unit-3

protective Device:—

A protective device is a component or system designed to prevent or mitigate damage to electrical circuits, equipment or personnel by interrupting or limiting the flow of electrical current in the event of an overload, short circuit, ground fault or other abnormal conditions.

Necessity of protective devices:—

i) protective devices are essential for ensuring the saffty of individual workers and the general public in various environment.

ii) protecting devices are essential to protect people and electrical circuit from current and voltages outside their normal operating ranges.

iii) They help meligate risk associated with hazard such as electrical faults, mechanical failures and environment danger.

iv) protective devices are important because they ensure that under fault condition, a high fault current cannot flow as well as protecting installation.

v) These are equipments applied to electrical power systems to detect abnormal and intolerable conditions and to initiate appropriate corrective actions.

vi) protective device are necessary to protect electrical appliance or equipment against short circuit.

vii) To protect electrical applince against overloading of equipment.

viii) They protect electrical appliances and machinery from damage caused by over current, over voltage or other electrical faults, extending the lifespan of the equipment.

* Various types of protective devices and the functions:-

1. Fuse:-

In electrical circuit a fuse is an electrical device used to protect the circuit from overcurrent. It consist of metal strip the liquefies when the flow of current through it is high. It is generally made

of a material with a low melting point, made up of an alloy of Tin (Sn) and Lead (Sn) alloy.
Composition of the tin and lead alloy is 62% of Tin & 38% lead which melts at 185°C.

Functions of fuse wire:-

i) Acts as a barrier b/w the electronic circuit and the human body.
ii) prevent device failure due to faulty circuit operations.
iii) Fuse prevent short circuits.
iv) Prevents overload and blackouts.
v) prevents damage that is caused due to mismatched loads.

2. Glass Cartridge fuse:-

- Glass Cartridge fuses are low cost electrical safety devices that are used for the overload protection of electrical circuit and appliances.
- They are cylindrical in shape and have a contact point at each end. Cartridge fuses are typically constructed from ceramic

glass or porcelain.
The contact point are connected by a fuse link, a length of material meant to melt or sacrifice itself, in the event of an over-current event.

Functions of Glass Cartridge fuse:-

i) Glass cartridge fuse are ideal for providing protection to devices or internal circuit from short-circuit and overcurrent.

ii) High voltage circuits such as those for electric ~~o~~ ranges and dryers are protected by cartridge fuse.

iii) They are deliverately weaker component which when too much current is drawn will blow.

iv) It provides protection against the overflows of current.

v) It stops the flow of current in the event of a short circuit, reducing the risk of fire or equipment damage.

Q3. HRC fuse:—

- It stands for High Rupturing Capacity fuse.
- It consists to which is welded silver current carrying element. The space within the body surrounding the element is completely packed with a filling power.
- HRC fuse is one kind of fuse, where the fuse wire carries a short circuit current in a set period. If the fault is occurs in the circuit then it blows off.
- The HRC fuse is made with glass otherwise some other kind of chemical compound.

Function of HRC ~~value~~ fuse:—

i) It is designed to protect the circuit in specific condition.

ii) Safely stop an over-current in an electrical circuits.

iii) It can clear high as well as low fault currents.

iv) It protects against ~~catapro~~ catasproic damage caused by excessive current.

v) It provides reliable discrimination.

4) Kit-Kat fuse:—

- Kit Kat fuse is a Semi-enclosed fuse which is also considered a rewirable fuse.
- This fuse is mainly designed for domestic wiring and small scale usage.
- There are two parts in Kit-Kat fuse wire and fuse base.
- It is very easy and quick to install and requires very minimum time for replacement as well.
- It is very cost-effective and considered as the cost effective form of fuses.
- Electrical Kit-Kat fuse require little to almost no maintainance thoughout its serving life.

Function of Kit-Kat fuse:—

i) It melts and breaks the circuit when exposed to excessive current.
ii) It operates to provide overcurrent protection of an electrical circuit.
iii) It provides adequate protection without needless interruption.
iv) It is sacrificial device, once a fuse has operated.

MCB:—

- It stands for miniature circuit breaker.
- MCB is an automatic switch that opens when excessive current flows through the circuit.
- In case of a fuse, once it has been operated, it must be replaced but in case of MCB depending on the type of MCB.
- Hence, fuse is known one of the sacrificial devices. This is why MCB is are used as alternative to the fuse in most of the circuit.
- A miniature circuit breaker (MCB) automatically switches off the electrical circuit during an abnormal condition of the network means in overload condition as well as faulty condition.

Functions of MCB:—

(1) It is used to protect an installation or appliance against sustained overloading and short circuit faults.

(2) It also give protection against earth faults.

(3) It is designed to protect against ~~earth faults~~ both overloading and short-circuiting.

iii) MCB can be used as manual switch to turn electrical circuit on or off.

iv) MCB protect electrical circuit from excessive current than can cause overheating and potential fires.

6) MCCB :—

- It stands for molded case circuit breaker.
- MCCB are used in high energy requirement application such as high-power equipment in industries or for commercial purpose.

- MCCB goes as high as 2500 amps.
- It is also of low voltage to meet IEC standards Trip characteristics can be adjusted. Interrupting rating range from 1000 to 2000 amps.

Function of MCCB :—

- ~~It stands for molded case circuit b~~
- It is used to protect an electrical circuit from overload or short-circuits.
- It works by automatically cutting off the power supply when a fault or

overcurrent situation arises thus preventing any damage to the electrical system.

(iii) electrical fault protection against short-circuit current and electrical switch for disconnection.

7) RCCB:—

- RCCB Stands for Residual Current circuit Breaker and Commonly Known as circuit Breaker.
- It is an electrical safety device that cuts off the electricity supply immediately upon detecting leakage that may result in an electric shock.
- An RCCB will detect a fault by measuring incoming and outgoing current in the line and neutral wires.
- It is current sensing device which can automatically measure and disconnect the circuit whenever a fault occur in the connected circuit or the current exceeds the rated sensitivity.

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Functions of RCCB:-

① It protects people from electric shocks or death caused by them.

(ii) It is a gadget that senses current and disconnect any low voltage circuit whenever a fault occurs.

(iii) By detecting leakage currents that might indicates insulation failures or other faults the RCCB can help prevent electrical fires.

(iv) RCCB do not provide protection against overloads or short circuit.

(8) ELCB:-

- ELCB stands for Earth-leakage Circuit Breaker.
- It is a safety device used in electrical installation with high earth ~~independ~~ impedence to prevent shock.
- It detects small stray voltage on the metal enclosures of electrical equipment and interrupts the circuit if a dangerous voltage is detected.
- Only widely used more recent installation instead use residual current device (RCD, RCCB, and RCCI) which instead detect leakage current directly.

Function of ELCB:-

i) It provides protection against electric shock and fires caused by ground faults or leakage current.

ii) It helps to break the circuit automatically whenever there is a current leak due to insulation failure or any other reason.

iii) The function of an ELCB is to enhance electrical safety by detecting earth faults and disconnecting the power supply to prevent electric shocks and reduce the risk of electrical fire.

iv) ELCB also help to prevent electrical fires by detecting leakage currents that could indicate faulty insulation or other issue that might lead to overheating and fire.

v) The ELCB helps to protect people from electric shocks that could occur if they come contact into ~~the~~ with live parts.

9) Relay

- A Relay is an electrically operated switch
- It consist of a set of input terminals for signals or multiple control signal and set of operating contact terminals.
- It detects the intolerable or undesirable condition with an assigned area and gives the command to the circuit breaker to disconnect the affected area.
- It works on the principal of electromagnetic attraction.

Function of Relay :—

i) It is used to control a circuit by an independent low-power signal.

ii) It controls the opening and closing of the circuit contacts of an electronic circuit.

Earthing

- Earthing is the processes in which the instataneous discharge of the electrical energy take place by transferring charges directly to the earth through low resistance wire.
- Low resistance earthing wire is choosen to provide the least resistance path for leakage of fault current.
- The electrical Earthing is done by connecting the non-~~ae~~ current carrying part of the equipment or neutral of supply system to the ground.
- mostly the galvanished iron is used for the earthing.

The earthing is essential because of the following reasons:-

i) The earthing protects the personnel from the short circuit current.

ii) The earthing provides the easiest path to the flow of short circuit current even after the fallure of the insulation.

iii) The earthing protects the apparatus and personnel from the high voltage surges and lighting discharge.

iv) Earthing is the safe and the best method off offering safety. The earth's potential zero and is treated as neutral, since low equipment is connected to earth. using low resistance wire, balancing is achieved.

Types of Earthing:—

i) pipe Earthing:—

A galvanised steel perforated pipe is buried underground vertically connecting all the electrical conductors to the earth. The depth of pipe in pipe earthing depends on the condition of the soil.

This method is affordable and requires low maintenance.

It specifies that the pipe should be at least 38.1mm diameter and 2m long. placed in permanently wet soil at a depth of 4.75 m.

Plate Earthing :- plate earthing is a method where a plate made of galvanised copper or iron is buried vertically at least 3 meters below ground level, providing a path for electrical discharge.

Explain various tools requires for wiring :-

i) Screwdrivers :- essential for attaching or detaching screws in electrical devices and outlets. common types include flathead, phillip and Torx screwdrivers. These tools are made of steel harded and tempered at the tip used to loosen or tighter screws with slotted heads.

They came in various sizes and shapes :-

a) Standard / flat screw driver :-
The blade tip is wedged shaped and resembles a negative (-) sign. This is used to drive screws with a single slot head.

b) philips screw drivers :-
This has a cross tip resembling a positive (+) This is used to drive screws with cross slot heads.

ii) pliers:—

- pliers are a hand tool used to hold objects firmly, possibly developed from tongs used to handle hot metal in Bronze Age Europe.
- They are also useful for bending and physically compressing a wide range of materials.
- Generally, pillers ~~at~~ consist of a pair of metal first class levers joined at a fulcrum positioned closer to one end of the levers, creating short jaws on one side of the fulcrum and longer handles on the other side.

iii) Try Square:—

A try square is a wood-working tool used for making and checking 90° angles on pieces of wood. Through wood workers use many different types of square, the try square is considered one of the essential tools for woodworking. A Try Square is made of two key parts, the blade (also known as a beam or tongue) and the Stock which are fixed together

at 90° to form and 'L' shape.

iv) punch :-
A tool usually in the form of a short rod of steel that is variously shaped at one end for different operation (such as forming, performing, embossing or cutting).

v) Hand drill Machine :-
A small portable drilling machine resembling a breast drill but designed to be held and operated by hand. A primitive drill consisting of a shaft carrying a point of stone, bone, shell or metal and revolved usually by the palms of the hands.

vi) portable drilling machine :-
portable drilling machine is a little compact component and use for drilling holes in workpieces in every point, which cannot be drilled in normal drilling machine. It can be use for drilling small diameter holes in big weldments or casting that position itself where they are lying.

viii) Electrician Knife:-

An electrician knife is designed to cut electrical insulation, cables, insulation and more. Not only for electricians, this pocket knife is a great tool for anyone for quick, easy cutting.

ix) Test lamp:-

A Portable lamp in socket with free leads to connect to various points of a faulty circuit to locate a defect.

x) Tester:-

A Tester is a machine or device that you use to test whether another machine or device is working properly.

* Different types of electrician tool and their functions:-

Electrical tool are needed to perform our job easier and faster.

Electrical tools are tools used to work on an electrical system.

Here are some common types of electrician tool and their function:-

1. Screwdrivers:-
   Useal to tighten or loosen screws in electrical panels, outlets, switches and other components. They come in different sizes and 0 types.
   - flathead screwdrivey
   - Phillips screwdrivey

2. pliers:-
   Essential for gripping, bending and cutting wires. Types include.
   - needle-nose pliers for reaching into tight spaces.
   - lineman's pliers for heavier cutting and twisting.

3. Wire Strippers:-
   - useal to remove insulation fovm electrical wires without damaging the metal conductor. They come with multiple notches for different wire guage.

Measuring and Testing tools:—

4) Voltage Tester:— A handled device used to check if an electrical wire or device is live.
Ensures safety before starting electrical work.

5) Multimeter:— Measure voltage, current and resistance in electrical circuit.

6) Circuit finder / Tracer:— Consists of a Transmitter and receiver to locate Specific circuit within walls or panels, ~~identy~~ identifying which breaker controls a Specific outlet or fixture.

Wire handling Tools:—

7) Fish Tape:— A long, flexible metal or fibreglass tape used to pull wires through conduit, walls and other hard to reach areas.

8) Cable Cutters:— Heavy-duty tools designed to cut through thick electrical cable and wires cleanly.

- Conduit wiring are different types:—

1) Surface conduit wiring system:—

- All steel conduits should be coated or finished with galvanised or enameled surface. Conduit acessories must be threaded type No steel conduit less than 12.7mm in diameter should be used.
- For this type of wiring, the first holes are made on the wall surface in a straight lines at equal distances. Then rowel plugs are fixed into these holes and saddles are installed above these rowel plugs through screws. After this conduits are installed above it. The size of the conduit used in this type of wiring depends on the no. of wires going to be passed through it.

Advantages:—

- Alterations or additions are possible in this system according to future needs.
- Its revamping, repairing and maintenance is quite easy.
- In case of PVC conduit, this wiring remains

protected from rust as well as fire.
- This type of wiring can also used in places prone to weather as well as chemical impacts.
- As a result of proper earthing of metal conduit, no danger of an electric shock exists in this type of wiring.

- It has a long life.
- It is a reliable and popular method for wiring purposes.

Disadvantages

- Its tends to be less attractive as compared to the concealed wiring.
- It requires significant labour and skilled technicians.
- They are not protected against mechanical shocks and as a result of such blows there always remains a risk of conduit getting uprooted.
- A significant amount of time is required for the purpose of installing this type of wiring.

ii) Concealed conduit wiring:—

- If the conduits is hidden inside the wall slots with the help of plastering, it is called concealed conduit wiring.
- In other word, the electrical wiring system inside wall, roof or floor with the help of plastic or mettalic piping is called concealed conduit wiring.
- It is the most popular, beautiful, strongest and common electrical wiring system nowdays.

Advantage

- It provides protection against mechanical damage.
- metals Conduits provides protection against fire due to short circuit etc.
- The whole system is water proof.
- Its life is long
- Replacement of defective wiring is easy
- It is shock proof if earthing is done properly.
- PVC conduits wiring is cheap
- PVC conduit wiring less time.

Disadvantage

- PVC conduit does not provide protection against fire.
- metal conduit wiring is very costly.
- metal conduit wiring requires more time.
- metal conduit wiring needs skilled labour.
- Very hard to find the defects in the wiring.
- Very complicated to manage additional connection in the future.

(ii) PVC casing capping wiring:—

- Casing and capping is one of the oldest and most popular wiring system still is use today.
- It is an electrical wiring method where PVC insulated wires are placed in plastic casing and covered with a cap.
- PVC casing and capping is a brilliant product that can be used for many purposes in wiring installation.
- They provide electrical safety and insulation and bear the distribution of the wires according to the capacity of the wire.