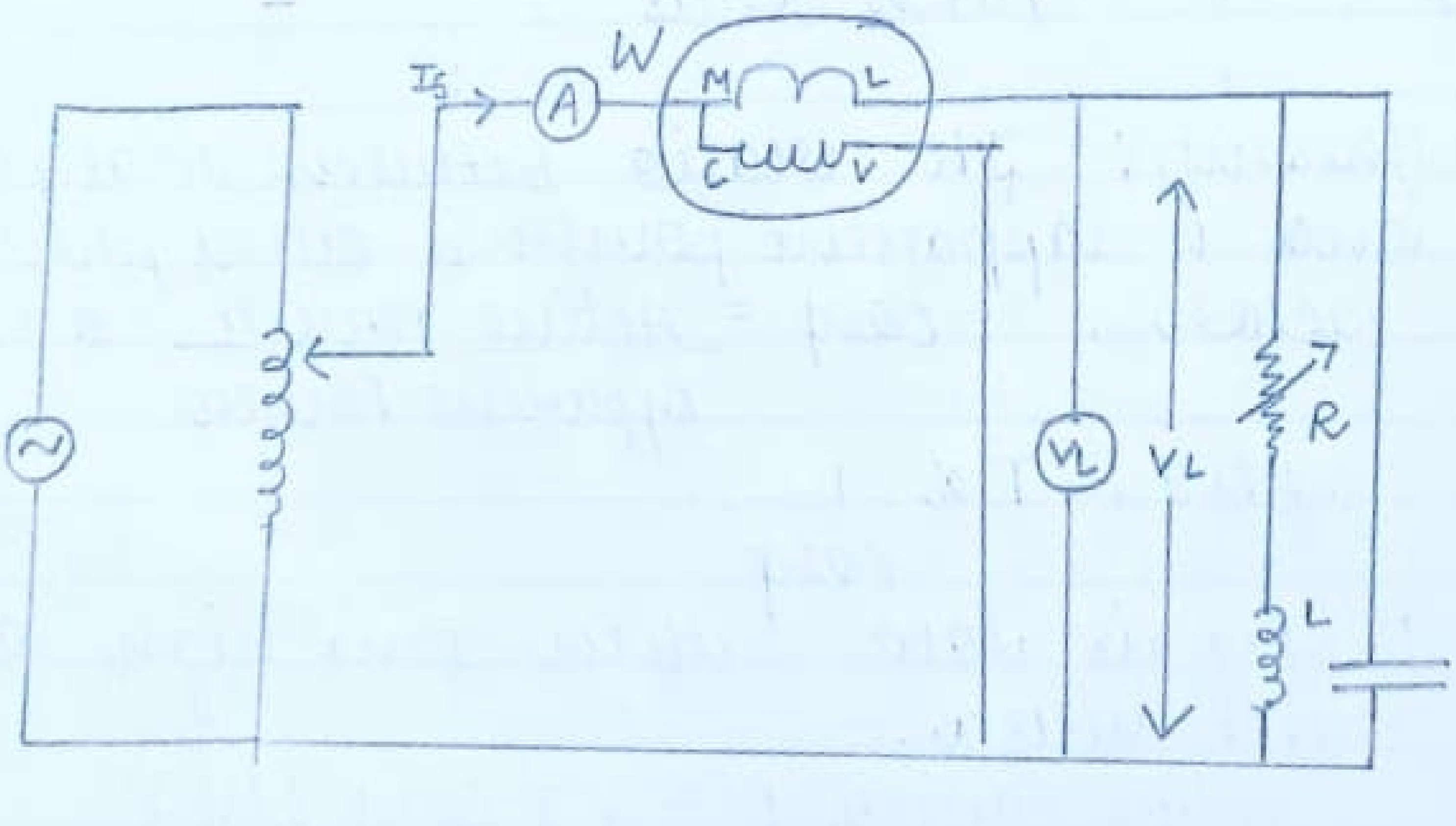
Power factor $= \frac{P}{S}$

Connection Diagram

a) without Shunt Capacitor



b) with shunt Capacitor



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EXPERIMENT NO:........................

Observations : Date:

a) without shunt Capacitor :

SNO	V(VOLT)	P(Watt)	I_s(Amp)	$\cos\phi = P/I_sV$
1.	90V	7.92W	0.139A	0.633
2.	105V	17W	0.211A	0.767
3.	120V	24W	0.28A	0.863

b) with shunt Capacitor :

SNO	V(Volt)	P(Watt)	I(Amp)	$\cos\phi = P/IV$
1	90V	7.8W	0.105A	0.823
2	105V	16.6W	0.175A	0.903
3	120V	29.5W	0.25A	0.983

Result :

on comparing table a) and b) power factor is improved

Precautions :

Don't touch the live wire

Take all readings very carefully

Always wear shoes

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