BEEE203

Module-4

Measuring Instruments
Domestic Wiring

Presented By,
Maria Sushma S
Assistant Professor
Department of EEE
ATMECE, Mysuru

Module-4

Measuring instruments:

- Construction and working principle of whetstone's bridge,
- Kelvin's double bridge,
- Megger,
- Maxwel's bridge for inductance,
- Schering's bridge for capacitance,
- Concepts of current transformer and Potential transformer. (Only balance equations and Excluding Vector diagram approach)
- Domestic Wiring: Requirements,
- Types of wiring: casing, capping.
- Two way and three way control of load.

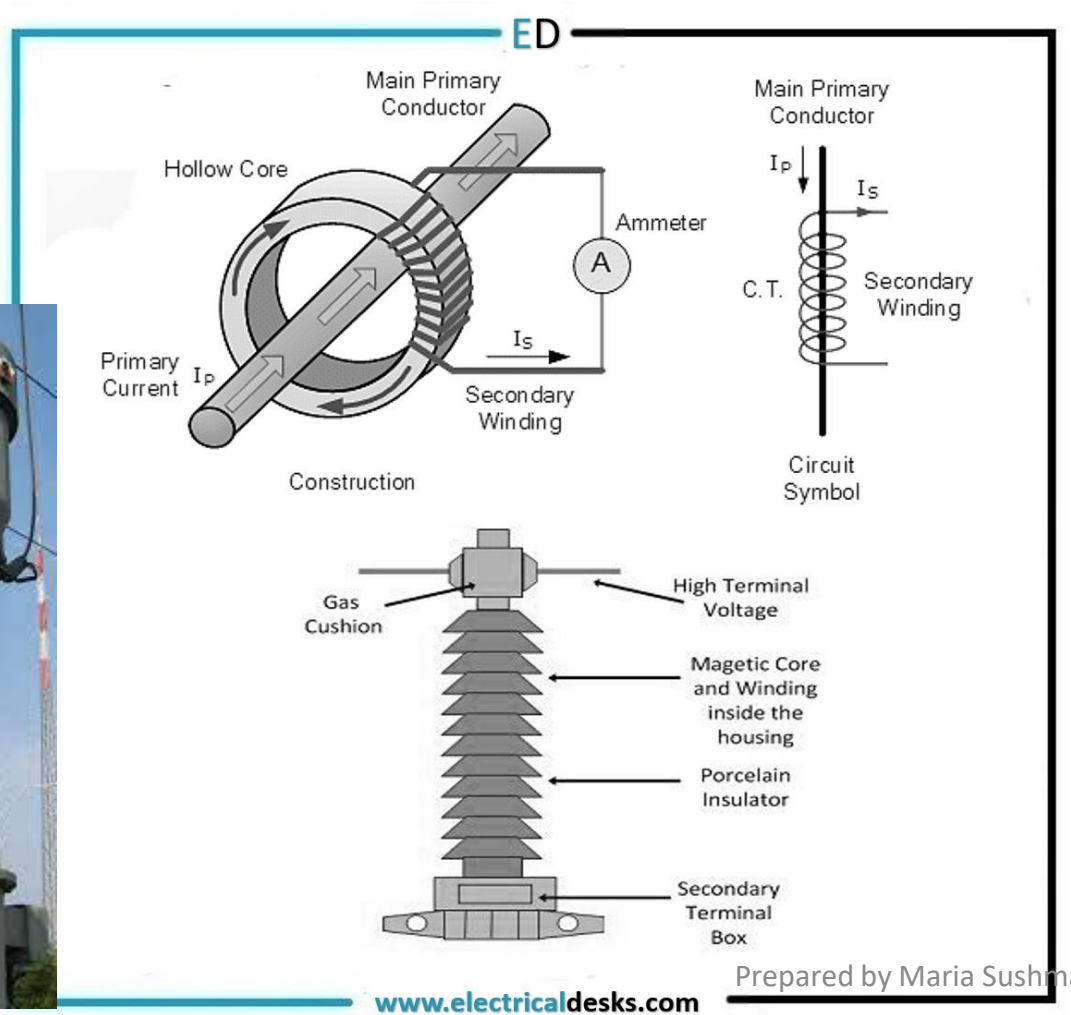
Instrument Transformers

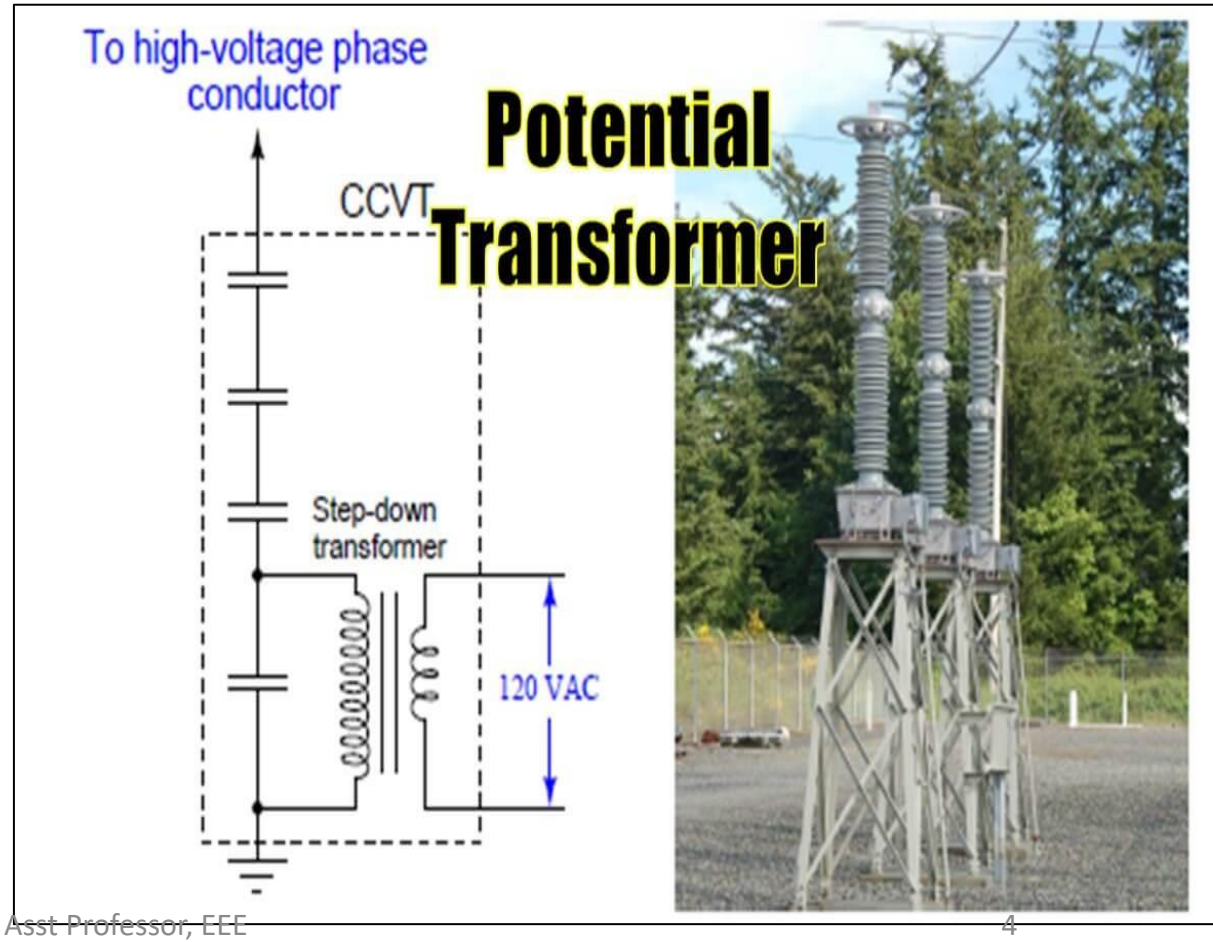
- The when large currents are to be measured in **d.c. circuits,** low-range ammeters with suitable shunts are used.
- For measuring high voltages, low-range voltmeters are used with high resistances connected in series with them.
- But it is neither convenient nor practical to use this method with **alternating current and voltage instruments.**
- For this purpose, specially constructed accurate ratio instrument transformers are employed in conjunction with standard low-range a.c. instruments.
- Their purpose is to reduce the line current or supply voltage to a value small enough to be easily measured with meters of moderates size and capacity.
- In other words, they are used for extending the range of a.c. ammeters and voltmeters.

Instruments transformers are of two types :

(i) Current transformers (CT)—for measuring large alternating currents.

(ii) Potential transformers (PT)—for measuring high alternating voltages,





Instruments transformers cntd.

Advantages of using instrument transformers for range extension of a.c. meters :

(1) The instrument is insulated from the line voltage, hence it can be grounded.

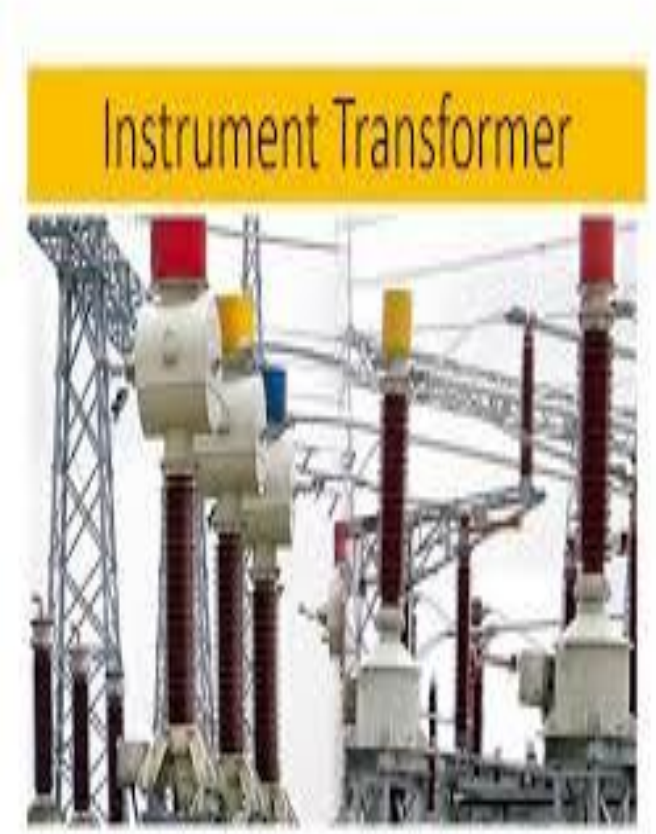
(2) The cost of the instrument (or meter) together with the instrument transformer is less than that of the instrument alone if it were to be insulated for high voltages.

(3) It is possible to achieve standardisation of instruments and meters at secondary ratings of 100—120 volts and 5 or 1 amperes

(4) If necessary, several instruments can be operated from a single transformer and power consumed in the measuring circuits is low.

Instruments transformers cntd.

- In using instrument transformers for current measurements, we must know the ratio of primary current to the secondary current.
- In using Potential transformers for voltage measurements, we must know the ratio of primary voltage to the secondary voltage.
- These ratios give us the multiplying factor for finding the primary values from the instrument readings on the secondary side.
- However, for energy or power measurements, it is essential to know not only the transformation ratio but also the phase angle between the primary and secondary currents (or voltages) because it necessitates further correction to the meter reading.



Instruments transformers cntd.

For range extension on a.c. circuits, instrument transformers are more desirable than shunts (for current) and multipliers (for voltage measurements) for the following reasons :

1. Time constant of the shunt must closely match the time constant of the instrument. Hence' a different shunt is needed for each instrument.
2. Range extension is limited by the current-carrying capacity of the shunt i.e. upto a few hundred amperes at the most.
3. If current is at high voltage, instrument insulation becomes a very difficult problem
4. Use of multipliers above 1000 becomes almost impracticable.
5. Insulation of multipliers against leakage current and reduction of their distributed capacitance becomes not only more difficult but expensive above a few thousand volts.

Info- Extension of range is a concept to measure the higher value of the current or voltage than the rating of the instruments by adding some external Resistance/Impedance of suitable value in series or parallel.

Current Transformer

- A current transformer-enables heavy alternating current to be measured with the help of a standard 5-A range a.c. ammeter.
- As shown in Fig, the current - or series-transformer has a primary winding of one or more turns of thick wire connected in series with the line carrying the current to be measured.
- The secondary consist of a large number of turns of fine wire and feeds a standard 5-A ammeter (Fig. 10.86) or the current coil of a watt-meter or watthour-meter (Fig. 10.87).
- For example, a 1000/5A current transformer with in single-turn primary will have 200 secondary turns. Obviously, it steps down the current in the 200 : 1 ratio whereas it steps up the voltage drop across the single-turn primary (an extremely small quantity) in the ratio 1 : 200.
- Hence if we know the current ratio of the transformer and the reading of the a.c. ammeter, the line current can be calculated.

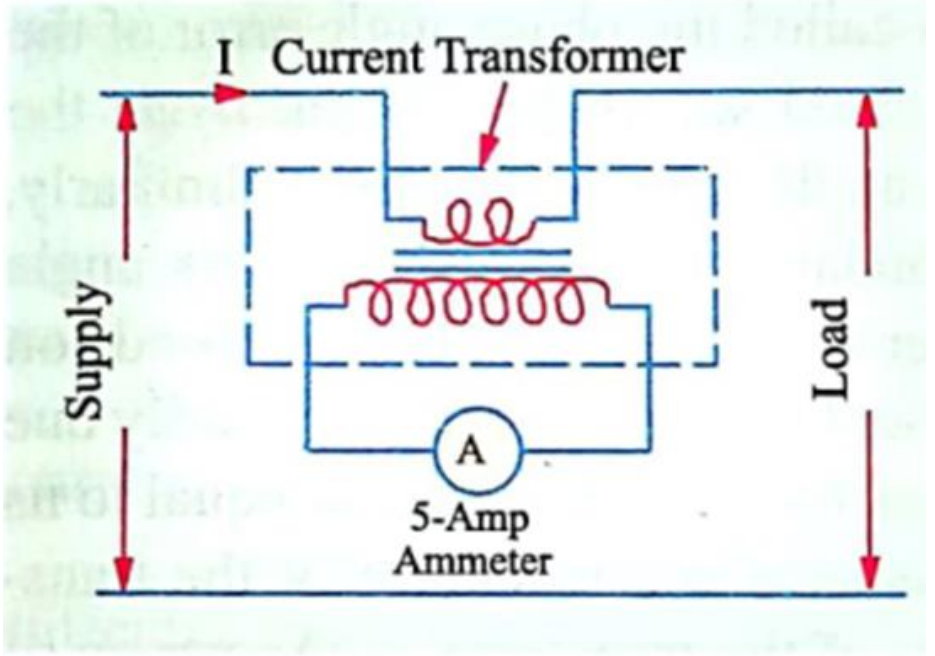


Fig. 10.86

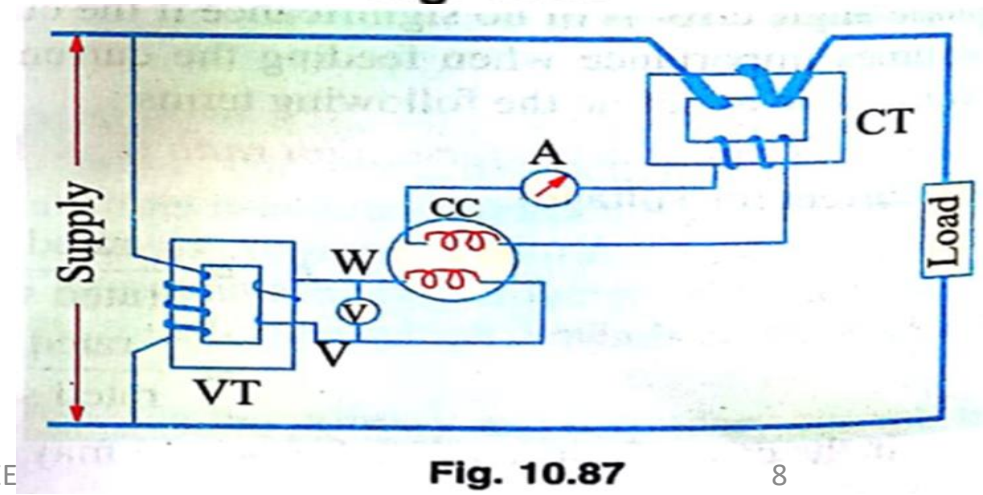


Fig. 10.87

- With ammeter resistance being extremely low, a current transformer operates with its secondary under nearly short-circuit conditions.
- The secondary winding must, first of all, be short-circuited before the instrument is disconnected.
- If it is not done then due to the absence of counter ampere-turns of the secondary, the unopposed primary m.m.f. will set up an abnormally high flux in the core which will produce excessive core loss with subsequent heating of and damage of the transformer insulation and a high voltage across the secondary

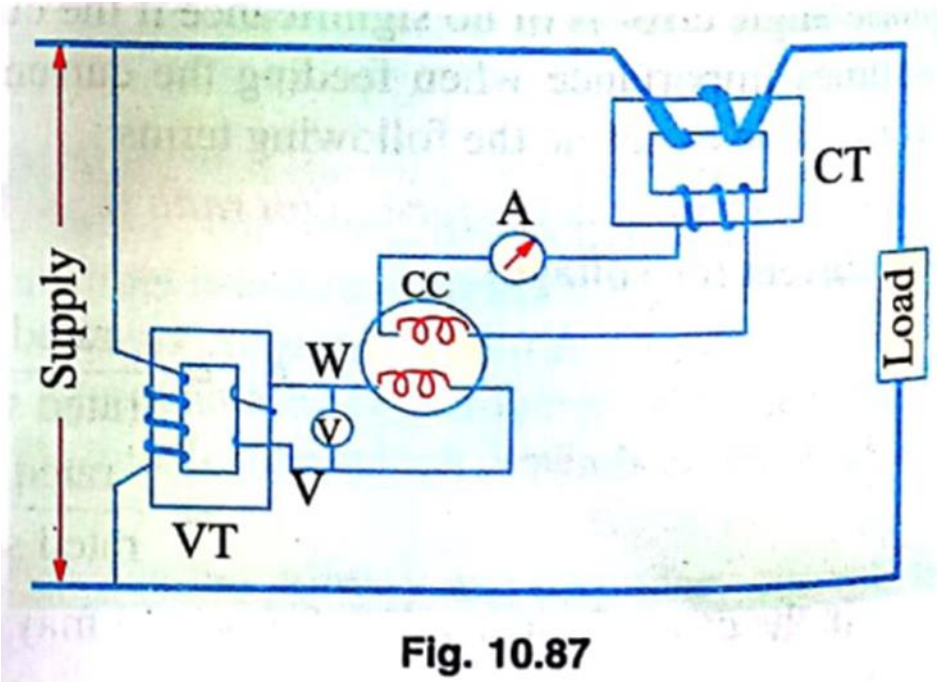


Fig. 10.87

Potential Transformer

- These transformers are extremely accurate-ratio stepdown transformers and are used in conjunction with standard low-range voltmeters (100-120 V) whose deflection when divided by transformation ratio, gives the true voltage on the primary or high- voltage side.
- In general, they are of the shell type and do not differ much from the ordinary two winding transformer except that their power rating is extremely small.
- Sine their secondary windings are required to operate instruments or relays or pilot lights, their ratings are usually of 40 to 100W.
- For safety, the secondary is completely insulated from the high voltage primary and is, in addition, grounded for affording protection to the operator. Fig. 10.89 shows the connection of such a transformer.

Potential transformer

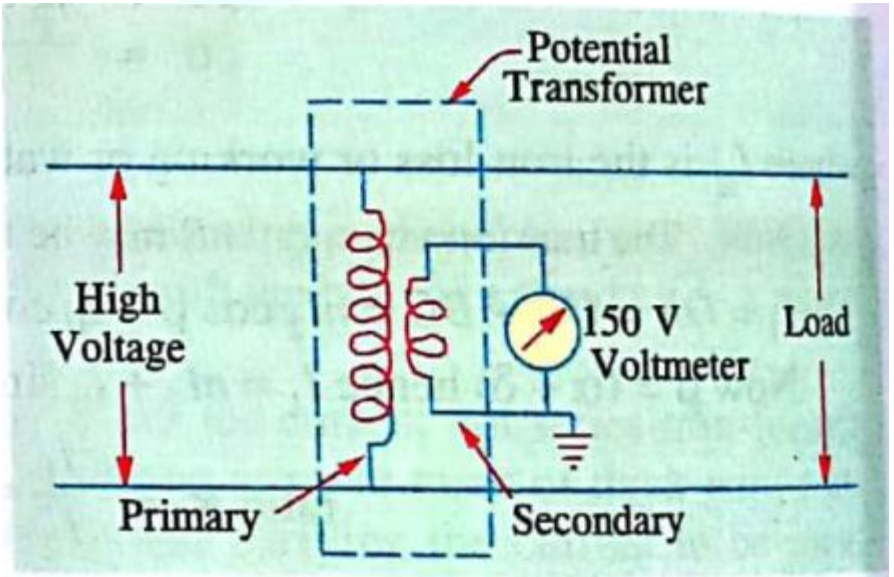
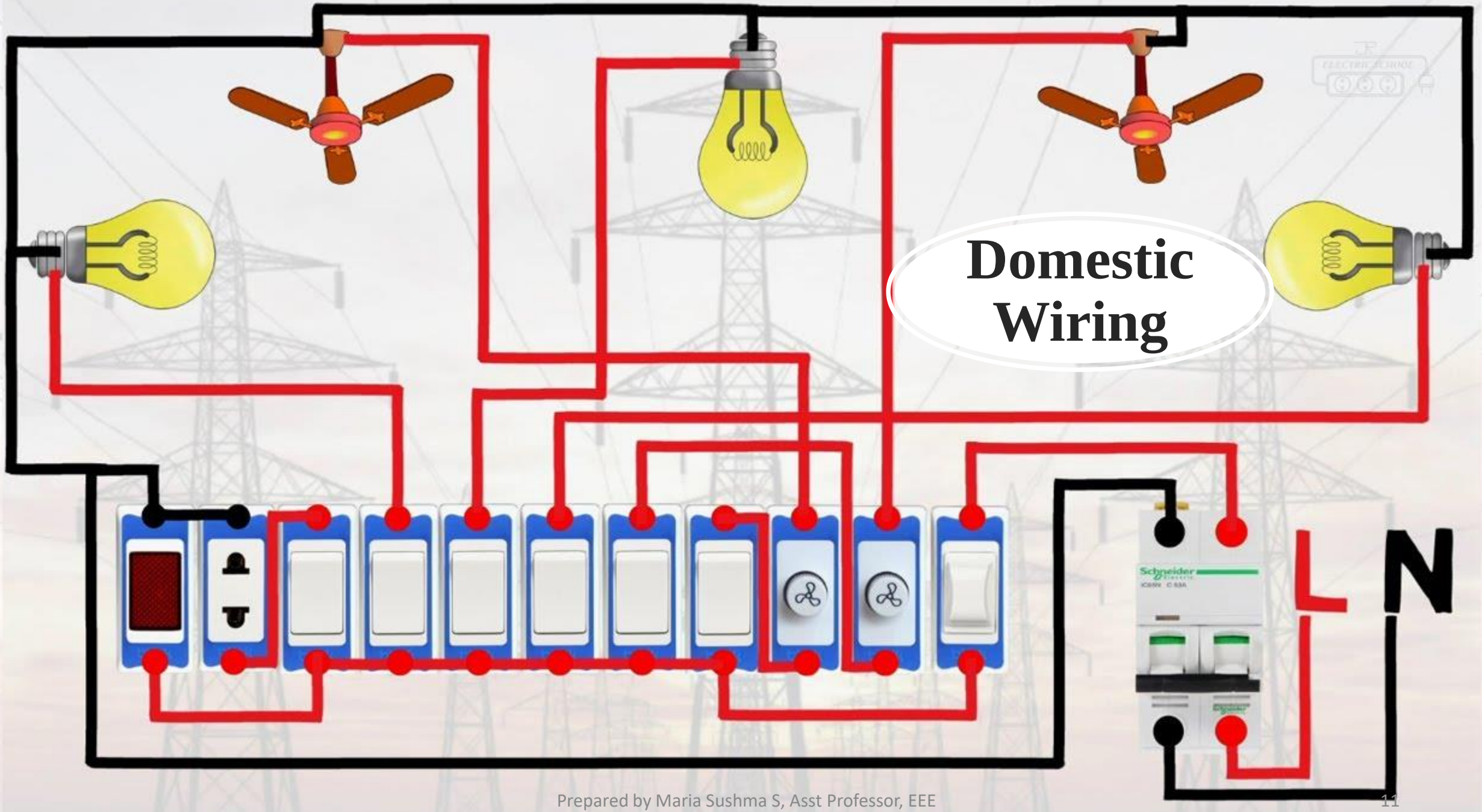
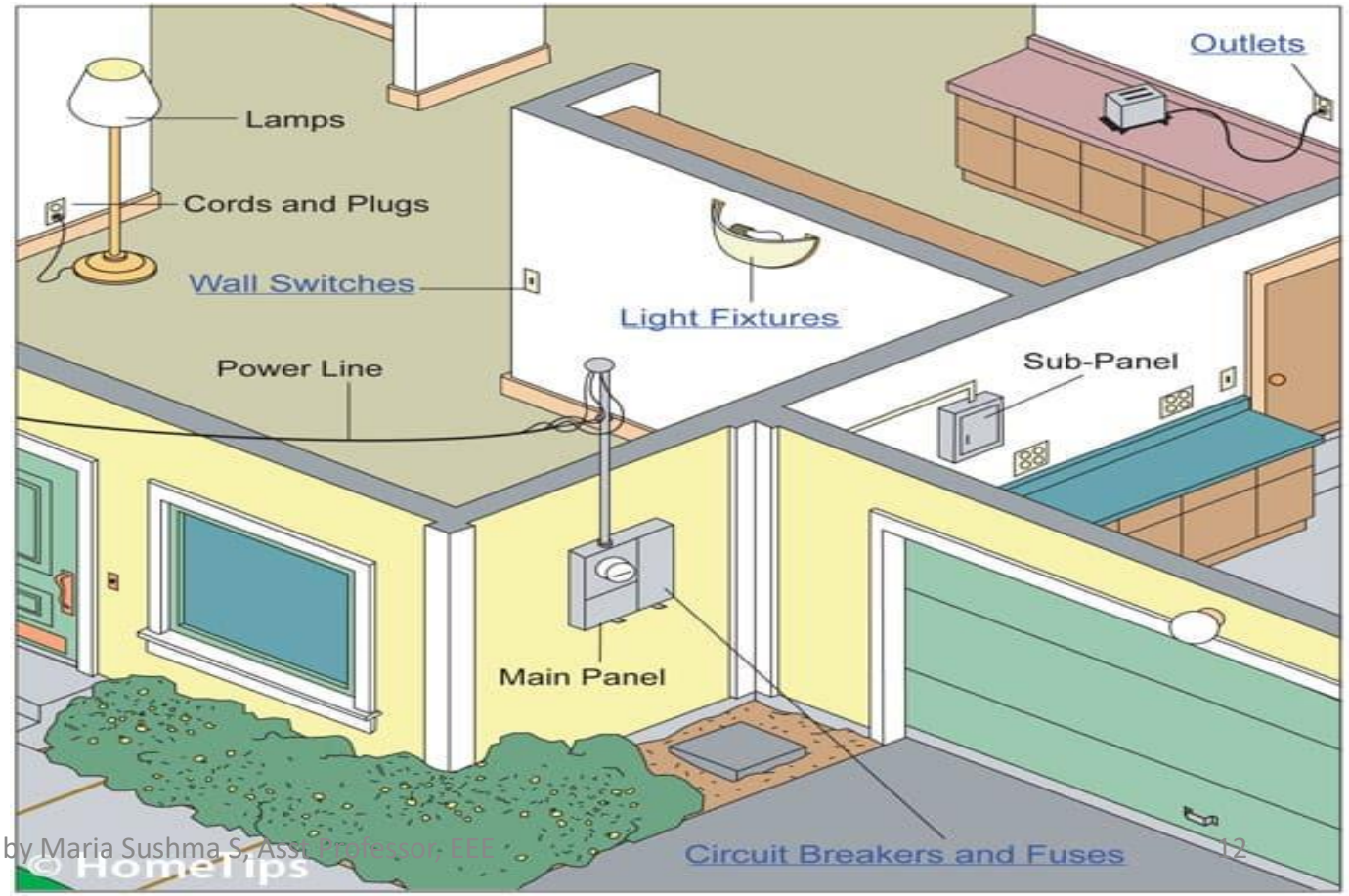


Fig. 10.89


Domestic
Wiring
L
N

Domestic Wiring

- ***Electrical wiring*** is the electrical power distribution through the wires.
- Electrical installation of cables and associated devices such as switchboard, distribution board, sockets, Lighting fixtures etc.
- Wiring is done in domestic premises for providing power for lighting, fans and domestic appliances is called domestic wiring.



Domestic Wiring

The primary objective of wiring system is to distribute electrical energy to the various points at which it is required, duly considering the following.

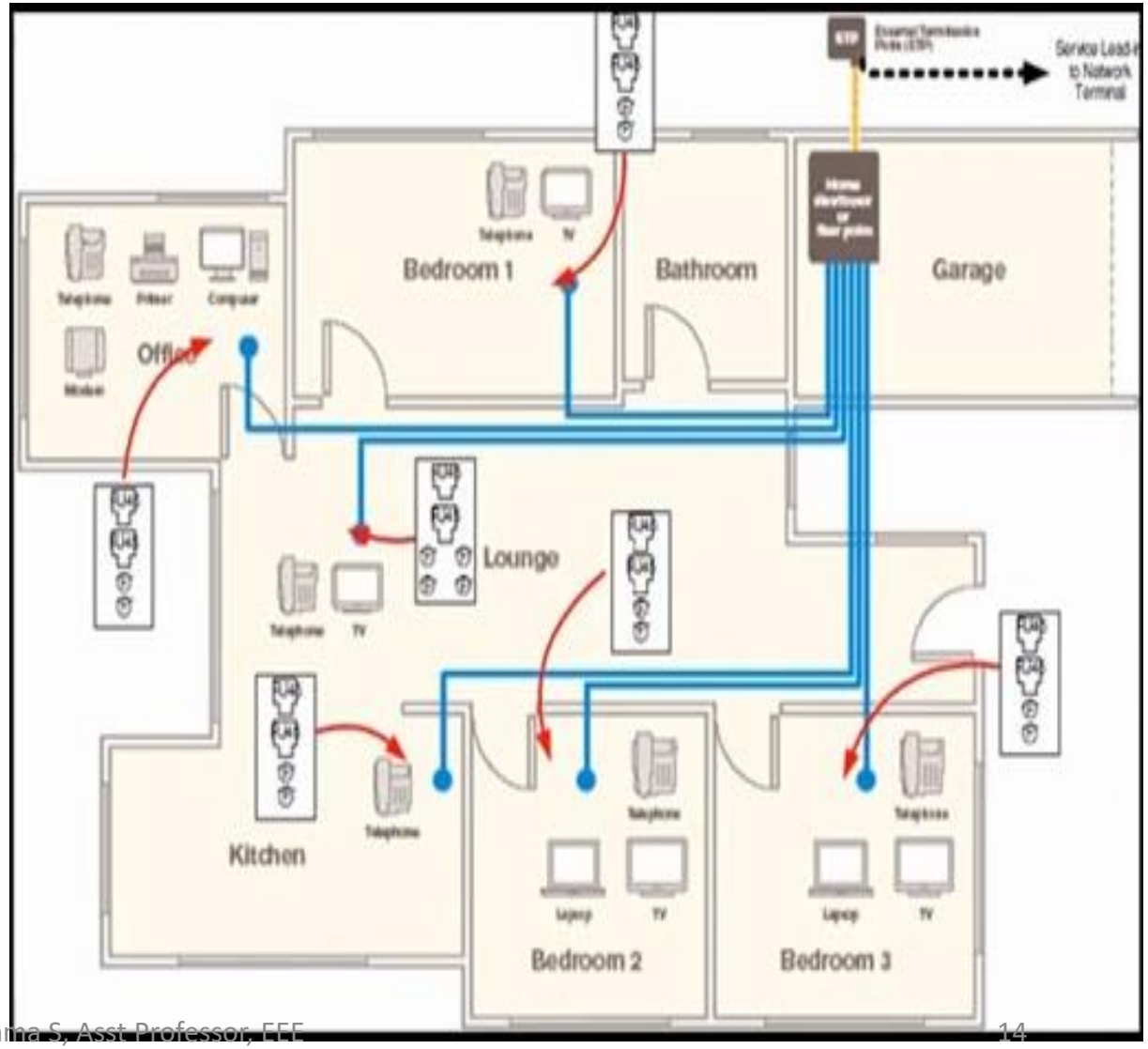
1. **Electrical safety**: This is the most important aspects – there must be no danger of leakage or of electric shock to persons using the supply.

2. **Mechanical immunity**: A wiring system which is suitable for one type of building may not be suitable for another. The wiring selected for a particular type of building should be able to withstand weather changes for a long period and should be protected from physical damage during its usage.

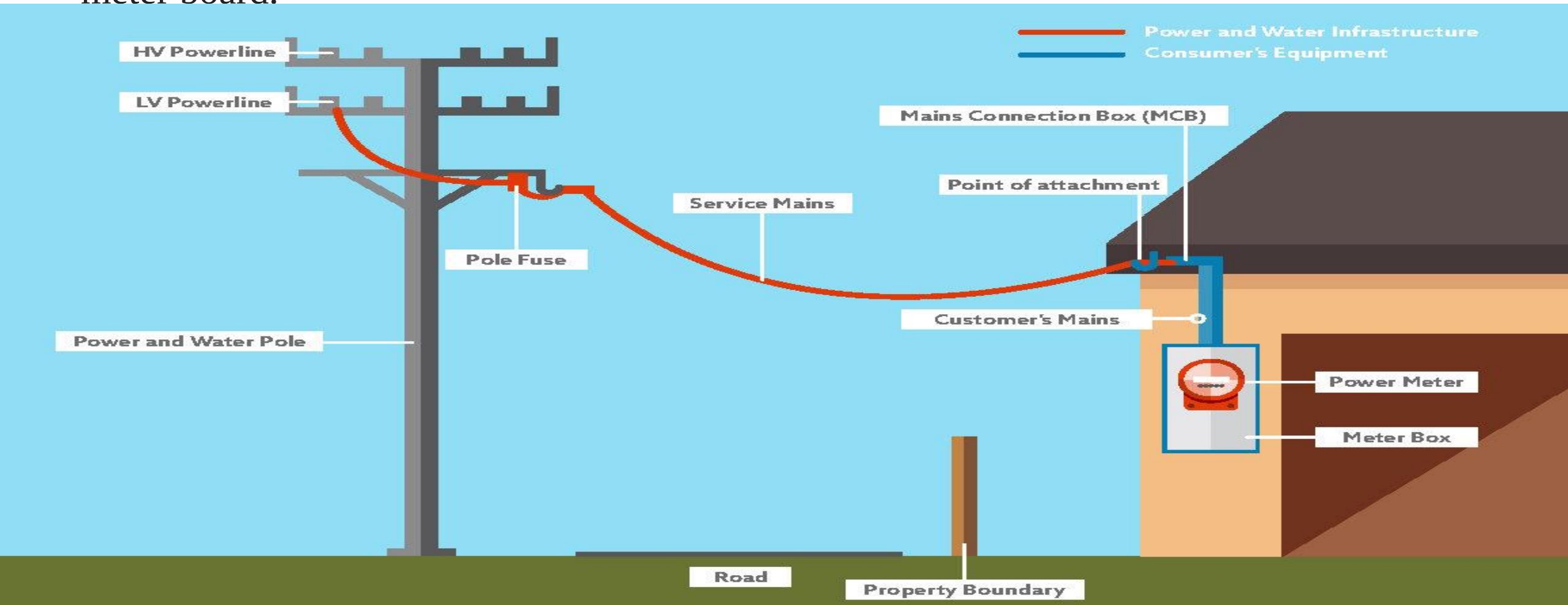
3. **Permanence**: There should not be any undue deterioration in wiring due to action of dampness, fumes, weather etc.

4. **Appearance**: In certain cases appearance or invisibility is important. However in case of factory wiring, appearance apart from neatness is usually not important.

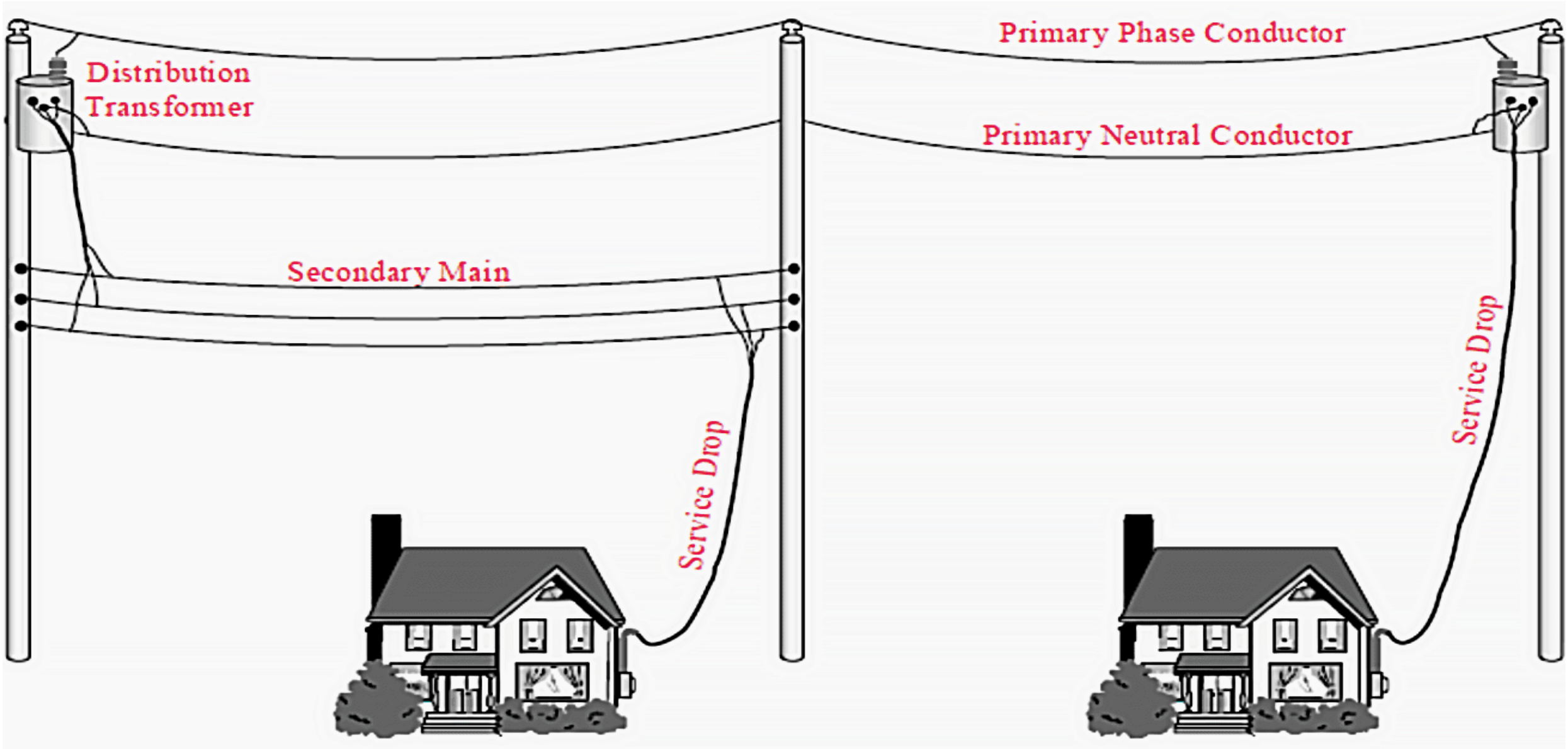
5. **Cost**: the cost of wiring installation is an important consideration. The system chosen should depend upon the type of building and the purpose for which it is used, keeping economy in view.

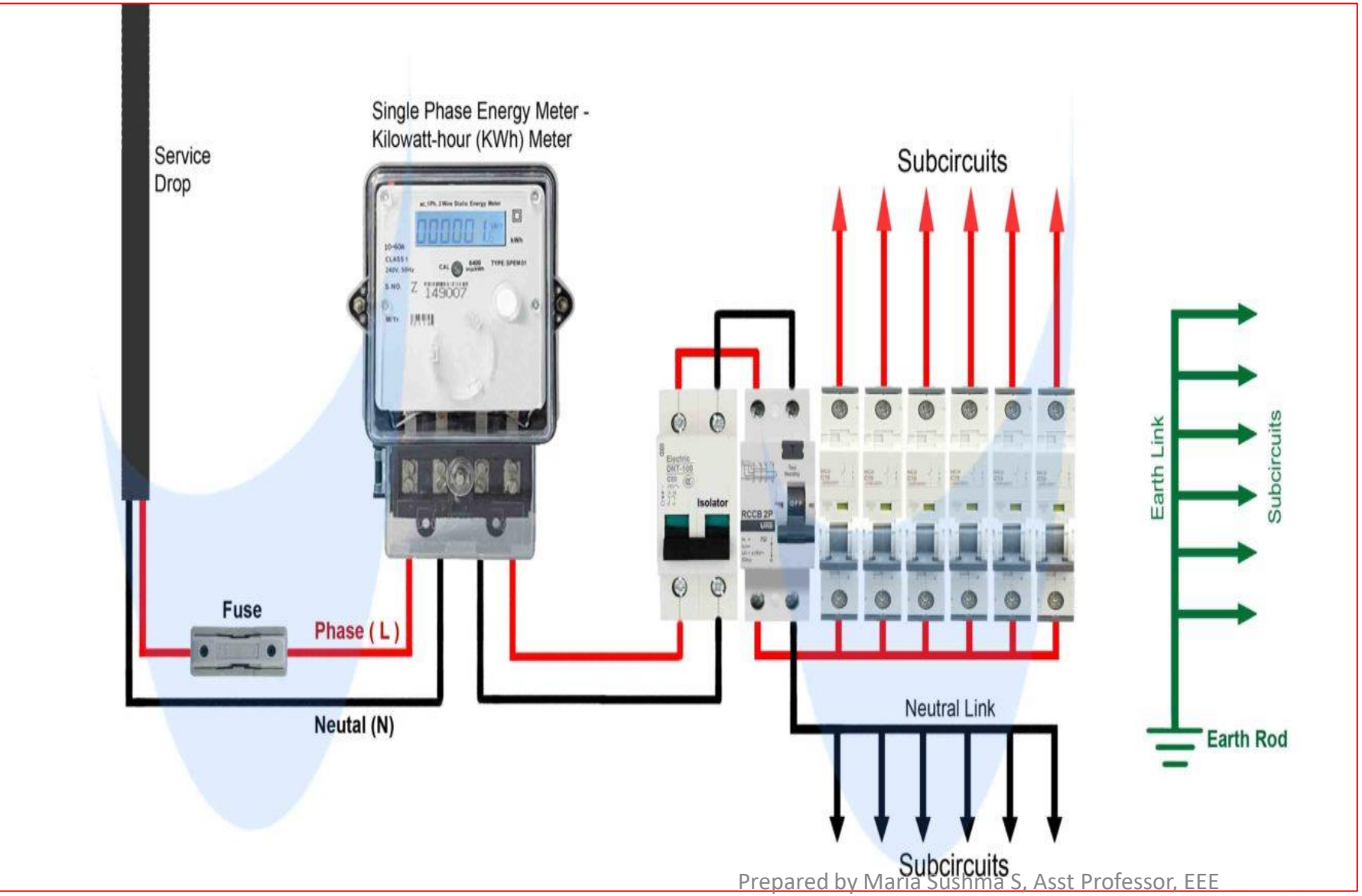

Bedroom 1
Bathroom
Garage
Lounge
Kitchen
Bedroom 2
Bedroom 3

- **Service mains** is tapping of electrical energy from the supplier's pole to consumers premises. Or it is a means of providing electric power supply from the existing pole up to the meter board.



Urban Service Line


Distribution Transformer
Primary Phase Conductor
Primary Neutral Conductor
Secondary Main
Service Drop
Service Drop


Service Drop
Single Phase Energy Meter - Kilowatt-hour (KWh) Meter
Subcircuits
Isolator
RCCB 2P
Fuse
Phase (L)
Neutal (N)
Neutral Link
Subcircuits
Earth Link
Subcircuits
Earth Rod

Types of Electrical Wiring

1. Internal Wiring.

2. Overhead Wiring.

3. Under Ground Wiring.

There are mainly 6 types of wires:

Vulcanized Indian Rubber wire (V.I.R)

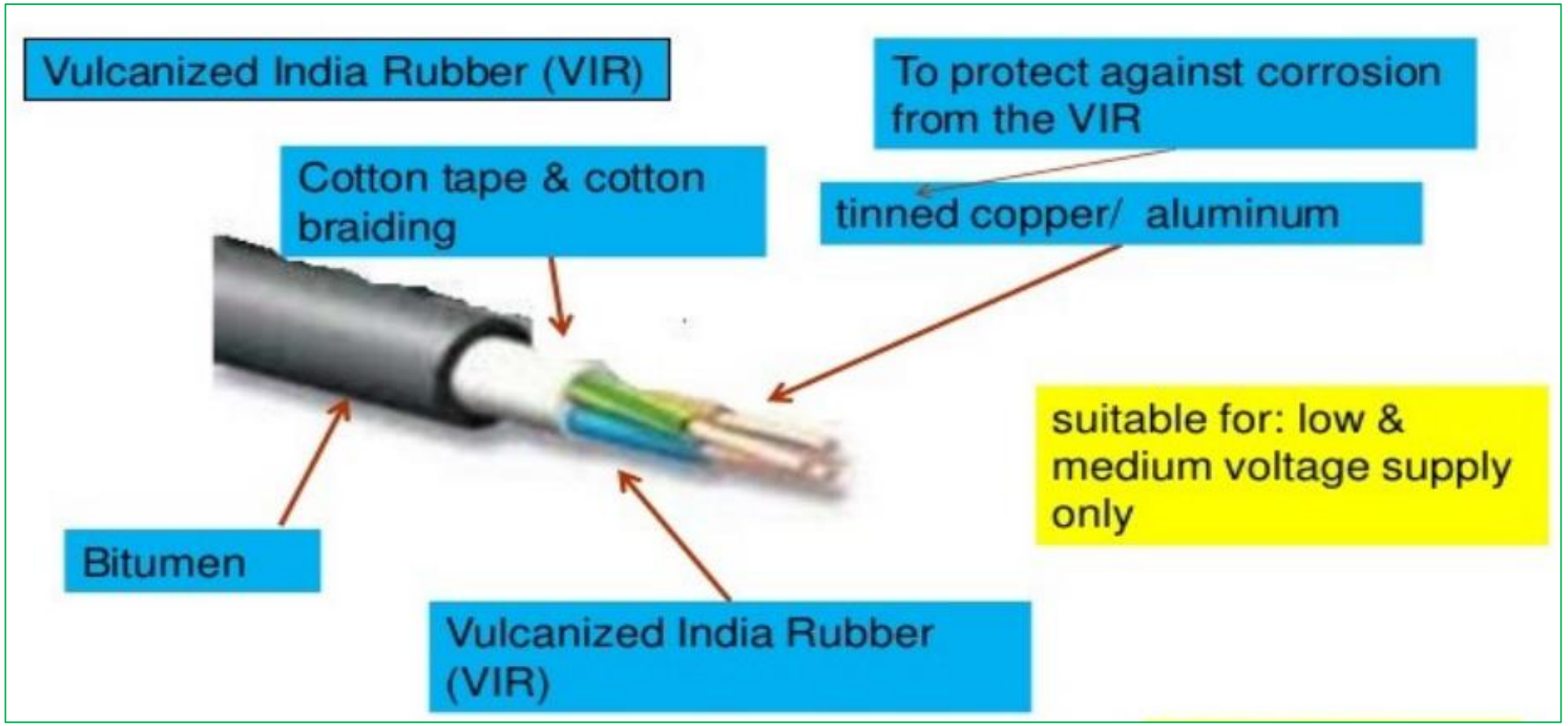
Tough rubber sheathed wire (T.R.S)

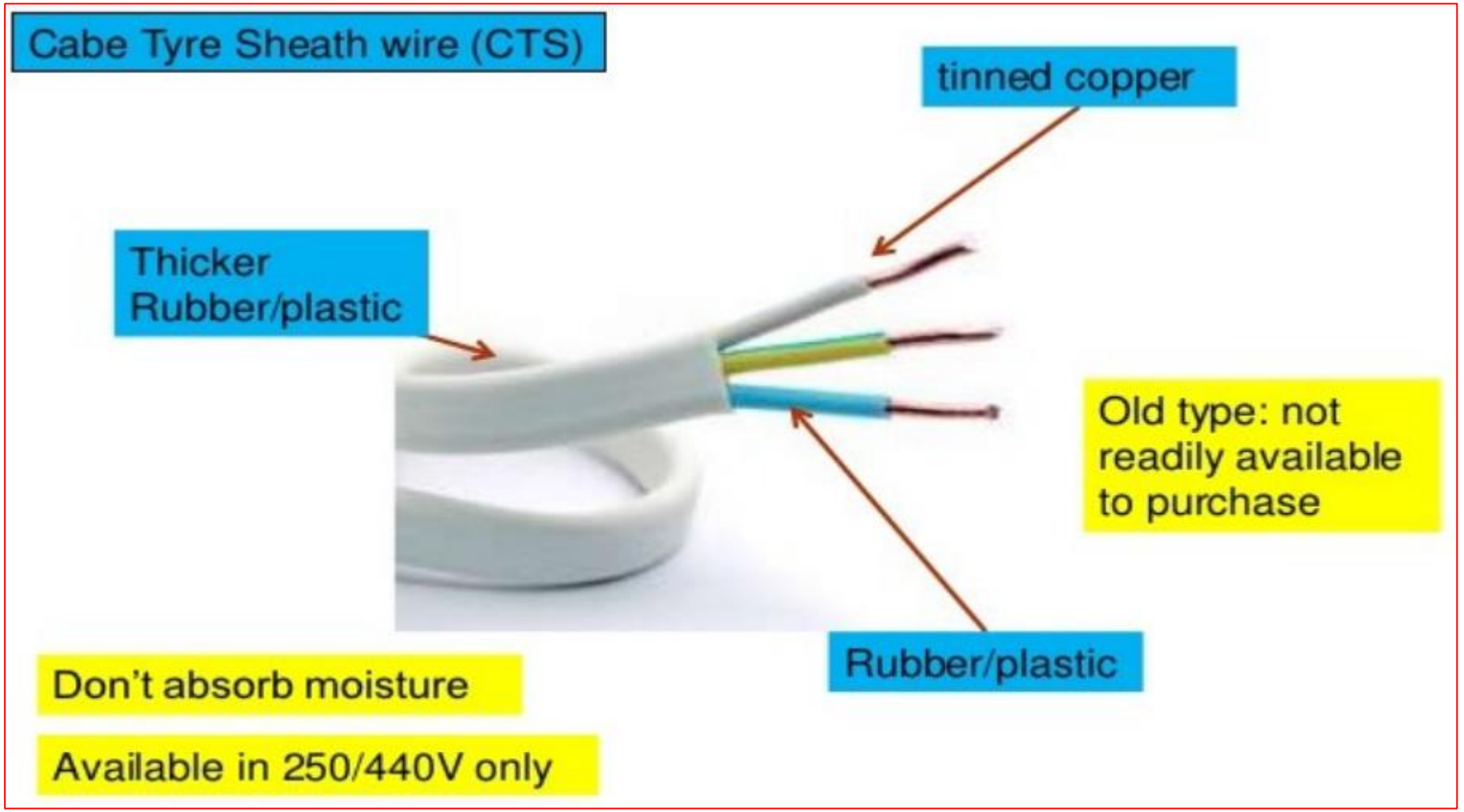
Poly vinyl chloride wire (P.V.C.)

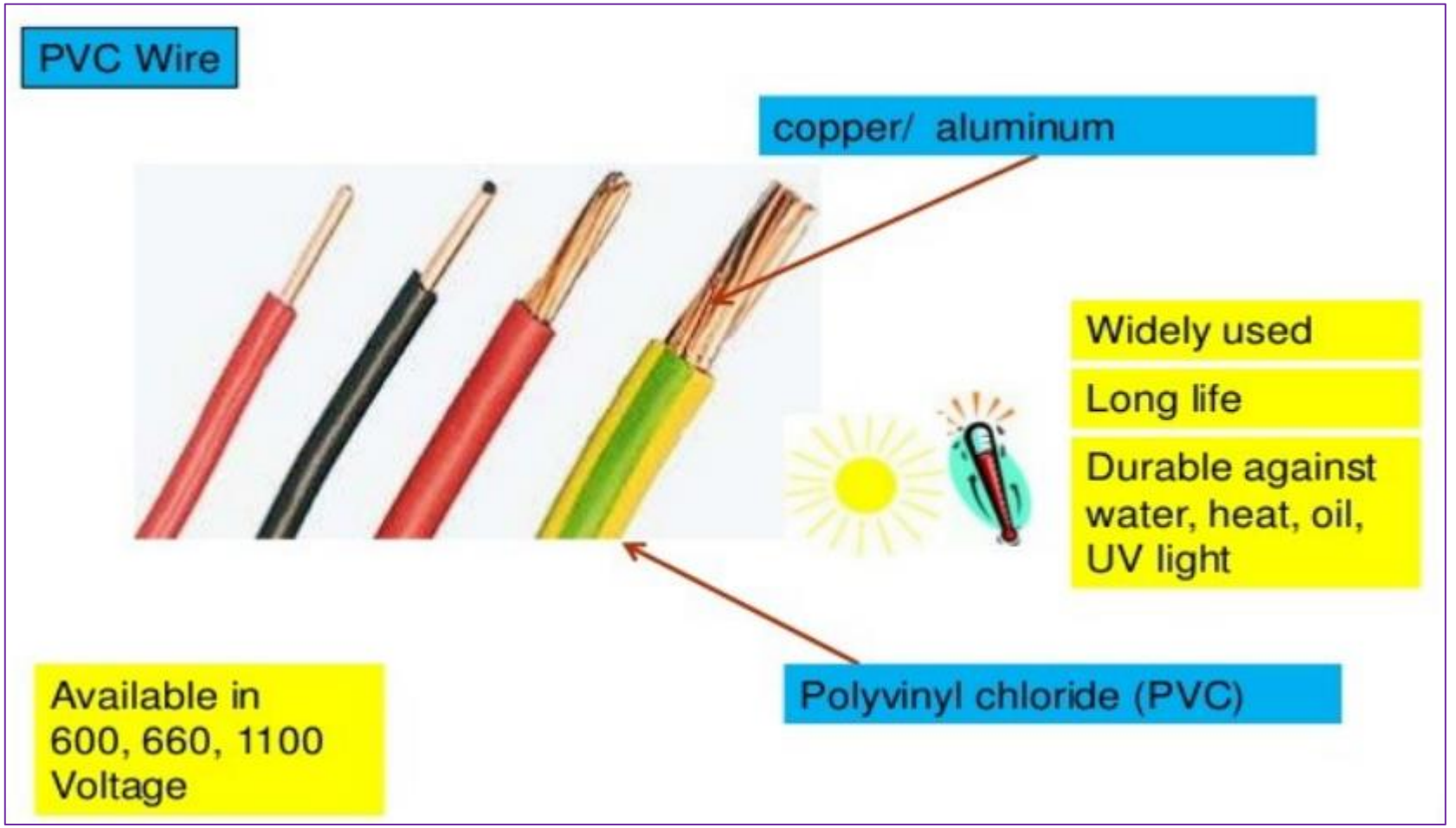
Lead alloy sheathed wire

Weather proof wires

Flexible wire


Vulcanized India Rubber (VIR)
To protect against corrosion from the VIR
Cotton tape & cotton braiding
tinned copper/ aluminum
suitable for: low & medium voltage supply only
Bitumen
Vulcanized India Rubber (VIR)


Cabe Tyre Sheath wire (CTS)
tinned copper
Thicker
Rubber/plastic
Old type: not
readily available
to purchase
Rubber/plastic
Don't absorb moisture
Available in 250/440V only


PVC Wire
copper/ aluminum
Widely used
Long life
Durable against water, heat, oil, UV light
Available in 600, 660, 1100 Voltage
Polyvinyl chloride (PVC)

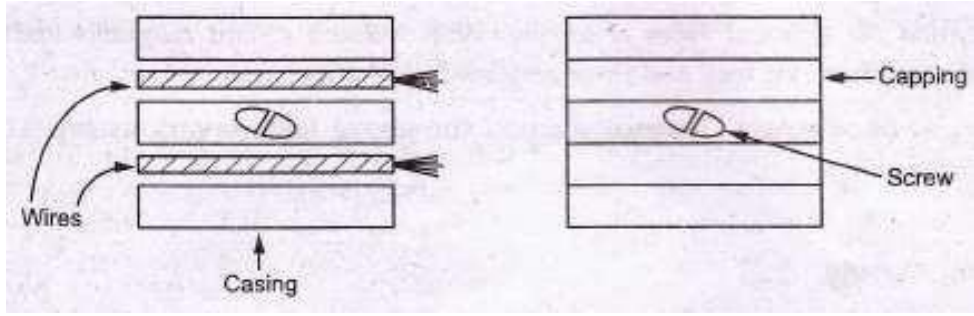
Types of wiring :

Various types of wiring used in practice are:

1. Cleat wiring
2. Casing wiring
3. Surface wiring
4. Conduit wiring

Casing capping wiring

- Casing is a rectangular strip made from ***teak wood or now a day's made up of P.V.C.***
- It has two grooves into which the wires are laid.
- Then casing is covered with a rectangular strip of wood or of the same width, called capping
- The capping is screwed into casing, which is fixed to the walls with the help of porcelain discs or cleats.
- In the case of devices that use low voltage, a casing and capping wiring system is used

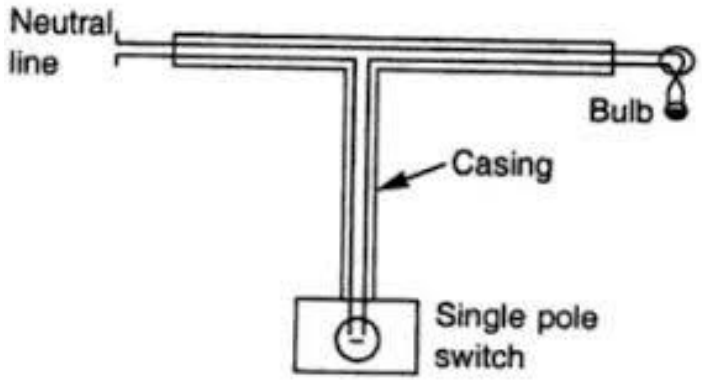



www.electricaltechnology.org


Casing Capping Joints
Casing & Capping Wiring

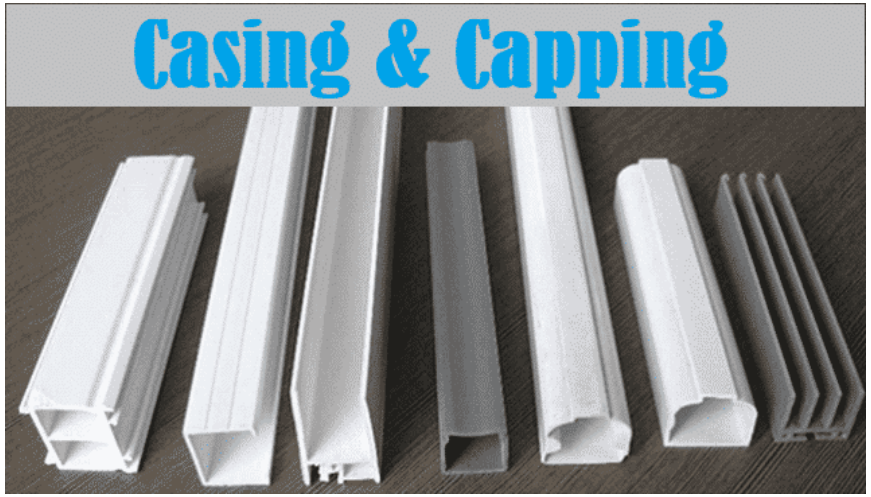
Advantages:

Good protection to the conductors from dangerous atmospheric conditions, neat and clean appearance



Disadvantages:

- In case of wooden casing capping, there is high risk of fire along with the requirement of skilled labour.
- The method is costly

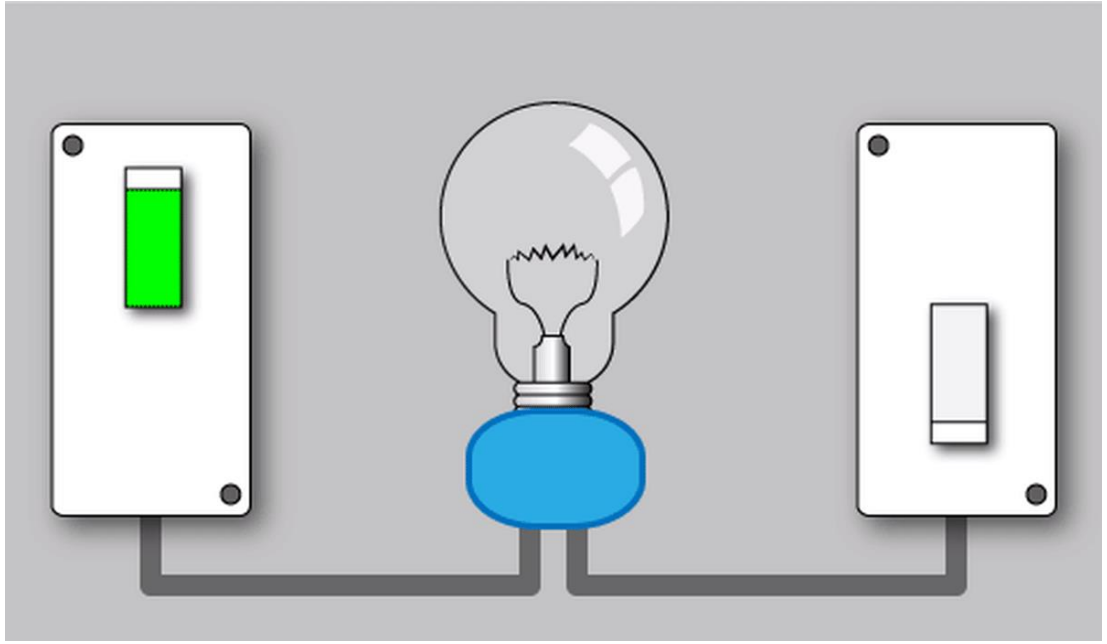


Two-way and three-way control

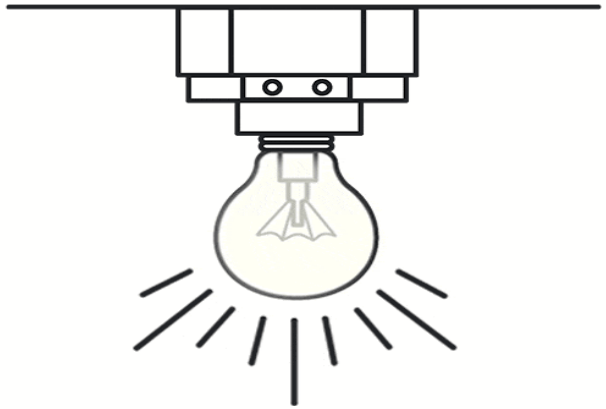
The domestic lighting circuits are quite simple and they are usually ***controlled from one point***.

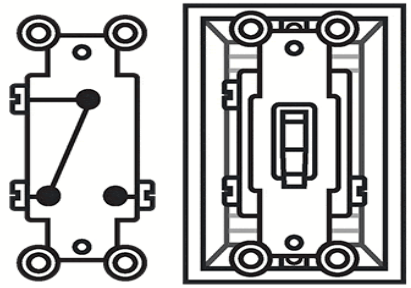
But in certain cases it might be necessary to control a single lamp from more than one point **(Two or Three different points).**

For example: staircases, long corridors, large halls etc.



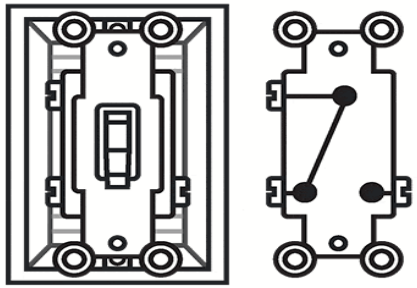
Two-way and three-way control



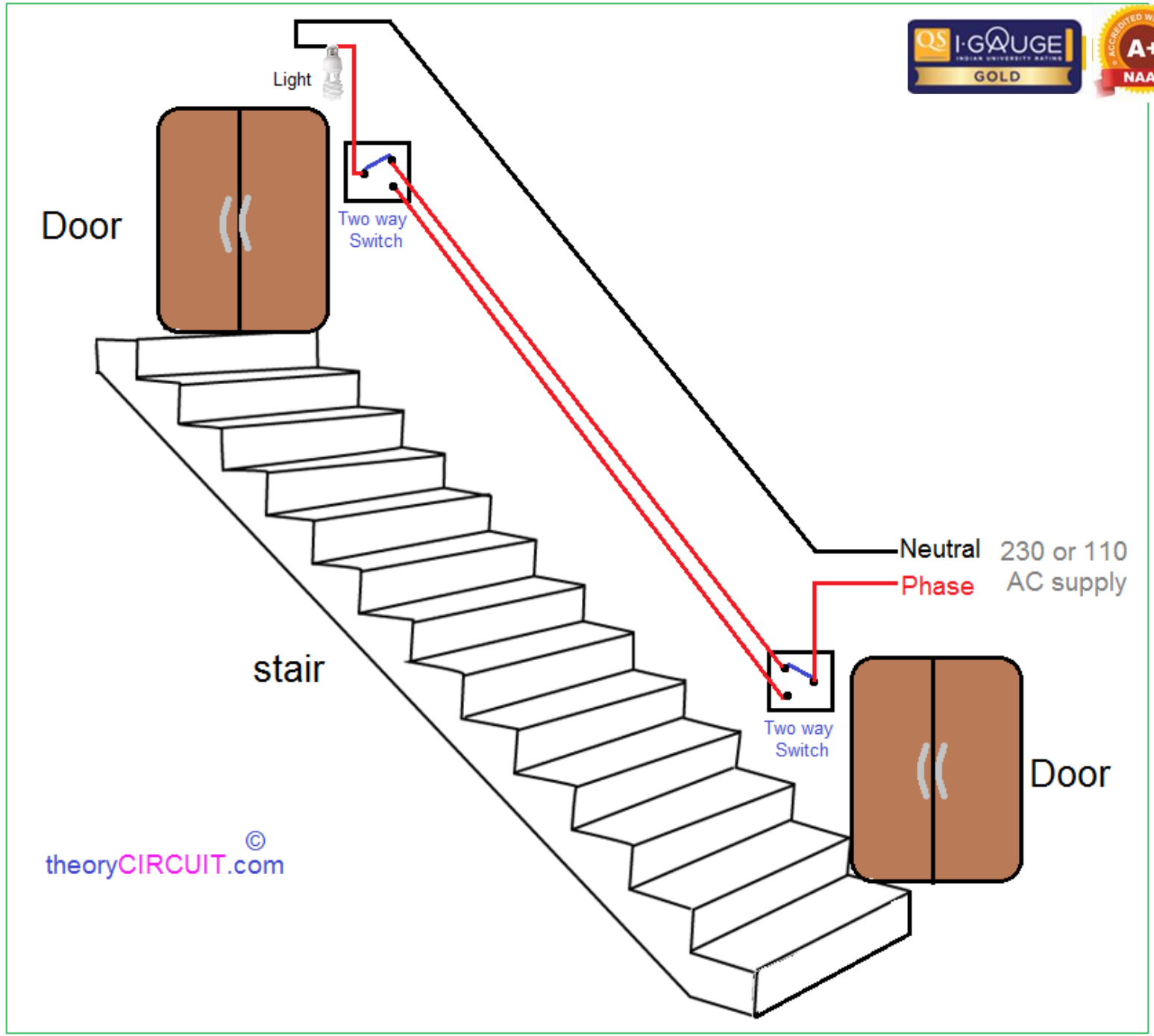


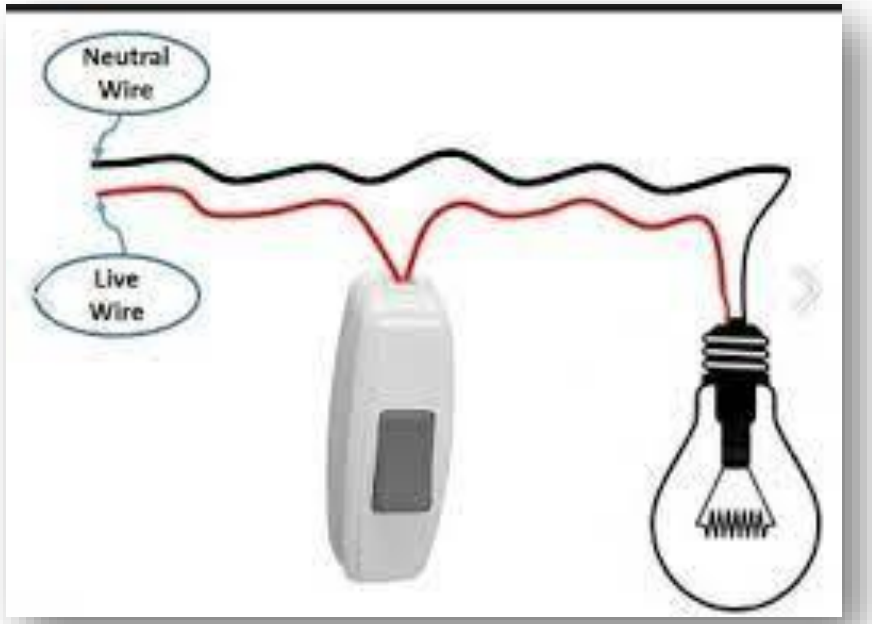
Up

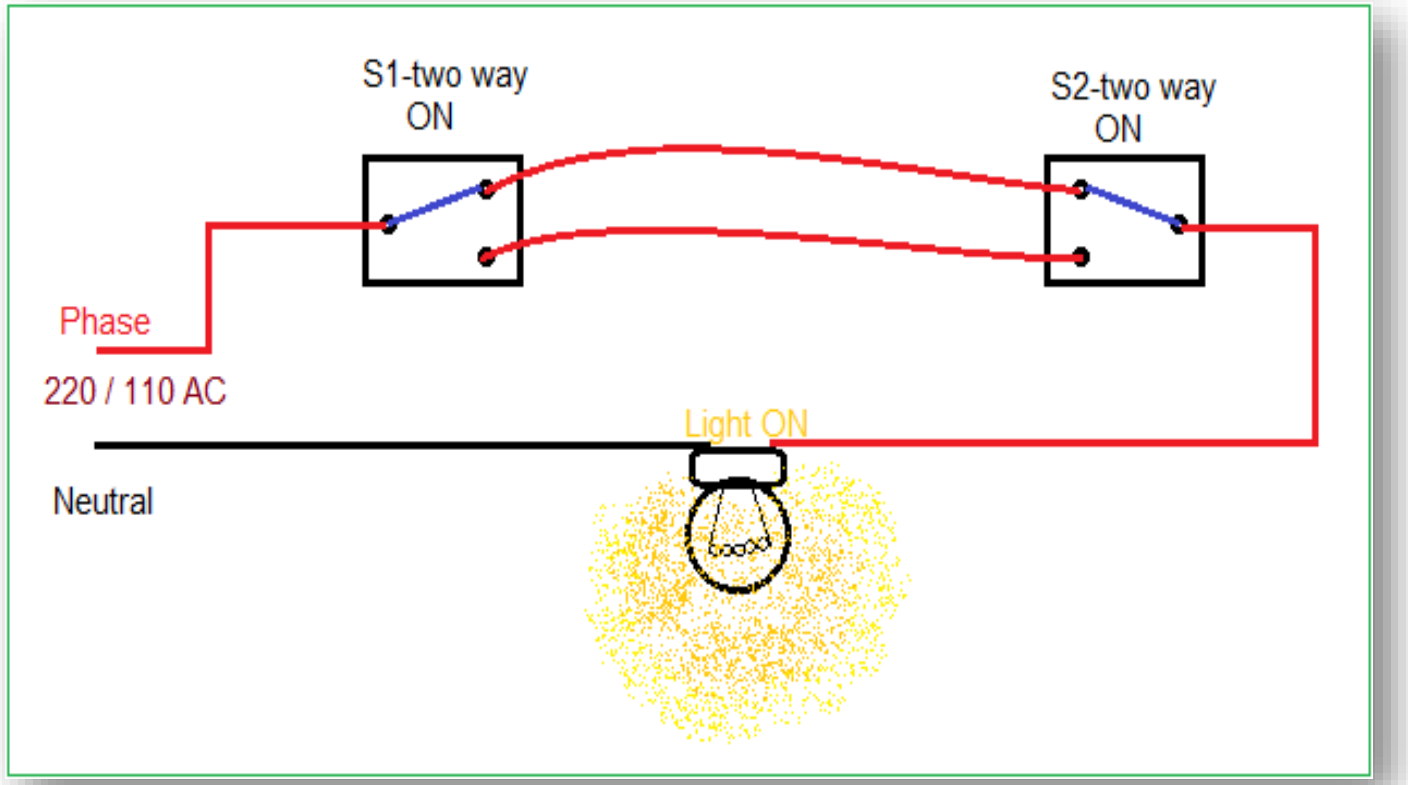
Down

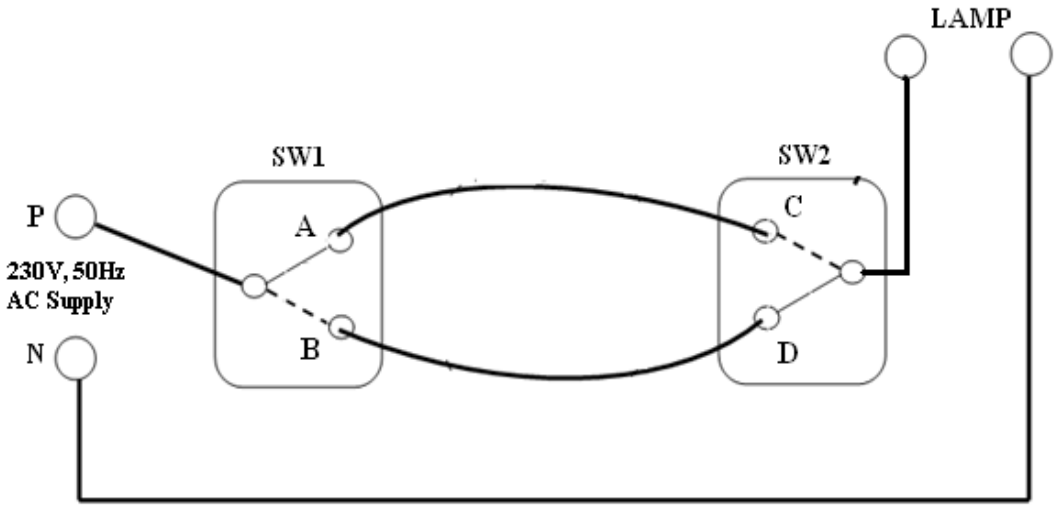


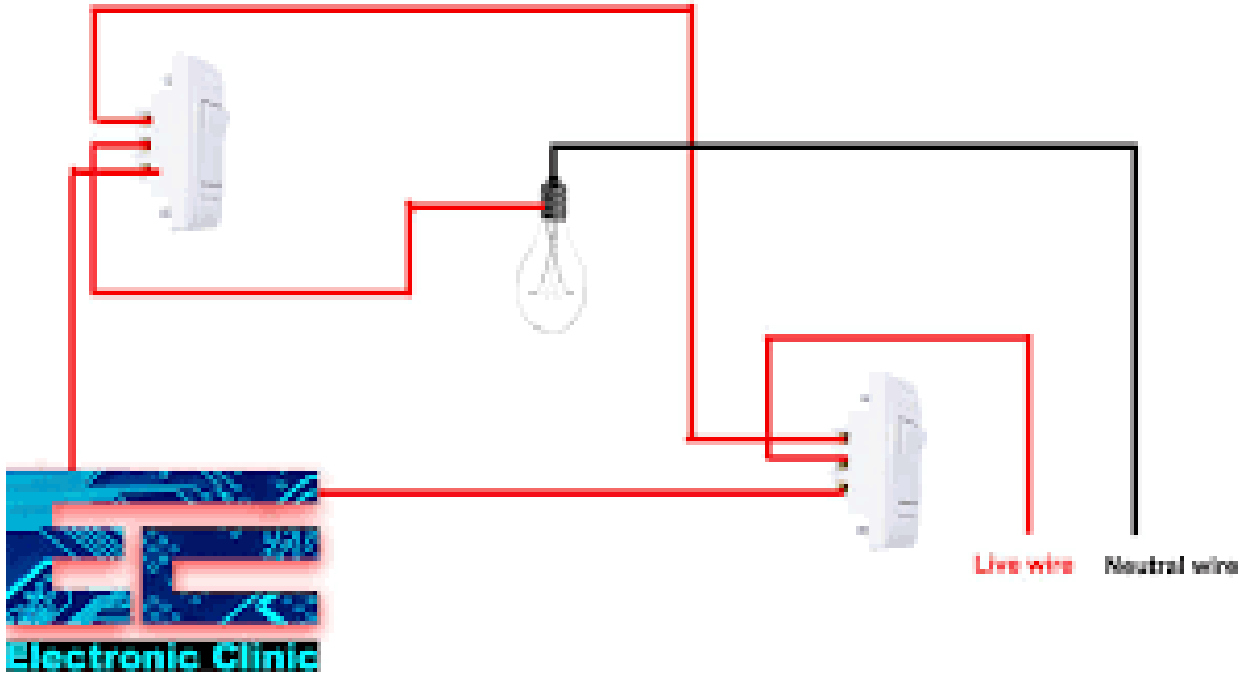
REALPARS

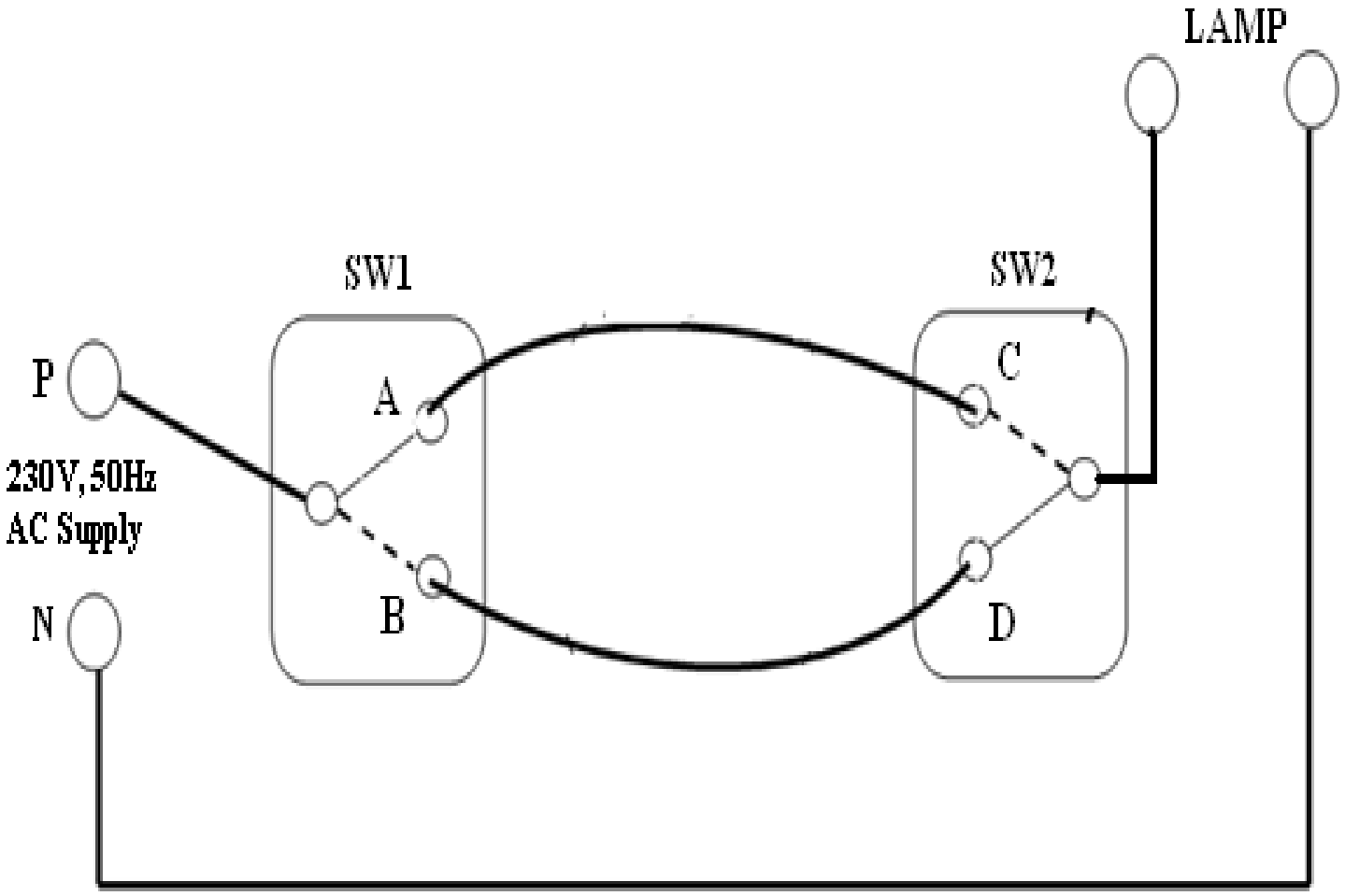

Light
Door
Two way
Switch
Neutral
Phase
230 or 110
AC supply
stair
Two way
Switch
Door
©
theoryCIRCUIT.com


Neutral Wire
Live Wire


S1-two way ON
S2-two way ON
Phase
220 / 110 AC
Neutral
Light ON

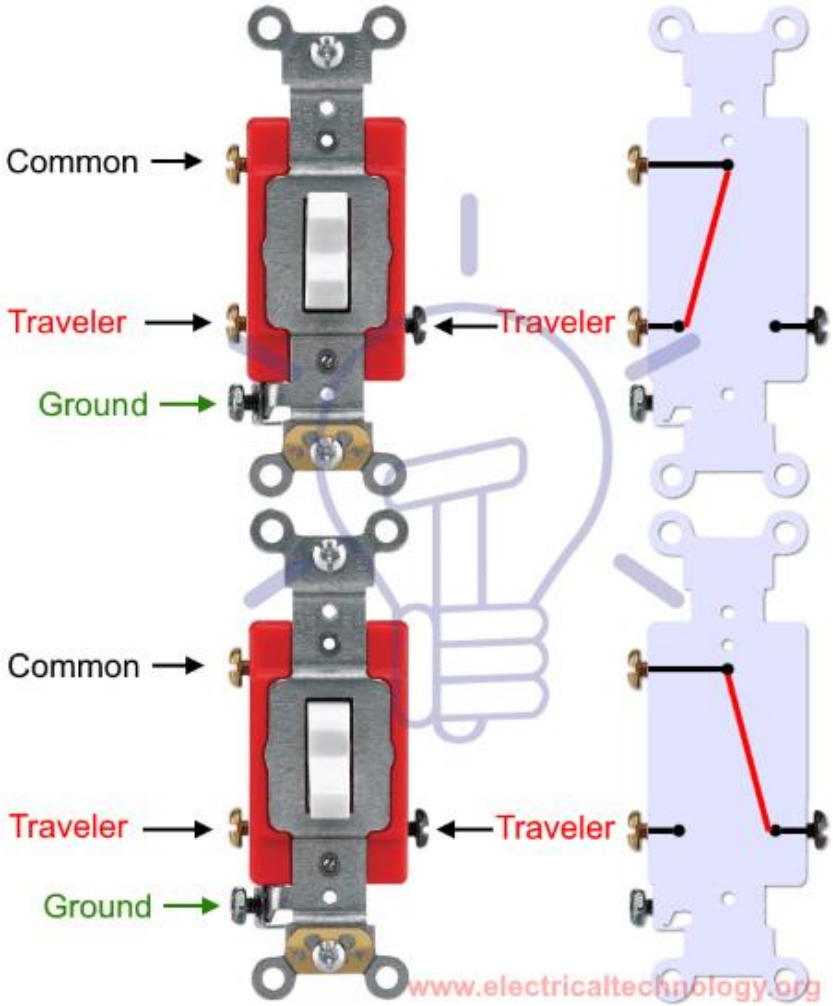

LAMP
SW1
SW2
P
230V, 50Hz
AC Supply
N
A
B
C
D

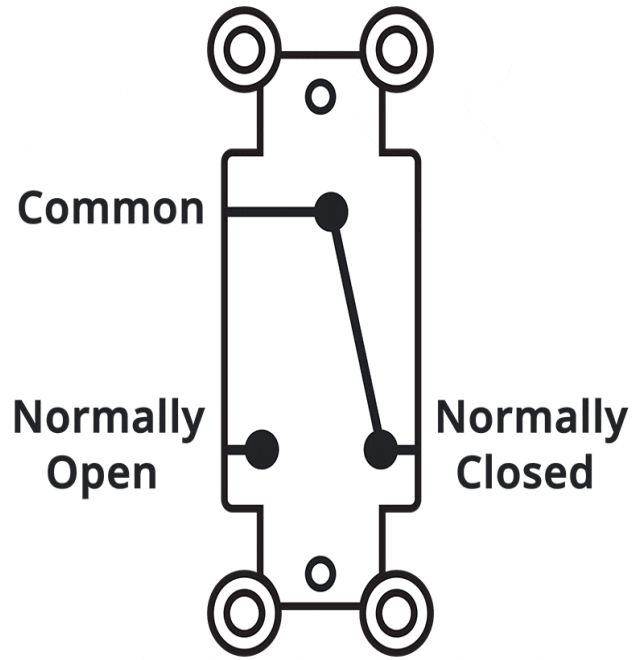

Live wire
Neutral wire
Electronic Clinic

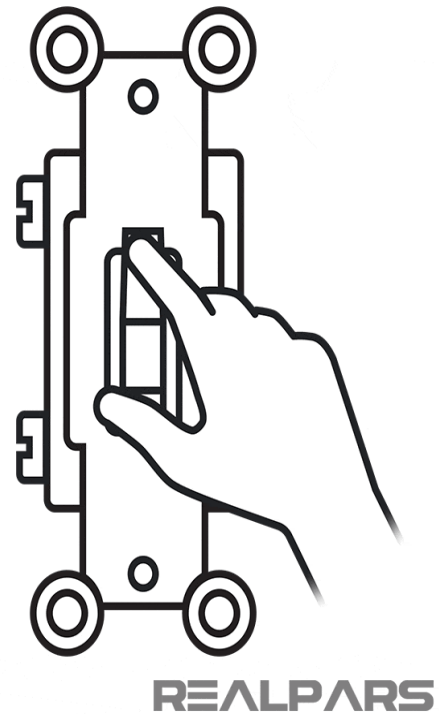


Switch -1	Switch-2	Lamp State	
A	C		
A	D		
B	C		
B	D		

Additional Information







Three- way Control of lamp:

It can be connected in two ways

a) **Straight connection**

b) **Cross connection**

a) Straight connection

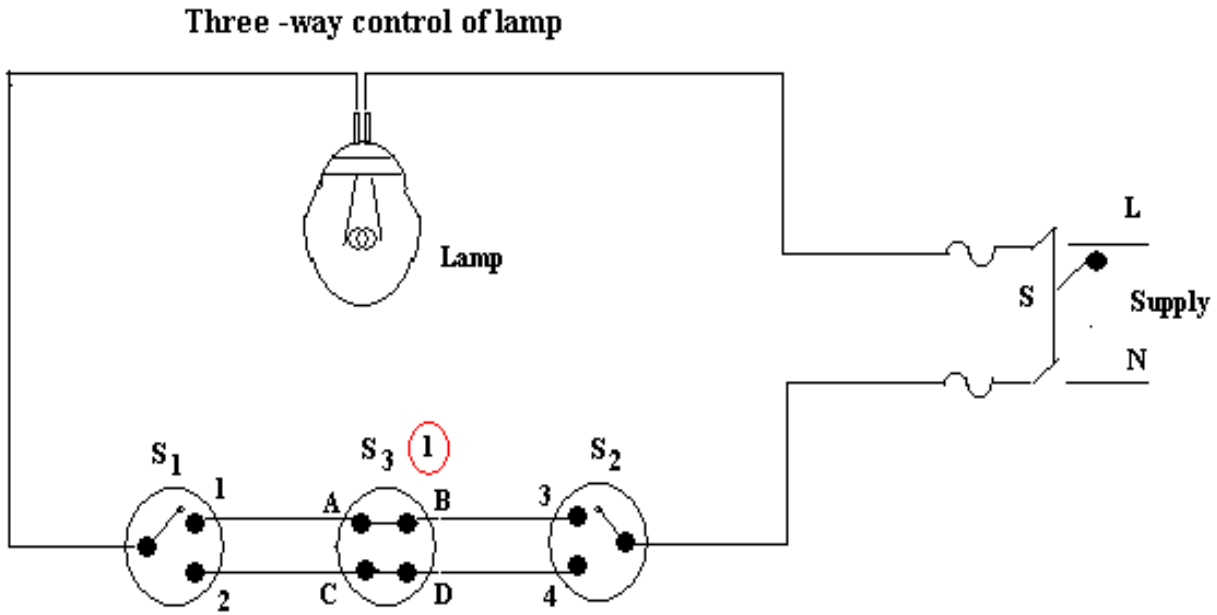


Figure 1 (a) Straight connection

Position of Switch 1	Position of Switch 2	Intermediate Switch Position		Lamp state
1	3	Straight Connection	A-B, C-D	
1	4		A-B, C-D	
2	3		A-B, C-D	
2	4		A-B, C-D	

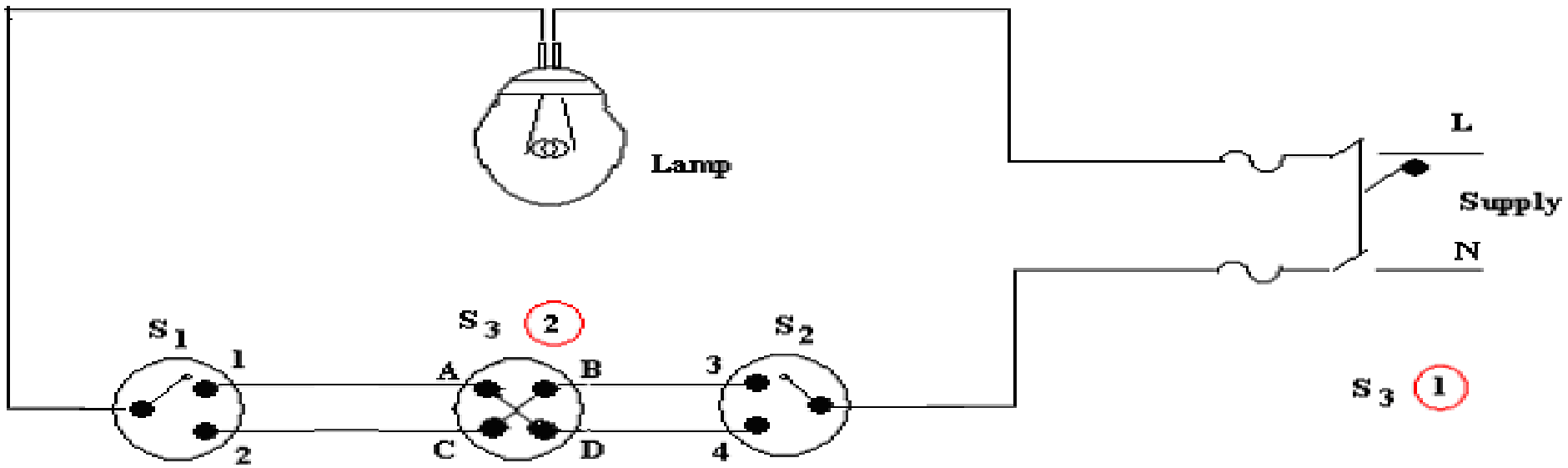
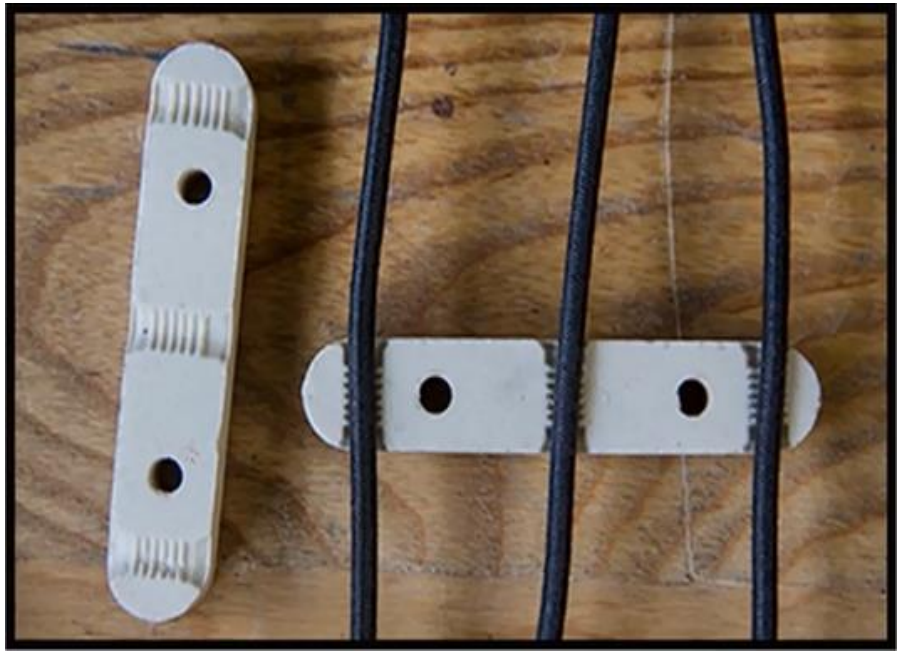


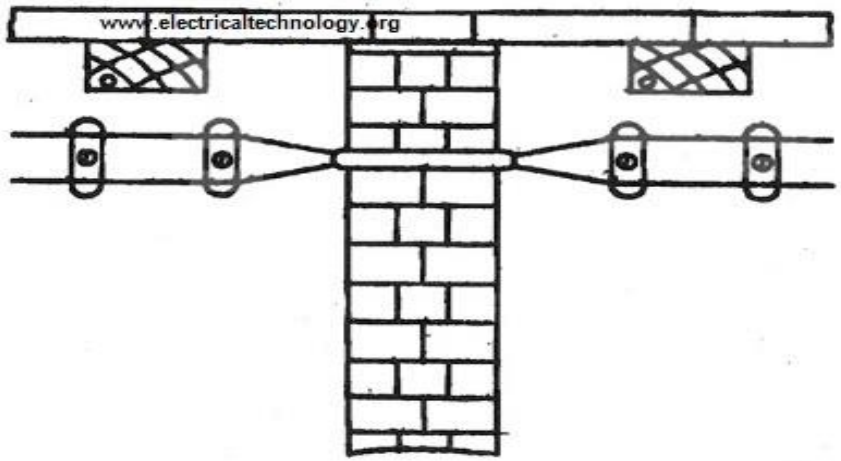
Figure 1 (b) Cross connection

Position of Switch 1	Position of Switch 2	Intermediate Switch Position		Lamp state
1	3	Cross Connection	A-D, B-C	OFF
1	4		A-D, B-C	ON
2	3		A-D, B-C	ON
2	4		A-D, B-C	OFF

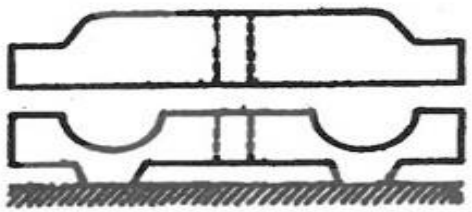
Cleat wiring

- In this type ***V.I.R(Vulcanised Indian Rubber) or P.V.C wires*** are clamped between porcelain cleats.
- The cleats are made up of ***two halves.*** One half is grooved through which wire passes while the other fits over the first.
- The whole assembly is then mounted on the wall or wooden beam with the help of screws
- The cleat wiring is used in industries for installation of high capacity current cables

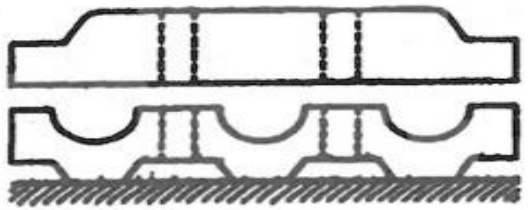




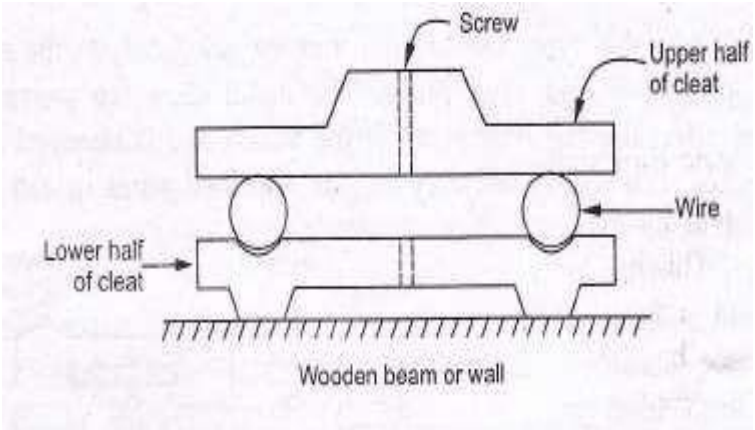
Use of Wall tube, wires are drawn from one room into the other through partition wall.



i. Cleat with two grooves



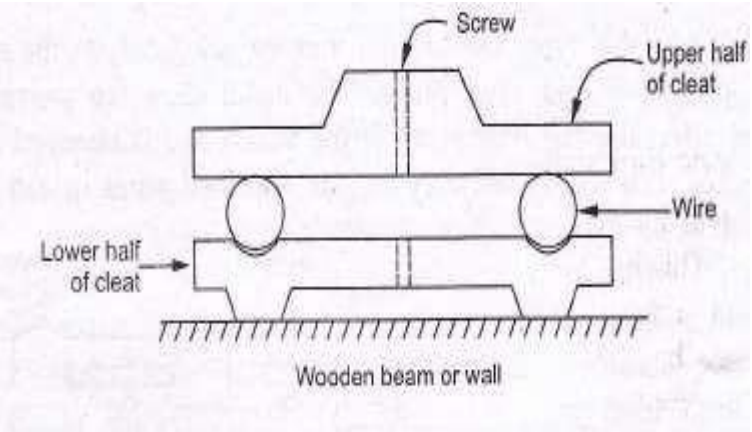
ii. Cleat with three grooves



Cleat Wiring

Advantages:

- Cheapest method
- Suitable for temporary work quickly installed
- Recovered without any damage of material
- Inspection and changes can be made very easily.

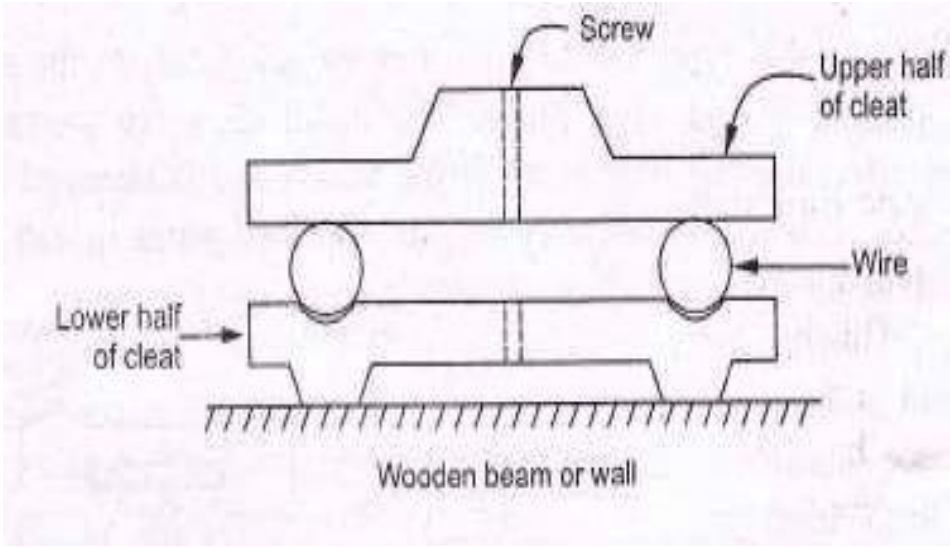


Disadvantages:

- Does not give attractive appearance
- Due to sagging at some places, it looks shabby
- The wires are directly exposed to atmospheric conditions like moisture, chemical fumes etc.
- Maintenance cost is very high.

Cleat Wiring:

- In this type of wiring, insulated conductors (usually VIR, Vulcanized Indian Rubber) are supported on porcelain or wooden cleats.
- The cleats have two halves one base and the other cap.
- The cables are placed in the grooves provided in the base and then the cap is placed.
- Both are fixed securely on the walls by 40mm long screws. The cleats are easy to erect and are fixed 4.5 – 15 cms apart.
- This wiring is suitable for temporary installations where cost is the main criteria but not appearance.



Advantages:

1. Easy installation
2. Materials can be retrieved for reuse
3. Flexibility provided for inspection, modifications and expansion.
4. Relatively economical
5. Skilled manpower not required.

Disadvantages:

1. Does not give an attractive appearance.
2. Due to sagging in some places, it looks shabby
3. The wires are directly exposed to atmospheric conditions like moisture, chemical fumes etc.
4. Maintenance cost is very high.