MODULE-5

Syllabus: ***Domestic Wiring:*** *Requirements, Types of wiring: casing, capping. Two way and three way control of load.*
Electricity Bill: *Power rating of household appliances including air conditioners, PCs, laptops, printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.*
Equipment Safety measures: *Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits.*
Personal safety measures: *Electric Shock, Earthing and its types, Safety Precautions to avoid shock.*

Types of Wiring Systems

1. Cleat Wiring :

The wires are supported on the porcelain cleats, which are placed at regular intervals.

Advantages
- Temporary connections
- Less cost
- Inspection and changes can be done easily
- Complete material recovered after disconnecting

Disadvantages
- Not suitable for permanent wiring
- Appearance is not good
- Wires are dangerous as they are exposed to atmospheric conditions
- Are liable to mechanical injury

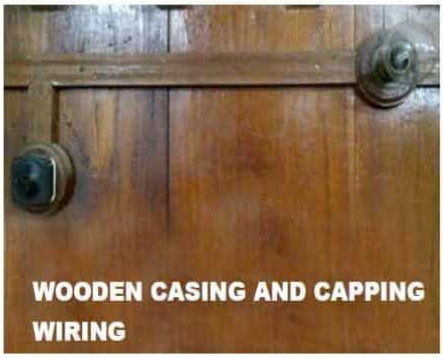
2. Casing and Capping wiring System

The casing is a rectangular strip of wood which has 2 grooves into which wires are laid. Capping is screwed into casing by means of screws.

Advantages
- Conductors are protected from atmospheric conditions
- Appearance is neat and clean
- Installation is simple

Disadvantages
- High risk of fire
- Skilled labours required for installation
- Costly


CLEAT WIRING


WOODEN CASING AND CAPPING WIRING

3. Conduit Wiring :

i) Surface Conduit

Conduits are mounted or supported on the walls with the help of pipe hooks or saddles. This is mainly used in workshops or in damp insulations like textile or flour mills

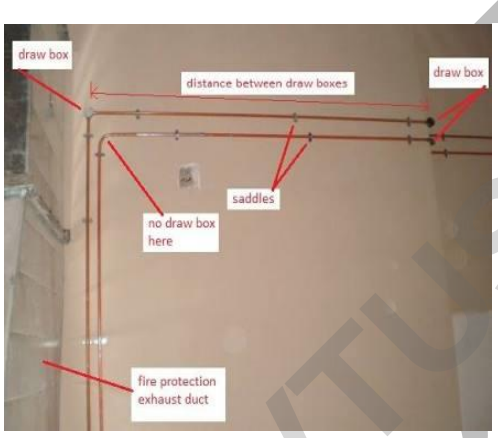
ii) Concealed Conduit wiring

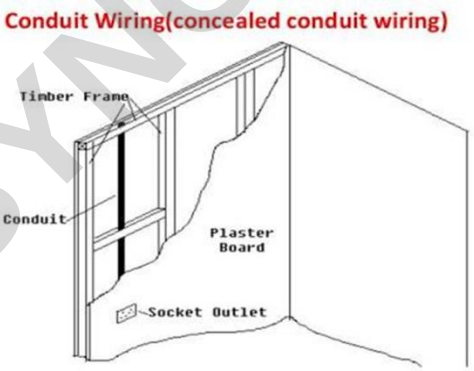
The conduits are burned under the wall at the time of plastering.
Used in the buildings where appearance is the important factor

Advantages

- Beauty of the premises is maintained
- Durable
- Long life
- Protects the wires from shocks, moistures and fire hazards
- Less maintenance

Disadvantages
Repair is difficult
Costly
Requires skilled labour
improper earthing leads to electric shock





Equipment Safety measures

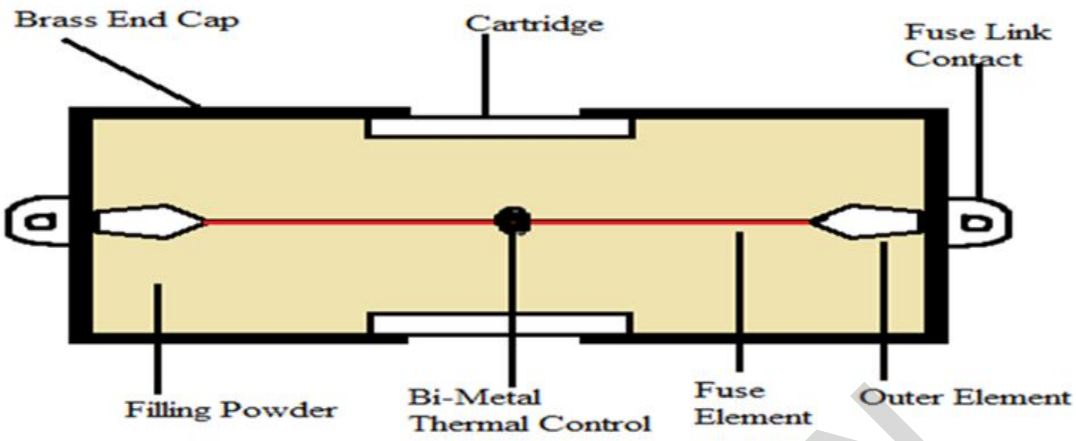
Protective Devices

Protection for electrical installation must be provided in the event of faults such as short circuit, overload and earth faults. The protective device must be fast acting and isolate the faulty part of the circuit immediately. It also helps in isolating only required part of the circuit without affecting the remaining circuit during maintenance. The following devices are usually used to provide the necessary protection:

- Fuses
- Relays
- Miniature circuit breakers (MCB)
- Earth leakage circuit breakers (ELCB)

Fuse

An Electric Fuse is a protective device which interrupts the flow of excessive current in an Electric circuit. This works on the principle of heating effect of the Electric Current



A Fuse consists of conducting wire, which has high resistivity and low melting point. The thickness of the Fuse wire is determined based on the amount of current flow in the circuit. If a fault causes a flow of excess Current then a Conductor break the Circuit by melting or separating it, the thin Conductor used is known as an Electric Fuse. The wire inside the Fuse melts if there is an occurrence of high Current due to a short Circuit or an overloaded Circuit. As a result of which the Current stops flowing since the wire has broken. In order to stop the flow of Electricity. Once a Fuse melts, it can be changed or replaced with a new Fuse. A Fuse is normally made up of elements like zinc, copper, aluminum and silver.

Miniature circuit breaker (MCB) :

An MCB - miniature circuit breaker is an electromagnetic device that embodies complete enclosure in a molded insulating material.

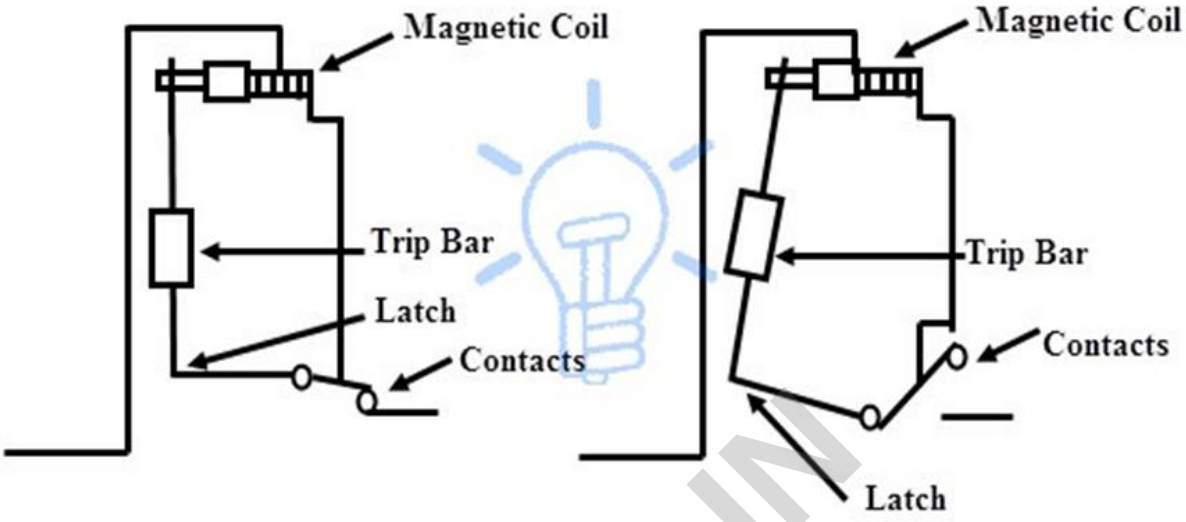
The main function of an MCB is to open the circuit automatically when the current passing through MCB exceeds the value for which it is set. It can be manually switched ON and OFF as similar to normal switch if necessary. An MCB is a simple, easily operable device and is maintenance-free too. It can be easily replaced.

The trip unit is the key part of the MCB on which the unit operates. The bi-metal present in the MCB circuit protects against overload current and the electromagnet in the circuit protects against short-circuit current.

Working

When the overflow of current takes place through MCB , the bimetallic strip gets heated and it deflects by bending. The deflection of the bi-metallic strip or trip bar releases a latch. The latch causes the MCB to turn off by stopping the flow of the current in the circuit. This process helps to safeguard the appliances or devices from the hazards happening due to overload or overcurrent. To restart the flow of current, MCB must be turned ON manually.

In the case of short circuit conditions, the current rises suddenly in an unpredictable way, leading to the electromechanical displacement of the plunger associated with a solenoid. The plunger hits the trip lever, it causes the automatic release of the latch mechanism by opening the circuit breaker contacts.



Comparison between Electric Fuse and MCB

ELECTRIC FUSE	MINIATURE CIRCUIT BREAKER – MCB
Whenever excessive current flows through the fuse, the conducting material inside it melts down thereby interrupting the current flow.	An electromagnetic mechanism present inside the MCB helps it to instantaneously interrupt the current flow during faults.
Fuses other than rewireable fuses cannot be reused.	Miniature circuit breakers can be reused after the clearance of faults.
Fuses acts faster than MCB. Typical tripping time 2ms.	Tripping time for MCB is 20ms.
Can protect against short circuit and overloads.	Can protect against short circuit and overloads.
Cheaper than MCB.	MCB costlier than fuses.
Fuse cannot be used as as an ON/OFF switch.	The Circuit breaker is used as an ON/OFF switches.

Personal safety measures:

Electric shock and precautions

An electric shock is the sudden discharge of electricity through a part of the body when a person comes in contact with electrical equipment.

The factors affecting the severity of shock are

1. Magnitude of the current through the body
2. Path of the current through the body
3. Time for which current is passed through the body
4. Frequency of the current
5. Physical and physiological condition of the person.

Precautions against Electric shock

- Avoid water at all times when working with electricity. Never touch or try repairing any electrical equipment or circuits with wet hands. It increases the conductivity of the electric current.
- Never use equipment with damaged insulation. The insulation of conductors must be proper and in good condition.
- Earth connection should be maintained in proper condition
- Use of the fuses and cables of proper rating.
- Use the rubber soled shoes while working.
- Megger tests should be done to check the insulation.
- Never touch two different terminals at the same time.
- Never remove the plug by pulling wire.
- The sockets should be placed at a proper height
- Switch off supply and remove the fuses before starting the work with any installation.
- Always use insulated screw drivers, and line testers.

Earthing :

Connection of the body of electric equipment to the general mass of the earth by wire of negligible resistance is called **Earthing**. It brings the body of the equipment to the zero potential during electric shock.

Necessity of Earthing

1. To protect the human beings from danger of shock in case they come in contact with the charged frame due to defective insulation.
2. It guarantees the safety of electrical appliances and devices from the excessive amount of electric current.
3. It protects the appliances from high voltage surges and lightning discharge.
4. It provides an alternative path for leakage of current hence protects the equipment.
5. It keeps the voltage constant in the healthy phase
6. It protects the Electric system and buildings from lightning.
7. It avoids the risk of fire in the electrical installation system.
8. To maintain the line voltage constant under unbalanced load condition.

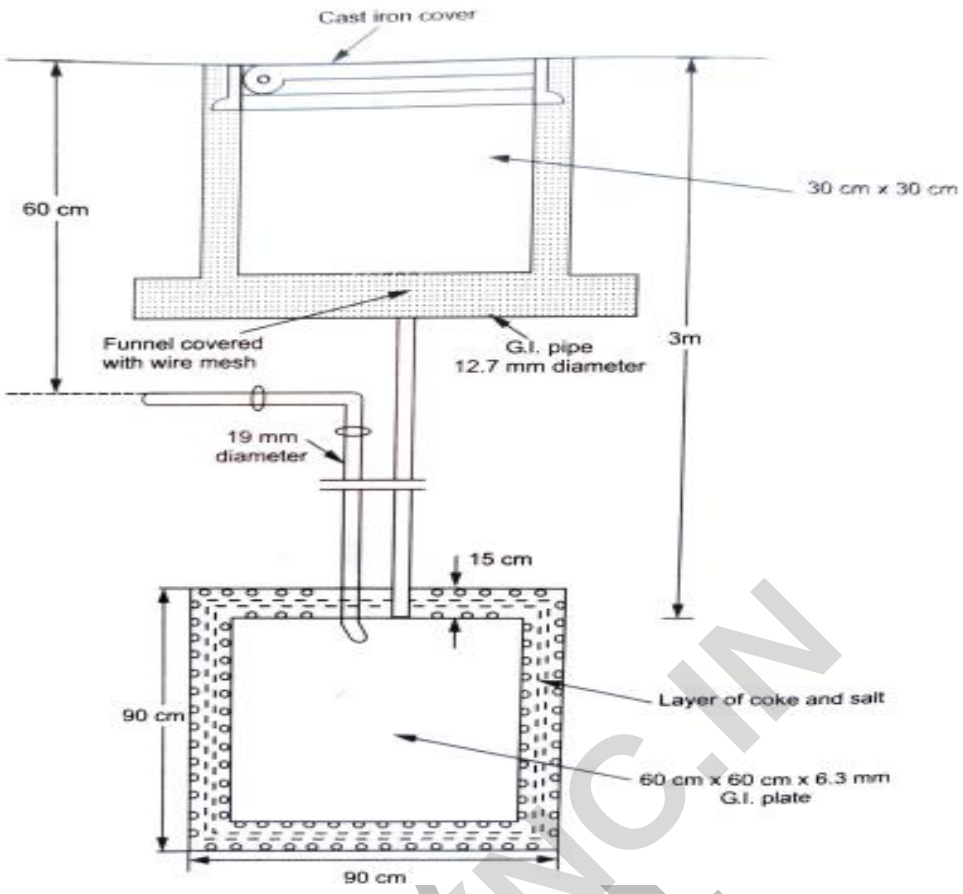
Types of Earthing

They are two types of earthing

1. Plate earthing
2. Pipe earthing

- **Plate Earthing** :

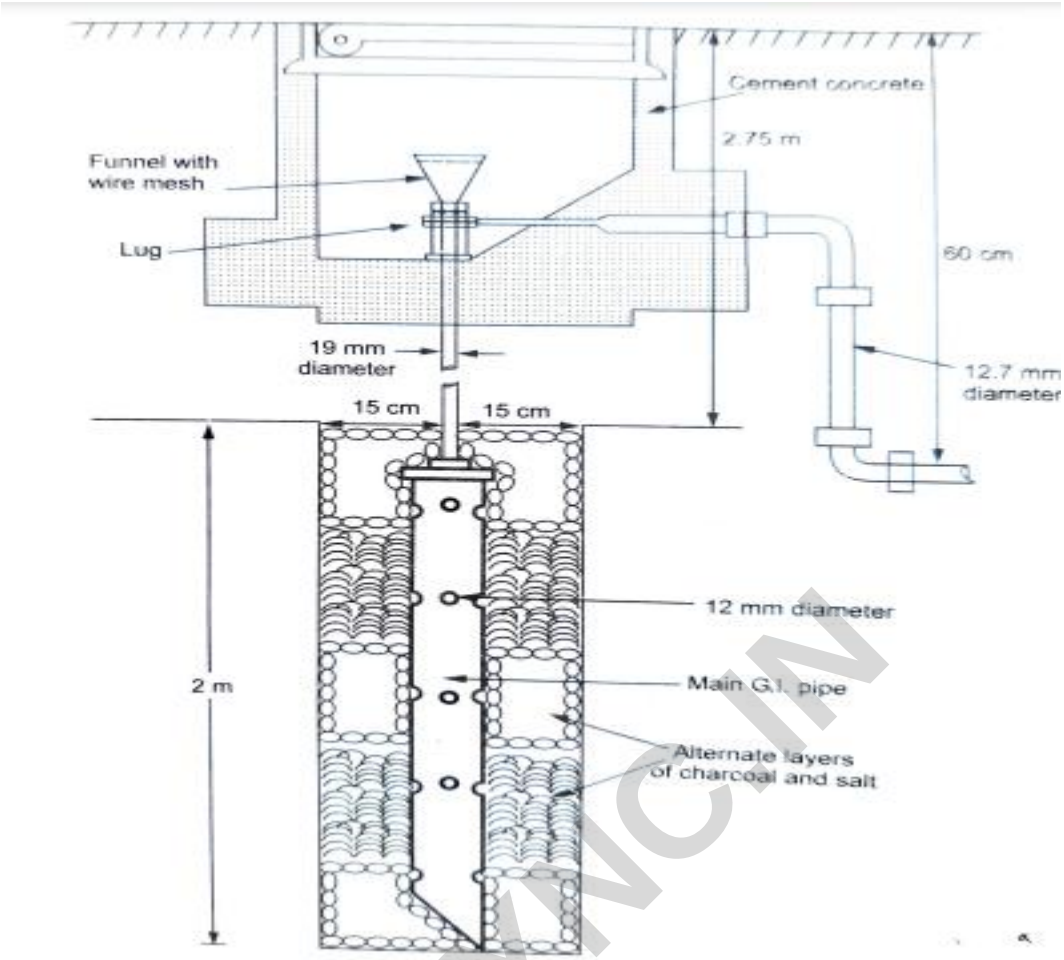
In this method a copper plate or GI plate of 60cmX60cmX3.18cm is placed vertically down inside the ground at a depth of 3m. The plate is surrounded by the alternate layers of salt and coal with a minimum thickness of about 15cm. The earth wires drawn through the GI pipe are bolted through the earth plate. The GI pipe is fitted with the funnel on a top in order to have an effective earthing by pouring the salt water periodically. The schematic arrangement is as shown below.



The earthing efficiency increases with the increase of the plate area and depth of the pit. The depth of the pit depends upon the resistivity of the soil.
The only disadvantage of this method is that discontinuity of earth wires from the earthing plate which is placed below the ground as it cannot be observed physically this may cause miss leading and result into heavy losses under fault condition

- **Pipe Earthing** :

In this method a Galvanized iron pipe of 38 mm diameter and length of 2 meters with 12 mm holes is placed vertically into the ground at a depth of 5m.This pipe acts as an earth electrode. The depth depends upon the condition of the soil
The pit area around the pipe is filled with the alternate layers of salt and coal for improving the condition of the soil and earthing efficiency. The earth wires are connected to the top section of the pipe above the ground level with nut and bolts. The funnel is provided to pour the salt water. The schematic arrangement is as shown below.



The contact surface of GI pipe with the soil is more as compare to the plate. Hence it can handle large leakage current for the same electrode size. The earth wires connected to the GI pipe above the ground level can be physically inspected time to time.
The only disadvantage of pipe earthing is that, the pipe length has to be increased sufficiently in case of soil of high specific resistivity. This increases excavation work and hence increased in cost.

Power rating of household appliances

The Rating of an electrical appliance indicates the voltage at which the appliance is designed to work and the current consumption at that voltage. The Power rating of the appliance is related the power it consumes. Every electrical appliance has a power rating which indicates the amount of electricity required to do work. . This is usually given in watts (W) **or kilowatts (kW).**
The Energy consumption of a device is calculated by multiplying the wattage of a device and operational hours

Energy consumption = Wattage X operational hours.
UNIT: The unit of electrical energy consumed is kWh. One kilowatt-hour is the electrical energy consumed by an electrical appliance of power 1 kW when it is used for one hour. Therefore 1kwh =1 unit.

Calculation of Power consumption of electrical home appliances.

Let us consider different home appliances to calculate approximate total energy consumption of house per month.

Sl NO	Appliances	Watts	NO	Total no of watts	Total no kilowatt (KW)	No of operational hours per day	Energy consumed in kwh(units) per day= energy consumed / 1000
1	Tube light	60 W	10	600	0.6	5	3
2	Fan	75 W	4	300	0.3	8	2.4
3	Refrigerator	200W	1	200	0.2	24	4.8
4	AC	1000W	1	1000	1	5	5
5	Laptop	50W	1	50	0.05	2	0.1
6	Television	50W	1	50	0.05	3	0.15
7	Grinders	1000W	1	1000	1	½	0.5
8	Printers	50W	1	50	0.05	½	0.025
9	Washing machine	2000W	1	2000	2	1	2
10	Micro wave	1000W	1	1000	1	1	1
						Total	**18.9=19units**

Therefore per day 19 units of energy is consumed

For 1 month = 19 x 30 = **570 units per month**

Tariff

The electrical energy generated in generating station is delivered to a large number of consumers at reasonable rates.

Definition of tariff: The rate at which the electrical energy is supplied to a consumer is known as tariff.

The tariff should include:

1. Recovery of cost of generating electrical energy in power stations
2. Recovery of cost of capital investment in transmission and distribution.
3. Recovery of operation and maintenance of supply of electrical energy.
4. A suitable profit on capital investment.

There different types tariff. The consumers who have appreciable maximum demand for them two part tariff method is employed.

Two Part Tariff

When the rate of electricity energy is charged on the maximum demand of the consumer and the units consumed is called two part tariff.

In this tariff scheme, the total costs charged to the consumers consist of two components: fixed charges and variable charges . It can be expressed as:

Total Cost = [A (kW) + B (kWh)] Rs

Where, Fixed charges - A = charge per kW of max demand

Variable charges - B = charge per kWh of energy consumed.

The fixed charges will depend upon maximum demand of the consumer and the variable charge will depend upon the energy (units) consumed. The fixed charges are due to generation, transmission and maintenance.

Advantages

If a consumer does not consume any energy in a particular month, the supplier will get the return equal to the fixed charges.

Disadvantages

If a consumer does not use any electricity, he has to pay the fixed charges regularly.

The maximum demand of the consumer is not determined. Hence, there is error of assessment of max demand.

Electricity Bill

Calculation of electricity bill for low tension domestic consumer is as follows.

The electricity bill consists of two components: fixed charges and variable charges (running charges). It can be expressed as:

Total Electricity Bill = [A (kW) + B (kWh)] + Tax

Where, Fixed charges - A = charge per kW of max demand

A= Total kW X charge per kW

Example: if the sanctioned load is 3KW then A= [1x85 + 2x95] = 275rs

(Note: For 1kw it is 85 rs and above 1kw it 95 rs per kw)

Where Variable charges - B = charge per kwh of energy consumed.

B = No of units consumed x rate per unit

Example: If the no of units consumed is 120 units then

B = [50 x4.1 + 50 x 5.55+ 20 x 7.1] = 624 rs

(Note: For 0- 50 units – 4.1 rs per unit, 50- 100 units – 5.55 rs , 100- 200 units – 7.1rs)

Therefore Total Electricity bill for given example is

= 275 +624+ Tax.