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(9)	To study the construction of d.c machine	17-18	28.05.21		
(10)	Questions	19	28.05.21		

Date 9-04-21

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Electrical Safety Rules

① Do not renew a blown fuse until you are satisfied as to the cause & rectified the irregularity

② Do not close any switch unless you are familiar with the circuit which it controls and know the reason for its being open

③ Do not touch or temper with any electrical gear or conductor, unless you have made sure that it is Dead & Earthed

④ Do not work on the live circuit without the express orders of the supervisor. Make certain that all safety precautions have been taken and you are accompanied by a second person competent to render First Aid & Artificial Respiration

⑤ Do not disconnect earthing connections or render of ineffective the safety gadgets installed on the mains and apparatus

⑥ Do not open or close switch or fuse slowly or hesitatingly. Do it quickly and positively

⑦ Do not use wire with poor insulation

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(8) Do not touch an electric circuit when your hands are wet or bleeding from a cut or abrasion

(9) Do not work on energized circuits without taking extra precaution, such as the use of rubber gloves

(10) Do not disconnect a plug by pulling a flexible cable when switch is on

(11) Do not use fire extinguisher on electrical equipment unless it is clearly marked for that purpose. Use sand and blanket instead

(12) Do not throw water on live electrical equipment in case of fire

(13) Do not attempt to disengage a person in contact with a live apparatus which you can not switch of immediately Insulate yourself from earth by standing of rubber

(14) Do not discontinue artificial respiration until recovery or death is certified by doctor

(15) Do not allow visitors and unauthorized persons to touch or handle electrical apparatus or come within the danger zone of H V apparatus

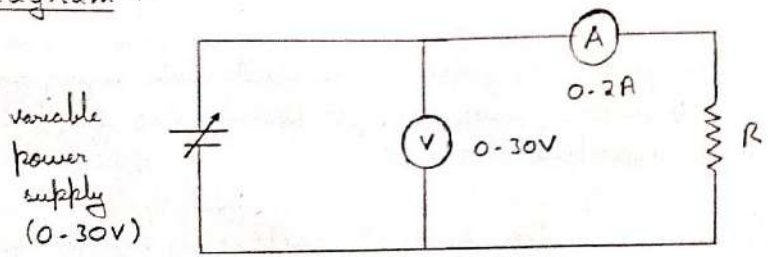
(16) Do not test circuit with bare hands

Teacher's Signature _____

Aim → To verify Ohm's law & its limitations

Apparatus →
① DC power supply 0-30V
② Voltmeter 2V-30V DC
③ Ammeter 2A DC
④ Trainer Kit
⑤ Connecting leads, etc

Diagram →



Observation Table →

S. NO.	Voltage (V)	Current (I)	Resistance (Ω)
1	5.0V	0.19A	26.3
2	10V	0.38A	26.3
3	15V	0.57A	26.3
4	20V	0.76A	26.3
5	25V	0.96A	26.0
6	30V	1.15A	26.0

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EXPERIMENT-1

Aim → To verify Ohm's law & its limitations

Apparatus →
① DC power supply 0-30V
② Voltmeter 2V-30V DC
③ Ammeter 2A DC
④ Trainer Kit
⑤ Connecting leads, etc

Theory → The ratio of potential difference (V) between any two points on a conductor the current (I) flowing between them is constant providing the temperature of conductor does not change.

In other words, V/I = Constant = R
where, R is the resistance between two points considered. It simply means that provided R is kept constant current is directly proportional to voltage. Ohm's law has a limitation that the temperature of resistance should not change.

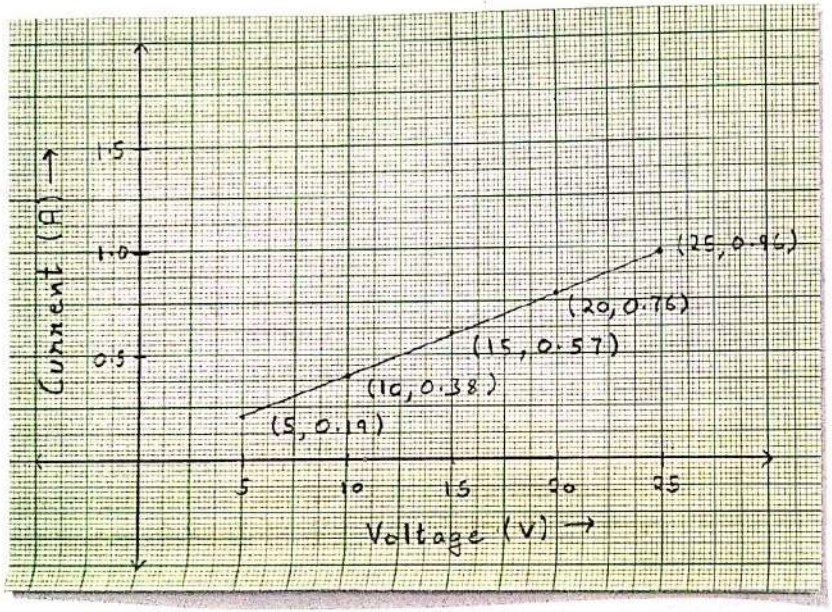
Procedure →

① Make the connections shown in figure
② Change the input DC supply and note down reading of voltmeter and ammeter and take four readings to verify ohm's law plot a graph.

Teacher's Signature _____

	Voltage (V)	Current (I)	Resistance (R)
Resistance At Room Temp	5V	0.13A	38.46 Ω
Resistance After Raising Temp	5V	0.09A	55.55 Ω

To verify Ohm's Law Limitations →



Result → Hence, Ohm's law & its limitations are proved

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③ Now raise the temperature of the resistance by connecting it to 230V AC

④ Repeat the experiment with DC supply and find out change in resistance after raising the temperature of resistance

Result → Hence, Ohm's Law and its limitations are proved

Teacher's Signature

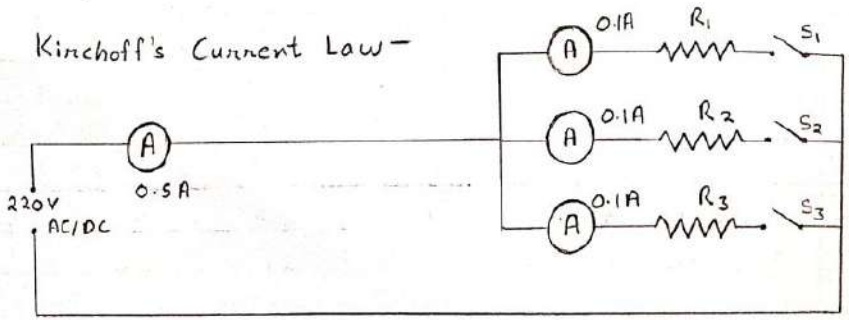
Aim → a) To verify Kirchoff's current law
b) To verify Kirchoff's voltage law

Apparatus → ① Trainer Kit
- To verify Kirchoff's current law
- To verify Kirchoff's voltage law

② AC supply 220V/440V
③ Connecting leads, etc

Circuit Diagram →

Kirchoff's Current Law –



S. No.	I_1	I_2	I_3	$I = I_1 + I_2 + I_3$
1	0.8	0	0	0.8
2	0.8	0.8	0	1.6
3	0.8	0.8	0.75	2.35

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EXPERIMENT - 2

Aim → a) To verify ~~Kirch~~ Kirchoff's current law
b) To verify Kirchoff's voltage law

Apparatus → ① Trainer Kit
- To verify Kirchoff's current law
- To verify Kirchoff's voltage law

② AC supply 220/ 440V
③ Connecting leads, etc.

Theory → Kirchoff's current law states that in any electrical network, the algebric sum of the current at a point (or junction) is zero. It simply means that the total current leaving a junction is equal to the total current entering that junction

Incoming current = Outgoing Current

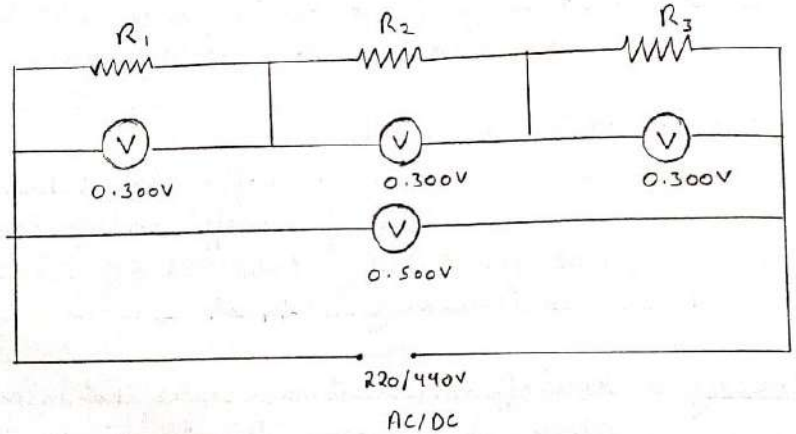
$$I = I_1 + I_2 + I_3$$

Kirchoff's voltage law states that the algebric sum of the products of current and resistance in each of the conductor in any closed path (mesh) in a network plus, the algebric sum of the emf's in that path is zero

$$\Sigma IR + \Sigma e.m.f = 0$$

Teacher's Signature _____

Kirchoff's Voltage Law -



S NO	V_1	V_2	V_3	$V = V_1 + V_2 + V_3$
1	140	140	130	410

Result → Hence, Kirchoff's current law & Kirchoff's voltage law are verified

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The algebric sum is that sum which takes into account the polarities of voltage drops

$$V = V_1 + V_2 + V_3$$

Procedure →

① For current law, give the 220V supply to the given circuit. Note down the value of current from each ammeter i.e I, I_1, I_2, I_3. Take different sets of reading by varing input voltage

$$I = I_1 + I_2 + I_3$$

② For voltage law, connect three loads in series as shown in fig. give 220V / 440V supply. Note down the reading on each voltage

$$V = V_1 + V_2 + V_3$$

Take different sets of readings by varing input voltage

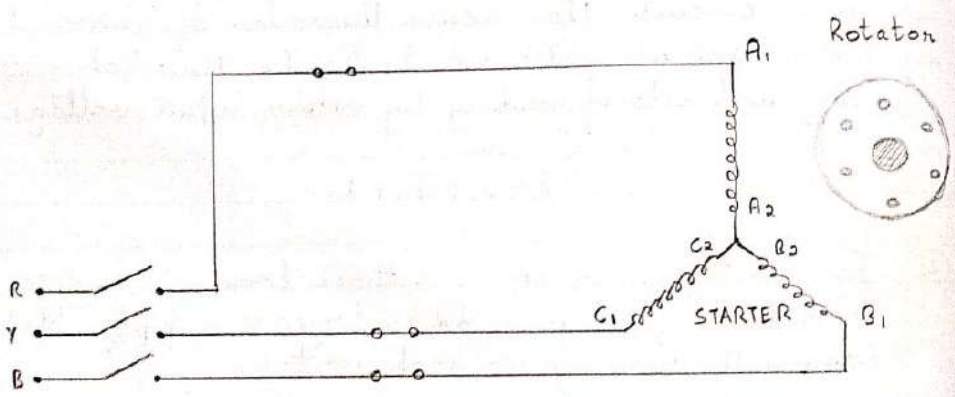
Result → Hence, Kirchoff's current law and Kirchoff's voltage law are verified

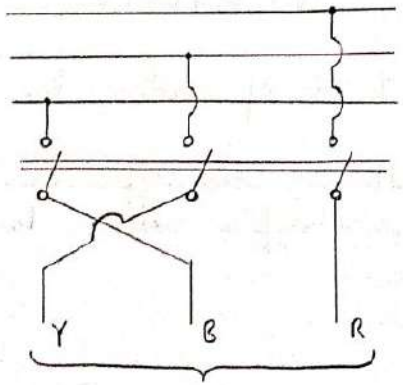
Teacher's Signature

Aim → To connect, start & reverse the direction of 3 phase conduction motor

Apparatus → ① Three phase induction motor
② star - delta starter

Circuit Diagram →





TPST SWITCH

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EXPERIMENT - 3

Aim → To connect, start & reverse the direction of 3 phase induction motor

Apparatus → ① Three phase induction motor
② Star delta starter

Theory → The motors connected to the mains through a ~~del~~ star - delta starter and TPST switch interchanging any two terminals at the TPST switch can reverse the direction of rotation

Procedure →

① Make the connections to the motor through TPST switch & star - delta starter
② Switch on TPST with auto transformer starter kept at minimum position
③ Now slowly increase the voltage through auto transformer until motor catches full speed
④ Observe the direction of motor
⑤ Stop the motor by opening TPST switch & bring the auto - transformer starter at minimum position
⑥ Interchange the two leads of the motor to the TPST switch
⑦ Repeat step 2 to 5

Teacher's Signature _____

RESULT → The direction of rotation of the motor in second case is found to be opposite to that in first case

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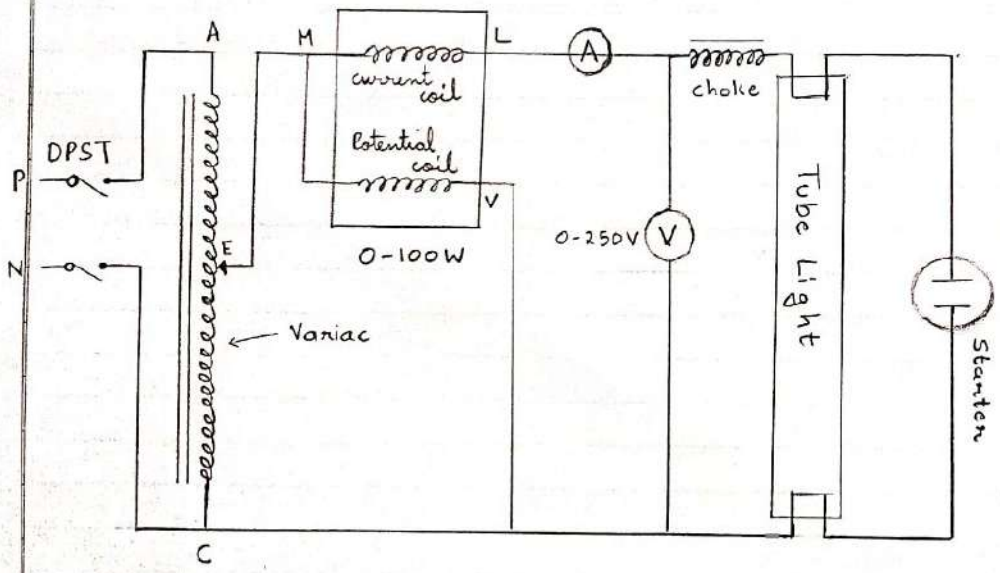
Result → The direction of rotation of the motor in second is found to be opposite to that in first case

Teacher's Signature

Aim → To measure the minimum operating voltage, current drawn, power consumed & the power factor of a fluorescent tube light

Apparatus → A 400W tube set (consisting of 40W fluorescent tube rod, starter & ballast) a variac, a DPST switch, a wattmeter, a ammeter & Voltmeter and connecting wires

Circuit Diagram →



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EXPERIMENT-4

Aim → To measure the minimum operating voltage, current drawn, power consumed & the power factor of a fluorescent tube light

Apparatus → A 400W tube set (consisting of 40W fluorescent tube rod, starter & ballast) a variac, a DPST switch, a wattmeter, a ammeter & voltmeter & connecting wires

Theory → The power factor of a fluorescent tube light is

$$\text{Power factor} = \cos\phi = \frac{W}{VI}$$

Where W (Wattmeter reading) is the actual power of AC load, V is voltmeter reading (operating voltage) & I is ammeter reading (operating current)

Procedure →

① Draw the circuit diagram, arrange the various components of the circuit as shown in the circuit & connect them

Teacher's Signature _____

Observations →

S. No.	Voltmeter Reading in Volt (V)	Ammeter Reading in Ampere (I)	Wattmeter Reading in Watt (W)	Power Factor ($\cos\phi = W/VI$)
1	180	0.15	15	0.55
2	200	0.22	23	0.52
3	220	0.25	32	0.58

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② Bring the variac at the minimum point and switch on DPST switch

③ Increase the applied voltage to the circuit by moving, sliding the knob of the variac slowly & so that the tube ~~to~~ just set on

④ Record the reading of wattmeter, voltmeter & ammeter

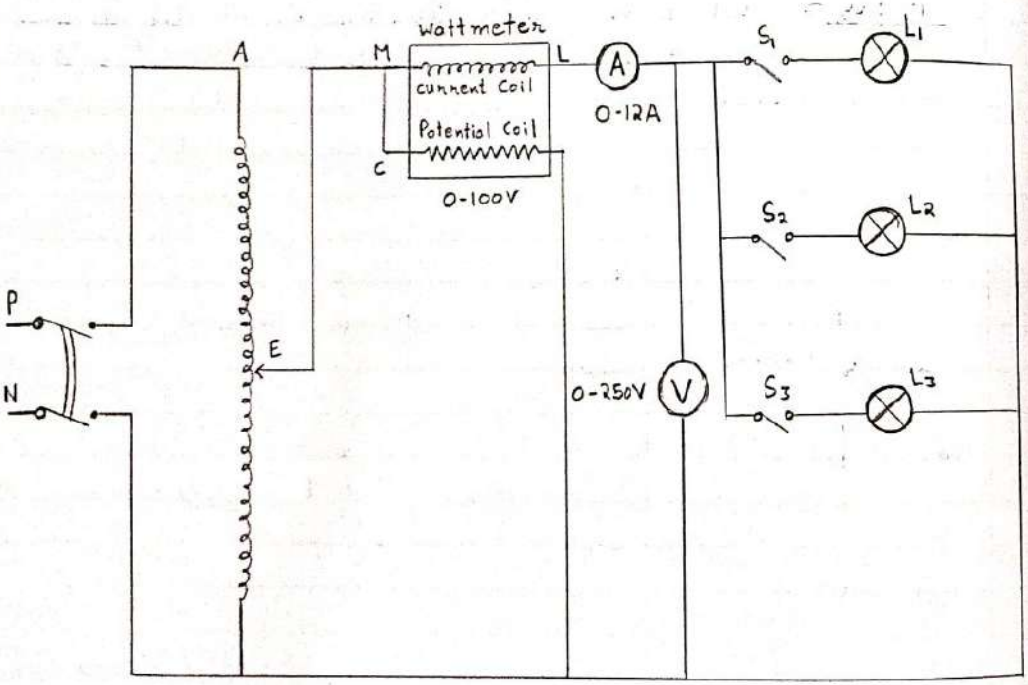
⑤ Calculate the power factor from the readings.

Teacher's Signature

Aim → To verify the rating of compact fluorescent lamp (CFL)

Apparatus Required → A 25 W C.F.L lamp, a variac, a DPST switch, a wattmeter, ammeter & voltmeter and connecting wires.

Circuit Diagram →



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EXPERIMENT - 5

Aim → To verify the rating of compact fluorescent lamp (CFL)

Apparatus Required → A 25 W C.F.L lamp, a variac, a DPST switch, a wattmeter, ammeter & voltmeter & connecting wires

Theory → The spiral CFL was invented in 1976 by Edward E. Hammer an engineer with general electric. The power factor of a CFL lamp is given by,

$$\text{Power Factor} = \cos\phi = W/VI$$

Where W (wattmeter reading) is the actual power of AC load, V is voltmeter reading (operating voltage) & I is ammeter reading (operating current)

Procedure → ① Draw the circuit diagram, arrange the various components of the circuit as shown in the figure & connect them

② Bring the variac at the maximum point & switch on DPST switch

③ Increase the applied voltage to the circuit by moving sliding the knob of variac slowly & so that the CFL just turns on

④ Record the readings of Wattmeter, voltmeter and the ammeter

Teacher's Signature _____

Observations →

S.No.	Rated Voltage On Lamp	Volt-meter Reading	Rated Current On Lamp	Ammeter Reading	Rated voltage On Lamp	Watt-meter Reading	Power factor On Lamp	P.F Cos ϕ
1	2.30	2.30	120 mA	0.12	25	17.8	0.85	0.63
2	2.30	2.30	120 mA	0.11	25	17.5	0.85	0.63
3	2.30	2.30	120 mA	0.10	20	17.5	0.84	0.58

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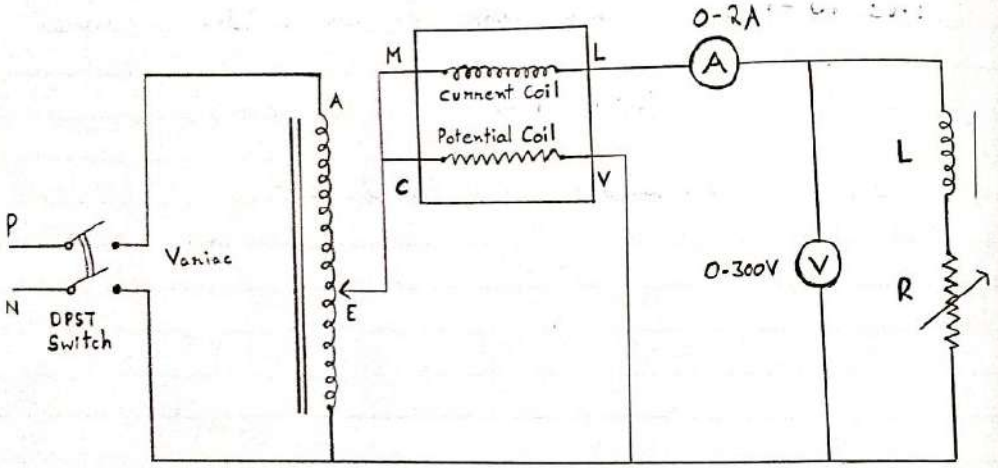
⑤ Calculate the rating of CFL

Teacher's Signature

Aim → To find the voltage - current relationship and power factor of a given R-L series circuit

Apparatus Required → ① One resistor & one choke coil
② One AC ammeter of range (0-2A)
③ One AC voltmeter of range (0-300V)
④ One AC wattmeter of range (0-1200W)

Circuit Diagram →



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EXPERIMENT - 6

Aim → To find the voltage - current relationship & Power factor of a given R - L series circuit

Apparatus Required → ① one resistor & one choke coil
② one AC ammeter of range (0-2A)
③ One AC voltmeter of range (0-300V)
④ One AC wattmeter of range (0-1200W)

Theory → For R-L series load to draw the phaser diagram, current I is taken as reference voltage drop in resistance V_R (=IR) is taken in phase with current vector, ~~whereas~~ whereas voltage drop in inductive vector. The vector sum of these two voltage drops is equal to the applied voltage V

$V_R = IR$ & $V_L = X_L I$

In right angle triangle OAB

$V = \sqrt{(V_R)^2 + (V_L)^2} \Rightarrow V = I\sqrt{R^2 + X_L^2}$

From the reading of voltmeter (V) & Ammeter (A) & wattmeter (W). Power factor can be calculated as

$$\text{Power factor (P.F)} = \frac{W}{VI}$$

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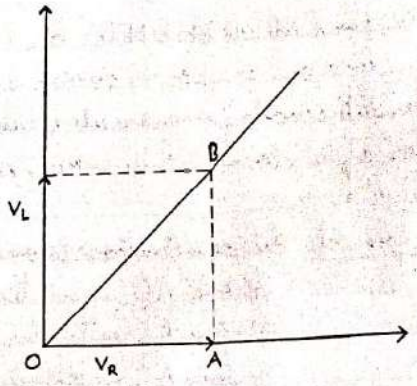

Observations →

S.No.	Voltmeter	Ammeter	Watt meter	Power Factor
1	200	0.5	80	0.8
2	285	1.2	170	0.54
3	300	1.5	170	0.38

Result → Voltage current relationship in R-L Circuit is

$$V = I\sqrt{R^2 + X_L^2}$$

Also, Power factor is given as

$$p.f = \frac{W}{VI}$$

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Procedure → ① Make the connections as shown in the diagram and get the connections checked by instructor

② Bring the variac at lowest point and switch on the supply

③ Increase the voltage through variac in steps and take the readings of voltmeter, ammeter & wattmeter

④ Plot the variation of current with voltage

Result → As a result, the voltage - current relationship in R-L series circuit is given as :-

$$V = I\sqrt{R^2 + X_L^2}$$

Also Power factor is given as :-

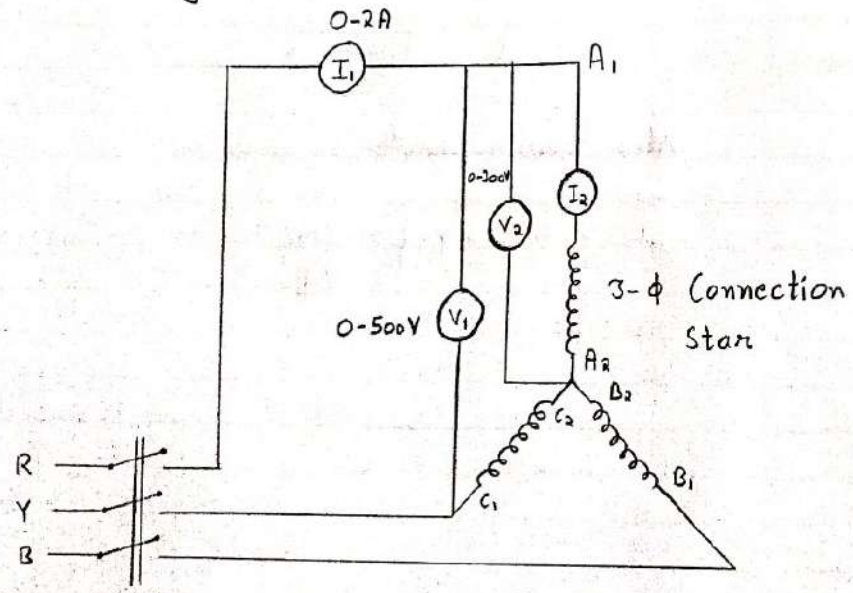
$$p.f = \frac{W}{VI}$$

Teacher's Signature

Aim → To find out the relationship between line voltage & phase voltage, relationship between line current & phase current relationship in case of star-connected & Delta connected 3 ϕ balanced load

Apparatus → ① Two ammeter of ranges (0-2A, 0-1A)
② Two voltmeter of ranges (0-500 V) (0-300 V)

Circuit Diagram →



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EXPERIMENT-7

Aim → To find out the relationship between line voltage & phase voltage, relationship between line current & phase currents relationship in case of star-connected & Delta-connected 3 ϕ balanced load

Apparatus → ① Two ammeter of ranges (0-2A, 0-1A)
② Two voltmeter of ranges (0-600 V) (0-300 V)

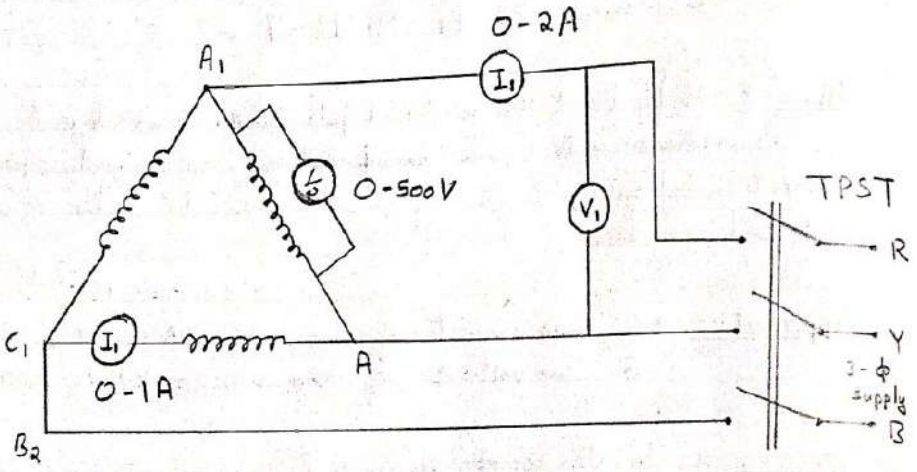
Theory → In star connection,
Same amount of current flows in phase winding as well as line conductor
So, $I_L = I_{ph}$

$E_{ph} = V_{ph}$ = phase voltage (b/w P- Neutral wire)
$E_L = V_L$ = line voltage (b/w 2 outers like R-Y)
$E_{RY} = E_R - E_Y$
Phase angle b/w E_R & E_Y is 60°

$$E_{RY} = \sqrt{E_R^2 + E_Y^2 + 2E_R E_Y \cos 60^\circ}$$
$$E_{RY} = \sqrt{E_R^2 + E_Y^2 + 2E_R E_Y \times 0.5}$$

As circuit is balanced so,
$E_R = E_Y = E_B = E_{ph}$
$\therefore E_{RY} = \sqrt{3}\, E_{ph}$
Line voltage = $\sqrt{3}$ phase voltage

Teacher's Signature _____



Observation Connection	Table Voltmeter Reading (V_1) in (Volts)	Voltage Reading (V_2) in (Volts)	Ammeter reading (I_1) in Ampere	Ammeter Reading (I_2) in Ampere	$\frac{V_L}{V_2}$	$\frac{I_1}{I_2}$
Star	207	120	0.11	0.11	1.725	1
Delta	207	207	1.28	0.75	1	1.73

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In Delta connection,

Line current, $I_R = I_{YR} - I_{RB}$

$I_R = I_{YR} + (-I_{RB})$

Phase angle b/w these currents is 60°

$I_R = \sqrt{I_{YR}^2 + I_{RB}^2 + 2 I_{YR} I_{RB} \cos 60°}$

$I_R = \sqrt{3 I_{ph}^2}$ [$\because I_{RB} = I_{YR} = I_{BY} = I_{ph}$]

$I_R = \sqrt{3}\, I_{ph}$

Line current = $\sqrt{3}$ phase current

Here $V_L = V_{ph}$

Procedure → ① Make the connections as shown in fig. 1 star connection and got the connections check by instructor

② Take the reading of both the voltmeter & ammeter and calculate the values of I_L / I_{ph} & V_L / V_{ph} to determine the relation between line voltage (V_L) and phase voltage (V_{ph}) and between line current (I_L) and phase current (I_{ph})

③ Now change the connections as shown in fig 2 for delta connections

④ Take the readings of both the voltmeter & ammeter and calculate the values for I_L / I_{ph} and V_L / V_{ph} to determine the relationship between the line voltage (V_L) & phase voltage (V_{ph}) and between line current (I_L) and phase current (I_{ph})

Result → Current ratio in star connection = 1

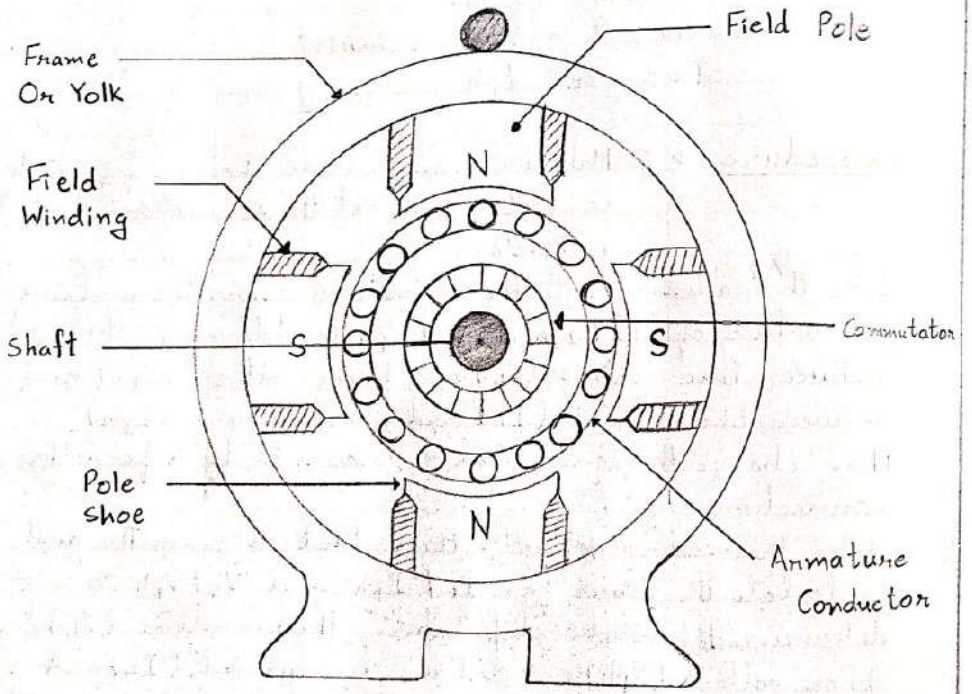
Current ratio in delta connection = 1:73

Teacher's Signature _____

Aim → To study the construction of d.c machine

Apparatus → Yoke, Pole core & pole shoes, pole coil & field coil, Armature core, Armature winding otherwise conductor, commutator, brushes & bearings

Circuit Diagram →



Construction Of DC Machines

EXPERIMENT - 8

Aim → To study the construction of d.c machine

Apparatus → Yoke, Pole core & pole shoes, pole coil & field coil, Armature ~~coil~~ core, Armature winding otherwise conductor, commutator, brushes & bearings

Theory → Construction Of DC Machine → The parts of DC machine are discussed below

① Yoke → Another name of a yoke is the frame. The main function of the yoke in the machine is to offer mechanical support intended for poles and protects the entire machine from moisture, dust, etc

② Pole And Pole Core → The pole of the DC machine is an electromagnet and the field winding is winding among pole. Whenever field winding is energized then the pole gives magnetic flux

③ Pole Shoe → Pole shoe in the DC machine is an extensive part as well as to enlarge the region of the pole. Because of this region, flux can be spread out within the air gap as well as extra flux can be passed through the air space toward armature

Teacher's Signature

④ Field Windings → In this, the windings are wounded in the region of the pole core & named as field coil. Whenever current is supplied through field winding then it electromagnetics the poles which generate required flux

⑤ Armature Coil → Armature core includes a huge number of slots within its edge. The armature conductor is located in these slots. It provides the low-reluctance path toward the flux generated with field winding

⑥ Armature Winding → The armature winding can be formed by interconnecting the armature conductor. Whenever an armature winding is turned with the help of prime mover then the voltage, as well as magnetic flux, gets induced within. The winding is allied to an exterior circuit

⑦ Commutator → The main function of the commutator in the DC machine is to collect the current from the armature conductor as well as supplies the current to load using brushes. And also provides uni-directional torque for DC motor

⑧ Brushes → Brushes in the DC machine gather the current from the commutator and supply it to the exterior load. Brushes wear with time to inspect frequently

Date

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ques 1 Why do we connect ammeter in series ?

ans An ammeter is a device which measures the amount of current flowing in a circuit. It is a very low resistance device. If it will be connected in parallel, it would draw most of the current & would get damaged. Hence, it is connected in series

ques 2 Why do we connect voltmeter in parallel ?

ans A voltmeter measures the potential difference of the circuit and it has high internal resistance. When the voltmeter is connected in parallel with a circuit component, the amount of current passing through the voltmeter is very less. Therefore, the current through the circuit is unaltered

ques 3 Why M and C is short circuit in wattmeter ?

ans In a wattmeter there are four terminals. M, L which are the coils and C, V which are called as pressure coils. To measure the current the measuring instrument should be placed in series with the load but in case of voltage, the instrument should be connected in parallel to the load, therefore M from the current coil & C from the pressure coil are can be short circuited to measure the power of the given circuit

Teacher's Signature