SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603203.

Department of Electrical and Electronics Engineering

LABORATORY MANUAL

(2023 Regulation)

BRANCH	**: Common to All Branches**
SEMESTER	**: I**
SUBJECT CODE	**: GE3134**
SUBJECT	**: Engineering Practices Laboratory (Group B: Electrical)**
ACADEMIC YEAR	**: 2023-2024 ODD**

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LIST OF EXPERIMENTS

ELECTRICAL ENGINEERING PRACTICES

1. Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket.
2. Light and Fan Wiring.
3. Staircase Wiring.
4. Measurement of Voltage, Current, Power and Power factor in electrical circuit.
5. Measurement of Energy using Analog & Digital Energy meter.
6. Measurement of Earth Resistance.
7. Study of Industrial house wiring.
8. Identification & Study of protective devices: Fuses & Fuse carriers, MCB, ELCB and Isolators with ratings and usage.

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Group B (Electrical)

Expt.
No: 1
Date:

Introduction to switches, fuses, indicators and lamps – Basic switch board wiring with lamp, fan and three pin socket

Aim:

To have an introduction to switches, fuses, indicators, lamps and to construct basic switch board using lamp, fan and three pin socket.

Apparatus Required:

S.No	Apparatus Name	Range / Type	Quantity
1	SPST Switch (Single Pole Single Through)		
2	Fuse		
3	Indicator		
4	Lamp		
5	Fan		
5	Energy meter		
6	Connecting wires		

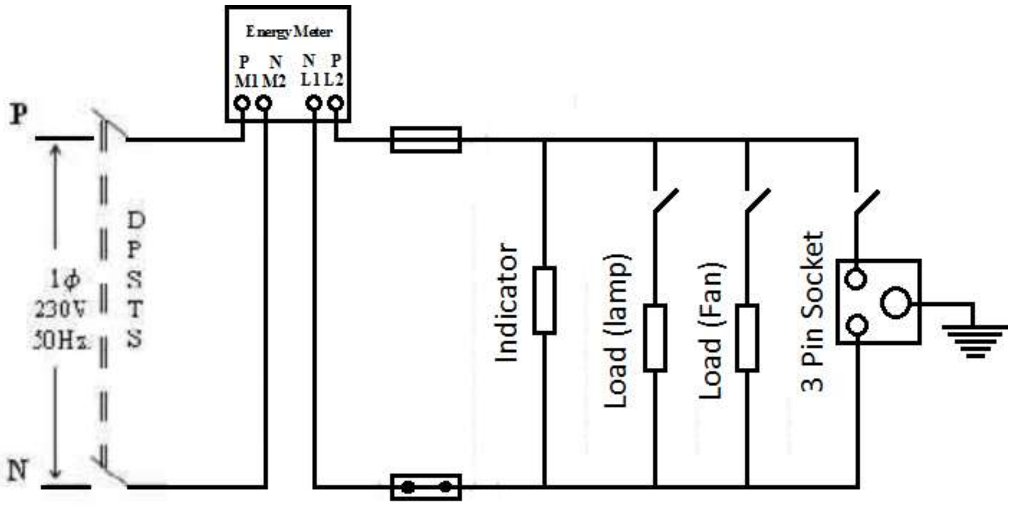
Theory:

Conductors, switches and other accessories should be of proper capable of carrying the maximum current which will flow through them. Conductors should be of copper or aluminum. In power circuit, wiring should be designed for the load which it is supposed to carry. Wiring should be done on the distribution system with main and branch distribution boards at convenient centers. Wiring should be neat with good appearance. Wires should pass through a pipe or box and should not twist or cross. The conductor is carried in a rigid steel conduit conforming to standards or in a porcelain tube.

Procedure:

1. Study the given wiring diagram.
2. Make the location points for energy meter, fuse, indicator, main switch box, switch board, lamp and ceiling rose.
3. Draw the lines for wiring on the wooden board.
4. Place the wires along with the line and fix.
5. Fix the lamp holder, switches, ceiling rose and socket in marked positions on the wooden board.
6. Connect the energy meter and main switch box in marked positions on the wooden board.
7. Give supply to the wired circuit.
8. Test the working of light and socket.

Circuit Diagram:



Name Plate Details:

Load :

Indicator	: P_1=____W, V=230V;	I_1=____A;	Switch: Nil
Lamp	: P_2=____W, V=230V;	I_2=____A;	Switch:
Fan	: P_3=____W, V=230V;	I_3=____A;	Switch:
3 Pin Socket	: P_4=____W, V=230V;	I_4=____A;	Switch:

Full Load :P=_____W; I=___A

- -

Fuse Rating Calculation:

125% of the Full load Current (I) = $\frac{125 \times I}{100}$ = $1.25 \times I$ = _____ ≈ _____ Amp

Result:

Expt.No:2 Date:

Light and Fan Wiring

Aim:

To perform the wiring of the Light and Fan.

Apparatus Required:

S.No	Apparatus Name	Range / Type	Quantity
1	Incandescent Lamp		
2	Lamp Holder		
3	Ceiling Fan		
4	Fan Regulator		
5	One Way Switch		
6	PVC Casing capping		
7	Connecting wires		
8	Switch Box		

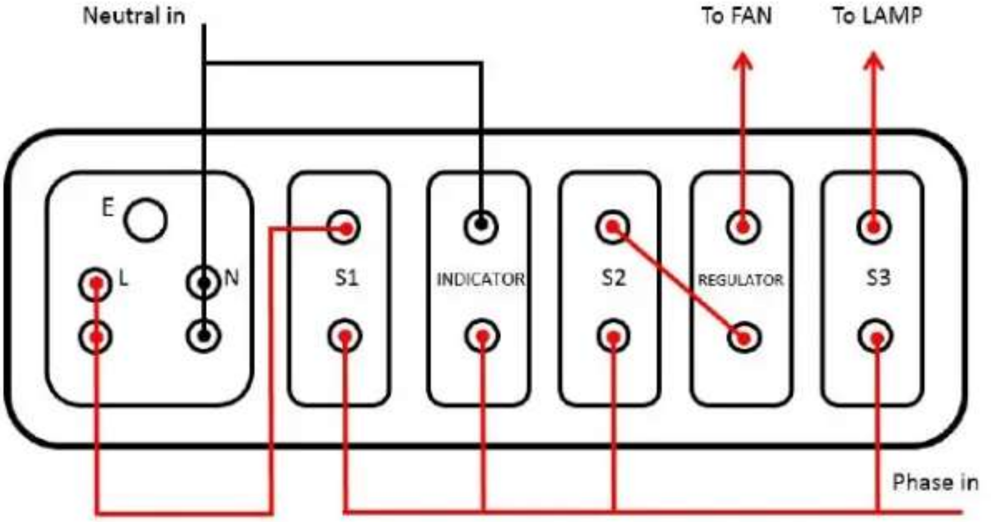
Theory:

The ceiling fan is a very essential electrical appliance in our home, office, or living places. In this wiring diagram of ceiling fan, connection of a capacitor with a fan motor is illustrated and also how to connect the fan regulator. A ceiling fan is a squirrel cage single-phase induction motor. As we know that, a single-phase induction motor is not self-starting. So, a capacitor is required to start the motor. Also, note that the ceiling fan is a capacitor start and capacitor run motor. It means that the capacitor used with a ceiling fan not only helps to start the motor but it also helps to gain more torque during running.

Procedure:

1. Make connections as shown in the figure.
2. Fix the switches, regulator, indicator and 5 pin socket by using necessary tools in the switch board front panel.
3. Do the internal connections using wires of required size.
4. Test the circuit and note down the observations.
5. Switch off the supply.

Circuit Diagram



Name Plate Details
Load :

Incandescent Lamp	: P=____W, V=230V;	I=____A;	Switch: I___A, 230V.
Ceiling Fan	: P= W, V=230V;	I= A;	Switch: I A, 230V.

Fuse Rating Calculation:

125% of the Full load Current (I) = $\frac{125 \times I}{100} = 1.25 \times I =$ _____ $\approx$ _____ Amp

Result:

Expt. No: 3 Date:

Aim:

Staircase Wiring

To control the status of the given lamp by using 2 two – way switches.

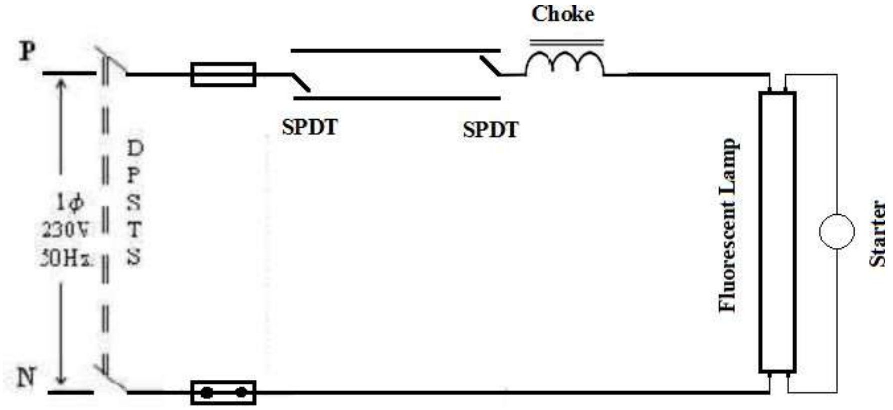
Apparatus Required:

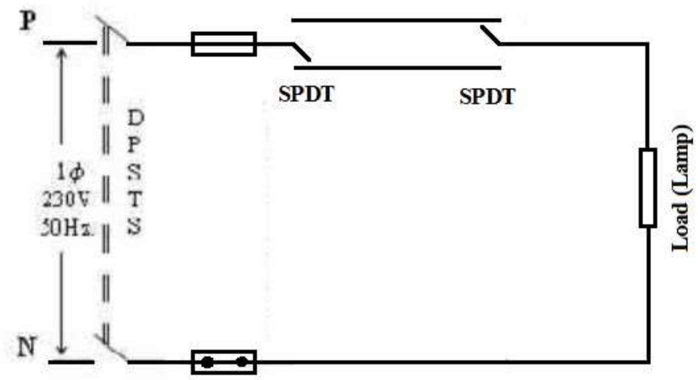
S.No	Apparatus Name	Range / Type	Quantity
1	SPDT Switch		
2	Lamp		
3	Connecting wires		

Procedure:

1. Place the accessories on the wiring board as per the circuit diagram.
2. Place the P.V.C pipe and insert two wires into the P.V.C pipe.
3. Take one wire connect one end to the phase side and other end to the middle point of SPDT switch 1.
4. Upper point of SPDT switch 1 is connected to the upper point of SPDT switch2.
5. Lower point of SPDT 1 is connected to the lower point SPDT switch2.
6. Another wire taken through a P.V.C pipe and middle point of SPDT switch 2 is connected to one end of the lamp holder.
7. Another end of lamp holder is connected to neutral line.
8. Screw the accessories on the board and switch on the supply.
9. Circuit is tested for all possible combination of switch position.

Circuit Diagram:





Name Plate Details

Load:

Fluorescent Lamp : P=____W, V=230V; I=____A; Switch:_____.

Fuse Rating Calculation:

125% of the Full load Current (I) = $\frac{125 \times I}{100}$ = $1.25 \times I$ = _____ ≈ _____ Amp

Result:

Expt. No: 4

Date:

Measurement of Voltage, Current, Power and Power factor in electrical circuit

Aim:

To measure voltage, current, power and power factor in a single phase AC circuit using R load.

Apparatus Required:

S.No	Name of the Apparatus	Range/Type	Quantity
1	Voltmeter		
2	Ammeter		
3	Wattmeter		
4	R Load		
5	Connecting Wires		

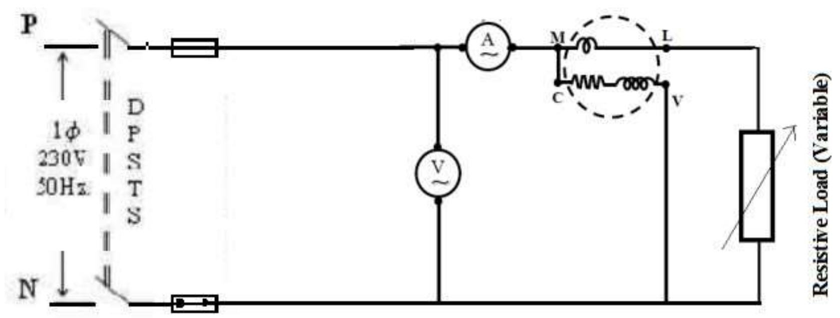
Theory:

Power in an electric circuit can be measured using a wattmeter. A wattmeter consists of two coils, namely current coil and pressure coil or potential coil. The current coil is marked as ML and pressure coil is marked as CV. The current coil measure the quantity that is proportional to the current in the circuit the pressure coil measures quantity that is proportional to the voltage in the circuit. The given wattmeter is loaded by direct loading. The ammeter is connected in series to the wattmeter. The voltmeter is connected in parallel to the wattmeter. The power consumed by the load is measured using the wattmeter and also calculated using the formula.

Procedure:

1. Connection is given as per circuit diagram.
2. Initially no load is applied.
3. Switching of the power supply.
4. Apply the load by adjusting R load.
5. Measure and record the values of voltmeter, ammeter and wattmeter.
6. After taking all the readings, reduce the load slowly to the minimum position.
7. Switch off the power supply.

Circuit Diagram:



Name Plate Details

Load :

Load : P=____W, V=230V; I=____A;

Fuse Rating Calculation:

125% of the Full load Current (I) = $\frac{125 \times I}{100}$ = $1.25 \times I$ = ______ ≈ _____ Amp

Observation Table:

Sl.No	Actual Load (W)	Voltage (V)	Current (A)	Power (W) Multiplication Factor=		Apparent Power (VA)	Power Factor (Cosϕ)
				Observed	Actual		
1							
2							
3							
4							
5							
6							

Real Power = V×I×Cosϕ (in Watts)

Actual Power = Observed Wattmeter reading × Multiplication Factor

Apparent Power = V×I (in Watts)

Power Factor (Cosϕ) = Actual Power / Apparent Power

Model Calculation:

Result:

Expt.No:5 Date:

Measurement of Energy using Analog & Digital Energy meter

Aim:

To measure the energy in a single phase circuit using analog and digital energy meter.

Apparatus Required:

S.No	Name of the apparatus	Range/type	Quantity
1	Single Phase Analog Energy meter		
2	Single Phase Digital Energy meter		
3	Voltmeter		
4	Ammeter		
5	Wattmeter		
6	Load		
7	Connecting Wires		

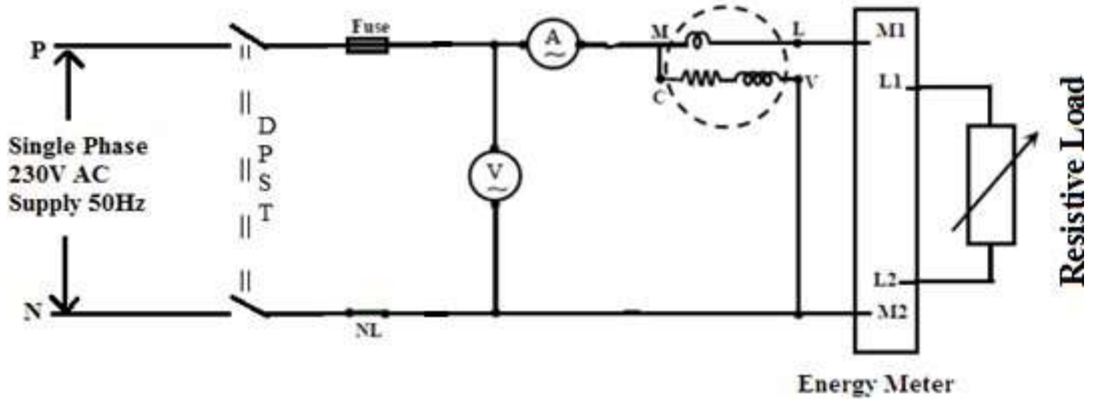
Theory:

Energy meters are integrating instruments and are used for measurement of energy in a circuit over a given time. Since the working principle of such instrument is based on electro-magnetic induction, these are known as induction type energy meter. There are two coils in an induction type energy meter, namely current coil and voltage coil. The current coil is connected in series with the load while the voltage coil is connected across the load. The aluminium disc experiences deflecting torque due to eddy currents induced in it and its rotations are counted by a gear train mechanism.

Procedure:

1. Connections are made as per the circuit diagram.
2. Supply is given to the switch by closing the DPST switch.
3. Load is switched on.
4. Time taken for five revolutions in the energy meter is noted and the Corresponding ammeter and voltmeter reading are noted.
5. The above procedure is repeated for different load current and for fixed number of revolutions.
6. Then the load is gradually released and supply is switched OFF.
7. The error is calculated by using the given formula.

Circuit Diagram:



Name Plate Details:

Load :

Load : P=____W, V=230V; I=____A;

Fuse Rating Calculation:

125% of the Full load Current (I) = $\frac{125 \times I}{100}$ = $1.25 \times I$ = _____ ≈ _____ Amp

Observation Table:

Sl. No	Load (W)	V (V)	I (A)	Power (W)		Time in Seconds (t) (5 Revs)	Calculated Energy (kWh)	Observed Energy (kWh)- **Analog Energy meter**	Observed Energy (kWh)- **Digital Energy meter**	% Error
				Observed	Actual					
1										
2										
3										
4										
5										

Model Calculation:

Calculated Energy= $\frac{P \times \frac{t}{3600}}{1000} kWh$

Observed Energy = (Number of Revolutions per sec / n) kWh

n - Energy Meter Constant

% of Error = [(Observed Energy – Calculated Energy) / (Observed Energy)]

Result:

Expt.No:6
Date:

Measurement of Earth Resistance

Aim:

To measure the earth resistance of an electrical equipment.

Apparatus Required:

S.No	Name of the Apparatus	Range/type	Quantity
1.	Megger		
2.	Connecting Rods		
3.	Connecting Wires		
4.			

Theory:

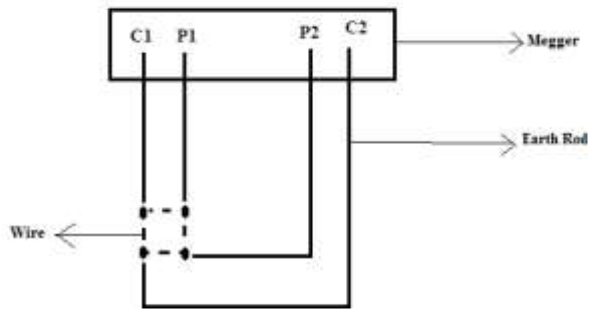
For this experiment we have to use the Megger. It is an instrument for testing the insulation resistance of the order of mega ohms.

A megger consists of an emf source and a voltmeter. The voltmeter scale is calibrated in ohms. In measurement, the emf of the self-contained source should be equal that of the source used in calibration. The deflection of the moving system depends on the ratio of the currents in the coils and is independent of the applied voltage. The value of unknown resistance can be found directly from the scale of the instrument. Figure shows detailed diagram of a megger. It consists of a hand driven dc generator of emf about 500V. The permanent dc meter has two moving coils. First one is deflecting coil and another one is controlling coil. The deflecting coil is connected to the generator through a resistor R2. The torque due to two coils opposes each other. It consists of three terminals E (earth terminal) and L (line terminal) and G (guard wire terminal).

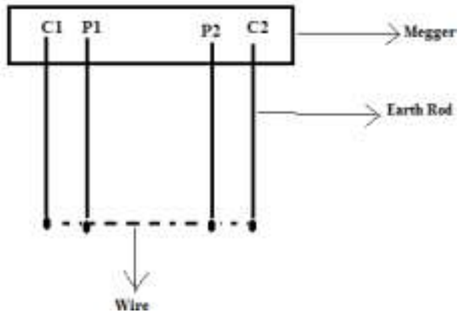
Operation:

When the terminals are open circuited, no current flows through the deflecting coil. The torque to the controlling coil moves the pointer to one end of the scale. When the terminals are short circuited, the torque due to the controlling coil moves the pointer to the other end of the scale i.e. zero mark. In between the two extreme positions the scale is calibrated to indicate the value of unknown resistance directly. The unknown insulation resistance is the combination of insulation volume resistance and surface leakage resistance. The guard wire terminal makes the surface leakage current to bypass the instrument hence only insulation resistance is measured.

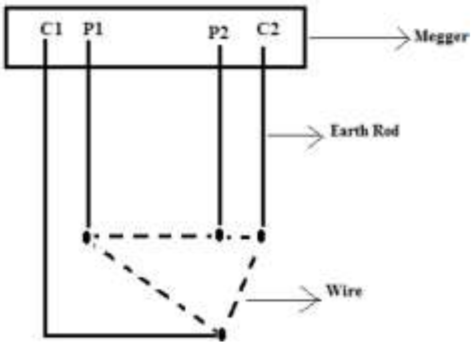
SQUARE POSITION



HORIZONTAL POSITION



TRIANGULAR POSITION



Tabulation:

S.No	Position (Distance in Meter)	Resistance (Ω)
1	**Square** C1-P1:___m, C1-P2:___m, C1-C2:___m, P1-P2:___m, P1-C2:___m, P2-C2:___m	
2	**Horizontal** C1-P1:___m, C1-P2:___m, C1-C2:___m, P1-P2:___m, P1-C2:___m, P2-C2:___m	
3	**Triangular** C1-P1:___m, C1-P2:___m, C1-C2:___m, P1-P2:___m, P1-C2:___m, P2-C2:___m	

Result:

Expt. No:7 Date:

Study of Industrial House Wiring

Aim:

To study about industrial house wiring.

Theory:

Basics of Doing Residential Wiring

Red wires are usually "hot". This means that there is a current (amps) flowing from the circuit breaker to the electrical box or the appliance.

The black wires usually are "returns". This means that they allow current (amps) to flow back to the circuit breaker after the electricity has passed through the load or appliance.

Black wires should not be connected together with ground wires, with the exception being back at the circuit panel bus bar. If you fail to observe this rule, then every single time the load is energized (such as turning on an appliance), electricity will flow through the ground wire and the return wire simultaneously. This is very dangerous.

A ground wire is usually bare and attaches to an appliance's frame. Under normal circumstances, current should not be passing through it. Only when there is a short circuit electricity should pass through the ground wire; this happens so that the circuit breaker will kill the flow of current to the site or appliance.

Basics of Doing Industrial Wiring

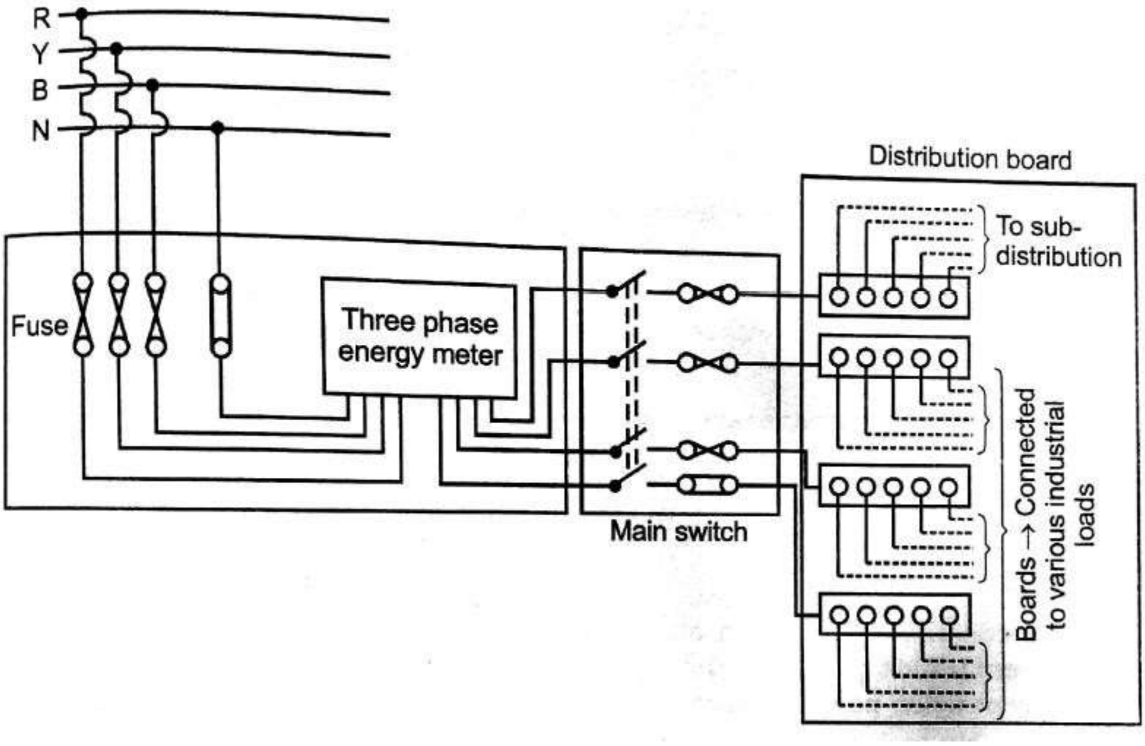
Smart industrial wiring is based on 3-phase electrical power. 3-phase electric allows less workload to be placed on each wire involved, while at once allowing them to work together to give you maximum results. With 3-phase electric, the wires are smaller and the motor is smaller than a typical single-phase motor. These factors allow greater efficiency and longer lasting motors and wires.

There are four types of 3-phase electrical power:

- Common 3 Wire
- Common 4 Wire
- 3 Wire with Grounded Hot Leg
- Special 4 Wire

No matter which type of 3-phase electrical power you choose to use, you'll need a voltage meter in order to determine the actual voltages that are available to you. The type does not determine this.

Industrial wiring typically runs through metal conduits, armored cable or a raceway. These enclosures are the safety ground–never the neutral wire.


R
Y
B
N
Distribution board
To sub-distribution
Fuse
Three phase energy meter
Boards → Connected to various industrial loads
Main switch

Result:

Expt.No:8
Date:

Identification & Study of Protective devices: Fuses & Fuse carriers, MCB, ELCB and Isolators with ratings and usage

Aim:

To identify and study about protective devices in electrical circuits.

Electrical Protective Device:

A device used to protect equipment, machinery, components and devices in electrical and electronic circuit against short circuit, over current and earth fault, is called as protective devices.

Necessity of Protective Devices:

Protective devices are necessary to protect electrical appliance or equipment against

a) Short Circuit
b) Abnormal variations in the supply voltage
c) Overloading of equipment
d) To protect operator against accidental contact with the faulty equipment, falling which the operator may get a severe shock.

Types of Protective Device:

Different types of protective devices that are commonly used in electrical and electronic circuits are

1. Fuse Wire or Fuse
2. MCB – Miniature circuit breaker
3. ELCB – Earth Leakage Circuit Breaker
4. ELCB & MCB
5. Earthing or Grounding

1. Fuse

Fuse generally means a fuse wire, placed in a fuse holder. It is a safety device which protects electrical and electronic circuit against over loads, short circuit and earth faults. The fuse link or fuse wire is made of low resistivity material and low melting point.

Operation of a Fuse

Fuse is a short length of wire designated to melt and separate in case of excessive current. The fuse is connected in the phase of the supply. It is always connected in series with the circuit components that need to be protected. When the current drawn by the circuit exceeds the rated current of the fuse wire, the fuse wire melts and breaks. This disconnects the supply from the circuit and thus protects the circuit and the components in the circuit.

Rating of Fuse Wire

The maximum current that a fuse can carry without being burnt, is called the rating of the fuse wire. It is expressed in Amperes. Current rating of the fuse selected for the circuit should be equal to the maximum current rating of the machinery, appliance or components connected in the circuit.

Fuse Carrier and Fuse Channel

Fuse carrier and channel are made of porcelain or Bakelite material. They are used for all domestic, commercial and industrial application upto 100A capacity.

Cartridge Fuse

This fuse unit is in the form of a cartridge. It's normally manufactured in the range of 2A to 100A. Whenever the fuse blows off, fuse with carrier is replaced by a new one. As it is sealed, it cannot be rewired.

Cartridge fuses are used to protect motors and branch circuit where higher amps or volt ratings are required. They are available in wide variety of sizes, amp and volt ratings up to 600Vac and 600amps. Cartridge fuses are used extensively in commercial, industrial and agricultural applications as well as residential fuse panels, air conditioning, pumps, appliances and other equipment. Cartridge Fuses are available in two types- General purpose fuses and Heavy duty fuses. General purpose fuses have no time delay and protect fuse panel, appliances and branch circuits. Heavy duty fuses have a time delay feature.

HRC Fuse

High Rupture Capacity fuse unit. It is normally designed for high current. When fuse is blown off, the entire unit is to be replaced by a new one. It cannot be rewired as it is a sealed one.

Characteristics of a good fuse wire

A good fuse wire should possess the following characteristics

a) Low resistivity
b) Low melting point
c) Low conductivity of the metal vapors formed, when the fuse is blown off.

Advantages of HRC Fuse

1. They require maintenance
2. They are reliable
3. They operate at high speed.
4. They have consistent performance
5. They clear both low and high fault current with equal efficiency.

2. Miniature Circuit Breaker

It is a safety device which works on magneto thermic release principle. It is connected in the phase between the supply and load. It is manufactured in standard rating of 6A to 40A.We can see it on the meter board of each and every house. When the current drawn by load exceeds the rated value, it acts and trips the circuit, by then protecting the apparatus, operator and appliance.

Advantages of MCB

1. They act and open the circuit in less than 5 milli seconds.
2. Automatic switch off under overload and short circuit condition
3. No fuse to replace or rewire. It needs no repairs.
4. Supply is restored by resetting it again.

3. Earth Leakage Circuit Breaker

This is a domestic safety device which trips the circuit when there is a small leakage to earth or body of the appliance. Thus it protects the operator from shocks and accidents. This is connected in the circuit of the appliance to be protected.

There are two types of ELCB

1. Voltage Earth Leakage Circuit Breaker
2. Current Earth Leakage Circuit Breaker

4. MCB & ELCB

It is the combination of both MCB and ELCB placed in one unit. It acts on both the occasion of earth leakage and overload and protect the circuit, appliance and the operator.

MCB Selection

The first characteristic is the overload which is intended to prevent the accidental overloading of the cable in a no fault situation. The speed of the MCB tripping will vary with the degree of the overload. This is usually achieved by the use of a thermal device in the MCB.

The second characteristic is the magnetic fault protection, which is intended to operate when the fault reaches a predetermined level and to trip the MCB within one tenth of a second. The level of this magnetic trip gives the MCB its type characteristic as follows:

Type	Tripping Current	Operating Time
Type B	3 To 5 time full load current	0.04 To 13 Sec
Type C	5 To 10 times full load current	0.04 To 5 Sec
Type D	10 To 20 times full load current	0.04 To 3 Sec

The third characteristic is the short circuit protection, which is intended to protect against heavy faults maybe in thousands of amps caused by short circuit faults.

The capability of the MCB to operate under these conditions gives its short circuit rating in Kilo amps (KA). In general for consumer units a 6KA fault level is adequate whereas for industrial boards 10KA fault capabilities or above may be required.

5. Earthing (or) Grounding

Connecting the metal body of an electrical appliance, machinery or an electrical installation to earth through a low resistance wire is called Earthing or Grounding.

Necessity of Earthing

Earthing is necessary for all domestic, commercial and industrial installation to safeguard the operator, tall buildings and machinery against lightning.

Metal body of all the electrical appliances, equipment and machinery, the earth points of all three-pin sockets and the body of the energy meter are connected to earth through a thick G.I. wire.

Whenever a live wire comes in contact with the body of the appliance, it is directly connected to earth the grounding wire and hence the body voltage comes to zero. Therefore the operator does not get any shock, when he comes in contact with body of the appliance.

The high voltage included during lightning is discharged to earth through grounding wire and thereby building and machinery are protected.

Isolators

Circuit breaker always trips the circuit but when there is an open contact of the breaker, it cannot be physically seen from outside of the breaker and that is why it is considered as the "not to touch" area of the electrical circuit. Thus, the isolators are created for the safety so that; one can see the condition of the section of the circuit before touching it. The isolator is a switch which isolates the part of the circuit system when it is required. Electrical isolators are the separate part of the system that is created for the safe maintenance. Isolators are generally used at the end of the breaker to repair or to replace.

The main difference between MCB, RCCB, and Isolators

Isolators are generally used in power system while on the other hand, MCB is the circuit breaker. Isolators are manually-operated device, and on the contrary, the circuit breaker is the automatically-operated device. Isolators cut the portion of the substance when a fault occurs. The other devices like MCB and RCCB operate without any interruption. The circuit breaker is the device of an Automatic circuit breaker or Miniature circuit breaker which trips the entire system and if any fault occurs, MCB is to protect the wires from the damage. RCCB detects the leakage current and protects from the electric shock.

Result:

Available Rating of Apparatus in Open Market

Switch:

Switch 1: I=5A, V=230V, **Switch 2:** I=10A, V=230V, **Switch 3:** I=16A, V=230V, **Switch 4:** I=20A, V=230V, **Switch 5:** I=32A, V=230V

Lamp:

Lamp 1: P=15 W, V=230V, **Lamp 2**: P=23 W, V=230V, **Lamp 3**: P=28 W, V=230V, **Lamp 4**: P=40 W, V=230V, **Lamp 5**: P= 60 W, V=230V, **Lamp 6**: P=100 W, V=230V **Lamp 7**: P=200 W, V=230V

Fan:

Fan 1: P= 24 W, V=230V, **Fan 2**: P= 35 W, V=230V, **Fan 3**: P= 60 W, V=230V

3 Pin Socket:

Socket 1: I=5A, V=230V, **Socket 2**: I=16A, V=230V, **Socket 3**: I=32A, V=230V

Energy Meter:

Meter 1: I=5A, V=230V, 1200 Revs/KWh, **Meter 2**: I=10A, V=230V, 1200 Revs/KWh **Meter 3**: I=20A, V=230V, 1200 Revs/KWh

Resistive Load:

Load 1: P=1kW, V=230V, **Load 2**: P=2kW, V=230V, **Load 3**: P=5kW, V=230V, **Load 4**: P=10kW, V=230V

Inductive Load:

Load 1: P=1kW, V=230V, **Load 2**: P=2kW, V=230V, **Load 3**: P=5kW, V=230V, **Load 4**: P=10kW, V=230V

Watt Meter:

Meter 1: V=300V, 5A, UPF, **Meter 2**: V=300V, 5A, LPF, **Meter 3**: V=300V, 10A, UPF, **Meter 4**: V=300V, 10A, LPF

Autotransformer:

Model 1: 1Phase, V=0-300V, 1kVA, **Model 1**: 1Phase, V=0-300V, 5kVA,

Voltmeter:

Meter 1: V=0-1V, **Meter 2**: V=0-10V, **Meter 3**: V=0-20V, **Meter 4**: V=0-150V, **Meter 5**: V=0-300V, **Meter 6**: V=0-600V

Ammeter:

Meter 1: I=0-1A, **Meter 2**: I=0-5A, **Meter 3**: I=0-10A, **Meter 4**: I=0-15A, **Meter 5**: I=0-20A, **Meter 6**: I=0-25A

Wire: Fuse:

Wire 1: I=1A, V=230V**, Wire 2**: I=5A, V=230V, **Wire 3**: I=16A, V=230V, **Wire 4**: I=32A, V=230V

Fuse 1: I=1A, **Fuse 2**: I=2A, **Fuse 3**: I=5A, **Fuse 4**: I=10A, **Fuse 5**: I=15A, **Fuse 6**: I=20A, **Fuse 7**: I=25A