# SNS COLLEGE OF TECHNOLOGY

**(An Autonomous Institution)**

**COIMBATORE-35**

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**Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai**

## DEPARTMENT OF BIOMEDICAL ENGINEERING

**COURSE NAME: 23EET103/ ELECTRIC CIRCUITS AND ELECTRON DEVICES**

**I YEAR / II SEMESTER**

**Unit III – WIRING, GROUNDING AND SAFETY**

Topic : Wiring

# ELECTRICAL WIRING

- A network of wires connecting various accessories for distribution of electrical energy from the supplier meter to the board to the numerous electrical energy consuming devices such as a lamps , fans and other domestic appliances through controlling and safety devices is known as wiring system.
- House wiring deals with the distribution within the domestic premises. House wiring is generally done for consumption of electrical energy at 230V, single phase or at 400V , three phase.

# ELECTRICAL WIRING

- Electrical Wiring is a process of connecting cables and wires to the related devices such as fuse, switches, sockets, lights, fans etc to the main distribution board is a specific structure to the utility pole for continues power supply

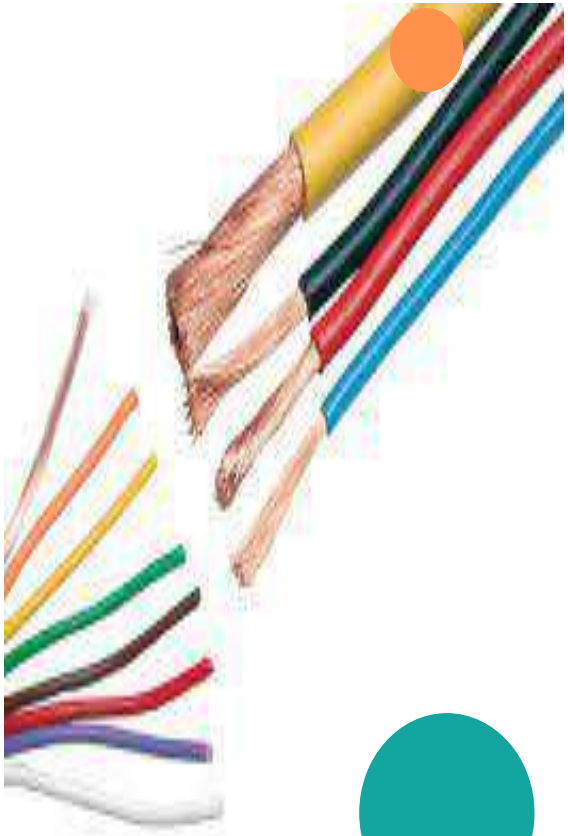
# FACTORS AFFECTING ELECTRICAL WIRING

- The choice of wiring system for a particular installation should be based on technical or economic considerations. In general, the following factors should be considered.

- **Safety:** First and foremost consideration is safety to a person using electricity against leakage, shock and fire hazard.

# FACTORS AFFECTING ELECTRICAL WIRING

- **Mechanical protection:** The wiring must be protected from mechanical damage during its use.
- **Permanency** : The wiring must not deteriorate unduly by action of weather, furnes , dampness etc.
- **Appearance**: The wiring must have a good appearance.
- **Accessibility**: In wiring there should be provision for extension , renewal or trouble shooting.



# GENERAL RULES

1. Every installation is to be properly protected near the point of entry of supply cables by a two-pole linked main switch and a fuse unit. In a two-wire installation if one pole is permanently earthed, no fuse, switch or circuit breaker is to be inserted this pole. A 3-pole switch and fuse unit is to be used in 3-phase supply.

2. The conductor used is to be of such a size that it may carry load current safely.

3. The conductors installed are to be safe in all respects.

4. Every sub-circuit is to be connected to a distribution fuse board.

5. Every line (phase or positive) is to be protected by a fuse of suitable rating as per requirements.

6. A switch board is to be installed so that its bottom lies 1-25 metres above the floor.

# GENERAL RULES

7. Adequate number of socket-outlets is to be provided at suitable places in all rooms so as to avoid use of long lengths of flexible cords.

8. All incandescent lamps unless otherwise required, are to be hung at a height of 2 metres above the floor level.

9. Lights and fans may be wired on a common circuit. Each sub-circuit is not to have more than a total of ten points of lights, fans and socket outlets. The load on each sub-circuit is to be restricted to 800 watts.

10. No fuse and switch is to be provided in earthed conductor.

11. Every circuit or apparatus is to be provided with a separate means of isolation such as a switch.

12. All apparatus requiring attention are to be provided with means of access to it.

13. In any building, light and fan wiring and power wiring are to be kept separate.

# GENERAL RULES

14. In 3-phase, 4-wire installation the load is to be distributed equally on all the phases.

15. No additional load is to be connected to an existing installation unless it ahs been ascertained that the installation can safely carry the additional load and that the earthling arrangements are adequate.

16. Lamp holders used in bath rooms are to be constructed or shrouded in insulating materials and fitted with protective shield and earth continuity conductor is not to be of size less than 7/0.915 mm.

17. The metal sheaths or conduits for all wiring and metal coverings of all consuming apparatus or appliances is to be properly earthed in order to avoid danger from electrical shock due to leakage or failure of insulation.

# GENERAL RULES

18. Each sub-circuit is to be protected against excessive current (that may occur either due to overload or due to failure of insulation) by fuse or automatic circuit breaker.

19. All live conductors are to be insulated or otherwise safe guarded to avoid danger.

20. After completion of work the installation is to be tested before energisation

# WIRING ACCESSORIES AND MATERIALS

- All the wiring systems and electrical installations needs the following accessories:

- Cables
- Flexible wires
- Switches
- Fuses
- Ceiling rose
- Lamp holders
- Plugs
- Socket outlets
- Junction boxes

# CABLES

- A cable is made of some conducting material such as copper or aluminum. It is surrounded by insulation and a sheath for mechanical protection.
- The cables are generally classified according to the insulation used. Different types of cables are as follows:

➢ Weather- proof cables

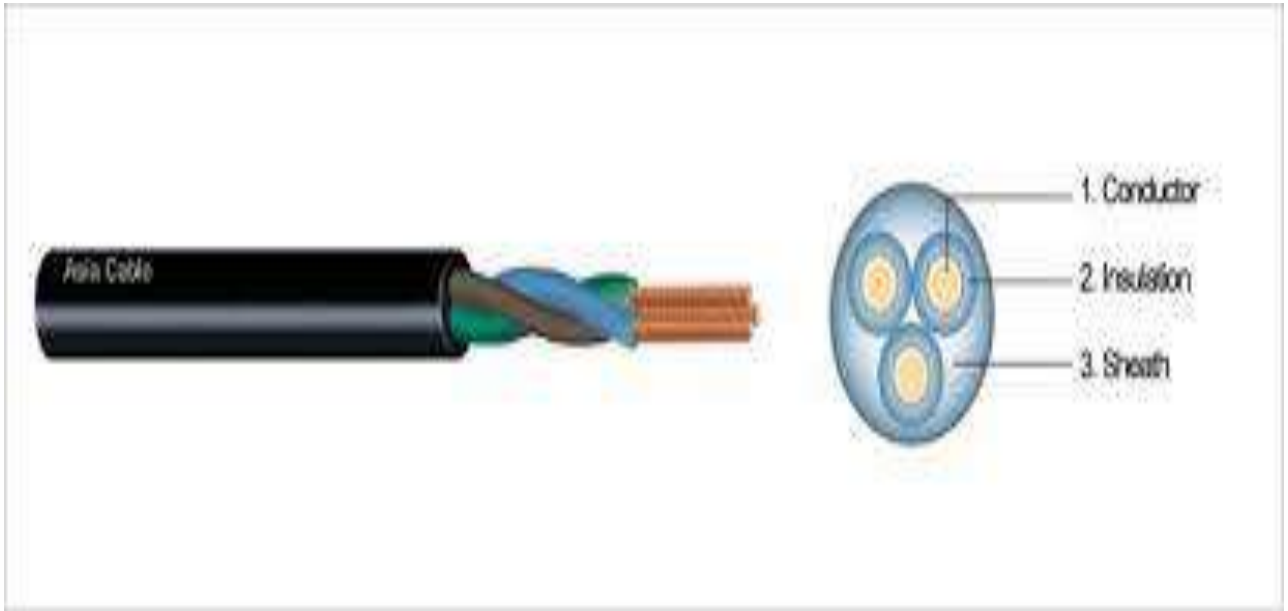
➢ Polyvinyl chloride insulated cables (PVC)

➢ Lead sheathed cables

➢ Cab tyre sheathed cables (CTS)

# FLEXIBLE CORD

- In the flexible cord, a large number of fine wires are used to form the conductor. These are insulated by plastic insulation.
- The flexible cords are used as connecting wires to connect the portable domestic appliances and light fittings etc.
- These cords are easy to guide and handle.



# SWITCHES

- A switch is supposed to carry out the make (connect) and break (disconnect) of electrical connection to the load.
- Switches should be connected to the live (L) wire in the circuit.
- The switches can be classified into two types as follows:

1. Tumbler switch
2. Flush switch

# FUSES

- In any electrical installation, fuse is used for protecting the appliances against over current. Fuse is used in different stages of the wiring.
- A fuse can be made of the following conducting materials:
  - Copper
  - Zinc
  - Lead
  - Tin
  - Aluminium
  - Alloys of lead and

# SOCKET OUTLETS

- The socket outlets are provided for temporary electrical connections such as table lamps, table fans, radio, TV, mobile chargers etc.
- The socket outlet can be of the following two types:

➢ Two pin type (Live, Neutral)

➢ Three pin type (Live, Neutral, Earth)

# PLUGS

- The plugs along with flexible cords are used for providing the electrical supply to the portable appliances like table fan, table lamps, radio etc.
- The plugs are available in two types, similar to the sockets:

1. Two pin plugs
2. Three pin plugs

# LAMP HOLDER

- A lamp holder supports the lamp and connects it to the supply system as well
- The lamp holders are classified into following different types:

1. Batten holders
2. Angle holder
3. Pendant holder
4. Water tight bracket holders
5. Bracket holders

# CEILING ROSE

- The ceiling rose is used for connecting the ceiling fans, pendant lamps etc to the supply system.
- Ceiling rose is made of the following two parts:

1. Base
2. Cover

# TYPES OF WIRING

- The type of wiring to be selected for a particular place of use is based on several factors such as durability , mechanical protection , appearance , environmental condition etc. The various type of wiring in practice are as follows:

- Cleat wiring
- Wooden casing and capping wiring.
- Batten wiring
- Conduit wiring.
- Lead sheathed wiring.

# TYPES OF WIRING

- There are additional types of conduit wiring according to Pipes installation (Where steel and PVC pipes are used for wiring connection and installation).

➢ Surface or open Conduit type

➢ Recessed or concealed or underground type Conduit

# SURFACE OR OPEN CONDUIT TYPE

- If conduits installed on roof or wall, It is known as surface conduit wiring. in this wiring method, they make holes on the surface of wall on equal distances and conduit is installed then with the help of rowel plugs


Surface Conduit Wiring

# CONCEALED CONDUIT TYPE

- If the conduits is hidden inside the wall slots with the help of plastering, it is called concealed conduit wiring. In other words, the electrical wiring system inside wall, roof or floor with the help of plastic or metallic piping is called concealed conduit wiring. Obviously, It is the most popular, beautiful, stronger and common electrical wiring system nowadays.

Concealed Conduit wiring

# CONCEALED CONDUIT TYPE

- Following conduits are used in the conduit wiring systems

➢ Metallic Conduit
➢ Non-metallic conduit

# METALIC CONDUIT WIRING

- Metallic conduits are made of steel which are very strong but costly as well.
- There are two types of metallic conduits.

➢ **Class A Conduit**: Low gauge conduit (Thin layer steel sheet conduit)

➢ **Class B Conduit**: High gauge conduit (Thick sheet of steel conduit)

# NON - METALIC CONDUIT WIRING

- A solid PVC conduit is used as non-metallic conduit now a days, which is flexible and easy to bend.

# ADVANTAGES

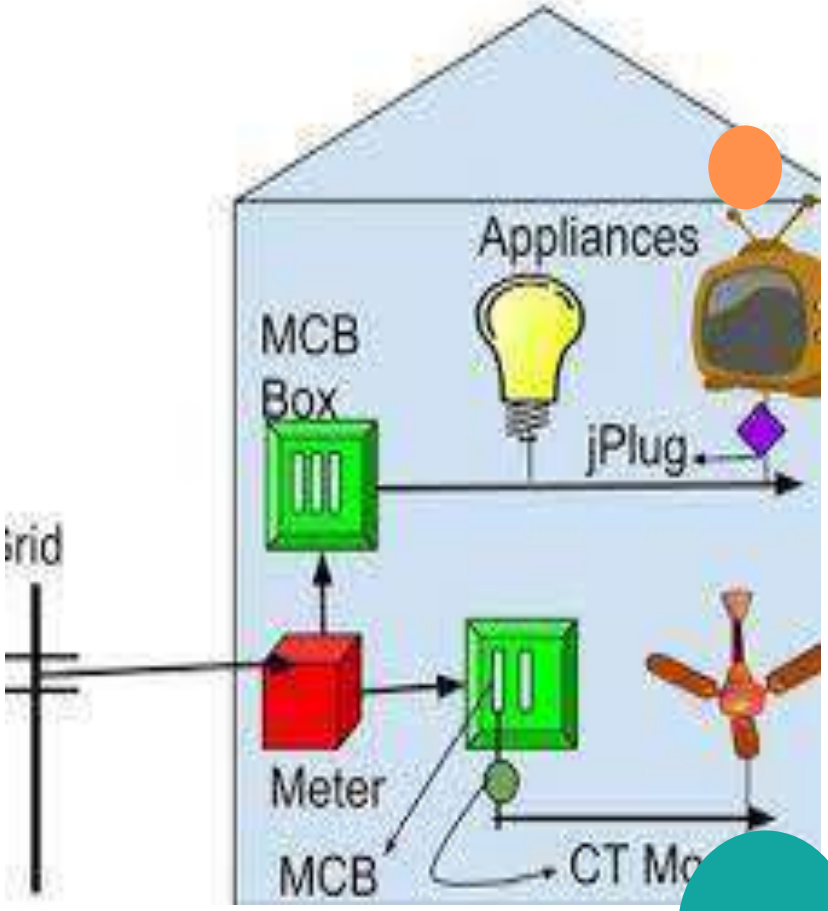
- It is the safest wiring system (Concealed conduit wring)
- Appearance is very beautiful (in case of concealed conduit wiring)
- No risk of mechanical wear & tear and fire in case of metallic pipes.
- Customization can be easily done according to the future needs.
- Repairing and maintenance is easy.
- There is no risk of damage the cables insulation
- It is safe from corrosion (in case of PVC conduit) and risk of fire.
- It can be used even in humidity , chemical effect and smoky areas.
- No risk of electric shock (In case of proper earthing and groundingof metallic pipes).
- It is reliable and popular wiring system.
- Sustainable and long-lasting wiring system.

# DISADVANTAGES

- It is expensive wiring system (Due to PVC and Metallic pipes, Additional earthing for metallic pipes Tee(s) and elbows et
- Very hard to find the defects in the wiring.
- Installation is not easy and simple.
- Risk of Electric shock (In case of metallic pipes without proper earthing system)
- Very complicated to manage additional connection in the future.

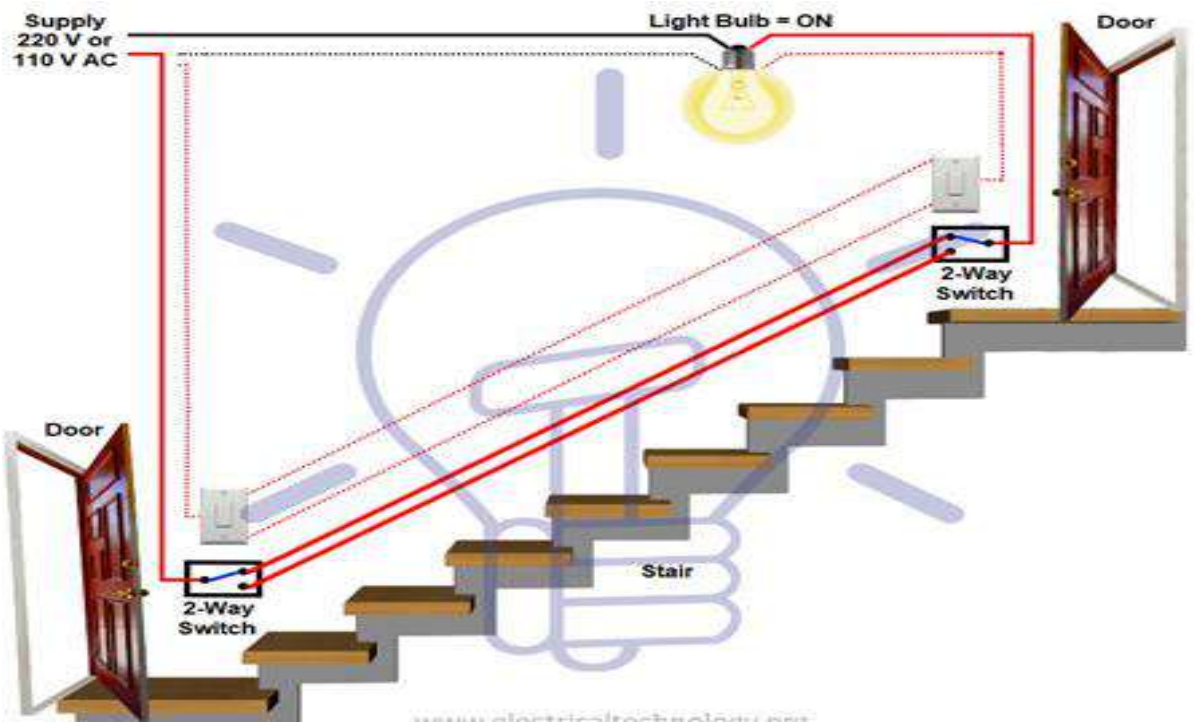
# RESIDENTIAL WIRING

- Residential electrical wiring systems start with the utility's power lines and equipment that provide power to the home, known collectively as the service entrance.
- The power is run through an electric meter, which records how much energy is used in the home and is the basis for the monthly electric bill.



# LAYOUT OF HOUSEHOLD WIRING

- **Staircase Wiring Circuit Diagram Connection**
- Here we can control a bulb from two different places by using two 2-way switches.



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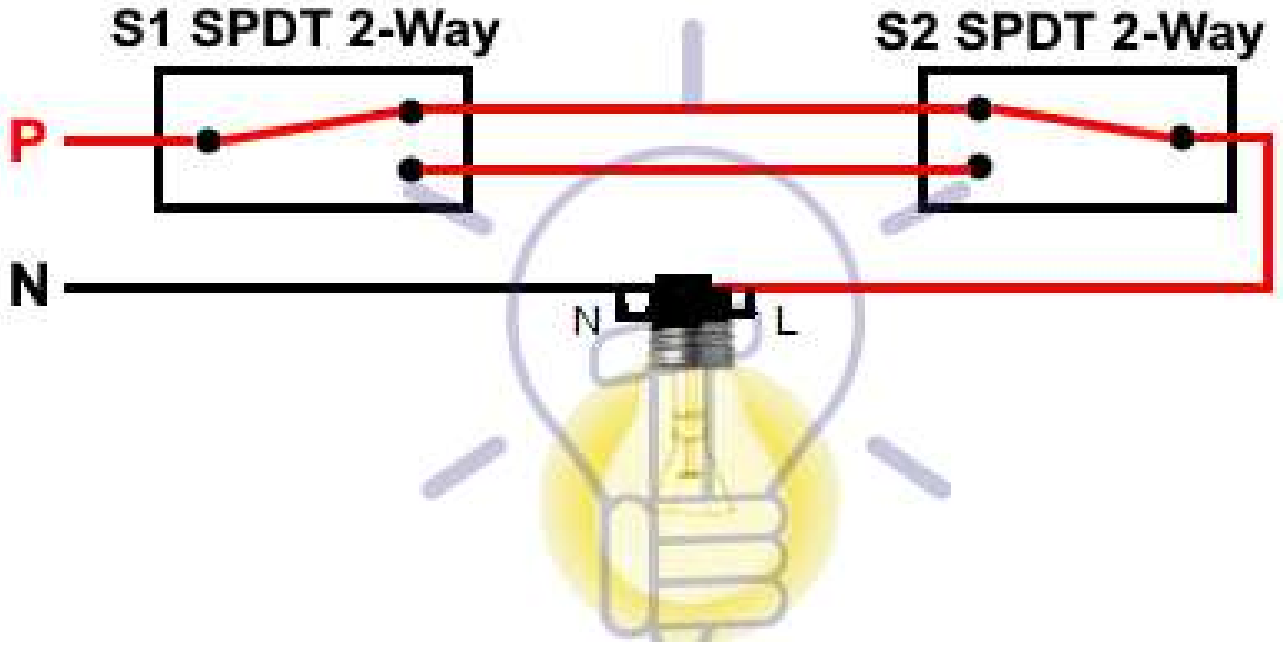

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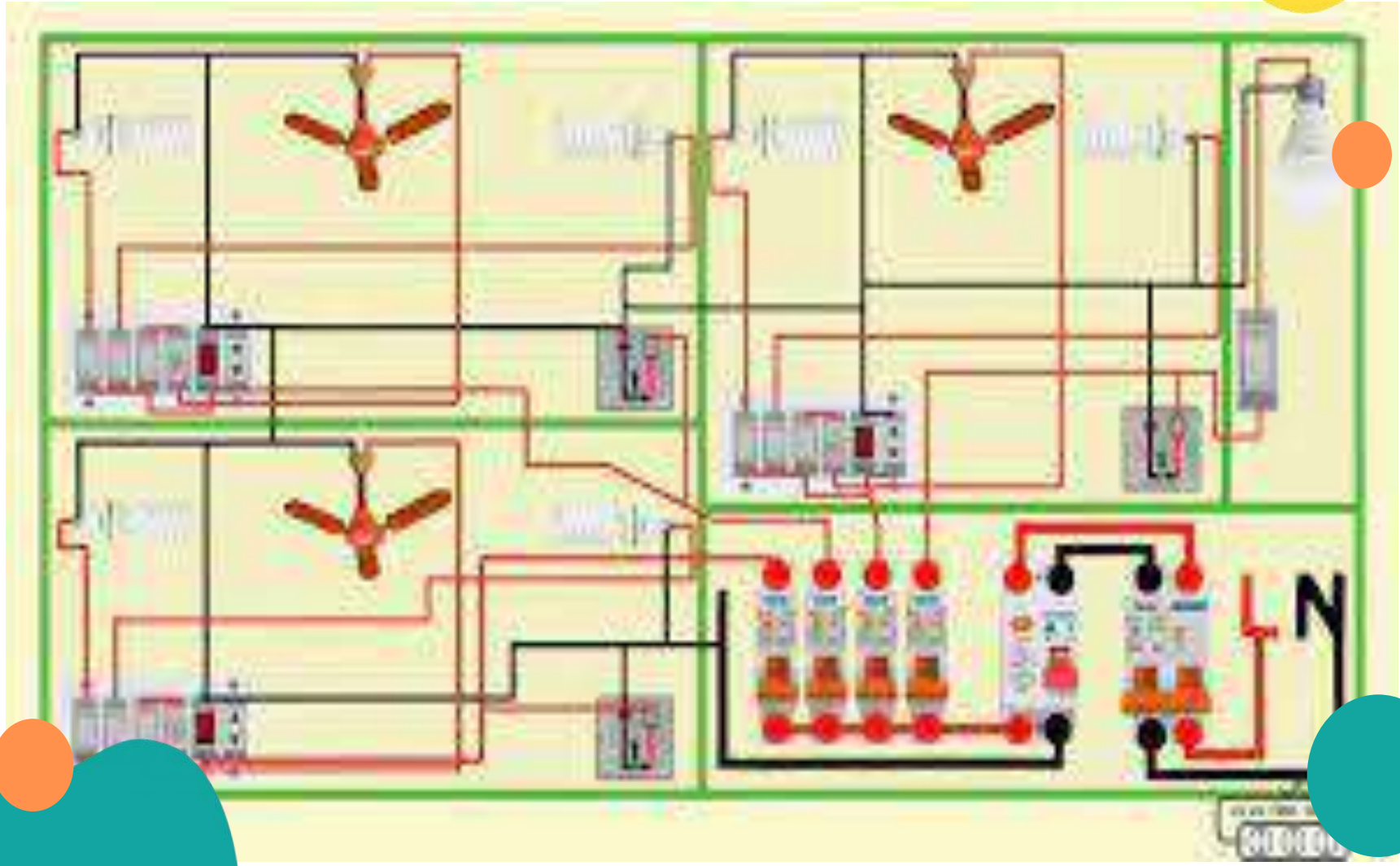

# SIZES AND LETTERING OF THE WIRING

It is essential to understand the types of wires and their characteristics regulated by the National Electrical Code (NEC) for various applications and installations.

**Size of the Wires -** The wire size ranges are determined by the wire gauge. Some standard wire sizes are 10, 12, 14, 18, etc. And say for around 10Amps, 18-gauge of wire will be required. And for 100Amps, a 2-gauge wire will be required.

**The Lettering of the Wires -** The insulation in wire types is represented by certain letters as per the instructions of NEC. The combinations like THHN, THWN, THW, and THHN are some popular types of wire insulations. And the letters stand for:

H- Heat resistance.

HH- High Heat resistance, which resists up to a temperature of 194 degrees Fahrenheit.

N- Nylon coating for resistance to damage.

T- Thermoplastic insulation.

W- Wet locations suitability.

X- Flame-resistant synthetic polymer coating.

# ELECTRICAL WIRES COLOUR CODE

- The live wires through which current runs are red.
- White-colored wires are always neutral (neutral wires are also black).
- For earthing or grounding, green color wires are used.
- For the outlets and switches, the hot wires are used, which are represented by black color.
- Blue and yellow color wires are hot wires that are used for appliances.


# Thank You