Valliammai Engineering College

SRM Nagar, Kattankulathur - 603203

Department of Electrical and Electronics Engineering

GE8261 – ENGINEERING PRACTICES LABORATORY

ELECTRICAL

LAB MANUAL

I Year- II Semester

Academic Year 2017-2018

(2017 Regulation)

GROUP B (ELECTRICAL)

III . ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.

2. Fluorescent lamp wiring.

3.Stair case wiring

4. Measurement of Voltage, Current, Power and Power factor using R Load.

5. Measurement of energy using single phase energy meter.

6. Measurement of resistance to earth of electrical equipment.

Beyond the syllabus experiment

1. Different types of joints for making wiring.
2. Characteristics of digital multimeter.
3. Assembling a transformer.
4. Bright and Dim lamp method.

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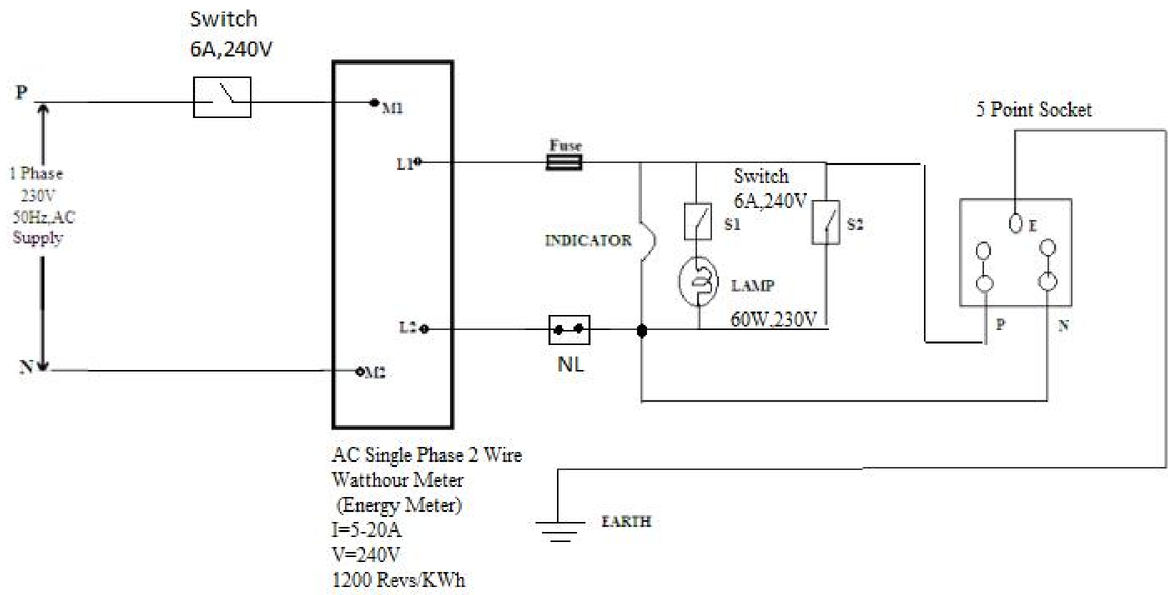
CIRCUIT DIAGRAM:



<u>Name Plate Details</u>

Switch

I=6A, V=240V

Incandescent Lamp

P=60W, V=230V,

Energy Meter

I=5-20A, V=240V, 1200 Revs/KWh

Fuse Rating

EX.NO:
DATE:

RESIDENTIAL HOUSE WIRING USING SWITCHES, FUSE, INDICATOR, LAMP AND ENERGY METER

AIM:

To Construct House wiring using switches, fuse, indicator, lamp and Energy Meter.

APPARATUS REQUIRED:

S.NO	APPARATUS NAME	RANGE / TYPE	QUANTITY
1	Single way Switch	6A,240V	1
2	Fuse	5A	1
3	Indicator	5A	1
4	Incandescent Lamp	60 W	1
5	Energy meter	240V,5-20A	1
6	Connecting wires	1/18 SWG	As per requirement

THEORY:

Conductors, switches and other accessories should be of proper capable of carrying the maximum current which will flow through them. The following table shows the rating for different accessories. Conductors should be of copper or aluminum. In power circuit, wiring should be designed for the load which it is supposed to carry. Power sub circuits should be kept separate from lighting and fan sub – circuits. Wiring should be done on the distribution system with main and branch distribution boards at convenient centers. Wiring should neat, with good appearance.

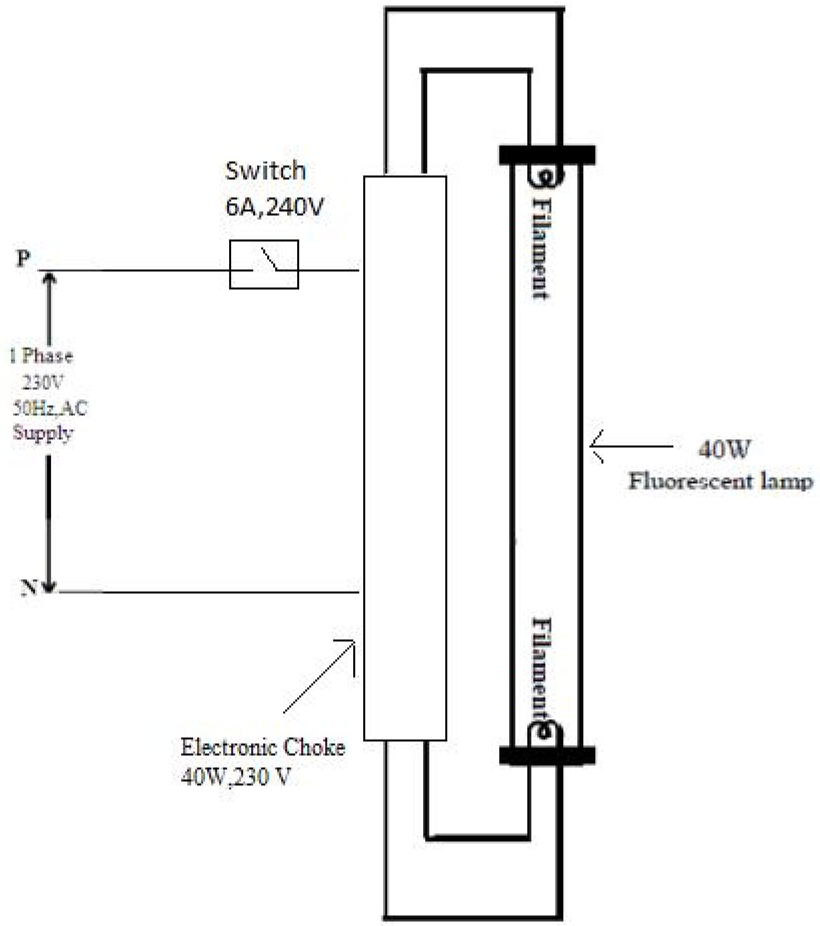
- Wires should pass through a pipe or box, and should not twist or cross.
- The conductor is carried in a rigid steel conduit conforming to standards or in a porcelain tube.

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 bulb holder, Switches, Ceiling rose, 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 a supply to the wires circuit.
8. Test the working of light and socket.

RESULT:

CIRCUIT DIAGRAM



Name Plate Details

Switch

I=6A, V=240V

Fluorescent Lamp

P=40W

Electronic Choke

P=40W,V=230V

Fuse Rating

EX.NO:
DATE:

FLUORESCENT LAMP WIRING

AIM:

To make and check the fluorescent lamp wiring.

APPARATUS REQUIRED:

S.NO	APPARATUS NAME	RANGE / TYPE	QUANTITY
1	Fluorescent Lamp	40W	1 Set
2	Connecting wires	1/18 SWG	As per requirement

THEORY:

Tube-lights, which are basically fluorescent, are the most commonly used high source for illumination in houses, industries, commercial organizations and public utility services. A fluorescent lamp is a low pressure mercury and public utility services. A fluorescent discharge lamp with internal surface coated with suitable fluorescent material. This lamp consists of glass tube provided at both ends with caps having two pins and oxide coated tungsten filament. Tube contains argon or krypton gas to facilitate starting with small quantity of mercury under low pressure. Fluorescent material, when subjected to electro-magnetic radiations of particular wavelength produced by the discharge through the mercury vapor, gets excited and in turn gives out radiation at some other wave length which falls under visible spectrum. Thus, the secondary radiations from fluorescent powder increase the efficiency of the lamp. Tube lights in India are generally made either 61cm long 20 W rating or 122 cm ling 40 W rating.

In order to make a tube light self starting, electronic choke is connected in the circuit. When switch S is closed, full supply voltage appears across the electrodes which are enclosed in a glasses bulb filled with argon gas. This voltage causes discharge in the argon gas with consequent heating of the electrodes. Due to this heating, the electrode in the starter which is made of bimetallic strip, bends and closes contact of the starter. At this stage, the choke, the filaments of the tube and the starter become connected in series across the supply. A current flows through the filaments and heats them. Meanwhile the argon discharge in the starter tube disappears and after a cooling time, the electrodes of starter cause a sudden break in the circuit. This causes a high value of induced EMF in the choke.

The induces EMF in the choke is applied across the tube light electrodes and is responsible for initiating a gaseous discharge because initial heating has already created good number of free electrons in the vicinity of electrodes. Thus, the tube light starts giving high output. Once the discharge through the tube is established, a much lower voltage than the supply voltage is required to maintain it. A reduction in voltage available drop across the choke. Power factor of the lamp is somewhat low and is about 0.5 lagging due to the inclusion of the electronic choke. A condenser, if connected across the supply, may improve the P.F to about 0.95 lagging. The light output of the lamp is a function of its supply voltage. At reduced supply voltages, the lamp may click a start but may fail to hold because of non availability of required holding voltages across the tube. Higher than normal voltage reduces the useful life of the tube light to a very great extent.

1. CHECKING OF CHOKE(ELECTRONIC CHOKE):

1. Check the chock for it's short and open with a test lamp as shown in the fig. And record the results and compare with the following table.

S. No	**State of the Lamp Glow**	**Condition of Choke**
1	Normal Glow	Internal Short circuit in choke
2	Dim	Good Working condition of chock
3	No Glow	Open circuit in the choke

2. CHECKING OF FILAMENT:

1. To test the filament on both sides of the fluorescent tube for it's continuity, make the connections as per the circuit. If the tube is in good condition, the lamp will glow normally. If the filament is not glowing the tube is burn off.
2. Discard the fluorescent tube, if there is open or fused filament in either side of the tube.

3. ASSEMBLING OF FLUORESCENT TUBE:

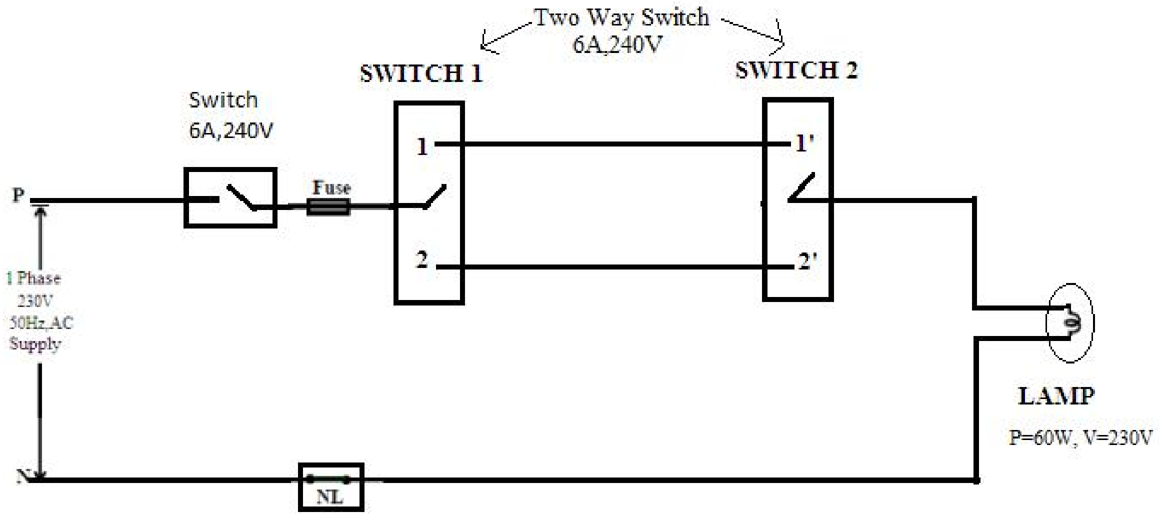
1. Assemble the fluorescent tube accessories like starter holder, holder for tube and chock in the fitting base with the help of screws.
2. Finally it is fixed in the tube holder to light it and switch ON the supply the lamp will glow.

PROCUDURE

1. Make connections as shown in the Figure.
2. Switch on the supply and adjust voltage to 230V. The tube light should start glowing.
3. Switch off the supply

RESULT:

CIRCUIT DIAGRAM:



<u>**Name Plate Details**</u>

Switch

I=6A, V=240V

Incandescent Lamp

P=60W, V=230V,

Fuse Rating

SWITCH POSITION:

SWITCH 1	SWITCH 2	LAMP POSITION
1	1’	ON
1	2’	OFF
2	2’	ON
2	1’	OFF

EX.NO:
DATE:

STAIRCASE WIRING

AIM:

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

APPARATUS REQUIRED:

S.NO	APPARATUS NAME	RANGE / TYPE	QUANTITY
1	Two way Switch	6A,240V	2
2	Incandescent Lamp	60 W,230V	1
3	Connecting wires	1/18 SWG	As per requirement

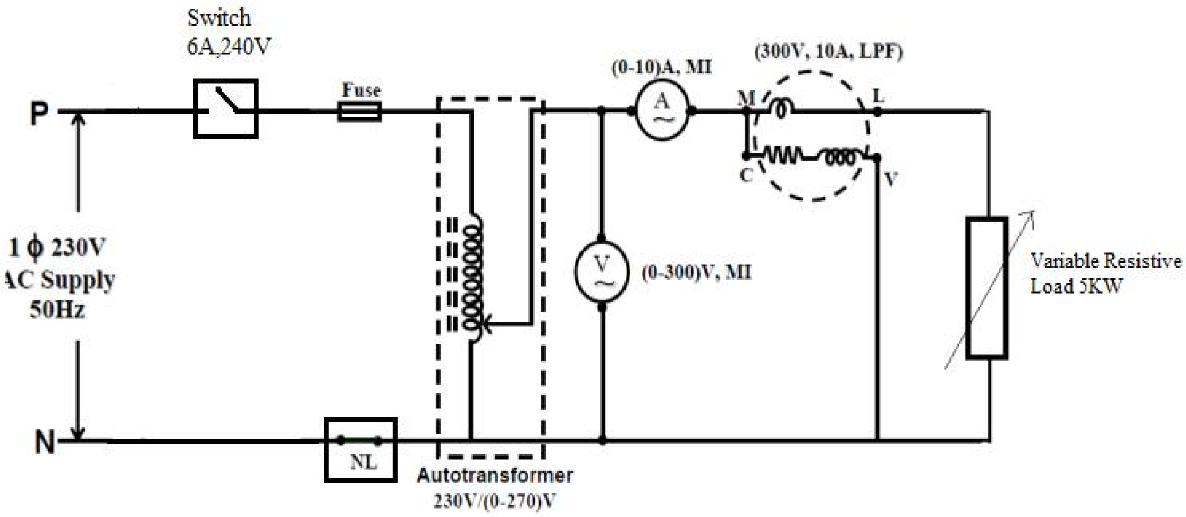
PROCEDURE:

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.

RESULT:

Thus the staircase wiring was done using two way switch.

CIRCUIT DIAGRAM



Name Plate Details

Switch

I=6A, V=240V

Autotransformer

V=230V

Voltmeter

V=(0-300)V,MI

Ammeter

I=(0-10A),MI

Watt meter

V=300V, I= 10A, LPF

Variable Resistive Load

P=5KW

Fuse Rating

OBSERVATION TABLE:

Multiplication Factor=

Sl.No	Voltage V (V)	Current I (A)	Wattmeter Reading (watts)		APPARANT POWER (watts) V*I	Power Factor cosϕ APP/ACT
			Observed	Actual		

EX.NO:
DATE:

MEASURMENT OF VOLTAGE, CURRENT, POWER AND POWER FACTOR USING R LOAD

AIM:

To measure power in a single phase AC circuit using wattmeter by RLC load.

APPARTUS REQUIRED:

S.no	Name of the apparatus	Range/type	Quantity
1.	Voltmeter	(0-300V) MI	1 no.
2.	Ammeter	(0-10A) MI	1 no.
3.	Wattmeter	300V,10A,LPF	1 no.
4.	R Load	5KW	1 no.
5.	Connecting Wires	1/18 SWG	As per requirements

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. Since the same current flows in both the coils, the current and voltage across the circuit are constant. The power consumed by the load is measured using the wattmeter and calculated using the formula.

FORMULAE:

Actual power = W x Multiplication factor
Where W – Observed wattmeter reading
Apparent power = VI watts
Where V – Voltmeter reading
I – Ammeter reading
Power Factor cos ¤ = Actual Power / Apparent Power

PROCEDURE:

1. Connection is given as per circuit diagram.
2. Initially no load is applied.
3. Autotransformer is set to minimum voltage position before switching of the power supply.
4. Set the rated voltage by using the autotransformer. Measure and record the values of voltmeter, ammeter and wattmeter on no load condition. Also carefully note the multiplication factor of the wattmeter that is mentioned in the wattmeter itself.
5. Apply the load by adjusting RLC load.

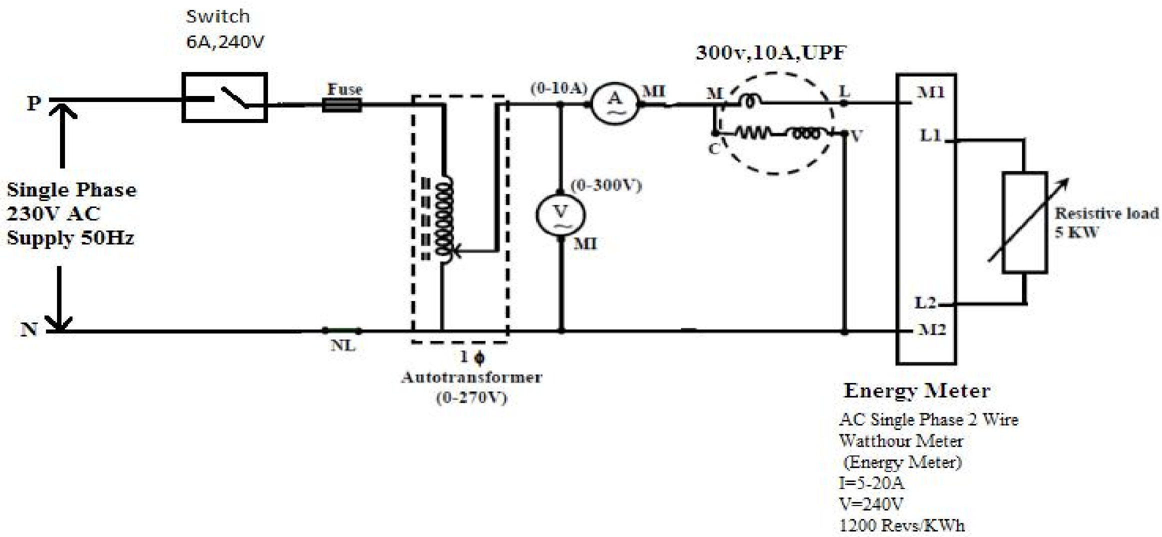
MODEL CALCULATION:

6. Measure and record the values of voltmeter, ammeter and wattmeter.
7. Repeat the steps 5 and 6 until the ammeter reading reaches 10A.
8. After taking all the readings, reduce the load slowly to the minimum and bring the voltage to minimum in the autotransformer. Switch off the power supply.
9. Calculate the power factor and power by the given formula.

RESULT:

Thus the power was calculated using wattmeter by RLC load.

CIRCUIT DIAGRAM



Name Plate Details

Switch

I=6A, V=240V

Autotransformer

V=230V

Voltmeter

V=(0-300)V,MI

Ammeter

I=(0-10A),MI

Watt meter

V=300V, I= 10A, LPF

Variable Resistive Load

P=5KW

Energy Meter

I=5-20A, V=240V, 1200 Revs/KWh

Fuse Rating

EX.NO:
DATE:

MEASURMENT OF ENERGY USING ENERGYMETER

AIM:

To measure the energy in a single in a phase circuit using direct Loading.

APPARTUS REQUIRED:

S.no	Name of the apparatus	Range/type	Quantity
1.	Single Phase Energymeter	1200rev/Kwh	1 no.
2.	Voltmeter	(0-300V) MI	1 no.
3.	Ammeter	(0-10A) MI	1 no.
4.	Wattmeter	300V,10A,LPF	1 no.
5.	R Load	5KW	1 no.
6.	Connecting Wires	1/18 SWG	As per requirements

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. S1 and S2 are the main supply terminals and L1 and L2 are the load terminals.

The ratings associated with the energy meter are.

- Voltage rating
- Current rating
- Frequency rating
- Meter Constant

TABULAR COLUMN:

S. No	Voltmeter reading in volts	Ammeter Reading in Amps	Wattmeter reading in Watts		Time taken for 5 revolutions	True Energy in KWh	Measured energy in KWh	% Error
			Obs	Act				

MODEL CALCULATION:

FORMULAE:

Energy meter specification = 1500 rev / kWh
True energy = Power (P) x time (s)
= P x t (ws)
= P x t / 3600 x 1000 k
Measured energy = n / 1500 kWh
Where n - number of revolutions / sec
% Error = (Measured energy- True energy / True energy) x100

PROCEDURE:

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

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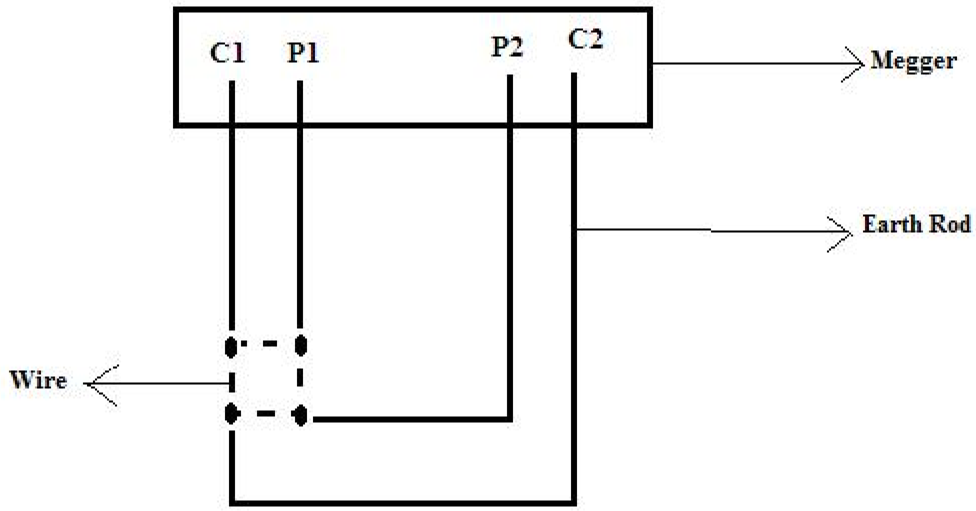
RESULT:

Thus the energy using single phase energy meter was measured.

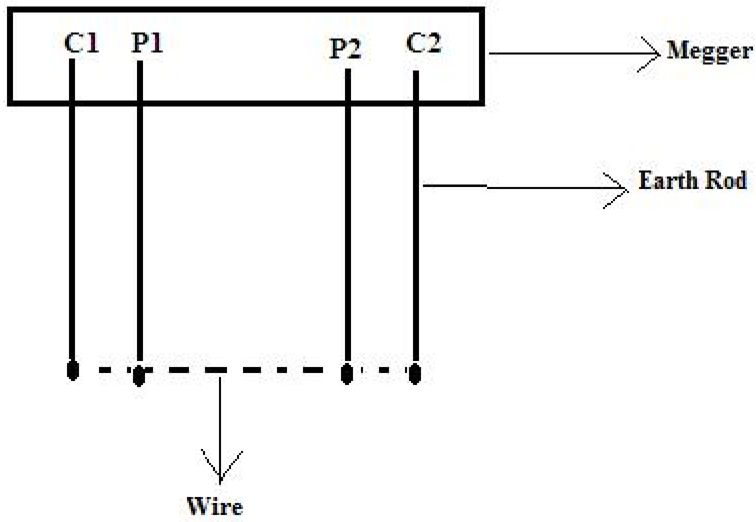
CIRCUIT DIAGRAM:

MEGGER

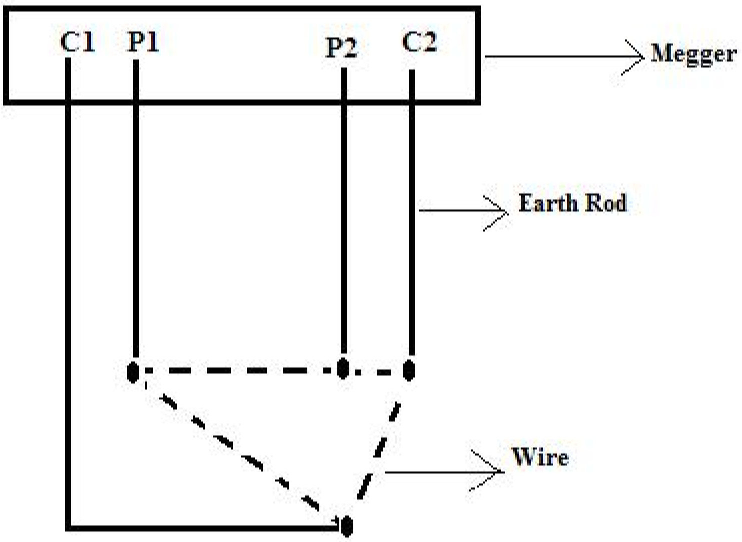
SQUARE POSITION



HORIZONTAL POSITION



TRIANGULAR POSITION



TABULATION:

S.NO	Position	Resistance (Ω)
1	Square	
2	Horizontal	
3	Triangular	
4		
5		

EX.NO:
DATE:

MEASUREMENT OF RESISTANCE TO EARTH OF ELECTRICAL EQUIPMENT

AIM:

To measure the resistance to earth / insulation resistance of the order of mega ohms.

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.

PRINCIPLE:

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 a 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 the 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 and the pointer is deflected 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.

RESULT:

Thus the earth resistance in

Horizontal position =
Square position =
Triangular position =

EX.NO:
DATE:

DIFFERENT TYPES OF JOINTS FOR MAKING WIRING

AIM:

To study the different types of electrical joints

APPARTUS REQUIRED:

S.No	Name of the apparatus	Range/type	Quantity
1	Connecting wire	1/18 SWG	As per requirement
2	Wire cutter	-	1
3	battery in battery holder with metal tags	1.5 V	1
4	Soldering iron and stand	-	1
5	Rosin-free flux cored solder	-	As per requirement
6	Voltmeter	(0-100V)	1

THEORY:

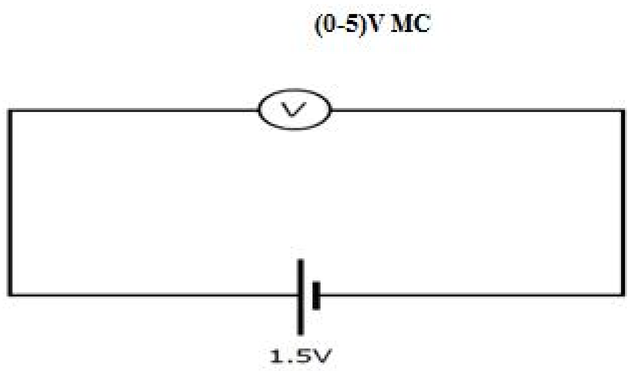
Electrical joints are the joints that connect the various components in an electrical circuit. They can be permanent (soldered or crimped), or temporary (bolted, clamped or plugged in). One of the most common permanent joints is solder. Soldering uses tin alloy solder, which has a low melting temperature. This is melted using a soldering iron and coated on the two components being joined.

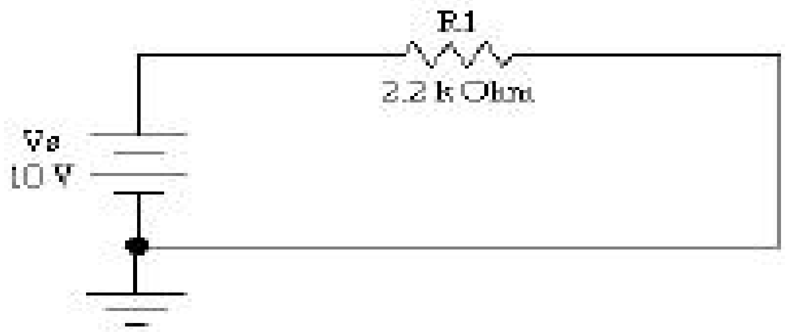
PROCEDURE:

1. Use a pair of wire strippers to take 1 cm of insulation off the end of each lead.
2. Turn the soldering iron on and wait for it to get hot.
3. When the iron is hot, clean the bit using the wet sponge. Make sure its surface is coated with a thin film of fresh solder by carefully touching some solder.
4. Touch the iron against one of the tags on the battery holder so it warms up. At the same time touch some solder against the tag so it melts and produces a thin layer of solder on the tag.
5. Do the same for the bared end of the lead (this process is sometimes called tinning).
6. Touch the soldering iron against the tag and, at the same time, bring the bare end of the lead into contact with the tag.
7. Remove the bit as soon as there is a layer of molten solder joining the wire to the tag.
8. Be careful not to move the joint while it cools down.
9. A good solder joint is shiny. If it's rough, touch the bit of the iron to the tag and add some solder until you get a better joint.
10. Clean the bit of the soldering iron on the wet sponge and repeat with the other tag and lead.
11. To check the soldered joints are working, connect the plug sockets to the voltmeter (see circuit diagram) and check the voltage across the battery.

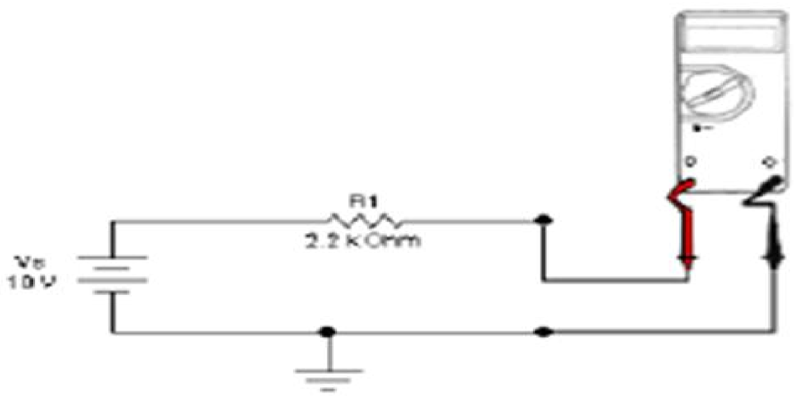
RESULT:

CIRCUIT DIAGRAM:





(A)



(B)

EX.NO:
DATE:

CHARACTERISTICS OF DIGITAL MULTIMETER

AIM:

i. To measure the resistance of a resistor using a digital multimeter
ii. To measure the DC voltage using a digital multimeter
iii. To measure the current in an electrical circuit using a digital multimeter

APPARATUS REQUIRED

S.no	Name of the apparatus	Range/type	Quantity
1	Digital multimeter with probes	-	1
2	Resistor	6.8Ω,100Ω, 2.2KΩ, 33KΩ, 270Ω, 1MΩ, 1KΩ	1
3	Regulated power supply	(0-30V)	1
4	Bread board	-	1
5	Voltmeter	(0-30V) MI	1

THEORY:

A digital multimeter is an instrument which is used for measuring various electrical quantities like DC voltage, AC voltage, DC current, AC current and resistance. In **digital multimeters** the measurement result is given in numerical form. The most important component in it is an analog-to-digital (A/D) converter, which converts the measured (or from it electronically formed) DC voltage into numerical presentation.

In addition to the usual multimeter functions, microprocessor technology has enabled some new features in digital multimeters. Readout holding 'freezes' the displayed value instantly after the probe touches the measurement point; thus the user may concentrate on aligning the testing wires to the measured object. Short-circuit testing beeps when the resistance is below a certain limit. A multimeter with recording of minimum and maximum values can be left to record minimum- maximum values on its own, no matter whether they are voltages, currents, resistances or temperatures. Peak value holding is useful, when the measured circuit has voltage transients or impulse currents of less than one period’s length. The use of offset makes it possible to record a signal value into the meter’s memory and adding this value to or subtracting it from the following values; in this way two different voltages can be compared quickly. When offset is used together with dB-function, the dB-values can be read directly on the meter. Offset can also be used for the compensation of the measurement error caused by the resistance of the measurement leads. Many multimeters can also measure frequency. Many meters select the measurement range automatically.

i. Measurement of resistance using a digital multimeter

TABULAR COLUMN:

S.No	**Nominal value**	**Ohmmeter reading**	**Percentage difference**
1	6.8Ω		
2	100Ω		
3	2.2KΩ		
4	33KΩ		
5	270Ω		
6	1MΩ		
7	1KΩ		

ii. Measurement of DC voltage using a digital multimeter

TABULAR COLUMN:

S.No	Power supply voltage	Digital multimeter reading
1	0.5	
2	2	
3	5	
4	15	
5	30	

PROCEDURE:

1. Connect the resistor into the bread broad
2. Connect the Black Probe to the COM terminal and Red Probe to the terminal marked with “Ω.”
3. Set the meter to “Ω.”
4. Connect the Black Probe to one end of the resistor , now connect the Red Probe to the other end of the resistor
5. Set the meter to “Ω” function
6. Now that the meter has given a reading
7. compare the difference between the measured resistance and the nominal resistance
8. The percentage difference is calculated by:

$$Percentage\_Error := \frac{Nominal\_Value - Measured\_Value}{Nominal\_Value} \cdot 100$$

9. Note the readings and find the value of resistance.

PROCEDURE:

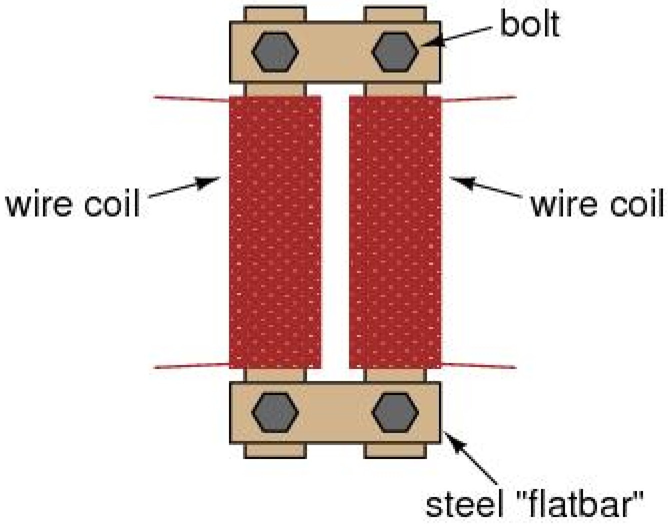
1. The voltmeter is placed in parallel with the circuit element whose voltage is to be measured
2. Locate the voltage adjustment knob, current adjustment knob, and the power switch on the power supply
3. Before you turn on the power supply rotate both the current and voltage adjustment knobs to the left.
4. Turn on the power supply and Note that both readings of current and voltage are at zero.
5. Now rotate the current knob about half way and set the voltage adjustment knob for a reading of 0.5 V.
6. Take the Digital multimeter and connect the Black Probe to the COM terminal on the meter and Red Probe to the terminal marked with "V" on the meter.
7. Set the meter to V---- function.
8. The Red Probe is connected to the positive (+) voltage terminal of the power supply and the Black Probe to the negative (-) voltage terminal of the power supply.
9. Set the power supply to the following voltages as stated in the Tabular column above and record the data’s.

iii. <u>Measurement of current in an electrical circuit using a digital multimeter</u>

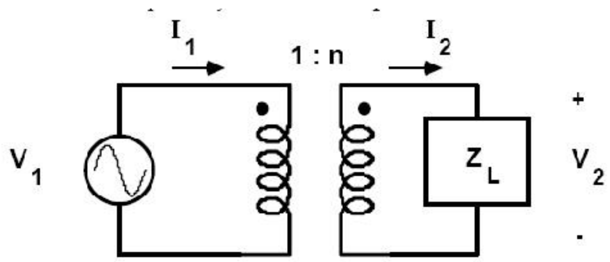
PROCEDURE:

1. Construct the circuit shown in the circuit diagram (A)
2. Set the digital multimeter selector switch to A--.
3. Connect the Black Probe to the COM terminal of the digital multimeter and the Red Probe to the digital multimeter terminal marked 300mA.
4. Insert the meter as shown in circuit diagram (B)
5. Now connect the source and read the current value.

RESULT



i) Construction of a Transformer



ii) Equivalent Circuit of a Transformer

EX.NO:
DATE:

ASSEMBLING A TRANSFORMER

AIM

The learning objectives of Assembling of Transformer are

- Effects of electromagnetism.
- Effects of electromagnetic induction.
- Effects of magnetic coupling on voltage regulation.
- Effects of winding turns on "step" ratio.

APPARATUS REQUIRED

- Power transformer, 120VAC step-down to 12VAC
- Terminal strip with at least three terminals.
- Household wall-socket power plug and cord.
- Line cord switch.
- Fuse and fuse holder

THEORY

A transformer is a four-terminal device in which AC complex power is applied at one pair of terminals (the primary) and a load is driven at the other pair of terminals (the secondary). The transformer is a magnetically coupled device with no direct electrical connection between the primary and the secondary windings, so no DC power can pass through the device. The behavior of an actual transformer is rather complicated, but several simplified models are available for analyzing basic transformer circuits.

An ideal transformer is lossless, meaning that the complex output power at the load is equal to the complex input power. The ideal transformer can either *step up* or *step down* the AC output voltage (**V2**) with respect to the input voltage (**V1**) in order to obtain the desired voltage level at the load. Since no power is lost in the ideal transformer, stepping up the output voltage by a factor n results in **V2** = n **V1**, and **I2** = **I1**/n, where n is the *turns ratio* of the transformer, i.e., [# of turns in secondary winding]/[# of turns in primary winding]. The dots (.) at the top of the diagram in Figure 11.1 are used to indicate the polarity of the windings: a positive AC voltage **V1** results in a positive AC voltage **V2**.

If we assume that the transformer is ideal we can identify the complex (phasor) expressions which relate the terminal voltages and currents.

$$nV_1 = V_2 \quad I_1/n = I_2 \quad V_2/I_2 = Z_L$$

Using these expressions we can also write

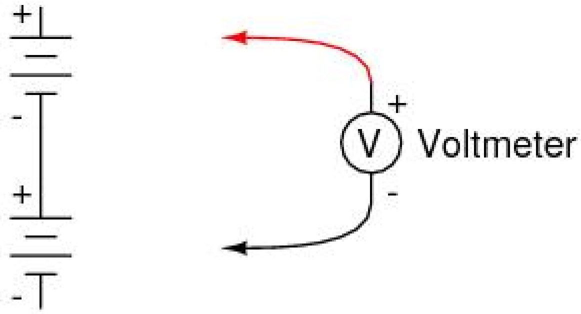
$$Z_1 = V_1/I_1 = (V_2/n)/nI_2 = (1/n^2)\cdot Z_L$$

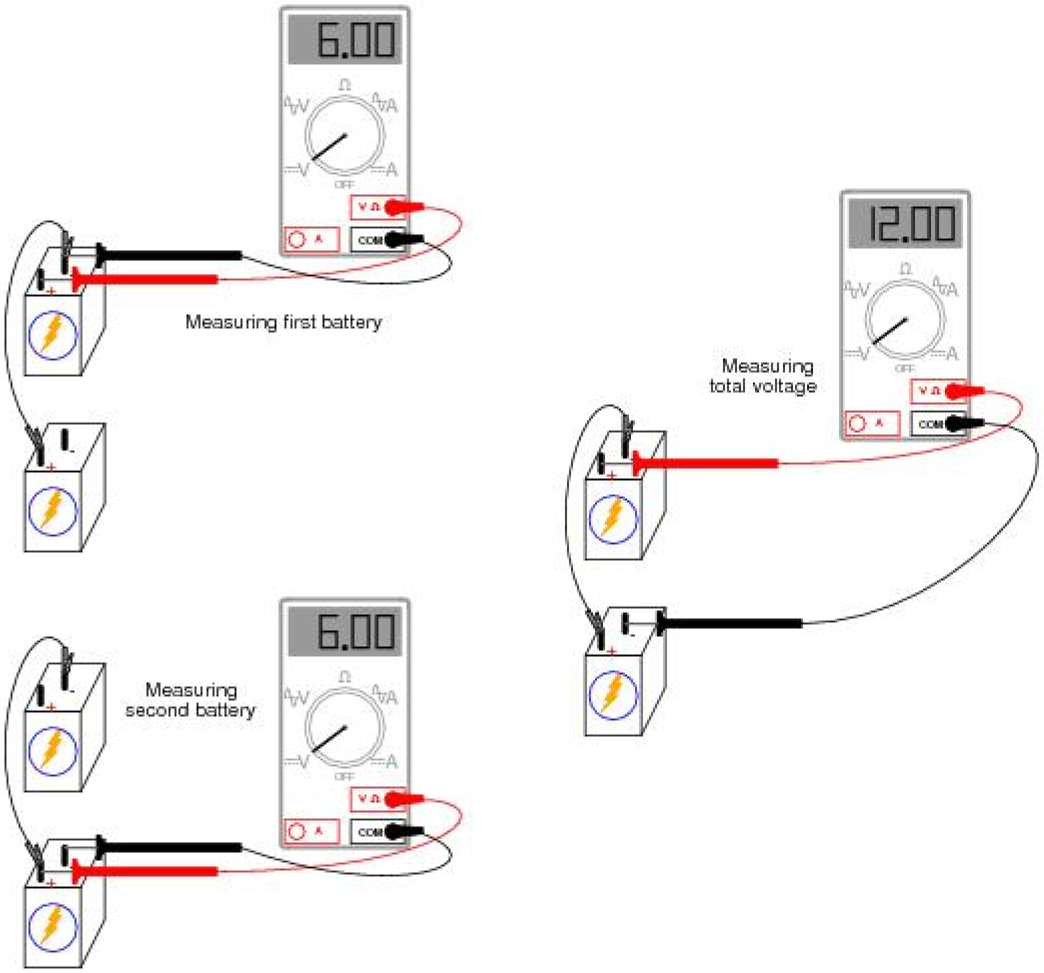
This result indicates that for an ideal transformer the input impedance seen at the primary is equal to the impedance attached to the secondary divided by the square of the turns ratio.

Wrap two, equal-length bars of steel with a thin layer of electrically-insulating tape. Wrap several hundred turns of magnet wire around these two bars. You may make these windings with an equal or unequal number of turns, depending on whether or not you want the transformer to be able to "step" voltage up or down. I recommend equal turns to begin with, then experiment later with coils of unequal turn count. Join those bars together in a rectangle with two other, shorter, bars of steel. Use bolts to secure the bars together (it is recommended that you drill bolt holes through the bars *before* you wrap wire around them).

Check for shorted windings (ohmmeter reading between wire ends and steel bar) after you're finished wrapping the windings. There should be no continuity (infinite resistance) between the winding and the steel bar. Check for continuity between winding ends to ensure that the wire isn't broken open somewhere within the coil. If either resistance measurements indicate a problem, the winding must be re-made. Measure the output voltage (secondary winding) of your transformer with an AC voltmeter. Connect a load of some kind (light bulbs are good!) to the secondary winding and re-measure voltage. Note the degree of voltage "sag" at the secondary winding as load current is increased. Loosen or remove the connecting bolts from one of the short bar pieces, thus increasing the *reluctance* (analogous to *resistance*) of the magnetic "circuit" coupling the two windings together. Note the effect on output voltage and voltage "sag" under load.

RESULT:





i) Series Connection

EX.NO:
DATE:

BRIGHT AND DIM LAMP METHOD

AIM

To connect batteries in Series and Parallel to perform Bright and Dim Lamp method at different voltage levels

APPARATUS REQUIRED

- One 9-volt battery
- Four 6-volt batteries
- 12-volt light bulb, 25 or 50 watt
- Lamp socket

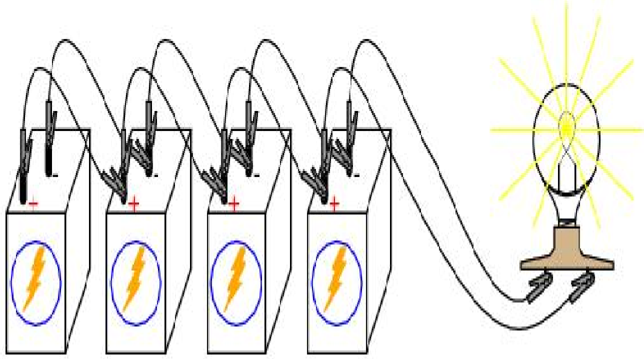
SERIES CONNECTION

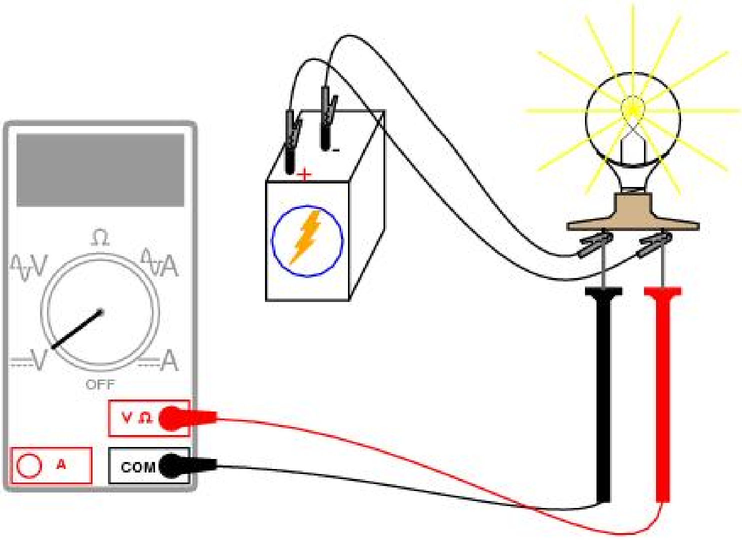
Connecting components in *series* means to connect them in-line with each other, so that there is but a single path for electrons to flow through them all. If you connect batteries so that the positive of one connects to the negative of the other, you will find that their respective voltages add. Measure the voltage across each battery individually as they are connected, then measure the total voltage across them.

PARALLEL CONNECTION

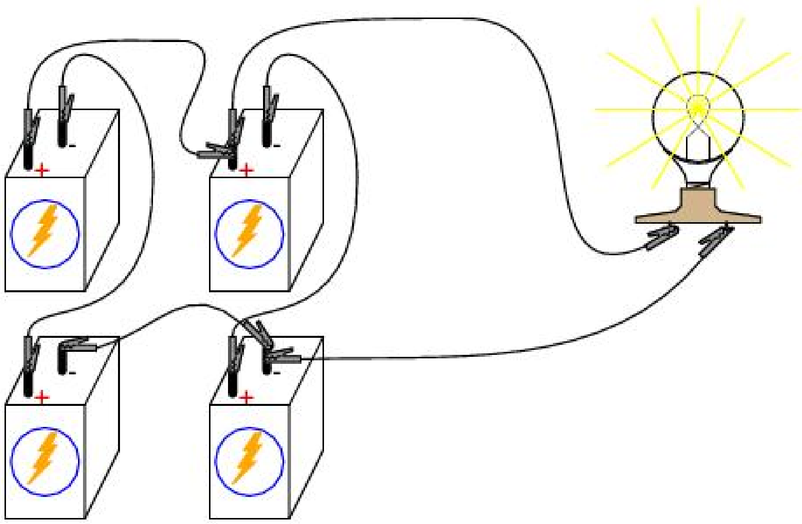
By connecting one 6-volt battery to the lamp. The lamp, designed to operate on 12 volts, should glow dimly when powered by the 6-volt battery. Use your voltmeter to read voltage across the lamp.

The voltmeter should register a voltage lower than the usual voltage of the battery. If you use your voltmeter to read the voltage directly at the battery terminals, you will measure a low voltage there as well. Why is this? The large current drawn by the high-power lamp causes the voltage at the battery terminals to "sag" or "droop," due to voltage dropped across resistance internal to the battery. We may overcome this problem by connecting batteries in *parallel* with each other, so that each battery only has to supply a fraction of the total current demanded by the lamp.





ii) Parallel Connection



iii) Series-Parallel Connection

Parallel connections involve making all the positive (+) battery terminals electrically common to each other by connection through jumper wires, and all negative (-) terminals common to each other as well. Add one battery at a time in parallel, noting the lamp voltage with the addition of each new, parallel-connected battery.By breaking the circuit for just one battery, and inserting our ammeter within that break, we intercept the current of that one battery and are therefore able to measure it. Measuring total current involves a similar procedure: make a break somewhere in the path that total current must take, then insert the ammeter within than break. To obtain maximum brightness from the light bulb, a *series-parallel* connection is required. Two 6-volt batteries connected series-aiding will provide 12 volts.

RESULT