

# **C.V. RAMAN POLYTECHNIC**

## **BHUBANESWAR**



### **LAB MANUAL**

**Year & Semester: 3<sup>RD</sup> Year, VI Semester**

**Subject Code: PR-1**

**Subject Name: ELECTRICAL WORKSHOP PRACTICE**

**DEPARTMENT  
OF  
ELECTRICAL ENGINEERING**

## **VISION OF DEPARTMENT**

To develop technically skilled Electrical Engineers contributing to sustainable development and technological advancement.

## **MISSION OF DEPARTMENT**

- To implement an effective teaching-learning process to develop skilled electrical engineers
- To provide technical and entrepreneurial skills to students and make them ready to be Placed in industry.
- Encouraging the students to pursue higher education and career-oriented courses.
- Developing ethics in students as well as responsibility towards the environment and The society

## **PROGRAM OUTCOMES (PO)**

<b>PO1</b>	Basic and discipline-specific knowledge
<b>PO2</b>	Problem analysis
<b>PO3</b>	Design/development of solutions
<b>PO4</b>	Engineering tools, experimentation, and testing
<b>PO5</b>	Engineering Practices for society, sustainability, and environment
<b>PO6</b>	Project Management
<b>PO7</b>	Lifelong Learning

## COURSE OBJECTIVE AND COURSE OUTCOMES

### PRACTICAL COURSE OBJECTIVE

- Develop Proficiency in Cable Identification and Joint Preparation.
- Master Cable Cutting, Crimping, and Lighting System Testing.
- Understand Battery Charging and Residential Wiring Techniques.
- Enhance Fault Finding and Repair Skills for Electrical Appliances and Motors.
- Acquire Skills in Motor Maintenance and Testing.

### PRACTICAL COURSE OUTCOMES (CO)

Course Name	Statements
CO1	Identification and Preparation of Cable Joints
CO2	Cable Cutting, Crimping, and Testing
CO3	Battery Charging and Residential Wiring.
CO4	Fault Finding and Repair of Electrical Appliances and Motors.
CO5	Maintenance and Testing of Electrical Systems.

## MAPPING OF LABORATORY EXPERIMENTS OF ELECTRICAL WORKSHOP PRACTICE TO DEFINED CO

SL NO	EXPERIMENT NO	COURSE OUTCOME
1	1,2	C01
2	3	C02
3	4,5	C03
4	6,7,8	C04
5	910	C05

## MATRIX OF COs AND POs

Course Outcomes	Expected Mapping of COs with Programme Outcomes (POs) (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)							Average CO
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
C01	3.0	2.0	1.0	2.0	2.0	-	2.0	2.0
C02	3.0	3.0	2.0	2.0	3.0	-	2.0	2.5
C03	3.0	3.0	2.0	3.0	-	-	2.0	2.6
C04	3.0	3.0	2.0	3.0	-	-	2.0	2.6
C05	3.0	3.0	2.0	2.0	3.0	1.0	2.0	2.3
Average PO	3.0	2.8	1.8	2.4	2.7	1.0	2.0	2.2 2.4

### **Program Specific Outcomes (PSOs):**

**PSO1:** Ability to apply electrical engineering knowledge, skills for testing, control & maintenance of electrical systems such as Machines, Power Systems, Drives & Automation.

**PSO2:** Ability to identify problems in the diversified areas of Electrical Engineering and determine the hardware or software solutions to support the Societal, Environmental & Industrial needs.

### **MATRIX OF COs AND PSOs**

<b>CO/PSO</b>	<b>PSO1</b>	<b>PSO2</b>	<b>Average CO</b>
<b>CO1</b>	<b>3.0</b>	<b>2.0</b>	<b>2.5</b>
<b>CO2</b>	<b>3.0</b>	<b>3.0</b>	<b>3</b>
<b>CO3</b>	<b>3.0</b>	<b>3.0</b>	<b>3</b>
<b>CO4</b>	<b>3.0</b>	<b>3.0</b>	<b>3</b>
<b>CO5</b>	<b>3.0</b>	<b>3.0</b>	<b>3</b>
<b>Average PSO</b>	<b>3.0</b>	<b>2.8</b>	

## LIST OF EXPERIMENTS

SL. NO.	NAME OF THE EXPERIMENT	PAGE NO.
1	Identification of single core (ST), Twin core (TC), three core(3C), four core(4C), copper and aluminium PVC, VIR & weather proof (WP) wire and prepare Britannia T joint and married joint.	1 – 6
2	Cutting of copper and aluminum cable and crimping lug to them from 2.5 mm <sup>2</sup> to 6 mm <sup>2</sup> cross section.	7 – 8
3	Connection and testing of fluorescent tube light, high pressure M.V. lamp, sodium vapor lamp, M.H. lamp, CFL and latest model lamps – measure inductance, Lux / lumens (intensity of illumination) in each case-prepare lux table..	9 – 22
4	Study battery charger and make charging of lead acid battery.	23 – 26
5	Erection of residential building wiring by CTS and conduit wiring system using main two points and test installation by test lamp method and a megger.	27 – 31
6	Fault Finding and repairing of ceiling Fan and observation of different parts.	32 – 35
7	To study about different parts of DC generator with different type of faults and their remedies.	36 – 40
8	Find out fault of DC motor starter and AC motor starter – prepare an inventory list of parts used in different starter.	41 – 50
9	To dismantle, over haul and assemble a single phase capacitor start induction motor.	51 – 53
10	To dismantle ,over haul and assemble a three phase squirrel cage and slip ring induction motor and to test and run it.	54 – 59

## **EXPERIMENT- 01**

**AIM OF EXPERIMENT:-** Identification of single core (ST), Twin core (TC), three core (3C), four core (4C), copper and aluminium PVC, VIR & weather proof (WP) wire and prepare Britannia T joint and married joint.

### **Single Core Wire:-**



Single core cables are made up of a single conductor covered by PVC insulation. They are mainly used in power and lighting circuits, both domestic and commercial applications. They are also used in the internal wiring of appliances suitable for installation in conduits and trunking. Single core cables are a good conductor of electricity as well as heat. These cannot melt or burn easily.

A single core wire is a cylindrical strand of metal. In single core wire there is only a single core of metal is present, mostly copper or aluminium.

These wires are available in different thickness and gauges.

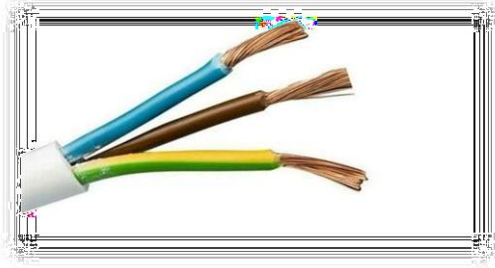
### **Twin Core Cable:-**



A range of flat thin wall twin core cables, suitable for automotive use.

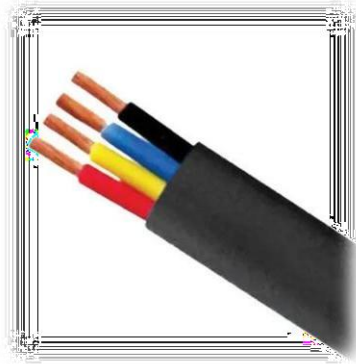
Thin wall low voltage cable, suitable for use in automotive and marine applications consists of conductors of stranded copper wire which are hard grade PVC insulated compared to stranded PVC cable, the reduced insulation thickness and higher current capacity greatly reduces weight and volume. For these reason, this cable is today used in reference to stranded PVC cable by vehicle manufacturers.

### **Three Core Cable (3C):-**



These cables are used generally for a perfect balanced 3 phase system. When the current on the 3 live wires of a 3-phase are equal and at an exact 120 degree phase angle, then the system is said to be balanced. The 3 phase loads are identical in all respects with no need of a neutral conductor.

#### **Four Core Cable:-**



When there is severe out of balance conditions, the amount of faulty current will raise to a very high level. Generally in the case of linear loads, the neutral only carries the current due to imbalance between the phases.

The non linear loads such as switch mode power supplies, computer, office equipments, lamp ballasts and transformers on low loads produce third order harmonic currents which are in the phase of all the supply phases.

These currents do not cancel at the star point of a three phase system as do normal frequency currents, but add up, so that the neutral carries very heavy third harmonic current.



## EXPERIMENT- 01 (A)

**AIM OF THE EXPERIMENT:-** To make a married joint of 7/22 P.V.C wire

**REQUIREMENT:-**

TOOLS			MATERIALS		
SI. NO	PARTICULARS	QUANTITY	SI. NO	PARTICULARS	QUANTITY
1.	Combination Plier	1	1.	P.V.C wire(aluminium)	30 cm
2.	Electrician knife	1	2.	Cotton waste	20 gms
3.	Side cutting plier	1			
4.	Steel rule	1			

**PROCEDURE:-**

1. Cut the wire in two equal pieces with the help of plier.
2. Remove the insulation up to the length of 7.5 cm from the other end as shown in fig. 2
3. The wires are scattered leaving the bare wire about 2.5 cm from the end of insulation as shown in fig. 3
4. Repeat the same process with the other piece of wire.
5. Cut off the central (middle) strand of each length with the help of side cutting plier as shown in fig.4.
6. Mix both piece of wire in such a way that they intersect each other as shown in fig.5
7. Hold one piece in left hand and wrap off the strand one by one over the other wires around the twisted conductor in opposite direction.
8. Cut the remaining conductor and round of the ends.
9. Repeat the same process on the other side with the second piece.
10. A complete married joint is shown in fig. 6

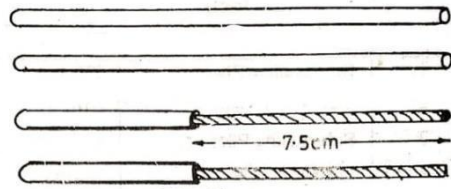


Fig. No.

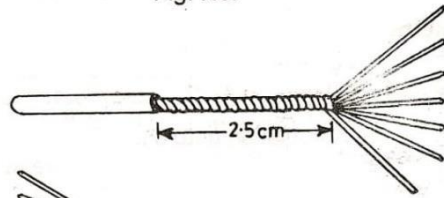


Fig. No.



Fig. No.

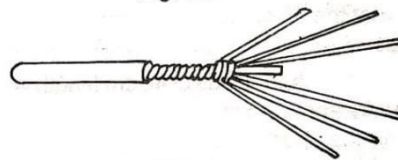
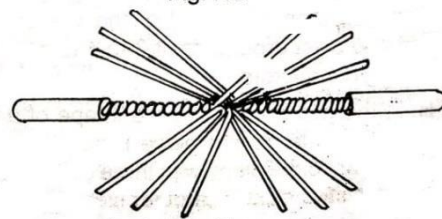


Fig. No.



**PRECAUTION:-**

1. There should not be any mark of cut by plier or knife on the conductor while removing the insulation.
2. The joint should be perfect in electrically as well as mechanically.
3. There should not be any gap in between turns.

**CONCLUSION:-** The tee joint is completed successfully.

**APPLICATION:-**

1. It is used to increase the length of cable.

## EXPERIMENT NO.-1(B)

**AIM OF EXPERIMENT:-**To make a Tee (T) joint of 7/22 P.V.C wire

**REQUIREMENT:-**

TOOLS			MATERIALS		
SI. NO	PARTICULARS	QUANTITY	SI. NO	PARTICULARS	QUANTITY
1.	Combination plier	1	1.	P.V.C wire(aluminium)	30 cm
2.	Electrician knife	1	2.	Cotton waste	20 gms
3.	Side cutting plier	1			
4.	Steel rule	1			

**PROCEDURE:-**

1. Cut the wire in two pieces of 15 cm length with the help of plier.
2. Remove the insulation up to a length of 6cm at the centre of running wire with the help of knife as shown in fig.2
3. Remove the insulation of about 10cm from one end of the tap wire as shown in fig. 2
4. Separate the strands of tap wire leaving the bare about 2.5 cm from the end of the insulation and divide the strands in two groups. 4 strands in one group and 3 –strands in other group as shown in fig-3 &4.
5. Bend the central strand of the vertical piece downward and twist around itself 3 to 4 turn and cut the remaining conductors.
6. Hold the two pieces like the shape of T and make the turn by 3 strands in one side and 3 strand in other side.
7. wrap the three strand of the vertical piece over the horizontal piece one by one closely and tightly.
8. Cut-off remaining conductors with the help of side cutting plier and round off the ends.
9. Repeat the same process on the other side in opposite direction as shown in fig.5

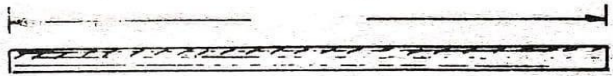


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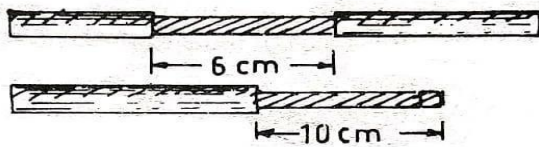


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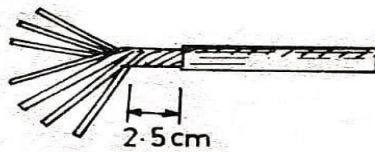


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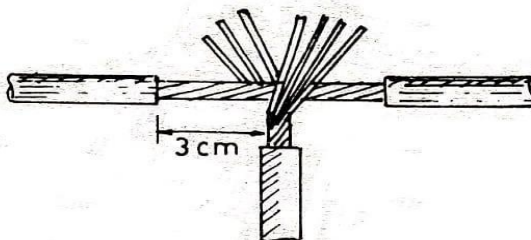


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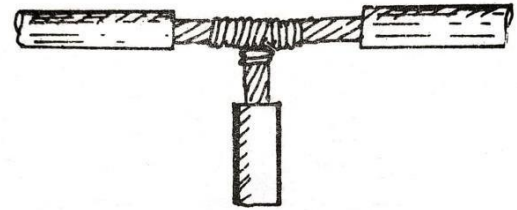


Fig. No.

### **PRECAUTION:-**

1. There should not be any mark of cut by plier or knife on the conductor while removing the insulation.
2. There should not be any gap between the turns.
3. The joint should be perfect in electrically as well as mechanically.

**CONCLUSION:-**The tee joint is completed successfully.

### **APPLICATION:-**

1. It is used to tap the electrical energy from the horizontal line.

### **DISCUSSION QUESTION**

1. What is S.W.G?
2. What are the different types of cables?
3. What are the different type of joints?
4. Why cable joint is necessary?

## EXPERIMENT NO.-02

**AIM OF EXPERIMENT:-** Cutting of copper and aluminum cable and crimping lug to them from 2.5 mm<sup>2</sup> to 6 mm<sup>2</sup> cross section.

### **REQUIREMENT:-**

TOOLS			MATERIALS		
SI. NO	PARTICULARS	QUANTITY	SI. NO	PARTICULARS	QUANTITY
1.	Combination plier	1	1.	Copper wire (4mm <sup>2</sup> )	10 cm
2.	Electrician knife	1	2.	Crimping lug	1 No.
3.	Side cutting plier	1			
4.	Steel rule	1			
5.	Crimping Tool	1			

### **PROCEDURE:-**

1. Remove the insulation of copper wire at its one end up to 30 mm.
2. The strip length should be equal to that of the cable lug barrel.
3. Fully insert the conductor in to the barrel of the cable lug.
4. Now keep the barrel of the lug on crimping die carefully and then compress the tool properly.

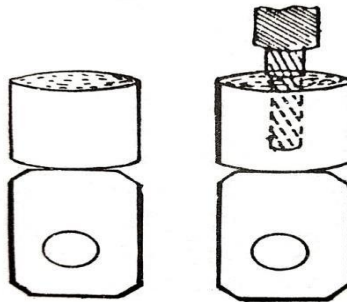


Fig. No.

### **PRECAUTION:-**

1. A correct cable lug should be chosen for the conductor type and size.
2. A correct crimping die should be used for cable lug.
3. The cable should not be loose in the lug.

**CONCLUSION:-** From this experiment we knew that how to crimping the lug by using crimping tool.

### **APPLICATION:-**

1. To make the perfect connection with the terminals of the electric motors etc. conductors are connected by putting them in the lug.

**DISCUSSION QUESTION:-**

1. What is crimper?
2. What is crimper lug?
3. What is the use of crimping Tool?
4. What does crimping wire means?

### **EXPERIMENT NO.-03**

**AIM OF EXPERIMENT:-** Connection and testing of fluorescent tube light, high pressure M.V. lamp, sodium vapor lamp, M.H. lamp, CFL and latest model lamps – measure inductance, Lux / lumens (intensity of illumination) in each case-prepare lux table.

## EXPERIMENT NO.-3 (A)

**AIM OF EXPERIMENT:-** To connect and test a fluorescent tube light.

**REQUIREMENT:-**

TOOLS			MATERIALS		
SI. NO	PARTICULARS	QUANTITY	SI. NO	PARTICULARS	QUANTITY
1.	Combination plier	1	1.	Fluorescent tube	1
2.	Electrician knife	1	2.	Tube Starter	1
3.	Side cutting plier	1	3.	Tube Choke	1
4.	Screw driver	1	4.	Tube Base	1
5.			5.	Test lamp	1

**THEORY:-**

Tube is made of glass with fluorescent powder coating to its inner surface. Tungsten filaments coated with barium oxide are placed at each side of tube. The mercury vapours with small quantity of argon gas at low pressure is filled up in the tube. Bi-pin caps are provided to its both ends for fixing the tube in holder.

When fluorescent tube is connect to supply through choke and tube starter, about 4 times to supply voltage, the voltage about 1000 volt is induced. Due to this filaments discharge the gas on heating and provide path for the flow of electrons as gas after discharge acts as a conductor. Mercury Vapours are vaporized and give full light.

The function of fluorescent powder coating is to change UV rays into light rays. It is available in different length and wattage and some common sizes are 20 watt(2ft),40 watt(4ft)

**Choke:-** It is designed by providing number of turns of winding wire on laminated core. Its function is to induced surge about four times voltage with respect to supply voltage

**Tube starter:-**Its function is like a ON-OFF switch to complete the circuit. There are two types of tube starter

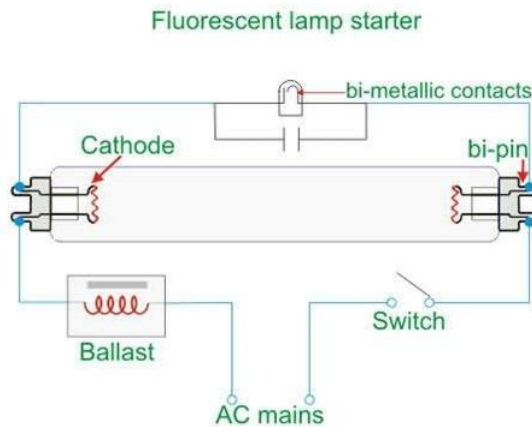
1. Glow type starter
2. Thermal type starter

Nowadays mostly glow type starter is used. It consists of two bimetallic strips with small quantity of helium gas at low pressure on very small gas tube. A very small condenser is connected in parallel to its terminals for reducing the sparking effect.

At the start the bimetallic strips remain open. Due to voltage at its terminals an electrical stress developed which discharge through the helium gas. Due to heat produced by this the bimetallic strips are short circuited and the flow of current stops through helium gas. In the meantime gas is cooled and bimetallic Strips again open. Thus a position of ON and OFF is achieved which glows the tube. Once the tube is ON



then, starter has no function.



### **PROCEDURE:-**

1. Draw connection diagram.
2. Fix the tube with tube base.
3. Connect phase wire to choke through switch.
4. Connect second terminal of choke holder.
5. Connect neutral to another holder terminal.
6. Connect starter holder terminal with one terminal of each tube holder.
7. Check the connection.
8. Switch ON the A.C supply.

### **PRECAUTION :-**

1. Connection should be correct and tight.
2. Phase wire should be connected to choke through switch.
3. The wattage of choke, starter, and fluorescent tube should be same.
4. Before fixing new tube test choke and starter.
5. Blackened side of tube indicates its life going to be completed.

### **COMMON FAULT IN FLUORESCENT TUBE THEIR CAUSSES AND REMEDIES**

#### **1 .FAULT :-TUBE FLICKERS**

Causes:-starter faulty, old tube, low voltage

Remedies:-

- a. Remove starter and test it.
- b. After removing starter, replace old tube.
- c. Check voltage with voltmeter.

#### **2. FAULT :-TUBE FILAMENTS GLOW ONLY**

Cause:-starter faulty.

Remedies :-Replace starter

### **3. FACULT :- TUBE GIVES NO LIGHT**

Cause:-starter faulty, choke faulty, tube faulty , no supply, open circuit.

Remedies:-

- a. Make and break the starter holder terminals with a piece of wire, if tube glow replace the starter.
- b. Test the choke & replace it if not in order
- c. Test the tube filaments with test lamp and replace it if not in order.
- d. Check the contact point of tube holder, if not in order replace holder.

### **4 .FAULT:- TUBE BURNT OUT SHORTLY OR TUBE ENDS BLACKENED**

Causes:- Tube weak

Remedies:-check resistance of choke and compare with new choke resistance, if not same replace choke.

### **5.FAULT:- TUBE JUST GLOW WHEN SWITCH IS OFF**

Cause:-phase wire is not controlled.

Remedies:-check phase wire with line tester and control it through switch.

**CONCLUSION:-** From above experiments we knew that how to connect and test a fluorescent tube.

## EXPERIMENT NO.- 3(B)

**AIM OF EXPERIMENT:-** To connect and test a High pressure mercury vapour lamp (H.P.M.V).

### REQUIREMENT:-

TOOLS			MATERIALS		
SI. NO	PARTICULARS	QUANTITY	SI. NO	PARTICULARS	QUANTITY
1.	Combination plier	1	1.	Mercury vapour lamp	1
2.	Electrician knife	1	2.	Choke	1
3.	Side cutting plier	1	3.	Holder	1
4.	Screw driver	1	4.	Test lamp	1
5.	Neon tester	1	5.	PVC insulation tape	1
			6.	PVC wire	As per required

### THEORY:-

- It consist of Evacuated glass bulb with another hard glass Evacuated glass tube in which two oxide coated tungsten filaments are placed at each end of the tube.
- A starting electrode near the upper main electrode through high resistance in series is placed.
- Inside the tube small quantity of mercury and low pressure argon gas is filled up.
- Here a choke coil is connected to the bulb which provides a high voltage at the time of starting to upper main electrode and starting electrode which discharge the gas and provide path for the flow of electron through main electrode.
- Because of low resistance it gives yellow blue light at the time of starting. After complete discharge of the gas and vaporization of mercury, it gives white bluish light within 3 to 5minutes.

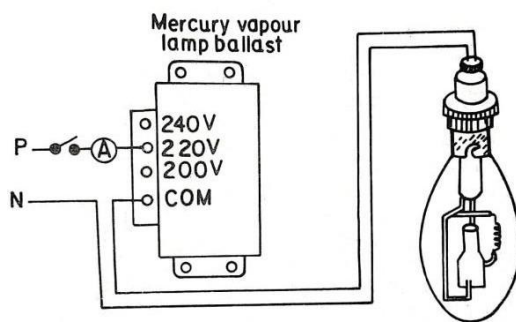
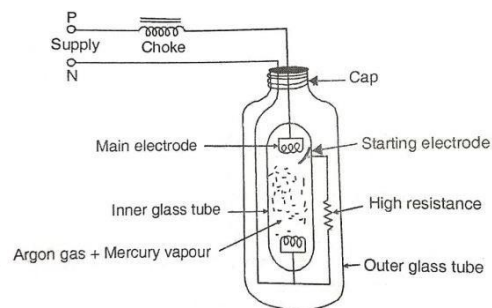


Fig. No.



High pressure mercury vapour lamp

**PROCEDURE:-**

1. Draw the connection diagram.
2. Test terminals of the choke by test lam and mark common terminals.
3. Connect one terminal of holder with choke common terminal.
4. Connect neutral to another holder terminal.
5. Check the connection.
6. Switch on the supply.

**PRECAUTION:-**

1. Connection should be correct and tight.
2. Lamp terminal should be connected with choke common terminal.

**CONCLUSION:-** From the above experiment we knew that how to connect and test a High pressure mercury vapour lamp.

**APPLICATION:-**

1. Microscopy, Molecular spectroscopy, Area and street lighting, Photolithography and Photo resistance

### EXPERIMENT NO.-3 (C)

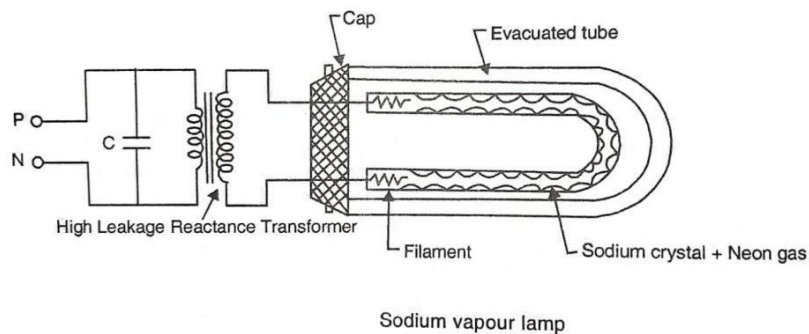
**AIM OF THE EXPERIMENT:-**To connect and test a sodium vapour lamp.

#### REQUIREMENTS:-

TOOLS			MATERIALS		
SI. NO	PARTICULARS	QUANTITY	SI. NO	PARTICULARS	QUANTITY
1.	Combination	1	1.	Sodium vapour lamp	1
2.	plier Electrician	1	2.	Auto transformer	1
3.	knife Side	1	3.	capacitor	1
4.	cutting plier	1	4.	PVC insulation tape	1
5.	Screw driver	1	5.	PVC wire	As per required
	Neon tester				

#### THEORY:-

- It consist of two 'U' shaped evacuated hard glass tubes. Inner tube is having sodium crystal and small quantity of neon gas with oxide coated tungsten filament on each side of the tube.
- Because of great effect of change of temperature on the lamp another evacuated outer tube is provided for safe guard.
- For starting the lamp, higher voltage about 380 to 450 volt is required. So for that a special type transformer known as reactance transformer having poor voltage regulation is used which supplies higher voltage at starting and then with the decrease in the resistance of gas after discharge the current increase in the tube.
- Thus, transformer gives normal working voltage about 110 volt. Due to use of poor regulation transformer. The power factor of the circuit falls and for that a capacitor is connected in parallel to supply to improve the power factor.
- During starting time, it gives reddish light due to discharge of neon gas and then sodium crystal turns into vapour form and gives yellow-pink light.



**PROCEDURE:-**

1. Draw connection diagram.
2. Make connection according to connection diagram.
3. Connect condenser across supply.
4. Switch 'on' A.C supply.
5. See colour of light of lamp at starting and at working position.
6. At starting it gives pink light and after about 10 to 15 minutes, it gives pale light.

**PRECAUTION:-**

1. Connection should be correct and tight.
2. Capacitor should be connected across the supply.

**CONCLUSION:-** From this experiment we knew that how to connect and test sodium vapour lamp.

**APPLICATION:-**

1. It is mostly used for roads and parking light etc.



### **EXPERIMENT NO.3 (D)**

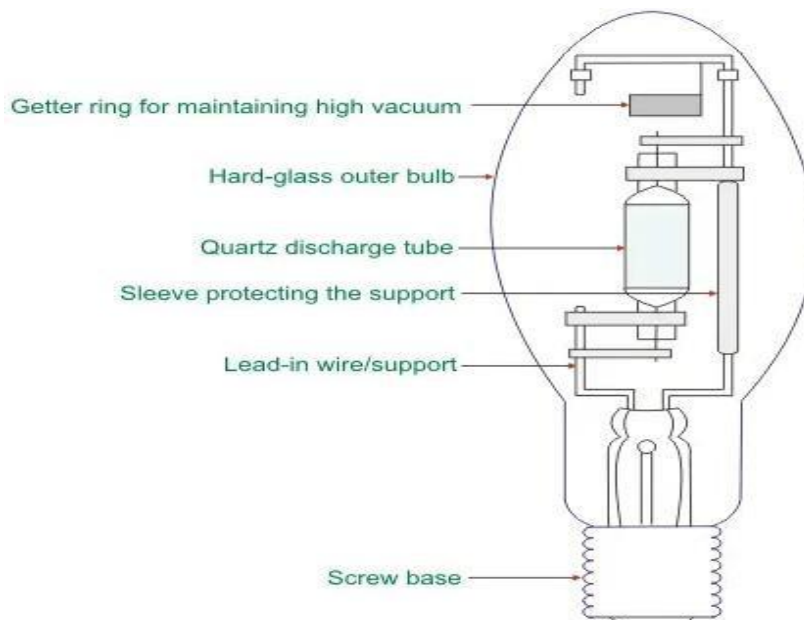
**AIM OF THE EXPERIMENT:-** To connect and test a Metal Halide Lamp (M H Lamp)

Metal halide lamp is special type of arc discharge lamp that works on the arc stream via some iodide salts along with argon gas and mercury vapor pressure at several milli meters with the arc tube temperature of 1000. Dr. reiling had discover metal halide lamp in 1960.

#### **THEORY:-**

- When full voltage is applied across the main electrodes, no arc is produced at the time of switching.
- The auxiliary electrode or starter electrode near the main electrode attached to the glass stem creates initial discharge between them.
- A bimetal switch there is short the starter electrode the main electrode just at the time of stating.
- Starter electrode is used to create initial arc between main and auxiliary electrode that heats up the metal halide salts.
- Starter electrode or auxiliary electrode is of high resistance to limit the current at initial arc.
- Again discharge is first in argon and then in mercury.
- Small amount of mercury be vapor helps to establish main arc formation between main electrodes through metal halides vapor one by one.
- To reach up to full light output this lamp takes 5 minutes.

#### **DIAGRAM OF METAL HALIDE LAMP:-**



**PROCEDURE:-**

1. Draw connection diagram.
2. Make connection according to connection diagram.
3. Switch ON the supply.

**PRECAUTION:-**

1. Connection should be correct and tight.

**CONCLUSION:-** From this experiment we knew that how to connect and test M H lamp..

**APPLICATION:-**

1. It is mostly used for roads and parking light etc.

### EXPERIMENT NO. – 3(E)

**AIM OF THE EXPERIMENT:-** To connect and test a Compact Fluorescent Lamp (C.F.L)

**REQUIREMENTS:-**

TOOLS			MATERIALS		
SI. NO	PARTICULARS	QUANTITY	SI. NO	PARTICULARS	QUANTITY
1.	Combination plier	1	1.	MH lamp	1
2.	Electrician knife	1	2.	Holder	1
3.	Side cutting plier	1	3.	pvc insulation tape	1
4.	Screw driver	1		pvc wire	As per required
5.	Neon tester	1			

**THEORY:-**

The compact fluorescent lamps are the latest addition in the family of lamps. The lamp generates light on the same principle as fluorescent tube. An electrical charges is passed through mercury vapour between two electrodes. The electrical field causes the vapour to emitting visible U.V (ultra violet) radiation. Fluorescent materials applied to the inside of the glass tube converts the U.V radiation into visible light. Different fluorescent materials emit light in different colour appearances. By bending each tube on itself, lamp designers have managed to reduce overall length of CFL. They are not much larger than ordinary light bulbs-

The compact fluorescent lamp with an electronic control gear and standard base have the following characteristics

1. High efficiency up to 80% energy saving.
2. Ten times the lamp life of incandescent lamp.
3. Excellent colour rendering and excellent light distribution.
4. Universal burning position.
5. Low weight i.e from 50 grams to 150 grams.
6. Suitable for emergency lighting on 230 volts D.C except 23 watt lamp.
7. The lamps available in 5,7,11,15,20,and 23 watts.

**PROCEDURE:-**

1. Prepare a lamp holder with wire.
2. Fix lamp with holder.
3. Switch ON the supply.

**PRECAUTION:-**

1. Connection should be correct and tight.

**CONCLUSION:-** From this experiment we knew that how to connect and test CFL.

**APPLICATION:-**

1. Domestic: living rooms, drawing room and especially where continuous economic lighting is needed.
2. Commercial: in corridor, hotels, offices.

**DISCUSSION QUESTION**

1. What is fluorescent lamp?
2. Why mercury is used in fluorescent lamp?
3. What is mercury light?
4. How does a MV lamp give a pink colour at the start?
5. Why sodium vapour lamp is yellow?
6. How does sodium vapour lamp work?

## EXPERIMENT NO.- 04

**AIM OF THE EXPERIMENT:-** Study battery charger and make charging of lead acid battery.

**APPARATUS REQUIRED:-**

SL NO	NAME OF EQUIPMENT	SPECIFICATION	QUANTITY
1	Bridge rectifier		
2	Resistor	1K $\Omega$	1no
3	Resistor	1K $\Omega$	2no
4	Resistor	1.2K $\Omega$	1no
5	Resistor	1.5K $\Omega$	2no
6	Resistor	10K	1no
7	Diodes	1N4007	3no
8	Diodes	1N4732A	
9	NPN transistor		As per required
10	LED		4
11	Potentiometer	50K $\Omega$	

**THEORY:-**

**Battery Charger:-**

A battery charger, or recharger, is a device use to put energy into a secondary cell or rechargeable battery by forcing an electric current through it. A trickle charger provides a relatively small amount of current, only enough to counteract self-discharge of a battery that is idle for a long time.

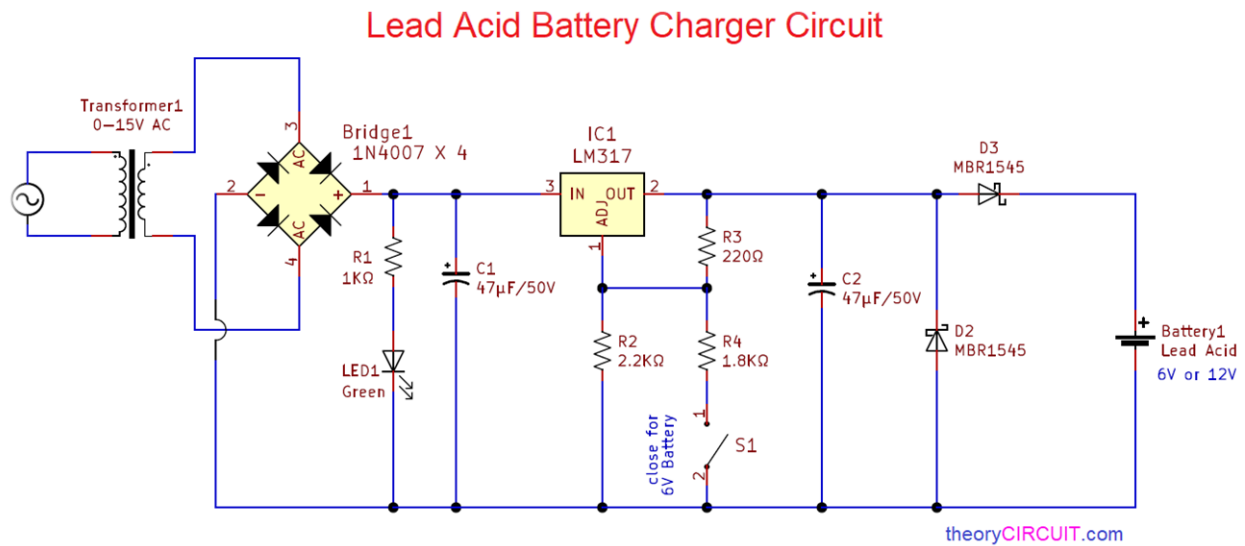
**Lead acid battery charger:-**

Lead acid batteries are one of the oldest rechargeable batteries available today. Due to their low cost (for the capacity) compared to newer battery technologies and the ability to provide high surge current (an important factor in automobiles), Lead Acid Batteries are still the preferred choice of Batteries in almost all vehicles.

The main concern with any battery is it discharges over time and must be recharged so that it can provided the necessary voltage and current. Different batteries have different strategies of charging and in the project, I will show you how to recharge a lead acid battery using a simple Lead Acid Battery Charger Circuit.

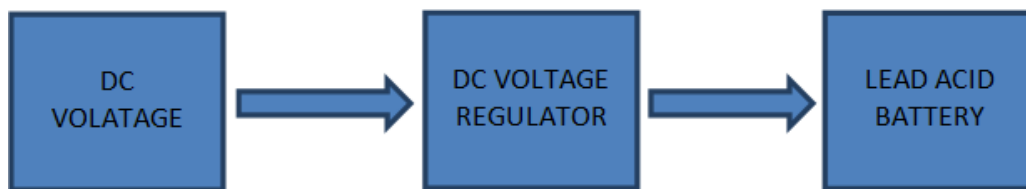
## CIRCUIT DIAGRAM:-

The circuit diagram of the Lead Acid Battery Charger Circuit



### **How to Recharge a Lead Acid Battery?**

To charge a battery from AC we need a step down transformer, a rectifier, filtering circuit, regulator to maintain the constant voltage. Then we can give the regulated voltage to the battery to charge it. Think if you have only DC voltage and charge the lead acid battery, we can do it by giving that DC voltage to a DC-DC voltage regulator and some extra circuitry before giving to the lead acid battery. Car battery is also a lead acid battery.



**BLOCK DIAGRAM OF CHARGER FOR LEAD ACID BATTERY**

A battery charger or recharger, is a device use to put energy into a secondary cell or rechargeable battery by forcing an electric current through it. A trickle charger provides a relative small amount of current, only enough to counteract self discharge of a battery that is ideal for a long time.

As seen in the above block diagram, a DC voltage is given to the DC voltage regulator. The voltage regulator use here is 7815, which is a 15V regulator. The regulated DC out voltage is given to battery. There is also trickle charge mode circuitry which will help to reduce the given current when the battery is fully charged.

#### **Circuit Explanation:-**

- The circuit mainly consists of a bridge rectifier (if you are using AC supply stepped down to 18V), 7815 regulator, zener diode, 12V Relay and a few resistor and diodes.
- The DC voltage is connected to the  $v_{in}$  of the 7815 and starts charging the battery through the relay and the  $1\Omega$  (5W) resistor.
- When the charging voltage of a battery reaches the tripping when i.e. 14.5V, the zener diode starts conducting and provides enough a base voltage to transistor.
- As a result, the transistor is active and its output becomes HIGH. This high signal will activate the relay and battery is disconnected from the supply.

#### **Note:-**

- The battery should be charged  $1/10^{\text{th}}$  its charging current. Sp the voltage regulator must generate  $1/10^{\text{th}}$  of the charging current produced by the battery.
- Heat sink should be attached to the 7815 Regulator to the get the batter efficiency.

### **CONCLUSION:-**

From this experiment we knew how to prepare a Lead Acid Batteries and its working.

### **DISCUSSION QUESTIONS:-**

1. How a lead acid battery charger is made?
2. What is the live of a lead acid battery?
3. What is need of a lead acid battery?
4. What are the advantages of lead acid battery?
5. What does acid battery die?

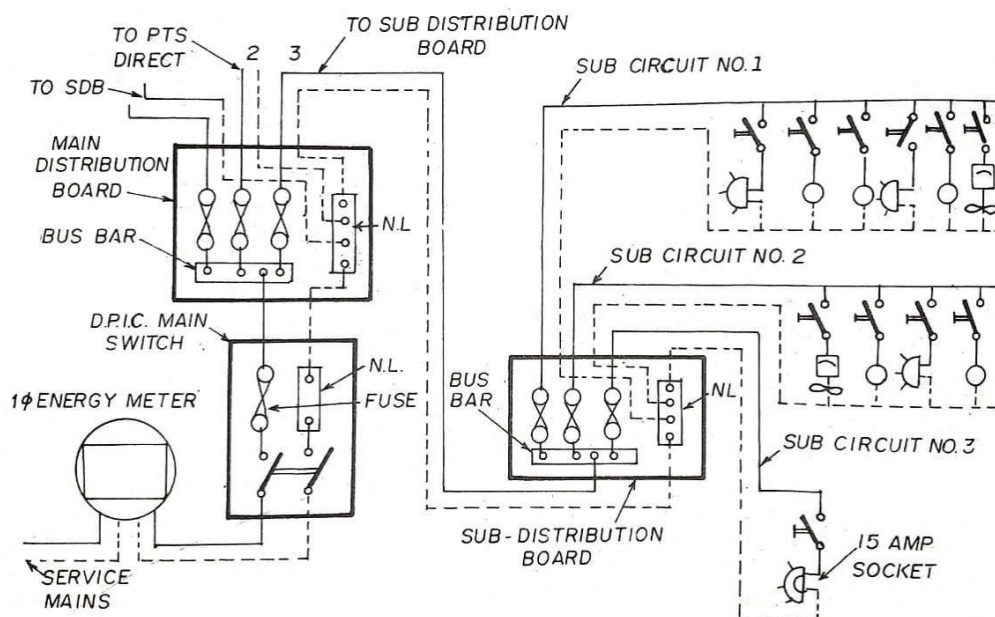


## EXPERIMENT NO.- 05

**AIM OF THE EXPERIMENT:-** Erection of residential building wiring by CTS and conduit wiring system using main two points and test installation by test lamp method and a megger.

**REQUIREMENTS:-**

TOOLS			MATERIALS		
SI. NO	PARTICULARS	QUANTITY	SI. NO	PARTICULARS	QUANTITY
1.	Hacksaw with blade	1	1.	Conduit pipe	As per required
2.	scale	1	2.	Conduit junction box 3-way	As per required
3.	Combination plier	1	3.	Conduit junction box 2-way	As per required
4.	Electrician knife	1	4.	Conduit saddle	As per required
5.	Side cutting plier	1	5.	Bends	As per required
6.	Screw driver	1	6.	Pvc wire(copper)	As per required
7.	Neon tester	1	7.	GI wire	As per required
8.	Hand drill machine	1	8.	Switch board	1
			9.	Regulator	1
			10.	One 3 pin socket switches	1
					4



### **PROCEDURE:-**

1. Make a connection diagram.
2. Make a line diagram of the wiring with chalk.
3. On the board or wall as per layout diagram.
4. Cut the conduit pipe according to the layout.
5. Fix junction box in the pipe and tighten them on the board with saddle.
6. Similarly install EM, DPIC, MDB, & SDB & SB according to their places.
7. Insert the G. I wire in the pipe and tighten a PVC wire on one of the end.
8. Pull the G .I wire.
9. Similarly put the wires in the pipe and complete it.
10. Insert the earth wire in the pipe and earthed the earth terminal of 3-pin socket ,SDB,MDB & DPIC.
11. Mark the point on the board for switch and socket and make connection.
12. Fix the ceiling rose and holder on junction box.
13. Test the wiring in series by giving supply.

### **TESTING OF INSTALLATION:-**

The following tests are carried out before energizing the domestic installation.

1. Insulation resistance test between conductor and earth.
2. Insulation resistance between conductors.
3. Polarity test.
4. Short circuit test.
5. Circuit continuity test
6. Earth continuity test

## **1. INSULATION RESISTANCE TEST BETWEEN CONDUCTOR AND EARTH**

- a. The main switch in OFF position.
- b. The fuse beyond the main switch should be in position i.e main fuse is taken out.
- c. All switches in ON position. Where fans are provided, close the fan switches and put the fan regulator in the ON position.
- d. The lamps and other equipments in their position.
- e. The phase and neutral terminals connected to each other and connect them to the line terminal (L) of the megger with a flexible wire. The earth (E) terminal of the megger is connected to either earth continuity conductor or direct to the earth electrode.
- f. Rotate the handle of the megger. If the wiring is satisfactory, the reading of megger must not be less than 0.5 mega ohm.
- g. If the insulation resistance is below the required value .the wiring section giving that value should be rewired or checked thoroughly till the required value is obtained.

$$\text{Insulation resistance} = \frac{50 \text{ mega ohm}}{\text{total number of points}}$$

## **2. TESTING OF INSULATION RESISTANCE BETWEEN CONDUCTORS**

To ensure that the insulation of the cable or wires is not damaged and that there is no leakage between them. The position of main switch, switches point portable equipments should be as under

- a. The main switch in OFF position and remove all the fuse grips.
- b. All switches in ON position.
- c. All lamps and other current consuming devices such as lamps, fans or portable apparatus plugged on 2 pin.
- d. The fuses beyond the main switch should be in position.
- e. Then connect the line terminal (L) of megger to the phase terminal of the installation and earth terminal (E) of the terminal of the megger to the neutral wire.
- f. Rotate the handle of the megger and note down the reading. It should not be less than 2 mega ohm or the insulation resistances between the two conductors=  $\frac{50 \text{ mega ohm}}{\text{total number of points}}$

### **3. POLARITY TEST**

This test is made to ascertain whether the phase wire is controlled by switch or not.

- a. The main switch is OFF position and lamps removed.
- b. One of the test lamp is connected to earth wire and other end to the incoming terminal of the switch.
- c. If the lamp light, it indicates that the switch is connected to phase wire, otherwise to neutral wire.

### **4. SHORT CIRCUIT TEST**

This test is made to confirm that the phase and neutral wires are not touching each other.

- a. Put the main switch in OFF position and remove all the fuse grips.
- b. Put all the circuit switches on ON position.
- c. Remove all bulbs from their holder.
- d. Connect both megger terminal E and L with the upper terminal of phase and neutral of the main switch.
- e. Rotate the handle of megger, if the megger shows zero reading, it means that phase and neutral wires are touching each other in the circuit . Check and remove the fault.

### **5. CIRCUIT CONTINUITY TEST:-**

- a. Put the main switch in ON position.
- b. Insert all the lamps and short circuit the sockets and ceiling rose.
- c. Put all the circuit switches in ON position.
- d. Connect both megger terminals with the terminals of main switch.
- e. Rotate the handle of megger. If the megger shows zero reading .it means the circuit continuity is all right. If the megger shows infinity then there is a break in the wiring, check and remove the fault.

### **6. EARTH CONTINUITY TEST:-**

This test is done to confirm the earth continuity of the conduits ,lead sheathing or earth terminals of wall-socket and whether they are properly connected to earth or not.

- a. Connect E terminal of megger with earthed body of the main switch . The L terminal of the megger is connected to all metallic parts of the installation and earth terminal of the 3-pin wall socket.

- b. Rotate the handle of the megger .If the megger shows zero reading then it shows the earth continuity is perfect. The high reading shows that either the wiring is not properly earthed or there is a break in the earth wire somewhere.

**PRECAUTION:-**

1. Whole earthing should be properly earthed.
2. Earth terminals of 3-pin socket should be earthed.
3. All wiring connection should not be loose.

**CONCLUSION:-**

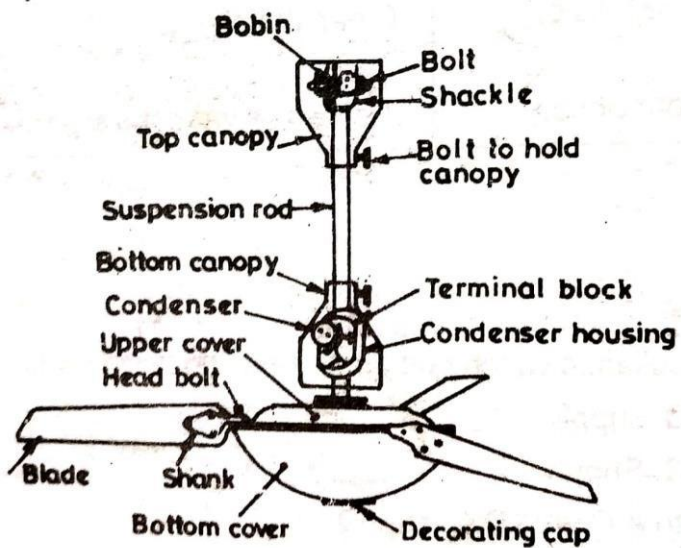
From this experiment we knew that how to do the conduit wiring for a residential building and test the installation by test lamp method and megger.

## EXPERIMENT NO.-06

**AIM OF THE EXPERIMENT:-** Fault Finding and repairing of ceiling Fan and observation of different parts.

### **REQUIREMENTS:-**

TOOLS			MATERIALS		
SI. NO	PARTICULARS	QUANTITY	SI. NO	PARTICULARS	QUANTITY
1.	Combination	1	1.	PVC tape	1
2.	plier Electrician	1	2.	PVC wire(copper)	As per required
3.	knife Side	1			
4.	cutting plier	1			
5.	Screw driver	1			
6.	Neon tester	1			
7.	Multimeter	1			
8.	Test lamp set	1			
	Mallet				



## **THEORY:-**

### **MAIN PARTS OF CEILING FAN**

#### **1. MOTOR:-**

- The motor employed for ceiling fan is generally a single phase permanent capacitor motor.
- The working voltage of motor is 230 volts 10% at a frequency of 50Hz.
- It has 2 parts

#### **(a) Stator:-**

This is the stationary part of the fan. Here two types of wiring are done, one is starting winding and other is running winding.

#### **(b) Rotor:-**

This is the rotating part of the fan. The winding is of squirrel cage type.

#### **2. BLADES:-**

- The ceiling fan fitted with 3or4 angular blades which are consists of steel sheet.
- The blades are 120<sup>0</sup> mechanically apart and may be curved at an angle of 10<sup>0</sup>.

#### **3. CANOPY:-**

- It is the shape of cup to cover the hook.
- There are two Canopies i.e. one for covering the hook and nut bolt at top and the other for covering the Capacitor are used in each fan.

#### **4. CAPACITOR:-**

- A Capacitor of 2 or 2.5 microfarad is used in series with the starting winding of fan.

#### **Function capacitor:-**

- Increase the starting torque.
- Better starting power factor.

#### **5. BALL BEARING:-**

- By providing ball bearing we can make a friction-free and noise-free movement between rotating and stationary parts of fan.
- The Fan may have single or double ball bearing.
- Different size of bearings is used for different size of fan.

#### **6. SUSPENSION SYSTEM:-**

- The Suspension system is to secure the fan in required position for proper running below ceiling.

#### **7. SPEED REGULATOR:-**

- The Speed regulator is used to control the speed of the fan.
- 

#### **PROCEDURE TO DISMANTCE A CEILING FAN:-**

1. Disconnect the fan from the supply.
2. Remove the blades and keep them safety.
3. Lower the upper canopy.
4. Hold the suspension rod and remove the suspension bolts.
5. Disconnect the two wires from the two way connector.
6. Disconnect the capacitor and remove it.
7. Remove the cotter pin from the lower portion of the suspension rod and remove it anticlockwise direction with the grip of 'V' clamp.
8. Mark the upper and lower covers with centre punch.
9. Loose the fan cover screws and remove them. Remove the lower cover with the help of screwdriver or wood and separate the rotor.
10. Remove the Condenser housing by gripping the stator and removing the cotter pin.
11. Remove the upper cover with the help of wood.
12. Wash the inner portion of the covers and bearing with old cloth, refit the fan, starting with the parts which were opened at the end.



### DIFFERENT TYPES OF FAULTS IN FANS AND THEIR REMEDIES:-

SERIAL NUMBER	DEFECTS	CAUSES	REMEDIES
1.	Fan does not work	1. Electric supply may not be there	1. Restore supply
2.	Fan is running very slow	1. There may be a fault in the regulator. 2. Either the capacitor is faulty. 3. May be open.	1. Test the regulator with test lamp. 2. Replace the capacitor. 3. Check the winding and connect it.
3.	Fan is vibrating	1. Blades are not uniform	1. Check and repair them
4.	The Speed of the fan does not increase or decrease	1. Regulator faulty	1. Replace faulty Regulator
5.	Fan is giving noise	1. Bearings are dry. 2. The nuts of the wings might be loose. 3. Wings may be bent.	1. Grease the bearing or replace them. 2. Check wings with their nut and tight them.
6.	The fan gives humming noise and does not start	1. Open circuit in one winding	1. Test the continuity of winding with test lamp and in case of faulty one, get it repaired.

#### PRECAUTION:-

1. Connection should be correct and tight.
2. Before fixing the new fan, check the capacitor.

#### CONCLUSION:-

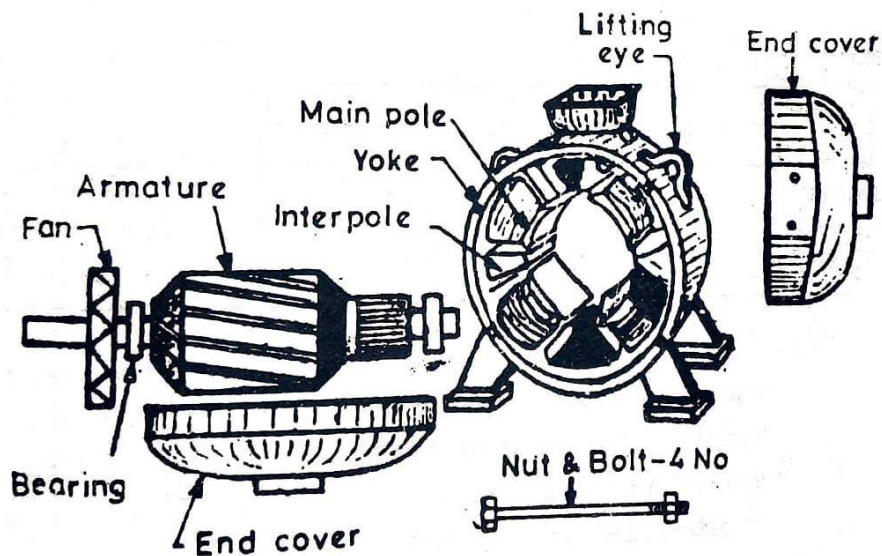
From the above experiment we knew that the different parts, connection and different types of faults of ceiling fan.

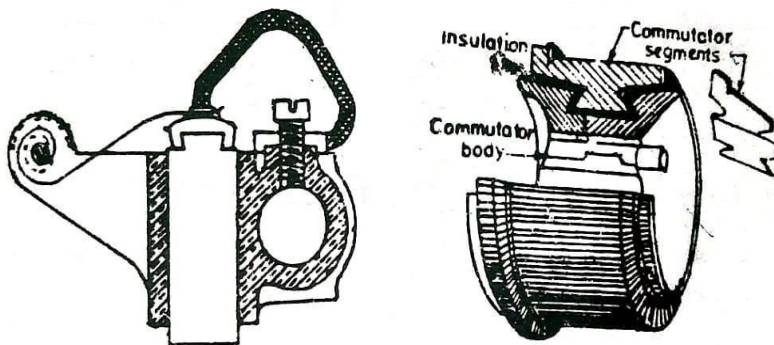
## EXPERIMENT NO.-07

**AIM OF THE EXPERIMENT:-**To study about different parts of DC generator with different type of faults and their remedies.

### **REQUIREMENTS:-**

TOOLS			MATERIALS		
SI. NO	PARTICULARS	QUANTITY	SI. NO	PARTICULARS	QUANTITY
1.	Combination plier	1	1.	Three phase generator	1
2.	Electrician knife	1	2.	lamp	1
3.	Side cutting plier	1	3.	Testing	1
4.	Screw driver	1	4.	board Pvc	1
5.	Neon tester	1	5.	tape	As per required
6.	Multimeter	1	6.	Pvc	-
7.	Test lamp set	1	7.	wire(copper)	-
8.	mallet	1	8.	Grease	-
				Kerosene oil	
				Cotton waste	





## **THEORY:-**

### **Parts of DC Generator**

**YOKE:-** It is an outer part of the machine called yoke and made of cast iron or cast steel. It has two main function, one is to hold all the other parts of the machine and second to provide magnetic path for the flow of magnetic lines of force, because of this yoke is always made of magnetic materials.

**FIELD POLE:-** It is an internal parts of the machine and is fitted with the body with the help of screw or nuts. Every machine has minimum two poles. It consists of two parts called pole cores and pole shoes. Pole cores are made of solid piece of cast iron, cast steel or laminated core but pole shoes are made of laminated core.

**ARMATURE:-** it is the revolving parts of the machine and is made of laminated core having cylindrical shape. The thickness of laminated core is 0.35 to 0.6 mm dipped in insulated varnish to minimized the hysteresis and eddy current loss.

**COMMUTATOR:-** It is cylindrical shaped made of hard drawn copper segments and each segments is insulated by thin layers of mica. Its function is to collect current from the coils of armature and converts it into D.C.

**BRUSH:-** Collection the current from the commutator is done by brush.

**BRUSH HOLDER:-**It is hollow brass rod which holds the brush like lamps holder and suitable spring is fixed with brush holder to provide spring pressure for brush.

**COOLING FAN:-**it is made of cast iron or aluminium and fitted with armature shaft opposite to commutator side. Its function is to circulate air and keep the machine cool.

**BEARING:-** it is fitted with side cover and its function is to minimise friction effect. There are so many types of bearing used in machine according to its capacity.

1. Bush bearing:- it is made of Gun-metal and used for small machine.
2. Ball bearing:- it is circular ring with number of balls and used for small and medium type machine.
3. Roller bearing:- It is circular ring with number of steel rollers and used for heavy duties machine.

**PROCEDURE:-**

1. Remove the supply terminals.
2. Mark dot on both side of end plate and body with the help of center punch.
3. Remove the key/screw from the shaft.
4. Remove the pulley with pulley puller.
5. Remove the bearing plates.
6. Remove both covers by striking gently on the cover with mallet.
7. Remove both bearing from the armature shaft with help of bearing puller.
8. Clean the bearings with kerosene oil and check its rotation and play etc.
9. Grease the bearings and fit them.
10. Clean the commutator with fine emery paper.
11. Test the armature earth, short circuit and insulation resistance by megger.
12. Check the connection, if required solder the commutator segment.
13. Assemble the machine parts.
14. Check the bedding test for brushes position.
15. Fixed both the end plates as per mark position.
16. Rotate the armature and see, it must be freely rotate.
17. At last fit the bearing cover and pulley.
18. Switch ON the supply.
19. Start the machine and test the following test.  
A. Current B. Speed C. Temperature D. Sound

## **FAULTS ,THEIR REASONS AND REMEDIES IN A D.C GENERATORS:-**

The faults, their possible reasons and its remedies are as follows:

### **GENERATOR FAILS TO BUILD UP VOLTAGE**

Sl. NO	REASONS	REMEDIES
1.	Direction of rotation reverse.	➤ Change the direction of rotation (D.O.R)
2	No residual magnetism.	➤ Recharge the poles by help of battery or D.C source.
3.	Open circuit in armature.	➤ Check the armature winding circuit.
4.	Open circuit in field winding.	➤ Check the field winding circuit
5.	Short circuit in field winding.	➤ Check the field winding circuit.
6.	Brushes contact not proper with commutator.	➤ Keep the brushes at M.N.A and contact should be proper.
7.	Rotating the generator at very low speed.	➤ Rotate the generator at proper speed.
8.	Shunt field resistance.	➤ Check the field resistance it may be above the critical value(too high) and do not produce appreciable flux.

### **GENERATOR HAVING HEAVY SPARKING AT COMMUTATOR**

Sl. NO	REASONS	REMEDIES
1.	Brushes are not at M.N.A position.	➤ Set the brushes at M.N.A position as per generator direction of rotation.
2	Not proper spring tension on brushes.	➤ Check and set the spring tension.
3.	Carbon or dust on the surface of commutator.	➤ Clean the commutator with fine sand paper.
4.	Commutator surface is not proper.	➤ Check and get it proper on lathe machine .
5.	Cross in armature winding.	➤ Check the armature winding and remove the fault.

6.	Wrong connection of inter poles.	➤ Check the direction of inter poles. It should be the same in the case of generator and opposite in case of motor with respect to main poles.
7.	Mica is not properly placed.	➤ Check the mica surface between two segments and set its surface properly.
8.	Brushes are not of proper size and grade.	➤ Check the size and grade of brushes.

### **GENERATOR PRODUCES MORE HEAT AND SOUND**

Sl. NO	REASONS	REMEDIES
1.	Defective bearing.	➤ Check and lubricate the bearing or replace the bearing.
2.	More load on armature.	➤ Reduce the load.
3.	Improper fitting on the end covers.	➤ Fit the bearing in covers properly and tight the screws.
4.	More sparking.	➤ Check the reasons explained in the above table.
5.	Not properly fixed.	➤ Check the foundation nut bolts.

### **PRECAUTION:-**

1. Before dismantling the machine , supply must be cut off.
2. Before dismantling mark should be put on at the end covers and body.
3. It should be hammered with mallet or light weight hammer.
4. Proper tools should be used for proper work.
5. The oil or grease should be avoided while cleaning the commutator.
6. Machine should be rotate freely.

**CONCLUSION:-**From this experiment we knew the different parts, different fault and their remedies of a D.C Generator.

## EXPERIMENT NO.-8

**AIM OF THE EXPERIMENT:-** Find out fault of DC motor starter and AC motor starter –prepare an inventory list of parts used in different starter

### **REQUIREMENTS:-**

1. Series lamp
2. Multi meter
3. Tester

### **FAULT FINIED AND SOLUTION OF AC MOTOR WITH A STARTER:-**

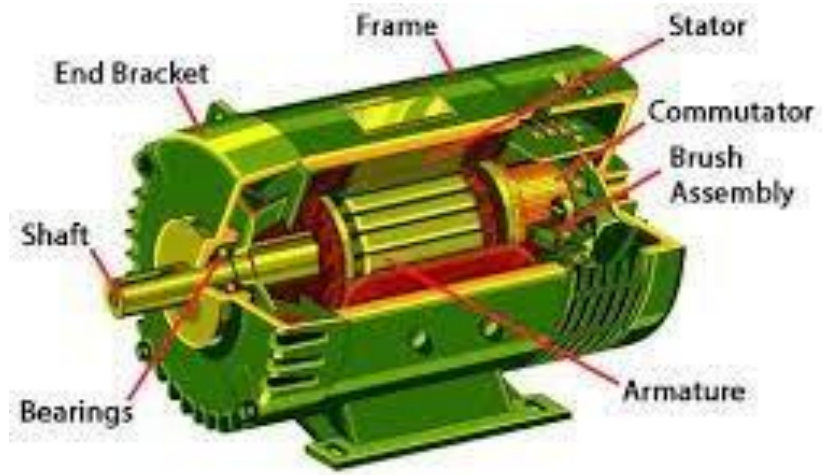
<b>PROBLEM</b>	<b>POSSIBLE CAUSE</b>	<b>TESTS</b>	<b>SOLUTION</b>
Motor will not start	<ol style="list-style-type: none"><li>1. Fault with supply.</li><li>2. Motor or load locked up.</li><li>3. Wrong connections in control circuit.</li></ol>	<ol style="list-style-type: none"><li>1. Check for connect voltage at motor terminal.</li><li>2. Make sure motor and load are free to turn.</li><li>3. Check to ensure contactor operate.</li></ol>	<ol style="list-style-type: none"><li>1. Fit new fuse, reset circuit breaker etc.</li><li>2. Remove clamps, lugs etc.</li><li>3. Sort out control circuit.</li></ol>
Supply or started trips out at start	<ol style="list-style-type: none"><li>1. Wrong or loose connection</li><li>2. Motor over load.</li><li>3. Intertie of load to high .</li><li>4. Low voltage due to volt drop in cable.</li><li>5. Over load or circuit breaker incorrectly set or sized.</li></ol>	<ol style="list-style-type: none"><li>1. check all lugs are properly crimped or soldered, and connections are tight.</li><li>2. Check load performance data.</li><li>3. Measue voltage at</li></ol>	<ol style="list-style-type: none"><li>1. Fix up connections.</li><li>2. Change motor for correct size.</li><li>3. Change cable for correct size.</li><li>4. Correct setting of overload or breaker or change.</li></ol>

		motor terminals while motor starting 4. Check setting of overload and circuit breaker and allow for starting current	
Motor starts but has no torque.  Motor does not reach full speed or takes a long time to accelerate.	1. Incorrect connection. 2. Delta wound motor connect in star. 3. star/delta starter staying in star . 4. Intertie of load to high. 5. Motor over loaded. 6. Low voltage due to volt drop in cables.	1. Check connection diagram and name plate data. 2. Check load . 3. Measure voltage at motor terminals while motor starting.	1. Sort out and correct connections. 2. Check timer and starter control circuit. 3. Change motor for correct size. 4. Change cable for correct size.
Motor overheating	1. Motor over loaded 2. Ineffective cooling 3. Excessive ambient 4. Wrong connection . 5. Delta wound motor in star. 6. Wrong single phasing 7. Wrong voltage of frequency. 8. Supply voltage unbalanced	1. Check load performance data 2. Check fan and air flow and temperature of air. look for build –up of dirt . 3. Check connection diagram name plate data . 4. Check volt and amps in all three phase. 5. Check name plate	1. Fix problem load or fit large motor . 2. Clean motor . sort out cooling of air temp. and flow . 3. Sort out connections. 4. Restore supply to all Phase. 5. Correct voltage frequency. Balance supply or accept unbalance.
No load amps in excess of full load amps .	1. Incorrect connection. 2. Star wound motor connection delta. 3. Voltage in excess of name plate 4. Motor supplied for different voltage or frequency.	1 & 2. Check connection diagram, and name plate data 3. Measure voltage at motor terminals. 4. Compare supply voltage and frequency to nameplate.	1 & 2. Sort out and correct connections at motor terminals. 3. Correct supply voltage. 4. Change motor for correct voltage and frequency.

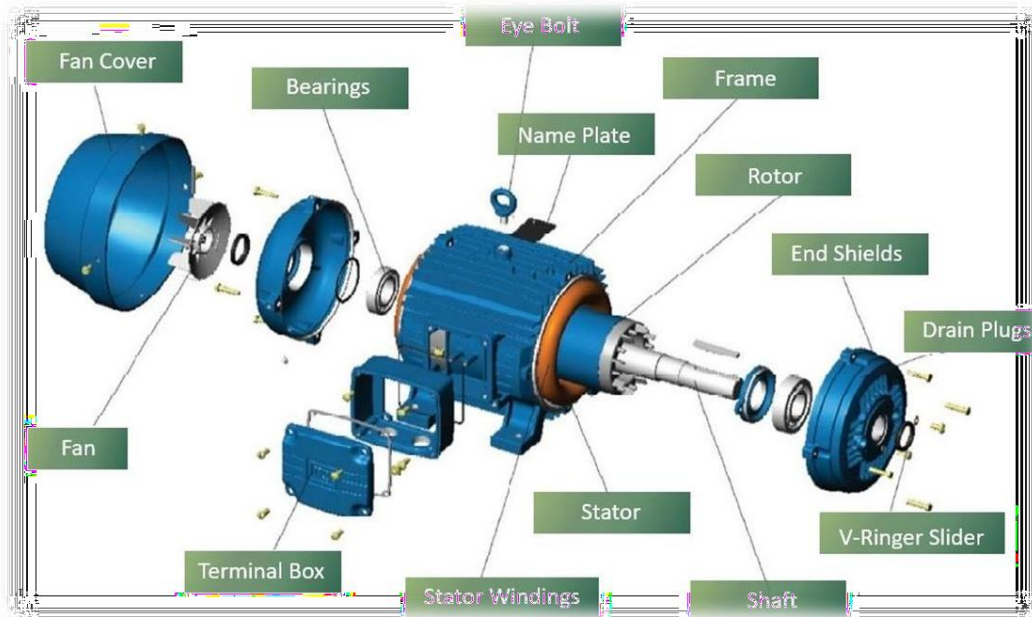


<p>Mechanical noise or vibration.</p> <p>Noise bearing</p> <p>Bearing overheating.</p>	<ol style="list-style-type: none"> <li>1. Trust from load or misalignment .</li> <li>2. Damaged bearings too much grease , no grease , or foreign matter in grease .</li> <li>3. Rotor pulling or foreign matter in air gap</li> <li>4. Out of balance load , coupling or pulley .</li> <li>5. Excessive belt pull.</li> <li>6. Motor foundations not rigid.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check gap between halves and alignment.</li> <li>2 &amp; 3. Turn shaft slowly by hand feel for roughness or stiffness .</li> <li>Check for bent shaft or fan rubbing.</li> <li>4. Run motor disconnected from</li> </ol>	<ol style="list-style-type: none"> <li>1. Re-align coupling</li> <li>2&amp;3. Clean bearing housing , change bearings and repack with fresh grease .</li> <li>4. Fix up out of balance items.</li> <li>5. loosen belt tension</li> <li>6. Increase strength of foundations.</li> </ol>
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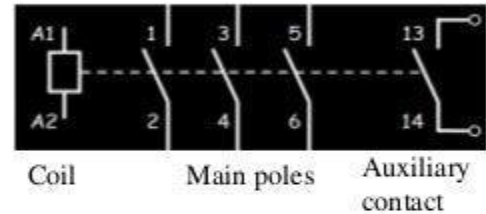
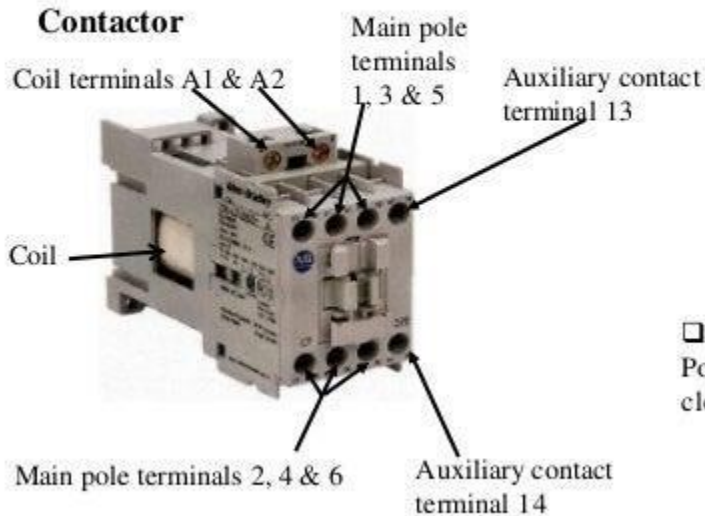
		<p>load and then with cooling or coupling removed.</p> <ol style="list-style-type: none"> <li>Run motor without belts.</li> <li>Check design and constructions foundations.</li> </ol>	
Motor amps in excess of nameplate full load amps on load.	<ol style="list-style-type: none"> <li>Motor overload.</li> <li>Low supply voltage.</li> <li>Wrong voltage or frequency.</li> <li>Wrong connection.</li> <li>Motor single phasing.</li> <li>Supply voltage unbalance.</li> <li>Motor speed not match to load.</li> </ol>	<ol style="list-style-type: none"> <li>Check load and performance data.</li> <li>Measure voltage at motor terminals.</li> <li>Check nameplate.</li> <li>4 &amp; 5. Check volts and amps in all three phase.</li> <li>Measure motor speed and check load speed requirements.</li> </ol>	<ol style="list-style-type: none"> <li>Fix problem with load or fit large motor.</li> <li>Fix problem, may be with large cables.</li> <li>Correct voltage or frequency.</li> <li>Sort out and correct 5&amp;6. Restore balance supply to all three phase .</li> <li>Change motor for correct motor speed.</li> </ol>
Excessive electrical noise.	<ol style="list-style-type: none"> <li>Wrong connection.</li> <li>Wrong voltage.</li> <li>Motor signal phase.</li> </ol>	<ol style="list-style-type: none"> <li>Check connections.</li> <li>Check voltage with name plate .</li> <li>Check volts with amps in all three accurately.</li> </ol>	<ol style="list-style-type: none"> <li>Fix up connection.</li> <li>Correct voltage.</li> <li>Restore supply to all three phase.</li> </ol>
Unbalance amps in different phase when motor loaded	<ol style="list-style-type: none"> <li>Unbalanced supplying voltage.</li> </ol>	<ol style="list-style-type: none"> <li>Measure phase to phase voltage accurately.</li> </ol>	<ol style="list-style-type: none"> <li>Balance supply or accept unbalanced.</li> </ol>
Motor runs in wrong direction.	<ol style="list-style-type: none"> <li>Wrong connections.</li> </ol>	<ol style="list-style-type: none"> <li>Watch shaft rotation.</li> </ol>	<ol style="list-style-type: none"> <li>Swop two phase of supply.</li> </ol>



**DIFFERENT PARTS OF A.C MOTOR AND STARTER**



## Components of DOL Starter



□ When coil is energised, it becomes a magnet  
Pole contacts closes & Auxiliary contact also closes



### FAULT FINDING AND SOLUTION OF DC MOTOR WITH A STARTER

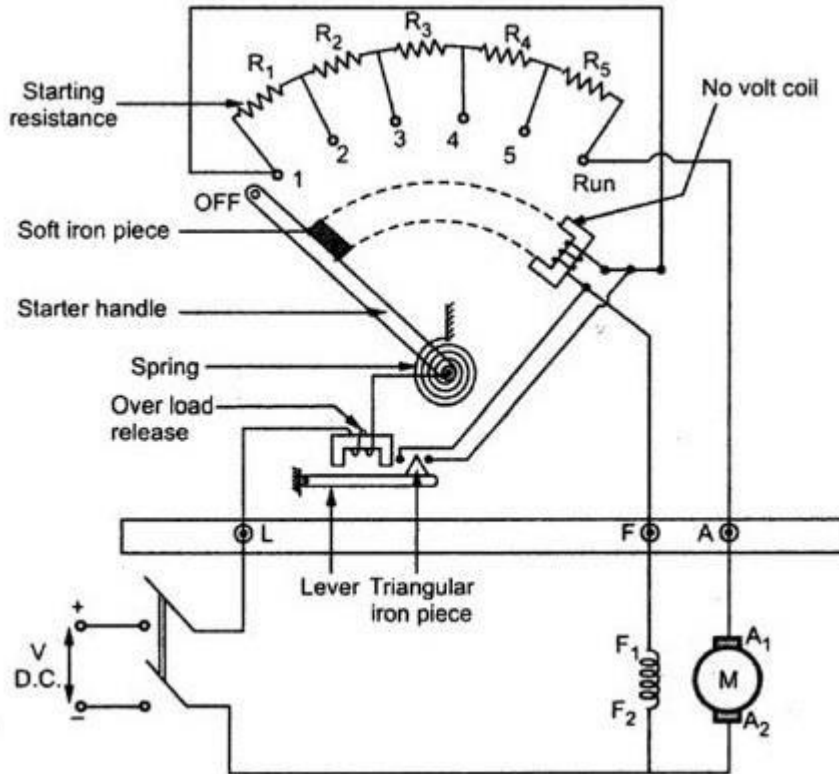
PROBLEM	CAUSES	REMEDIES
Motor fails to start	<ol style="list-style-type: none"> <li>1. Main supply off.</li> <li>2. The brushes are not making good contact with the commutator.</li> <li>3. open circuit in armature or in field winding</li> <li>4. There may be break in wiring or cable.</li> <li>5. There may be break in starter resistance.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test supply or fuse with test lamp.</li> <li>2. Clean the commutator with sand paper and set the brusher to exert pressure and make good contact.</li> <li>3. Test the armature and field windings with a test lamp.</li> <li>4. Test the continuity of the ending from main switch to motor.</li> <li>5. Test the starter.</li> </ol>
Motor gives shock	<ol style="list-style-type: none"> <li>1. Armature of field coils brush holder may be earthed.</li> <li>2. The body of the motor is not properly earthed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test the insulating of rocker arm. Tight the earth wire.</li> <li>2. Test the earth wire if it is loose, tight it.</li> </ol>

Motor blows fuse at start	<ol style="list-style-type: none"><li>1. The capacity of the fuse is small as compared to load.</li><li>2. Over load .</li><li>3. Body of the machine may be earthed.</li><li>4. Short circuit in the starter</li></ol>	<ol style="list-style-type: none"><li>1. Replace fuse with proper size.</li><li>2. Reduced the load.</li><li>3. Trace the earth by megger or test lamp and insulated it.</li><li>4. Check the starter resistance and remove the defect.</li></ol>
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	<p>resistance.</p> <p>5. Wrong starting and moving the handle very quickly.</p>	<p>5. Start the motor properly by slowly moving the handle.</p>
<p>Motor runs at a very high Speed</p>	<p>1. No load(in case series motor )</p> <p>2. Motor may be different compound.</p> <p>3. Open circuit is in no coil.</p> <p>4. Supply voltage is too high.</p> <p>5. The field regulator of shunt field may be completely in "ON" position.</p>	<p>1. Put the load on motor before starting.</p> <p>2. Check and reverse the direct of current in series field.</p> <p>3. Test the continuity with test lamp or megger.</p> <p>4. Check supply voltage, if it is possible reduce the voltage.</p> <p>5. Adjust the regulator to the OFF position at the time of starting.</p>
<p>Low speed then rated speed</p>	<p>1. Low voltage.</p> <p>2. Bearing may be loose.</p> <p>3. Excessive load on the motor.</p> <p>4. Short circuit or earth in the armature.</p>	<p>1. Check the supply voltage and start the motor according to its rated voltage.</p> <p>2. Replace the bearing.</p> <p>3. Reduce the load.</p> <p>4. Rest polarity of main poles with a compass needle and connect them alternating "N" and "S".</p>
<p>Sparking on the brushes</p>	<p>1. Commutator surface is not round and smooth.</p> <p>2. Commutator is dirty.</p> <p>3. Mica level above the commutator segment.</p> <p>4. Loose contact of brushes with the commutator.</p> <p>5. Brushes holder are loose.</p> <p>6. Brushes are not in the neutral axis.</p> <p>7. Over load on the motor.</p>	<p>1. Turn commutator on lathe a and also clean with send paper.</p> <p>2. Clean the commutator with send paper or petrol.</p> <p>3. Cut down the mica 1/10 " below the commutator with a fines saw.</p> <p>4. Adjust thye spring tension.</p> <p>5. Tighten the brushes properly .</p> <p>6. Adfjust brushes position.</p> <p>7. Reduce load.</p>

Sound in the motor	<ol style="list-style-type: none"><li>1. Loose fitting of foundation.</li><li>2. Loose field pole to the yoke.</li><li>3. Sound from brushes.</li><li>4. Loose bolts of side covers.</li><li>5. Defective bearing.</li></ol>	<ol style="list-style-type: none"><li>1. Tight the nut bold of the foundation.</li><li>2. Tight the field pole.</li><li>3. Check the armature shaft on lathe machine and get the fault rectifier.</li><li>4. Apply a little gasoline on the brushes.</li><li>5. Tight the nut bolts.</li><li>6. Check and replace if</li></ol>
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		necessary.
Over heating	<ol style="list-style-type: none"> <li>1. Short circuit in the windings.</li> <li>2. Faulty or dirty bearing.</li> <li>3. Over load on motor.</li> <li>4. Due to sparking at the commutator.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test the winding and remove the fault.</li> <li>2. Wash it properly.</li> <li>3. Reduce the load.</li> <li>4. Remove the cause and reduce the sparking.</li> </ol>



### 3-Point Starter

**CONCLUSION:-**

From this experiment we knew the different parts of D.C Motor Starter and A.C Motor Starter with different types of fault.

**DISCUSSON QUESTION:-**

1. What is crawling?
2. What is cogging?
3. What is plugging?
4. What is NVR?
5. What is OLR?



## EXPERIMENT NO.-9

### AIM OF THE EXPERIMENT:-

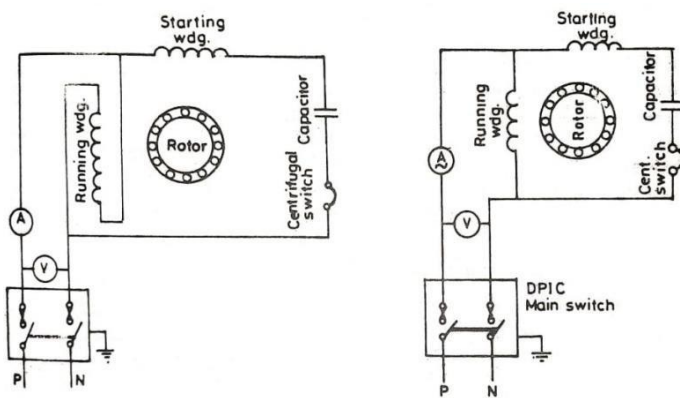
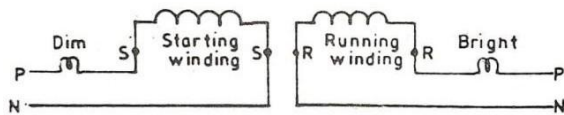
To dismantle, over haul and assemble a single phase capacitor start induction motor.

### REQUIREMENTS:-

TOOLS			MATERIALS		
SI. NO	PARTICULARS	QUANTITY	SI. NO	PARTICULARS	QUANTITY
1.	Combination plier	1	1.	Single phase motor	1
2.	Electrician knife	1	2.	capacitor	1
3.	Side cutting plier	1	3.	lamp	1
4.	Screw driver	1	4.	Testing board	1
5.	Neon tester	1	5.	Pvc tape	1
6.	Multimeter	1	6.	Pvc wire(copper)	As per required
7.	Test lamp set	1			
8.	Mallet	1			

### THEORY:-

In this type of motor, two types of winding are done, starting winding and running winding. A capacitor is connected in series of starting winding.



## **PROCEDURE-**

1. Identify the starting and running winding through testing lead and write S-S ,R-R on the piece of paper and fix it to them as shown in figure.
2. Test the capacitor.
3. Connect the capacitor in the series of starting winding.
4. Make the connection according to figure B and connect ampere meter and voltmeter in the circuit.
5. Run the motor by putting the switch ON.
6. Tabulate the reading.
7. To change direction of rotating of motor inter change the wire of running winding .the direction of rotation will change as shown in figure C.

## **COMMON FAULT IN A.C SINGLE PHASE MOTOR**

### **1. MOTOR FAILS TO START:-**

It may be due to following reasons

- a. Capacitor is faulty.
- b. No supply.
- c. Open circuit in the winding.
- d. Over load.
- e. Defective centrifugal switch.

### **2. FUSE BURNS OUT WHEN MOTOR IS CONNECTED WITH SUPPLY:-**

It may be due to the following reasons

- a. Short circuit in the winding.
- b. Shorted capacitor.
- c. Grounded winding.
- d. Over loaded.
- e. Defective centrifugal switch.
- f. Bearing are over tight.

### **3. SLOW SPEED OF THE MOTOR:-**

It may be due to following reasons.

- a. Defective capacitor.
- b. Short circuit in the winding.
- c. Wrong connection.
- d. Rotor bars are loose.

#### **4. MOTOR GIVES A HUMMING NOISE BUT DOES NOT RUN:-**

it may be due to following reasons

- a. Defective capacitor.
- b. Over loaded.
- c. Open circuit in the following.

#### **5. SMOKE FROM THE MOTOR:-**

it may be due to following reasons

- a. Short circuit in the winding.
- b. Defective centrifugal switch.

#### **7. DIRECTION OF MOTOR IS WRONG:-**

it may be due to following reasons

- a. Wrong connection.
- b. Defective capacitor.

#### **PRECAUTION:-**

1. All Connection should be correct and tight.
2. The capacitor of this motor is the starting capacitor . It should be tested on direct supply.
3. If the centrifugal switch does not open, the sound of motor change .the motor should be immediately stopped otherwise the winding might burn.
4. Ampere meter should be connected in series.

**CONCLUSION:-** From this experiment we knew the different parts, connection and different fault of a single phase induction motor.

#### **APPLICATION:-**

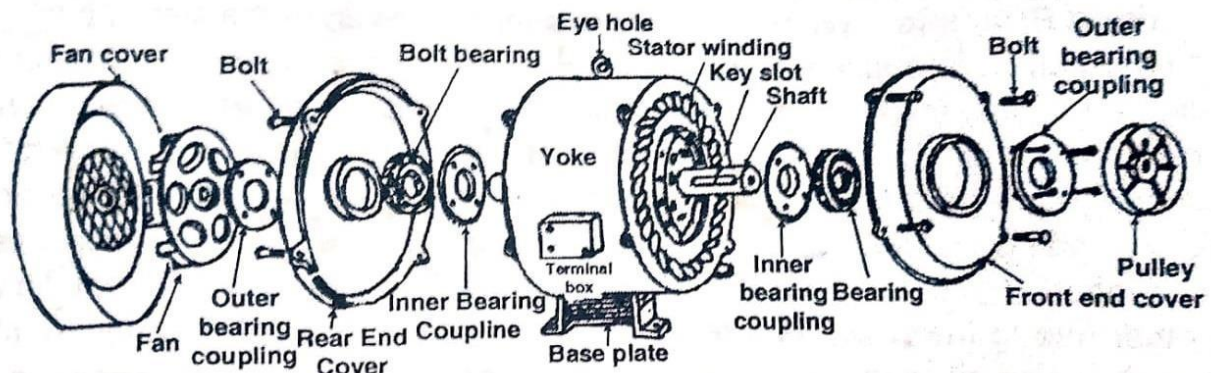
This type of motor is used in drill machine ,grinders etc.

## EXPERIMENT NO.-10

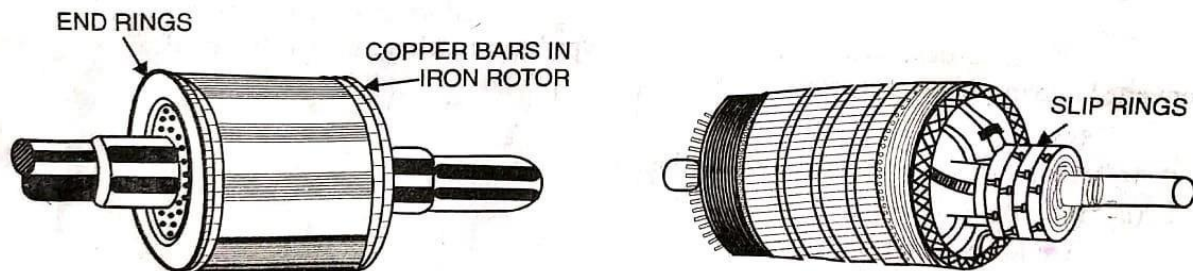
**AIM OF THE EXPERIMENT:-**To dismantle ,over haul and assemble a three phase squirrel cage and slip ring induction motor and to test and run it.

### **REQUIREMENTS:-**

TOOLS			MATERIALS		
SI. NO	PARTICULARS	QUANTITY	SI. NO	PARTICULARS	QUANTITY
1.	Combination plier	1	1.	Three phase motor	1
2.	Electrician knife	1	2.	lamp	1
3.	Side cutting plier	1	3.	Testing board	1
4.	Screw driver	1	4.	PVC tape	1
5.	Neon tester	1	5.	PVC wire(copper)	As per required
6.	Multimeter	1	6.	Grease	-
7.	Test lamp set	1	7.	Kerosene oil	-
8.	Mallet	1	8.	Cotton waste	-



Parts of squirrel Cage Induction Motor



## **THEORY:-**

A 3-phase induction motor has two main parts (1) stator and (2) rotor. The rotor is separated from the stator by a small air-gap which ranges from 0.4 mm to 4 mm, depending on the power of motor.

**Stator:-** It consist of a steel frame which encloses a hollow, cylindrical core made up of thin laminations of silicon steel to reduce hysteresis and eddy current losses. A number of evenly spaced slots are provided on the inner periphery of the laminations. The insulated conductors are placed in the stator slots and are suitably connected to form a balanced 3-phase star or delta connected circuit.

**Rotor:-** The rotor , mounted on shaft, is a hollow laminated core having slots on its outer periphery . The winding placed in these slots (called rotor winding) may be one of the following two types:

- (1) Squirrel cage rotor:- it consist of a laminated cylindrical core having parallel slots on its outer periphery. One copper or aluminium bar is placed in each slot. All these bars are joined at each end by metal rings called end rings. This forms a permanently short-circuited winding which is indestructible. It is because the rotor bars are permanently short circuited and it is not possible to add any external resistance to the rotor circuit to have a large starting torque.
- (2) Wound rotor:- it consist of a laminated cylindrical core and carries a 3-phase winding similar to the one on the stator. The rotor winding is uniformly distributed in the slots and is usually star-connected. The open ends of rotor winding are brought out and joined to three insulated slip rings mounted on the rotor shaft with one brush resting on each slip ring. The three brushes are connected to a 3-phase star-connected rheostat.

### **PROCEDURE:-**

1. Remove the supply terminals.
2. Mark dot on both side of end plate and body with the help of center punch.
3. Remove the key/screw from the shaft.
4. Remove the bearing plates.
5. Remove both covers by striking gently on the cover with mallet.
6. Remove both bearing from the armature shaft with help of bearing puller.
7. Clean the bearings with kerosene oil and check its rotation and play etc.
8. Grease the bearings and fit them.
9. Test the short circuit and insulation resistance by megger.
10. Assemble the machine parts.
11. Switch ON the supply.
12. Start the machine and test the following test.  
A. Current B. Speed C. Temperature D. Sound

### **FAULTS AND REMEDIES OF 3PHASE MOTORS:-**

#### **1. MOTOR FAILS TO START**

<b>SI. NO</b>	<b>FAULT</b>	<b>REMEDIES</b>
1.	Failure of supply	➤ Check the supply at the main switch.
2.	The low supply voltage.	➤ Check the voltage by voltmeter.
3.	Wrong connection.	➤ Compare with correct connection.
4.	Due to over load.	➤ Start the motor without load.
5.	The bearing have jammed.	➤ Check and replace if defective.
6.	Fault in the rotor circuit.	➤ Check the end ring of the rotor conductor .if it is loose, set the ring tight.
7.	The winding have ground.	➤ Check the motor winding by the megger and remove the fault.
8.	Single phasing.	➤ Check the supply and all 3 phases must come to motor terminals.

## 2. THE MOTOR IS VIBRATING

SI. NO	FAULT	REMEDIES
1.	The foundation nut-bolt are loose.	➤ Tighten the nut-bolts.
2.	Defective bearing	➤ Check and replace if needed.
3.	The motor alignment is not pro	➤ Make the alignment proper by spirit level or thread.
4.	The rotor ia unbalanced.	➤ Turn it on the lathe machine and get the fault removed.
5.	Single phase.	➤ Check all three phases by test lamp.

## 3. OVER HEATING OF MACHINE

SI. NO	FAULT	REMEDIES
1.	Wrong connection. More	➤ Compare the correct connection with diagram.
2.	or less voltage. Open	➤ Check the voltage by voltmeter.
3.	circuit in the rotor.	➤ Test the rotor and remove the fault.
4.	Short circuit in the stator winding. The	➤ Test the winding and rewind if needed.
5.	phase sequence is wrong.	➤ Determine the correct phase sequence of the motor.
6.	Over loading.	➤ Reduce the load.
7.	Bearing may be loose or very tight.	➤ Check the bearing.

#### 4. MOTOR BLOW OFF FUSE

SI. NO	FAULT	REMEDIES
1.	The size of fuse wire is not according to the capacity of motor.	➤ Connect the fuse wire according to the capacity of motor.
2.	More load.	➤ Reduce the load.
3.	Short circuit in the stator winding.	➤ Check the winding and rewind if necessary.
4.	Wrong connection.	➤ Check the connection according to the correct connection.
5.	Phase sequence is wrong.	➤ Check the phase sequence again and correct it.
6.	loose connection.	➤ Tight the connection.

#### 5. MOTOR START BUT DOES NOT TAKE LOAD

SI. NO	FAULT	REMEDIES
1.	Low voltage.	➤ Measure the voltage at the motor terminals and if found low, try to find out the reason for it.
2.	Open circuit in the rotor.	➤ Check the rotor bars of the squirrel cage motor. If it is loose solder it again. Check the rotor of the slipring motor and set it right.
3.	Defective	➤ If it is loose ,replace it.
4.	bearing. Over	➤ Reduce the load..
5.	loading.	➤ Tight the bell.
	Belt is loose.	



## 6. SUDDENLY STOPPING OF THE MOTOR

SI. NO	FAULT	REMEDIES
1.	Due to over loading motor takes more current.	➤ Reduce the load.
2.	Defective bearing.	➤ Replace the bearing.
3.	Low voltage.	➤ Check the reason for low voltage and set it right.
4.	Burning or grounding of coil.	➤ Check and remove the fault.
5.	Burning out of fuses.	➤ Replace the burnt fuses.

## 7. THE ROTOR GETS HEATED UP

SI. NO	FAULT	REMEDIES
1.	Loose ring in the squirrel cage.	➤ Solder the ring or replace the rotor if needed.
2.	The bearing are defective or worn	➤ Replace the bearing.

### PRECAUTION:-

7. Before dismantling the machine, supply must be cut off.
8. Before dismantling mark should be put on at the end covers and body.
9. It should be hammered with mallet or light weight hammer.
10. Proper tools should be used for proper work.

**CONCLUSION:-**From this experiment we knew the different parts, connection and different fault of a three phase squirrel cage and slip ring induction motor.

