Wiring Materials & Accessories

Short Note: Part-2

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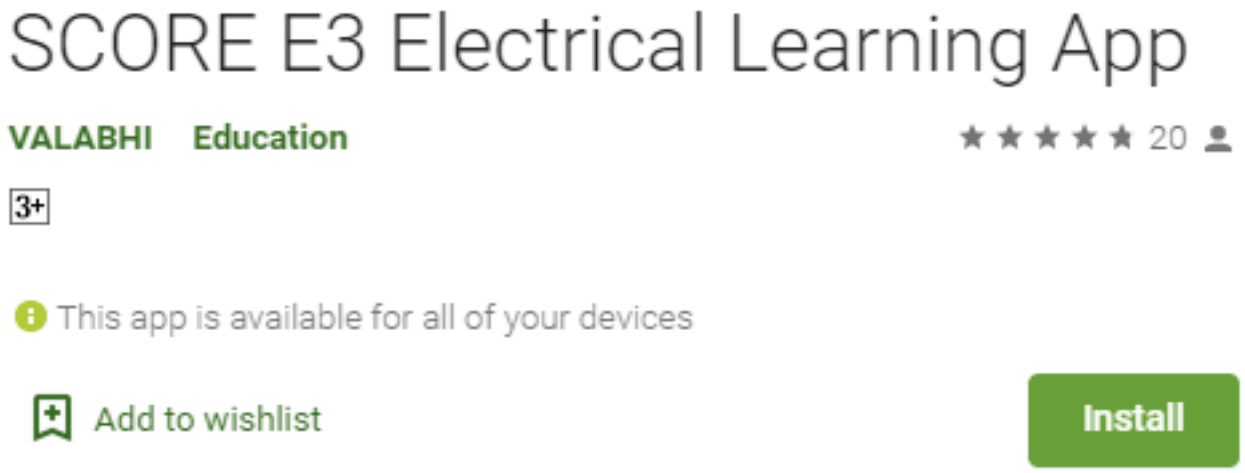

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Course Overview

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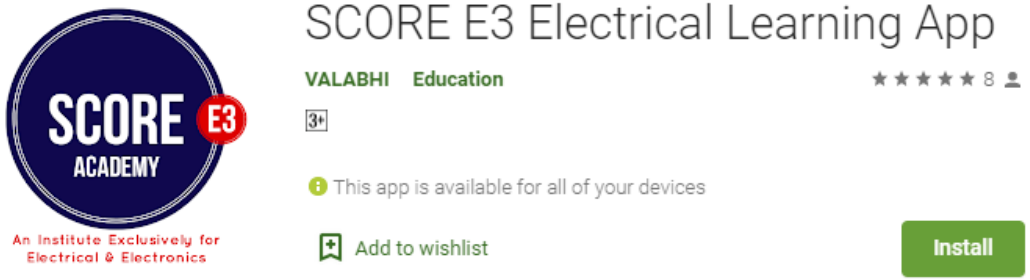
- Introduction
- Wiring system
- Wiring materials and accessories
- Domestic Installation
- Earthing System
- Testing



Conductor materials used in cables

- Copper and aluminium are the materials used in power and lighting cables

Advantages of copper wiring

- Conductivity of copper is high compare with aluminium.
- Copper is mechanically strong, hard, extremely tough, durable and ductile. it is high resistive to corrosion and oxidation. it can withstand dampness and high temperature.
- Now a days for domestic installation copper wires are used.

Advantages of aluminum wiring

- Aluminum is considerably less expensive than copper.
- Aluminum is a lightweight material and very flexible, making it easier to work with.
- This makes it more desirable to use, especially in large projects requiring extensive wiring.

Insulating materials

- High resistivity
- High flexibility
- High dielectric strength
- Non inflammability
- Non hygroscopic
- Highly resistive to moisture, acids or alkalies.
- Capability to withstand high rupturing voltages and high temperature without much deterioration.

No one insulating materials have all above mentioned qualities, so the type of insulating materials used in a cable depends upon the service

Rubber

- Dielectric strength -30kv/mm
- Disadvantage- it Absorbs moisture

Vulcanized India Rubber

- Does not absorb moisture from the atmosphere.
- Main drawback is due to Sulphur content ,it attacks copper, so copper conductor is tinned before providing the insulation.

Impregnated paper

- Cheap
- Heat conductivity is high(VIR) and capable to withstand higher temperature without deterioration.
- Disadvantage-Hygroscopic (tending to absorb moisture from air).
- Rarely used PVC and XLPE insulated cables are predominantly used

Polyvinyl Chloride

- Low cost
- Inert to oxygen, oils, alkalies and acids so it is preferred over VIR in extreme environments-cement ,chemical factory.
- Employed for low and medium voltage domestic and industrial lights and power installation

Cable Types

- Conductor used- Cu ,Al conductor
- Number of cores used- single, twin, three core cables
- Voltage grade -250/440 volt cables or 650/1100 volt cables

  the safe voltage which insulation of the cable can withstand .cables employed for domestic wiring are graded 650/1100 V grade.
- Type of insulation used- VIR, TRS/CTS, lead sheathed, PVC, weather proof , XLPE, Flexible cords and cables

Vulcanized Indian Rubber cables

- Available in 240/440 volt and 650/1100 volt grades.
- VIR cable consists of tinned copper conductor covered with a layer of VIR insulation

TRS/CTS cables

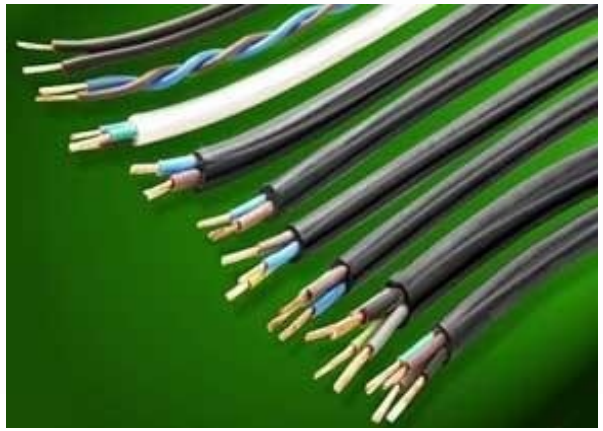
- Available in 240/440 volt and 650/1100 volt grades.
- Vulcanized rubber insulated conductor with an outer protective covering of tough rubber- provide additional insulation and protection against wear and tear, also it is water proof.
- Low cost and light weight compare to lead sheathed cable
- Similar properties to those of lead sheathed cables and thus provided cheaper substitute to lead sheathed cable.

Lead sheathed cables

- Available in 240/415 volt grade.
- Vulcanized rubber(PVC/TRS) insulated conductor with a continuous sheath of lead.
- Good Protection against absorption of moisture and mechanical injury so can be used without using casing or conduit.

Flexible cords and cables

- Consists of wires silk/cotton/plastic covered
- Flexible cords have tinned copper conductors
- Using large no of strands for flexibility
- These wire or cables are used as connecting wires for such purposes as from ceiling rose to lamp holders, socket outlet to portable apparatus radios, fans, lamps, heaters etc.
- These may not be used in fixed wiring



Weather proof cables

- Used for outdoor wiring and for power supply
- Available in 240/440 volt and 650/1100 volt grades
- Not affected by heat or sun or rain

PVC Cables

- Available in 240/440 volt and 650/1100 volt grades.
- PVC insulation provides better flexibility.
- Used in casing capping, batten and conduit wiring.
- Inert to oxygen, oils, alkalies and acids so it is preferred over VIR in extreme environments-cement ,chemical factory.
- Though the insulation resistance of PVC is lower than that of VIR but its effect is negligible for low and medium voltages for industrial lights and power installation.

Advantage of PVC cables over other type of Cables

- Non hygroscopic insulation almost unaffected by moisture
- Complete protection against most form of electrolytic/chemical corrosion
- Tough sheath with excellent fire resisting qualities
- Good ageing characteristics
- Not affected by vibrations

XLPE cables

•PVC and XLPE cables are built of insulation made of polymers

Advantage of XLPV cables over other type of Cables

- Higher current rating
- Higher short circuit current rating
- Longer service life
- Can withstand 130° c for short time
- Low dielectric loss
- The resistance to acids, alkalies are good

Presently XLPE cables are used extensively for high tension and low tension work .even for distribution work at 3 p 415V industry is using XLPE

Multi-strand cables

- More flexible and durable so can be handle conveniently
- More heat radiating capacity
- Skin effect is less
- The no of strands in the stranded cable must be 3,7,19,37,61,91 and so on
- The size of cables is given in various manner

  3/20 , 19/1.12mm and 19.34mm

Energy meter

- The electrical energy meter is essentially a small electric motor
- AC energy meter are of induction type and are further classified as single phase , three phase three wire and three phase four wire
- These are of current rating of 2.5,5,10,25,50 and 100 amperes and of voltage rating 240 V (single phase) and 415 V (three phase) commonly used for domestic and power wiring
- The meters used on 11kv and above are connected through CT and PT these meters are doubly earthed

Main switch

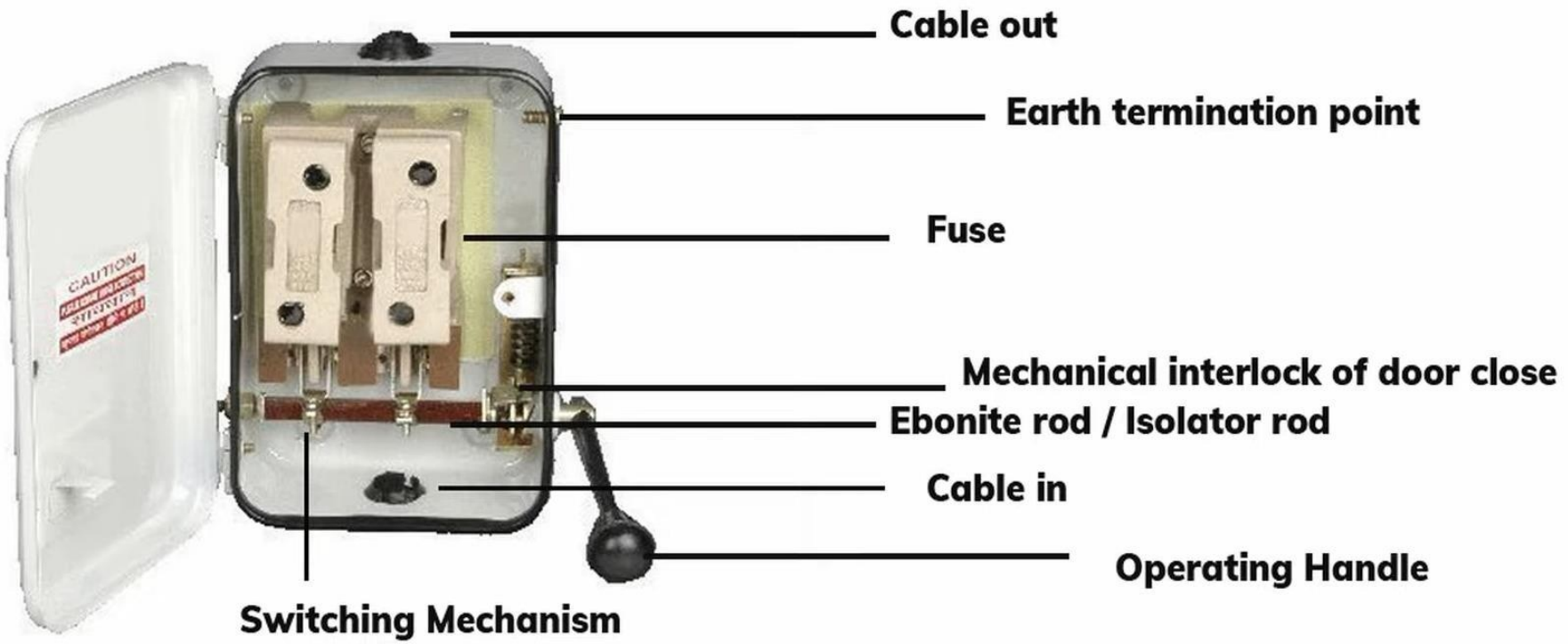
- As per IE rule 50 a suitable linked switch is to be provided immediately after the meter board and a suitable cut out must be provided after the linked switch to protect the circuit against excessive current

- switch fuse(main switch + fuse) is a combined switch and is known as Iron clad switch E.g. : DPIC,TPIC,TPNIC

- Since no fuse is provided in neutral(IE rule 32) in DPIC switch one fuse carrier is furnished with fuse element and other with thick copper wire.

Main switch

ICDP Switch : Iron Clad Double Pole Swtich

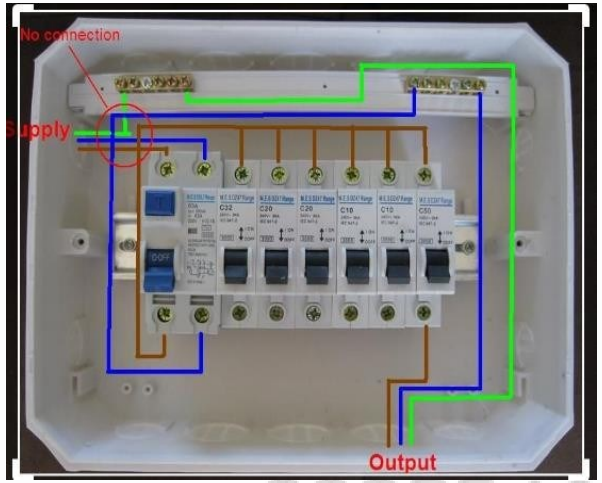


Distribution board

- Distribution board is an assembly of parts including one or more fuses or circuit breakers, arranged for the distribution of electrical energy to various circuits or other distribution boards known as sub main distribution boards.
- The no of ways depends upon the circuits or sub-circuits to be fed

3 Phase DB

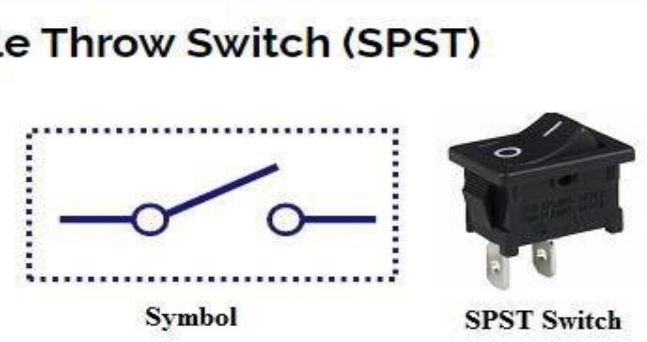
Single Phase DB

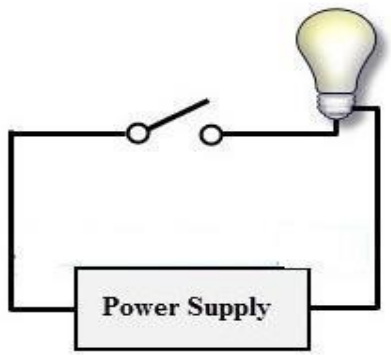


Lighting Accessories

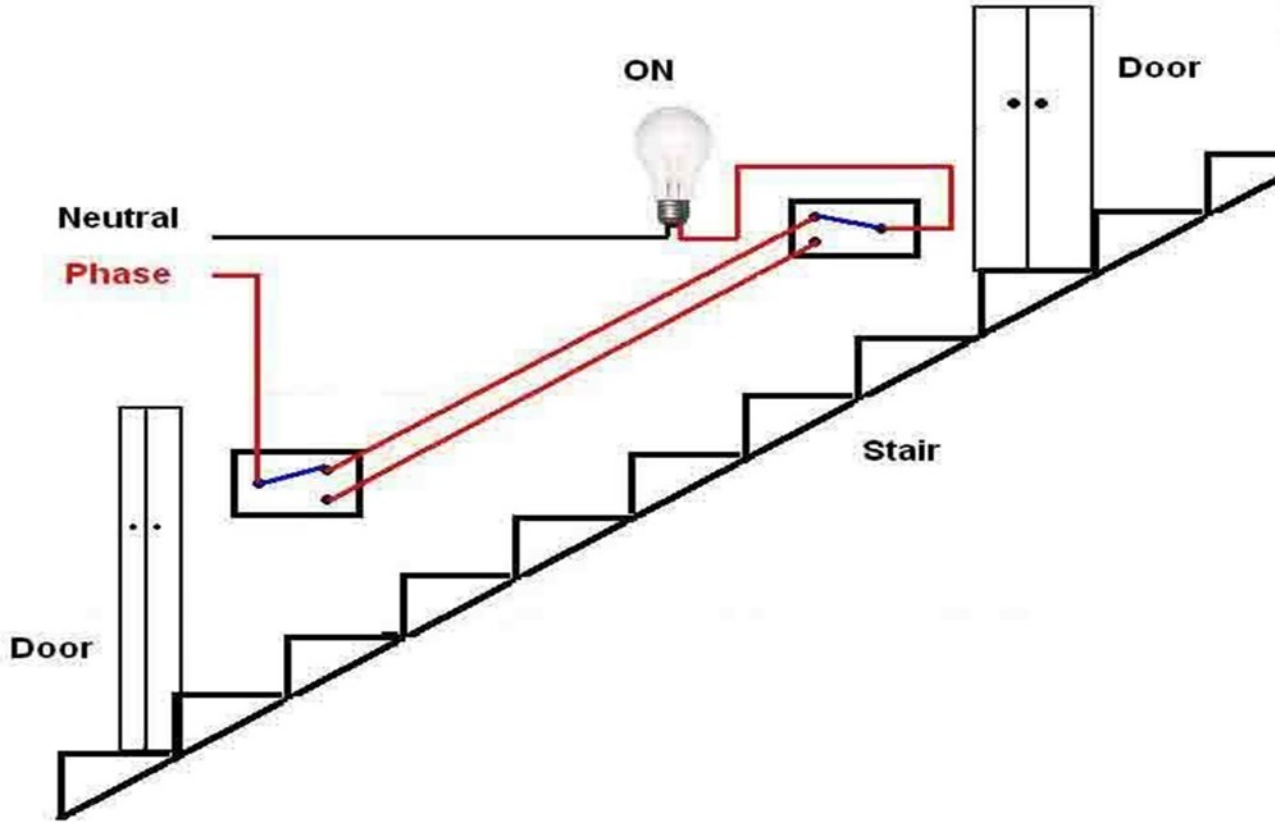
Functional switches

One way switch

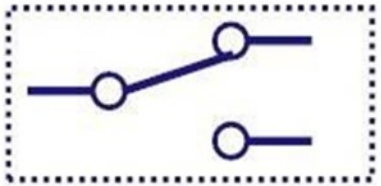




Two way switch

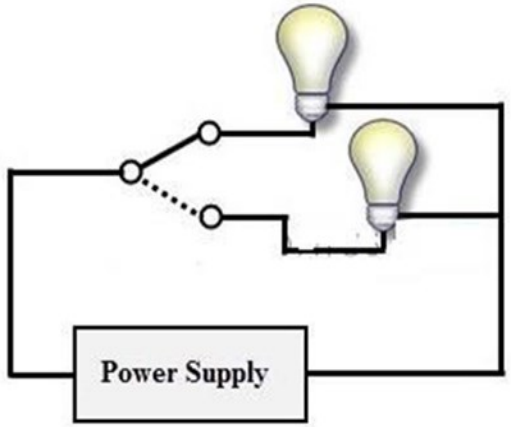


Single Pole Double Throw Switch (SPDT)



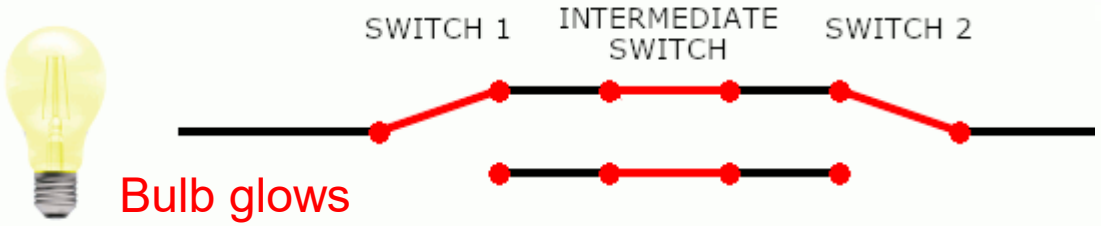
Symbol

SPDT Switch

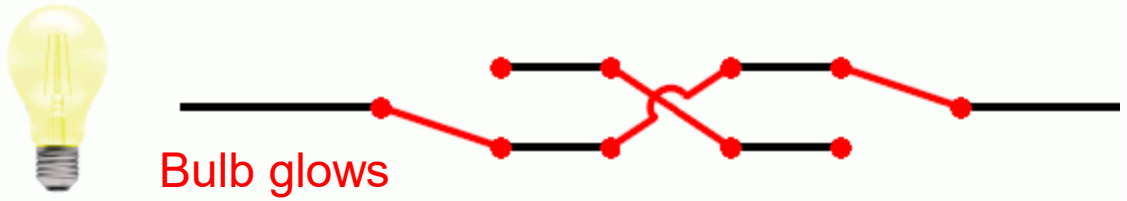


SPDT Switch Circuit

Intermediate switch



Bulb glows



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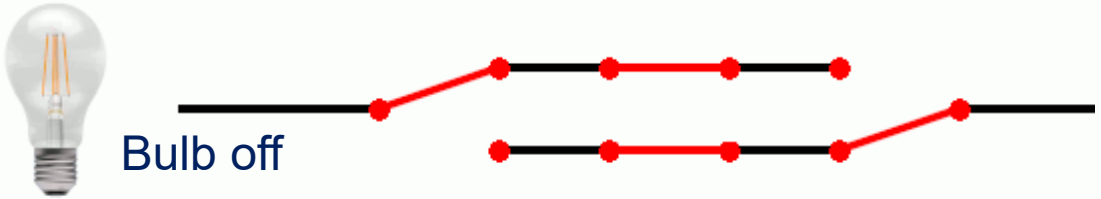

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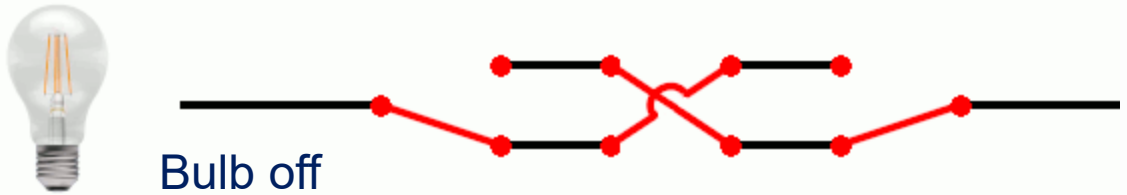

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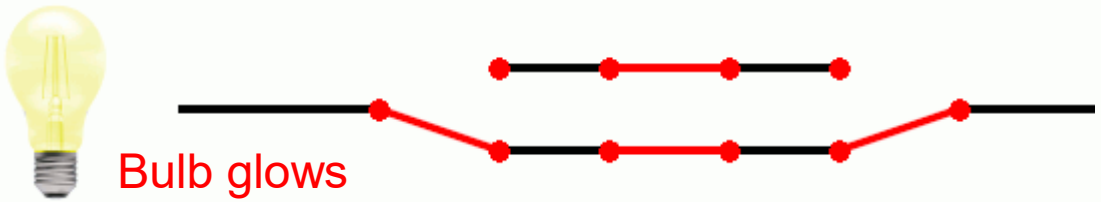

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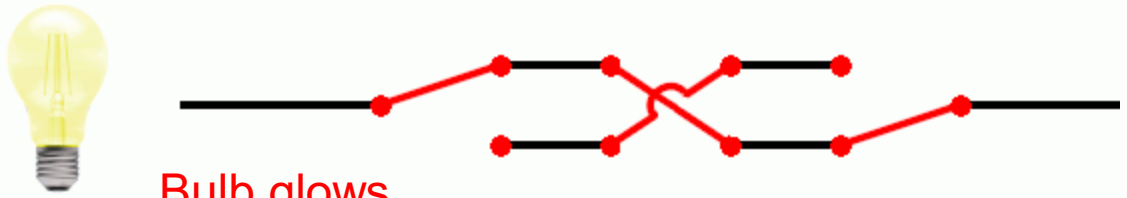

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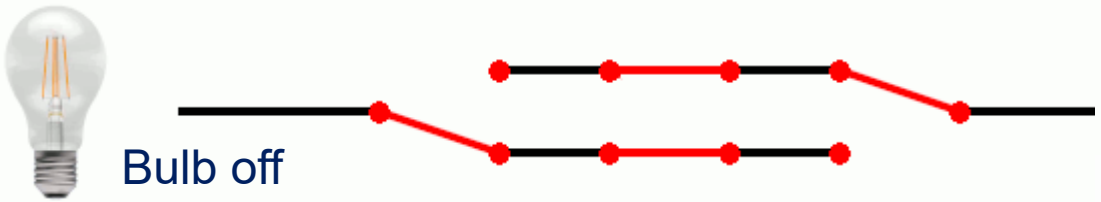

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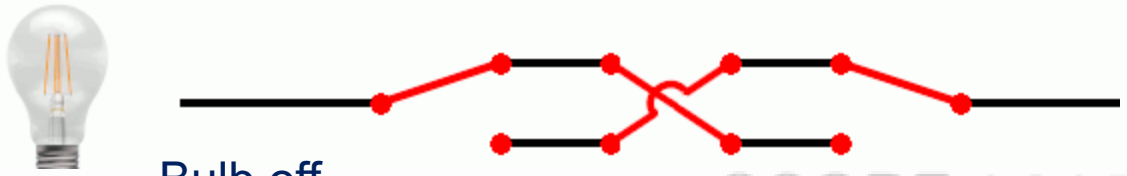

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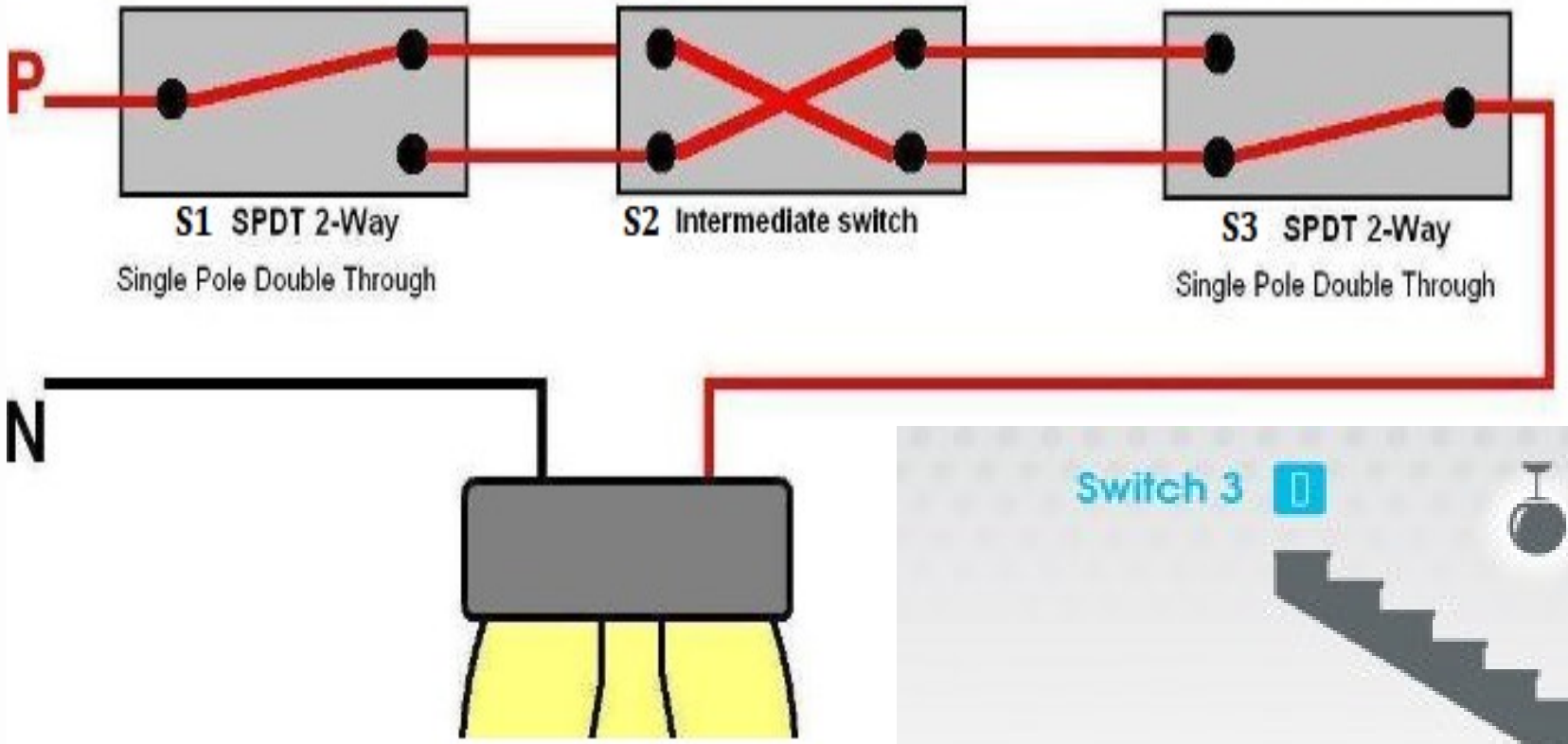

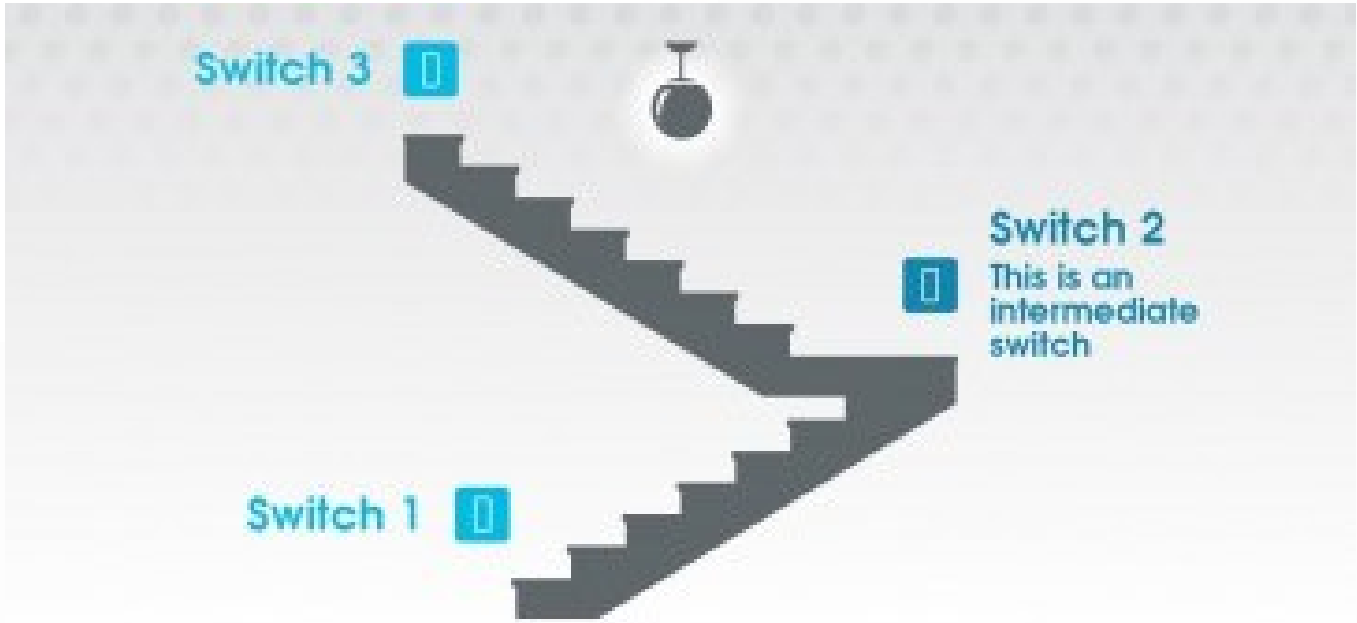

Intermediate Switch wiring

Knife switch

- Composed of a hinge which allows a metal lever, or knife, to be lifted from or inserted into a slot or jaw

  The hinge and jaw are both fixed to an insulated base, and the knife has an insulated handle to grip at one end

- Used commonly in the past

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Socket outlets

Plugs

Ceiling Rose

- Base
- Cover

loop-in ceiling roses, which also include the functionality of a junction box.

Lamp holders

Lamp holders type -may be either brass or Bakelite

According to the size of the lamp holders there are three types

1. Bayonet cap(BC)- up to 200 watts
2. Edison Screw(ES)- up to 300 watts
3. Goliath Edison screw- above 300 watts

Bayonet cap

Edison Screw

Goliath Edison Screw

- **Batten Holder:** This type of lamp holder is fitted directly on the wooden board, which itself is fixed on the wall. The lamp is then supported in the batten holder

- **Pendant Holder:** When the bulb is to be suspended from the ceiling rose, this type of holder has to be used for holding the lamp

- **Angle Holder:** Angle holders are used when the light of the lamp is needed at a certain angle. These are directly fixed to the walls

- **Bracket Holders:** These are used where direct light is needed in the room. These are also used on table lamps. Brackets used with such type of holders are made of brass material

- **Watertight Bracket Holder:** These are provided with tubular glasses with watertight covers. These are mainly used for street lighting. They are also used for supporting bulbs outside the house premises

Protective Device for Wiring Installation & Motors

Fuses

- Simplest and cheapest device used for interrupting an electrical circuit under short circuit or excessive overload.
- Action of fuse based upon the heating effects of electric current.
- Under normal operating conditions it is designed to carry the full load current.
- If the current increases beyond this designed value due any of the reasons mentioned above, the fuse melts isolating the power supply from the load.
- Inverse time –current characteristics enables its use for overload protection

- Fuses are used almost exclusively for the protection of cables in low voltage light and power circuits
- for transformers of rating not exceeding 200kva in primary distribution system and for motor protective fuse.

Characteristics of Fuse Material

- Low melting point
- Low ohmic losses
- High conductivity
- Lower rate of deterioration

Fuse Element material

- The materials commonly used for fuse elements are tin, lead, silver, copper, zinc, aluminium and alloy of lead and tin.
- Alloy of lead(37%) and tin(63%) is used for small current rating fuses(say not beyond 15A)
- beyond 15A tinned copper wire fuse are employed.
- Zinc (in strip form only) is good if a fuse with considerable time- delayed is required.
- fuse is provided only in phase or live pole never on neutral pole.
- The safe current of fuse wire is independent of its length.

Fuses

- Fusing current- minimum value of current at which the fuse element or wire melts
- For round wire the approximate value of fuse current is I= kd where k is fuse constant
  fusing current depends on various factor such as
  1. Type of material used
  2. The X-sectional area(round or rectangular) length ,Diameter
- Fusing factor=minimum fusing current/current rating of fusing element
- Cut off factor- the time taken by a fuse to interrupt the circuit in fault
- Fusing current for a stranded fuse will be less than the product of the fusing current for one strand and the no of strands
- For a Rewirable fuse which employs copper wire as the fuse element ,fusing factor is equal to 1.9 to 2
- Rewirable or kit-kat type fuse is most commonly used in house wiring
  Standard rating are 6, 16,32, 63, 100A

Types of fuses

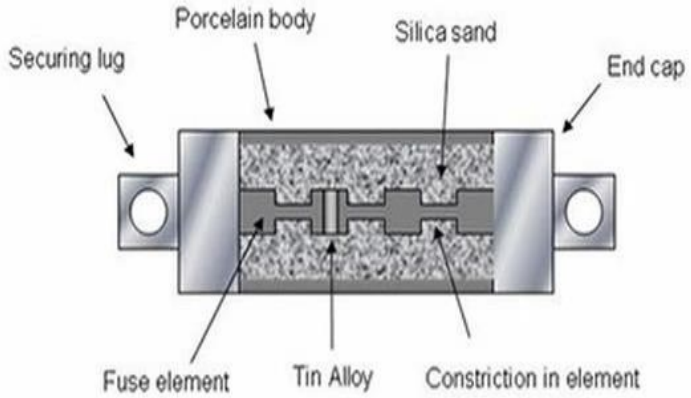
- Supply main fuse -This fuse is provided by supplier and is fixed just after the service meter and sealed by him. The rating of this will be as per load current of the consumer
- Consumer main fuse - This is another fuse of rating slightly less than that of supply main fuse provided by supplier and placed after the consumers main switch
- Sub circuit fuse - a separate fuse is provided for each branch circuit
- Point fuses - In good quality indoor wiring of building , every light and plug point is provided with its individual fuse is known as point fuse

HRC fuse(High rupturing capacity)

- Low voltage HRC fuses are used in the area of main DB's in low voltage networks where there is high prospective short circuit current
- HRC fuses may be rated to interrupt current of 120 kA

Advantages of HRC fuse

- It clears high as well as low fault currents
- Do not deteriorate with age
- Having high speed operation
- Require no maintenance
- Cheaper than other circuit interrupting devices with same rating
- Fusing operation is fast without noise and smoke



Disadvantages of HRC fuse

- After each operation they have to be replaced

MCB (Miniature Circuit Breaker)

- MCBs are primarily used as an alternative to the fuse. Unlike a fuse, an MCB operates as automatic switch that opens in the event of excessive current flowing through the circuit and once the circuit returns to normal condition, it can be reclosed

Function

- Protection against overload –currents above the rated value that last longer than what is normal for the application
- Protection against SC faults –During a fault such as a Phase -Neutral or Line fault (Phase-Phase), there are extremely high currents that must be interrupted immediately

- For switching on/off a circuit

MCB(Miniature Circuit Breaker)

- MCBs are compact devices used in distribution boards for the protection against overload and short circuit
- Overload protection is achieved by thermal trip mechanism using a bimetallic strip
- Short circuit protection is achieved by electromagnetic trip mechanism
- When MCB is in the ON position, current passes through a solenoid coil and a bimetallic strip
- When an overload condition persists for few seconds, the bimetallic strip bends and triggers the trip mechanism
- When a short circuit occurs, the circuit should open immediately, but the bimetallic strip does not respond quickly
- Then the solenoid attracts plunger and thus triggers the trip mechanism

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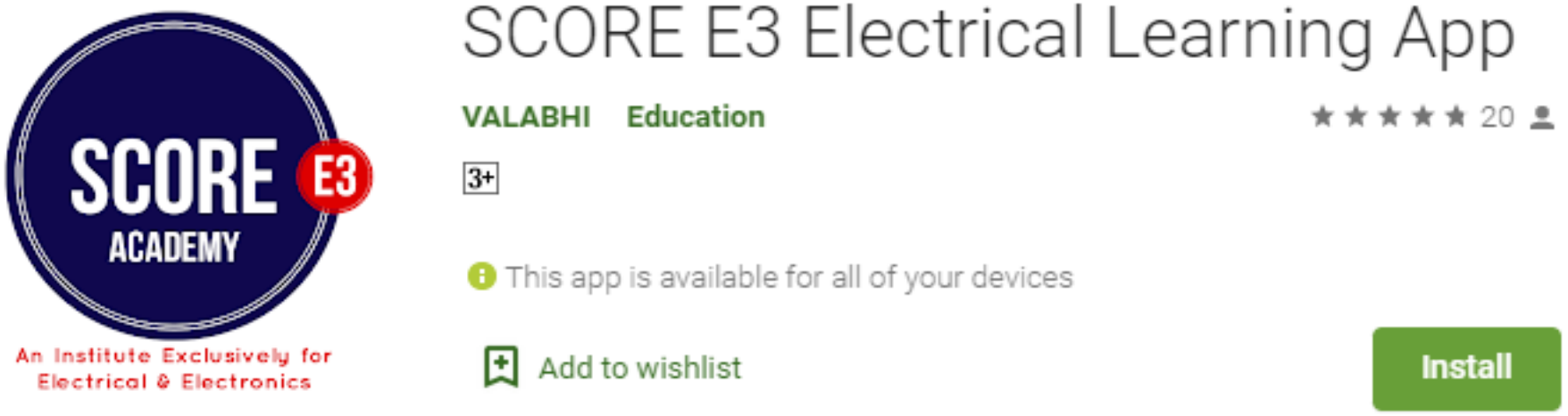

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Types of MCBs

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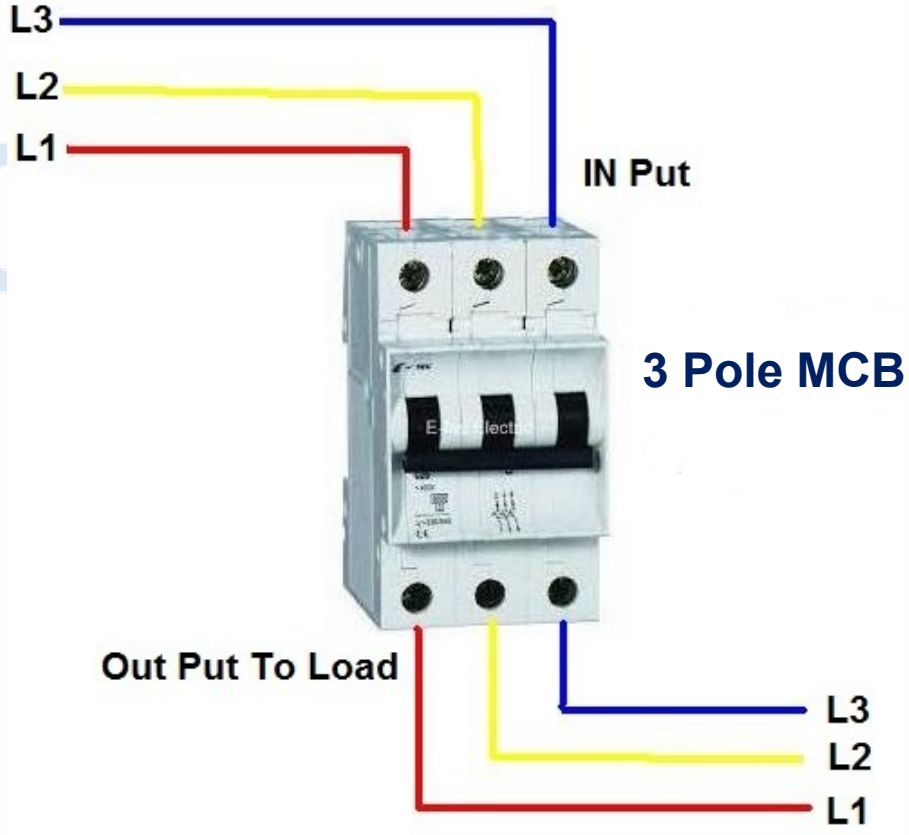
Single pole MCB

Double pole MCB



3 Pole MCB

TPN (Triple pole with Neutral) MCB

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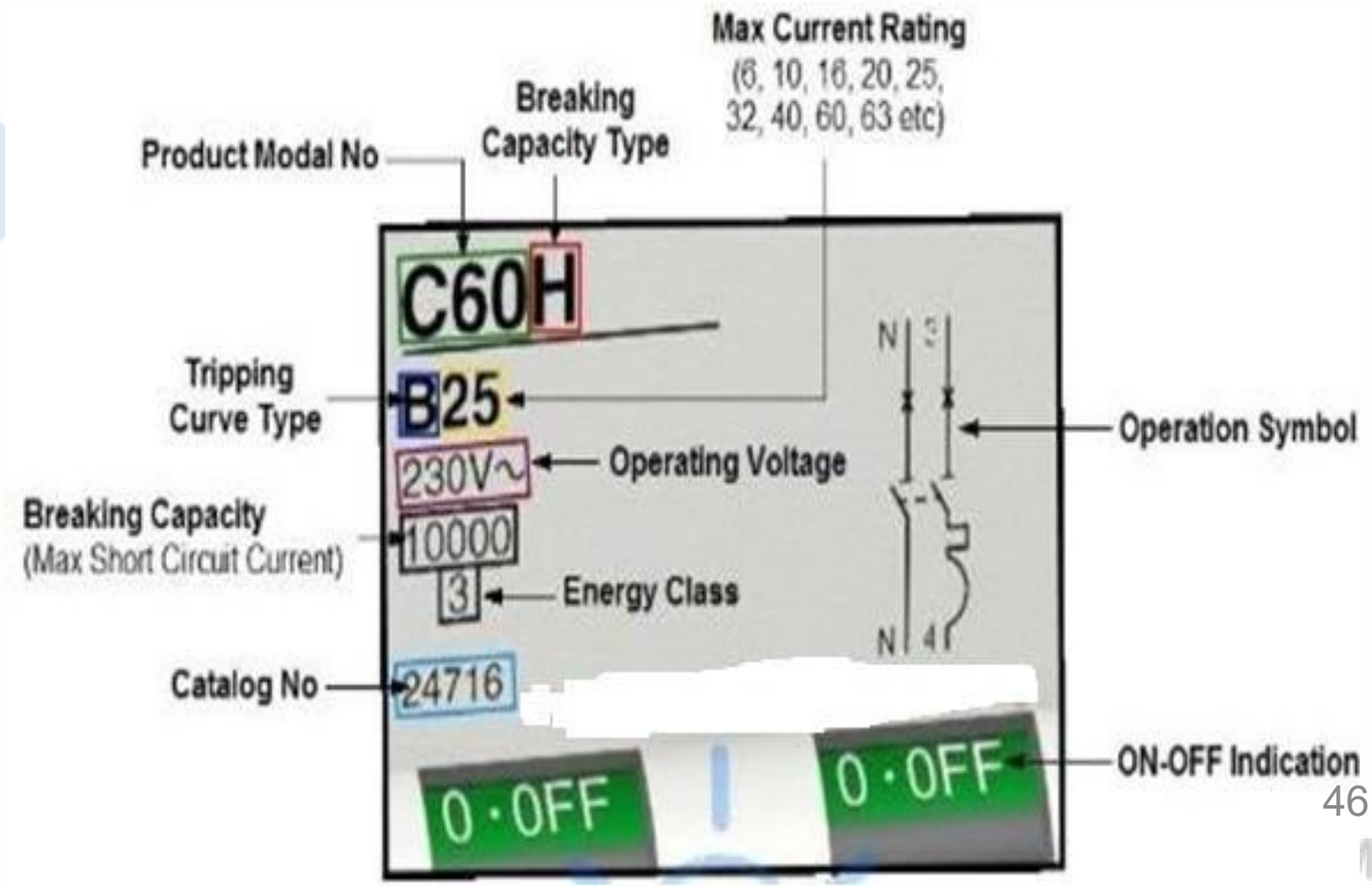
MCB



Specifications of MCB

- Current rating-Amperes(A)
- Short Circuit Rating - KiloAmperes (kA)
- Operating Characteristics-B,C,D etc
- Rated current of MCB is the threshold value above which it will trip

  MCBs are usually available in the range of 0.5A to 100A

- An MCB's Short-circuit rating is given in Kilo Amps(kA) & this indicates the level of its ability to work
- For example a domestic MCB would normally have a 6kA fault level, where as one used in an industrial application may need a unit with a 10kA fault capability

Classification of MCBs

Type B MCB

- This type of MCB trips between 3 and 5 times full load current
- Type B devices are mainly used in residential applications or light commercial applications. Mainly with resistive elements

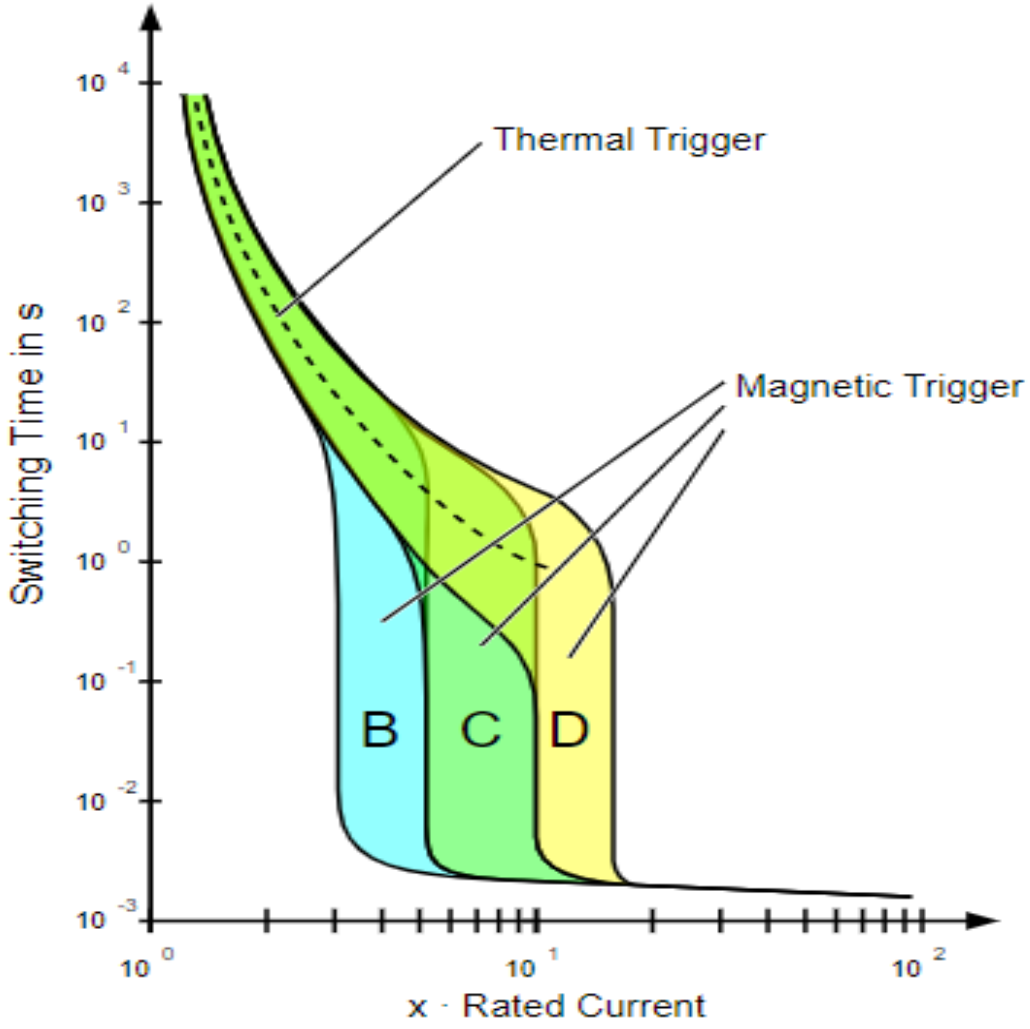
Type C MCB

- This type of MCB trips between 5 and 10 times full load current
- This is used in commercial or industrial type of applications where there could be chances of higher values of short circuit currents in the circuit
- The connected loads are mainly inductive in nature (e.g. induction motors)

Type D MCB

- This type of MCB trips between 10 and 20 times full load current.
- These MCBs are use in specialty industrial / commercial uses where current inrush can be very high. Examples include transformers or X-ray machines, large winding motors etc.

Operating Characteristics of MCB



Type	Tripping Current	Operating Time
Type B	*3 To 5 times the full load current*	0.04 To 13 Sec
Type C	*5 To 10 times the full load current*	0.04 To 5 Sec
Type D	*10 To 20 times the full load current*	0.04 To 3 Sec
Type K	*8 To 12 times the full load current*	<0.1 Sec
Type Z	*2 To 3 times the full load current*	<0.1 Sec

Type K	The protection of loads that cause frequent short duration (approximately 400 ms to 2 s) current peaks in normal operation.
Type Z	For the protection of loads such as semiconductor devices or measuring circuits using current transformers.

Classification of MCBs

- L-Series MCB for Lighting Circuits: Suitable for resistive Load installation with Low & Steady Currents like heaters , ovens, geysers, electric irons , etc. The L-Series MCB's are also used for protection of distribution equipment like wires, Cables, metering equipment etc

- G-Series MCB for Motor Circuits: It is suitable for use in installation with high inrush current peaks which require closer over-load protection. These include inductive Loads such as motors, A.C. transformers , halogen –fluoresent – sodium vapour lamps,machine tools etc

MCCB -Molded Case Circuit Breaker

- The main distinctions between molded-case and miniature circuit breaker are that the MCCB can have current ratings of up to 2,500 amperes, and its trip settings are normally adjustable
- An additional difference is that MCCBs tend to be much larger than MCBs

Difference between MCB and MCCB

Characteristics	MCB	MCCB
Full form	Miniature Circuit Breaker	Molded Case circuit breaker
Rated current	6A to 100A	10A to 2500A.
Interrupting rating	Up to 18KA	10KA to 200KA
Trip Mechanism	Thermal / Magnetic	Thermal / Magnetic / Electronic
Size	Small	Large
Application	Indoor Type	Indoor / Outdoor Type
Trip characteristics Settings	Not adjusted	Fixed /Adjustable
Suitable for	Low current circuits (homes, shops, school and offices).	High power rating i.e. commercial and industrial use

Earth Leakage Circuit Breaker ELCB	SCORE ACADEMY Residual Current Circuit Breaker RCCB
Old technology	Latest technology
Voltage operated device – operate only when voltage is sensed across sensing coil connected to the earth conductor	Current operated device- Operate when there is residual current (difference between phase current and neutral current)
Provides protection from Indirect earth fault only, that is why no longer in use	Provides protection from both Direct & Indirect earth fault
	Residual Current Sensitivity – 10mA, 30mA, 100mA, 300mA, 500mA, 1000mA

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ELCB

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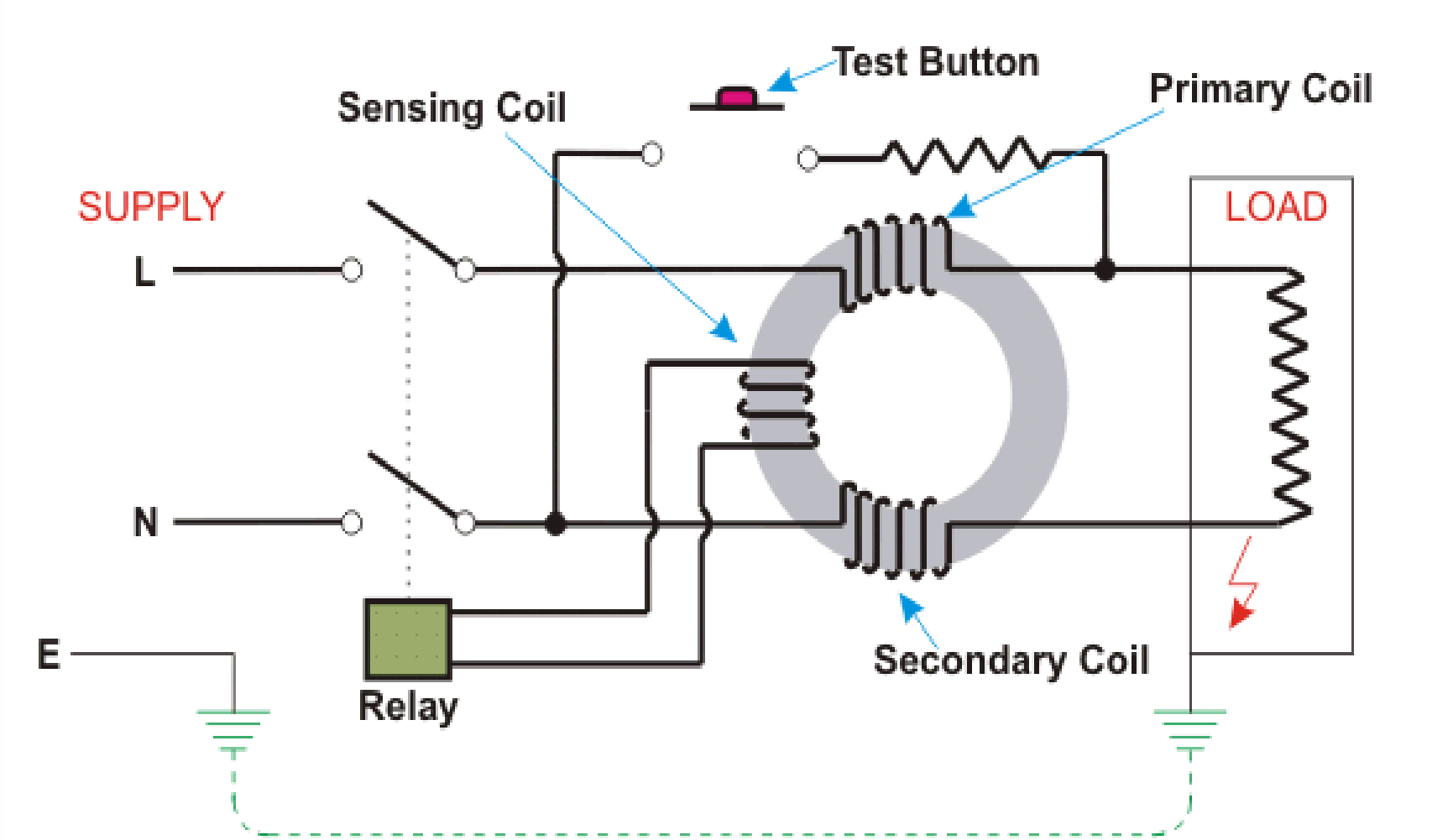
RCCB

SINGLE PHASE RCCB - Internal Diagram



Three phase RCCB

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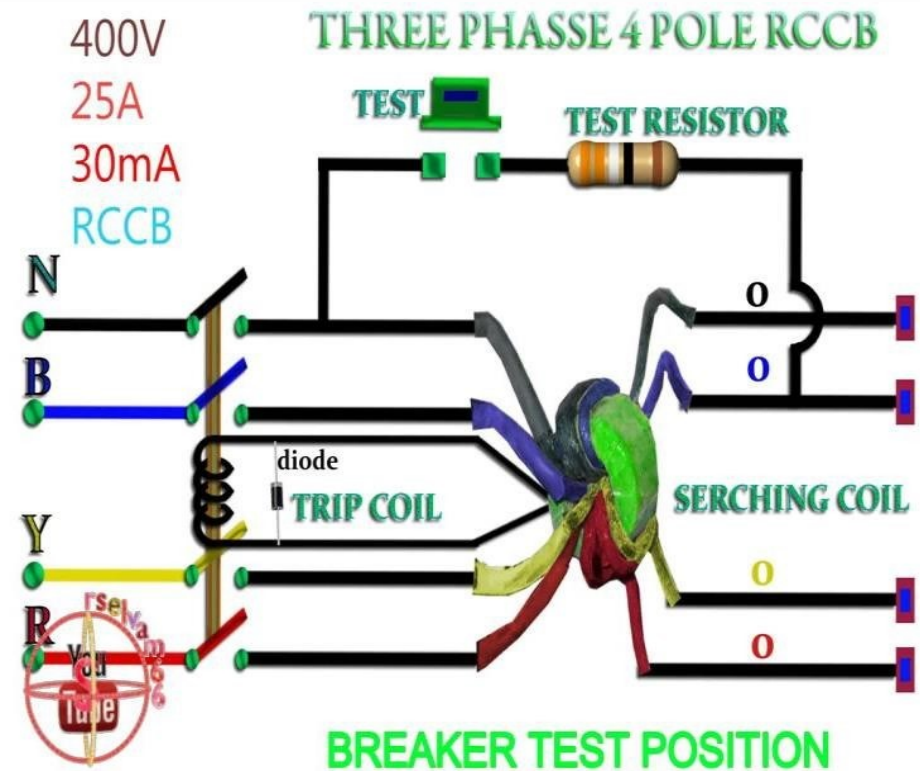

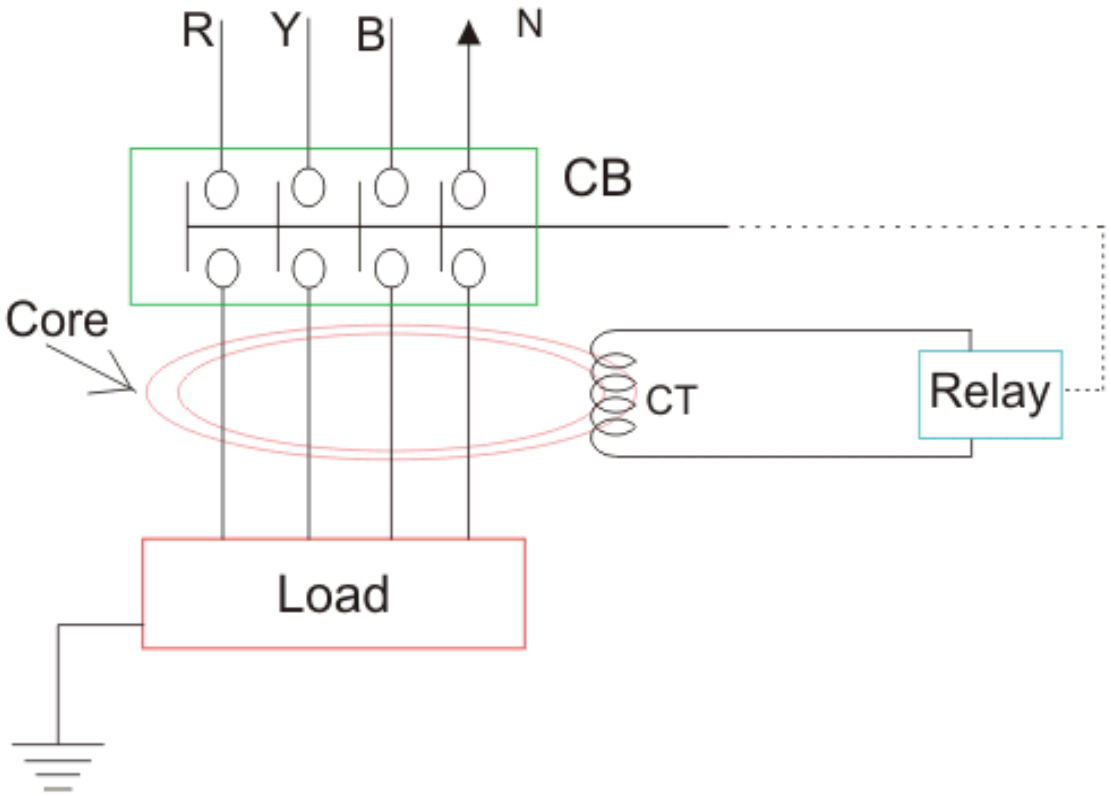

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RCBO(Residual Circuit Breaker with Overload)

- RCCBs don't offer protection against current overloads
- It is now possible to get an MCB and RCD in a single unit, called an RCBO
- RCBOs are commonly used in applications where there is the need to combine protection against over current (overload and short-circuit) and protection against earth leakage currents

Device	Full Form	Purpose
MCB	Miniature Circuit Breaker	Over current/Short circuit protection
MCCB	Molded Case Circuit Breaker	Over current/Short circuit protection
ELCB	Earth Leakage Circuit Breaker	Earth leakage protection
RCCB	Residual Current Circuit Breaker	Earth leakage protection
RCD	Residual Current Device	Earth leakage protection
RCBO	Residual-Current circuit Breaker with Overcurrent protection	Earth leakage protection + Over current protection + Short circuit

Effects of electrical current on the human body

Current	Reaction
1 mA	Just a faint tingle
5 mA	Slightly shock felt. Disturbing but not painful
6-25 mA- women	Painful shock , muscular control is lost.
9-30 mA- men	
50-150 mA	Extremely painful shock, respiratory arrest, severe muscle contraction. Death is possible

Questions Set-2

1. The third pin of the three pin plug connection for household electrical equipments provide
   a) check for phase and neutral connection
   b) more efficiency for the equipment
   c) return path for the current
   d) safety for the operator

2. The safe current of fuse wire is independent of .
   a) Area of cross section
   b) length
   c) resistivity
   d) Diameter

3. Fuse wire is prepaid using .
   a) copper
   b) aluminium
   c) Tin & lead
   d) silver and iron

4. In a 3 pin plug the earth pin is long and have a more diameter than other Paints it is:
   a) Easy to manufacture
   b) To contact earth pin first
   c) to avoid loose connection
   d) to make attractive

5. One lamp can be controlled from five locations by using intermediates switches and two way switches. How many numbers of intermediate switches and two way switches are required to control a lamp from 5 positions?
   a) Intermediate switches 2 and two way switches 3
   b) Intermediate switches 4 and two way switches 1
   c) Intermediate switches 1 and two way switches 4
   d) Intermediate switches 3 and two way switches 2

6. A staircase point is operated with -------switch
   a) two one-way switch
   b) two intermediate switch
   c) two-two way switch
   d) three -one way switch

7. Elcb are specially used to disconnect the supply in - condition
   a) short-circuit
   b) open circuit
   c) ground or earth
   d) overload

8. ICTP switches are usually rated for------
   a) current
   b) voltage
   c) power
   d) current and voltage

10. stranding of cables is done to
   a) increase flexibility
   b) decrease the x sectional area
   c) increase internal resistance
   d) none of the above

11. The size of ceiling fan is generally determined by
    a) sweep
    b) length of the blade
    c) no of the blades
    d) weight of the motor.

12 Pick out the odd one of the following
    a) electronic energy metre
    b) RCCB
    c) MCCB
    d) ELCB

13. In 19/2.24 cable the number 2.24 stands for
    a) SWG no
    b) area of each strand in mm
    c) diameter for each strand in mm
    d) no of stand

14. For isolating 3 phase supply, which type of main switch is used
    a) ICDP
    b) ICTP
    c) cut out
    d) intermediate switch

15. what factor is the basics of selecting a switch
    a) its current rating
    b) its voltage rating
    c) frequency of supply
    d) its power rating

16. The resistance of 100 meter length of copper wire of 14 SWG is 'x' ohms. the resistance of hundred meter of copper wire of 8 SWG will be
    a) more than 2x ohms
    b) equal to x ohms
    c) more than x ohms
    d) less than x ohms

17. For controlling a lamp from more than two places independently the switch used is
    a) knife switch
    b) two way switch
    c) single pole switch
    d) Intermediate switch

18. When two strands of fuse wire are twisted together when the fusing current of the combination will be
    a) Less than the sum of individual fusing currents
    b) More than the sum of individual fusing current
    c) Less than the fusing current of one fuse wire
    d) Equal to the sum of individual fusing current

19. Fuse in a circuit provides protection against
    a) open circuit
    b) short circuit
    c) open circuit and short circuit
    d) over load and short circuit

20. The fuse should have
    a) Low resistance and high melting point
    b) high resistanc eand high melting point
    c) low resistance and low melting point
    d) high resistance and low melting point

21. The sweep of ceiling fan is determined by
    a) Length of the blade from fan centre
    b) the distance between adjacent blade tips
    c) distance between adjacent blade tips
    d)the diameter of the circle formed by the blade tips of fan

22. in MCB over load tripping is executed by
    a) magnetic coil
    b) overload coil
    c) bimetalic strip
    d) solinoid

23. ELCB works on the principle of
    a) over load current
    b) sc current
    c) residual current
    d) neutral current

24. Which of the following wires will have the least diameter
    a) 1 SWG
    b)10 SWG
    c) 16 SWG
    d) 40SWG

25. If strands are twisted, then fusing current will
    a) Increase
    b) Reduce
    c) Remain same
    d) May increase or decrease

26. Fusing factor is defined as the ratio between
    a) Maximum fusing current and rated voltage
    b) Maximum fusing current and rated current
    c) Minimum fusing current and rated current
    d) Minimum fusing current and rated voltage

27. For a current upto 10A which material is used as the fusing element?
    a) Copper
    b) Silver
    c) Alloy of lead and tin
    d) Zinc

28. The rating of fuse is expressed in terms of

a) Ampere
b) volt
c) VAR
d) kVA

29. What is the fusing factor for rewireable fuse?

a) 1.1
b) 1.4
c) 2.1
d) 2.5

30. What is the term for the time taken by a fuse to interrupt the circuit in fault?
    a) Time factor
    b) Fusing factor
    c) Cut-off factor
    d) Fusing current

31. Which type of lamp holder is used for the lamps above 300 watts?
    a) Edison screw holder
    b) Goliath screw holder
    c) Angle holder
    d) Bracket holder

32. The quantity of current gives just bearable shock to a normal human body is

    a) between 15 – 20 mA
    b) between 1000– 200 mA
    c) between 8 – 15 mA
    d) between 1 – 8 mA

33. Which type of load is protected by the L-series MCB?

a) Motors
b) Geyser
c) Hand tools
d) Air conditioner

34 What is the purpose of the flexible cords in domestic wiring?

a) Concealed wiring
b) Permanent connection
c) Run cable through holes in ceiling
d) Connection for transportable appliances

35. Which type of circuit breaker is used above 100 A current rating?

a) Miniature Circuit Breaker (MCB)
b) Earth Leakage Circuit Breaker (ELCB)
c) Moulded Case Circuit Breaker (MCCB)
d) Residual Current Circuit Breaker (RCCB)

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36. What is the purpose of tin coating on copper fuse wire?

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a) Withstand high temperature
b) Increase the fusing factor
c) Prevent oxidation of copper wire
d) Increase the mechanical strength

37. Where the Iron Clad Double Pole (ICDP) main switch is used?

a) Large industrial installations
b) Control main or branch circuits
c) Single phase domestic installations
d) Three phase power circuit installations

38.What is the purpose of the fuse cut out provided at the incoming power supply?

a) To ensure the line is not over loaded
b) To maintain the stabilized supply voltage
c) To protect the circuit from the leakage current
d) To protect the human beings from electric shock

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39. Which electrical equipment is provided with 'L' series MCB?
    a) General lighting
    b) Motors
    c) Air conditioner
    d) Halogen lamp

40. Which is the application of DC series MCB?
    a) 1 p AC motor
    b) 3 p AC motor
    c) Locomotives
    d) Air conditioners

41. Which type of conduit used for gas tight explosive installation?
    a) Flexible conduits
    b) Rigid steel conduits
    c) Rigid non-metallic conduits
    d) Flexible non-metallic conduits

42. What is the function of circuit breaker?
    a) Making contact at normal condition
    b) Making contact at abnormal condition
    c) Breaking automatically at abnormal condition
    d) Physical breaking contact at abnormal condition

43. What is the function of bimetallic strip in MCB ?
    a) Over load protection
    b) Short circuit protection
    c) Over voltage protection
    d) Earth leakage protection

44. Which types of accessories are used to operate a portable appliance?
    a) Safety accessories
    b) Holding accessories
    c) Outlet accessories
    d) Controlling accessories

45 Which type of accessories of fuse is comes under?

a) Controlling accessories
b) Holding accessories
c) Safety accessories
d) Outlet accessories

46.What is the effect of low current rated cable used to connect higher current load?

a) Voltage drop increases
b) Load current increases
c) Voltage drop decreases
d) Cable damage due to heat

47. What is the advantage of stranded conductor over solid conductor?

a) Cost is less
b) More flexible
c) Less voltage drop
d) More insulation resistance

48.Which electrical equipment 'L' series type MCB's are used?

a) Oven
b) Locomotives
c) AC motors
d) Air conditioners

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