Electrical Maintenance
Std- XII\textsuperscript{th}
Wires:

They form necessary connections between the supply source and the apparatus which uses it. The necessary requirements of wires are that it should conduct electricity efficiently, cheaply and safely.

Types of wires:

1. V.I.R. (Vulcanized Indian Rubber) Wire
2. Lead sheathed Wire
3. CTS or TRS (Cab Tyre Sheathed or Tough Rubber sheathed) Wire
4. Weather proof Wire
5. Flexible wires.
6. P.V.C. wires

I] V.I.R. or S.B.R.C. (single Braid Rubber covered):

![V.I.R. Wire Diagram]

a) In this type of wire, single tinned copper or aluminum conductor is used. Tinning of conductor prevents the sticking of rubber to the conductor. Conductor is covered with a layer of rubber insulation.

b) Over this rubber insulation is put up a cotton-protective braid which is usually saturated with flame retarding and moisture resistant compound.

c) Finally it is finished with wax for cleanliness and helps pulling action of it into the conduits.

d) Thickness of rubber insulation depends upon the voltage for which wire is required; they are available for 250 V or 600V.

II] Lead sheathed wire:

![Lead sheathed Wire Diagram]

a) Ordinary V.I.R. wires are specified for dry locations.

b) In order to use rubber insulated wire in damp conditions, the ordinary rubber wires are covered with continuous sheath of lead.

c) Lead covering is about 1.25mm thick.

d) Mechanical protection is good but wires are heavy and costly.
III] C.T.S or T.R.S Wire:

a) Ordinary wire is provided with rubber insulation is not water resistant.
b) But T.R.S. wires are provided with tough rubber compound which does not deteriorate even after long exposure to moisture.
c) It can be used in wet locations

![C.T.S or T.R.S Wire Diagram]

IV] Weather Proof Wire:

a) Such type of wires consists of three layers of fibrous yarn provided over Cu conductor.
b) Before these braids are applied conductors are saturated with waterproof compound.
c) It is used for outdoor purposes, since it can withstand rain, sunlight, chemical action.
d) They are resistant to atmospheric variation.

![3 Layers of Fiberous Material Diagram]

V] Flexible Wires:

a) Wires used for household appliances are very flexible.
b) Flexible wires consist of thin hair like conductors grouped together.
c) Flexibility is required firstly from the point of view of handling the equipment and secondly to prevent wires from break.
d) Generally sizes of wires are “14/0.0076 or 162/0.0076”
   162/0.0076”
   0.0076 inches or 0.1930 mm
   It means 14 or 162 strands of Cu conductors having diameter 0.0076 inch.

VI] PVC Wires (Poly vinyl chloride):

a) A modern thermoplastic material which is often used as an alternative to rubber.
b) It resists chemical action.
c) It resists adverse climate conditions.
d) It is lighter in weight.
e) It offers mechanical protection.
f) It has a tendency to crack at low temperature and soften at high temperature.

**WIRING ACCESSORIES**
1. SWITCHES
2. LAMP HOLDER
3. CEILING ROSE
4. SOCKET OUTLET
5. PLUG
6. DISTRIBUTION BOX
7. FUSE
8. WIRES

1. **SWITCHES**: A switch is a mechanical device used to make or break the electrical circuit contacts. A switch should so operate that it should make the contact firmly and break the contact instantaneously. For this action there is a spring provided to the movable blades. A switch can perform mainly two functions- ON, by closing its contacts, or fully OFF, by opening its contacts. When contacts are closed, it creates a path for the current to flow, and vice-versa, an open contact will not allow the current to flow. In electrical wiring, switches are most commonly used to operate electric lights, permanently connected appliances or electrical outlets.

Types of switches:

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Types of switches</th>
<th>Specification (Lighting Circuits)</th>
<th>Specification (Power Circuits)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Surface switch</td>
<td>5A, 230V</td>
<td>15A, 230V</td>
</tr>
<tr>
<td>2</td>
<td>Piano switch/flush switch</td>
<td>5A, 230V</td>
<td>15A, 230V</td>
</tr>
<tr>
<td>3</td>
<td>Pull switch or ceiling switch</td>
<td>5A, 230V</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Grid switch</td>
<td>5A, 230V</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Rotary switch</td>
<td>5A, 230V</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Push button switch</td>
<td>5A, 230V</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Intermediate switch</td>
<td>5A, 230V</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>Industrial iron clad switch</td>
<td>16A, 32A, 63A, 100A, 200A and so on. 230V, 440V</td>
<td></td>
</tr>
</tbody>
</table>

1. **Surface switch (or Tumbler Switch)**: These switches are mounted on mounting blocks or directly fixed over the surface of the wall. Such types of switches project out of the surface of the wall. They are classified as:

a. **One way/single way switch** - This switch is provided with single pole. It has two contacts, which is a common marked as COM or C. The common is for the live wire that supplies the input voltage to the switch. The other terminal is marked as L1 and is the output to the light fixture.
b. Two way switches - A two way light switch is a simple single pole "changeover" switch with three terminals. These are typically labeled COM, L1, and L2 (Some may label the L1 and L2 positions as "1 Way" and "2 Way"). The advantage of a two-way switch is the ability to control a single device from two separate locations. A convenient and apt use for them is for locations like stairways, a long corridor or a very large room.

2. Piano switch (or Flush switch): These switches are enclosed in wooden board or P.V.C. board recessed into the wall. Switches does not project out. Current carrying parts are not easily accessible.
3. **Pull switches:** Pull switches are fixed on ceiling and all live parts are out of reach of operator. Pull cord is provided with a single pull on the cord for on/off positions. A pull switch is a switch that is actuated by means of a chain or string. An electric pull switch is attached to a toggle type switch. One pulls to switch on and next pull to switch off. The most common use of a pull switch is to operate a ceiling electric light.

4. **Grid switches:** These switches are similar to surface switches, only they are lighter. So, they are useful for portable machines and appliances.

5. **Rotary switches:** These switches consist of an insulated handle to which blades are fixed. These blades move in steps by the movement of handle and make contact with the terminals. A rotary switch is a kind of switch that has a rotating shaft attached to a terminal. That terminal is able to make or break a connection to one (or more) other terminals. Rotary switches may feature different switch positions that can be set by rotating the switch spindle in one or another direction. Some common examples where a rotary switch might be used is in a multi-speed fan or as a band selector on multi-band radios.

6. **Push button switches:** These switches open or close with quick action when pressed. It is used for starting motors or ringing bells. They are widely used in automatic control applications as Normally Open (Start) switch or Normally Closed (Stop) switch.
Push button switches

7. Intermediate switch: This switch has four contacts when dolly is up the top and bottom contacts are bridged and when down, the contacts are cross connected. This kind of switch is used in a hall, go-downs, big rooms, where different lamps are required to turn on and off from different places and in a multistory building, the ground floor or car parking lights can be controlled from any floor.

8. Industrial iron clad switch:
   a. This switch is used as a main switch by consumer to have self control of the electric circuit.
   b. This switches are heavy duty and strong in construction.
   c. This switch is combined with fuses.
   d. Fuses are fitted in iron cover.

Two types are:  
I) I.C.D.P. (Iron clad double pole): It is used in single phase circuit.
II) I.C.T.P. (Iron clad triple pole): It is used in three phase circuit.

For domestic installations switches are designed for
Voltage rating: 230v, 440v
Current rating: 16A, 32A, 63A, 100A, 200A so on
2. **LAMP HOLDER**: A lamp holder is used to hold the lamp required for lighting purpose. Lamp holders are either molded or porcelain interior with a solid or spring plunger and wire terminals. Types are:
   a. Pendant holder
   b. Batten holder
   c. Bracket holder
   d. Edison screw holder.
   e. Fluorescent lamp holder
      (i) Bi-pin type
      (ii) Bayonet caped tube holder
   f. Starter holder
3. CEILING ROSE: A ceiling rose is used to provide a tapping to a pendant lamp holder through a flexible wire or a connection to a fluorescent tube, ceiling fans. Ceiling rose consists of a circular porcelain or Bakelite base provided with two or three terminal plates. To a threaded base porcelain or Bakelite cover is fixed.
4. SOCKET OUTLET: The socket outlets have insulated bases with three terminal sleeves. The two thin terminal sleeves are making connection to the two core cables with the third terminal sleeve thicker in cross section is used for an earth connection.

5A socket outlets are used for lighting circuits.
15A heavy duty is used for power circuits.

5. PLUG: For tapping power from socket outlets three pin plugs are used. The thicker pin is used for earth connection. Three pin 5A for lighting circuits and 15A three pin plugs are used for power circuit.

Round 3 pin 5A plug                  Round 3 pin 15A plug

6. DISTRIBUTION BOX:
   a. Distribution boards are iron-clad and house fuse banks.
   b. Fuses in D.B. can be easily removed.
   c. D.B. is used for splitting the circuit.
   d. For connecting neutral, D.B. is provided with neutral link.
7. **FUSE:** It is a safety device connected in series with the phase wire. When current exceeds its normal rated value, the fusing element in the fuse melts and breaks the circuit. The fusing element is made of lead-tin alloy, copper or silver. Following are the types of fuses:

![Diagram of fuse types]

- **Rewirable [semi enclosed]**
  - Round type fuse or cut out
  - Kit-Kat fuse
- **NON-Rewirable [totally enclosed]**
  - Cartridge fuse
  - H. R. C. FUSE

8. **CONNECTOR BLOCKS:** It consists of one or more brass connecting barrel with set screws to clamp the wires. It is surrounded by molded blocks of insulated materials like Bakelite and porcelain. The brass barrel is fitted in the connector block.
9. **Adaptors:** When the connections are made from lamp holders, the adaptor is used. It consists of portable fitting temporary in place of fixed brackets, batten or pendent holders. The ends of the flexible chord are connected from back side to the two plates in adaptor which make contact with plunger in lamp holder.
Types of Wiring System:
1. Cleat wiring
2. Batten wiring
   a. C.T.S system
   b. Lead-sheath system
3. Casing & capping wiring
4. Conduit wiring

Cleat Wiring:

1. Wires are supported in porcelain cleats.
2. Cleats are made in two halves. One of which is grooved to receive wire & other is put over it. Whole of it is fixed on wall by means of screws.
3. This system is suitable for temporary purpose.
4. Cleats used should not be more than 60cm apart horizontally or vertically.
5. Sharp bends should be avoided.
6. Spacing of the cleats under the bend should be reduced.
7. When wires are to pass through walls. They must be taken through conduits.
Advantages:
(i) Very cheap.
(ii) Skilled labors are not required.
(iii) Less time required for wiring.
(iv) Recovery of material can be made when wiring is no longer reqd.

Disadvantages:
(i) Cannot be used for permanent job.
(ii) Appearance is shabby due to sagging and collection of dust & dirt.
(iii) Cannot be used in damp places, water-pipes, factories, smithy shop.

Application:
(i) It is used for temporary purpose like Project work.
(ii) Temporary lighting at dry places.

BATTEN WIRING:
1. Lead covered or Metal sheathed
2. C.T.S. type of wiring system

1. Lead covered or Metal sheathed:

1) This type of wiring system consists of rubber insulated conductor covered with an outer sheath of lead alloy containing 95% lead which provides protection from mechanical injury and dampness. Wires are fixed by means of metal clips spaced at regular intervals which must not be more than 30 cm.
2) Metal clips (joint clips) are fixed at an interval of 10 cm horizontally and 15 cm vertically on wooden batten.
3) Lead sheath must be earthed. This is done to avoid electrolytic action due to leakage current, which deteriorate the lead covering.
4) Also earthing provides safety against metal sheath becoming live.

Advantages:
(i) Protection from dampness.
(ii) Fault finding is easy.
(iii) Semi-skilled workers required.
(iv) Mechanical protection is good.
(v) Easy installation
(vi) Cheap in material cost
(vii) Appearance is better.
(viii) Customization is easy
(ix) Less chance of leakage current

**Disadvantages:**
(i) Costly.
(ii) Continuous earth wire should run along with lead wire in case of lead sheathed wiring system.
(iii) Not suitable for outdoor wiring
(iv) Humidity, smoke, steam etc directly affect on wires.
(v) Heavy wires are not recommended for this wiring scheme.
(vi) Only suitable for voltage below 250 V.
(vii) High risk of fire

**Application:**
(i) It is used for domestic work.

2. **C.T.S. type of wiring system:**

a) In C.T.S. types of wiring system, C.T.S. wires are fixed by means of metal clips on wooden beams or perfectly straight and well varnished wooden batten.
b) Metal clips (joint clips) are fixed at an interval of 10 cm horizontally and 15 cm vertically on wooden batten.
c) The wiring should not be given any right angle bend.
d) It is preferred to pass the wire through the conduit pipe when passing through the walls, ceiling or floor.
Advantages:
(i) Life is long.
(ii) Fault finding is easy.
(iii) Semi-skilled workers required.
(iv) Time required for installation is less.

Disadvantages:
(i) Appearance is shabby.
(ii) Fair possibility of fire.
(iii) Maintenance cost more.

Application:-
(i) It is used for domestic work.

2. **CASING AND CAPING:**

1) This system of wiring is most commonly adopted for residential buildings.
2) It consists of rectangular wooden blocks made of teakwood called casing.
3) It has usually 2 grooves, into which wires are led.
4) Casing at the top is covered by means of rectangular strip of wood called capping.
5) Casing and capping are given double coating of varnish.
6) Nowadays, PVC casing capping system is used. It is more durable, less time required, cost is less & light in weight.
7) Points to be considered while installing such wiring system.
   - Teak wood should be used to avoid trouble of white ants.
   - In 20mm casing max no. of wires should not be more than 8.
   - T-junction boxes, outer & inner corners should be used at proper places.
   - Length of casing is generally 6 feet. Joints of casing and capping should not overlap each other.

**Advantages:**
(i) Life is long.
(ii) Cost is medium.
(iii) PVC capping casing can be used at moist places.
(iv) Mechanical protection is more than cleat & batten wiring.
Disadvantages:-
(i) In wooden casing – capping possibility of fire is more.
(ii) Skilled labors required.

Application:-
(i) It is used for domestic work.

4. CONDUIT WIRING SYSTEMS:

- In this system, VIR or PVC wires are run in tubes called conduits.
- Conduits are of two types:
  (i) Metal conduits are made of galvanized iron or High grade steel.
  (ii) PVC conduits.
- Conduits can be either buried under plaster or can be supported over the walls by means of saddles or pipe hooks.
- Wiring with conduit on surface of walls is known as surface conduit wiring used for workshops.
- Whereas wiring with conduits buried under plaster is called concealed conduit wiring.
- Conduits are generally erected first and wiring is done later.
- Wires are pulled through the conduits with the help of steel wires.
- This drawing of wires is called fishing.
Advantages:
(i) It provides protection against fire due to short circuit.
(ii) It provides protection against mechanical injury.
(iii) It provides protection against moisture, fumes in chemical industry & factories.
(iv) Concealed conduit wiring do not spoil the beauty of premises.

Disadvantages:-
(i) Fault finding is difficult inspection bends are necessary.
(ii) Continuous earth wire should run along metal conduit.
(iii) Skilled workers are required.

Application:-
(i) It is used in chemical industries, workshop and black smith’s shop.

Precautions:
(i) Use High Grade steel pipe for surface conduit, G.I. for concealed conduit & PVC pipe for general purpose.
(ii) Work must be done by the skilled persons.
Earth wire should be continuously run through the conduits.
Appropriate threading must be done not less than 1.5 cm.
Pipes must be properly supported by saddles.
Inspection bends & tees must be used at proper places.

**Selection of wiring:**
Factors affecting wiring:
(i) Durability.
(ii) Safety.
(iii) Appearance.
(iv) Cost factor.
(v) Accessibility.
(vi) Maintenance cost.

**Durability:-** Type of wiring selected should be durable according to the type of building. Ex: Cleat wiring is suitable for temporary purpose.

**Safety:-** While selecting type of wiring one has to look into the safety aspect. Ex: In chemical factory, where fumes are produced, batten or wooden casing capping should not be used.

**Appearance:-** Wiring should not spoil beauty of premises.

**Cost:-** Type of wiring should meet the consumer’s requirement within available resources.

**Accessibility:-** Extension and renewal of wiring should be possible.

**Maintenance cost:-** Maintenance cost should be low.

**COMPARISON TABLE OF VARIOUS WIRING SYSTEMS**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Particulars</th>
<th>Cleat Wiring</th>
<th>Lead sheath</th>
<th>C.T.S system</th>
<th>Casing &amp; Caping</th>
<th>Conduit System</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Life</td>
<td>Short</td>
<td>Long</td>
<td>long</td>
<td>long</td>
<td>Very long</td>
</tr>
<tr>
<td>2</td>
<td>Maintenance Cost</td>
<td>Nil</td>
<td>medium</td>
<td>medium</td>
<td>Medium</td>
<td>Nil</td>
</tr>
<tr>
<td>3</td>
<td>Initial cost</td>
<td>Low</td>
<td>High</td>
<td>medium</td>
<td>medium</td>
<td>Very High</td>
</tr>
<tr>
<td>4</td>
<td>Applications</td>
<td>Temporary purpose</td>
<td>Damp places</td>
<td>House</td>
<td>House, offices</td>
<td>Work- shops, factories</td>
</tr>
<tr>
<td>5</td>
<td>Mechanical Protection</td>
<td>Nil</td>
<td>Good</td>
<td>Fair</td>
<td>Fair</td>
<td>Very good</td>
</tr>
<tr>
<td>6</td>
<td>Possibility of Fire</td>
<td>Nil</td>
<td>Fair</td>
<td>fair</td>
<td>In wooden casing caping: fair</td>
<td>Nil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>In p.v.c. casing Caping: nil</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Protection from Dampness</td>
<td>No</td>
<td>Very high</td>
<td>Good</td>
<td>Wooden: slight</td>
<td>Pvc: good</td>
</tr>
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</tr>
<tr>
<td>8</td>
<td>Type of labour Required</td>
<td>Skilled labours not required</td>
<td>Semi-skilled</td>
<td>Wood: highly skilled</td>
<td>Pvc: semi-skilled</td>
<td>Highly skilled</td>
</tr>
<tr>
<td>9</td>
<td>Appearance</td>
<td>Shabby</td>
<td>Not good</td>
<td>Not good</td>
<td>good</td>
<td>Very good</td>
</tr>
<tr>
<td>10</td>
<td>Accessibility</td>
<td>Suitable</td>
<td>Suitable</td>
<td>Suitable</td>
<td>Suitable</td>
<td>Not suitable</td>
</tr>
<tr>
<td>11</td>
<td>Recovery of Material when Wiring is no Longer required</td>
<td>Possible</td>
<td>Not possible</td>
<td>Not possible</td>
<td>Not possible</td>
<td>Possible</td>
</tr>
<tr>
<td>12</td>
<td>Time require for installation</td>
<td>Very Less</td>
<td>Less</td>
<td>Less</td>
<td>Less</td>
<td>More</td>
</tr>
</tbody>
</table>

- **HOUSE WIRING PROCEDURE:**

  1] Plan or layout is made which decides location of meters, points and switch board.
  2] Energy meter should be installed outside the room.
  3] Main switch should be provided immediately after the energy meter.
  4] Depending upon number of points and their location number of circuits are decided
  5] Proper distribution board is chosen considering the future demand.
  6] Proper fuses and switches at proper places are installed.
- **CONNECTING ONE LAMP ONE SWITCH, INDICATING LAMP AND FUSE IN A CIRCUIT:**

![Diagram 1: One Lamp - One Switch](image)

- **230 V 1φ A.C. Supply**
- **N**
- **P**
- **Fuse [F]**
- **Switch [S]**
- **Indicating Lamp**
- **L**

- **CONTROLING TWO LAMPS INDEPENDENTLY IN A CIRCUIT:**

![Diagram 2: Two Lamps - Two Switches](image)

- **L1**
- **L2**
- **N**
- **P**
- **S1**
- **S2**

Lamp 1 controlled by switch 1
Lamp 2 controlled by switch 2
• **STAIRCASE WIRING (CONTROLING ONE LAMP FROM TWO PLACES):**

![Staircase Wiring Diagram](image)

Lamp can be made 'ON' or 'OFF' by any switch.

**Staircase wiring**

(One lamp controlled from two places)

$S_1$ & $S_2$ = Two way Switches

• **GODOWN WIRING:**

![Godown Wiring Diagram](image)

$S_1$ = One way switch

$S_2$, $S_3$ = Two way switches
**Operation:**

When S1 is made ‘ON’, L1 is light up.

When S2 is operated then L1 is disconnected and L2 is lighted up.

When S3 is operated L2 is switched ‘OFF’ and L3 is lighted up and so on.

Similarly for making the lamps ‘OFF’ in sequence, S3 then S2 and finally S1 are operated.

The wiring is suitable for godown and hence the name given is godown wiring.

- **ONE LAMP CONTROLLED FROM THREE PLACES:**

- **ONE POINT SERIES PARALLEL TESTING BOARD:**

![Diagram](image)
• **TWO POINT SERIES PARALLEL TESTING BOARD:**

![Diagram of two-point series parallel testing board]

So₂ = Series Socket  
So₁ = Parallel Socket  
S₁ & S₂ = One way Switches

• **Before selecting wiring system, following points should be considered:**

1. **Safety**: In workshops, laboratories, factories etc. the wiring must be completely protected from mechanical damage and also be isolated from the operator. Hence conduit wiring is preferred. For moist places, lead sheath wiring is used.

2. **Life of wiring**: If the wiring is required for temporary purpose, then cleat wiring is most economical. For house wiring, open batten wire is sufficient. For offices, casing capping is desirable.

3. **Appearance of wiring**: In places like palace or V.I.P bungalow then the beauty is to be maintained. The beauty of the bungalow should not be spoiled by running the wires along walls etc. The wiring should not appear outside and hence concealed conduit wiring is used.

4. **Cost**: For low cost, CTS batten wiring is done. For medium cost, casing capping wiring can be done, and if the consumer is capable of paying more, than PVC conduit or concealed conduit wiring can be done.
## HOME ASSIGNMENT

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Question</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q.1</td>
<td>Draw a neat labelled diagram of VIR Wire?</td>
<td>2M</td>
</tr>
<tr>
<td>Q.2</td>
<td>With a neat labelled diagram explain Lead sheathed wire?</td>
<td>2M</td>
</tr>
<tr>
<td>Q.3</td>
<td>Draw a neat labelled diagram of CTS Wire?</td>
<td>2M</td>
</tr>
<tr>
<td>Q.4</td>
<td>With a neat labelled diagram explain Weatherproof wire?</td>
<td>2M</td>
</tr>
<tr>
<td>Q.5</td>
<td>With a neat labelled diagram explain flexible wires?</td>
<td>2M</td>
</tr>
<tr>
<td>Q.6</td>
<td>Draw a neat labelled of various types of switches?</td>
<td>3M</td>
</tr>
<tr>
<td>Q.7</td>
<td>Explain with neat labelled diagram of Ceiling rows</td>
<td>2M</td>
</tr>
<tr>
<td>Q.8</td>
<td>Explain neat labelled diagram of adaptors?</td>
<td>2M</td>
</tr>
<tr>
<td>Q.9</td>
<td>Explain with neat labelled diagram of Cleat wiring system?</td>
<td>3M</td>
</tr>
<tr>
<td>Q.10</td>
<td>Explain with neat labelled diagram of CTS or TRS wiring system.?</td>
<td>3M</td>
</tr>
<tr>
<td>Q.11</td>
<td>Draw a neat labelled diagram of Conduit wiring system?</td>
<td>2M</td>
</tr>
<tr>
<td>Q.12</td>
<td>Draw a neat labelled diagram of One lamp control from one location?</td>
<td>2M</td>
</tr>
<tr>
<td>Q.13</td>
<td>Draw a neat labelled diagram of two lamp control from one location?</td>
<td>2M</td>
</tr>
<tr>
<td>Q.14</td>
<td>Draw a neat labelled diagram of one lamp control from three places.</td>
<td>2M</td>
</tr>
<tr>
<td>Q.15</td>
<td>Draw a neat labelled diagram of one lamp series parallel testing board?</td>
<td>2M</td>
</tr>
<tr>
<td>Q.16</td>
<td>State and compare various types of wiring system in tabular form?</td>
<td>6M</td>
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</tbody>
</table>